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An analysis of the pre- and post-coronavirus pandemic self-assessed tax payments of SME taxpayers in Indonesia

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Abstract

Small and medium enterprise (SME) taxpayers globally were severely impacted by the Covid-19 pandemic. This study analyses self-assessed presumptive tax payment data from 319 Indonesian tax offices to estimate how SME taxpayers' capacity to submit self-assessed tax payments responsively changed during January 2016-February 2023. We predict the expected amount of self-assessed tax payments in 2020 without the presence of the pandemic (pre-pandemic) and in 2022 in the presence of the pandemic (post-pandemic). Our predictive analyses are then compared to actual tax payments during March 2020-February 2021 and March 2022-February 2023. This benchmark case analysis may assist 'lesson-drawing' by tax administrations in developing countries to inform tax policy responses under presumptive tax systems.

Keywords: Covid, presumptive taxes, SME taxpayers, emerging economies, tax administration, data analytics

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1. INTRODUCTION

Tax revenues are crucial for public policy governance in most economies, particularly in emerging countries, where they mostly rely on the revenues to support their public policies. Among various tax revenues in Indonesia, self-assessed tax payments are especially important as these tax payments are submitted 'actively' based on the taxpayers' knowledge about the tax due on the taxable income earned. In aggregate, self-assessed tax receipts provide an input into a country's voluntary compliance rate and its relationship with tax agency enforcement action (see Lederman (2018) for an extensive review of this relationship).

The arrival of the coronavirus pandemic in 2020 drastically distorted various aspects of economic activities both globally, and in Indonesia. As the number of Covid-19 cases increased, the Indonesian government was forced to impose restrictions on mass gatherings, thus reducing most economic activities to limit the spread of the virulent disease (World Health Organization, 2020). This policy, in turn, influenced self-assessed tax compliance with a concomitant reduction in payment levels, especially those submitted by Indonesian small and medium enterprises (SMEs).

SMEs play an important role in Indonesia, absorbing 97% of the total workforce and contributing over 60% of its gross domestic product (GDP) in 2019 (Organisation for Economic Co-operation and Development (OECD), 2022). In response to their critical role and the reduction in tax payments, this study presents baseline evidence on how the self-assessed tax payments of Indonesian SMEs under a presumptive tax regime altered during the initial months of the pandemic, using revenue data from 32 regional tax offices. This study contributes to the literature on voluntary compliance under a presumptive tax by documenting the recovery of SME compliance with our repeat analysis over a second time period, two years after the pandemic.

Our study is motivated by two intersecting factors. First, it is evident that the coronavirus pandemic, as an extraordinary situation, acted as a severe shock to various economic sectors. However, attempts to indicate the influence of the pandemic on tax revenues are relatively limited, although tax systems were a critical policy focus of governments in responding to the pandemic (Daly, 2023). The second factor and primary objective of this research is to provide empirical data and analytical evidence on the use of presumptive taxes for SMEs designed to reduce compliance burden and increase compliance (Mas-Montserrat et al., 2023). Thus, this study provides a benchmark contribution to the literature of a developing country severely affected by Covid-19, in terms of pre- and post-pandemic tax receipts. The study is relevant in a wider context, of other developing countries, as they can extend this study's methodology and findings for the purposes of cross-national learning and benchmarking tax compliance through data analytics, to contribute to their own policy responses.

Although various studies have been undertaken into the influence of pandemic situations on economic activities (see, for example Susilawati et al., 2020), research which specifically examines the self-assessed tax payments of SMEs under a presumptive tax regime (in Indonesia or elsewhere), by reference to the coronavirus pandemic situation, is relatively scarce (Duve & Schutte, 2021). However, analysing the revenue impact of the pandemic is a useful starting point to identify the capacity differences of SME taxpayers in various regions and to synchronise tax policy settings in relation to the recovery of potential tax revenues, similar to various Covid-19-related policies used by various countries, including the Australian JobKeeper scheme (Corral

de Zubielqui & Harris, 2024) and the UK Self-Employment Income Support scheme (Chen et al., 2024; Daly, 2023).

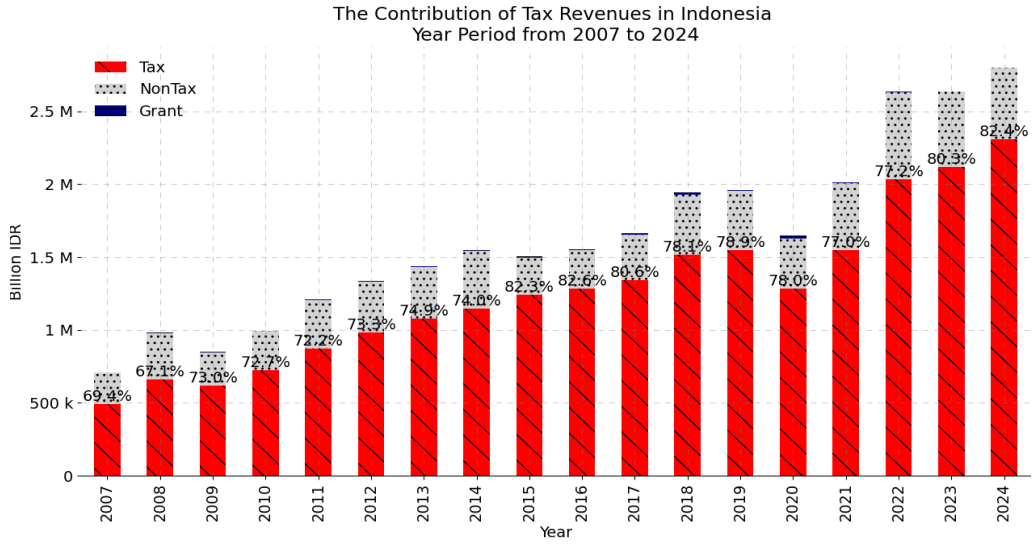
This article is structured as follows. The next section provides a brief review of the Indonesian tax system, with a focus on SMEs and outlines the Indonesian tax environment, the taxation of SMEs in Indonesia, and prior Indonesian tax compliance studies. Section 3 discusses prior literature on policy responses after Covid-19 and the pandemic's influence on self-assessed tax reporting behaviour. Section 4 outlines the materials, data and methods adopted in this study. Section 5 outlines our results and concluding remarks are offered in section 6.

2. INDONESIAN INSTITUTIONAL SME TAX ENVIRONMENT

2.1 Tax environment

Indonesia is the world's fourth most populous country with an estimated population of 281 million in 2024 (Central Bureau of Statistics, Indonesia, 2024), but with a relatively low tax/GDP ratio that has averaged around 10%-12% over the last decade (OECD, 2023). In Indonesia more than 70% of the national budget has been supported by tax revenue since 2009 (Central Bureau of Statistics, Indonesia, 2025). Figure 1 illustrates the importance of tax revenues in the state budget of Indonesia during the period from 2007 to 2024, and as a percentage of total government receipts.

Fig. 1: Indonesian Tax Revenue Contributions During the Period from 2007 to 2024 (IDR Billion)



Source: adapted from Central Bureau of Statistics, Indonesia (2025).

Indonesian state tax revenue is administered by the Directorate General of Taxes (DGT). Established in 1945 (Junisar & Priyatmoko, 2017), the DGT currently operates across 34 regional tax offices, in which the two largest are the large taxpayers regional tax

office and the Jakarta special regional tax office (Directorate General of Taxes, Indonesia, 2024a) and 32 regional tax offices serving SME taxpayers (Nuryanah et al., 2023). The main objective of implementing a market segment system was to concentrate on achieving targeted tax revenue by focusing on the most prominent contributing taxpayers (Parlaungan, 2017). However, the new system also has its drawbacks. In particular, the DGT has less focus on small- or low-contribution taxpayers such as personal income taxpayers. This is reflected in the tax revenue from personal income taxpayers who have contributed less than 2% of the total tax revenue during the period from 2014 to 2023 (Directorate General of Taxes, Indonesia, 2024b). Finally, as Hidayat (2024) concludes, the establishment of a Large Taxpayer Office does not necessarily result in increased tax compliance by firms.

The Indonesian government launched a series of tax reforms in 1983 which have been ongoing over the years since. These reforms commenced the shift from an official assessment to a self-assessment system (Odano, 1987) and then required taxpayers to comply with the tax law by self-registering, calculating taxable income, claiming tax credits deduction, and lodging tax returns. Tax offices, under the DGT, are organisationally structured to operate and conduct services according to the type of tax, e.g., personal income tax, corporate tax, withholding tax, and value added tax (VAT).

2.2 Taxing Indonesian SME businesses

In a global context, Indonesia is ranked 81st out of 188 countries in the latest World Bank/PwC *Paying Taxes* indicator (World Bank & PwC, 2019). One of the present authors (Ferry, 2022) has noted that Indonesian self-employed taxpayers can have difficulties in abiding by the tax law to calculate their tax liabilities and submit their tax returns without assistance. Thus, one of the hindrances that Indonesian self-employed taxpayers encounter in compliance is the ability to maintain proper bookkeeping and records. The government responded to this issue with the provision of a concession for SMEs by introducing the 'deemed net income' method of calculating their tax liability. This is a presumptive method to define net income by multiplying annual gross income by a specific rate in accordance with the business sector of the SMEs (Director General of Taxation Decree No. 536 Year 2000 regarding the Deemed of Net Income for Taxpayers who Compute Net Income Using Norms; Director General of Taxation Regulation No. 17 of 2015 concerning the Deemed of Net Income; see also Mas-Montserrat et al., 2023). Taxpayers who are eligible to apply this method only need to undertake simple recordkeeping by calculating gross income. This policy is designed to help reduce the SMEs' burden for those who would otherwise have difficulty in maintaining proper records. A further initiative was introduced in 2013, prescribed by Government Regulation No. 46, 2013 (GR-46/2013), by commencing the presumptive tax regime and applying a final tax at 1% rate on annual income up to IDR 4.8 billion (USD 291,885). Five years later, the rate was reduced to 0.5% (Government Regulation (PP) No. 23 of 2018 concerning Income Tax on Income from Business Received or Earned by Taxpayers with Certain Gross Turnover).

Tables 1 and 2 respectively describe the criteria of Micro, Small, and Medium Enterprises (MSMEs) in Indonesia, based on net assets and annual income and compare the tax rate applied between the taxpayers who apply the presumptive tax rate and those who use the conventional tax rate.

Table 1: The Criteria of Micro, Small, and Medium (MSM) Enterprises in Indonesia

	Criteria	
Enterprise	**Net Assets**	**Annual Income**
Micro	IDR 50 Million or less	IDR 300 Million or less
Small	> IDR 50 M − 500 Million	> IDR 300 M − 2.5 Billion
Medium	> IDR500 M − 10 Billion	> IDR 2.5 B − 50 Billion

Source: adapted from the Micro Small and Medium Enterprises Law No. 20 Year 2008.

Table 2: Tax Rate Applied for MSM Enterprises in Accordance with GR-46/2013

Enterprise	Presumptive Tax Rate	Conventional Tax Rate
Micro	Yes	No
Small	Yes	No
Medium		
- annual income up to IDR 4.8 Billion	Yes	No
- annual income > IDR 4.8 − 50 Billion	No	Yes

Source: adapted from the Micro Small and Medium Enterprises Law No. 20 Year 2008 and the Government Regulation No. 46 Year 2013.

Duve and Schutte (2021) and Aditya (2020) reviewed the intended compliance cost consequences of presumptive tax regimes, with Ferry and co-authors (2023) representing one of the earliest attempts to integrate opportunity costs and psychological costs based on the direct experience of Indonesian individual taxpayers. Their empirical results confirmed that the Indonesian presumptive tax regime significantly reduces explicit costs, although tax regime choice is not a significant determinant for implicit and psychological costs. Ferry et al. (2023) concluded that the psychological costs of tax compliance are more or less identical, despite the alternative tax regimes in place in Indonesia. This may have arisen as a result of the fact that individual SMEs who use the

presumptive tax regime need to prepare for conversion to the conventional tax regime in 2025, when the opportunity to use the presumptive tax expires. Hence, they may need to undertake similar recordkeeping practices as those who use the conventional tax regime.

The World Bank (Suharnoko Sjahrir et al., 2020) studied Indonesian SMEs just prior to the Covid-19 pandemic and noted that (at the time) compliance levels of SMEs were extremely low with only about 15% of SMEs filing and reporting their taxes in 2017 despite SMEs being the backbone of the Indonesian economy (OECD, 2022). The World Bank study sought to use behavioural insights to investigate the effects of a field experiment with an experimental design spanning three treatments (Simple, clear and salient information; Information plus public good provision; Information plus deterrence) neatly operationalised using a free calendar. The results indicated that sending any type of calendar increased the payment rate relative to the control group. The most successful calendar for increasing payment rate was however the third group (Information plus deterrence), corroborating earlier findings reported by Hasseldine and co-authors (2007). The World Bank study shows that the DGT has two available mechanisms to increase revenue: (1) to increase the rate of compliance (i.e., more SMEs paying taxes), a deterrence framing was more effective; and (2) to increase the value of payments (SMEs making higher tax payments), guidance information was more effective.

2.3 Prior Indonesian academic tax compliance research

Seminal contributions to the field of tax compliance research have stemmed from an interdisciplinary blend of economic modelling and fiscal psychology approaches and date back to the 1970s with pioneering work by Allingham and Sandmo (1972), Lewis (1982) and others. A large and continuing stream of research has since been published spanning both developed and developing countries. For broader reviews, see for example, the work of Alm (2019), Alm and Malezieux (2021), and Richardson and Sawyer (2001). During this century, tax compliance research has become much more common in developing economies, with Indonesia being no exception. Accordingly, the remainder of this section details a non-exhaustive summary of Indonesian tax compliance research prior to, during, and after, the Covid-19 pandemic, although the number of Indonesian studies published remains relatively limited, especially as other Indonesian studies were considered as out-of-frame due to a focus on VAT (e.g., Iswahyudi, 2017) or large companies (e.g., Purba & Tran, 2023).

Inasius (2019b) examined the relationship between taxpayers; trust in tax authorities, and their power on voluntary and enforced Indonesian tax compliance. Framed as a test of Kirchler and co-authors' (2008) slippery slope framework, 274 usable questionnaire responses were collected from SME retailers, with the study finding that trust in tax authorities was significantly associated with voluntary tax compliance, but perceived power was not significant, thereby providing only limited support for the slippery slope framework in this context.

In a separate related study, also motivated by the slippery slope framework, Inasius (2019a) surveyed Jakarta SMEs to investigate factors influencing compliance behaviour. His general findings were that referral groups, probability of audit, tax knowledge and perceptions of equity and fairness all influenced self-reported tax compliance.

Probowulan and Zulkarnnaeni (2022) carried out a meta-analysis on potential Indonesian tax non-compliance. However, this study is somewhat limited in that only 12 Indonesian studies were found over the 2010-2020 period on Google Scholar. Further, those authors did not explicitly identify or reference these studies, and meaningful interpretations from their analysis are difficult to establish. In a similar manner, Toly and co-authors (2023) studied 130 businesses in Surabaya finding that fairness perceptions influence tax compliance, but for their sample they did not find empirical support for trust in government affecting tax compliance.

Two studies addressed the relationships between tax knowledge, trust and tax compliance. Susanti and Sunardi (2023) studied 100 MSME respondents finding most taxpayers have a very basic knowledge of tax and lack trust in authority. Similarly, Fitria and co-authors (2024) used an online Google form to survey 350 Indonesian MSMEs from six provinces during July-October 2023. Their sample was well-educated (over 63% with a Bachelor's degree) suggesting a possible 'self-selection' effect, which may have contributed to their finding that tax knowledge increases SMEs' compliance intentions.

Timothy and Abbas's (2021) study provided more useful findings. Using survey data from 239 Indonesian SMEs they used structural equation modelling to report positive associations between tax morality and tax compliance, but they also found associations between perceptions of justice and weaker support for the association between trust in public authorities and compliance levels. Timothy and Abbas (2021, p. 176) concluded that intrinsic motivation has a meaningful association with Indonesian SMEs' compliance, providing support for Alm and Martinez-Vazquez's (2007) contention that to increase compliance in a developing country, social norms should be strengthened.

3. COVID-19 AND INDONESIAN SME TAX COMPLIANCE

As the world recovered from the coronavirus pandemic, policy-makers dedicated significant time and resources globally responding to the shock caused by Covid-19 (Daly, 2023). One OECD (2021) report commissioned by the G20 Finance Ministers and Central Bank Governors noted the slowing of economic growth, the acceleration of digitalisation, rising inequalities, and ageing populations. More specifically, the report detailed tax policy challenges faced by developing countries, and in the context of the present study, amongst other suggestions, noted that developing countries often have large informal sectors that narrow the tax base putting tax revenue under pressure, and that tax reform opportunities exist.

One such policy response has been the increasing use of presumptive tax regimes as noted by Duve and Schutte (2021), and with Mas-Monserrat and co-authors (2024) finding that a lack of data and analysis is one of the observed challenges, the current study responds by providing benchmark case evidence. Such evidence-based analysis can eventually allow for a more detailed understanding of the characteristics of the businesses operating in Indonesia and allow for the evaluation of whether the presumptive tax regime effectively incentivises business start-ups and increases tax compliance.

In framing tax compliance research, Alm (2022) highlighted three well-known frameworks that have sought to explain tax compliance (an enforcement paradigm, the slippery slope framework, and psychological contract theory) which he discussed in the context of experimental findings (see Alm, 2019) to make two broad conclusions. First,

trust is a major factor in shaping the effectiveness of public policies; and second, trust is not fixed but can vary significantly, and may even be influenced by systematic policy interventions (Alm, 2022, pp. 357-358). It is not within the scope of this study to simply repeat a discussion of the extensive evidence already provided by Alm (2019) and Lederman (2018) who both reviewed the support for, and implications of, an enforcement paradigm, a service paradigm, and a trust paradigm, but rather to draw on this literature in the context of Indonesian SMEs.

Saptono and Khozen (2023) framed their tax compliance study by using individuals' responses to the Covid-19 pandemic as an indicator for perceived fiscal exchange. That is, participants were asked questions relating to whether the Indonesian government's tax expenditures for Covid-19 were responsible, how satisfied participants were with social services delivery related to Covid-19, provision of infrastructure (e.g., hospitals), and the supply of related services (e.g., PCR/antigen tests), and how infected patients were all measured as a part of the structural equation model tested. They also noted the use by governments, including Indonesia, of fiscal policy responses to Covid-19 and their results on perceived fiscal exchange show that this predicted taxpayers' willingness to pay taxes.

Mas-Montserrat et al. (2024, p. 24) noted the importance of survey data in relation to the evaluation of presumptive tax regimes, and Nuryanah et al. (2023) provided this by evaluating the MSME tax administration reform using a survey study of 518 MSME respondents. They concluded that most survey participants perceived that the Indonesian presumptive tax regime is consistent with tax system principles of equity, certainty, convenience, and economy.

Anisykurlillah et al. (2024) focused on tax literacy and the need for the tax authority to enhance literacy especially for those taxpayers facing changes in tax rates. Erina et al. (2024) focused on tax morale, a construct also influenced by tax literacy, or tax awareness (see also, Widuri et al., 2024). The Erina et al. (2024) study noted that Indonesian tax morale is still low, with return non-filing being a problem at both individual and corporate levels. Likely, taxpayers are less motivated to file returns given relatively frequent tax amnesties being offered in Indonesia (see Inasius et al., 2020). Similar findings regarding tax morale, perceived fairness, and tax simplicity in relation to tax compliance intentions are also reported by Purnomo et al. (2024) and Tahar and Bandi (2024) in relation to the slippery slope framework.

4. MATERIALS AND METHODS

In this study, we collected a panel of monthly self-assessed presumptive tax payments data from the DGT's data warehouse, which includes self-assessed presumptive tax payments, using the specific code for the presumptive tax payments of 411128 420, administered in 319 small tax offices.[1] Following the study of Lütkepohl and Xu (2012), we transformed the absolute tax payments into log values to make the data variance more stable. The data was then regrouped into 43 cities (see the geographic distribution and the complete list of the tax offices in Appendix 1 and online datasets, respectively), based on the availability of the tax offices in the immediate vicinity. This enabled the researchers to more accurately observe the phenomenon of changing self-assessed tax

[1] Scholars who wish to undertake research related to the taxation of Indonesia may seek data support from the Directorate General of Taxes, Indonesia through the official online channel at https://eriset.pajak.go.id/.

payments in the regions that would provide additional information value over monthly tax statistics recorded by each tax office. To provide a general background of the data, Table 3 presents the descriptive statistics, including the averages (mean), standard deviations (std), minimums (min), and maximums (max) of the 43 cities' payment data (listed geographically from west to east Indonesia).

Table 3: Means, Standard Deviations, Minimums, and Maximums of Self-Assessed Presumptive Tax Payments (Log Values)

City	mean	std	min	q1	q2	q3	max
Aceh	8.76	0.11	8.59	8.68	8.74	8.83	9.07
Medan	10.05	0.14	9.67	9.94	10.06	10.14	10.29
Sibolga	9.52	0.10	9.25	9.46	9.52	9.58	9.71
Padang	9.16	0.14	8.88	9.03	9.19	9.26	9.41
Batam	9.57	0.20	9.02	9.35	9.63	9.71	9.88
Palembang	9.65	0.15	9.34	9.52	9.66	9.75	9.95
Pekanbaru	9.64	0.13	9.33	9.54	9.65	9.72	9.88
Bengkulu	8.69	0.11	8.45	8.60	8.70	8.76	9.05
Jambi	9.27	0.14	8.96	9.18	9.27	9.35	9.79
Belitung	9.23	0.12	8.92	9.17	9.24	9.30	9.52
Lampung	9.41	0.15	9.13	9.27	9.44	9.52	9.70
Tangerang	10.01	0.18	9.60	9.84	10.05	10.15	10.35
Jakarta	10.69	0.19	10.26	10.52	10.73	10.82	11.02
Depok	9.05	0.16	8.74	8.92	9.07	9.15	9.37
Bekasi	9.77	0.19	9.38	9.57	9.82	9.90	10.08
Bogor	9.48	0.16	9.16	9.33	9.52	9.59	9.77
Bandung	10.11	0.20	9.68	9.91	10.17	10.24	10.45
Cirebon	9.30	0.16	8.98	9.11	9.34	9.41	9.57
Semarang	10.05	0.15	9.70	9.92	10.08	10.15	10.30
Surakarta	9.97	0.15	9.67	9.87	9.99	10.08	10.34
Yogyakarta	9.58	0.18	9.22	9.41	9.64	9.71	9.91
Surabaya	10.15	0.18	9.78	9.97	10.20	10.27	10.43

Sidoarjo	9.86	0.15	9.56	9.69	9.91	9.97	10.13
Malang	9.95	0.13	9.68	9.85	9.98	10.04	10.19
Denpasar	9.77	0.27	9.30	9.50	9.89	9.98	10.12
Mataram	9.55	0.14	9.24	9.44	9.57	9.65	9.80
Pontianak	9.63	0.13	9.27	9.54	9.64	9.72	9.85
Palangkaraya	8.89	0.11	8.63	8.81	8.88	8.97	9.14
Banjarmasin	9.20	0.14	8.89	9.09	9.21	9.29	9.61
Balikpapan	9.54	0.13	9.27	9.45	9.56	9.63	9.80
Manado	9.23	0.12	8.92	9.15	9.23	9.31	9.51
Gorontalo	8.61	0.15	8.25	8.50	8.63	8.70	8.87
Palu	9.02	0.09	8.80	8.96	9.02	9.07	9.23
Mamuju	8.10	0.12	7.82	8.01	8.11	8.19	8.49
Makassar	9.63	0.13	9.32	9.53	9.66	9.71	9.85
Kendari	8.82	0.11	8.48	8.75	8.82	8.89	9.07
Ambon	9.02	0.10	8.71	8.97	9.02	9.08	9.24
Sorong	8.47	0.16	8.16	8.34	8.47	8.57	9.19
Timika	8.21	0.16	7.83	8.07	8.23	8.31	8.53
Jayapura	8.64	0.19	8.21	8.52	8.67	8.77	9.04
Biak	8.33	0.20	7.92	8.14	8.34	8.50	8.70
Manokwari	8.12	0.20	7.76	8.01	8.13	8.23	9.08
Merauke	8.30	0.17	7.90	8.17	8.33	8.42	8.63

Source: adapted from data analysis results.

Analysing the influence of the Covid-19 pandemic on tax revenue requires a careful estimation of how much revenue would be collected without the presence of the pandemic. Thus, to capture the expected self-assessed tax payments in the absence of the virus, we applied a Seasonal Auto-Regressive Integrated Moving Average (SARIMA) framework to the tax payments in each representative city during the 50-month period from January 2016 to February 2020. Next, we took account of the influence of the pandemic, and estimated the post-pandemic rebound in economic activity by re-applying the SARIMA models of the tax payments during the 74-month period from January 2016 to February 2022.

The SARIMA framework combines the analysis of past values (auto-regressive), difference order (integrated), and past residuals (moving-average) to determine the autocorrelation function within the time series. Initially developed by Box and Jenkins (1970), the framework was then adjusted by incorporating seasonal, repeated, and random trend effects so that the optimal fit of a time series analysis can be determined. Our analysis opted for these features by automatically applying a Python library of pmdarima 2.0.4 (Smith et al., 2017). We then comprehensively examined a series of SARIMA models and selected a model with the least prediction error.

After selecting the optimal fit model and generating predictions according to the model, the prediction results were compared to the proxy of the self-assessed tax revenues (log values), respectively during the period from March 2020 to February 2021 (during pandemic) and March 2022 to February 2023 (post-pandemic). Any difference arising between the predictions and the proxy values was assessed by applying established evaluation criteria, including Mean-Absolute-Error (MAE), Mean-Squared-Error (MSE), Root-Mean-Squared-Error (RMSE), and Mean-Absolute-Percentage-Error (MAPE). Following the analysis, the chosen SARIMA model for each city in the study was summarised together with the accuracy evaluations, and is reported in Appendices 2 and 3, respectively.

5. RESULTS

Table 4 shows the differences between the actual self-assessed tax revenues collected in 43 Indonesian cities and the predicted tax collections per our analytical model. The first panel on the left compares the gap during the Covid-19 pandemic situations commenced in Indonesia (from March 2020 to February 2021) and the second panel on the right contrasts the difference during the two years after the pandemic (from March 2022 to February 2023). As a reference, negative values indicate that the actual values were less than the predictions derived from the analysis whereas positive values imply that the actual tax revenues collected exceeded the SARIMA forecasts.

Table 4 shows that excepting the two cities of Banjarmasin and Belitung, all the cities recorded average negative values, indicating a negative growth during the pandemic. A further examination in the min column revealed the three deepest decreases were detected in Manokwari (-0.812), Denpasar (-0.602), and Kendari (-0.566). The results verified the outcomes in the average column, which showed the three lowest gaps appeared in Denpasar (-0.379), Kendari (-0.318), and Manokwari (-0.294).

Table 4: Influence of Covid-19 on the Self-Assessed Presumptive Tax Payments (Before and After)

Gap during Pandemic				Gap after Pandemic		
Min	Max	Mean	City	Min	Max	Mean
−0.223	−0.0235	−0.109	Aceh	−0.015	0.119	0.0605
−0.343	0.0838	−0.18	Medan	−0.00272	0.537	0.341
−0.209	0.112	−0.0112	Sibolga	−0.0454	0.334	0.177
−0.35	−0.0144	−0.21	Padang	0.0709	0.358	0.207
−0.392	0.0602	−0.152	Batam	0.125	0.642	0.502
−0.315	0.0217	−0.161	Palembang	−0.0262	0.269	0.169
−0.377	−0.0441	−0.218	Pekanbaru	−0.0465	0.379	0.232
−0.325	−0.0557	−0.17	Bengkulu	0.0343	0.225	0.146
−0.421	0.0548	−0.205	Jambi	−0.0202	0.346	0.191
−0.245	0.175	0.0142	Belitung	0.000585	0.31	0.208
−0.334	−0.0109	−0.13	Lampung	−0.0181	0.24	0.154
−0.498	0.0182	−0.287	Tangerang	0.0173	0.35	0.232
−0.451	0.0584	−0.133	Jakarta	0.0548	0.441	0.316
−0.333	0.479	−0.0673	Depok	−0.00816	0.316	0.195
−0.398	0.0255	−0.127	Bekasi	−0.00428	0.23	0.15
−0.337	0.0949	−0.0937	Bogor	−0.00997	0.33	0.17
−0.423	0.0985	−0.145	Bandung	0.0642	0.475	0.331
−0.326	0.0684	−0.219	Cirebon	0.00971	0.361	0.235
−0.257	0.0609	−0.0616	Semarang	0.0108	0.309	0.182
−0.282	0.0658	−0.0869	Surakarta	0.0342	0.335	0.224
−0.472	0.0653	−0.241	Yogyakarta	0.0212	0.4	0.239
−0.402	0.0674	−0.128	Surabaya	0.0307	0.444	0.308
−0.294	0.0438	−0.11	Sidoarjo	−0.0372	0.256	0.122
−0.256	0.0753	−0.0549	Malang	0.033	0.321	0.186
−0.602	0.0568	−0.379	Denpasar	0.0413	0.643	0.375
−0.377	−0.043	−0.227	Mataram	−0.00725	0.247	0.159

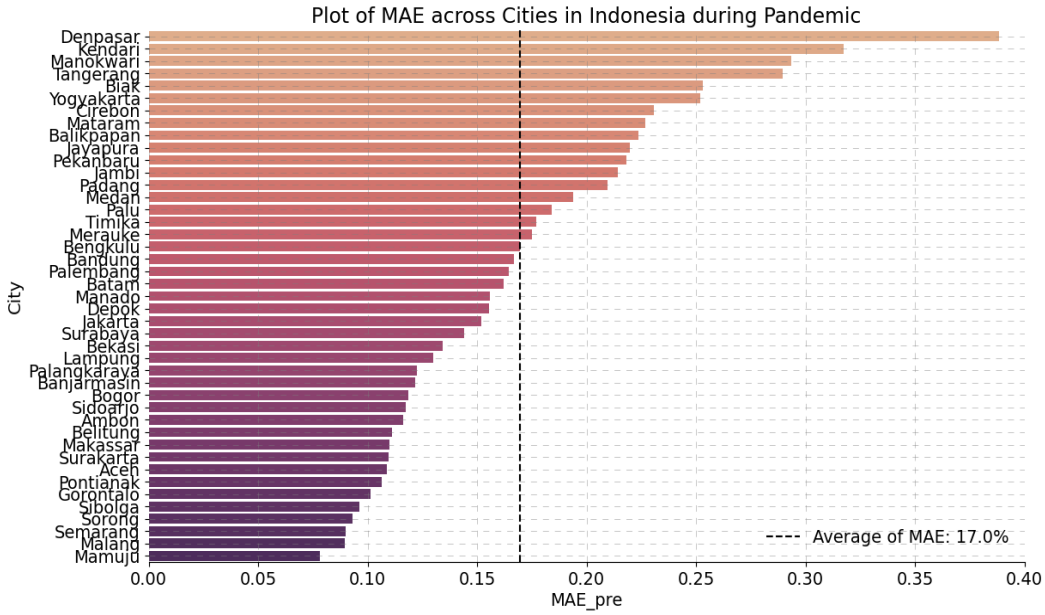
−0.271	0.121	−0.0305	Pontianak	−0.0827	0.407	0.259
−0.275	−0.0272	−0.122	Palangkaraya	−0.0473	0.272	0.111
−0.21	0.258	0.00822	Banjarmasin	−0.0639	0.437	0.225
−0.343	−0.016	−0.224	Balikpapan	0.00566	0.278	0.169
−0.301	0.00986	−0.154	Manado	0.0184	0.215	0.135
−0.335	0.0317	−0.0901	Gorontalo	−0.0336	0.27	0.161
−0.276	−0.045	−0.184	Palu	−0.0533	0.191	0.0783
−0.245	0.0333	−0.0712	Mamuju	−0.142	0.108	0.0258
−0.324	0.0591	−0.0934	Makassar	−0.0459	0.25	0.149
−0.566	−0.117	−0.318	Kendari	−0.102	0.201	0.124
−0.285	0.157	−0.0307	Ambon	0.0159	0.196	0.144
−0.174	0.173	0.0174	Sorong	−0.0195	0.344	0.177
−0.42	0.00708	−0.176	Timika	0.0502	0.247	0.193
−0.439	0.00976	−0.218	Jayapura	−0.054	0.252	0.124
−0.404	−0.0628	−0.253	Biak	0.00402	0.176	0.101
−0.812	−0.0435	−0.294	Manokwari	−0.317	0.246	0.0964
−0.329	0.11	−0.157	Merauke	−0.0456	0.203	0.109

Source: adapted from data analysis results.

The deepest decrease, which occurred in Denpasar, is highly likely due to the sudden changes in mobility, limiting individuals' access to retail and recreation outlets (Sparrow et al., 2020). As the region also substantially relies on tourism, it is unsurprising that Denpasar experienced the deepest economic contraction during the pandemic (Desdiani et al., 2022).

Our aggregate results for each of the 43 cities, together with the average decrease of around 0.17, are presented in Figure 2, which shows the decreasing self-assessed presumptive tax revenue as a percentage of mean absolute error.

Fig. 2: Decreasing Self-Assessed Presumptive Tax Payments as the Percentage of Mean Absolute Error



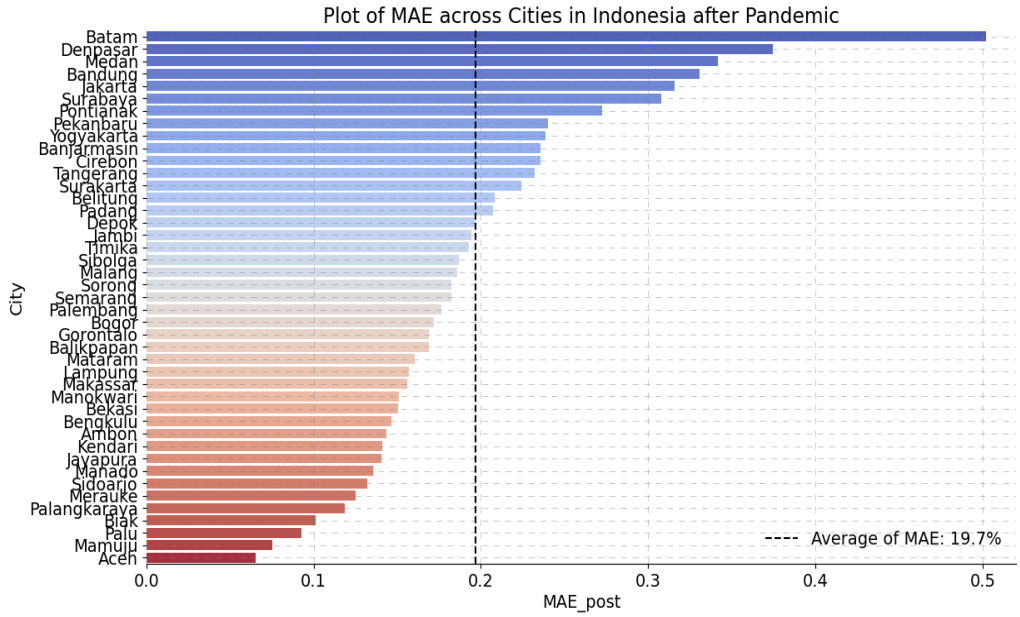
Source: adapted from data analysis results.

In contrast to the situation during the pandemic, all cities recorded positive average values. A closer examination in the max column revealed that the three highest jumps were spotted in the self-assessed tax payments in Denpasar (0.643), Batam (0.642), and Medan (0.537). A similar result emerged in the average values, which found the three topmost rebounds were detected in Batam (0.502), Denpasar (0.375), and Medan (0.341).

It appears that Batam, which has been designated as a special economic zone, recorded a quick recovery of wholesale and retail sectors whereas Denpasar gained the momentum of the ease of the travel restrictions, attracting the return of foreign travellers visiting the region. In the case of Medan, which is home to the resilient sector of agriculture industries and more particularly palm oil industry, creating fast economic rebounds, and therefore in line with the analysis of Anas et al. (2022).

Figure 3 illustrates the increasing self-assessed presumptive tax revenue as the percentage of MAE as well as the average increase among the 43 cities (approximately 0.197).

Fig. 3: Increasing Self-Assessed Presumptive Tax Payments as the Percentage of Mean Absolute Error



Source: adapted from data analysis results.

Overall, the analysis results indicate that the Covid-19 pandemic has reduced the expected self-assessed tax payments in 43 representative cities in Indonesia, with an average decrease around 17.0%, as illustrated in Figure 2. The hardest hit, which can be seen in the case of Denpasar, is notably due to the region being highly reliant on non-restricted access movements as well as experiencing large changes in retail and recreational activities, and therefore restricting its capacity to generate economic growth.

Fortunately, the influence of the pandemic has been reduced to an extent that after two years, self-assessed presumptive tax payments have now increased. This increase has been observed in 43 regions by an average of 19.7%, as shown in Figure 3. The highest economic rebounds were located in Batam, Denpasar, and Medan. While Batam and Medan are regions with dominant resilient and quick recovery sectors (agriculture in Medan and retail in Batam), Denpasar is a region with a robust tourism sector. To provide a complete set of our results, Appendices 4 and 5, respectively, display the influence of the Covid-19 pandemic situation on the self-assessed presumptive tax payments of SMEs across 43 cities in Indonesia during the pandemic and two years after the pandemic.

6. DISCUSSION AND CONCLUSION

The influence of Covid-19 on tax revenue collections, with a limited amount of available data, necessitated careful discussion, both within the Indonesia DGT and globally (Daly, 2023). In terms of presumptive tax regimes, there are a number of challenges (Mas-Montserrat et al., 2023, 2024) which include the problem of a lack of data and tax compliance analysis. This study provides an evidence-based analysis,

designed to allow for a more nuanced understanding of the characteristics of the businesses operating in Indonesia and an evaluation of whether the regime effectively incentivises business start-ups and increases tax compliance.

In terms of a wider context, we provide a benchmark contribution to the literature of a developing country severely affected by Covid-19, in terms of pre- and post-pandemic presumptive tax receipts. While the findings relate specifically to Indonesia, our study is relevant in a wider context, e.g., for other developing countries, as they can potentially replicate our methodology for cross-national 'lesson-drawing' to generate their own findings and benchmark their own tax compliance through data analytics, in order to feed into their own policy responses (Daly, 2023).

Our benchmark analysis focuses on the impact of the Covid-19 crisis on self-assessed presumptive tax payments submitted by the SMEs in 43 cities in Indonesia during the pandemic and post-pandemic period. More precisely, we applied a SARIMA framework to estimate the expected presumptive tax payments of SMEs and then compared it to their actual tax payments to evaluate the severity of the pandemic on the self-assessed presumptive tax revenue of SMEs.

We constructed our analyses in two consecutive phases with the first phase being during the pandemic, when the data of self-assessed presumptive tax payments of SMEs from January 2016 to February 2020 was used to generate the predicted self-assessed presumptive tax payments in March 2020-February 2021 (pandemic period). The second phase is based on a pandemic effect scenario when the similar data in the first phase was further extended to February 2022 and was applied to develop the prediction of self-assessed presumptive tax payments in March 2022-February 2023 (post-pandemic period).

Our primary finding indicates that during the pandemic, on average, the self-assessed presumptive tax payments submitted by SMEs decreased by 17.0%. The region which was most seriously impacted by the pandemic is noted to be severely dependent on non-restricted access movements. The results, while being specific to the presumptive tax revenues generated from the SMEs, are still approximately comparable with the analysis of Malkina (2021) in the Russian regions and the findings of Clemens and Veuger (2020) in the US, in which both studies report that the Covid-19 pandemic resulted in, respectively, total tax revenues losses of 13.9% and a decrease of income tax projection by 11.5% from the pre-Covid-19 period. Nonetheless, the decline of tax revenue in Indonesia is far worse than the average decrease of expected tax revenue in European countries (-4%) in 2020, as reported by Țibulcă (2022).

Secondly, we note that within two years after the pandemic, the Indonesian economy started to rebound, with SMEs' self-assessed presumptive tax payments, on average, increasing by 19.7%. This recovery has been attributed to the careful approach of the government in implementing conservative fiscal policy (Indrawati et al., 2024). In addition, Indonesia has benefited from an increase in commodity prices (see, for example: Fang & Shao, 2022 and Orhan, 2022) as regions with dominant trade and agriculture sectors recording significant increases.

This study is not without limitations. First, our study is context-specific, so may not be generalisable to other regions or time periods. Second, as information available to the DGT might change over time, as well as their administrative capacities, a recurrent evaluation incorporating any changes over time will need to be conducted and the need

for any required adjustments evaluated. Further, it is important to note that during the period under the study, the Government of Indonesia (2024) had initiated various tax incentives for Covid-19 handling and national economic recovery, such as the income tax borne by the government for taxpayers in the presumptive tax regimes. The total expenditures of such incentives for the four-year period starting from 2020 to 2023, respectively, are IDR 671 billion, 801 billion, 178 billion, and 99 billion. A further initiative is the exemption of presumptive tax for SME taxpayers whose recorded annual income is below IDR 500 million (see Government Regulation (PP) No. 55 of 2022 concerning Adjustments to the Regulation in the Field of Income Tax). The nature and analysis of such incentives and initiatives, however, are beyond the scope of this study, as we solely focus on the changes of the self-assessed presumptive tax payments of SMEs during and after the pandemic.

To conclude, this study reports clear differences across various regions in the correlation between the Covid-19 pandemic and self-assessed presumptive tax payments of SMEs in Indonesia. Future research could apply the setting of the study to thoroughly examine disaggregated tax types (such as income tax, VAT, land tax) and across different types of tax offices (e.g., large regional tax offices). In addition, future studies with better access to richer information could also extend our findings and focus on collecting primary data to assist in confirming more detailed and theory-driven research hypotheses.

The Covid-19 pandemic and its aftermath delivered sharp and salient lessons to governments worldwide about the importance of being aware of the threat of potential economic, geopolitical and health shocks. Clearly, it is critical for tax agencies to analyse and understand the compliance behaviour of all taxpayers (including SMEs), what drives it, and what policy responses are available. Some of this analysis requires an evaluation of not just enforcement activities, but also service provision to improve taxpayers' education and tax literacy. One unique Indonesian example, where a free calendar was provided to taxpayers, showcases what can potentially be achieved with a relatively simple administrative idea (Suharnoko Sjahrir et al., 2020). This study and other studies cited in our article, show that there now exists a sizable amount of research activity on Indonesian tax compliance and administration with no sign of abatement, as evidenced by the recent working papers of Bauer and Hidayat (2024) and Schipp et al. (2024).

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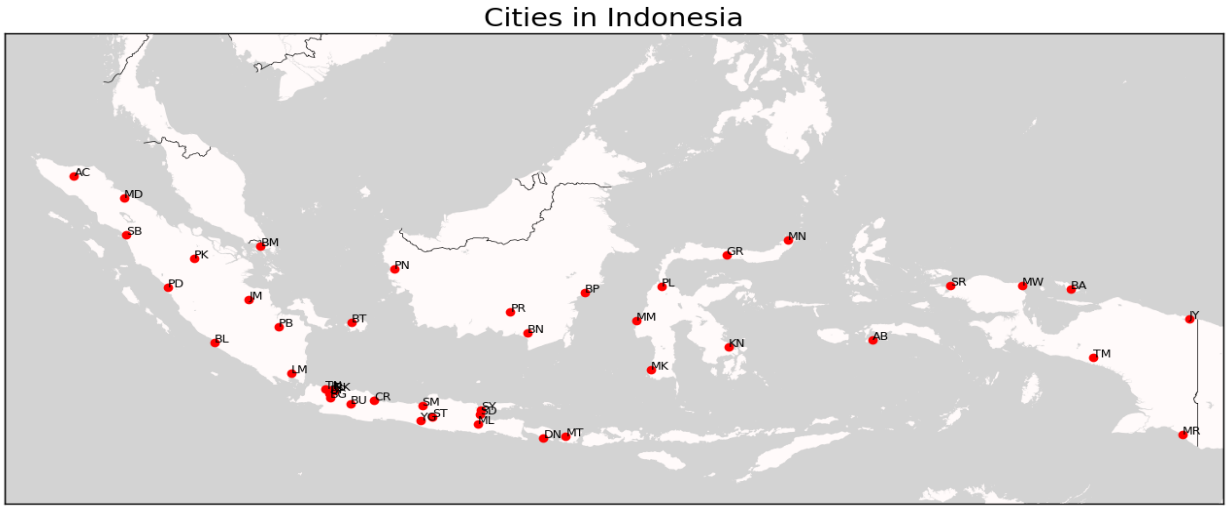
8. APPENDICES

Appendix 1: Distribution of Representative Cities in Indonesia



Appendix 2: Evaluation During Pandemic

City	Optimal_Model	MAE	MSE	RMSE	MAPE
Aceh	(1,1,0)(0,1,1)[12]	0.109	0.0162	0.127	0.0126
Medan	(1,1,0)(0,1,1)[12]	0.194	0.0447	0.212	0.0197
Sibolga	(1,1,0)(2,1,0)[12] intercept	0.0964	0.0125	0.112	0.0103
Padang	(0,1,1)(0,1,1)[12]	0.21	0.0517	0.227	0.0234
Batam	(1,1,0)(2,1,1)[12] intercept	0.162	0.0414	0.203	0.0174
Palembang	(1,1,0)(1,1,0)[12]	0.165	0.0363	0.191	0.0174
Pekanbaru	(1,1,0)(1,1,0)[12]	0.218	0.056	0.237	0.023
Bengkulu	(0,1,1)(2,1,0)[12] intercept	0.17	0.0363	0.19	0.0199
Jambi	(1,1,0)(1,1,0)[12]	0.214	0.0595	0.244	0.0236
Belitung	(0,1,1)(2,1,0)[12] intercept	0.111	0.0172	0.131	0.0121
Lampung	(2,1,0)(1,1,0)[12]	0.13	0.0261	0.162	0.0141
Tangerang	(0,1,0)(1,1,0)[12]	0.29	0.101	0.318	0.0298
Jakarta	(1,1,0)(1,1,0)[12] intercept	0.152	0.0437	0.209	0.0147
Depok	(0,1,1)(2,1,0)[12] intercept	0.156	0.0456	0.214	0.0174
Bekasi	(1,1,0)(1,1,0)[12] intercept	0.134	0.0323	0.18	0.0142
Bogor	(1,1,0)(1,1,0)[12] intercept	0.119	0.0256	0.16	0.0128
Bandung	(1,1,0)(1,1,0)[12] intercept	0.167	0.0444	0.211	0.0171
Cirebon	(1,1,0)(0,1,1)[12]	0.231	0.0597	0.244	0.0254
Semarang	(1,1,0)(2,1,0)[12] intercept	0.0901	0.0154	0.124	0.00913
Surakarta	(1,1,0)(2,1,0)[12] intercept	0.11	0.0204	0.143	0.0112
Yogyakarta	(2,1,0)(1,1,0)[12]	0.252	0.0746	0.273	0.027
Surabaya	(1,1,0)(1,1,0)[12] intercept	0.144	0.0346	0.186	0.0146
Sidoarjo	(1,1,0)(2,1,0)[12] intercept	0.118	0.0214	0.146	0.0122
Malang	(1,1,0)(2,1,0)[12] intercept	0.0896	0.0141	0.119	0.00916
Denpasar	(1,1,0)(2,1,0)[12] intercept	0.388	0.176	0.419	0.0414
Mataram	(1,1,0)(0,1,1)[12]	0.227	0.0585	0.242	0.0242
Pontianak	(1,1,0)(2,1,0)[12] intercept	0.107	0.0179	0.134	0.0112
Palangkaraya	(1,1,0)(0,1,1)[12]	0.122	0.0187	0.137	0.014
Banjarmasin	(0,1,1)(2,1,0)[12] intercept	0.122	0.0204	0.143	0.0133

Balikpapan	(0,1,0)(0,1,1)[12]	0.224	0.0586	0.242	0.0239
Manado	(1,1,0)(0,1,1)[12]	0.156	0.0311	0.176	0.0173
Gorontalo	(1,1,0)(2,1,0)[12] intercept	0.101	0.0219	0.148	0.0121
Palu	(0,1,0)(2,1,1)[12]	0.184	0.0379	0.195	0.0207
Mamuju	(0,1,1)(1,1,0)[12] intercept	0.0783	0.0106	0.103	0.00987
Makassar	(1,1,0)(2,1,0)[12] intercept	0.11	0.0229	0.151	0.0117
Kendari	(2,1,2)(0,1,1)[12]	0.318	0.114	0.337	0.0367
Ambon	(1,1,0)(1,1,0)[12] intercept	0.116	0.0197	0.14	0.0131
Sorong	(0,1,1)(2,1,0)[12] intercept	0.0931	0.0125	0.112	0.0112
Timika	(1,1,0)(2,1,0)[12] intercept	0.177	0.0421	0.205	0.0222
Jayapura	(0,1,1)(2,1,0)[12]	0.22	0.0669	0.259	0.0262
Biak	(1,1,0)(2,1,0)[12]	0.253	0.0703	0.265	0.0313
Manokwari	(0,1,1)(0,1,1)[12]	0.294	0.12	0.346	0.0373
Merauke	(1,1,0)(0,1,1)[12]	0.175	0.0394	0.199	0.0217

Source: adapted from data analysis results.

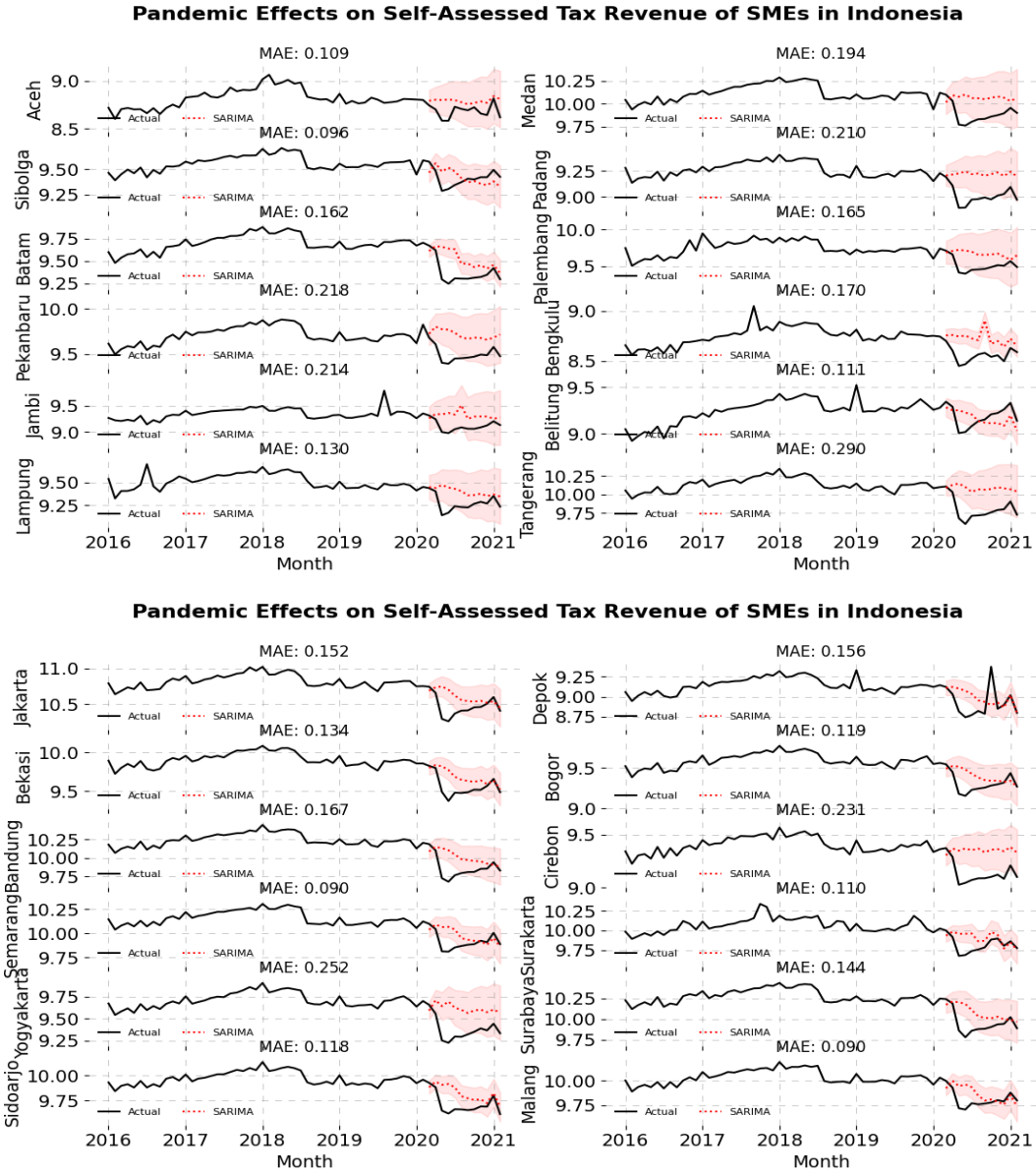
Appendix 3: Evaluation Post Pandemic

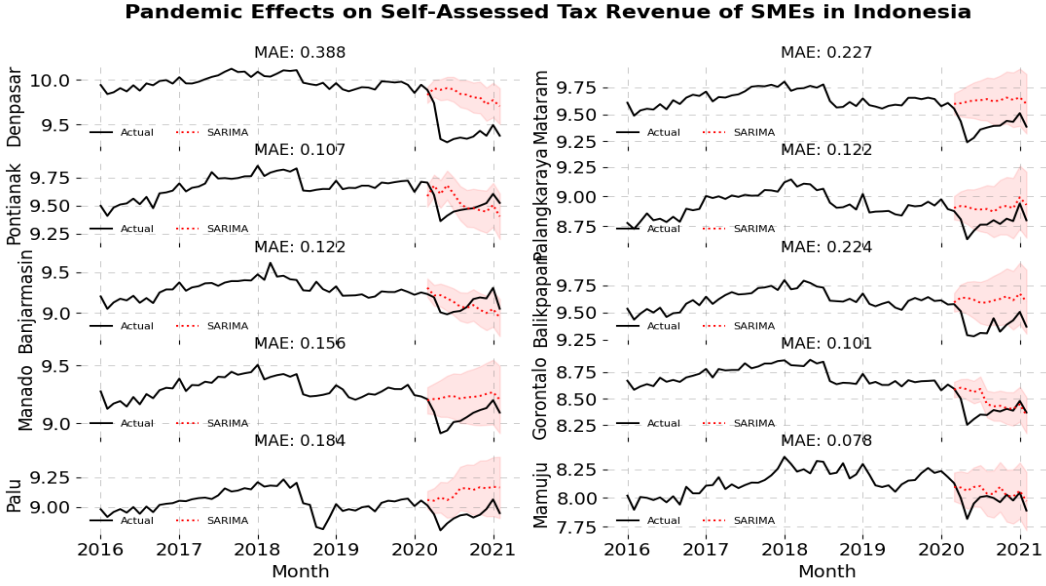
City	Optimal_Model	MAE	MSE	RMSE	MAPE
Aceh	(0,1,1)(0,1,1)[12]	0.0652	0.00535	0.0731	0.00748
Medan	(0,1,0)(2,1,0)[12]	0.342	0.147	0.383	0.0337
Sibolga	(0,1,1)(2,1,1)[12]	0.187	0.0448	0.212	0.0195
Padang	(0,1,0)(2,1,0)[12]	0.207	0.0486	0.22	0.0228
Batam	(0,1,0)(0,1,1)[12]	0.502	0.282	0.531	0.0527
Palembang	(0,1,1)(0,1,1)[12]	0.176	0.0385	0.196	0.0184
Pekanbaru	(1,1,0)(2,1,0)[12]	0.24	0.068	0.261	0.0249
Bengkulu	(1,1,0)(2,1,0)[12]	0.146	0.0245	0.157	0.0168
Jambi	(0,1,1)(2,1,0)[12]	0.194	0.0493	0.222	0.0209
Belitung	(0,1,0)(2,1,0)[12]	0.208	0.053	0.23	0.0224
Lampung	(0,1,1)(0,1,1)[12]	0.157	0.0304	0.174	0.0168
Tangerang	(0,1,0)(0,1,1)[12]	0.232	0.0641	0.253	0.0233
Jakarta	(0,1,0)(0,1,1)[12]	0.316	0.115	0.339	0.0295
Depok	(0,1,1)(2,1,0)[12]	0.196	0.0479	0.219	0.0218
Bekasi	(0,1,0)(0,1,1)[12]	0.15	0.0285	0.169	0.0156
Bogor	(0,1,0)(0,1,1)[12]	0.172	0.037	0.192	0.0183
Bandung	(0,1,0)(2,1,0)[12]	0.331	0.124	0.352	0.0329
Cirebon	(1,1,0)(2,1,0)[12]	0.235	0.0682	0.261	0.0254
Semarang	(0,1,0)(2,1,0)[12]	0.182	0.0403	0.201	0.0183
Surakarta	(0,1,0)(2,1,0)[12]	0.224	0.0561	0.237	0.0226
Yogyakarta	(0,1,0)(2,1,0)[12]	0.239	0.0673	0.259	0.0251
Surabaya	(0,1,0)(0,1,1)[12]	0.308	0.111	0.333	0.0305
Sidoarjo	(0,1,0)(2,1,1)[12]	0.132	0.0223	0.149	0.0135
Malang	(0,1,0)(2,1,0)[12]	0.186	0.0408	0.202	0.0188
Denpasar	(0,1,0)(2,1,0)[12]	0.375	0.162	0.403	0.0387
Mataram	(0,1,0)(2,1,0)[12]	0.161	0.0302	0.174	0.0169
Pontianak	(0,1,0)(2,1,1)[12]	0.273	0.0884	0.297	0.0281
Palangkaraya	(1,1,0)(0,1,1)[12]	0.119	0.0179	0.134	0.0134
Banjarmasin	(0,1,1)(0,1,1)[12] intercept	0.236	0.0674	0.26	0.0259

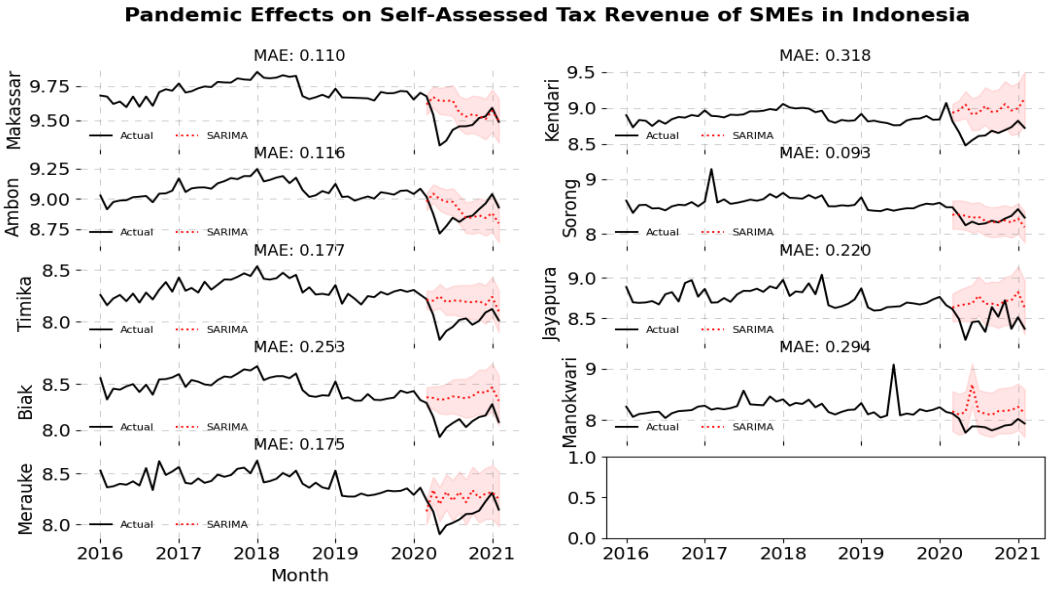
Balikpapan	(0,1,0)(0,1,1)[12]	0.169	0.0349	0.187	0.0178
Manado	(0,1,0)(2,1,0)[12]	0.135	0.0217	0.147	0.0147
Gorontalo	(1,1,0)(2,1,0)[12]	0.169	0.0346	0.186	0.0197
Palu	(0,1,0)(2,1,1)[12]	0.0929	0.011	0.105	0.0102
Mamuju	(0,1,1)(1,1,0)[12]	0.0755	0.00722	0.0849	0.00932
Makassar	(0,1,0)(2,1,1)[12]	0.156	0.031	0.176	0.0163
Kendari	(0,1,1)(2,1,0)[12]	0.141	0.0223	0.149	0.0161
Ambon	(0,1,0)(2,1,0)[12]	0.144	0.0239	0.155	0.016
Sorong	(0,1,1)(0,1,2)[12]	0.182	0.0421	0.205	0.0215
Timika	(1,1,0)(2,1,0)[12]	0.193	0.0404	0.201	0.0237
Jayapura	(0,1,1)(2,1,0)[12]	0.141	0.0241	0.155	0.0165
Biak	(0,1,0)(0,1,1)[12]	0.101	0.0131	0.114	0.0123
Manokwari	(0,1,1)(2,1,0)[12]	0.151	0.0311	0.176	0.0187
Merauke	(1,1,0)(0,1,1)[12]	0.125	0.0193	0.139	0.0152

Source: adapted from data analysis results.

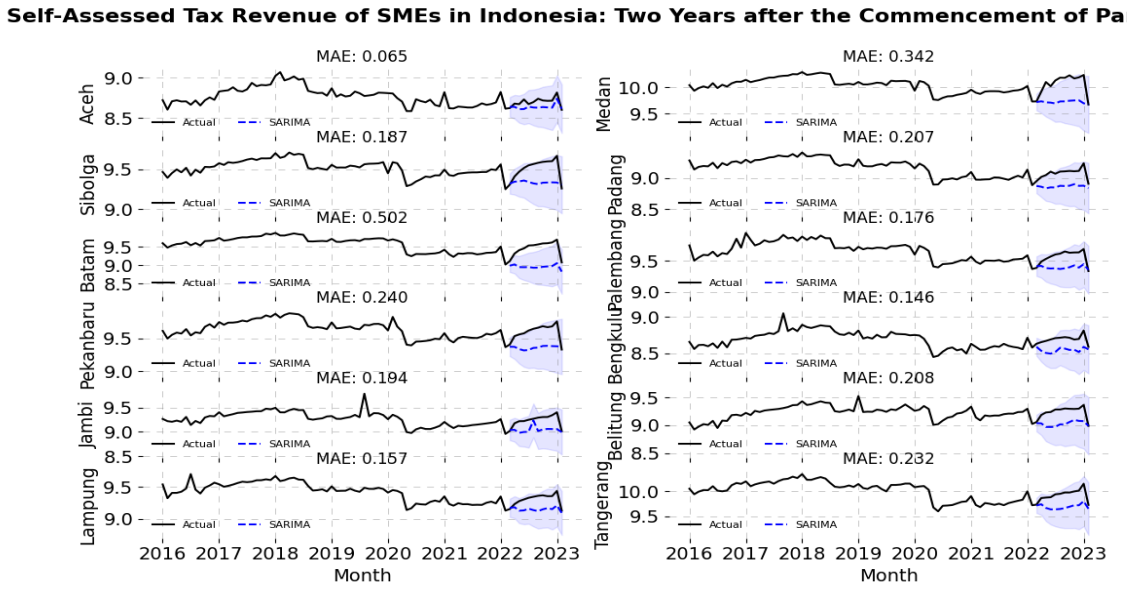
Appendix 4: Covid-19 Effects on Self-Assessed Presumptive Tax Revenues of SMEs in Indonesia

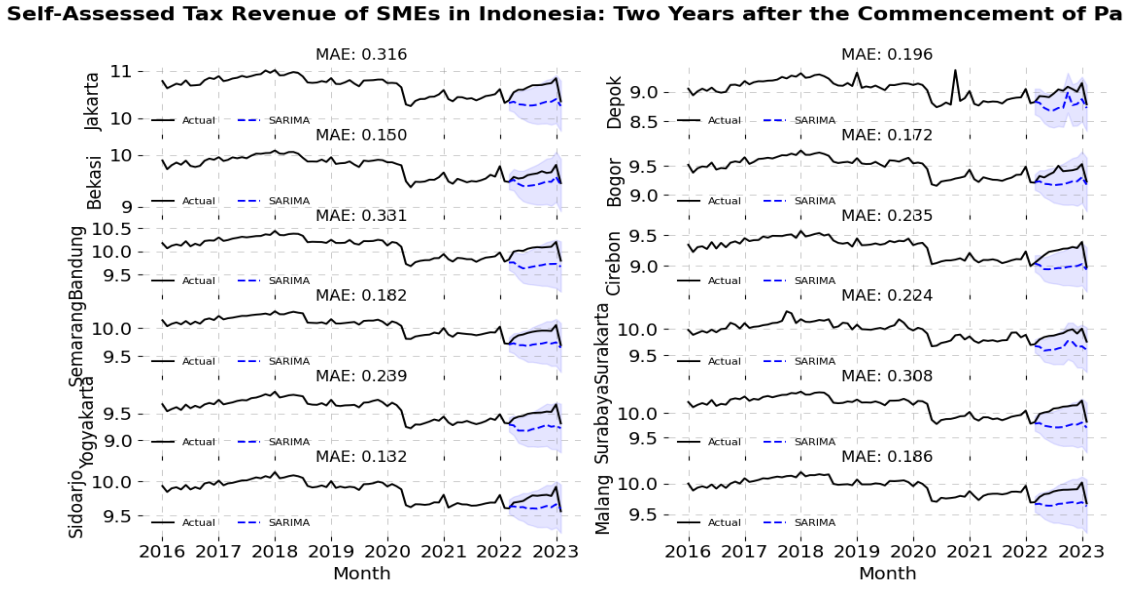


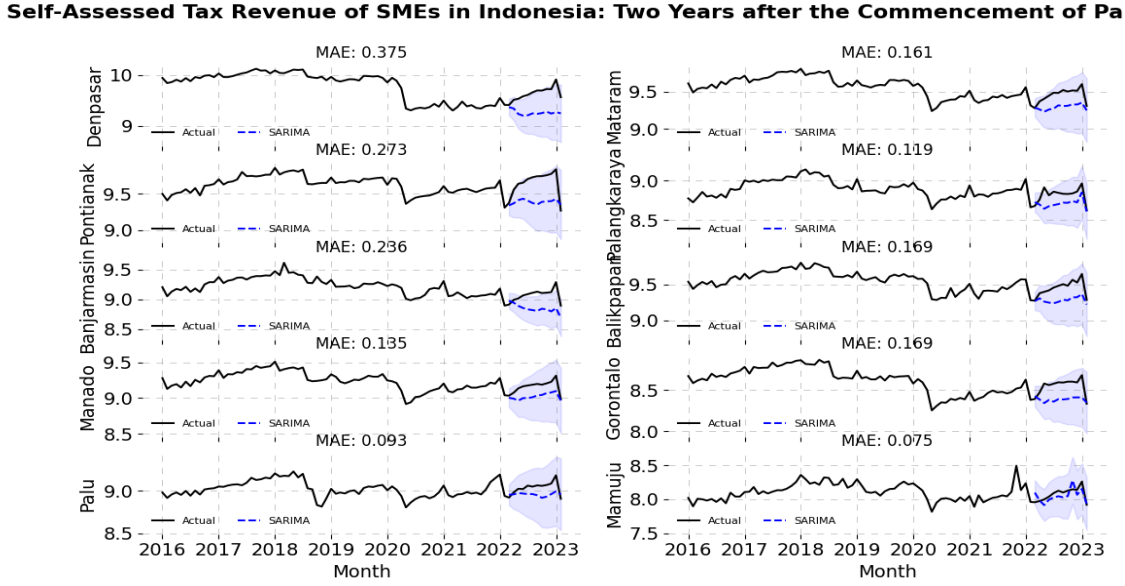

Pandemic Effects on Self-Assessed Tax Revenue of SMEs in Indonesia
Denpasar
MAE: 0.388
Pontianak
MAE: 0.107
Banjarmasin
MAE: 0.122
Manado
MAE: 0.156
Palu
MAE: 0.184
Mataram
MAE: 0.227
Palangkaraya
MAE: 0.122
Balikpapan
MAE: 0.224
Gorontalo
MAE: 0.101
Mamuju
MAE: 0.078
Actual
SARIMA
2016
2017
2018
2019
2020
2021
Month

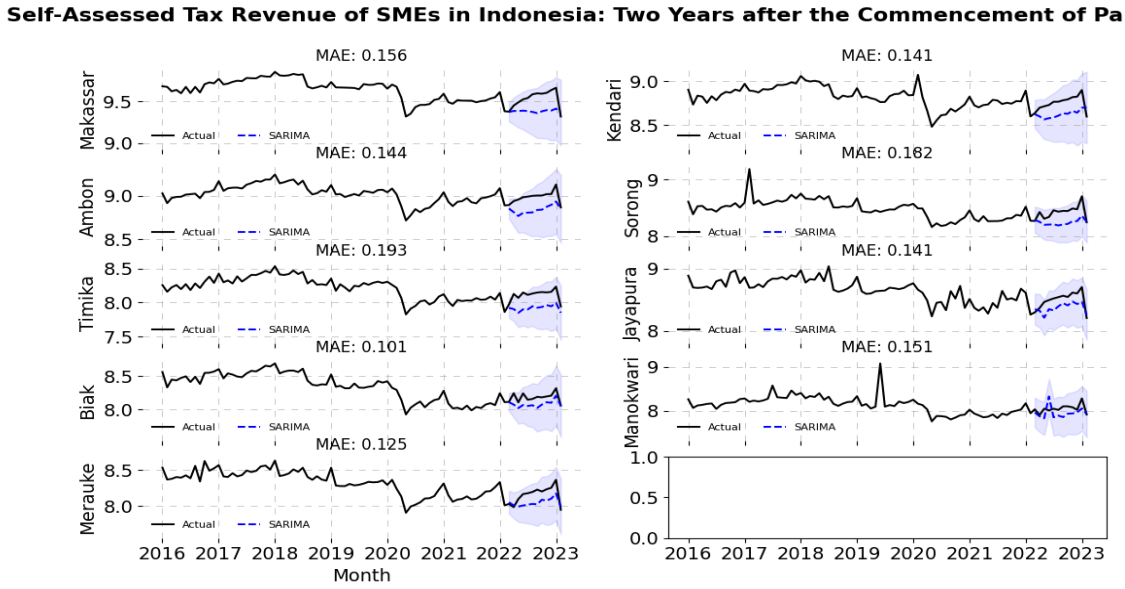

Pandemic Effects on Self-Assessed Tax Revenue of SMEs in Indonesia
Makassar
MAE: 0.110
Ambon
MAE: 0.116
Timika
MAE: 0.177
Biak
MAE: 0.253
Merauke
MAE: 0.175
Kendari
MAE: 0.318
Sorong
MAE: 0.093
Jayapura
MAE: 0.220
Manokwari
MAE: 0.294
Actual
SARIMA
2016
2017
2018
2019
2020
2021
Month

Appendix 5: Self-Assessed Presumptive Tax Revenues of SMEs in Indonesia: Two Years After the Commencement of Covid-19






Self-Assessed Tax Revenue of SMEs in Indonesia: Two Years after the Commencement of Pandemic
Denpasar
MAE: 0.375
Pontianak
MAE: 0.273
Banjarmasin
MAE: 0.236
Manado
MAE: 0.135
Palu
MAE: 0.093
Mataram
MAE: 0.161
Palangkaraya
MAE: 0.119
Balikpapan
MAE: 0.169
Gorontalo
MAE: 0.169
Mamuju
MAE: 0.075
Actual
SARIMA
2016 2017 2018 2019 2020 2021 2022 2023
Month


Self-Assessed Tax Revenue of SMEs in Indonesia: Two Years after the Commencement of Pandemic
Makassar
MAE: 0.156
Ambon
MAE: 0.144
Timika
MAE: 0.193
Biak
MAE: 0.101
Merauke
MAE: 0.125
Kendari
MAE: 0.141
Sorong
MAE: 0.182
Jayapura
MAE: 0.141
Manokwari
MAE: 0.151
Actual
SARIMA
2016 2017 2018 2019 2020 2021 2022 2023
Month