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Prediction of the Opsen PKB Potential in East Java

Galuh Fitria RAMADHANI[1], Ayu Fury PUSPITA[2]

[1,2] Faculty of Economics and Business, Brawijaya University, Indonesia

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Corresponding Author:
Galuh Fitria Ramadhani
Email:
r.galuhfitria@gmail.com

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Abstract:

Purpose:
Opsen PKB, as the latest additional tax levy imposed on taxpayers, needs to be studied to predict its revenue potential in order to support maximum tax realization.

Methodology:
Therefore, this study was written with the aim of predicting the potential of Opsen PKB in East Java using time series analysis via two scientific methods, namely simple linear regression and single exponential smoothing. The use of two different scientific methods for prediction is done to provide two different views on it.

Findings:
The results of the prediction calculation using simple linear regression showed good forecast accuracy and a steady increase in Opsen PKB. However, the prediction results were linearly patterned for the next ten periods, indicating that the model was not able to capture fluctuations in the time series data.

Implication:
Meanwhile, the results of calculations using one of the single exponential smoothing models predicted a decline for the next period, with no pattern.

INTRODUCTION

Decentralization in Indonesia is defined as the transfer of authority for implementing governmental responsibilities and financing from the central government to regional governments, with the aim of improving efficiency, effectiveness, and accountability in public administration (Wardhana, 2019). In the fiscal domain, this relationship is primarily organized through regulations on regional taxes and retributions, which determine the distribution of taxing powers between levels of government. The decentralization of regional taxation began with Law No. 18 of 1997 on Regional Taxes and Retributions, as amended by Law No. 34 of 2000. However, the General Elucidation of Law No. 28 of 2009 later acknowledged that Law No. 18 of 1997 was ineffective in enhancing the role of regional tax and retribution revenues in regional budgets because it did not grant sufficient authority to provincial governments to optimize tax revenues and did not impose sanctions on regions that failed to submit current regional regulations to the central government. These shortcomings led to the enactment of Law No. 28 of 2009 on Regional Taxes and Retributions.

During its implementation, Law No. 28 of 2009 contributed positively to Indonesia's fiscal decentralization system. Data presented by the Directorate General of Fiscal Balance of the Ministry of Finance in the socialization of Law No. 1 of 2022 show that Law No. 28 of 2009 helped increase the ratio of regional tax revenue to gross regional domestic product, improve regional financial management—as reflected in the growing number of Regional Government Financial Reports (LKPD) with unqualified audit opinions—reduce disparities in financial capacity among regions, and increase the proportion of public services that operate properly and are well maintained. Nevertheless, the system was still considered to have room for improvement, particularly in raising tax ratios and further strengthening regional fiscal capacity (Hilmiyah, Maretaniandini, & Tsabita, 2023). To align the legal framework with developments in fiscal decentralization, the government enacted Law No. 1 of 2022 on

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Financial Relations between the Central Government and Regional Governments, which repealed Law No. 28 of 2009 and Law No. 33 of 2004 on Fiscal Balance between the Central Government and Regional Governments. One of the key innovations introduced by Law No. 1 of 2022 is the surtax mechanism known as Opsen Pajak.

Under Law No. 1 of 2022, Opsen Pajak is defined as an additional tax levy, calculated as a percentage of the tax payable, imposed on taxpayers of Motor Vehicle Tax (Pajak Kendaraan Bermotor/PKB), Vehicle Registration Tax (Bea Balik Nama Kendaraan Bermotor/BBNKB), and Non-metallic Minerals and Rocks Tax (Pajak Mineral Bukan Logam dan Batuan/MBLB). The law stipulates that the opsen rate for PKB and BBNKB is 66% and is collected by regency/municipality governments, while the opsen rate for MBLB is 25% and is collected by provincial governments. Although the formula for calculating PKB itself remains unchanged between Law No. 28 of 2009 and Law No. 1 of 2022—both calculate PKB by multiplying the tax rate by the Motor Vehicle Sales Value (NJKB), which is adjusted by a weight reflecting road damage and/or environmental pollution—the mechanism for distributing revenues has shifted. Under Law No. 28 of 2009, PKB received by the provincial government was subject to a Revenue Sharing Fund (Dana Bagi Hasil/DBH) system, whereby 30% of PKB revenue was transferred to regency/municipality governments. By contrast, Law No. 1 of 2022 replaces the DBH mechanism for PKB with the opsen system, in which regency/municipality governments receive a share of PKB through the application of a 66% opsen rate on the payable tax, as further regulated in regional regulations, such as Malang City Regional Regulation No. 4 of 2023.

The shift from DBH to Opsen Pajak is intended to accelerate and simplify tax collection synergy between provincial and regency/municipality governments. Government Regulation No. 35 of 2023 designates the governing entity of the region where the motor vehicle is registered as the authorized tax collector, while the Director General of Taxes has emphasized that the new scheme eliminates the need to wait for revenue-sharing transfers by providing a more direct distribution of tax revenues (Kanwil DJPb Provinsi Lampung, 2023; Siswanto, 2023). However, numerical examples using Malang City regulations illustrate that, while the distribution mechanism changes, the total tax burden borne by taxpayers does not increase dramatically. For instance, under Law No. 28 of 2009, a vehicle with an NJKB of IDR 100,000,000 and a PKB rate of 1.5% yields a taxpayer burden of IDR 1,500,000, while the DBH portion of 30% affects the distribution but not the amount paid by the taxpayer. Under Law No. 1 of 2022, with a PKB rate of 1.2% and an opsen rate of 66%, the total burden becomes IDR 1,992,000. These figures suggest that the change in the system may not necessarily translate into a substantial increase in local input tax results, even though it significantly alters revenue flows between levels of government.

The introduction of Opsen PKB is particularly relevant in regions with large motor vehicle bases. East Java Province, for example, recorded 24,023,666 registered motor vehicles in 2023, including public and government-owned vehicles (Badan Pusat Statistik, 2024). This magnitude indicates considerable potential for PKB and Opsen PKB to strengthen regional own-source revenue and fiscal independence over time. At the same time, the modest difference between tax burdens under the old DBH system and the new Opsen scheme raises critical questions about the actual fiscal benefits that local governments can derive from Opsen PKB and the accuracy of current estimates of its potential contribution to regional revenue. It underscores the need for more rigorous empirical analysis of Opsen PKB potential at the provincial level.

Previous studies on the Opsen Pajak system for local revenue (Pendapatan Asli Daerah/PAD) have mainly emphasized aspects such as local government readiness, benefits, and taxpayer compliance. Another stream of research has analyzed the potential of the Opsen PKB system for PAD using performance and potential analyses. For instance, Hilmiyah et al. (2023) assessed tax performance through indicators such as tax revenue ratio, tax effort, tax elasticity, typology of standings, and tax collection ratio, and estimated potential using simple linear regression based on variables including Revenue Sharing Fund, Opsen PKB, and the average increase in the number of motor vehicles. While such studies provide important insights into the design and early impact of Opsen PKB, they typically rely on a single forecasting method—simple linear regression—when estimating tax potential.

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The Regional Tax and Retribution Potential Exploration Module issued by the Ministry of Finance of the Republic of Indonesia (2021) recognizes simple (and multiple) linear regression as a useful time series forecasting method for examining time-dependent variables and performing medium-term forecasts using time as an independent variable. However, linear regression assumes independence of observations over time and constant variance, which can lead to discrepancies between real-world dynamics and prediction results. To address these limitations, the module recommends complementing regression with smoothing methods—particularly simple moving averages and single exponential smoothing—as alternative approaches for forecasting regional tax potential (Ministry of Finance of the Republic of Indonesia, 2021). This recommendation is particularly relevant for PKB, whose realization is sensitive to trends in motorization, economic conditions, and regulatory change.

In light of these considerations, this study investigates the potential of Opsen PKB in East Java by comparing potential estimates generated using simple linear regression and single exponential smoothing. The analysis employs a macro approach based on growth rates and focuses on evaluating the forecast results of both methods using relevant data prior to the implementation of Opsen PKB. With 2009 as the base year, PKB realization data from 2010–2016 are used to generate forecasts, which are then compared with actual realization data from 2017–2023. These forecasts subsequently serve as the basis for predicting Opsen PKB potential and for assessing the accuracy of each method in forecasting PKB. Accordingly, the core research question is: How is the prediction of the potential implementation of Opsen PKB in East Java calculated using simple linear regression and single exponential smoothing methods? The findings are expected to provide academic benefits by offering two methodological perspectives on predicting Opsen PKB and practical benefits by serving as a reference for policymakers in East Java—especially the Regional Revenue Agency—in formulating effective and efficient policies and strategies for implementing Opsen PKB.

Regional Tax. Regional taxes are a key component of Indonesia's fiscal decentralization framework. Law No. 28 of 2009 states that regional government is implemented through the delegation of authority, rights, and obligations to organize regional autonomy within the national administrative system, financed partly through regional taxes and retributions that are recorded as Regional Own-Source Revenue (PAD) (Government of Indonesia, 2009). Under this law, regional taxes are divided into provincial and regency/municipal taxes. Provincial taxes consist of Motor Vehicle Tax (PKB), Motor Vehicle Title Transfer Fee (BBNKB), Motor Vehicle Fuel Tax, Surface Water Tax, and Cigarette Tax, whereas regency/municipal taxes include hotel, restaurant, entertainment, billboard, street lighting, non-metal mineral and rocks (MBLB), parking, groundwater, swallow's nest, rural and urban land and building (PBB-P2), and land and building acquisition (BPHTB) taxes (Government of Indonesia, 2009).

Law No. 1 of 2022 on Financial Relations between the Central Government and Regional Governments refines this structure by grouping regional taxes into seven provincial taxes—PKB, BBNKB, heavy equipment tax, motor vehicle fuel tax, surface water tax, cigarette tax, and opsen for MBLB—and nine regency/municipal taxes, including PBB-P2, BPHTB, specific goods and services tax, billboard tax, street lighting tax, MBLB tax, swallow's nest tax, Opsen PKB, and Opsen BBNKB (Government of Indonesia, 2022). This reclassification aims to strengthen regional fiscal capacity while maintaining alignment with national tax policy.

Motor Vehicle Tax (PKB). Motor Vehicle Tax (PKB) is regulated under both Law No. 28 of 2009 and Law No. 1 of 2022. In both laws, PKB is defined as a tax on the ownership and/or control of motor vehicles, which include all wheeled vehicles and their trailers operated on land, driven by a motor or similar device that converts energy into propulsion, as well as heavy and large equipment using wheels and motors that are not permanently attached and can also operate on water (Government of Indonesia, 2009, 2022).

Under Law No. 28 of 2009, PKB is one of five provincial taxes. The tax object is the ownership and/or control of motorized vehicles, and the tax subject is individuals or entities that possess or control such vehicles. The tax base is the product of the Motor Vehicle Sales Value (Nilai Jual Kendaraan Bermotor/NJKB) and a weight reflecting the relative level of road damage and/or environmental pollution caused by vehicle use. The PKB rate

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for first ownership is set between 1% and 2%, while progressive rates for second and subsequent ownership range from 2% to 10%, as determined by regional regulations (Government of Indonesia, 2009).

Law No. 1 of 2022 retains PKB as a provincial tax but introduces several changes. Renewable energy-based motor vehicles are excluded from the PKB object, and the maximum rate for first ownership is reduced to 1.2%, with a progressive rate of 6% for second and subsequent ownership (Government of Indonesia, 2022). These provisions are operationalized in East Java through Provincial Regulation No. 8 of 2023, which sets the PKB rate for personal and corporate taxpayers at a maximum of 1.2% for first ownership, and progressive rates of 1.7%, 2.2%, 2.7%, and 3.2% for second, third, fourth, and fifth (and subsequent) ownership, respectively (East Java Province Government, 2023).

Provincial Tax Revenue Sharing and Opsen PKB. Before the introduction of opsen, the Provincial Tax Revenue Sharing Fund (Dana Bagi Hasil/DBH) for PKB was governed by Article 94 of Law No. 28 of 2009. A portion of provincial tax revenue—30% of PKB and BBNKB, 70% of motor vehicle fuel and cigarette taxes, and 50% of surface water tax—was allocated to regency/municipal governments, with technical arrangements specified in provincial regulations such as East Java Governor Regulation No. 40 of 2017 (Government of Indonesia, 2009; East Java Governor, 2017). This mechanism aimed to reduce fiscal disparities by sharing provincial tax revenues with lower-tier governments.

Law No. 1 of 2022 replaces the DBH mechanism for certain taxes with a surtax system known as Opsen Pajak (Government of Indonesia, 2022). In the official explanation, opsen is described as a substitute for revenue sharing that can enhance regional independence without increasing the burden on taxpayers, support regional financial management, and encourage tax extensification. Opsen is imposed on the tax payable of PKB, BBNKB, and MBLB, with fixed rates of 66% for Opsen PKB and Opsen BBNKB and 25% for MBLB, while implementation details are determined by regional regulations (Government of Indonesia, 2022).

Government Regulation No. 35 of 2023 further stipulates that the competent authority in the region where the motor vehicle is registered is responsible for tax collection, integrating opsen into existing regional tax administration (Government of Indonesia, 2023). At the local level, Malang City implements Opsen PKB through Regional Regulation No. 4 of 2023, which defines Opsen PKB as a surtax imposed on the principal PKB, with a rate of 66%. The object of Opsen PKB is the PKB payable; the tax subject is identical to PKB taxpayers, the collector is the relevant provincial agency, and collection is carried out simultaneously with PKB using the PKB payable as the tax base (Malang City Government, 2023).

Forecasting Methods for Tax Revenue.

1. Simple Linear Regression. Linear regression is a statistical model used to analyze the relationship between a dependent variable and one or more independent variables (Anderson, Sweeney, & Williams, 2011). In simple linear regression, a single independent variable is used to explain variations in a single dependent variable. Although commonly applied to estimate relationships, linear regression can also be used to forecast future values when the values of both variables are known (Hasibuan & Musthofa, 2022). Parameters are typically estimated using the least squares method, which minimizes the sum of squared residuals (Anderson et al., 2011).

However, when applied to time series data, linear regression assumes independence of observations and constant variance over time. These assumptions are often violated in practice due to autocorrelation and changing volatility, potentially leading to biased or inefficient forecasts (Anderson et al., 2011).

2. Single Exponential Smoothing. Exponential smoothing is a time series forecasting technique that generates predictions using weighted averages of past observations, assigning greater weight to more recent data (Anderson et al., 2011). The Regional Tax and Retribution Potential Exploration Module issued by the Ministry of Finance recommends single exponential smoothing as one of the preferred methods for forecasting regional tax potential (Ministry of Finance of the Republic of Indonesia, 2021).

Single exponential smoothing is expressed as:

$$F_{t+1}=\alpha Y_t+(1-\alpha)F_t,$$

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where F_(t+1)is the forecast for period t+1, αis the smoothing constant ($0 \leq \alpha \leq 1$), Y_tis the actual value at time t, and F_tis the forecast at time t(Anderson et al., 2011; Ministry of Finance of the Republic of Indonesia, 2021). Different values of α(e.g., 0.1–0.9) can be tested, and the value that minimizes forecast error is selected.

3. Forecast Accuracy Measures. Forecast accuracy can be evaluated using several error measures. Mean Absolute Error (MAE) calculates the average absolute difference between actual and forecast values, giving equal weight to all errors. Smaller MAE values, relative to the scale of the data, indicate better forecast performance (Anderson et al., 2011; Kotu & Deshpande, 2019). Mean Squared Error (MSE) computes the average of squared forecast errors, preventing positive and negative errors from cancelling out and making the metric more sensitive to large deviations or outliers (Anderson et al., 2011).

Mean Absolute Percentage Error (MAPE) measures the average absolute percentage error, making it scale-independent (Anderson et al., 2011). According to Lewis (as cited in Montaño, Juan, & Palmer, 2013), MAPE values below 10% indicate highly accurate forecasts, values between 10–20% indicate accurate forecasts, 20–50% indicate reasonable forecasts, and values above 50% are considered inaccurate. Because of these interpretive benchmarks, MAPE is commonly used to compare models and datasets in forecasting studies (Montaño et al., 2013).

Previous Studies. Empirical research on Opsen PKB and regional tax forecasting is still evolving. Hilmiyah, Maretaniandini, and Tsabita (2023) analyzed the potential of the Opsen PKB system for local revenue in Cirebon Regency using a quantitative approach. Their study separated performance analysis—based on tax revenue ratio, tax effort, elasticity, typology, and collection ratio—from potential analysis using simple linear regression, which incorporated revenue sharing, Opsen PKB, and the growth in registered motor vehicles. The results show that while PKB performance is effective, tax effort remains low, and the opsen mechanism can generate approximately 10% higher revenue than the previous DBH system (Hilmiyah et al., 2023).

Dewi, Jaya, and Husein (2024) employed triple exponential smoothing to forecast PKB revenue in North Sumatra and reported low MAPE values, indicating high forecast accuracy. Suprayogi (2022) used double exponential smoothing to forecast central government tax revenues and found that this method provides reliable support for national tax planning. At the city level, Damayanti (2023) applied the Markov Chains algorithm combined with time series analysis to estimate the potential of local taxes—hotel, restaurant, entertainment, and parking taxes—in Malang City for 2022–2026, showing that potential estimates vary across methods and tax types.

Overall, these studies underscore the importance of robust time series techniques in forecasting regional tax revenues and evaluating new fiscal instruments such as Opsen PKB. However, they tend to focus on single methods or specific regions and tax objects, indicating the need for comparative studies that systematically assess simple linear regression and single exponential smoothing in the context of PKB and Opsen PKB at the provincial level.

Research Framework.

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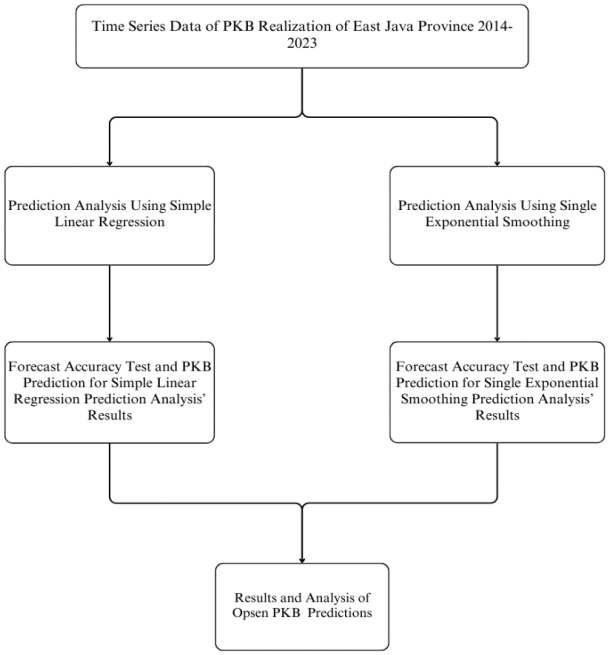

Figure 1. Research Framework

METHODS

This study employs a quantitative descriptive approach, which uses statistical procedures to analyze numerical data without manipulating the variables under study (Creswell, 2009; Gidion, 2019). The approach is appropriate because the research relies on time series data of Motor Vehicle Tax (PKB) implementation in East Java and applies two time-series forecasting methods—simple linear regression and single exponential smoothing—to estimate PKB realization and the resulting Opsen PKB potential. Time is treated explicitly as the ordering dimension of the series, consistent with time-series analysis using non-multivariate models (Profillidis & Botzoris, 2018).

The research subject is the population of processed PKB implementation data in East Java Province. Population is understood as the entire set of objects or subjects that possess certain characteristics determined by the researcher and from which conclusions are drawn (Sugiyono, 2010). The study uses secondary data obtained from the Regional Revenue Agency of East Java Province. PKB realization data for 2013–2023 were accessed from the agency's electronic work reports and online archives, while PKB data for 2009–2012 were obtained through a formal request to the same agency. These time series are then processed into an annual PKB realization dataset for 2009–2023. Additional supporting information on concepts, definitions, and methods was gathered through a literature study of journal articles, books, and other scientific sources to ensure that the theoretical and methodological foundations are based on carefully reviewed references.

In terms of operational definitions, the variables consist of one independent variable and one dependent variable. The independent variable (X) is time, defined as the sequence of years within the forecasting horizon used to estimate PKB and Opsen PKB. Time is commonly used as the sole independent variable in univariate time-series models (Profillidis & Botzoris, 2018). The dependent variable (Y) is Opsen PKB, observed as a function of predicted PKB over time. According to Law No. 1 of 2022, Opsen PKB is an additional tax levy, expressed as a certain percentage, imposed by regency/municipal governments on PKB payable (Government of

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Indonesia, 2022). PKB itself is defined as a tax on the ownership and/or control of motor vehicles; in this study, the value of Opsen PKB in each period is obtained by applying the statutory opsen rate to the forecasted PKB realization.

The data analysis proceeds in two main stages corresponding to the two forecasting methods. First, simple linear regression is applied by estimating the intercept (b_0) and slope (b_1) using the least squares method, with time as the independent variable and PKB realization as the dependent variable (Anderson, Sweeney, & Williams, 2011; Hasibuan & Musthofa, 2022). The resulting regression equation is used to generate PKB forecasts for the evaluation period. These forecasts then serve as the basis for calculating Opsen PKB predictions by multiplying the forecasted PKB by the applicable opsen rate. Second, single exponential smoothing is implemented following the formula $F_{t+1}=\alpha Y_t+(1-\alpha)F_t$, where Y_t is the actual PKB realization, and F_t is the forecast at time t(Anderson et al., 2011; Ministry of Finance of the Republic of Indonesia, 2021). The method is applied repeatedly using smoothing constants (α) of 0.1–0.9 to obtain alternative PKB forecasts; the best αis selected based on forecast accuracy and then used to project PKB in subsequent periods, which are again converted into Opsen PKB values using the statutory rate.

For both methods, forecast accuracy is evaluated using Mean Absolute Error (MAE), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE). MAE measures the average absolute deviation between actual and forecast values, while MSE computes the average of squared errors, making it more sensitive to large deviations (Anderson et al., 2011; Kotu & Deshpande, 2019). MAPE expresses forecast errors as percentages, allowing comparison across models and scales; the interpretation of MAPE follows the criteria proposed by Lewis, where values below 10% indicate highly accurate forecasts, 10–20% accurate, 20–50% reasonable, and above 50% inaccurate (Montaño, Juan, & Palmer, 2013). The method that yields the lowest error values—especially in terms of MAPE—is deemed to provide the best predictive performance and is therefore used as the primary basis for analyzing Opsen PKB potential in East Java.

RESULTS AND DISCUSSION

Overview of PKB Realization. The analysis uses annual realization data of Motor Vehicle Tax (PKB) in East Java Province from 2009–2023 as the basis for forecasting PKB and deriving Opsen PKB potential. The data were compiled from the Government Agency Performance Accountability System (SAKIP) online archives of the East Java Provincial Government and additional records obtained from the Regional Revenue Agency of East Java Province. Over the 15 years, PKB realization increased from IDR 2.07 trillion in 2009 to IDR 7.78 trillion in 2023, with temporary declines in 2020–2021 but an overall upward trend, reflecting growth in the motor vehicle base and tax collection performance.

Forecasting Results Using Simple Linear Regression. Simple linear regression was first applied with time (year) as the independent variable (X) and PKB realization as the dependent variable (Y). The estimated model produced an intercept of approximately IDR 1.87 trillion and a slope (regression coefficient) of about IDR 502.34 billion, implying that, on average, PKB realization increases by around IDR 502 billion each year. The coefficient of determination (R^2) was 0.96–0.97, indicating that the linear trend explains about 96–97% of the variation in PKB realization, which suggests a strong overall goodness of fit.

Forecasts were first generated for 2010–2016 using the regression equation and compared with actual realizations to assess accuracy. The resulting error measures show a Mean Absolute Error (MAE) of approximately IDR 137.06 billion, a Mean Squared Error (MSE) of about 3.77×10^{22}, and a Mean Absolute Percentage Error (MAPE) of 4.06%. Following Lewis's classification cited in the forecasting literature, an MAPE below 10% can be considered highly accurate (Kotu & Deshpande, 2019), so the regression model performs well in this initial evaluation.

Using the same equation, PKB forecasts were then generated for 2017–2023 and extended to 2024–2030 (years 15–21 in the coding scheme). For 2017–2023, the model slightly underestimates PKB in some years and overestimates in others. Differences between forecasted and actual PKB realization range from −0.06% in 2017

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to −14.97% in 2021, with larger negative deviations in years affected by policy changes and macroeconomic shocks. Applying the statutory Opsen PKB rate of 66% to the forecasted PKB values yields predicted Opsen PKB in 2017–2023 of roughly IDR 3.89–5.88 trillion, and IDR 6.21–8.20 trillion for 2024–2030. These projections represent the potential annual revenue that could be collected by regency/municipal governments through Opsen PKB if the linear trend continues under the current legal framework (Government of Indonesia, 2022).

Forecasting Results Using Single Exponential Smoothing. Single exponential smoothing was then applied as an alternative time-series method, following the formulation recommended in the Ministry of Finance's Regional Tax and Retribution Potential Exploration Module (Ministry of Finance of the Republic of Indonesia, 2021). Several smoothing constants (α = 0.1–0.9) were tested. The model with α = 0.9 produced the best initial accuracy, with MAE of about IDR 505.96 billion, MSE of around 3.55×10^{23}, and MAPE of 13.23%. Although these error values are higher than those of the regression model in the first evaluation period, the high α allows the model to respond quickly to recent changes by assigning greater weight to the latest PKB realizations (Anderson, Sweeney, & Williams, 2011; Kotu & Deshpande, 2019).

Using α = 0.9, forecasts were generated for 2017–2023. Compared with actual PKB, the model generally underestimates in 2017–2020 (with deviations of −10.77% to −7.31%) but comes closer in 2021–2023 (deviations between −4.08% and −3.07%, with one positive deviation of 4.17% in 2020). When MAPE is recalculated for this second period, it declines substantially to around 3.52%, indicating that the exponential smoothing model becomes more accurate as it adapts to the most recent observations.

The corresponding Opsen PKB predictions are obtained by applying the 66% rate to the forecasted PKB. For 2017–2023, the single exponential smoothing model yields forecasted Opsen PKB in the range of approximately IDR 3.89–4.98 trillion. Because single exponential smoothing is intrinsically a one-step-ahead method, only one further forecast (for 2024) can be generated without additional actual data; this yields a predicted Opsen PKB of about IDR 5.12 trillion.

Comparison of Forecasting Models. The comparative analysis of simple linear regression and single exponential smoothing highlights trade-offs between trend-based and adaptive forecasting approaches. In the first evaluation period (2010–2016), simple linear regression clearly outperforms single exponential smoothing, with an MAPE of 4.06% compared with 13.23% for the exponential model. It is consistent with the view that linear regression is advantageous when the underlying series exhibits a stable global trend (Kotu & Deshpande, 2019). The high R^2 further confirms that, over the long run, PKB realization in East Java follows a strong upward trend that can be captured by a linear function of time (Heykal et al., 2024).

However, the regression model assumes linearity, homoscedasticity, and independence of errors, which are often violated in fiscal time series subject to shocks and policy changes (Anderson et al., 2011). This limitation becomes visible when the model is used to forecast 2017–2023: despite maintaining a low overall MAPE, the regression forecasts begin to systematically overestimate PKB in several years, with deviations exceeding 10% in 2020–2022. These years coincide with the COVID-19 pandemic and the transition to the new fiscal relations regime under Law No. 1 of 2022, which may have disrupted the trend (Government of Indonesia, 2022).

In contrast, the single exponential smoothing model, while initially less accurate, shows improved performance in the later period as it adjusts to recent data. With a high smoothing constant (α = 0.9), the model quickly incorporates new shocks and structural changes, producing forecasts for 2017–2023 that yield a lower MAPE (around 3.52%) than the regression model in the same period. This pattern illustrates the strength of exponential smoothing in handling short-term dynamics and non-linearities in fiscal series, even though it does not explicitly model trend or seasonality (Kotu & Deshpande, 2019).

Overall, the results indicate that neither method dominates across all horizons: simple linear regression is superior for capturing long-run trends and medium-term projections, whereas single exponential smoothing performs better for short-run forecasts in periods of structural change. A pragmatic strategy for PKB and Opsen PKB forecasting in East Java combines both approaches, using regression for long-term planning and exponential smoothing for short-term budgeting and monitoring.

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Implications for Opsen PKB Potential in East Java. From a policy perspective, both forecasting approaches show that Opsen PKB has substantial revenue potential in East Java. Using the regression-based forecasts, Opsen PKB is projected to reach around IDR 3.89–5.88 trillion in 2017–2023 and up to IDR 8.20 trillion by 2030, assuming the historical trend continues and collection efficiency is maintained. The exponential smoothing model, which is more conservative in its forecasts, suggests Opsen PKB in the range of IDR 3.89–4.98 trillion for 2017–2023 and around IDR 5.12 trillion for 2024.

These magnitudes are consistent with the intention of the opsen system to enhance regional fiscal independence without introducing new tax objects (Government of Indonesia, 2022; Ministry of Finance of the Republic of Indonesia, 2021). For regency/municipal governments in East Java, the results imply that effective implementation of Opsen PKB—through improved administration, enforcement, and coordination with provincial authorities—could generate significant additional resources for financing public services. At the same time, the divergence between the two forecasting methods underscores the importance of adopting a cautious, scenario-based approach in fiscal planning, especially in the early years of policy implementation.

Methodological Implications and Limitations. The findings also carry several methodological implications. First, the observed sensitivity of the regression model to structural breaks confirms that purely trend-based models may overestimate future revenues when unexpected shocks occur. Second, the improved performance of single exponential smoothing in the later period shows the value of adaptive methods that place greater weight on recent data, particularly when tax policy and economic conditions are changing (Kotu & Deshpande, 2019). Third, the relatively high MAE and MSE of the exponential smoothing model indicate that reliance on a single smoothing parameter is insufficient to capture complex dynamics fully; more advanced methods such as double or triple exponential smoothing (Holt–Winters) could be explored in future research to model both level and trend components (Anderson et al., 2011).

Finally, a key limitation is that this study uses only one tax base (PKB) and one province (East Java). While this focus is appropriate for an initial evaluation of Opsen PKB potential, subsequent studies could extend the framework to other provinces, incorporate additional explanatory variables (such as vehicle registrations, economic growth, and policy interventions), and compare alternative forecasting techniques recommended in the Ministry of Finance's module (Ministry of Finance of the Republic of Indonesia, 2021). Such extensions would provide a more comprehensive evidence base for designing and refining the Opsen PKB system nationally.

CONCLUSION

The results of calculations utilizing simple linear regression and single exponential smoothing methods yield two formulas with differing PKB and Opsen PKB realization prediction outcomes. The linear regression method shows the results of the prediction analysis for years 8 to 14, which has a trend pattern and is linear. This method predicts an annual 4% increase in the realization of PKB and Opsen PKB. Although at the first phase of calculation this method shows promising accuracy with a 4,06% MAPE value, at the second phase of calculation this method shows a decrease in accuracy, shown by the final MAPE value of 6%.

Single exponential smoothing produces different results from the simple linear regression method. The single exponential smoothing method predicts an average of 9,53% drop in the realization value of PKB throughout all prediction calculations (both year 1 – 7 for the first phase and year 8 – 14 for the second phase). However, single exponential smoothing shows a higher accuracy in prediction—this is shown in the 3,52% final MAPE value. This method uses a smoothing constant of 0.9 with a prediction formula of $F_{(t+1)}=0,9Y_t+(1-0,9)\ F_t$.

REFERENCE

Anderson, D. R., Sweeney, D. J., & Williams, T. A. (2011). *Statistics for business and economics (11th ed.)*. South-Western Cengage Learning.

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Badan Pusat Statistik. (2024, February 20). Jumlah Kendaraan Bermotor Menurut Jenis Kendaraan di Kota Malang (Unit), 2023. Retrieved 2024 from Badan Pusat Statistik: https://www.bps.go.id/id/statistics-table/3/VjJ3NGRGa3dkRk5MTlU1bVNFOTVVbmQyVURSTVFUMDkjMw==/jumlah-kendaraan-bermotor-menurut-provinsi-dan-jenis-kendaraan--unit---2023.html

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches (3rd ed.).* Sage.

Damayanti, M. T. (2023). Penerapan Algoritma Markov Chains dan Time Series Analysis untuk Memprediksi Potensi Pajak Daerah di Kota Malang Tahun 2022–2026.

Dewi, R. S., Jaya, I., & Husein, I. (2024). Peramalan penerimaan Pajak Kendaraan Bermotor menggunakan metode triple exponential smoothing di Sumatera Utara.

East Java Governor. (2017). Governor Regulation of East Java Number 40 of 2017 on Procedures for Managing Revenue Sharing of Regional Tax Revenue to Regency/Municipal Governments.

East Java Governor. (2019). Governor Regulation of East Java Number 94 of 2019 concerning Calculation of the Basis for Imposition of Motor Vehicle Tax and Motor Vehicle Title Transfer Fee.

East Java Province Government. (2023). Peraturan Daerah Provinsi Jawa Timur Nomor 8 Tahun 2023 tentang Pajak Daerah dan Retribusi Daerah.

Gidion. (2019). Research methodology: penulisan skripsi, tesis, dan karya ilmiah. CV. Magna Raharta Tama (Mahata).

Government of Indonesia. (1997). Law No. 18 of 1997 concerning Regional Taxes and Regional Retributions.

Government of Indonesia. (2000). Law No. 34 of 2000 concerning Amendment to Law No. 18 of 1997 on Regional Taxes and Regional Retributions.

Government of Indonesia. (2004). Law No. 33 of 2004 concerning Fiscal Balance between the Central Government and Regional Governments.

Government of Indonesia. (2009). Law No. 28 of 2009 concerning Regional Taxes and Regional Retributions.

Government of Indonesia. (2022). Law No. 1 of 2022 concerning Financial Relations between the Central Government and Regional Governments.

Government of Indonesia. (2023). Government Regulation No. 35 of 2023 concerning General Provisions of Regional Taxes and Regional Retributions.

Hasibuan, L., & Musthofa, S. (2022). Penerapan Metode Regresi Linear Sederhana untuk Prediksi Harga Beras di Kota Padang. *JOSTECH Journal of Science and Technology, II*(1), 85-95.

Heykal, M., Prasetya, S., & Harsanti, P. S. (2024). Pengaruh Kualitas Pelayanan terhadap Kepuasan Pelanggan pada Jasa Wisata (Open Trip) CV Tidung Island. *Jurnal Ekonomi Manajemen Akuntansi*, *30*(1), 250-265. https://doi.org/10.59725/ema.v30i1.226

Hilmiyah, F., Maretaniandini, T. S., & Tsabita, A. Z. (2023). Analisis Potensi Opsen Pajak Kendaraan Bermotor bagi Penerimaan Daerah: Studi Kasus Kabupaten Cirebon., III, pp. 123-138.

Kanwil DJPb Provinsi Lampung. (2023, June 27). Press Release: Implementasi Opsen Pajak di Provinsi Lampung di Kebut. Retrieved March 7, 2024 from Kanwil DJPb Provinsi Lampung: https://djpb.kemenkeu.go.id/kanwil/lampung/id/data-publikasi/berita-terbaru/2914-press-release-implementasi-opsen-pajak-di-provinsi-lampung-di-kebut.html

Kotu, V., & Deshpande, B. (2019). Time Series Analysis. In V. Kotu & B. Deshpande, Data Science (pp. 395-445). Elsevier Inc.

Malang City Government. (2023). Malang City Regional Regulation No. 4 of 2023 concerning Regional Taxes and Regional Retributions.

Ministry of Finance of the Republic of Indonesia. (2021). Regional Tax and Retribution Potential Exploration Module.

Montaño, J., Palmer, A., Sesé, A., & Cajal, B. (2013). Using the R-MAPE Index as a Resistant Measure of Forecast Accuracy. Psicothema, 500-506.

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Profillidis, V. A., & Botzoris, G. N. (2018). Modeling of transport demand: Analyzing, calculating and forecasting transport demand. Elsevier.

Siswanto, D. (2023, March 25). Ini Tujuan Opsen Pajak di UU HKDP. From Kontan: https://nasional.kontan.co.id/news/ini-tujuan-opsen-pajak-di-uu-hkdp

Sugiyono. (2010). Metode Penelitian Pendidikan Pendekatan Kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.

Suprayogi, M. A. (2022). Model double exponential smoothing dalam peramalan penerimaan pajak pemerintah pusat Indonesia.

Wardhana, D. (2019). Decentralization, Democratization, And Social Protection in Indonesia: A Systematic Review of the Literature. *The Indonesian Journal of Development Planning, III*(2), 165. doi: https://doi.org/10.36574/jpp.v3i2