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URBAN $PM_{2.5}$ POLLUTION DYNAMICS IN PETALING JAYA, MALAYSIA: A TEMPORAL APPROACH

(Dinamik Pencemar $PM_{2.5}$ Bandar di Petaling Jaya, Malaysia: Suatu Pendekatan Temporal)

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ABSTRACT

In 2021, Malaysia experienced a 25% increase in fine particulate matter ($PM_{2.5}$) concentrations compared to 2020. During this period, Petaling Jaya was recognised as one of the most polluted cities in the country. The study intended to investigate the dynamics of daily average concentrations of particulate matter smaller than 2.5 micrometres ($PM_{2.5}$) and other air pollutants with notable significant levels in 2021 in Petaling Jaya, Malaysia, for the year 2021 relative to the levels in 2020. To achieve this, an autoregressive distributed lag (ARDL) model was employed. Results from the paired sample *t*-test indicated sulphur dioxide (SO_2) as having significantly higher concentrations in 2021 compared to 2020. The ARDL bound test established a long-term association between SO_2 and $PM_{2.5}$. The Augmented Dickey (ADF) unit root test supported the suitability of the ARDL model by demonstrating variable integration at different levels. The ARDL model analysis revealed that SO_2 had a significant long-term negative impact on $PM_{2.5}$, while exhibiting a significant effect in the short term. An adjustment speed of 34% indicated that the system could rectify approximately one-third of any deviation from the long-term equilibrium between SO_2 and $PM_{2.5,}$ one day following a disturbance. Various reasons could be cited for the discrepancies in model performance across different time frames and pollutants, such as seasonal fluctuations, changes in human activities, adjustments to regulations, and external influences. This study provides crucial insights into the dynamic interactions between air pollutants and contributes to more effective air quality management strategies.

Keywords: $PM_{2.5}$; Petaling Jaya; paired sample *t*-test; autoregressive distributed lags model

ABSTRAK

Pada tahun 2021, Malaysia mengalami peningkatan sebanyak 25% pada kepekatan partikel terampai halus ($PM_{2.5}$) berbanding tahun 2020. Pada waktu tersebut, Petaling Jaya dikenalpasti sebagai salah satu bandar paling tercemar dalam negara. Kajian ini bertujuan untuk menyiasat dinamik kepekatan purata harian partikel terampai bersaiz kurang daripada 2.5 micrometer ($PM_{2.5}$) dan pencemar udara lain yang mempunyai aras yang ketara pada tahun 2021 di Petaling Jaya, Malaysia, untuk tahun 2021 relatif kepada aras pada tahun 2020. Untuk tujuan ini, model autoregresif lat tertabur (ARDL) telah digunakan. Hasil daripada ujian-*t* sampel berpasangan menunjukkan yang sulfur dioksida (SO_2) mempunyai kepekatan tinggi yang signifikan pada tahun 2021 berbanding tahun 2020. Ujian terikat ARDL memantapkan perkaitan jangka masa panjang antara SO_2 dan $PM_{2.5}$. Ujian Augmented Dickey (ADF) menyokong kesesuaian model ARDL dengan menunjukkan integrasi pembolehubah pada pelbagai aras. Analisis model ARDL menunjukkan SO_2 mempunyai impak negatif jangka masa panjang yang signifikan kepada $PM_{2.5}$, sambil mempamerkan kesan signifikan dalam jangka masa pendek. Pelarasan kepantasan pada 34% menunjukkan bahawa sistem ini mampu membetulkan lebih kurang satu pertiga daripada sebarang penyimpangan daripada keseimbangan jangka masa panjang diantara SO_2 and $PM_{2.5,}$ sehari selepas gangguan. Pelbagai punca boleh dipetik berkenaan percanggahan pada prestasi model merentasi pelbagai jangka masa dan pencemar, contohnya turun-naik musiman, perubahan aktiviti manusia, pelarasan peraturan, dan pengaruh luar. Kajian ini memberi

pandangan penting kepada interaksi dinamik antara pencemar udara dan menyumbang kepada pengurusan strategi kualiti udara yang lebih efektif.

Keywords: $PM_{2.5}$; Petaling Jaya; ujian-*t* sampel berpasangan; model autoregresif lat tertabur

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