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Population With Psychological Depression and Influencing Factors in Taiwan: A Macro-Level Study

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Abstract

This paper investigates the determinants of the prevalence of psychological depression in Taiwan, examining over ten socioeconomic and demographic factors. We collected macro-level data from 2012-2021 across 19 cities and counties, and analyzed it using cross-sectional random effects models. Our findings show a consistent rise in antidepressant usage, exacerbated by local events such as presidential elections and global events such as COVID-19. The analysis of this trend takes into account significant factors from the labor market, population structure, and family-related aggregate variables. Policy recommendations include, on the level of the individual, providing psychological counseling, promoting healthy lifestyles, and implementing stress management strategies. On the societal level, addressing labor market inequalities, supporting unemployed and vulnerable groups, and fostering healthy marital dynamics are also crucial to mitigating depression risks and promoting mental well-being in Taiwan, especially during periods of local and global instability.

Keywords: depression, panel data, Taiwan

I. Introduction

As social changes have accelerated and technological complexity has advanced, the demand for diverse social and employment skills inherent to social survival has increased, resulting in heightened pressures of the social environment and a greater propensity for developing mental illnesses. According to the World Health Organization (WHO), approximately 3.8% of the global population suffers from depression, with a significant proportion being individuals aged 60 and above (WHO 2023). In Taiwan, data from the National Health Insurance Administration indicate a steady rise in cases of depression from 2016-2018. Additionally, the Ministry of Health and Welfare's (MOHW) suicide prevention handbook highlights that 15% of those with depression succumb to suicide, emphasizing the urgency of addressing this issue (MOHW 2024a). While prevention and treatment are vital, identifying and addressing the root causes of mental illnesses remain crucial for developing effective strategies and policies.

Previous research on depression has examined various aspects, including assessment tools, symptom standards, and demographic trends. For instance, Comstock and Helsing (1977) found correlations between racial groups and depression, while considering and controlling for marital status, education level, income, and gender. Their findings showed a higher prevalence of depressive symptoms among Black individuals compared to Whites, with females in the White demographic exhibiting a higher prevalence than males. They also identified higher probabilities of depressive symptoms among young adults, unmarried individuals, non-labor force participants, low-income earners, and those with lower education levels.

Subsequent studies, such as that of Dooley et al. (2000), conducted research on a survey of 5,113 respondents using the Center for Epidemiologic Studies Depression (CES-D) Scale. Their findings revealed that unemployment, underemployment, or non-labor force status are associated with a higher likelihood of experiencing depressive symptoms. Recent studies utilizing the CES-D scale, such as that of Fitzpatrick et al. (2020), have explored the relationship between social vulnerability, personal stressors, social or psychological resources, and depressive symptoms among U.S. adults during the COVID-19 pandemic. Data collected from 10,368 participants identified higher CES-D scores among socially vulnerable groups characterized by female gender, non-White ethnicity, unmarried status, Hispanic background, and unemployment. These findings suggest that an increased risk of depression would also occur among these demographic segments during the pandemic. Subsequently, the WHO (2022) released data indicating that the COVID-19 pandemic led to a 25% rise in the global prevalence of anxiety and depression, especially among young people and women, highlighting the importance of sustained investigation into the mental health impacts of global crises.

Over the past 50 years, research on depression has primarily focused on micro-level data related to individual characteristics such as gender, education, and income. However, the influence of macroeconomic factors on mental well-being is increasingly recognized as significant. For instance, Melgar and Rossi (2010) conducted a seminal study on the impact of both individual and macroeconomic factors on depressive symptoms using data from the Gallup Public Opinion Polls spanning 93 countries. Their analysis revealed that urban residency was significantly associated with more depressive symptoms, while GDP per capita had no discernible effect. However, greater income inequality, indicated by a higher Gini coefficient,

was linked to increased depressive symptoms. Alois (2014) extended this research by examining factors such as median income, the Gini coefficient, income ratios, and poverty rates among women and single mothers across 30 countries. The findings indicated that as income inequality widened, women's happiness levels decreased while unhappiness increased.

This study seeks to contribute incrementally to depression research by investigating additional macroeconomic variables and comparing them with micro-level findings to discern broader economic determinants of depression. The variables under scrutiny include regional income levels, labor force participation, unemployment rates, educational attainment, income inequality, disability rates, aging population levels, dependency ratios, and occurrences of marriage, divorce, and domestic violence. To understand the relationships between our selected socioeconomic variables and regional depression prevalence, we draw on both macro- and micro-level research. Hypotheses derived from studies by Dooley et al. (2000), Melgar and Rossi (2010), and Alois (2014) suggest that higher income inequality, unemployment, and lower household income are linked to reduced financial stability, decreased social engagement, and limited access to medical resources, potentially increasing depression prevalence across regions. Micro-level research by Comstock and Helsing (1977) hypothesizes that the factors of no labor force participation and low educational attainment exacerbate these effects for individuals by undermining financial stability and weakening community stress management. Additionally, theoretical frameworks like the stress process model (Pearlin 1989) and social integration theory (Durkheim 1952) explain how domestic violence, divorce, and low marriage rates increase regional depression by fostering stress, trauma, and social isolation. Higher disability rates and an aging population, linked to persistent health challenges and social isolation, align with the disability stress model (Turner and Noh 1988) and theories of

aging and mental health (Rowe and Kahn 1997). Finally, high dependency ratios, which strain economic resources and increase stress on working-age individuals, can elevate regional depression levels, as understood through economic strain theory (Conger et al. 1990).

In this study, we aim to identify nuanced relationships and interactions among variables influencing depression rates. By including interaction terms—such as those between unemployment rate and educational attainment, dependency ratio and aging population, and female population ratio and marriage cases—we capture combined effects and discern how the marginal effects of individual variables vary with different levels of their interacting partners. These interactions are crucial as they provide insights into how various demographic and economic conditions interact to either mitigate or exacerbate depression risk. This methodological framework advances previous studies, such as Alois (2014), by employing a broader range of macroeconomic variables and interaction terms between socioeconomic and demographic factors at regional levels. This approach offers a deeper understanding of the multifaceted influences on depression and informs more effective and targeted policy interventions for the Taiwanese populace.

The subsequent structure of this paper is as follows: Section II discusses data sources and presents descriptive statistics. Section III introduces empirical models and analyzes the empirical results. Finally, Section IV synthesizes the key findings and presents policy recommendations.

II. Variables and Description of Data

Taiwan, an island economy with a population exceeding 23 million, is comprised of six special municipalities, 13 counties, and three autonomous

municipalities, as depicted in Figure 1. Known for its rich cultural heritage and vibrant society, Taiwan also confronts challenges associated with high population concentration, which is particularly evident in urban centers such as the Taipei Metropolitan Area (Taipei City, New Taipei City, and Keelung City), Taichung City, and Kaohsiung City.[1] The dynamic urban life in these areas reflects a complex interplay of luxury and entertainment versus work exhaustion and exclusion stemming from intense economic competition and societal pressures. This unique mix of rapid economic development, diverse population demographics, cultural dynamics, and societal challenges provides an intriguing context for studying mental health issues, including depression. Understanding these dynamics not only benefits Taiwan but also offers insights for addressing similar challenges in other densely populated

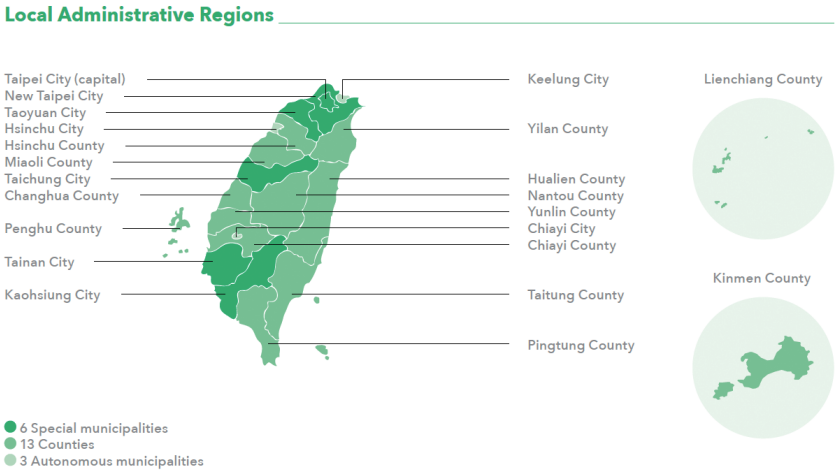

Figure 1. Cities and counties in Taiwan

Note: See the online version (https://doi.org/10.6191/JPS) for the full-colored figure.
Source: Governmental Portal of Taiwan (n. d).

1 The World Population Review (n. d.) indicates that in 2024, these three areas constitute 30%, 12%, and 12% of Taiwan's total population, respectively.

Asian economies with comparable cultural backgrounds. Notably, our study excludes Taiwan's outer island counties of Penghu, Kinmen, and Lienchiang due to incomplete data, and we focus solely on the 19 cities and counties of Taiwan's main island from 2012-2021.

Data Sources and Characteristics of Labor Market Variables

The macroeconomic variables examined in this study, along with those in prior research, are crucial for understanding depression severity across cities and counties in Taiwan. These variables include average annual household disposable income, labor force participation and unemployment rates, education levels (measured by the proportion of individuals whose highest education level is a high school diploma), and income inequality assessed by the Gini coefficient. They provide insights into societal dynamics, regional disparities, and mental health trends. Data related to these variables are accessible from the Directorate General of Budget, Accounting, and Statistics website of the Executive Yuan in Taiwan. However, obtaining city- or county-level Gini coefficients directly is not feasible. Thus, we rely on the "Statistics of Household Income Distribution by Decile after Tax," provided by the Fiscal Information Agency, Ministry of Finance in Taiwan, to derive 10 quintiles of after-tax household income. This dataset enables us to compute the yearly Gini coefficients required for our analysis.

Figure 2 presents the yearly averages for the five macroeconomic variables in the income and labor market category across the 19 selected cities and counties in Taiwan from 2012-2021. This information sketches a regional overview of development status, educational levels, and income inequalities in each area. Generally, our findings show varying but relatively high income levels of household disposable income (in New Taiwan Dollars, NTD), in

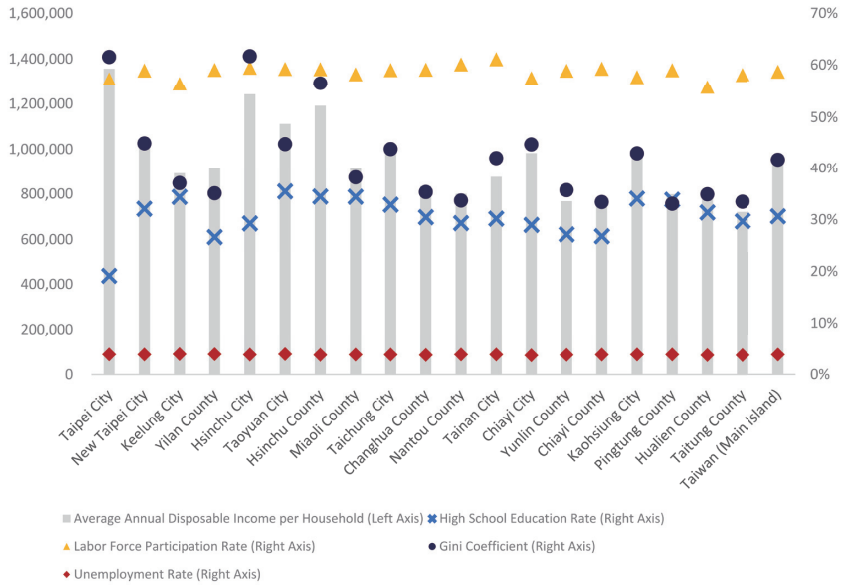

Figure 2. Yearly average of income and labor market variables in Taiwan (2012-2021)

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the northern cities, counties, and the six special municipalities. However, these areas also exhibit relatively high Gini coefficients, indicating potential socioeconomic challenges for their residents.

Regarding unemployment rates, minimal discrepancies exist among the 19 selected cities and counties, with yearly averages consistently below 4%. Coupled with a robust labor force participation rate of around 60%, this suggests favorable economic development in Taiwan over the past decade. Additionally, the yearly average proportion of the population aged 15 and above with only a high school degree decreases as the number of college-educated individuals increases within a city or county. This trend, prevalent throughout Taiwan, reflects the government's efforts to enhance educational resources over the past decades.

Data Collection and Features of Population Structure Variables

This study uses antidepressant usage as a proxy for assessing depression severity across cities and counties in Taiwan. The data on antidepressant users is sourced from the National Health Insurance Administration under MOHW. This variable includes citizens who, in a given year, have been prescribed N06A and N06CA antidepressants (in combination with psycholeptics) according to the Anatomical Therapeutic Chemical Classification System developed by the WHO. Our approach is similar to that of Brody and Gu (2020), who used antidepressant usage rates among adults to gauge depression severity in the United States. However, unlike Brody and Gu, who calculated rates using the adult population, applying this method to our study presents challenges. Dividing the number of regional antidepressant users by the total population could misrepresent the data by conflating the impact on the numerator (depression cases) with variations in the denominator (total population). Moreover, using the total population might dilute the prevalence of depression, particularly in regions with a higher number of non-relevant population groups, such as newborns, who are unlikely to use such medication. While antidepressant usage does not directly equate to a clinical depression diagnosis and can be influenced by healthcare-seeking behavior and resource availability, it remains the most appropriate measure for our analysis.

To stabilize variance and account for the wide range in values, we transformed variables such as antidepressant usage, the number of people with disabilities, and the population aged 65 and over into their natural logarithms. This transformation, common in econometric analysis, facilitates the interpretation of percentage changes when examining the impact of explanatory variables. Although it does not directly control

for population size, it helps address heteroscedasticity and enhances the interpretability of variable relationships. As Pek et al. (2017) note, data transformations can alter the scale and relationships of variables, making their effects more interpretable and meaningful in statistical inference. This transformation offers a practical compromise that balances interpretability with statistical rigor. Additionally, the inclusion of the female population ratio and dependency ratio offers insights into demographic shifts and societal dynamics crucial for analyzing mental health trends.

The Gender Equality Committee of the Executive Yuan provides data on people with disabilities, while statistics on the female ratio and the elderly population come from the Ministry of the Interior. The dependency ratio is extracted from the Directorate General of Budget, Accounting, and Statistics website, completing the comprehensive set of variables for our analysis.

Figure 3, in which the data is laid out geographically from north to south, plus also the average for the whole island of Taiwan at the end, illustrates also that Taiwan's six special municipalities have notably high annual averages of antidepressant users, with Taipei City exceeding 200,000, likely reflecting their larger populations. However, when adjusting for population size to calculate depression prevalence rates, Chiayi City shows the highest rate (14.96%), while Hsinchu County has the lowest (3.87%), compared to the national average of 6.05%. This underscores the limitations of using population-based rates, as they may misrepresent data by conflating the number of antidepressant users with population variations, including non-relevant groups like infants. The figure also reveals substantial populations of people with disabilities and those aged 65 and over in these municipalities, indicating that areas with significant changes in these groups may see corresponding increases in antidepressant usage. Furthermore, variables such as the female population ratio and dependency

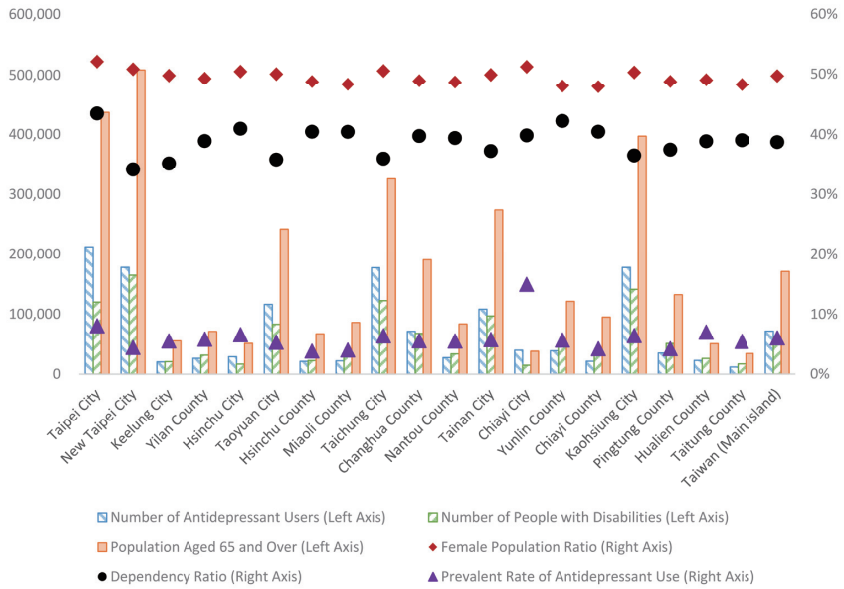

Figure 3. Yearly average of population structure variables in Taiwan (2012-2021)

Note: See the online version (https://doi.org/10.6191/JPS) for the full-colored figure.

ratio are examined as potential determinants of antidepressant use, with detailed comparisons provided in Figure 3 to avoid repetitive descriptions.

Data Compilation and Insights into Family-Related Variables

Our final set of selected variables includes statistics on marriages, divorces, and domestic violence cases recorded in each city and county. Data on domestic and family violence cases are sourced from the Gender Equality Committee of the Executive Yuan, while information regarding marriages and divorces is provided by the Ministry of the Interior. These variables will be transformed into natural logarithms for our regression analysis to examine their impact on the percentage change of antidepressant users in each city or county.

Building on the literature reviewed in the previous section, we acknowledge that marriage has the potential to contribute to individuals' happiness, which may correlate with lower levels of depression. However, it is important to note that higher marriage rates in a city or county do not necessarily indicate better marital quality or directly translate to reduced antidepressant usage. Therefore, our study aims to investigate whether areas with more married couples also exhibit lower numbers of antidepressant users. Additionally, we are interested in exploring whether factors such as divorce cases and incidences of domestic violence could contribute to a more severe situation of depression in these areas. Figure 4 presents the yearly averages for these family-related variables. The interplay of societal factors such as marriage, divorce rates, and domestic violence on mental health outcomes is intricate and multifaceted. Understanding these dynamics offers insights into potential interventions for addressing community-level mental health challenges.

In this section, we have presented all the variables employed in this study. Before proceeding to the empirical analysis and results discussion in the next section, we conclude by providing the correlation matrix of these variables in Appendix 1. Appendix 1 offers an initial overview of the pairwise relationships between variables, aiding in understanding their interconnections.

III. Empirical Analysis: Models and Results

In the preceding section, we introduced three groups of variables to elucidate factors influencing depression prevalence in cities and counties across Taiwan. By integrating these variables, we aim to identify key determinants of depression severity in each city or county. Our empirical model is defined as follows:

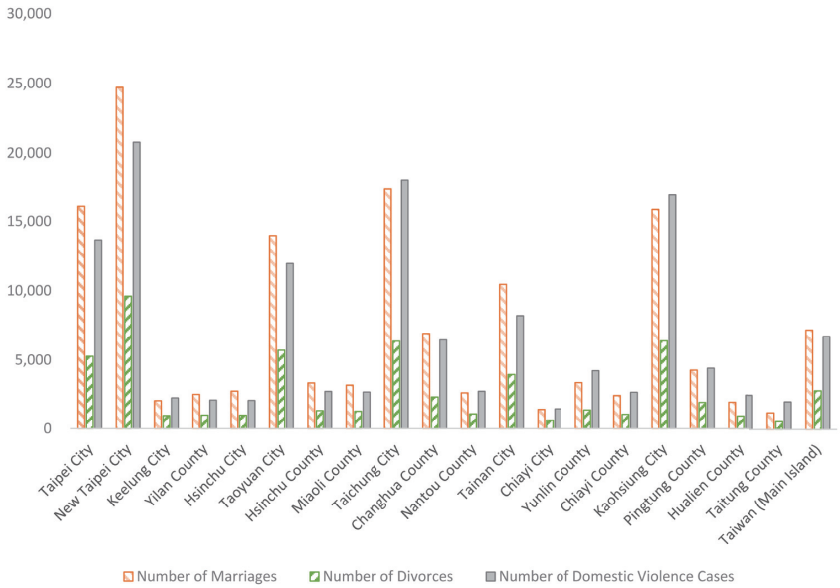

Figure 4. Yearly average of marriage, divorce, and domestic violence variables in Taiwan (2012-2021)

Note: See the online version (https://doi.org/10.6191/JPS) for the full-colored figure.

$$\ln(depression_{i,t}) = \mathbf{X}'_{i,t}\boldsymbol{\beta} + \varepsilon_{i,t}, \text{ where } \varepsilon_{i,t} = \alpha_i + \lambda_t + \nu_{i,t} \quad \ldots\ldots (1)$$

In equation (1), the subscripts i and t denote the administrative region (city or county) and year, respectively. The dependent variable is the logarithmically transformed number of antidepressant users in each of the 19 administrative regions from 2012-2021. This transformation allows interpretation of percentage changes, especially when assessing the marginal effects of the explanatory variables. Explanatory variables such as average annual disposable income per household, the number of people with disabilities, the population aged 65 and over, the number of marriages, divorces, and domestic violence cases are log-transformed for the same purpose. Variables expressed as percentages (labor force participation

rate, unemployment rate, Gini coefficient, high school education rate, dependency ratio, and female population ratio) are kept at their original levels. These 12 variables are included in the raw vector $\mathbf{X}'_{i,t}$, with their respective regression coefficients in the vector β.

The regression residuals $\varepsilon_{i,t}$ in panel data typically include three components. The first is cross-section fixed effects (α_i), representing the variation of the dependent variable across cities and counties after accounting for the explanatory variables. If these effects show minimal discrepancies based on the Hausman (1978) test, cross-section random effects may be used to control for regional heterogeneity. The second component comprises time-specific fixed effects (λ_t), capturing trends over time, achieved with a linear time trend or yearly dummies. The final component is the white noise term ($v_{i,t}$), which requires no further discussion.

Our estimation results for equation (1), presented Appendix 2, are segmented into four models. Models A and B form one group, while Models C and D form another, each using the same explanatory variables. The difference lies in capturing time-specific effects: Models A and C use a linear time trend, reflecting the average annual growth rate of antidepressant users across the 19 administrative regions, while Models B and D use time dummies to capture annual fluctuations, providing a comparison against the average growth rate. By separating the effects of a linear trend and yearly dummies while controlling for other variables, we can assess the impact of specific events, such as the COVID-19 pandemic, on the growth rate of antidepressant users in our sample.

The distinction between Models A and B versus Models C and D lies in our use of different interaction terms to capture marginal effects and address multicollinearity concerns. For instance, when we include

both unemployment rates and high school education rates along with their interaction term in the regression, the coefficients tend to be estimated as insignificant due to the high correlation coefficient (0.93) between the interaction term and high school education rates. This issue can be resolved by removing one of the variables, such as high school education rates, from all four models. Similar strategies are applied to variables like dependency ratios and the elderly population. The correlation coefficient between the interaction term of dependency ratios and the elderly population and the elderly population itself is 0.98. These treatments are implemented across the four models in separate regression analyses.

We proceed with an analysis of the estimation results in Appendix 2. All four models use cross-section random effects estimation, as cross-section fixed effects diminish. This indicates that there is not a strong region-specific pattern in antidepressant use when accounting for our selected explanatory variables across the 19 cities and counties in Taiwan.

Drawing on studies concerning exploring the relationship between income and depression by Comstock and Helsing (1977) suggesting higher depression vulnerability among low-income individuals and Melgar and Rossi (2010) and Alois (2014) finding no consistent link between regional GDP per capita and depression, we examine the impact of household disposable income on the number of antidepressant users in Taiwan's administrative regions. Our findings, consistent across Models A to D in Appendix 2, mirror those of Melgar and Rossi and Alois, indicating no clear association between regional wealth and antidepressant use. This implies that personal or household income, which more directly impacts financial stability, social engagement, and medical access, may be a more significant factor in depression than regional income averages. Similarly, our analysis did not support the hypothesis that regional labor force participation rates

affect emotional well-being, in contrast to Dooley et al. (2000), who found higher depressive symptoms among non-participants. These discrepancies may stem from differences in data structure between macro- and micro-level studies and varying perceptions of macroeconomic and individual influences on depression risk.

The Gini coefficient, another income-related macroeconomic variable, consistently correlates positively with the number of antidepressant users across our Models A to D. This finding aligns with previous studies by Melgar and Rossi (2010) and Alois (2014), where the perception of income inequality often leads to increased unhappiness, as extensively discussed in recent papers by Patel et al. (2018) and Tibber et al. (2022). This relationship could be attributed to several factors. Psychological impacts of income inequality, such as heightened stress and reduced access to resources like healthcare and education, are known to exacerbate mental health issues like depression. Additionally, social comparison theory suggests that disparities between wealthy and less affluent individuals can lead to feelings of inferiority and low self-esteem, further affecting mental well-being. Thus, the positive correlation underscores the complex interplay between socioeconomic factors, individual welfare, and mental health outcomes.

The studies by Dooley et al. (2000) and Fitzpatrick et al. (2020) have highlighted a positive correlation between unemployment and depression, findings supported by our Taiwan-based macro data analysis across Models A to D in Appendix 2. Our results indicate a significant impact of regional unemployment rates on antidepressant usage prevalence. Additionally, regions with a higher percentage of individuals possessing only a high school degree (indicating lower college education rates) tended to show reduced depression severity at given levels of unemployment, with thresholds for high school education rates approximately between 24%

and 36%. This may be attributed to high school completion symbolizing a certain level of maturity, potentially aiding individuals in coping with periods of unemployment and decreasing their susceptibility to depression. However, data in Figure 2 highlights a worrying trend in Taipei, the capital city, where the average high school education rate falls below 20%. This situation potentially leads to a higher prevalence of depression linked to worsening unemployment conditions in this area. Consistent with Dooley et al. (2000), our findings suggest that while unemployment increases depression, the adverse effect is significantly more pronounced for individuals with college degrees or higher. Individuals with college degrees or higher may experience greater pressure and a comparative mindset, increased expectations, financial commitments, social stigma, and loss of occupational identity, all of which can potentially worsen their mental health during unemployment.

An intriguing trend observed among individuals aged over 65, illuminated by Melgar and Rossi (2010), suggests they may experience fewer depressive symptoms compared to those in the 15-64 age group. This could be influenced by various factors, including less exposure to competitive urban environments. However, our analysis, using city and county data from Taiwan, indicates that regions with more individuals aged 65 and over tend to have higher numbers of antidepressant users according to Models A and B in Appendix 2. A positive aspect emerges upon deeper examination: a higher dependency ratio generally mitigates the impact of aging on depression, as shown in Models A, C, and D. However, as the proportion of elderly dependents within the dependency ratio increases, this positive impact diminishes. This could be due to resource strain, social isolation, healthcare access issues, caregiver burden, economic dependency, and intergenerational conflict. Therefore, understanding the interaction

between the dependency ratio and the elderly population is essential for assessing its impact on antidepressant use.

Our analysis in Models A to D reveals the relationships between disabilities and depression, and between domestic violence and depression, yielding expected yet meaningful results. A city or county in Taiwan with higher numbers of individuals with disabilities or domestic violence cases is associated with higher antidepressant usage. Additionally, the associations between divorces, marriages, and antidepressant usage within city or county contexts reveal that an increase in divorces generally links to a lower prevalence of antidepressant users across all four models, albeit with a negative but statistically insignificant effect in Model B. This counterintuitive finding might be explained by several factors: higher divorce rates could indicate individuals leaving unhappy marriages, leading to improved well-being. Regions with higher divorce rates might also have better social support systems and cultural acceptance of divorce, reducing associated stress.

Conversely, higher marriage rates correlate with more antidepressant users in Models A and B, holding in Models C and D with the interaction of the female population ratio and the number of marriages. This may be due to higher marriage rates not necessarily indicating better marital quality, with regions experiencing higher marital stress. Traditional gender roles and societal expectations can place additional pressure on married women, particularly in metropolitan regions with a higher female population, leading to increased stress and depression. These findings differ from those of Comstock and Helsing (1977), who identified heightened probabilities of depressive symptoms among unmarried individuals. This discrepancy could stem from the different data types used: Comstock and Helsing (1977) employed survey data, capturing individual-level variations, whereas our study uses macroeconomic aggregate data, reflecting

broader regional trends. Changes in societal norms, marital dynamics over time, and variations in healthcare access might also contribute to these differing results. These findings underscore the complex interplay between demographic factors, marital status, and depression outcomes, emphasizing the need for a deeper examination of societal dynamics and their implications for mental health interventions.

Revisiting the discussion on yearly fixed effects using linear time trends or time dummies, while considering the explanatory variables, yields significant insights. Models A and C demonstrate a steady annual increase in antidepressant usage by 1.88% to 2.04% across our sample regions. In contrast, Models B and D exhibit varying yearly fixed effects from 2012-2021, with average growth rates of 1.85% (Model B) and 2.19% (Model D). These figures roughly align with MOHW's report of a 20% increase in depression prevalence among Taiwanese youth over the past decade (2024 estimate) (MOHW 2024b). Thus, these growth rates in fixed effects each year appear suitable for gauging depression severity in Taiwan.

Figure 5 illustrates these fluctuations, highlighting spikes in antidepressant usage rates following presidential elections in 2012, 2016, and 2020. Post-election years witnessed increases in antidepressant users: 2013 (10.62% to 11.22%), 2017 (4.19% to 4.78%), and 2021 (4.29% to 4.55%), suggesting political transitions may exacerbate depression rates. These findings echo research by Christopher Ojeda from the University of California-Merced, whose forthcoming book, "The Sad Citizen: How Politics Makes Us Depressed," explores the impact of modern democratic politics on mental health. Additionally, Landwehr and Ojeda (2021) found that severe depressive symptoms decrease the probability of voting by 0.05 to 0.25 points, indicating a close link between depression and political engagement across various policy contexts.

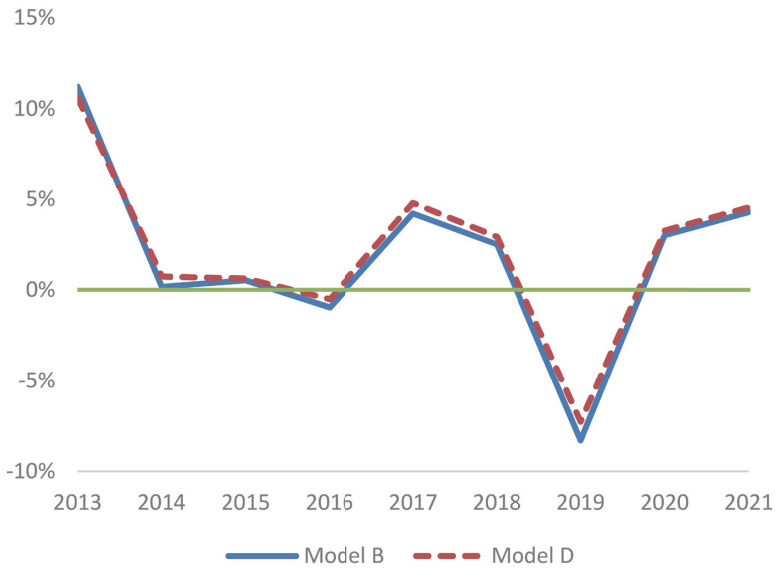

Figure 5. The rate of change in yearly fixed effects for antidepressant users

Note: See the online version (https://doi.org/10.6191/JPS) for the full-colored figure.

The sharp decline in antidepressant usage in 2019 requires scrutiny. This decline cannot be fully explained by presidential elections or the COVID-19 pandemic alone. Potential factors, including changes in medical and pharmaceutical policies—such as the discontinuation of the commonly used antidepressant medication "Prozac Tab" on April 1, 2019—warrant consideration. Furthermore, the onset of the COVID-19 pandemic in late 2019 complicated trends, with Models B and D indicating a rise to 3% and 3.25% respectively in antidepressant usage rates in 2020. This trend persisted into 2021, peaking between 4.29% and 4.55% post-election. In contrast, Models A and C suggest a more stable average increase of 1.88% to 2.04% per year based on linear trends. This stark rise during 2020-2021 likely stems from local political events post-election and global factors such as the COVID-19 pandemic. This observation suggests

Taiwanese individuals may be more responsive to local than global events. Antidepressant usage rates in 2013, driven by local political shifts, surpassed those during the 2020-2021 COVID-19 outbreaks. This sensitivity may reflect heightened awareness of political issues impacting mental health. Taiwan's effective pandemic response in 2020-2021 potentially stabilized emotions and increased public confidence, influencing antidepressant usage differently than global events. Thus, a comprehensive analysis of societal, environmental, and economic factors is crucial for understanding antidepressant usage dynamics.

IV. Concluding Remarks

In this paper, we offer a nuanced perspective on socioeconomic indicators and demographic factors influencing depression and antidepressant usage in cities and counties in Taiwan. This enhances our understanding of mental health dynamics. Unlike studies focusing on general happiness indexes via surveys, our use of macro data—specifically, antidepressant records from Taiwan's National Health Insurance Administration—provides a broader view of mental health trends. This highlights the crucial need for detailed mental health data collection, setting an example for other countries to adopt similar approaches for informed policymaking.

Addressing the rise in depressive symptoms requires proactive, evidence-based government intervention. Our study highlights key areas for policy action to alleviate depression. For example, employment protection and vocational training for educated but unemployed individuals can reduce unemployment and antidepressant use. Additionally, reducing income inequality and supporting people with disabilities and the elderly are vital for mental health. Tackling domestic violence demands comprehensive

government strategies, including educational campaigns to promote healthy relationships and better spousal communication. Community-based initiatives, such as support channels, regular monitoring, and interventions for individuals with violent tendencies, are also crucial to preventing domestic violence and safeguarding victims' mental well-being.

Lastly, our analysis highlights the rising trend in antidepressant usage, indicating a growing population affected by depression and anxiety disorders. The government must prioritize preventive policies to address this issue, including offering free psychological counseling, promoting balanced lifestyles, regular physical activity, and stress-relief techniques. During global crises like the COVID-19 pandemic, ensuring adequate medical resources and implementing measures to reassure the populace is crucial. Taiwan has set a global example in this regard. By adopting proactive policies and interventions, Taiwan can effectively tackle rising depression rates and improve mental health outcomes across the population.

At the conclusion of this paper, we acknowledge the limitations inherent in this study. The data spans from 2012-2021, thus the effects of the COVID-19 pandemic, which began to subside in 2023, could not be fully assessed. Future research should explore post-pandemic trends in antidepressant usage to determine if the upward trajectory continues or shows signs of improvement. Additionally, the cross-sectional nature of this study, limited to a 10-year period, restricts our ability to capture temporal relationships, and delayed effects of macro-level factors on depression might not be reflected in our data. Collaborating with government agencies to improve data collection would provide more comprehensive validation of our findings and policy recommendations. Therefore, considering potential administrative and effect lags, caution should be exercised to avoid overgeneralizing the results and policy suggestions.

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Appendix 1. Correlation Matrix of Socioeconomic Variables in Taiwan (2012-2021)

	DEPRESS	INC	LFP	UR	HS	GINI	DIS	FEM	ELDER	DEPR	MAR	DIV	VIO
Number of Antidepressant Users (DEPRESS)	1.00												
Average Annual Disposable Income per Household (INC)	0.52***	1.00											
Labor Force Participation Rate (LFP)	0.03	0.05	1.00										
Unemployment Rate (UR)	0.03	-0.04***	-0.19***	1.00									
High School Education Rate (HS)	-0.16**	-0.19***	-0.06	0.11	1.00								
Gini Coefficient (GINI)	0.43***	0.92***	0.09	-0.07	-0.23***	1.00							
Number of People with Disabilities (DIS)	0.94***	0.31***	0.10	0.09	-0.01	0.22***	1.00						

	DEPRESS	INC	LFP	UR	HS	GINI	DIS	FEM	ELDER	DEPR	MAR	DIV	VIO
Female Population Ratio (FEM)	0.72***	0.73***	-0.10	-0.03	-0.23***	0.66***	0.53***	1.00					
Population Aged 65 and Over (ELDER)	0.96***	0.43***	0.10	0.03	-0.12	0.34***	0.97***	0.60***	1.00				
Dependency Ratio (DEPR)	-0.14*	0.24***	0.11	-0.30***	-0.59***	0.35***	-0.32***	-0.09	-0.15**	1.00			
Number of Marriages (MAR)	0.89***	0.40***	0.07	0.13*	0.07	0.29***	0.95***	0.59***	0.90***	-0.44***	1.00		
Number of Divorces (DIV)	0.89***	0.38***	0.08	0.12	0.13*	0.27***	0.96***	0.57***	0.91***	-0.45***	0.99***	1.00	
Number of Domestic Violence Cases (VIO)	0.94***	0.39***	0.05	0.10	0.07	0.29***	0.97***	0.58***	0.94***	-0.32***	0.95***	0.96***	1.00

Note: Significance levels are indicated as *, **, and *** for 10%, 5%, and 1% levels of significance, respectively.

Appendix 2. Regression Results for Determinants of Antidepressant User Numbers

Explanatory variable	Dependent variable: ln (Number of antidepressant users)			
	Model A	Model B	Model C	Model D
Constant	-1.0544	-2.0277	3.7963**	1.9727
	(1.4870)	(1.3543)	(1.7157)	(1.5769)
ln (Average annual disposable income per household)	0.0209	0.0540	-0.0127	0.0171
	(0.0900)	(0.0801)	(0.0888)	(0.0798)
Labor force participation rate	0.3505	0.4232	0.2458	0.2914
	(0.3966)	(0.3619)	(0.3869)	(0.3477)
Unemployment rate	16.6541***	21.9478***	16.9856***	21.8415***
	(5.8259)	(6.1912)	(5.6004)	(5.9917)
(Unemployment rate) × (High school education rate)	-68.4146***	-64.9786***	-63.5846***	-61.4390***
	(14.5769)	(12.9533)	(13.8783)	(12.3493)
Gini coefficient	0.5245***	1.5039***	0.5652***	1.4175***
	(0.1630)	(0.3608)	(0.1557)	(0.3052)
ln (Number of people with disabilities)	0.5849***	0.5483***	0.5980***	0.5733***
	(0.1741)	(0.1589)	(0.1313)	(0.1202)

Explanatory variable	Dependent variable: ln (Number of antidepressant users)			
	Model A	Model B	Model C	Model D
ln (Population aged 65 and over)	0.3737**	0.2961**		
	(0.1473)	(0.1398)		
Dependency ratio	-2.2060***	-0.6788	-8.6467***	-6.0577***
	(0.5766)	(0.6164)	(2.2914)	(2.1870)
(Dependency ratio) × [ln (Population Aged 65 and Over)]			0.5039***	0.4123**
			(0.1716)	(0.1602)
ln (Number of marriages)	0.1863**	0.1752**	-0.7741***	-0.4224
	(0.0722)	(0.0839)	(0.2750)	(0.2771)
(Female population ratio) × [ln (Number of marriages)]			1.8830***	1.1979***
			(0.4684)	(0.4543)
ln (Number of divorces)	-0.3006***	-0.0400	-0.2946***	-0.0687
	(0.0753)	(0.0839)	(0.0721)	(0.0818)
ln (Number of domestic violence cases)	0.2435***	0.0966*	0.2645***	0.1234**
	(0.0434)	(0.0481)	(0.0427)	(0.0482)
Linear trend	0.0188***		0.0204***	
	(0.0056)		(0.0045)	
Adjusted R^2	0.8887	0.9174	0.8986	0.9192
Hausman test statistic	12.2801		19.2420	

Note: The Hausman test statistics are obtained from cross-sectional random effects models, which do not include a linear trend component or time-specific factors. Standard errors are denoted in parentheses, with significance levels indicated as *, **, and *** for 10%, 5%, and 1% levels of significance, respectively.

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Research Note

臺灣憂鬱症用藥人口及其影響因素：總體層面之研究

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摘要

本文探討臺灣憂鬱症用藥人口的影響因素，研究涵蓋超過十個社會經濟與人口相關變量。我們蒐集了2012年至2021年間臺灣19個本島縣市的總體數據，並使用跨區間隨機效果模型進行分析。研究結果顯示，在考慮來自勞動市場、人口結構及家庭相關的綜合變數之顯著影響後，抗鬱藥物的使用人次呈現穩定上升趨勢，且國內如總統大選及全球如新冠疫情事件則進一步加劇此一趨勢。在政策建議方面，本文的結論除了支持各縣市提供心理諮詢、促進健康生活方式及協助民眾進行壓力管理策略外，還包括改善勞動市場的不平等條件、支持失業及弱勢群體，並宣導健康的婚姻關係。在臺灣面對國內及全球不穩定時期，降低各縣市憂鬱症風險並促進心理健康至為重要。

關鍵詞：憂鬱症、追蹤資料、臺灣

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