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## Article

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# Reexamining the economic globalization-welfare state nexus: a Bayesian mixed approach to linear and non-linear dynamics

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## ABSTRACT

Previous research on the globalization-welfare state nexus has typically been conducted within a linear monotonic framework, focusing on two primary hypotheses. The efficiency hypothesis predicts that globalization shrinks the welfare state's size. In contrast, the compensation hypothesis argues that globalization increases demand for social security, leading to an expanded welfare state. Empirical evidence on this relationship is mixed, with multicollinearity suggested as one possible explanation. This study explores the non-linear, non-monotonic aspects of this nexus using a yearly panel of 10 ASEAN countries from 1970–2019, analyzed through a Bayesian mixed regression. The study focuses specifically on the effects of economic globalization. The results demonstrate a non-linear, non-monotonic relationship characterized by an inverted U-shape, where economic globalization initially expands the welfare state but, after reaching a certain point, leads to its retrenchment. This outcome supports a combination of both the compensation and efficiency hypotheses, aligning with the principles of non-linear and complex system sciences. The study offers a solid and reliable foundation for predicting long-term globalization processes and formulating comprehensive integration policies in ASEAN in the context of declining public expenditures.

## IMPACT STATEMENT

The study aims to explore the monotonic and non-monotonic relationships between economic globalization and the welfare state in ASEAN. Unlike similar research, this study employs a Bayesian hierarchical approach to handle multicollinearity, revealing a non-linear and non-monotonic effect of economic globalization on the welfare state, consistent with the Armey curve. The findings provide a robust foundation for formulating long-term globalization policies for ASEAN countries.

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## 1. Introduction

There are two prevailing perspectives on how economic globalization, or globalization more broadly, impacts fiscal autonomy, often representative of the welfare state in theoretical and empirical analyses. The first perspective, known as the efficiency hypothesis, documents that free trade and the mobility of production factors increase competition among national governments, pressuring them to reduce tax rates and fiscal power (Ursprung, 2008). On the contrary, the compensation hypothesis posits a positive relationship between economic liberalization and government expenditure (Rodrik, 1998), arguing that globalization heightens external risks, necessitating higher public spending as a form of social insurance. Empirical studies investigating the link between economic globalization and the welfare state have typically relied on a linear, monotonic approach, resulting in findings consistent with one of the aforementioned hypotheses. However, these studies often produce mixed outcomes due to limitations such as small sample sizes, a narrow focus on specific dimensions of economic globalization, or, more importantly, the biases inherent in Newtonian classical sciences. First, *prima facie* evidence suggesting a

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negative relationship between globalization and government expenditure is evident from the rapid increase in international trade and capital mobility during the period of ‘High globalization’ (Milanovic, 2016) or ‘New globalization’ (Baldwin, 2016) starting from 1990. This period coincided with an aggregate decline in government consumption as a share of GDP. These observed trends indicate a possible reversal in the relationship between globalization and the welfare state. Thus, by utilizing a larger data sample and embracing the philosophy of nonlinear science and complex systems, we anticipate a non-linear, non-monotonic relationship between globalization and the welfare state. It is noteworthy that the linear, monotonic assumptions of classical science have been fundamental to the social sciences since Newton’s publication of *Principia*. Due to flaws in models for forecasting, the uncertainties of linearity prompted the development of the first mathematical model of nonlinear phenomena in the 1960s (Burke, 2009). To our knowledge, aside from the recent assessment by Yong & Chi (2022), no studies have explored the non-linear, non-monotonic relationship between economic globalization and the welfare state. Additionally, no research has specifically focused on ASEAN countries (Anderson & Obeng, 2021; Busemeyer, 2009; Cameron, 1978; Dreher et al., 2008; Garrett & Mitchell, 2001; Rodrik, 1997; Yong & Chi, 2022, and many others). The ASEAN community is attracting growing interest for several reasons, including the involvement of many countries in the region in global trade agreements, the implementation of the ASEAN Economic Community (AEC), high economic growth rates, and the region’s proximity to two major economic centers, China and India (Jamhari et al., 2021). Second, economic indicators of globalization are popularly utilized due to their perceived strong impact on government size and the welfare state. It is worth mentioning that economic globalization is a complex phenomenon that cannot be sufficiently represented by a single indicator like financial or trade liberalization. This complexity prompted the creation of the KOF globalization indices by the Swiss Institute of Economics (KOF stands for ‘Konjunkturforschungsstelle’). Finally, most importantly, earlier frequentist research encounters issues with multicollinearity, where some covariates are strongly correlated, leading to bias. To address multicollinearity, this research employs a Bayesian mixed (or hierarchical) regression. The superiority of the Bayesian framework over frequentist analysis in solving multicollinearity is highlighted by Block et al. (2011), Winship & Western (2016), and recently, Dan & Thach (2024). Furthermore, the mixed-effects approach allows for capturing variations across units (Nezlek, 2008).

From the above discussion, we pose a substantial question: Does a non-linear, non-monotonic or a linear, monotonic relationship exist between economic globalization and the welfare state in an ASEAN sample? The study aims to provide insights into both the linear, monotonic and non-linear, non-monotonic effects of economic globalization on the welfare state using a panel of 10 ASEAN countries from 1970 to 2019. Compared to previous research, we utilize a longer time frame to examine the relationship beyond the traditional monotonic framework. The findings reveal a non-linear, non-monotonic linkage between economic globalization and the welfare state, supporting both the compensation and efficiency hypotheses at different stages of globalization. This aligns with modern philosophical perspectives that emphasize the non-linearity and non-monotonicity in relations among phenomena and processes in an increasingly globalized world (Burke, 2009). The results obtained in this study on non-linear, non-monotonic patterns contribute significantly to the in-depth understanding of globalization processes’ impacts on national economies.

The rest of the study is structured as follows: Section I discusses the motivation, aim, and contribution of the study. Section II reviews the analytic framework and empirical literature. Section III introduces the Bayesian mixed technique, describes the data, and specifies the baseline model. The main results are presented and discussed in Section IV, followed by the conclusion in Section V.

## 2. Literature review

Theoretical and empirical literature on the globalization-welfare state relations is characterized by conflicting, inconsistent and inconclusive arguments and findings. Conceptually, there are two contradictory hypotheses: compensation and efficiency. Empirical analyses of the association between globalization and the welfare state (using government size as a proxy for the welfare state) provide mixed evidence. The first generation of studies, emerging in the 1990s, focused primarily on the net effect of globalization on the welfare state employing aggregate data, yielding ambiguous outcomes. In the meantime,

the second generation of studies applied more advanced quantitative techniques and achieved more convincing results, utilizing disaggregated data and new variables representing the scale of the welfare state and globalization. However, no final consensus has been reached regarding the relationship between globalization and the welfare state. Reviewing 19 research papers published between 1995 and 2006, Gemmell et al. (2008) found an equal number of studies reporting positive and negative correlations between trade or capital flow openness and government expenditure. More recently, Anderson & Obeng (2021), reviewing 13 empirical works published since 2006, revealed similarly mixed results. Several factors contribute to these conflicting results, such as small sample sizes, various model specifications (Anderson & Obeng, 2021), and different measures of globalization (Ashraf et al., 2017; Kimakova, 2009; Meinhard & Potrafke, 2011), and diverse samples and observations (Jetter & Parmeter, 2015). Most crucially, conventional frequentist techniques implemented in previous studies suffer from multicollinearity, where the key independent variable, globalization, and primary covariates are strongly correlated. Multicollinearity can lead to biased estimation (Dan & Thach, 2024). Additionally, previous analyses focused on linear, monotonic connections, ignoring the possibility of non-linear, non-monotonic ones. A monotonic relationship is one where variables move in a consistent direction relative to each other: as one variable increases or decreases, the other variable also increases or decreases, but not necessarily at a constant rate. In contrast, a non-monotonic relationship allows the direction of the relationship between the variables to change. This means that as one variable increases or decreases, the other variable does not consistently increase or decrease. A relationship, whether linear or non-linear, can be either monotonic or non-monotonic.

Negative linear, monotonic relations align with the efficiency hypothesis. As emphasized by the classical approach of political economy, exemplified by Adam Smith and David Ricardo, increasing trade and financial liberalization enhances competition among national governments. The efficiency hypothesis posits that trade openness and factor mobility lead to a reduction in government size, lower tax revenue, and decreased government expenditure, ultimately eroding the welfare state (Schulze & Ursprung, 1999). During the globalization process, governments strategically compete in international markets to attract foreign direct investment (FDI), skilled labor, and high-tech advancements. Consequently, globalization imposes constraints on national fiscal autonomy, narrows taxation bases, reduces government expenditure, and alters budget composition. By its nature, globalization renders all nations 'smaller.' Small, open economies experience more intense international competition compared to larger countries, leading them to depend less on capital gains and corporate taxes. Consequently, as predicted by tax competition literature, a global race to the bottom in tax rates ensues (Bretschger & Hettich, 2002; Devereux & Griffith 1998). From this perspective, a negative linear, monotonic connection exists between economic globalization and the welfare state. Empirical research supporting the efficiency point of view reveals negative relationships between globalization and the welfare state. For example, Cusack & Garrett (1992) identified a negative relationship between international financial integration and the growth of government spending (excluding defense spending) in a panel sample of 16 OECD countries from 1955 to 1989. Rodrik (1997), utilizing a yearly panel dataset from OECD countries spanning 1966–1991, explored a negative correlation between lagged trade liberalization and both social expenditure and total government expenditure. His findings suggested that in countries and periods with fully open capital accounts, trade openness has a more significantly negative correlation with social spending and total government expenditure compared to countries with capital restrictions. Similarly, Garrett & Mitchell (2001), analyzing a sample of 18 OECD countries during 1961–1993, concluded that trade liberalization negatively affects government expenditure, though not government consumption and social security transfers. Using a sample of 17 OECD countries from 1961 to 1993, Kittel & Winner (2005) found that FDI is negatively related to the welfare state, as measured by total government expenditure as a share of GDP. However, the effects of other variables, such as trade openness and imports from low-wage countries, are non-significant. More recently, Busemeyer (2009) also discovered a negative relationship between trade liberalization and government expenditure in an OECD sample.

Conversely, the compensation perspective suggests a positive linear, monotonic relationship, indicating that government scope is broader in more open economies. This perspective posits that increased international integration heightens demand for social security, prompting governments to expand social welfare expenditures (Rodrik, 1998). Greater international integration increases external risks, leading to

instability and job fluctuations, thereby raising the demand for social insurance and compensation for those adversely affected by globalization (Kim, 2009; Rodrik, 1998). Politicians respond to these demands by increasing social welfare spending to secure re-election (Dreher et al., 2008; Ursprung, 2008). Providing strong support for this hypothesis, Cameron (1978) highlighted that increased trade dependence significantly contributed to the growth of the public sector in 18 industrial countries between 1960 and 1975. Similarly, Rodrik (1998) identified a strong positive influence of trade liberalization on government consumption in his analysis of 125 countries from 1985–1989 and 103 countries from 1990–1992. Vaubel (2000, 2005), Meinhart & Potrafke (2011), and Ferreira & Oliveira (2019) also found positive correlations between globalization and social spending. Specifically, Meinhart & Potrafke (2011) revisited the evidence by analyzing an annual panel dataset of 186 countries from 1970 to 2004, utilizing data from the Penn World Tables on government sector size and the KOF index of globalization. Their results indicate that globalization led to an increase in government sectors worldwide.

In addition to the two aforementioned directions in the literature, some studies report mixed or non-significant findings. Kaufman & Segura-Ubiergo, utilizing data from 14 Latin American countries between 1973 and 1997, demonstrated that trade openness and capital liberalization negatively impacted social security spending. However, they found that capital liberalization positively influenced education and health spending. Bretschger & Hettich (2002) concluded that while the efficiency hypothesis explains tax patterns, the compensation hypothesis explains spending patterns in 14 OECD countries from 1967–1996. In a reevaluation of Garrett & Mitchell (2001) using advanced methodologies, Kittel & Winner (2005) found no support for either the efficiency or compensation hypothesis. Instead, their findings indicate that domestic economic and demographic factors, such as unemployment rates and dependency ratios, have a more significant influence on government expenditures. Dreher et al. (2008) found that globalization does not impact budget composition, using data from 60 countries (1971–2001) and 10 OECD countries (1991–2000) with four different proxies for globalization. Recent findings showed that there is no substantial evidence for a global race to the bottom in tax rates (Plümper et al., 2009). Ashraf et al. (2017) found that greenfield FDI had a positive effect on government consumption, while M&A FDI had no effect, based on a sample of 130 developed and developing countries from 2003 to 2011. In a study by Kim et al., trade globalization positively influenced total government spending, whereas financial globalization had a negative impact, in an analysis of 53 OECD and non-OECD countries from 1980 to 2011. Anderson & Obeng (2021) revealed that *de jure* trade globalization generally increased consumption spending, aligning with the compensation hypothesis. In contrast, *de jure* financial globalization tended to decrease consumption spending, supporting the efficiency hypothesis. Most recently, Yong & Chi (2022) reassessed the impact of trade openness and financial liberalization on the welfare state, finding an inverted U-shaped effect of trade liberalization on the welfare state but no large influence from financial liberalization. Tekin et al. (2023) found support for both the compensation and efficiency hypotheses in 11 transition economies in the Central and Eastern European (CEE) region from 1996 to 2021.

From the above analyses, three gaps are identified:

- i. Earlier studies have primarily focused on linear, monotonic relationships between overall globalization or its sub-indices and the welfare state, overlooking potential non-linear, non-monotonic interactions. The divergent and even contradictory trends of economic globalization and government spending—with increasing economic openness and a shrinking share of government consumption in GDP over recent decades—suggest a non-linear, non-monotonic relationship between these processes. Thus, we hypothesize a non-linear relationship following an inverted U-shaped pattern, as modern complex sciences suggest.
- ii. The conventional frequentist techniques employed in a series of prior globalization-spending studies cannot effectively handle multicollinearity issues, leading to biased and non-robust outcomes. ‘Just as exact collinearity leads to non-identification of parameters, high collinearity can be considered as weak identification of the parameters’ (Pesaran & Smith, 2019).
- iii. There is a lack of empirical analysis on the link between economic globalization and the welfare state in the ASEAN context, making it challenging to design a comprehensive globalization strategy for these nations.



### 3. Bayesian mixed regression, model and data

Although the implementation of Bayesian techniques for data analysis has revolutionized many fields, from genetics to macroeconomics since the 1990s, the Bayesian framework has been notably absent in empirical research on the nexus between globalization and the welfare state. In general, our work introduces researchers in this area to Bayesian estimation to address model uncertainty arising from statistical complexities. Bayesian analysis offers a more flexible and intuitive framework for dealing with uncertainty and overcomes several drawbacks of the frequentist approach (Thach et al., 2019; Briggs, 2023). Most notably, Bayesian inferences provide more robust estimates by combining prior knowledge with available data and offering an entire posterior distribution of the parameters. In Bayesian inferences, the data  $x$ , which a realization of  $X \sim f(x|H)$ , is integrated with prior information encapsulated in a prior distribution with density  $\pi(H)$ . This integration results in the posterior distribution  $\pi(H|x)$ , summarizing the updated beliefs. The posterior distribution is derived from the joint distribution  $f(x|H)\pi(H)$  using Bayes' formula:

$$\pi(H|x) = \frac{f(x|H)\pi(H)}{\int f(x|H)\pi(H)dH} \quad (1)$$

Where  $m(x) = \int f(x|H)\pi(H)dH$  is the marginal density of  $X$  (see Berger, 1985; Bernardo & Smith, 1994; Robert & Casella, 2004).

Specifically, Bayesian methods handle multicollinearity more effectively than frequentist methods (Block et al., 2011; Dan & Thach, 2024; Pesaran & Smith, 2019; Winship & Western, 2016). In frequentist regression, exact collinearity between regressors makes their individual coefficients unidentified (Pesaran & Smith, 2019), leading to unstable coefficient estimates and inflated standard errors. With collinearity, small deviations from this assumption can cause significant changes in estimates (Winship & Western, 2016). As emphasized by Pesaran & Smith, (2019), given an informative prior, Bayesian posterior means are well defined. Furthermore, a Bayesian mixed (hierarchical) approach with specific priors effectively addresses non-stationarity in data. Non-stationarity, which can result from trends, seasonal effects, or structural breaks, may lead to spurious regression, producing misleading results with artificially high R-squared values and significant t-statistics that do not reflect true relationships. Bayesian mixed models can manage non-stationarity by allowing parameters to vary over time or across different regimes. Additionally, incorporating informative priors in Bayesian inference helps regularize estimates and integrate prior knowledge, making it a valuable tool for handling non-stationarity (Spall, 1988).

The study adopts a Bayesian mixed regression to investigate the impact of economic globalization on the welfare state. The baseline model is specified as follows:

$$Expenditure_{it} = a_0 + a_1 GlobalizationEc_{it} + a_2 X_{it} + Reffects + \varepsilon_{it}. \quad (2)$$

To capture the non-linear and non-monotonic nature in the globalization-spending relationship, we incorporate the quadratic term of  $GlobalizationEc$  into the model (2).

$$Expenditure_{it} = b_0 + b_1 GlobalizationEc_{it} + b_2 GlobalizationEc_{it}^2 + b_3 X_{it} + Reffects + \varepsilon_{it}. \quad (3)$$

where  $Expenditure$  is the welfare state,  $GlobalizationEc$  is the economic measure of the KOF globalization,  $X$  is a vector of controls,  $\varepsilon$  is the random error,  $Reffects$  is random effects, and  $t, i$  are year and country, respectively.

Our analysis utilizes the 2023 KOF globalization dataset, covering the period from 1970 to 2021, along with the 2023 World Development Indicators (World Bank) and annual panel data from the most recent Penn World Tables, version 10.01, updated only to 2019. These datasets include the dependent variable, welfare state ( $Expenditure$ ), the key predictor, economic globalization ( $GlobalizationEc$ ), and various baseline control variables available from 1950 to 2019 (data on the KOF globalization indices has been available since 1970). Hence, our panel dataset encompasses 10 ASEAN countries (Brunei, Indonesia, Cambodia, Laos, Myanmar, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) from 1970 to 2019.

In Table 1, the measure of the welfare state is defined as the government's share of real GDP per capita, as compiled by the Penn World Tables, excluding transfer payments. The key predictor,

**Table 1.** Interpreting variables in the Bayesian mixed model.

Variables		Proxies	Period	Notation	Data source
Dependent	Welfare state	Natural logarithm of share of government consumption in real GDP	1970–2019	Expenditure	PWT 10.01 dataset
Independent	Economic globalization	Natural logarithm of the economic sub-index of the KOF globalization index	1970–2019	GlobalizationEc	Swiss Institute of Economics
	Real per capita income	Natural logarithm of real per capita GDP	1970–2019	IncomePc	PWT 10.01 dataset
	Age dependence rate	Natural logarithm of the sum of the population in the ages 0–14 years and the population in the ages 65+ as a percentage of the total population	1970–2019	Dependence	2023WDI dataset
	Country size	Natural logarithm of total population	1970–2019	Population	PWT 10.01 dataset
	Urban population	Natural logarithm of urbanization rate	1970–2019	Urbanization	2023 WDI dataset

Source: Authors.

GlobalizationEc, is the economic dimension of the KOF globalization index. This measure is employed to concentrate on the economic impacts of globalization. Note that the 2023 KOF index synthesizes 24 variables into a comprehensive index and three sub-indices, each representing the economic, social, and political dimensions of globalization. These variables are organized into six groups: (1) actual flows of trade, investment, and income payments to foreign nationals, (2) restrictions on international trade and capital accounts, (3) data on personal contacts with individuals in foreign countries, (4) data on information flows, (5) data on international cultural integration, and (6) data on international political integration. The economic globalization sub-index comprises the first two groups, the social globalization sub-index includes the next three groups, and the political globalization sub-index consists of the last group. Collectively, these components form the overall index (Gygli et al., 2019).

Drawing on Alesina & Wacziarg (1998), Dreher et al. (2008), and Potrafke (2009), the study incorporates real per capita GDP (IncomePc), age dependency ratio (Dependence), total population (Population), and urbanization rate (Urbanization). Real per capita GDP provides insight into the overall socio-economic condition. According to Wagner's law, increases in the levels of GDP per capita lead to increases in government expenditure as a share of GDP. As a country becomes wealthier, the demand for public services such as education, healthcare, infrastructure, and social welfare tends to increase. Higher income levels enable citizens to expect and demand better and more comprehensive public services. Besides, economic growth often brings about greater complexity in economic activities and social structures, necessitating more government intervention in terms of regulation, redistribution, and provision of public goods. The age dependency ratio adjusts for demographic structure and development. As the age dependency ratio increases, meaning there are more dependents (young and elderly) relative to the working-age population, it leads to increased government spending for several reasons. Older populations typically require more healthcare and social services, leading to higher public expenditure on these services. Furthermore, a higher proportion of young dependents necessitates more investment in education and related services. Lastly, increased numbers of elderly dependents require more spending on pensions and social security programs. Overall, more dependents generally increase the need for various welfare programs to support non-working populations. We measure urbanization by the proportion of the population living in urban areas. As expected, government expenditure will increase with rising urbanization. The rationale is straightforward: higher urbanization can lead to congestion, potentially decreasing citizen welfare, which may necessitate increased government expenditure to offset the welfare loss. However, spending on non-rival public goods like roads and street lighting may decrease with growing urbanization due to economies of scale (Anderson & Obeng, 2021). Total population serves as a proxy for country size, reflecting that larger populations tend to correlate with a smaller government share of GDP (Alesina & Wacziarg, 1998). Regarding total population, Alesina & Wacziarg (1998) suggest that countries with larger populations tend to have lower government consumption spending as a share of GDP for several reasons. Firstly, the per capita cost of providing non-rival goods is reduced in larger populations due to economies of scale (see Rodrik, 1998; Jetter & Parmeter, 2015). Additionally, larger



populations exhibit more heterogeneous preferences for public goods provision. The overall effect depends on balancing the costs of increased heterogeneity in preferences against the benefits of lower per capita costs in public goods provision, with the latter potentially outweighing the former. Consequently, the impact of total population on government spending can be either positive or negative (Alesina & Wacziarg, 1998; Rodrik, 1998). Log transformations are applied to all variables to normalize skewed data, reduce the impact of outliers, and stabilize variance (Table 1). Moreover, taking the logarithm can stabilize the variance.

For setting priors in the model, standard normal priors are used. Given that all parameters can take either positive or negative values, we assume a normal distribution with a mean of 0 and a mildly informative variance of 1 for the GlobalizationEc regressor, similar to the remaining covariates (Block et al., 2011). A non-informative inverse gamma (0.01, 0.01) is assigned to the variance components, including the variance of random effects and the overall variance, as suggested by Van de Schoot et al. (2015).

Prior distributions for the model parameters are as follows:

$$\begin{aligned}\alpha &\sim \text{Normal}(0, 1), \\ \sigma_0^2 &\sim \text{Igamma}(0.01, 0.01), \\ \sigma_1^2 &\sim \text{Igamma}(0.01, 0.01),\end{aligned}$$

where  $\alpha$  is a vector of structural parameters and  $\sigma_0^2, \sigma_1^2$  are the variance of random effects and the overall variance, respectively.

## 4. Simulation outcomes

### 4.1. Descriptive statistics and pairwise correlations

The descriptive statistics table (Table 2) provides a comprehensive overview of the key variables, highlighting their average values, variability, and range, which is crucial for understanding the distribution and characteristics of the data, as well as for interpreting subsequent analytical results. Expenditure, representing government consumption spending as a share of GDP, has an average value of approximately 15.77%. The standard deviation of 5.63% indicates moderate variability around the mean. The minimum value is 4.82%, and the maximum is 31.88%, showing a broad range of government expenditure shares across different countries. The Economic Globalization Index (GlobalizationEc) has a mean score of 50.93, suggesting a moderate level of economic globalization on average among the sampled countries. The standard deviation of 19.70 shows substantial variation. The index ranges from 17.68 to 94.58, indicating that some countries are highly globalized while others are much less so. Per capita income (IncomePc) has a mean of \$14,058.82, but the high standard deviation of \$22,210.67 indicates a significant disparity in income levels across countries. The minimum value is \$533.03, and the maximum is \$99,005.20, highlighting the wide income range from very low-income to very high-income countries. The dependence ratio (Dependence) has a mean of 64.23, suggesting that, on average, there are 64 dependents for every 100 working-age individuals. The standard deviation of 17.77 indicates moderate variability. The dependence ratio ranges from 27.31 to 98.21, reflecting a substantial range of dependency burdens across countries. Population size (in millions) has an average of approximately 48.94 million people, with a high standard deviation of 58.46 million, indicating considerable variation in country sizes. The smallest population is around 0.22 million, and the largest is about 270.63 million, demonstrating a vast range of population sizes among the countries studied. Urbanization, expressed as the percentage of the

**Table 2.** Descriptive statistics.

Variable	Obs	Mean	Std. dev	Min	Max
Expenditure	486	0.1576643	0.0563471	0.048244	0.318799
GlobalizationEcI	486	50.92878	19.69739	17.6842	94.58176
IncomePc	486	14058.82	22210.67	533.028	99005.2
Dependence	486	64.2271	17.76848	27.31119	98.2091
Population	486	48.94011	58.46113	0.218175	270.6256
Urbanization	486	41.869	25.94483	4.477	100

Source: Authors.

**Table 3.** Correlation between main variables.

Parameters	Expenditure	GlobalizationEc	IncomePc	Dependence	Population	Urbanization
Expenditure	1.0000					
GlobalizationEc	0.0980	1.0000				
IncomePc	0.4116	0.7980	1.0000			
Dependence	0.0035	−0.7827	−0.7311	1.0000		
Population	−0.3811	−0.1508	−0.4623	0.1050	1.0000	
Urbanization	0.2001	0.8308	0.8642	−0.6943	−0.2596	1.0000

Source: Authors.

**Table 4.** Change-points for economic globalization and government spending as a share of GDP (median estimates for ASEAN).

Variables	Expenditure			GlobalizationEc		
	Mean	MCSE	PPI	Mean	MCSE	PPI
Change point	1994.082	1.28606	[1970.362, 2018.603]	1991.808	0.014363	[1989.282, 1994.829]
Level prior to change point	0.102288	0.011832	[0.001095, 0.6093414]	38.09207	0.015481	[35.21662, 41.01347]
Level post change point	0.0837273	0.012277	[0.0009984, 0.4692861]	61.50988	0.015607	[58.45602, 64.77817]

Note. A Markov chain Monte Carlo sampler is efficient when the MCSE (Markov chain standard error) is approximately close to one decimal place. The PPI (Posterior probability interval) represents the 95% probability that a parameter lies between two values in the population.

Source: Authors.

population living in urban areas, has a mean of 41.87%. The standard deviation of 25.94% shows considerable diversity in urbanization levels. The range extends from 4.48% to 100%, indicating that while some countries are almost entirely urban, others have very low urbanization rates.

Furthermore, according to Table 3, the variable of interest, GlobalizationEc, shows high correlations with IncomePc, Dependence, and Urbanization (all exceeding 0.7). Furthermore, IncomePc is also highly correlated with Dependence and Urbanization (both above 0.7), and Dependence is correlated with Urbanization (above 0.6). This suggests that our baseline econometric model faces significant multicollinearity, a problem that frequentist methods are not well-equipped to handle (Block et al., 2011; Pesaran & Smith, 2019; Winship & Western, 2016).

#### 4.2. Explanatory analysis of change points

Bayesian change-point modeling addresses stochastic data, particularly time series, which undergo abrupt changes at certain points in time. Our objective is to identify the change-point and examine the characteristics of the stochastic processes before and after this point. The results in Table 4 indicate that the change-point for economic globalization occurs in 1991, as mentioned in the Introduction, while the change-point for government spending is in 1994. Therefore, we observe two contradictory trends: the economic globalization index rises from 38 to 62, while the share of government spending decreases from 10% to 8%.

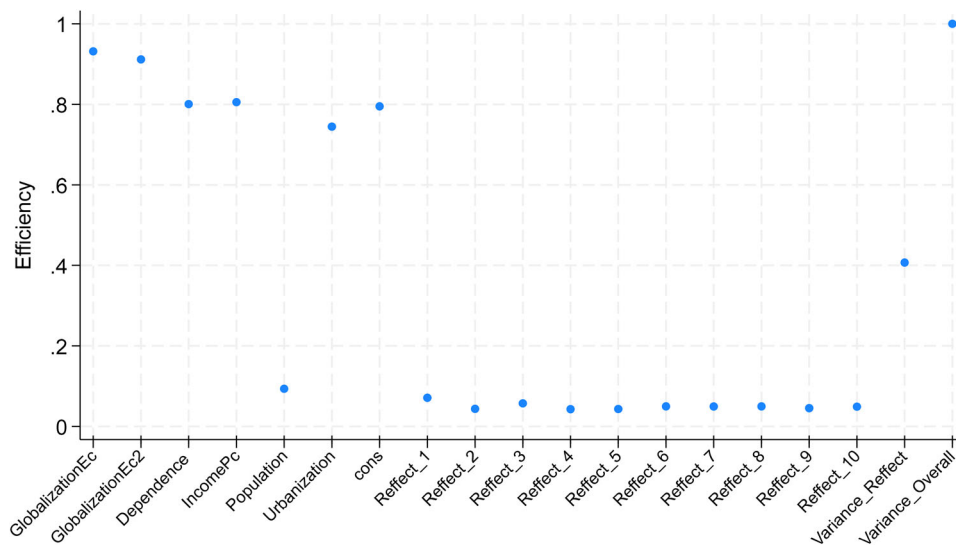
#### 4.3. Comparison between Bayesian linear, monotonic and non-linear, non-monotonic models

To determine which Bayesian model, linear, monotonic (2) or non-linear, non-monotonic (3), performs better, the study conducts a sensitivity analysis accessing wide-spread Bayesian information criteria, such as deviance information criterion (DIC), log marginal-likelihood, Bayes factor, and model probability. Lower DIC values indicate superior model fit and reduced complexity, pointing towards a more favorable model. Along with the DIC, the log marginal likelihood, also known as the log evidence, is used to compare different models. The log marginal-likelihood takes into account both the complexity of the model and how well it explains the observed data. Models with higher log marginal-likelihoods indicate a better fit. As a Bayesian special metric for model comparison, Bayes factor gauges the likelihood of data under one model against another. Models with higher Bayes factors are preferred, as they offer better data explanation than rival models. Bayesian model selection calculates the posterior probability of each

**Table 5.** Bayesian metrics.

Metrics	DIC	Log marginal-likelihood	Log Bayes factor	Model probability
Linear, monotonic	−1909.951	876.9869	.	0.0738
Non-linear, non-monotonic	−1904.549	879.516	2.529097	0.9262

Source: Authors.

**Figure 1.** Results of ESS analysis

Source: Authors.

model given the data, offering a measure of belief in each model's suitability for explaining the data. Compared to frequentist R-squared as a single-point estimate of model goodness-of-fit, and generally not suitable for non-linear models with intricate relationships, Bayesian metrics consider the entire parameter distribution, yielding a more comprehensive understanding of uncertainty (Shalizi, 2019). Hence, Table 5 exhibits that the non-linear, non-monotonic model outperforms the linear, monotonic model. The further analysis will be conducted within the selected non-linear, non-monotonic model.

#### 4.4. Analysis of robustness

Before carrying out Bayesian inferences for the non-linear, non-monotonic model, it is crucial to test the Markov chain Monte Carlo (MCMC) convergence to ensure the robustness of the analysis. We perform comprehensive diagnostic tests to evaluate the convergence of the MCMC chains for our model. Specifically, we use the Effective Sample Size (ESS) test and obtain the results presented in Figure 1. The efficiency of all parameters, including the representative random effects, exceeds the warning threshold of 0.01, indicating acceptable convergence. Besides, the presence of significant random effects suggests their relevance in the relationship between economic globalization and the welfare state.

Additionally, a specific sensitivity analysis is conducted by adjusting the prior variance for the parameter of interest, GlobalizationEc, as proposed by Block et al. (2011). To ensure model robustness, we tested variations in the variance of the normal prior with values of 1, 5, 10, 20, 50, 100, 1000 and 10,000 (see results in Table 6). The outcomes of the sensitivity analysis confirm that the results remain valid across different prior specifications.

Furthermore, to verify the robustness of the estimates for the variable GlobalizationEc, the study follows the way Alesina & Wacziarg (1998) and Meinhart & Potrafke (2011) do. First, a Bayesian univariate mixed model with GlobalizationEc as the sole predictor is estimated (see Column 1–2, Table 7). Subsequently, the control variables are included along with this predictor (see Column 3–6, Table 7). As demonstrated in Table 5, the estimated coefficient for GlobalizationEc does not change its sign across the simulations, confirming the robustness of the results.

**Table 6.** Checks for robustness to different prior specifications.

Parameters	Prior variance specifications							
	1	5	10	20	50	100	1000	10,000
GlobalizationEc	0.347	0.363	0.366	0.359	0.352	0.358	0.358	0.350
GlobalizationEc 2	−0.050	−0.053	−0.053	−0.052	−0.051	−0.052	−0.052	−0.051
Dependence	0.011	0.011	0.011	0.010	0.012	0.013	0.014	0.013
IncomePc	0.018	0.018	0.017	0.018	0.019	0.018	0.019	0.018
Population	−0.014	−0.013	−0.011	−0.016	−0.017	−0.010	−0.012	−0.014
Urbanization	−0.005	−0.006	−0.006	−0.006	−0.005	−0.006	−0.006	−0.005
Cons	−0.562	−0.575	−0.587	−0.587	−0.564	−0.584	−0.510	−0.579
Random effects' variance	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.005
Overall variance	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Source: Authors.

**Table 7.** Simulation outcomes.

Parameters	Mean 1	MCSE 2	PPI 3	Mean 4	MCSE 5	PPI 6
Dependence variable: Expenditure						
GlobalizationEc	0.308	0.001	[0.139, 0.479]	0.347	0.001	[0.141, 0.559]
GlobalizationEc2	−0.045	0.000	[−0.068, −0.021]	−0.050	0.000	[−0.081, −0.021]
Dependence				0.011	0.000	[−0.029, 0.052]
IncomePc				0.018	0.000	[0.005, 0.031]
Population				−0.014	0.000	[−0.032, 0.002]
Urbanization				−0.005	0.000	[−0.024, 0.013]
cons	−0.359	0.002	[−0.665, −0.052]	−0.562	0.001	[−0.919, −0.209]
Variance of random effects	0.006	0.000	[0.002, 0.016]	0.005	0.000	[0.002, 0.012]
Overall variance	0.001	0.000	[0.001, 0.001]	0.001	0.000	[0.001, 0.002]

Source: Authors.

#### 4.5. Analysis of simulation outcomes

According to the outcomes of the Bayesian mixed model in Table 7, one primary result is that the quadratic term of GlobalizationEc (GlobalizationEc2) has a negative sign, indicating a non-linear, non-monotonic relationship between economic globalization and the welfare state in ASEAN countries, depicted by an inverted U-shaped curve. An inverted U-shaped plot occurs when the dependent variable initially increases with the independent variable up to a certain point, after which the dependent variable starts to decrease. This finding differs from most prior studies, except for Yong & Chi (2022). The inverted U-shaped relationship implies that at low levels of globalization, accelerating globalization initially leads to higher government expenditure. However, beyond a certain threshold, further increases in globalization result in decreased government expenditure. This phenomenon can be attributed to various economic, social, and political factors. In the early stages of globalization, governments have to expand social safety nets and welfare programs to support citizens affected by the transition, such as those displaced by international competition or technological changes, in line with the compensation hypothesis. As globalization progresses, however, the increased efficiency and productivity gains from global integration may minimize the need for extensive government intervention, consistent with the efficiency hypothesis. Private sector growth can lead to higher revenues and employment, reducing reliance on government support. Additionally, highly globalized economies might face increased tax competition as they strive to attract and retain multinational companies. This can lead to lower corporate tax rates and reduced tax revenues, forcing governments to curtail spending to maintain fiscal discipline. From its early stages to its current maturity, ASEAN has consistently reaffirmed its commitment to regional economic prosperity by advancing the master plans of the AEC, including the immediate objectives of AEC 2025. To deepen its global economic integration, the Regional Comprehensive Economic Partnership (RCEP) including all the ASEAN nations came into effect on 1 January 2022, creating the world's largest free trade area. This agreement encompasses one-third of the global market, contributing 30.6% of the world's nominal GDP and 28.7% of global GDP as of 2021. This milestone, achieved after eight years of negotiations, highlights ASEAN's resolve to strengthen its global economic ties (VNTR, 2022). ASEAN nations are increasingly integrated into global markets, impacting various aspects of their economies, including agricultural product prices.

An increase in Dependence (proxied by age dependency ratio) is likely to lead to a higher demand for government expenditure, as more economically inactive dependents typically rely on government support (Meinhard & Potrafke, 2011, Anderson & Obeng, 2021). Interpreting Wagner's Law (Wagner, 1983), Musgrave's (1969) argues that a rise in per capita income is likely to cause a larger proportion of government expenditure relative to GDP, which suggests a positive association between real per capita income and government expenditure. Rudra (2002) argues that in less developed countries, weak labor power coupled with trade openness negatively impacts social expenditures. In contrast, in more developed nations, workers benefit from stronger labor organizations, which enable them to secure higher welfare spending. Regarding country size (proxied by total population), as argued by Alesina & Wacziarg (1998), Rodrik (1998), and Jetter & Parmeter (2015), countries with larger populations typically exhibit lower government expenditure due to the lower average cost of supplying non-rival goods, which benefits from economies of scale. Furthermore, government expenditure tends to decrease with urbanization, as the cost of providing additional non-rival public goods, such as infrastructure like roads and street lighting, tends to decline with economies of scale (Meinhard & Potrafke, 2011, Anderson & Obeng, 2021).

## 5. Conclusion

There is a rich body of literature on the relationship between economic globalization and the welfare state. However, past analyses were predominantly conducted within the conventional framework of Newtonian linear sciences, which hampers the accurate forecasting of long-term globalization trends and the development of effective economy-opening strategies. This research explores both the linear, monotonic, and non-linear, non-monotonic effects of economic globalization on the welfare state, represented by the share of government consumption in real GDP, across 10 ASEAN countries from 1970 to 2019. Economic globalization is measured using the economic sub-index of the KOF globalization index. To address estimation biases from multicollinearity and account for country-specific factors, a Bayesian mixed framework incorporating Gaussian normal priors on structural predictor variables is employed. To mitigate omitted variable bias, the model includes baseline controls such as age dependency ratio, real per capita GDP, total population, and urbanization rate. Implemented from the perspective of non-linear, complex sciences, our study reveals a nonlinear and non-monotonic relationship between economic globalization and the welfare state in ASEAN countries, described by an inverted U-shape. These results can be interpreted through the lenses of the compensation hypothesis and the efficiency hypothesis, depending on the stages of globalization. The findings suggest that ASEAN nations need to formulate a long-term globalization strategy in the context of government size limits, relying on the nonlinear, non-monotonic development tendencies in a highly globalized world.

The inverted-U relationship between economic globalization and government expenditure in ASEAN countries highlights the need for a phased and adaptive approach to public policy. This approach should be divided into three key phases: expansion and investment, optimization and innovation, and streamlining and sustaining.

Early phase: Expansion and investment:

- *Infrastructure Development:* Prioritize investments in critical infrastructure such as transportation, energy, and digital networks to support economic activities and enhance connectivity within the ASEAN region and globally.
- *Education and Healthcare:* Invest in education and healthcare to build a skilled workforce capable of competing in the global market. Emphasize vocational training and higher education in fields critical to the region's economic growth.
- *Middle phase: Optimization and innovation:*
- *Public-private partnerships:* Leverage public-private partnerships to fund and manage large-scale infrastructure and service projects. This can help mitigate fiscal burdens while enhancing efficiency and innovation.

- *Research and development*: Allocate resources to R&D and innovation to drive productivity and economic diversification. Support sectors where ASEAN countries have comparative advantages, such as technology, agriculture, and manufacturing.

Later phase: Streamlining and sustaining:

- *Efficiency in public spending*: As globalization advances, focus on improving the efficiency of public spending. Implement performance-based budgeting and rigorous financial management practices to ensure that expenditures yield the highest returns.
- *Fiscal sustainability*: Maintain fiscal discipline by managing public debt and ensuring that revenue collection mechanisms are robust and fair. Consider broadening the tax base and improving tax compliance to support sustainable public finances.

The primary limitation of this study lies in the use of a relatively small sample of 10 ASEAN countries for Bayesian inferences, which may not fully capture global trends in the relationship between globalization and government expenditure. Future research should consider utilizing a larger, more diverse global sample. Additionally, given that data for the KOF globalization indices are available only from 1970 and the most recent PWT version 10.01 extends only to 2019, the study excludes the effects of the COVID-19 pandemic and the Russia-Ukraine war (2020–2023). Future studies should aim to cover a longer timeframe.

### Author's contributions

Nga N.T.N. conceived the idea. Thach N.N. analyzed the theories, conducted the literature review, performed econometric estimation, and presented the results. All the authors interpreted the outcomes and contributed to the final manuscript.

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### Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.



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