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Determinants of Economic Misery in Selected Muslim-Majority OPEC Economies

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Abstract: The misery index combines unemployment and inflation, two macroeconomic problems that adversely affect both individual and societal well-being. By taking into account both unemployment and inflation rates, the misery index measures the extent of economic distress within society and the deterioration of macroeconomic well-being. In addition to economic developments, social and political factors may also play an important role in determining the level of the misery index. This study examines the effects of economic growth, oil rents, energy use, and government integrity on the misery index, a composite indicator based on inflation and unemployment, in six selected Muslim-majority OPEC member countries (Algeria, Iran, Kuwait, Libya, Nigeria, and Saudi Arabia) over the 2002–2020 period using a random-coefficient panel model. These countries were selected based on their respective shares of global crude oil production and variation in their per capita income levels. The main objective of this study is to test whether the effects of these variables are homogeneous across countries and to determine how country-specific structural and institutional characteristics shape the dynamics of macroeconomic welfare loss. In this regard, a random-coefficient model is used to examine country-specific variations in the misery index by accounting for macroeconomic and resource-related factors, as well as institutional quality variables such as government integrity, and to identify heterogeneity across selected Muslim-majority OPEC economies. The analysis indicates that the effects of the explanatory variables such as economic growth, oil rents, energy use, and government integrity on the Misery Index vary significantly across countries in both sign and magnitude. Oil rents had a mitigating effect on the Misery Index in Algeria and Libya but positive in Iran, while no statistically significant effect was found in the remaining countries. The study moves beyond an average-effects approach by identifying country-specific effect patterns. These findings suggest that policymakers in the selected Muslim-majority OPEC member countries should adopt differentiated strategies that account for institutional and structural differences rather than rely on one-size-fits-all policy solutions.

Keywords: misery index, government integrity, oil rents, energy consumption, Muslim-majority OPEC member countries

JEL Classification: Q32, O13, F63, D73, C23

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Introduction

Inflation and unemployment are among the most macroeconomic challenges facing economies (Oner, 2012; Danmarks Nationalbank, 2023). The misery index, developed by Okun in the 1970s (Nessen, 2008; Dews, 2016), combines these two economic indicators, both of which adversely affect individual and societal well-being, into a single measure of economic distress (Cohen et al., 2014; Heilemann & Schuhr, 2025). The index implicitly assigns equal weight to inflation and unemployment (Ersin, 2024). However, no consensus exists regarding the relative weights that should be assigned to these components (Blanchflower et al., 2014), and the equal-weighting assumption may obscure their differing distributional consequences (Asher et al., 1993). As components of the misery index, inflation and unemployment not only affect the economic quality of life but may also serve as indicators of the effectiveness of government policies, the functioning of labor markets, and the level of public trust (Shahabadi & Davarikish, 2025). Inflation and unemployment are negatively associated with individuals' subjective well-being and overall welfare (Welsch, 2007).

Okun's misery index has been criticized for oversimplifying economic distress and was subsequently extended by Barro in 1999 and Hanke in 2008 (Ovat, 2019). By incorporating real GDP growth rates and long-term interest rates into Okun's misery index, Barro's extension allowed for more accurate cross-country comparisons of relative changes in economic performance (Hanke, 2009; Işık & Öztürk Çetenak, 2018). Hanke's modified misery index is calculated by subtracting the percentage change in real GDP per capita from the sum of the unemployment rate, inflation rate, and bank lending rate (Seggie, 2015; Hanke, 2019; Ovat, 2020). Because it incorporates a per capita measure, the index is considered more suitable for cross-country comparisons (Kasap, 2023). In the literature, the "misery index" is widely used as an indicator of economic and social well-being (Cohen et al., 2014; Lechman, 2019). Furthermore, given the economic and social costs of high unemployment and inflation, the misery index serves as an indicator of poverty (Grabia, 2011), because inflation erodes real wages and unemployment worsens living conditions, thereby exacerbating poverty.

Recent research has sought to broaden the scope of the misery index by incorporating a wider range of economic and social variables (Gakuru & Yang, 2025). Incorporating these socioeconomic dimensions into the analysis may improve our understanding of the institutional weaknesses and inefficiencies reflected in changes in the misery index. Specifically, reductions in purchasing power, disruptions

to sources of income, and inflationary pressures associated with economic growth may contribute to higher levels of corruption. Similarly, corruption may be linked to inequality through unemployment, which may also contribute to social distress. The relationship between the misery index, an indicator of macroeconomic welfare loss, and corruption, a proxy for institutional quality, has received considerable attention in the political economy literature (Akinlo, 2024; Bayar & Aytemiz, 2019; Mignamissi et al., 2025; Osuma & Nzimande, 2025).

Various studies have examined the relationships between the misery index and a range of economic, institutional, and social indicators, including corruption (Akinlo, 2024; Bayar & Aytemiz, 2019), crime rates (Açcı & Çuhadar, 2021; Tang & Lean, 2009), domestic credit volume, nominal exchange rates, and deposit interest rates (Ersin, 2024), income distribution (Ghaffary Fard et al., 2022), economic performance (Masárová et al., 2022), and human development (Singh, 2024). This body of research provides evidence that the misery index is shaped by a wide range of economic, social, and political factors and therefore suggests that its analysis should not be confined to economic factors. In this context, the natural resource curse hypothesis, which posits that resource-rich countries tend to experience weaker economic performance than resource-poor countries, provides a framework for analyzing rent-seeking and Dutch disease (Muradov, 2022; Şanlısoy & Ekinci, 2019). Reduced investment incentives and adverse effects on fiscal policy, income inequality, and demographic outcomes are among the mechanisms through which the resource curse may operate (Mien & Goujon, 2021).

The resource curse refers to the negative association between natural resource abundance and economic growth and may operate through both economic and political mechanisms. Economic channels include commodity price volatility, insufficient investment in human capital, and Dutch disease, whereas political channels include institutional weaknesses, rent-seeking behavior, and weak democratic governance (Ansari, 2016; Faizi & Ak, 2024; Meijia & Castell, 2012). In resource-rich countries, corruption, weak state institutions, and a lack of accountability may undermine governance and exacerbate social problems (Ross, 2003).

The extent to which natural resource abundance translates into greater prosperity depends on institutional quality (Mehlum et al., 2006). Countries characterized by impartial institutions, rational resource allocation, and strong accountability mechanisms are less likely to experience the resource curse (Barigbon, 2025; Robinson et al., 2006). In the presence of weak institutions, higher natural resource rents may hinder the establishment of property rights, contribute to sociopo-

litical instability, and ultimately reduce individuals' subjective well-being. In this context, whether abundant natural resources such as oil contribute to economic development depends on state capacity, the policies implemented, and the structure of the export sector (John, 2010). Drawing on the resource curse and "raw material trap" frameworks, Auty (2000) argues that commodity dependence constrains production diversification and weakens incentives for productive investment during the development process. The key concern is that commodity dependence may intensify the structural fragility of these economies by raising unemployment and inflation and, consequently, the misery index. By encouraging rent-seeking, commodity dependence may increase income inequality, suppress wages, and, in the absence of effective governance mechanisms, contribute to a higher misery index and weaker economic performance.

Hausmann and Rigobon (2002) argue that, in the presence of financial market failures, volatility in natural resource revenues may encourage the allocation of these revenues to non-tradable sectors, resulting in excessive specialization and increasing an economy's vulnerability to oil price shocks. This process may increase inflation and unemployment, thereby raising the misery index. The channeling of resource rents toward consumption may further exacerbate this vulnerability, particularly where institutional quality is low. As Humphreys et al. (2006) show, the principal mechanisms underlying the natural resource curse include underspecialization due to asymmetric information, the Dutch disease, insufficient investment in education, corruption, a weak state structure, and threats to democracy. Taken together, these findings indicate that explaining the resource curse requires consideration not only of economic factors but also of social and political dimensions (Biresselioglu et al., 2019).

As Sachs and Warner (2001) emphasize, resource-rich economies tend to experience slower economic growth, and greater resource dependence is associated with weaker long-term economic performance. Existing research suggests that this adverse relationship operates primarily through institutional channels (Akça et al., 2015; Busse & Gröning, 2011; Feng & Gao, 2023). Therefore, the central issue lies not in the availability of natural resources but in the institutional framework through which they are managed. The study also includes the government integrity indicator, alongside the other explanatory variables, to estimate its effect on the misery index. Furthermore, the existing literature generally examines the economic and institutional determinants of the misery index separately; integrated empirical analyses that jointly assess macroeconomic, resource-related, and insti-

tutional variables, including economic growth, energy consumption, oil rents, and government integrity, remain scarce. OPEC member countries account for 36% of global crude oil production, while the six countries examined in this study (Algeria, Iran, Kuwait, Libya, Nigeria, and Saudi Arabia) collectively account for approximately 25% of global crude oil production. These countries also exhibit considerable variation in their levels of per capita income (OPEC, 2025). Cross-country differences in per capita income and institutional quality may help explain why oil wealth generates different social welfare outcomes across these countries.

In sum, the overarching purpose of this study is to examine how macroeconomic, resource-related, and institutional factors affect the misery index, which is used as a proxy for social welfare loss. This issue is particularly relevant in a global environment in which energy prices are affected by crises, wars, and pandemics. In this context, given OPEC member countries' substantial share of global crude oil production and their differing levels of per capita income, the study seeks to identify the determinants of the misery index, with particular emphasis on resource rents and institutional quality, by addressing the following research question: How do country-specific structural characteristics and institutional differences affect the misery index as a proxy for social welfare loss? In this regard, a random-coefficient model is used to examine country-specific variations in the misery index by accounting for macroeconomic and resource-related factors, as well as institutional quality variables such as government integrity, and to identify heterogeneity across selected Muslim-majority OPEC economies.

Literature

The misery index, which combines inflation and unemployment rates, is used as an inverse measure of economic well-being. However, the weak economic performance observed in some resource-rich countries warrants an examination of the resource curse hypothesis. According to this hypothesis, oil rents may increase the misery index by generating macroeconomic instability, even after economic growth and energy consumption are taken into account. Existing studies also examine how institutional quality shapes the relationship between oil rents and the misery index (Effiong, 2023; Khan et al., 2020; Ovat, 2019).

Studies examining the relationship among the resource curse, oil rents, and economic hardship constitute a distinct strand of the literature. Mignamissi and Kuete (2021) examine the effect of natural resource rents on happiness levels using a sample of 149 countries. The study includes the level of democratization as a

control variable. The findings indicate a statistically significant negative association between natural resource rent and happiness. Furthermore, the findings indicate that this negative association is more pronounced in developing economies and countries with relatively weak democratic institutions. The results provide support for the resource curse hypothesis, suggesting that natural resource revenues may be associated with lower levels of economic and social well-being. Slesman (2024) examines the relationship between oil rents and happiness, as a measure of subjective well-being, using a sample of 31 net oil-exporting countries and finds that unemployment and inflation have significant negative effects on happiness, whereas oil rents may indirectly enhance subjective well-being. However, the effect of oil rents on unemployment may vary depending on the levels of corruption and institutional quality. Similarly, Opalaye & Nwachukwu (2019), using data from four oil-producing African countries (Algeria, Cameroon, Egypt, and Nigeria), find that oil rents are not significantly associated with higher levels of happiness, whereas oil prices are positively associated with happiness. Furthermore, the study finds that economic growth is negatively associated with happiness. Ampofo et al. (2020) analyze a group of mineral-rich countries, including Australia, Brazil, Canada, Congo, India, Saudi Arabia, the United States, and Venezuela, and find no consistent evidence of bidirectional causality between natural resource revenues and economic growth across the full sample. Nevertheless, the authors identify a nonlinear long-run relationship between the variables. The findings vary across countries: in some, including Brazil and Canada, natural resources promote economic growth, whereas in others they hinder it, thereby providing country-specific support for the resource curse hypothesis. Although the study does not directly examine the misery index, its findings suggest that the implications of resource abundance for economic well-being may depend on country-specific conditions. In this regard, both institutional quality and the level of resource dependence are decisive factors.

A second strand of the literature focuses on the relationship between institutional quality and the misery index. Given the close relationship between institutional quality and economic and social well-being, analyses of the misery index should account for indicators such as corruption and government effectiveness. Brunnschweiler (2008) examines the relationship between natural resource abundance and economic growth using a sample of 100 countries over the 1970–2000 period and incorporates institutional quality indicators such as the rule of law and government effectiveness. The study reports a positive direct relationship between natural resource wealth and economic growth. Brunnschweiler's (2008) findings

provide no evidence that natural resource abundance undermines institutional quality and therefore do not support the resource curse hypothesis. Osuma and Nzimande (2025) examine the relationship between the misery index and social well-being using a sample of 19 sub-Saharan African countries and find no evidence that corruption directly affects this relationship. Olayungbo and Adediran (2017) investigate the short- and long-run relationships among economic growth, institutional quality, and oil rents in Nigeria. They find that the corruption index, used as a proxy for institutional quality, and oil rents are positively associated with economic growth in the short run but negatively associated with it in the long run. Their findings provide support for the resource curse hypothesis and the Dutch disease mechanism. A key finding is that the estimated effect of institutional quality on economic growth is greater in magnitude than that of oil rents. Dadgar and Nazari (2018) analyze the relationship between the misery index and economic growth in Iran over the 1974–2011 period, dividing the sample into distinct political periods to account for changes in governance. The study shows that economic growth is negatively related to the misery index and that there is a significant relationship between the type of governance and the misery index. As stated by Akinlo (2024), in Nigeria, an increase in the misery index raises corruption levels in both the short and long term, whereas an increase in the rate of economic growth lowers corruption levels only in the long run. Examples in the literature show that the relationship between resource dependence, institutional quality, and macroeconomic performance varies by country and over time. This nonlinear relationship may be particularly important in rentier states, as governance capacity and institutional quality shape whether resource abundance results in social welfare gains or losses.

The effects of natural resource rents on the misery index may vary across countries. Tule et al. (2017) examine Nigeria's misery index using the expectations-augmented Phillips curve and Okun's law and find that increases in crude oil prices generally reduce the misery index, although this effect is not consistently observed. The study also finds that Nigeria's domestic structural problems complicate the relationship between crude oil prices and the misery index. Aslanlı and Ahmadov (2026) examine the resource curse in Kazakhstan and Azerbaijan over the post-Soviet period (1991–2024) using economic, political, and governance indicators, including real GDP growth, fiscal policy, institutional quality, and export diversification. They find that resource-curse-related fluctuations in real GDP growth play a more decisive role in shaping overall economic performance than the other indicators considered. The selected institutional and governance indicators suggest that the mechanisms underlying the resource curse are primarily political rather

than purely economic. Furthermore, government effectiveness is strongly negatively correlated with political rights, suggesting an association between restrictions on political rights and greater governmental capacity to formulate and implement decisions. This suggests that analyses of institutional factors associated with socioeconomic outcomes such as the misery index and happiness should consider political rights and democratic mechanisms alongside government effectiveness. Using the NARDL method, Şanlısoy and Ekinci (2019) examine whether Dutch disease is present in Azerbaijan based on the relationship between real GDP and oil prices. They find that, although real GDP and oil prices are interdependent in the long run, increases and decreases in oil prices have asymmetric effects on GDP. The study finds no evidence of Dutch disease.

The relationship between energy use and the misery index may operate through indirect channels. Changes in energy use, particularly those driven by fluctuations in energy prices, may have both transitory and persistent effects on inflation and unemployment, the two components of the misery index. For example, increases in oil, gas, or electricity prices may raise production and transportation costs, thereby contributing to inflation and slower economic activity; the resulting contraction may increase unemployment and ultimately raise the misery index. Conversely, an adequate and reliable energy supply may support industrial production, productivity, and employment, thereby reducing unemployment and strengthening economic performance. The extent to which these mechanisms operate varies over time and across countries. Therefore, energy use may indirectly affect the misery index through its impact on prices, production, and employment. Kozaryn and Altman (2019) examine the relationship between energy use and subjective well-being at the societal level using data from multiple sources and levels of government over four decades. Contrary to expectations, the results indicate that life satisfaction, a commonly used measure of subjective well-being, is not significantly associated with energy use at the national, state, or county level. The misery index will be affected both temporarily and permanently by changes in energy use based on energy prices. Increases in electricity, gas, or oil prices may generate inflationary pressures, reduce productivity and economic activity, and increase unemployment, thereby raising the misery index. Conversely, an adequate and reliable energy supply may lower the misery index by supporting production, productivity, and employment. Therefore, energy use may indirectly affect the misery index through its effects on inflation and unemployment.

Studies examining the direct relationship between the misery index and energy use are quite limited in the current literature. In contrast, a substantial body of

literature examines the relationships between energy consumption and the two main components of the misery index: inflation and unemployment. Therefore, although empirical evidence on the composite index is limited, the relationships between energy consumption and its two components provide an indirect basis for examining this link. In this context, a negative association between energy consumption and unemployment is reported by Daştan (2024) for fossil fuel consumption in BRICS countries, Apergis and Salim (2015) for a sample of 80 countries, El Moummy et al. (2021) for Morocco, Khobai et al. (2020) for South Africa, and Yılancı et al. (2020) for Austria, Portugal, and Spain. In addition, Yılmaz and Altay (2016) find that energy consumption is associated with lower inflation in Türkiye. Afia (2019) empirically examines the relationships among energy consumption, economic growth, and happiness, emphasizing happiness as an indicator of subjective well-being. The direct and indirect effects of energy consumption on happiness are distinguished by estimating its effect on per capita income and the subsequent effect of income on happiness.

A review of the existing literature suggests that oil rents, energy use, economic growth, and institutional quality may influence social welfare through various transmission mechanisms. In this context, the study moves beyond the traditional resource curse framework's focus on economic growth by considering the combined effects of inflation and unemployment, as captured by the misery index. Furthermore, rentier-state characteristics may shape the macroeconomic consequences of resource abundance for social welfare, while energy use may capture changes in the structure of production associated with the expansion of modern sectors. To assess their effects on the misery index, oil rents and government integrity are included as indicators of resource dependence and institutional quality, respectively, while energy use is included to capture the structure and transformation of productive activity in countries with similar resource endowments. The study examines whether these variables exert heterogeneous effects on the misery index across six oil-exporting countries (Algeria, Iran, Kuwait, Libya, Nigeria, and Saudi Arabia) and investigates the country-specific mechanisms through which these effects operate.

Methodology

This study analyzes the relationship between the misery index and economic growth, oil rents, energy consumption, and government integrity in six Muslim-majority OPEC member countries for which data are available (Algeria, Iran, Kuwait, Libya, Nigeria, Saudi Arabia). Data on government integrity were obtai-

ned from the Heritage Foundation website, while data on the other variables were obtained from the World Bank website. The variables used in the model and their descriptive statistics are presented in Tables 1 and 2. The study's dependent variable is the misery index, while economic growth, oil rents, energy consumption, and government integrity serve as the explanatory variables.

Table 1

Definitions of the variables

Variables	Definition	Source
Misery	Misery index (Inflation rate+Unemployment rate)	World Bank, WDI
Lgdp	GDP (2015 constant values and logarithmic)	World Bank, WDI
Lenergyuse	Energy, per capita oil equivalent kg (Logarithmic)	World Bank, WDI
Oilrent	Oil rent (as of % GDP)	World Bank, WDI
Govint	Government integrity	Heritage Foundation

Table 2

Statistical Values of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Misery	114	17.11379	10.50597	1.98845	50.64735
Lgdp	114	11.32168	0.3539028	10.61985	11.87434
Oilrent	114	29.14714	16.32299	2.68429	64.81644
Lenergyuse	114	3.386249	0.5049677	2.415565	4.079832
Govint	114	31.72281	13.73809	10	70

In this study, the relationship between the dependent and independent variables is analyzed using a random-coefficients model. The random coefficients model allows the coefficient vector to vary across countries. Country-specific coefficients are treated as random deviations from a common mean, with cross-country heterogeneity captured by their covariance matrix. The random coefficients model is constructed as follows:

$$Misery_{it} = \alpha + \beta_1 Lgdp_{it} + \beta_2 Lenergyuse_{it} + \beta_3 Oilrent_{it} + \beta_4 Govint_{it} + \varepsilon_{it}$$

In the model above, Misery represents the misery index, which is the sum of inflation and unemployment; Lgdp represents the logarithm of the GDP level for each country; Lenergyuse represents the logarithmic value of the per capita oil equivalent in kg; Oilrent represents the ratio of oil rent to GDP; and Govint represents government integrity/corruption related to governance. Furthermore, α_i represents the unobserved time-invariant country-specific effect; i indexes the countries included in the analysis; t indexes time; and ε_{it} represents the error term. The expected effects for the independent variables in the model are as follows:

- $\beta_1<0$: An increase in income level is expected to reduce unemployment and inflationary pressures, thereby lowering the Misery Index.
- $\beta_2>0$: Although increases in energy use are related to production and growth, energy price shocks can raise the Misery Index by increasing macroeconomic vulnerabilities through cost inflation and external dependency channels.
- β_3: The impact of oil rents is uncertain. Oil rents can support growth and reduce the Misery Index; ($\beta_3<0$) however, they can also increase it by creating institutional weakness and vulnerability through the "resource curse" mechanism ($\beta_3>0$).
- $\beta_4<0$: Increased government integrity (better governance, lower corruption) is expected to strengthen economic stability and thus lower the Misery Index.

Before estimating a random-coefficient model, the necessary preliminary tests must be conducted. Firstly, as in time series studies, stationarity is crucial when working with panel data. Analyses performed on non-stationary series lead to spurious regression problems, compromising the reliability of the empirical results. The stationarity of the series is tested using first or second-generation unit root tests.

The cross-sectional correlation test plays an important role in determining which of the aforementioned unit root tests to use. First-generation unit root tests are used when the series exhibit no cross-sectional dependence. However, if cross-sectional dependence is present, second-generation unit root tests should be used. Although various tests for cross-sectional dependence are available in the literature, the LM test developed by Breusch and Pagan (1980) was used in this study. The LM test often provides more reliable results when T>N (Tatoğlu, 2017**, p. 208).

The null hypothesis, H_0, represents $cov(u_{it}, u_{jt}) = p_{ij} = 0$, where $i \neq j$ holds for all t values. H_0 states that there is no cross-sectional correlation, while H1 states that there

is a cross-sectional correlation. Hypothesis H0 also serves as the null hypothesis of the Breusch-Pagan LM cross-sectional correlation test. In this context, the LM test statistic can be expressed as follows:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2$$

The term ρ_{ij}^2, represents the sample pairwise correlation between the residuals of cross-sectional units *i* and *j*, while (T) denotes the time dimension (Pesaran, 2004). This expression is calculated using the formula given in the equation below.

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t=1}^{T} e_{it} e_{jt}}{\left(\sum_{t=1}^{T} e_{it}^2\right)^{1/2} \left(\sum_{t=1}^{T} e_{jt}^2\right)^{1/2}}$$

In the equation above, the expression e_{it} is formulated as $e_{it}=y_{it}-\hat{\alpha}_i-\hat{\beta}_i' x_{it}$. In this equation, e_{it}, which represents the OLS estimate of the error term u_it, also represents the residual (Pesaran, 2004). However, the Breusch-Pagan (LM) cross-sectional correlation test remains valid when $T \rightarrow \infty$ and N is constant (Baltagi et al, 2012:165).

$$LM \sim X^2 ((N (N-1))/2)$$

According to the above expression, it exhibits an asymptotic χ^2 distribution with N(N-1)/2 degrees of freedom. The results of the cross-sectional dependence test are presented in Table 3.

Table 3

Cross-sectional correlation test

	Lgdpcons	Oil rent	Misery	Lenergyuse	GovİntegrityIntegrity
Breusch Pagan LM Statistics	181.168*	197.275*	33.963*	3.766*	106.249*
Probability	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
Pesaran CD Statictics	8.854*	13.954*	-0.395	3.027*	-2.912*
Probability	(0.000)	(0.000)	(0.693)	(0.003)	(0.004)
Cross-Sectional Correlation Test for the Overall Panel					
	Statistics	Probability			
Breusch Pagan LM	29.773**	0.013			
Pesaran Scaled LM	2.697*	0.007			

Note:* and ** indicate statistical significance at the 1% and 5% levels, respectively.

According to the results of the Breusch–Pagan LM test, cross-sectional dependence is observed both for the individual variables and for the overall panel. Based on these findings, it is appropriate to employ second-generation panel unit root tests when determining the stationarity of the series. Although various unit root tests are available, this study employs the panel unit root test with structural breaks developed by Im, Lee, and Tieslau (2010) to examine the stationarity of the series. In this context, the test is based on the argument that if structural breaks are present in the series, conventional unit root tests may be insufficient to detect a unit root. Therefore, this approach tests for the presence of a unit root while endogenously determining the structural break dates for each cross-sectional unit. For each series, the augmented Dickey–Fuller (ADF)-type regression proposed by Im, Lee, and Tieslau (ILT) is specified as follows:

$$\Delta y_{i,t} = \delta_i' \Delta Z_{i,t} + \emptyset_i \bar{S}_{i,t-1}' + \sum_{j=1}^{k} d_{ij} + \Delta \bar{S}_{i,t-j} + e_{i,t}$$

In the equation above $y_{(i,t)}$ denotes the series to which the unit root test is applied. For example, if =MIisery$_{i,t}$, the regression tests the stationarity of the Misery Index $\Delta y_{(i,t)}$ the first difference of the series being tested; $z_{i,t}$: the vector of deterministic components (constant/trend and, if present, structural break dummies). If there is no break, typically (=[1,t]′. If there is a break, level and/or trend break dummies are included. =[1,t]′ the one-period lag of the detrended series obtained after removing the deterministic components and any structural breaks. This term provides the main information required to determine whether the series contains a unit root or is stationary. $\sum_{j=1}^{k} d_{ij} + \Delta \bar{S}_{i,t-j}$ is the lagged differences added according to the ADF logic; their purpose is to reduce autocorrelation in the error term. The lag length (k) is generally selected using AIC/BIC criteria or sequential testing. In this context, the hypotheses are…

- H_0:ϕi=0: (unit root in the panel; series not stationary)
- H_1:ϕi<0 :(stationarity in at least some units) is established. The results of the ILT panel unit root test with structural breaks are presented in Table 4.

Table 4

Panel Unit Root Test Results with Structural Breaks

Variables	Level		Trend	
	Single break	Double break	Single break	Double break
Lgdpcons	-7.507*	-18.089*	-6.056*	-17.023*
	(0.000)	(0.000)	(0.000)	(0.000)
Oil rent	-8.148*	-13.748*	-5.857*	-11.554*
	(0.000)	(0.000)	(0.000)	(0.000)
Misery	-9.212*	-15.203*	-6.265*	-14.782*
	(0.000)	(0.000)	(0.000)	(0.000)
Lenergyuse	-8.944*	-17.312*	-6.498*	-11.441*
	(0.000)	(0.000)	(0.000)	(0.000)
GovInt	-6.914*	-15.588*	-9.428*	-18.831*
	(0.000)	(0.000)	(0.000)	(0.000)

Note: * indicates statistical significance at the 1% level.

According to the results of the ILT panel unit root test with structural breaks presented in Table 4, the variables are stationary in levels. The next step involves testing homogeneity. In this study, the Delta homogeneity test developed by Pesaran and Yamagata (2008) was used to determine whether the slope coefficients of the panel regression model are homogeneous across countries. Pesaran and Yamagata (2008) standardized the Swamy statistic and defined the Delta test as follows:

$$\hat{\Delta} = \sqrt{N}\left\{\frac{N^{-1}S - k}{\sqrt{2k}}\right\} \sim x_k^2$$

In this equation, k denotes the number of explanatory variables in the regression. The bias-adjusted Delta statistic, which accounts for finite-sample properties, is defined as follows:

$$\hat{\Delta}adj = \sqrt{N}\left\{\frac{N^{-1}S - E(\tilde{z}_{iT})}{\sqrt{Var(\tilde{z}_{iT})}}\right\} \sim N(0,1)$$

In the Delta homogeneity test, the test statistics asymptotically follow a standard normal distribution. One of the hypotheses of the Delta tests, the null hypothesis H_0: $\beta_1=\beta$, states that the slope coefficients are homogeneous. The hypothesis that the slope coefficients are heterogeneous is called the alternative hypothesis

and is expressed as H_1:$\beta_i \neq \beta$ (Pesaran and Yamagata, 2008). This test assesses whether the slope coefficients associated with Lgdp, Oilrent, Lenergyuse, and Govint are homogeneous across countries when the misery index is the dependent variable, thereby informing the choice between homogeneous- and heterogeneous-coefficient panel estimators. The results of the Delta homogeneity test are presented in Table 5.

Table 5

Homogeneity test results

	Delta Test	Probability
Δ	3.712*	0.000
Δadj	4.488*	0.000

Note:*, indicates statistical significance at the 1% level.

According to the results in Table 5, the model is heterogeneous. Given these results, this study employs the random-coefficient model (RCM) developed by Swamy (1970), allowing the slope coefficients to vary across countries. The random coefficient model directly incorporates coefficient heterogeneity. In this way, the restrictive homogeneity assumption of pooled models is also relaxed. Swamy (1970) models cross-sectional heterogeneity in panel data with random coefficients and proposes an efficient estimator for the mean coefficient β.

$$y_i = X_i \ \beta_i + \quad u_i \quad \beta_i = \beta + \delta_i$$

(Tx1) (Tx Λ) (Λx1) (Tx1)

For i = 1, 2, ..., N, there are T observations on each of the variables u_i and x_i. The matrix x_i (i = 1, 2, ..., N) is of level Λ and contains Λ observations on the non-stochastic regressor, $X_{It,\Lambda}$ (t = 1,2...., T, ʎ=1,2..... Λ); β_i and u_i and ui are unobserved random vectors, and ui is the heterogeneity bias. $\beta_i = \beta + \delta_i$ (i=1,2.....N, where δ_i _i is a vector Λx1 composed of random elements.

Assumption 1 : $Eu_i = 0 \quad Eu_i u_j' = \begin{pmatrix} \sigma_{ii} I \text{ if } i=j \\ 0 \text{ if } i \neq j \end{pmatrix}$

Assumption 2: $E\beta_i = \bar{\beta}$

Assumption 3: $E\,(\beta_i - \bar{\beta})\,(\beta_i - \bar{\beta})' = \begin{pmatrix} \Delta \text{ if } i=j \\ 0 \text{ if } i \neq j \end{pmatrix}$

Assumption 4: β_i and u_i are independent and β_i ve β_j i ≠j are independent.

Assumption 1 implies that the disturbance variance for each cross-sectional unit remains constant over time and that the disturbance terms exhibit neither

cross-sectional dependence nor serial correlation. σ_{ii} is the variance of the distortion term of the i-th microunit for any given time period. In other words, the distortions are heteroscedastic, with different variances across microunits. Furthermore, they are not structurally and temporally correlated. Assumptions 2 and 3 imply that the regression coefficient vectors β_i' are not random and correlated among microunits, but follow the same distribution as the mean $\bar{\beta}$, and the variance-covariance matrix Δ. This distribution is assumed to be stable over time. The unbiased estimator of σ_{ii} is expressed as follows.

$$S_{ii} = \frac{y_i' M_i y_i}{T-\Lambda} \text{ where } M_i = I - X_i(X_i'X_i)^{-1}X_i'$$

The unbiased estimator of Δ is given by the following expression.

$$\hat{\Delta} = \frac{S_b}{N-1} - \frac{1}{n}\sum_{i=1}^{n} S_{ii}\,(X_i'X_i)^{-1} \text{where } S_b = \sum_{i=1}^{N} b_i b_i - \frac{1}{N}\sum_{i=1}^{N} b_i \sum_{i=1}^{N} b_i'^2$$

Assuming that an estimate is available for S_{ii} (i=1,2,....., N) and , the estimator is formulated as follows.

$$b(\hat{\theta}) = C(\theta)\sum_{i=1}^{N}\left\{\hat{\Delta} + S_{ii}\,(X_i'X_i)^{-1}\right\}^{-1} b_i \text{ and from here}$$

$$C(\hat{\theta}) = \left[\sum_{j=1}^{N}\left\{\hat{\Delta} + S_{jj}\,(X_j'X_j)^{-1}\right\}^{-1}\right]^{-1}$$

This yields the following equality. The random coefficients model offers a powerful method when structural differences across countries can alter the regression coefficients. Therefore, it produces more realistic results than classical fixed-effects or pooled models when the effects of variables such as GDP, oil rents, energy use, and government integrity on the misery index differ across countries, a condition known as coefficient heterogeneity. Furthermore, the model reduces the risk of biased estimates by accounting for heterogeneity. The results of the random coefficients model are presented in Table 6.

Table 6

Random coefficient model results

Countries	Variable	Coef	StdErr	Z	Probability
Algeria	Lgdpconstant	-8.538538	32.790370	-0.260000	0.795000
	oilrentsof~p	-0.158861	0.029115	-5.460000	0.000000*
	Lenergyuse	-18.133880	34.260720	-0.530000	0.597000
	Govint	0.295758	0.088361	3.350000	0.001000*
	_cons	162.198200	266.198700	0.610000	0.542000

Countries	Variable	Coef	StdErr	Z	Probability
İran	Lgdpconstant	-176.227400	52.706680	-3.340000	0.001000*
	oilrentsof~p	0.339497	0.170328	1.990000	0.046000**
	Lenergyuse	317.607000	86.023240	3.690000	0.000000*
	Govint	-0.648546	0.341488	-1.900000	0.058000***
	_cons	993.696900	337.434900	2.940000	0.003000
Kuwait	Lgdpconstant	11.466300	13.072640	0.880000	0.380000
	oilrentsof~p	0.055835	0.057470	0.970000	0.331000
	Lenergyuse	10.662320	6.184829	1.720000	0.085000***
	Govint	-0.016646	0.092294	-0.180000	0.857000
	_cons	-165.309300	148.512900	-1.110000	0.266000
Libya	Lgdpconstant	-12.124230	9.610088	-1.260000	0.207000
	oilrentsof~p	-0.227033	0.078376	-2.900000	0.004000*
	Lenergyuse	24.707580	12.721770	1.940000	0.052000***
	Govint	0.912500	0.234291	3.890000	0.000000*
	_cons	61.596590	111.627300	0.550000	0.581000
Nigeria	Lgdpconstant	2.851028	10.146130	0.280000	0.779000
	oilrentsof~p	-0.069776	0.075743	-0.920000	0.357000
	Lenergyuse	-4.007511	1.537366	-2.610000	0.009000*
	Govint	-0.163868	0.188584	-0.870000	0.385000
	_cons	-2.913465	113.839000	-0.030000	0.980000
S.Arabia	Lgdpconstant	-2.731266	7.942640	-0.340000	0.731000
	oilrentsof~p	0.031180	0.065022	0.480000	0.632000
	Lenergyuse	15.175670	7.340748	2.070000	0.039000**
	Govint	-0.165495	0.076025	-2.180000	0.029000**
	_cons	-11.801550	84.839500	-0.140000	0.889000

Note: *, **, *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Conclusion

This study examines the dynamics of the misery index, a macroeconomic welfare indicator based on inflation and unemployment, in six Muslim-majority OPEC member countries (Algeria, Iran, Kuwait, Libya, Nigeria, and Saudi Arabia) between 2002 and 2020 using a random-coefficient panel model that accounts for countr-

y-specific structural differences. The country-specific coefficient estimates show that the impact of key determinants on the Misery Index cannot be represented by a single "average" parameter; rather, the relationships vary significantly between countries in both magnitude and sign. This finding suggests that factors such as dependence on commodity revenues, energy-intensive production structures, national income, and the role of the public sector in the economy shape the country-specific mechanisms that increase or reduce economic misery.

The findings indicate that the effect of oil rents varies across countries. Differences in how governments manage and distribute natural resource rents are a source of cross-country variation. In Algeria and Libya, increases in oil rents significantly reduce the misery index. By contrast, the positive relationship found for Iran is consistent with the findings reported by Mignamissi and Kuete (2021) and Ampofo et al. (2020). In the remaining countries, the relationship between the two variables is statistically insignificant and should not be interpreted as evidence of an effect. Although Iran, Algeria, and Libya are classified by the World Bank as upper-middle-income economies, the estimated effect of oil rents is negative in Algeria and Libya but positive in Iran. This pattern suggests that heterogeneity in the effects of oil rents cannot be attributed solely to differences in income levels. The effects generally depend on revenue management frameworks, fiscal institutions, and the channels through which oil rents are directed into the domestic economy (for example, how Sovereign Wealth Funds or Stabilization Funds, where they exist, are managed). Funds established to manage revenue volatility can, when allocated to public infrastructure projects and employment-supporting expenditures, help stabilize the economy over the long term and lower the misery index by using savings accumulated during periods of high oil prices to mitigate unemployment and inflation (El-Anshasy et al., 2017; Lamb et al., 2013; van der Ploeg, 2017). Heavy dependence of the public budget on oil rents reinforces the state's role as a distributor of rents and may weaken regulatory frameworks and institutions (Sharifi & Majidi, 2025). When resource allocation is transparent and supported by strong institutions, it can promote market stability and investment, thereby helping to reduce the misery index. In particular, reliance on natural resource rents allows governments to finance popular social welfare programs and subsidies through public expenditure while prioritizing employment creation in the natural resource sector. Consequently, the public budget functions as a redistribution mechanism that may help lower the misery index, as observed in Algeria and Libya (Almaz, 2015; Montambault Trudelle, 2024; Walker, 2023). This pattern suggests that the economic consequences of resource rents are not uniform but largely depend on their allocation to productive investment and economic diversification, as well as on institutional quality.

Similarly, the effect of energy use varies across countries: higher energy use is significantly associated with a higher misery index in all sampled countries except Nigeria, where the association is negative. In Nigeria, increased energy use may stimulate employment and economic growth by expanding productive capacity, thereby lowering the misery index. In the other countries, the positive association may reflect consumption-driven energy use and the fiscal burden created by energy subsidies, both of which may raise the misery index. In this context, the negative impact is exacerbated by inefficiency, structural fragility, or external dependence. This result suggests that energy use may increase employment and lower the misery index by expanding production capacity but may also produce adverse outcomes because of inefficiency, structural fragility, or external dependence. Specifically, energy use may increase production costs and generate cost-push inflation while also affecting the labor market through economic volatility and productivity constraints. Taken together, these findings suggest that natural resource rents do not necessarily improve economic well-being and that the resource curse may emerge under unfavorable institutional and structural conditions.

The effect of government integrity also varies significantly across countries: it is positively associated with the misery index in Algeria and Libya but negatively associated with it in Saudi Arabia. The significant negative association between government integrity and the misery index in Saudi Arabia provides support for the resource blessing hypothesis, which emphasizes the welfare-enhancing role of institutional quality. This finding supports the idea that the impact of public accountability and transparency on the misery index cannot be classified as simply good or bad; rather, factors such as the composition and effectiveness of public intervention and the quality of governance are decisive. Therefore, rather than proposing a single solution for every country, the policy implications point to country-specific strategies that account for each country's institutional and structural constraints. This can also be explained by the fact that the same policy intervention may produce different outcomes under different institutional, structural, and economic conditions.

The estimated effect of economic growth on the misery index is negative only in Iran; the estimates for the remaining countries are statistically insignificant. This result suggests that economic growth in Iran is associated with a lower combined level of inflation and unemployment. Additionally, this outcome is similar to the results of Dadgar and Nazari (2018) for Iran and Günay and Azazi (2026) for Turkey. However, these findings are inconsistent with those reported by Opalaye and Nwachukwu (2019).

Four main conclusions can be drawn from the results. First, the impact of oil rents is markedly heterogeneous: increases in oil rents significantly reduce the misery index in Algeria and Libya, significantly increase it only in Iran, and have no statistically significant effect in the remaining countries. This pattern shows that resource revenues do not automatically reduce macroeconomic distress; rather, the way revenues are managed, the impact on domestic demand and prices, exchange-rate and competitiveness effects, and the effects of fiscal policy are all determining factors.

Second, the estimated effect of energy use varies across countries. In Iran, Kuwait, Libya, and Saudi Arabia, increased energy use raises the Misery Index through inflationary pressures, cost channels, and dependence, whereas in Nigeria, it mitigates the Misery Index through production capacity and employment channels. Third, government integrity, used as a proxy for institutional quality, also has heterogeneous effects across countries. In this context, government integrity is positively associated with the misery index in Algeria and Libya but negatively associated with it in Saudi Arabia and Iran. This situation emphasizes that factors such as the composition of public revenue and expenditure, transparency in spending, fiscal discipline, efficiency, and consideration of public welfare are critical, rather than the size of the public sector. Furthermore, the marginal statistical significance of the government integrity coefficient in Iran precludes strong policy recommendations. Under the rentier-state framework, the relationship between institutional quality, proxied by government integrity, and economic distress appears to depend on country-specific characteristics, as the case of Iran illustrates. Finally, economic growth is associated with a lower misery index in Iran, while its estimated effect is statistically insignificant in the remaining countries.

The findings indicate that economic policies in Muslim-majority OPEC member countries should account for country-specific structural and institutional differences rather than adopt a uniform approach. The fact that the impact of oil rents on the misery index varies in direction and magnitude across countries indicates that natural resources alone do not guarantee greater prosperity. Instead, outcomes depend on how these rents are managed and allocated and how they interact with institutional structures. When effectively managed, resource rents may support production and income growth while reducing inflation and unemployment. In this context, it is crucial that resource rents are directed towards productive investments, economic diversification, and sectors that support long-term growth, rather than towards consumption-based expenditures. Furthermore, economic po-

licies should support production and employment without generating inflationary pressures while also promoting long-term growth.

Finally, the statistical insignificance of several country-specific coefficients suggests that uncertainty may persist because of the panel's relatively short time dimension and potential measurement differences. In this context, future studies should test the robustness of these findings using alternative variable definitions, lag structures, and additional institutional controls to identify the sources of heterogeneity more directly.

In sum, cross-country differences in per capita income and institutional quality may help explain why oil wealth produces different social welfare outcomes. The overarching purpose of this study is to examine how macroeconomic, resource-related, and institutional factors affect the misery index as a proxy for social welfare loss. This issue is particularly relevant in a global environment in which energy prices are affected by crises, wars, and pandemics. In this context, given OPEC member countries' substantial share of global crude oil production and their differing levels of per capita income, the study seeks to identify the determinants of the misery index, with particular emphasis on oil rents and institutional quality, by addressing the following research question: How do country-specific structural characteristics and institutional differences affect the misery index as a proxy for social welfare loss? In this regard, a random-coefficient model is used to examine country-specific variations in the misery index by accounting for macroeconomic and resource-related factors, as well as institutional quality variables such as government integrity, and to identify heterogeneity across selected Muslim-majority OPEC economies. However, data limitations restrict the analysis to the 2002–2020 period, while a more detailed micro-level examination of sectoral and distributional effects lies beyond the scope of this study.

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