The Role of Oil Price Shocks in Shaping Unemployment Dynamics

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Abstract

In this paper, we investigate the responses of national, oil-state, and state unemployment rates to structural oil price shocks. We find that an oil supply shock increases the long-term unemployment rate. On the other hand, an economic activity shock decreases the unemployment rate in the short term but has no long-term effect. Inventory demand shocks cause high long-term unemployment. Dividing the unemployment rate based on movements between employment to unemployment (e2u) and non-employment to unemployment (n2u), we find that both transitions behave similarly, and e2u drives most of the response in the unemployment rate.

1 Introduction

This paper explores the intricate dynamics of oil price shocks and their impact on unemployment rates across different states of the U.S. economy. Our investigation is rooted in the significant shift in the U.S.'s reliance on imported oil, a change brought about by the "shale revolution" and advancements in domestic oil production. This transition, as highlighted by Brown & Yücel (2013) and Karaki (2018), has fundamentally altered the economic landscape, reducing the overall dependence on oil imports but simultaneously creating new economic vulnerabilities, especially for states heavily reliant on oil production. These regions, now more sensitive to fluctuations in oil prices, face challenges of decreased economic diversification and heightened susceptibility to market shifts.

We investigate how these vulnerabilities translate into variations in unemployment rates, not just at a national level but also within specific categories of oil and non-oil states. We recognize that the former may benefit from increased oil prices due to a heightened dependency on oil revenues. This dichotomy is crucial. As Brown & Yücel (2013) noted, oil states tend to experience increased employment rates with rising oil prices, hinting at a potential asymmetry in how the labor markets of different states respond to these shocks.

Our study further considers individual state-level impacts, providing a comprehensive picture of how different regions within the U.S. respond to oil price shocks. Additionally, we analyze the response of the labor market to oil price shocks, categorized into supply and demand shocks, with a focus on two distinct categories of unemployment transitions: from employment to unemployment (e2u) and from non-employment (outside the labor force) to unemployment (n2u). The differentiation in the nature of oil price shocks – supply shocks, global economic activity-driven demand shocks, oil consumption demand shocks, and oil inventory demand shocks – as outlined by Baumeister & Hamilton (2019), provides a complex backdrop against which these labor market shifts can be analyzed.

We begin by considering the effect of oil supply shocks. In scenarios where oil production falls permanently post-supply shock, oil-producing states are likely to experience a decline in employment opportunities within the oil sector. This reduction in sector-specific employment could lead to an increase in e2u transitions as employees in the oil industry face unemployment. Conversely, the effect on individuals previously outside the labor force (n2u) might be less immediate, emerging gradually as the broader economic consequences of the supply shock become apparent.

We then examine the effect of the three oil demand shocks. When oil prices rise due to increased global economic activity, oil-producing states may witness a surge in employment within the oil sector, driven by heightened demand. This increase in employment opportunities could decrease e2u transitions, as the oil sector absors more of the existing workforce. However, the effect on n2u transitions might be less pronounced, given that these individuals are generally less responsive to short-term economic fluctuations. Following an oil consumption demand shock, an initial increase in oil production may temporarily boost employment opportunities in oil-producing states, potentially reducing e2u transitions and increasing n2u transitions. However, as the oil market stabilizes and the initial surge in production plateaus, the long-term impact on the n2u category will likely be minimal. Lastly, our analysis extends to reactions to oil inventory demand shocks. Characterized by their transient nature, where both oil prices and production levels quickly revert to baseline, these shocks are expected to have a minimal and short-lived impact on both e2u and n2u transitions.

By integrating these mechanisms into our research, we aim to provide a comprehensive analysis of how different oil price shocks variably influence labor market transitions in various regions of the United States. Our study seeks to explain the intricate relationship between oil market dynamics and unemployment rates, considering the distinct experiences of those transitioning from employment and those previously outside the labor force.

2 Literature Review

The intricate relationship between oil price shocks and unemployment rates in the United States at the national and state levels has been extensively explored in economic literature, revealing diverse impacts across different regions and economic conditions. Brown & Yücel (2013) examine the historical vulnerability of the U.S. economy to imported energy and the transformative effect of the shale revolution. Their findings suggest that while increased domestic oil and gas production has reduced reliance on imports and diversified the economy, it has also introduced new vulnerabilities, particularly in states with significant energy production. They note that oil price increases have a differential impact, with most states suffering adverse effects while certain oil-producing states benefit from these hikes. This dichotomy underscores the economic shifts brought about by rising oil prices, with a potential nationwide job loss exceeding half a million in the wake of a 25% increase in oil prices.

Karaki (2018) builds on this understanding by focusing on the state-level implications of oil price shocks. The study examines the asymmetrical effects of oil prices on unemployment rates across oil-producing and non-oil-producing states, highlighting the increased sensitivity of certain regions to oil market dynamics. Alsalman (2023) further contributes to this field by using an SVAR model to analyze the responses of the U.S. unemployment rate to various structural oil price shocks. The study finds that demand-driven oil shocks significantly influence the real price of oil and unemployment rates, with adverse supply shocks leading to an increase in unemployment.

3 Revisiting the effects of different types of oil shocks on national and state unemployment rates

Karaki (2018) is the first paper to investigate the transmission of structural oil price shocks to state-level unemployment rates in the U.S., offering valuable insights into the dynamics of regional business cycles. Using data from 1976 to 2015, Karaki sheds light on the changing landscape of oil price impacts on state economies, especially for states with significant oil and gas industry presence. This paper employs a recursively identified structural near-VAR (SVAR) model, following Kilian & Park (2009), to explore the effects of different oil shocks on unemployment. The model disentangles the effects of oil supply, aggregate demand, and oil-specific demand shocks on unemployment.

He finds that adverse oil supply shocks typically elevate unemployment rates across most states, with some oil-rich states showing a muted response. Aggregate demand shocks, on the other hand, tend to lower unemployment rates across both oil-producing and non-producing states. Intriguingly, oil-specific demand shocks do not significantly impact the national unemployment rate, although their effects vary by state. Further, the study's historical decompositions reveal that aggregate demand shocks primarily contributed to national and state-level unemployment rate changes during the shale boom (2004m1 to 2014m6). However, during the period of oil price declines (2014m6 to 2015m12), both aggregate and oil-specific demand shocks played significant roles in affecting unemployment rates.

This analysis will investigate Karaki's structural near-VAR model, focusing on its underlying assumptions and potential limitations.

Karaki follows the methodology of Kilian (2009) and Kilian & Park (2009), which assumes a zero short-run oil supply elasticity. This assumption, however, has been challenged by subsequent empirical research. Notably, Baumeister & Hamilton (2019) provide a revised estimate of the short-run oil supply elasticity at around 0.15. This suggests that the oil suppliers are more responsive to oil price changes in the short term than earlier studies assumed. This suggests that models, including Karaki (2018), may underestimate the influence of these shocks on the oil market and, by extension, on macroeconomic variables such as unemployment rates.

Karaki (2018) employs the Kilian (2009) index, a measure of global real economic activity derived from shipping costs, as a proxy for world economic activity. However, Hamilton (2021) and Baumeister & Guérin (2021) highlight significant limitations in this measure. Hamilton shows that this index's correlation with world output, particularly annual GDP growth, is weaker than alternative measures and fails to reflect global economic trends accurately. Baumeister & Guérin (2021) show that the Kilian index performs poorly in out-of-sample forecasting of global real GDP. Both studies suggest that the world industrial production index of Baumeister & Hamilton (2019) is a superior indicator of global real activity.

While Karaki's model follows traditional approaches focusing on production, global activity, and oil prices, it overlooks the nuanced role of inventories, as emphasized by Kilian & Murphy (2014) and Baumeister & Hamilton (2019).

We adopt a local projection model instead of the SVAR approach pursued by Karaki (2018). Alsalman (2023) also uses local projections to test the robustness of unemployment responses to various identified oil supply shocks. Her analysis reveals persistent increases in the unemployment rate beyond 18 months from the oil supply shocks identified by Baumeister & Hamilton (2019). This finding contrasts sharply with the results derived from Karaki (2018), where the unemployment rate shows only marginal and short-term increases after oil supply shocks.

Expanding on Alsalman's work, our analysis covers all four structural oil price shocks identified by Baumeister & Hamilton (2019), assessing their impacts on U.S. national and state unemployment rates. We focus on quantifying the unemployment responses to a 10% immediate increase in oil prices.

We now shift to the empirical framework of our study. First, we detail the data used for our analysis, covering the sources and preprocessing steps. Then, we describe the implementation of the local projection model.

4 Data and Methodology

4.1 Data Sources

In our estimation, we use the Current Population Survey (CPS) monthly individual survey data from Flood et al. (2023) for the sample period January 1976 to December 2019. We use this data to calculate the number of unemployed and the total labor force at the national, oil state, and state levels. We then seasonally adjust each of these series using the X-13 ARIMA procedure and calculate the seasonally adjusted unemployment rate for the three different subsets of the US.

The individual-level data allows us to aggregate the total unemployed and labor force at the oil-state level. In their analysis of the shale oil sector's economic contribution during the 2014-16 oil price drop, Baumeister & Kilian (2016) assert that focusing solely on the direct contribution of the oil sector may underestimate its broader impact on the economy. This assertion is particularly evident in oil states like North Dakota and Texas, where the oil boom from 2010 to 2015 bolstered the oil sector and led to significant growth in related sectors like services, residential housing, and infrastructure. The subsequent bust, triggered by falling oil prices, had a cascading effect, causing contractions across these interconnected sectors. This phenomenon underscores the unique economic dynamics of oil states, which are deeply intertwined with and reactive to oil price fluctuations.

Consequently, we adopt Baumeister & Kilian (2016) 's classification of states into oil and non-oil categories to investigate how oil price shocks differentially impact unemployment rates in these distinct groups. They define oil states as those whose oil share in value added in 2014 was above 5%. [1] According to this classification, Alaska, Montana, New Mexico, North Dakota, Oklahoma, Texas, and Wyoming are classified as "oil states".

The CPS data, with its detailed individual-level information, will later be used to analyze the movement of individuals between different employment states, especially in the context of oil price shocks. This nuanced analysis will be crucial in understanding how these shocks affect labor market dynamics, particularly in oil states.

In our analysis, the main task is to examine the labor market dynamics using structural oil shocks. To this end, we utilize the identified structural oil price shocks from Baumeister & Hamilton (2019), who provide us with a time series of four distinct shocks: an oil supply shock, a global economic activity shock, an oil consumption demand shock, and an oil inventory demand shock. By incorporating these distinct shocks into our study, we aim to provide a comprehensive view of the dynamic interplay between oil market fluctuations and labor market responses. As a measure of the real oil price, we deflate the monthly US refiner's acquisiton cost of imported crude oil obtained from the Energy Information Administration

[1] This classification is based on the method of Hamilton and Owyang (2012), where the state-level oil share is calculated by multiplying the number of barrels of crude oil produced in a state in 2014 by the annual domestic first purchase price and then dividing this product by the state's personal income for that year. In our next iteration of this paper, we plan to update the list of oil states by reapplying this methodology to 2019, the final year in our sample period.

(EIA) using the CPI(CPIAUCSL) in line with Karaki (2018) and Alsalman (2023).

Further, the granularity of the CPS data is particularly advantageous for examining labor market dynamics in response to oil price shocks. This dataset not only provides insights into the overall unemployment rates but also enables a detailed analysis of the movement of individuals between different employment states. We use the variable WHYUNEMP which specifies why respondents were unemployed – either actively seeking work or on temporary layoff from a job during the previous week. Responses for WHYUNEMP distinguish between workers who had lost jobs (due to temporary layoff, involuntary job loss, or ending of a temporary job), those who had quit jobs, those who were re-entering the labor force after an extended absence from the work force, and those who were seeking their first jobs (new entrants). We group the workers who have lost or quit their jobs in the employed to unemployed (e2u) subcategory and those who are reentering and new entrants in the non-employed to unemployed (n2u) subcategory. These are the people who come from outside the labor force. We then proceed to calculate the unemployment rates for these two components. They sum up to the aggregate unemployment rate.

4.2 Model

In our analysis, we employ the Local Projections method, introduced by Jordà (2005), to estimate the impact of structural oil price shocks on unemployment rates. While local projections estimate the same IRFs as Vector Autoregressions (VARs), they offer a more flexible approach to separate the choice of identification scheme from the estimation approach (Plagborg-Møller & Wolf (2021)). This flexibility is particularly beneficial when dealing with varying horizons, as it simplifies both the estimation process and subsequent hypothesis testing. Moreover, local projection estimators, being straightforward regression coefficients, provide an intuitive interpretation.

We estimate the following linear projection for horizons, $h = 0, 1, \ldots, H$ following Alsalman (2023)

$$u^g_{t+h} = \mu^{g,j}_h + \beta^{g,j}_h \epsilon_{j,t} + \sum_{l=1}^{13} \delta^{g,j'}_{h,l} \mathbf{w}^{g,j}_{t-l} + \xi^{g,j}_{h,t} \tag{1}$$

where, $\mathbf{w}^{g,j}_t = (\epsilon_{j,t}, u^g_t)$ is the vector of the data at time t, $\epsilon_{j,t}, j = 1,2,3,4$ is an identified structural oil price shock, u^g_t is the unemployment rate of the subset g of the United States: the national level, oil state level, and the state level. Specifically, $g \in \{\text{US,oil-states,non-oil-states}\} \cup S$, where, $S = \{s : s \text{ is a state in the US or the District of Columbia}\}$. Our coefficient of interest is $\left\{\beta^{g,j}_h\right\}_{h\geq 0}$, the impulse response function of u^g_t with respect to $\epsilon_{j,t}$ at horizon h. Montiel Olea & Plagborg-Møller (2021) suggest that if the true model is believed to be a VAR of order p, then $p+1$ lags should be included in the local projections. Our identified shock series comes from the monthly global oil market model estimated by Baumeister & Hamilton (2019), who use a lag length 12. So, we choose, $p = 13$ in our estimation.

We estimate this Local Projection (LP) separately for each combination of subset g and shock type j and report the impulse responses up to two years following the shock. For easy interpretation of our results, we normalize the impulse responses to structural oil shocks that increase the oil price by 10% on impact. To achieve this, we scale the LP coefficient of the response of the unemployment rate, u^g_{t+h}, to the oil shock $\epsilon_{j,t}$ by $\beta^{o,j}_t$, the LP coefficient of the real oil price at $h = 0$, the impact horizon of the same shock in equation (2).

The LP for the oil price is below:

$$o^j_{t+h} = \mu^j_h + \beta^{o,j}_h \epsilon_{j,t} + \sum_{l=1}^{13} \delta'^{,j}_{h,l} \mathbf{x}^j_{t-l} + \xi^j_{h,t} \tag{2}$$

where o_{t+h} represents the natural log of the real oil price and $\mathbf{x}^j_t = [o_t, \epsilon_{j,t}]$. In subsequent analyses, we also examine the effect of the structural oil shocks on the size of unemployment duration classes. For that analysis, we replace the LHS of equation (1) by $d^{i,g}_{t+h}$, the natural logarithm of the size of duration class $i, i = 1, \ldots, 4$.

4.3 Results

4.3.1 Response of oil prices

This section presents the key findings from our analysis, beginning with the response of oil prices to various structural shocks and subsequently exploring their impacts on unemployment rates.

In Figure 1, we show the response of oil prices to various structural oil price shocks, each calibrated to trigger a 10% increase in oil prices on impact. The response patterns reveal the unique impacts of different shocks, marked by their maximum values and statistical significance. For the negative oil supply shock, oil prices initially surge and remain significantly elevated at the 95% confidence level for up to 17 months, peaking at 19% five months post-impact. In the context of an economic activity shock, oil prices witness their maximum increase of 51% seven months after the shock, with this response remaining significant at the 95% level for the first 10 months. The influence of this shock continues over three years, with oil prices still 27% higher than the baseline. The response to an oil consumption demand shock is even more pronounced and consistent. The peak increase of 16% above the baseline occurs just two months post-shock, and this response remains statistically significant at the 95% level across all observed months, highlighting its persistent effect.

Among the different shocks, the oil inventory demand shock stands out for its unique impact on oil prices. This shock shows statistical significance at the 95% level only at the time of impact and five and six months post-impact. While the response is significant at the 68% level for the first eight months, it exhibits marginal significance at later horizons, particularly at 16 to 18 months. The most notable response is observed six months after the shock, where the maximum cumulative increase in oil prices reaches 36%. This distinct pattern of significance, with its narrow window of high confidence levels, highlights the unique nature of the oil inventory demand shock compared to other shocks in terms of its impact on oil prices.

Having established the varying impacts of structural oil price shocks on oil prices, we now focus on their effects on the national unemployment rate.

4.3.2 Response of national unemployment rate

In Figure 2, we present the response of the national unemployment rate to various structural oil price shocks, each calibrated to induce a 10% increase in oil prices upon impact.

Upon the impact of an oil supply shock, we observe a marginal increase in the unemployment rate of 0.03 percentage points (pp). The national unemployment rate increases from 0.3 pp 18 months post-shock to 0.6 pp by the end of three years. This delayed effect contrasts with Karaki (2018), who found a significant increase in unemployment one year after the shock.

An increase in oil prices due to an economic activity shock initially reduces the national unemployment rate, reaching a trough of -1.96 pp 12 months post-shock. This short-term stimulatory effect fades in the long run, with the response turning insignificant after two years, deviating from Karaki (2018) and Alsalman (2023), who reported long-term growth-retarding effects.

The oil consumption demand shock's impact on national unemployment is not significant at the 95% level upon impact and remains muted. However, it is significant only at the 68% level. The maximum decrease in unemployment is -0.15 pp, observed 21 months post-shock, but the effect fades, turning insignificant after 22 months.

The oil inventory demand shock shows a unique pattern. While the immediate impact on unemployment is insignificant, it becomes significantly growth-retarding at most horizons post-shock. The increase in the national unemployment rate is notable three months after the shock at 0.28 pp, intensifying to a 2.45 pp increase three years later. Unlike Karaki and Alsalman, who did not report significant impacts of a singular "oil-specific" demand shock on national unemployment, our analysis distinguishes between consumption and inventory demand shocks. This distinction provides a more refined view of the effect of shocks originating from increased demand for oil on unemployment rates.

The effect of economic activity shock and inventory demand shock is similar for both types of unemployment. However, oil consumption demand shocks have no effect on the n2u unemployment rate.

4.3.3 Response of oil and non-oil state unemployment rate

Our approach calculates the average unemployment rate for oil and non-oil states separately to capture the distinct labor market dynamics in these categories. We compute this rate for oil states by summing the total number of unemployed individuals across all oil states and dividing this by the total labor force in these states. We apply a similar process to non-oil states. This methodology yields what can be considered the average unemployment rate for each category, providing a clearer picture of how regional economies, characterized by their reliance on the oil sector, respond differently to fluctuations in oil prices.

Figures 3 and 4 display the responses of unemployment rates in oil and non-oil states to the four structural oil price shocks. In these figures, we group the shocks with similar magnitudes: the oil supply and oil consumption demand shocks are plotted together due to their comparable impacts, as are the economic activity and oil inventory demand shocks.

Starting with the oil supply shock, oil states experience a decrease in unemployment rates upon impact, which is significant at medium horizons. However, this trend reverses in the long run, leading to increased unemployment. The initial decrease reaches a trough of -0.25 percentage points (pp) at 6 months, while the eventual increase peaks at 0.31 pp 34 months post-shock. In contrast, non-oil states initially see a slight increase in unemployment by 0.05 pp on impact, which quickly becomes insignificant. Nevertheless, the long-term effect is an escalating unemployment rate starting 16 months after the shock and continuing until 36 months, peaking at 0.66 pp at 32 months. In summary, oil states initially benefit from an adverse oil supply shock. However, oil and non-oil states experience higher unemployment rates in the long run, with the latter showing more substantial increases than the former.

Regarding the response to increased oil consumption, both oil and non-oil states see a reduction in long-term unemployment rates. Oil states observe a persistent and significant reduction, with a trough of 0.27 pp 20 months post-shock and an overall decrease of 0.16 pp even three years later. The unemployment reduction for non-oil states fades roughly two years after the shock, with the most significant decrease being 0.15 pp at 19 months.

The impact of increased economic activity leading to higher oil prices shows a similar pattern for both categories of states, with an initial reduction in unemployment rates becoming insignificant over time. However, this effect lasts longer for oil states (up to 31 months) than non-oil states (up to 24 months). The most significant reductions for oil states are 2.18 pp at 13 months, and for non-oil states, 1.99 pp at 10 months after the shock.

Lastly, the response to oil inventory demand shocks differs notably between oil and non-oil states. There is no significant short-term effect for oil states, but unemployment rates begin to increase significantly after 15 months, reaching a peak increase of 1.65 pp three years post-shock. Non-oil states experience a rise in unemployment rates starting as early as 3 months after the shock, escalating continuously up to three years, with the peak increase of 2.59 pp occurring 34 months later.

When it comes to the two subcategories of unemployment rate, from figures **??** - **??**, we learn that the overall increase in oil state unemployment due to an oil supply shock is mostly due to an increase in e2u unemployment rate in the long run. While an oil consumption demand shock, does not affect n2u unemployment rate, it permanently reduces the e2u unemployment rate in oil states. Both e2u and n2u unemployment rates for similar patterns in response to economic activity and oil inventory demand shocks like the national unemployment rate.

4.3.4 Response of state unemployment rates

Figures 5-**??** display the diverse responses of each state to four different structural oil price shocks, all configured to elevate the real oil price by 10% upon impact. To underscore the variation in response magnitudes across states, the left panels in each figure showcase a cross-section of responses at specific horizons. These horizons are selected based on the peak or trough response of either the national or the oil state unemployment rate, which we utilize as reference points in our analysis. The states are arranged from the largest to the smallest response for each shock. Complementing this, the right panels detail the month of maximum effect for each state or the month of minimum response in the case of a trough. This dual-panel setup allows for an in-depth exploration of the magnitude and timing of state-level unemployment responses to each type of oil price shock.

In our previous subsection, we noted that the oil state unemployment response to an oil supply shock reaches its trough at 6 months, with a decline in the unemployment rate of -0.25 percentage points (pp). Therefore, we initially examine the state-level unemployment rates 6 months following an oil supply shock. At this juncture, both national and non-oil state unemployment rates have reverted to their baseline levels. Numerous states exhibit a neutral response to the oil supply shock at this horizon. However, states such as Oklahoma, Texas, Louisiana, and West Virginia demonstrate a notable decrease in unemployment rates. This finding is particularly intriguing when contrasted with Karaki (2018), who did not observe any such decrease in unemployment rates for these states at any horizon.

Interestingly, while we do not include Utah and Louisiana in our categorization of oil states, their inclusion in Karaki's classification strengthens our observation that oil states benefit from oil supply shocks in the short term. West Virginia presents an exceptional case, showing the most significant reduction in unemployment by -0.75pp six months post-shock. This contrasts sharply with Karaki's findings of increasing unemployment rates after an adverse oil supply shock. Karaki's results, citing Brown & Yücel (2013), suggest that West Virginia, with its robust coal industry, benefits from higher oil prices due to a parallel rise in coal prices, leading to increased coal production and employment. While Brown and Yucel's reasoning might hold, it aligns more closely with our results than Karaki's. The right panel of Figure 5 further reinforces our findings, indicating that the horizons of the smallest unemployment responses in West Virginia and similar states occur within 15 months of the shock's impact.

As we recall from Figure 1, oil prices remain elevated for up to two years following an oil supply shock. Turning to Figure ??, which examines the long-term impact of this shock, we find that most states reach their peak response between two and three years post-shock. This pattern is particularly pronounced in oil states. For instance, West Virginia, which initially saw short-term benefits, underwent a notable shift, moving to 15th from the bottom in terms of net response of unemployment to an oil supply shock. Similarly, despite its moderate and initially insignificant gains, New Mexico now ranks just above West Virginia, reflecting a significant long-term impact. In contrast, Louisiana exhibits a stable trend, continuing to show no significant long-term effects and maintaining its position towards the lower end of the impact spectrum. Most states, with a few exceptions, exhibit their peak response to the oil supply shock around the two-year mark. This timeline aligns with the patterns observed at both the national and oil-state levels, where the maximum response typically occurs approximately two years after the shock. Such consistency across various levels of analysis highlights the widespread and lasting nature of oil supply shocks on state economies, underscoring the need for tailored economic strategies to mitigate these impacts.

Figure ?? provides a detailed view of the state-level responses to an economic activity shock at horizon 12, corresponding to the trough observed in the national unemployment rate. This horizon, 9 to 15 months post-impact, is crucial as it captures the peak decrease in unemployment rates across states due to increased oil prices driven by heightened economic activity. Notably, oil prices remain significant for up to 30 months following the shock, underscoring the enduring nature of this impact.

A striking observation from this analysis is that nearly all states exhibit a decrease in unemployment, except Arkansas and Louisiana, which peak at a later horizon. Of particular interest is West Virginia, which stands out with a substantial long-term decrease in unemployment of approximately 4.2 percentage points. This result is noteworthy, as it indicates that West Virginia, traditionally not categorized as an oil state, gains significantly from increases in oil prices linked to economic activity in the long run. Furthermore, the arrangement of states in Figure ?? reveals that oil states are predominantly positioned in the top half of the figure. This placement suggests that oil states, on average, benefit less from oil price increases due to economic activity than non-oil states. This could indicate an economic dynamic, where non-oil states may derive greater relative benefits from economic activities that lead to increased oil prices, possibly due to their diversified economic structures.

In the analysis depicted by the Figure 8, we focus on the response to oil consumption demand shocks, particularly at horizon 21, where the national unemployment rate reaches its trough. A key observation from this plot is the position of almost all oil states at the bottom, indicating that they experience the most significant reductions in unemployment rates in response to these shocks. Among these, New Mexico stands out with the maximum decrease in unemployment, showing a notable reduction of -0.4 percentage points. Interestingly, Texas and Alaska, also oil states, benefit the least from this shock, with their unemployment rates reducing by just -0.2 percentage points.

This pattern suggests that oil consumption demand shocks have a variable impact within oil states, with some states, like New Mexico, experiencing more substantial benefits than others. We could attribute the variation in the extent of these benefits among oil states to differences in their economic structures and their relative reliance on the oil sector. The fact that these states are predominantly clustered towards the bottom of the plot reinforces the idea that oil states, in general, tend to benefit more from oil consumption demand shocks compared to non-oil states, likely due to the direct and indirect employment opportunities these shocks generate within the oil industry.

The final plot in our series, examining the impact of oil inventory demand shocks at horizon 36 (figure ??), reveals a consistent pattern of increasing unemployment rates across 43/51 states. This horizon is particularly significant as it aligns with the peak response for national and oil-state unemployment rates, underscoring the widespread impact of these shocks. Interestingly, states such as Wyoming, Oklahoma, and North Dakota, which are heavily reliant on the oil industry, experienced their most significant increases in unemployment earlier, around the 18-21 month mark. Nevertheless, even at horizon 36, they continue to face considerable increases in unemployment rates, ranging between 2 and 3%.

One critical observation is the short-lived nature of the increase in oil prices due to inventory demand, which subsides within a month. This rapid decline warrants a cautious interpretation of our results, as the prolonged impact on unemployment contrasts with the transient nature of the price shock. Michigan and Alabama stand out in this analysis, exhibiting the highest increases in unemployment rates of approximately 6% at horizon 36.

This analysis of oil inventory demand shocks paints a complex picture. While the direct impact on oil prices is transitory, the effects on state unemployment rates are more persistent and pronounced. This discrepancy highlights the intricate relationship between oil market dynamics and broader economic indicators like unemployment, especially in states with significant oil industry presence or other economic dependencies related to oil prices.

From **??** and **??**, we see oil states at the bottom of the e2u unemployment rate and at the top of n2u unemployment rate. In response to oil inventory demand shocks, we see that both components of the unemployment rate increase at the end of 3 years.

As we draw our results section to a close, it is crucial to highlight some specific state-level observations. With its significant petrochemical industry, Louisiana exhibited an insignificant response to our economic activity shock. This finding aligns with Karaki's (2018) analysis, suggesting that petrochemical industries in Louisiana and Texas might not benefit from rising oil prices due to their negative impact on petrochemical production. Similarly, Delaware, another state with a notable petrochemical industry, showed a muted response to oil consumption demand shocks and, at the same time, was among the states with the slightest increase in unemployment rate due to oil inventory demand shocks.

These state-specific responses underscore the intricate interplay between different sectors within regional economies and how they mediate the impact of oil price shocks. While some oil states displayed pronounced responses, others, like Louisiana and Delaware, had more subdued reactions, indicating that the effects of oil price fluctuations are different even within states that share specific economic characteristics.

4.4 Conclusion

In conclusion, our comprehensive analysis reveals the complex yet enlightening impacts of structural oil price shocks on oil prices and unemployment rates across the United States. We have uncovered significant variations in responses at both the national and state levels, highlighting the intricate interplay between global oil market dynamics and local economic conditions. At the national level, the impacts on unemployment rates varied depending on the nature of the oil price shock. We observed marginal increases in unemployment following oil supply shocks, notable decreases due to economic activity shocks, and increases in response to oil inventory demand shocks. Our state-level analysis provided further insights, revealing how regional economic structures and industry compositions significantly influence local labor market reactions to these global shocks. Particularly interesting were the diverse responses within oil states. While some exhibited pronounced reactions to oil price shocks, others showed more subdued responses. Notably, the short-term impact of oil supply shocks on some oil states was less intense than anticipated. We find that most of the unemployment rate fluctuations are explained by the e2u unemployment rate and very little is explained by movements from outside labor force.

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Appendix

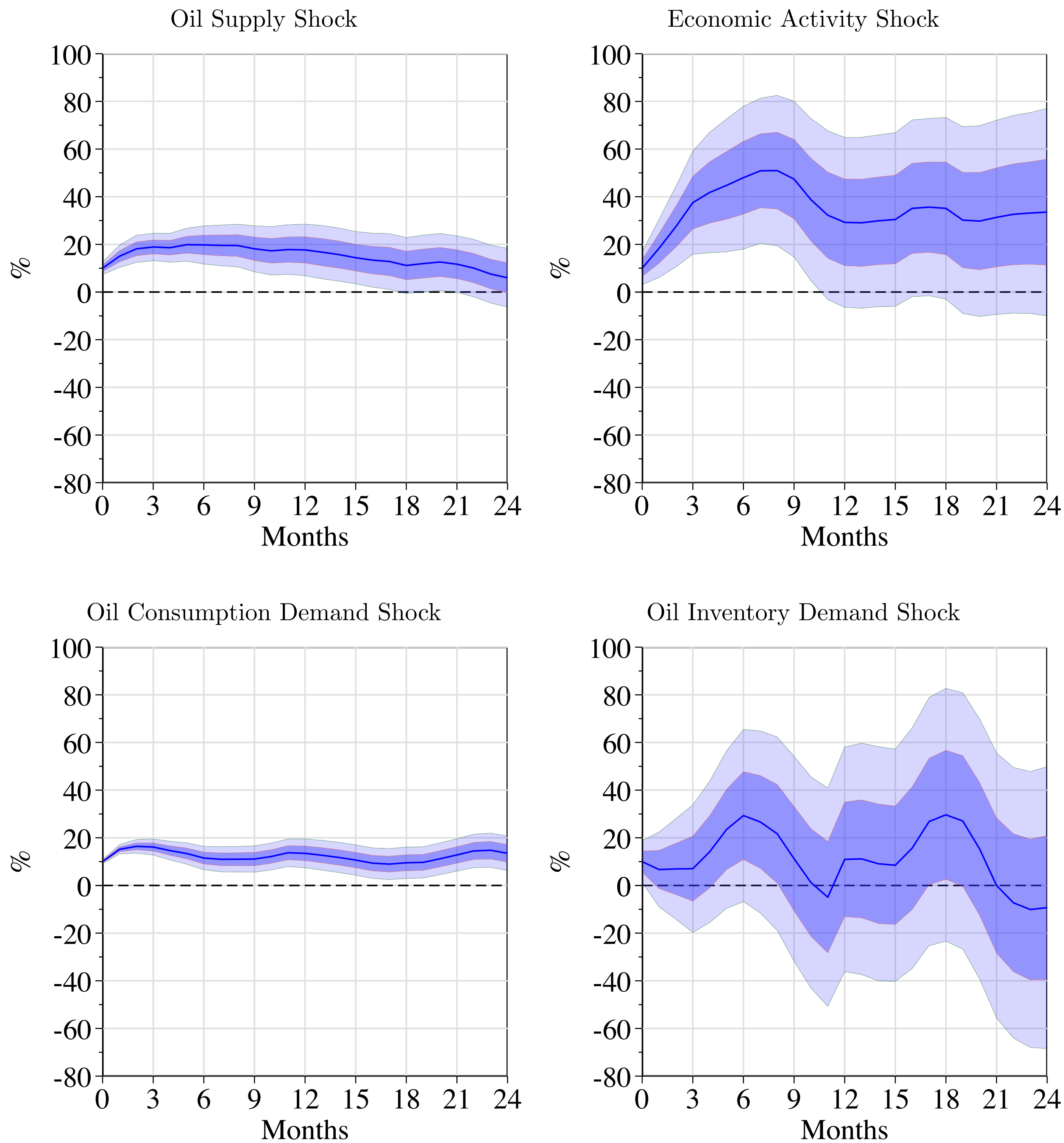

Figure 1: Responses of the real oil price to exogenous oil price shocks.

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

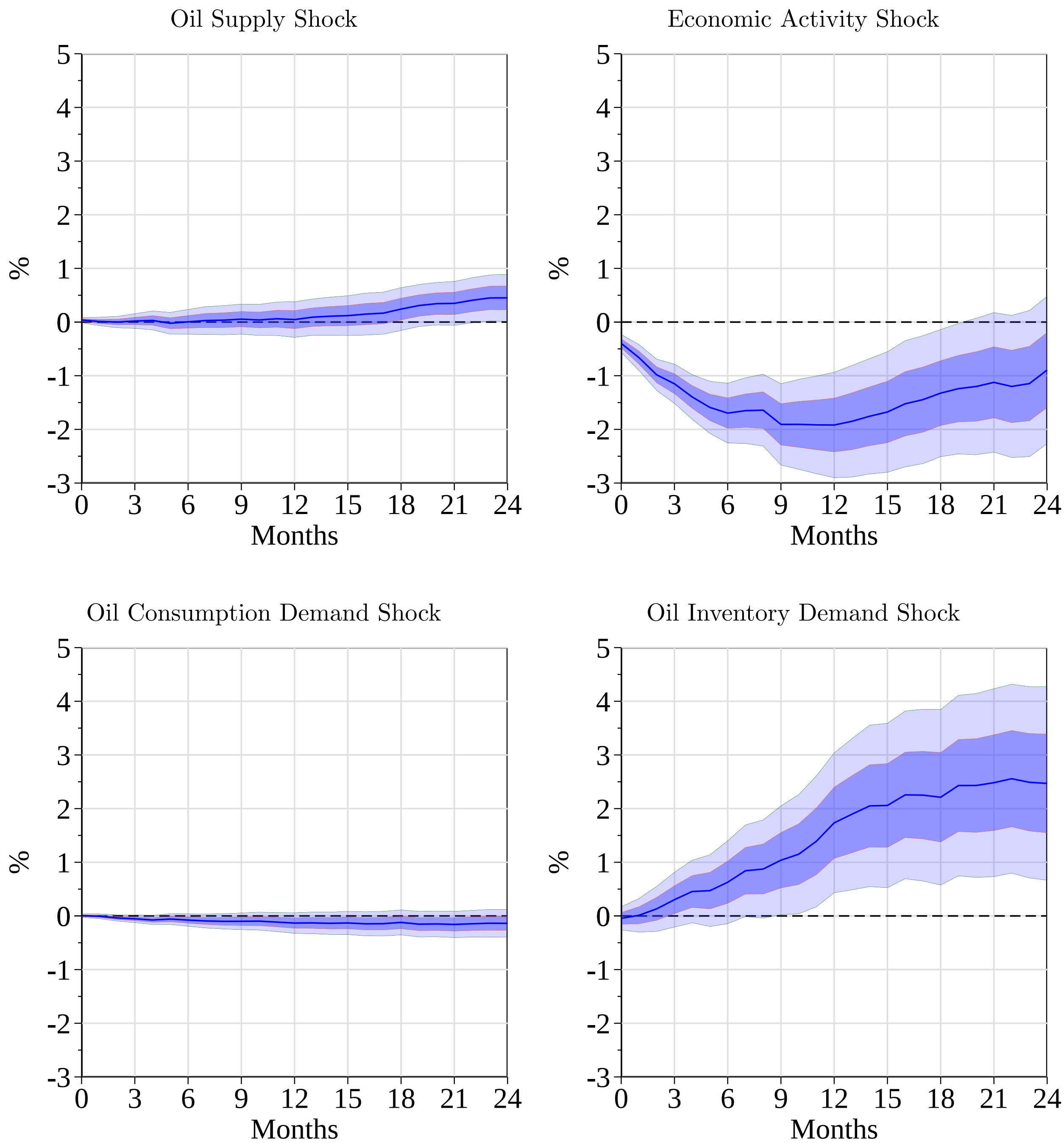

Figure 2: Responses of the national unemployment rate to exogenous oil price shocks.

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

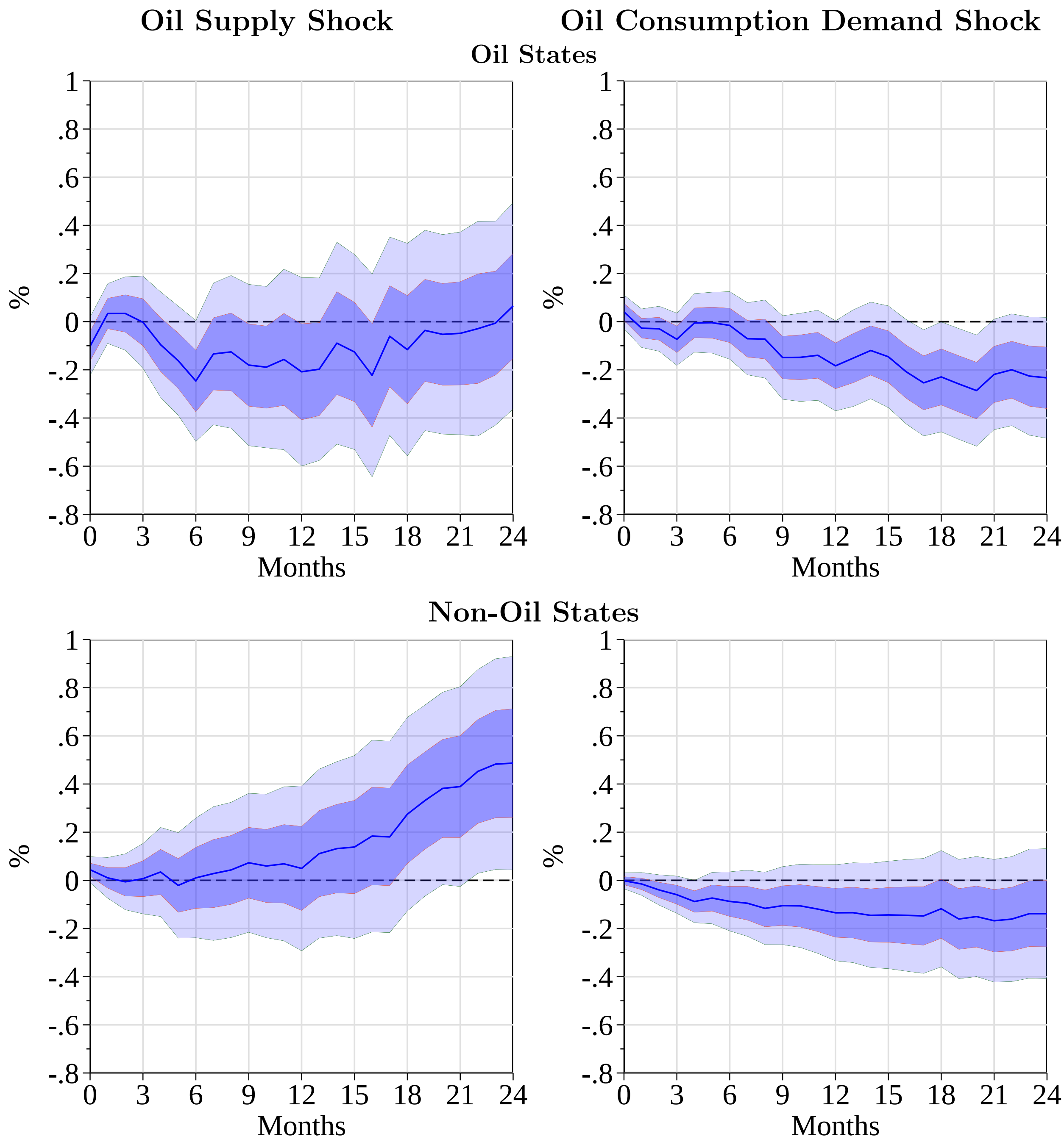

Figure 3: Responses of the oil-state level unemployment rate to exogenous oil price shocks.

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

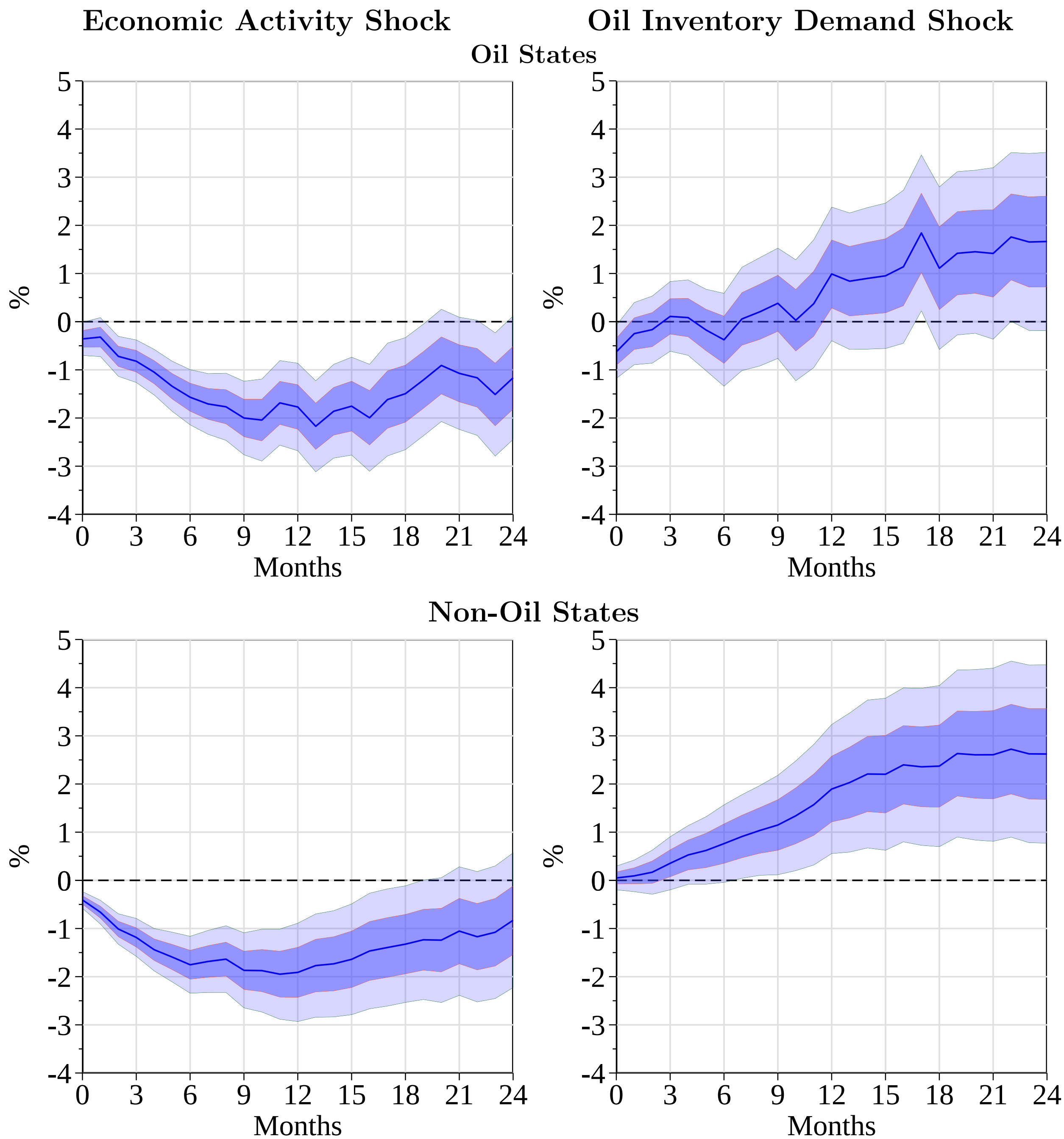

Figure 4: Responses of the oil-state level unemployment rate to exogenous oil price shocks.

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

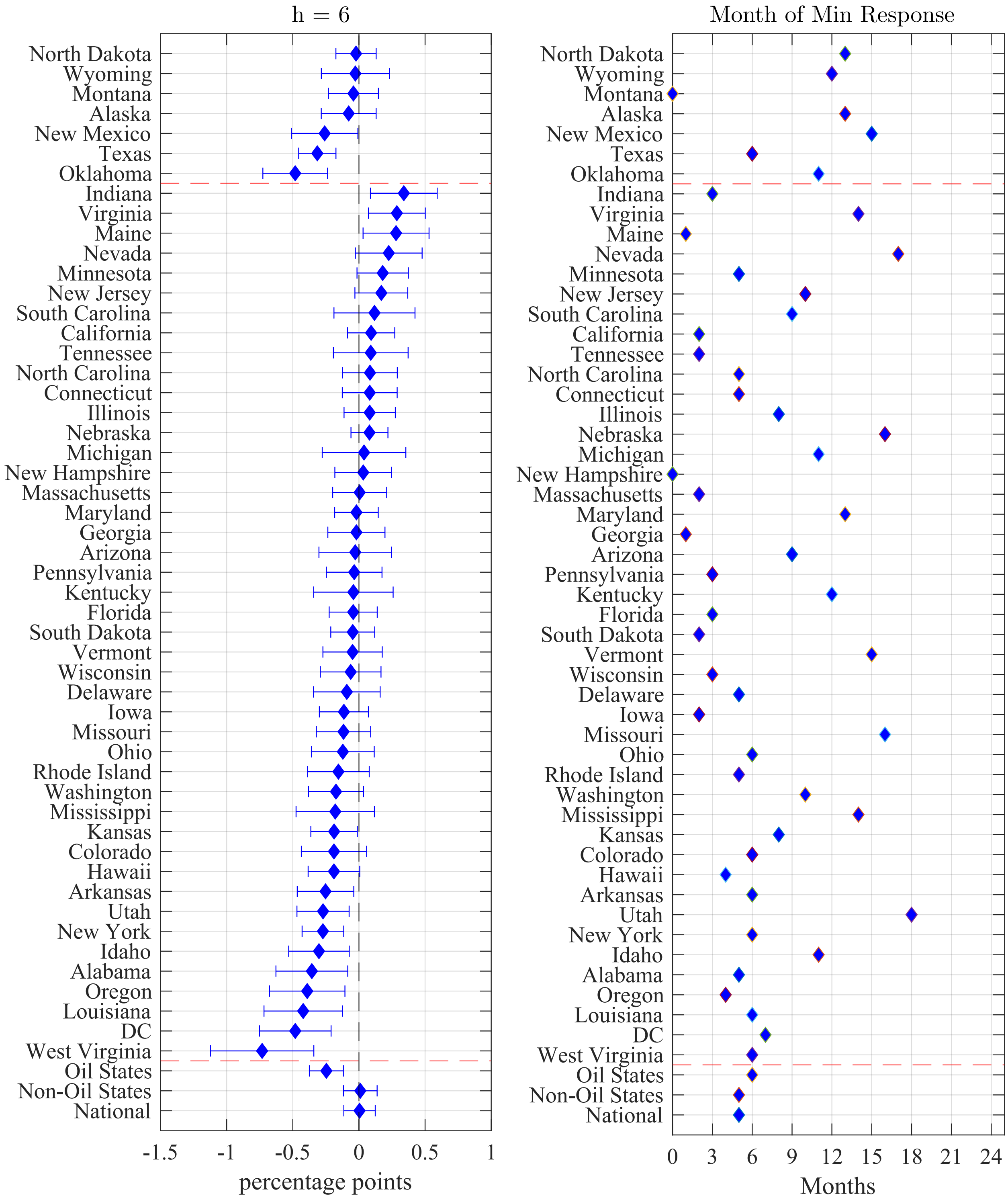

Figure 5: Responses of the state unemployment rates to an adverse oil supply shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. In the left panel, the diamonds represent the point estimates with 68 percent confidence intervals calculated using Eicker-Huber-White robust standard errors. In the right panel, the diamonds indicate the month of minimum response of the state's unemployment rate.

Figure 6: Responses of the state unemployment rates to an adverse oil supply shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. In the left panel, the diamonds represent the point estimates with 68 percent confidence intervals calculated using Eicker-Huber-White robust standard errors. In the right panel, the diamonds indicate the month of maximum response of the state's unemployment rate.

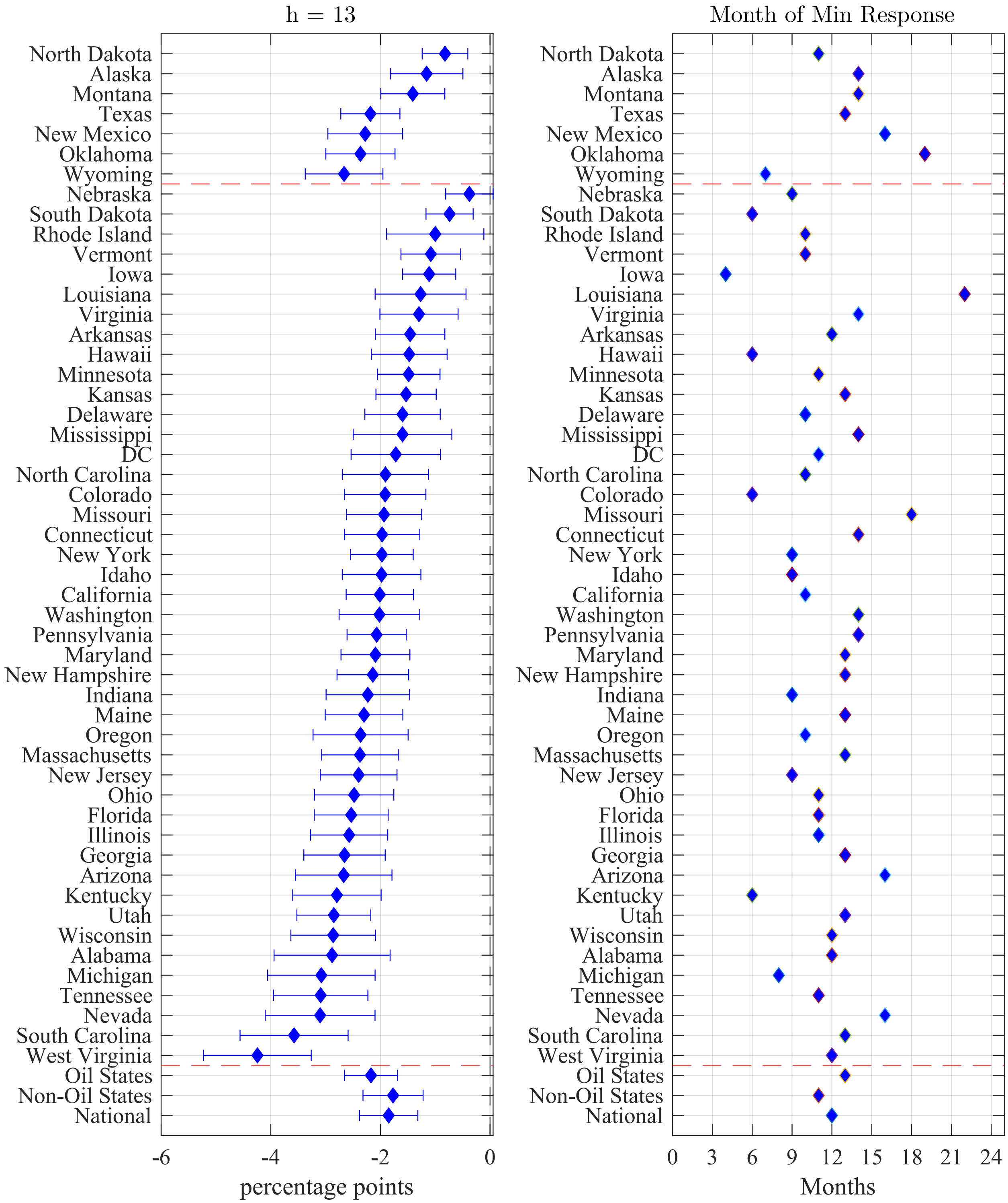

Figure 7: Responses of the state unemployment rates to an economic activity shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. In the left panel, the diamonds represent the point estimates with 68 percent confidence intervals calculated using Eicker-Huber-White robust standard errors. In the right panel, the diamonds indicate the month of minimum response of the state's unemployment rate.

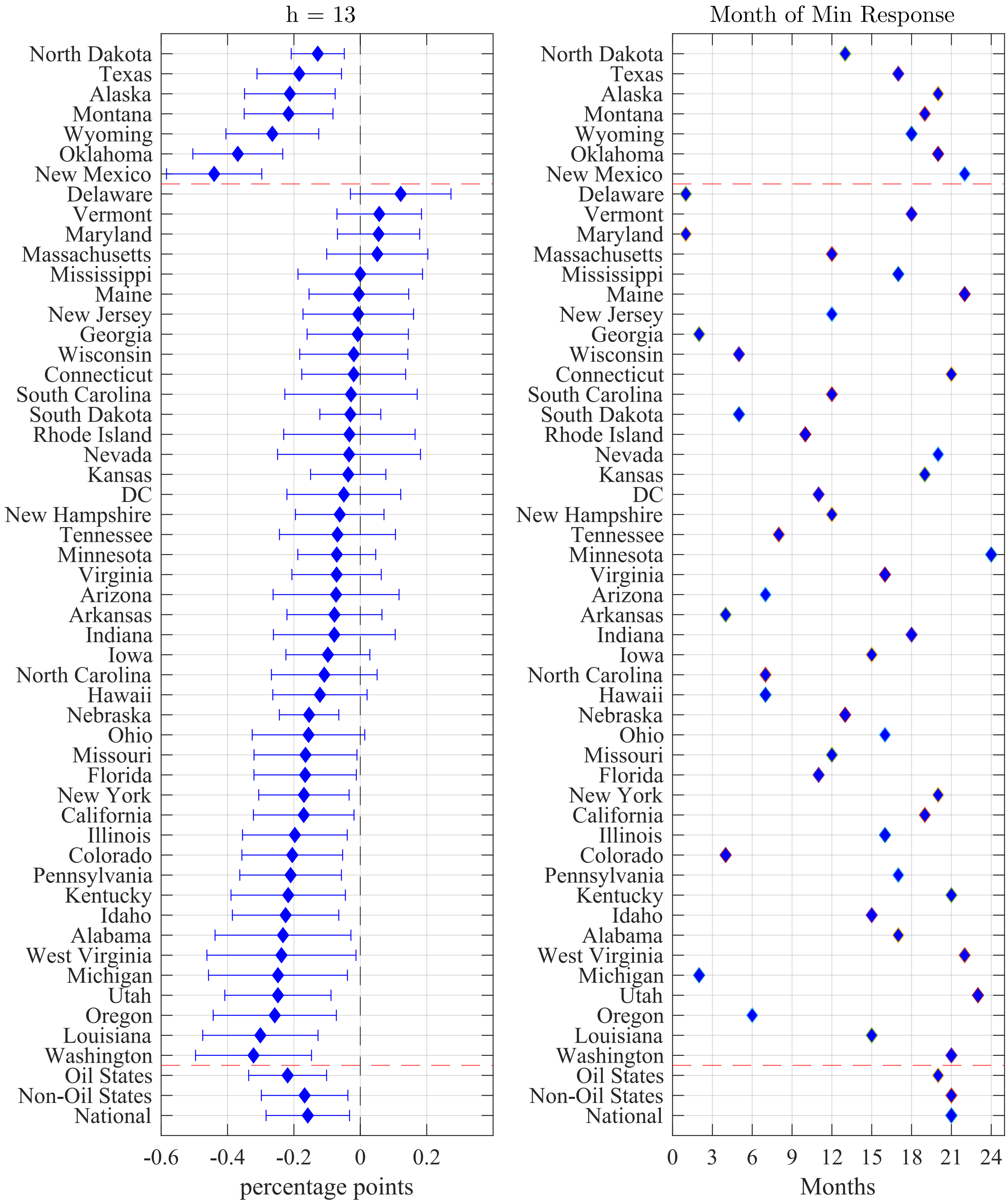

Figure 8: Responses of the state unemployment rates to an oil consumption demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. In the left panel, the diamonds represent the point estimates with 68 percent confidence intervals calculated using Eicker-Huber-White robust standard errors. In the right panel, the diamonds indicate the month of minimum response of the state's unemployment rate.

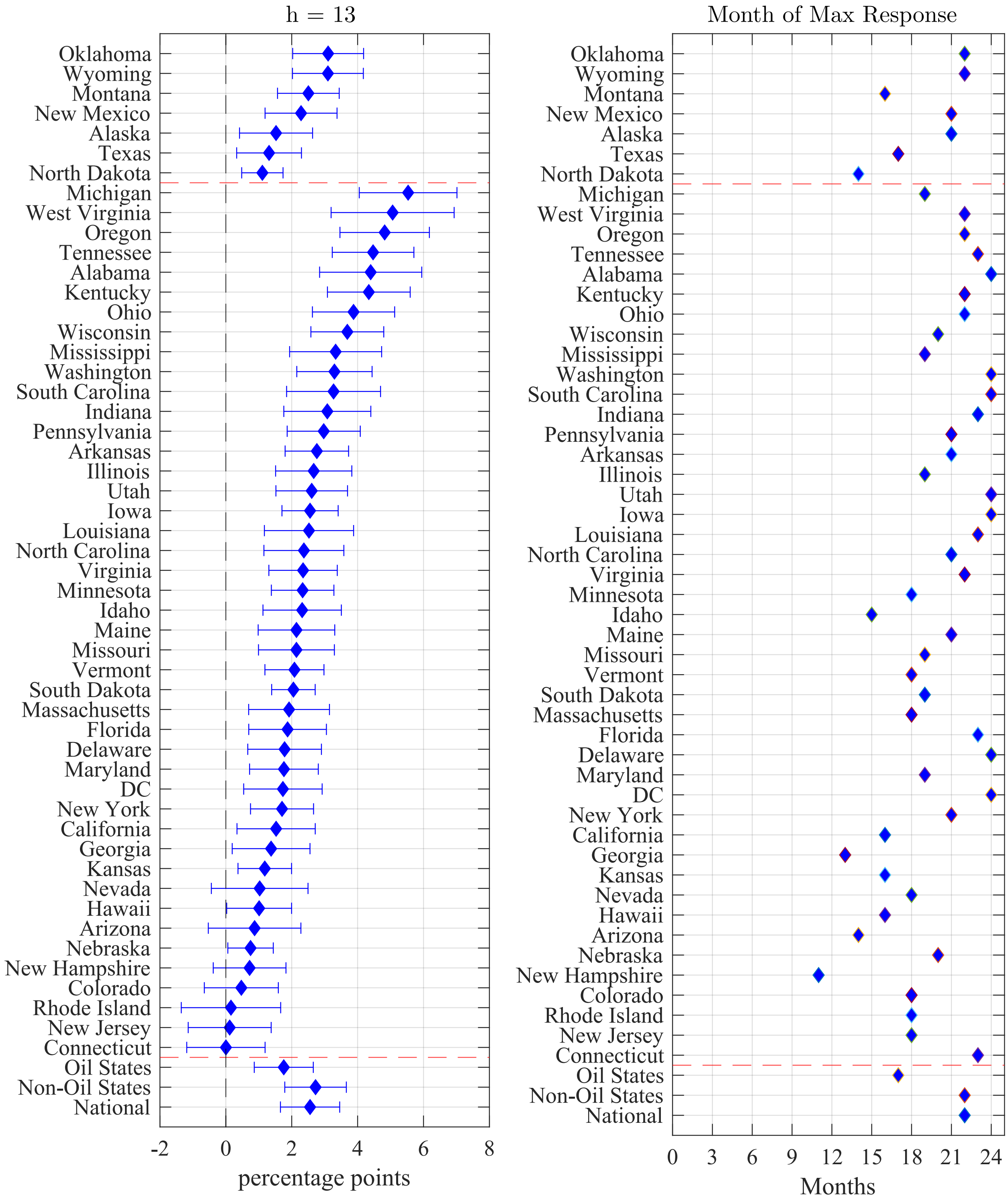

Figure 9: Responses of the state unemployment rates to an oil inventory demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. In the left panel, the diamonds represent the point estimates with 68 percent confidence intervals calculated using Eicker-Huber-White robust standard errors. In the right panel, the diamonds indicate the month of maximum response of the state's unemployment rate.

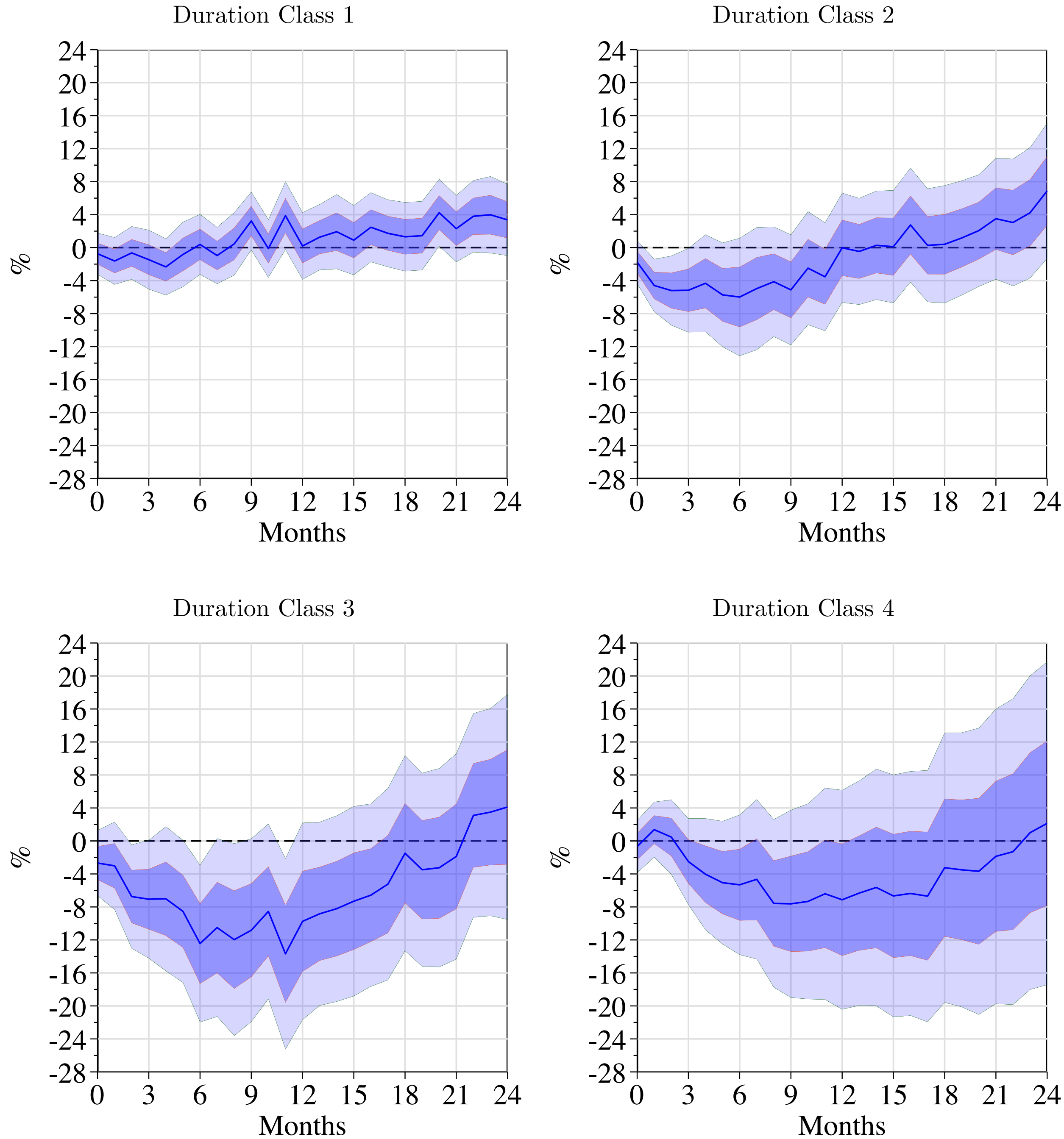

Figure 10: Responses of national-level unemployment duration classes to an adverse oil supply shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

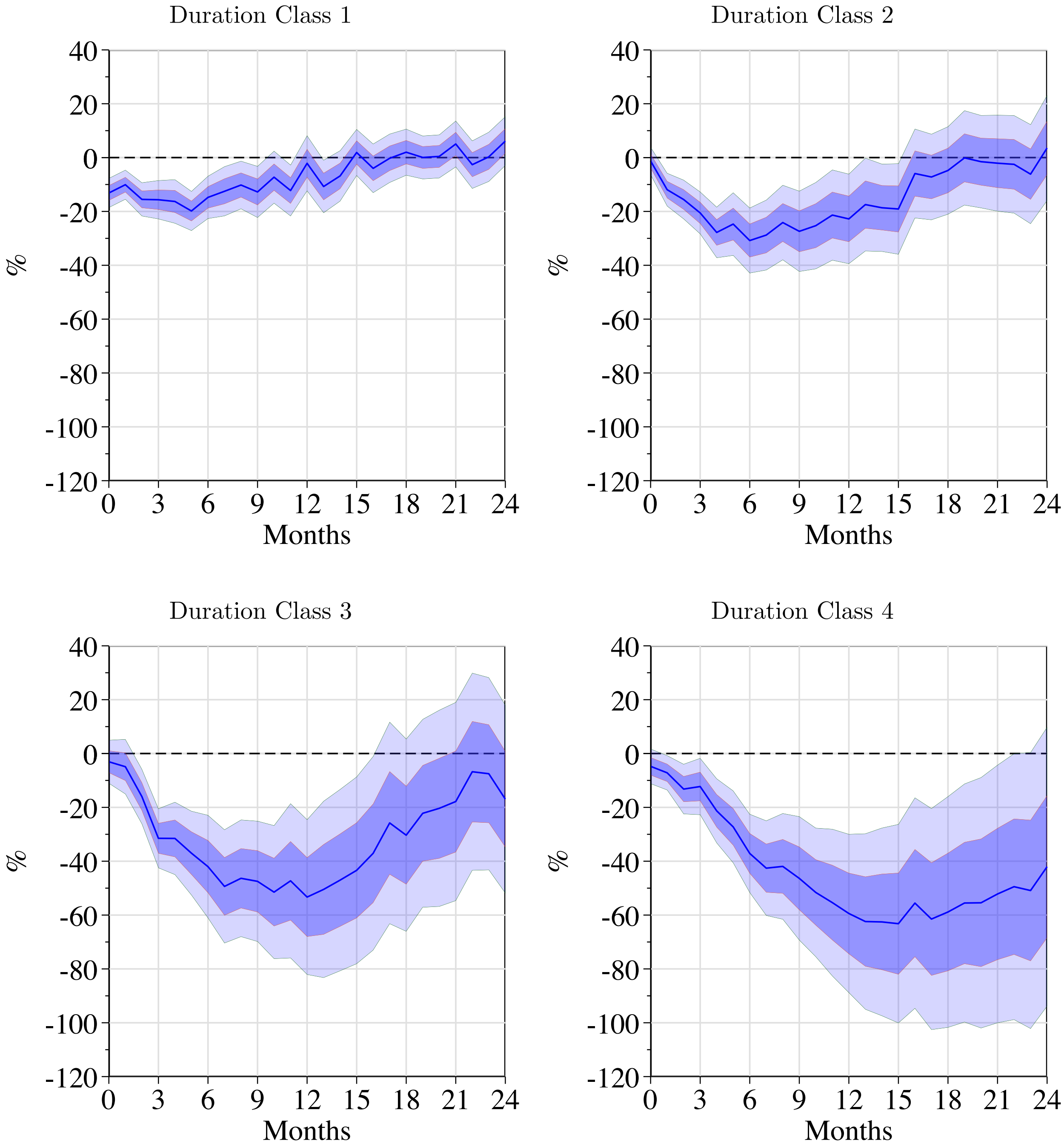

Figure 11: Responses of national-level unemployment duration classes to an economic activity shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

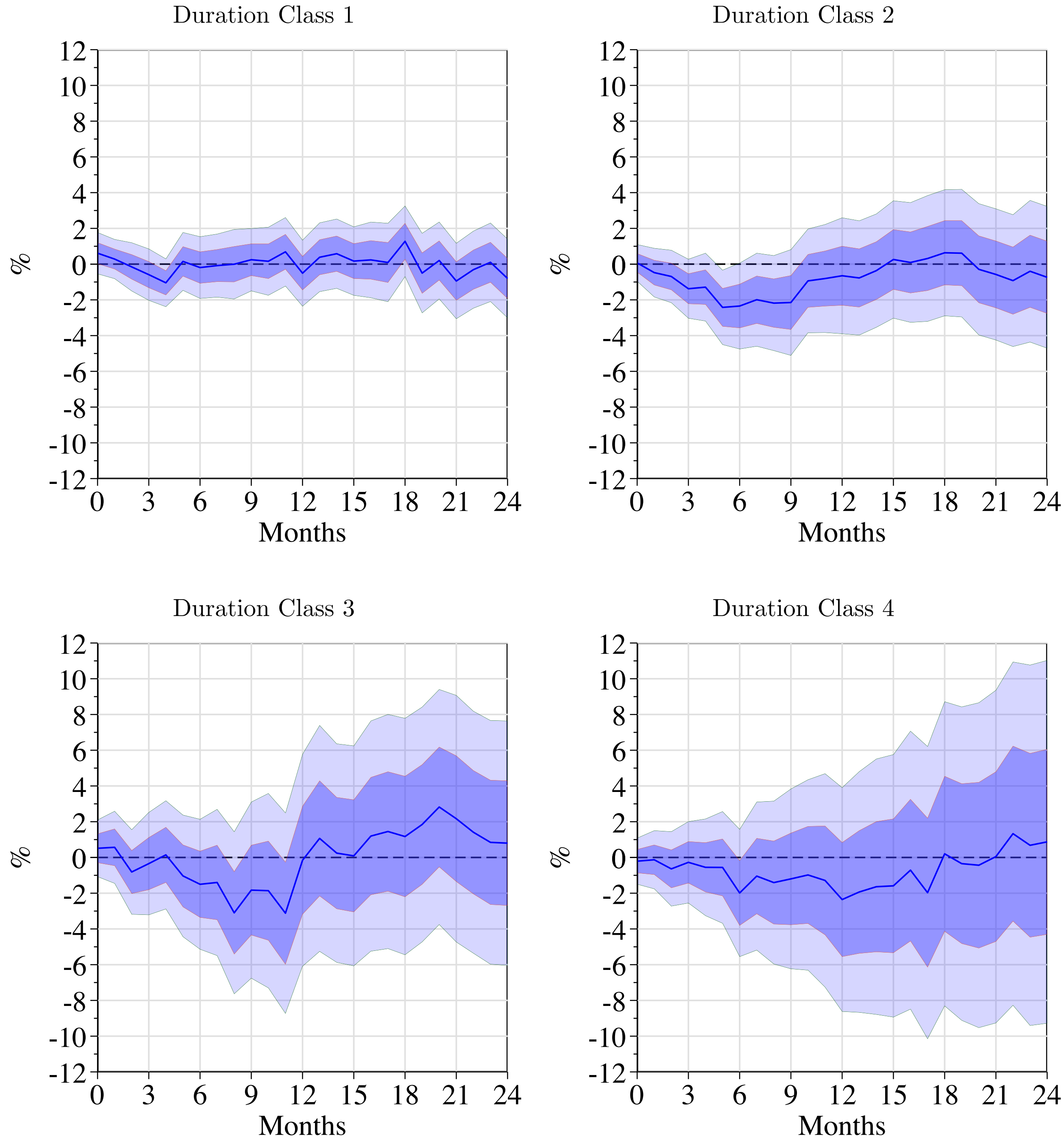

Figure 12: Responses of national-level unemployment duration classes to an oil consumption demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

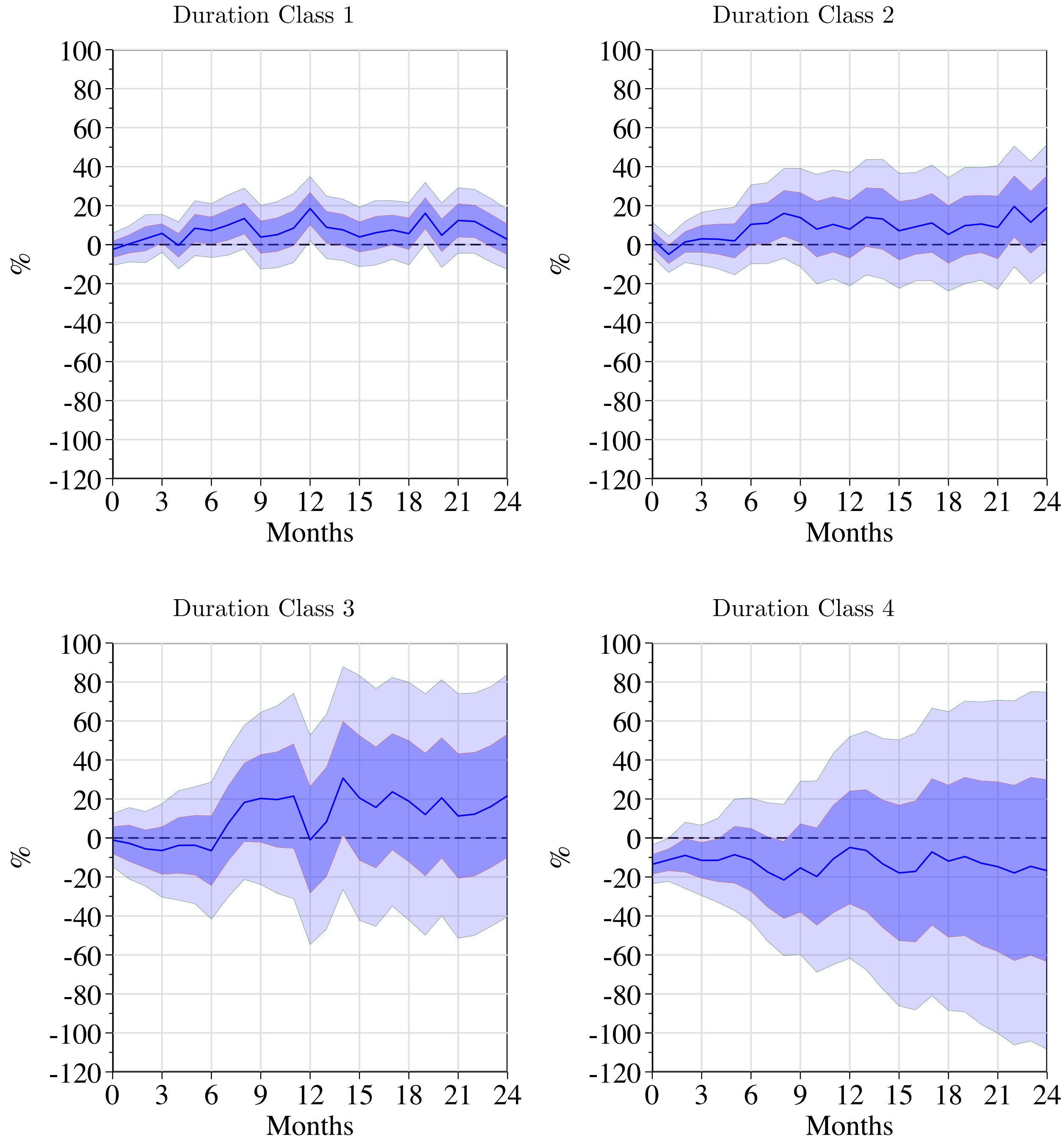

Figure 13: Responses of national-level unemployment duration classes to an oil inventory demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

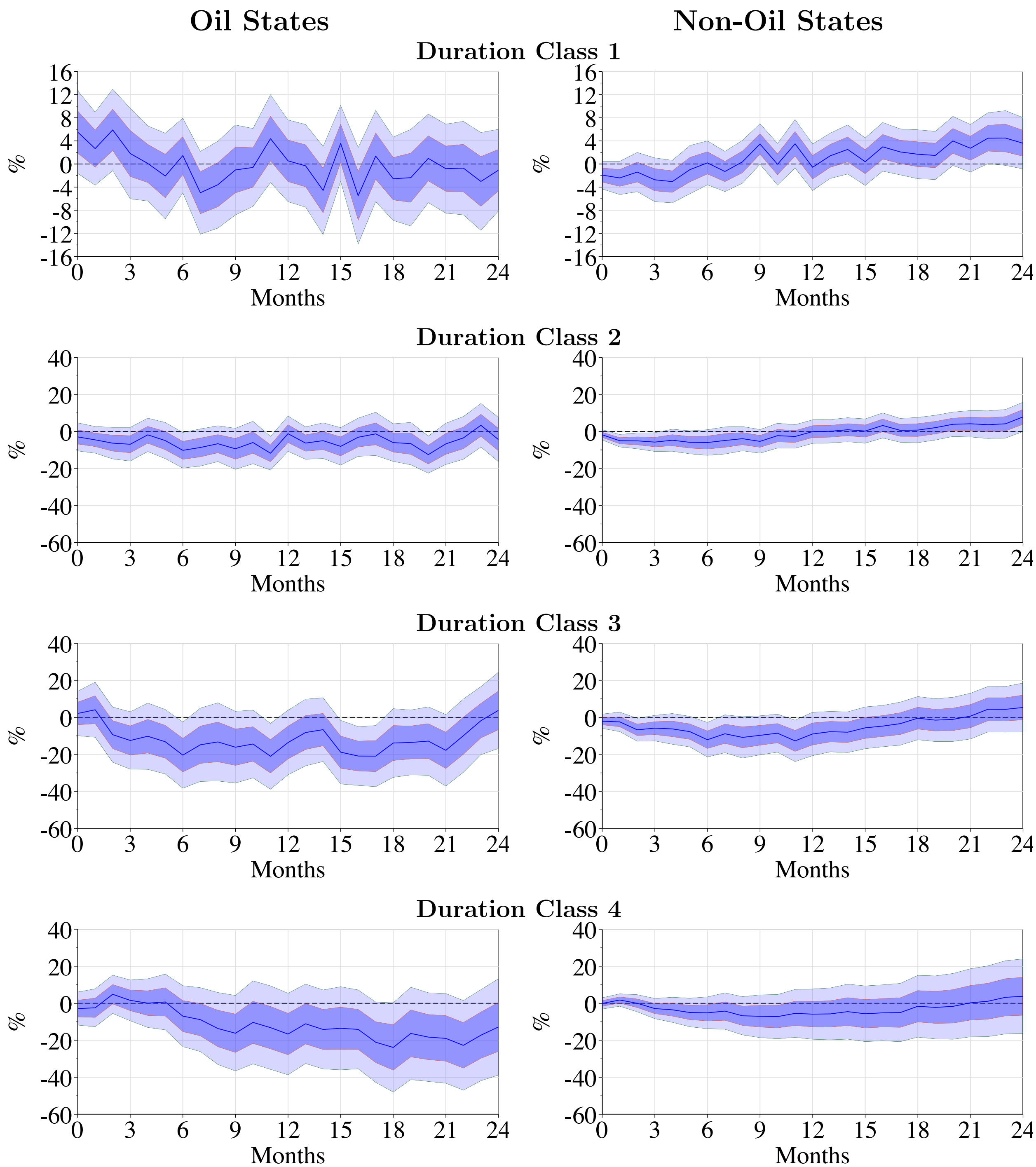

Figure 14: Responses of oil-state-level unemployment duration classes to an adverse oil supply shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

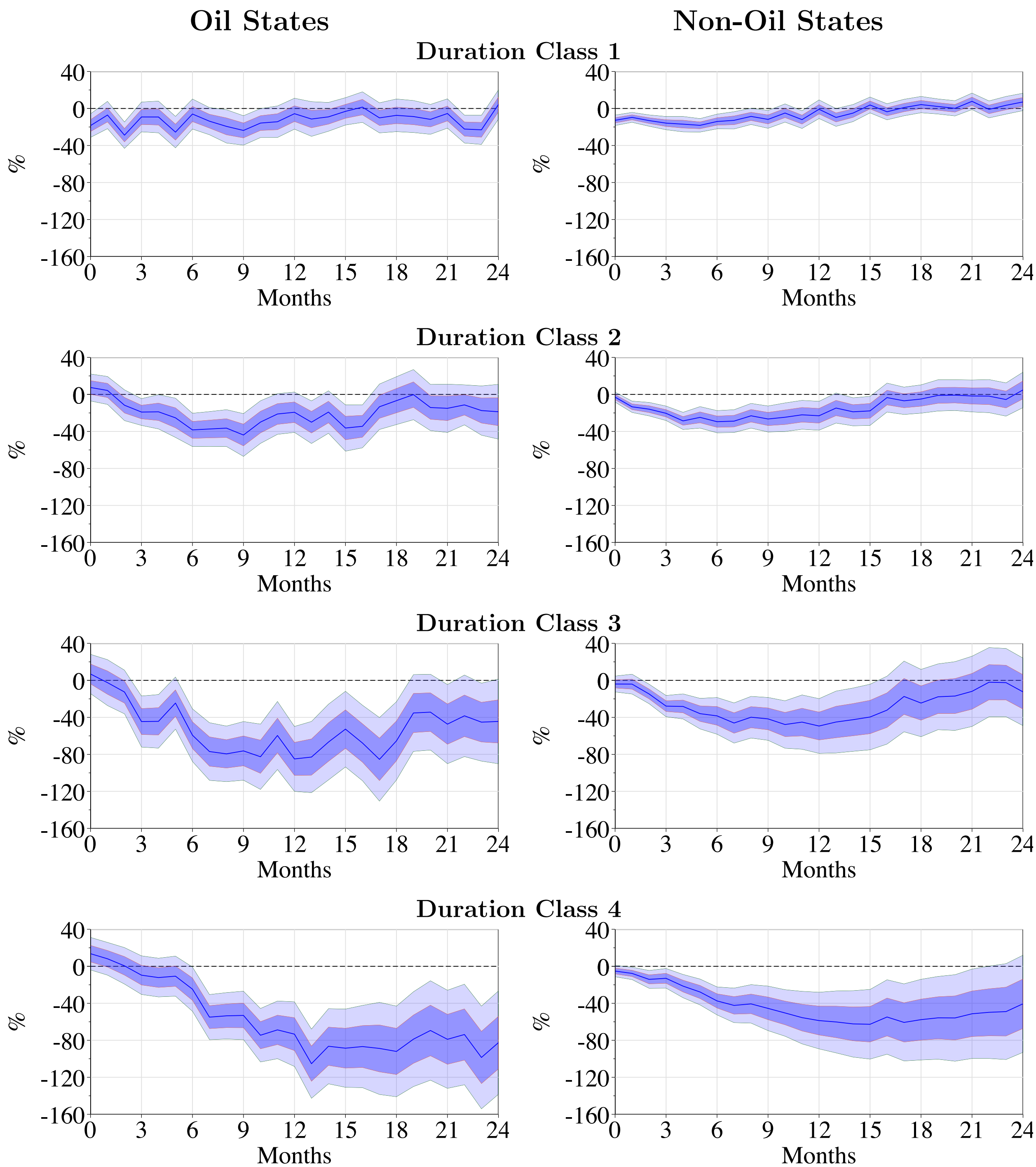

Figure 15: Responses of oil-state-level unemployment duration classes to an economic activity shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

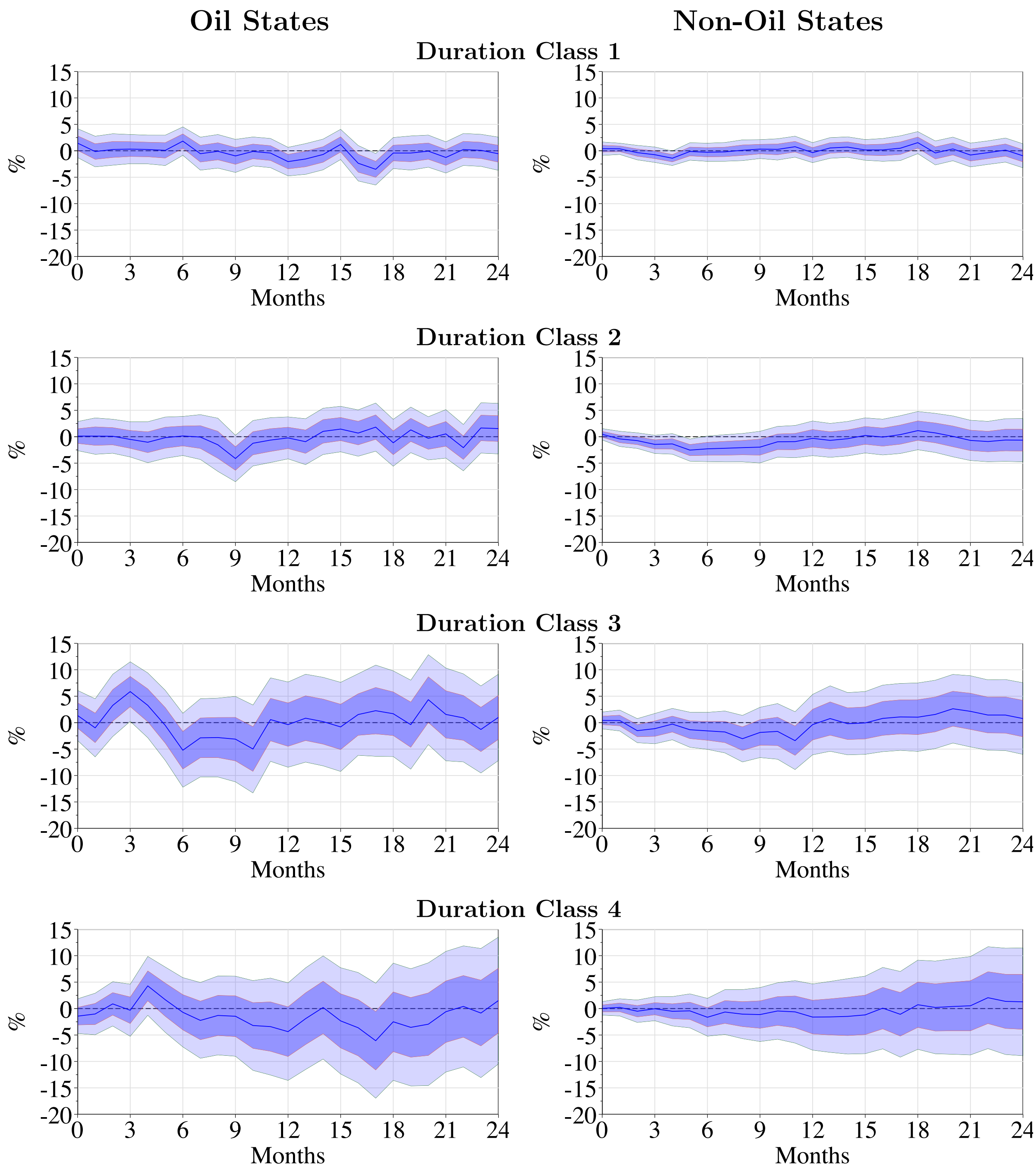

Figure 16: Responses of oil-state-level unemployment duration classes to an oil consumption demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.

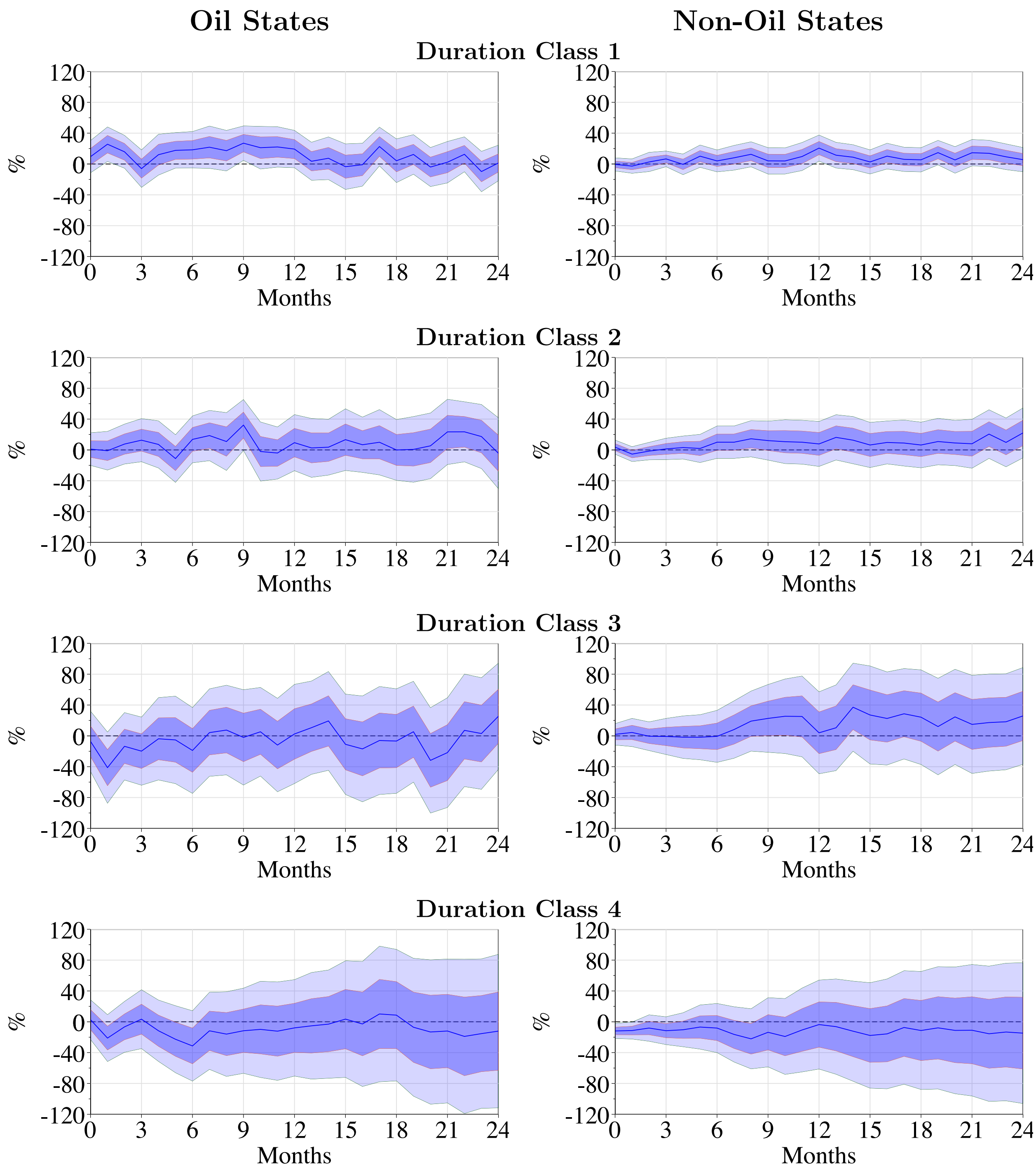

Figure 17: Responses of oil-state-level unemployment duration classes to an oil inventory demand shock

Notes: Impulse responses are normalized to increase the real price of oil by 10 percent on impact. The solid line is the point estimate, and the dark and light-shaded areas are 68 and 95 percent confidence bands, respectively, calculated using Eicker-Huber-White robust standard errors.