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To tax or to spend? Modelling tax policy responses to oil price shocks

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ABSTRACT

Global crude oil prices surged in 2022 due to geopolitical conflicts, raising living costs worldwide. In response, policy measures such as fuel excise cuts and energy profits levies have been adopted by policymakers worldwide. We assess the efficacy of these two fiscal policy responses to temporary supply-side oil price shocks, using a dynamic general equilibrium model with rich fiscal and industry detail. Our focus is Australia, a distinctive country that functions both as an oil importer, and a liquefied natural gas (LNG) exporter. This dual role amplifies the inflationary pressure for Australian households and industries caused by an oil price rise, because the domestic LNG industry is largely foreign-owned and capital intensive. Inflated profits therefore flow offshore, and little of the terms of trade gain stemming from the oil-indexed LNG export price accrues to domestic economic agents. We find a temporary fuel excise cut can limit GDP and employment losses, but its effectiveness in relieving household cost-of-living pressure comes at the cost of increased net foreign debt. Higher oil prices also weaken the case for this policy from an allocative efficiency perspective. In contrast, an energy profits levy can stimulate national income without compromising the budget.

1. Introduction

The economic disruptions following Russia's invasion of Ukraine in 2022 caused a spike in world oil prices. Brent crude oil prices rose to over $US100/barrel for five months, and trough to peak, crude oil prices rose by approximately 50%. Historical patterns suggest that geopolitically-generated oil supply disruptions and price surges affect global economies via a series of channels, including increases in energy prices and import prices (and thus terms of trade losses), and contractions in industry output (Hamilton, 2013).

Policymakers face two questions when deciding how to respond to supply-side oil price shocks like this. First, what types of fiscal measures can provide relief when oil prices rise? Second, of the available responses, which are most effective in mitigating the economic damage from oil price shocks? As discussed by Peersman and Van Robays (2012), oil supply shocks affect nations differently depending on their energy industry composition. Hence, the answers to these questions are conditional on a country's energy structure. For this reason, energy and industry structure details are of great importance when studying oil price shocks and fiscal responses.

Different fiscal responses to the recent oil supply shock were evident, particularly across oil-importing and energy-exporting countries. For oil-importers, particularly in Europe, fuel excise reductions were widely adopted (Celasun et al., 2022). Aimed at temporarily counteracting the impact of oil price pass-through on final fuel prices, this measure can be implemented quickly. However, its inherent fiscal cost makes it hard to sustain if the oil shock persists, limiting its appeal for jurisdictions facing fiscal pressures (Mork et al., 1994; Celasun et al., 2022). Policymakers in some energy-exporting countries instead focused on taxing the windfall profits of energy producers, using proceeds to fund household support payments. For example, targeting fossil fuel extraction sectors, the UK government introduced a temporary Energy Profits Levy on oil and gas profits in 2022 (Seely, 2022). Some European countries also imposed temporary windfall taxes on electricity producers. See the summary and discussion by Vernon and Baunsgaard (2022).

Australia has significant natural gas reserves and is among the top liquefied natural gas (LNG) exporters in the world. Australia exports its gas in the form of LNG mainly to the Asian-pacific market, where prices are explicitly linked to oil prices through long-term contracts with a lag of three to six months (Cassidy and Kosev, 2015).[1] As a consequence of this oil price indexation, unlike other regional gas markets, gas prices in the Asian market are inextricably linked to world oil prices (Zhang et al.,

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[1] Unlike the unified international crude oil market, the global natural gas market is segmented into three major regional markets with very different pricing mechanisms (Bachmeier and Griffin, 2006; Ji et al., 2014).

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2018). This is also known as the "oil-gas price linkage" and means that global oil price fluctuations directly pass through to Australian LNG export prices and domestic gas prices. This amplifies inflationary pressures felt by Australian households when global crude oil and thus refined petroleum prices rise, while in contrast Australian LNG exporters potentially realise super-normal profits. These super-normal profits largely flow offshore however, with the Australian LNG industry characterised by high levels of foreign direct equity investment (Cassidy and Kosev, 2015).

In recent years, Australia has significantly reduced its domestic oil production capacity and become more reliant on foreign imports of both crude oil and refined petroleum. This is juxtaposed against its position as one of the largest non-oil energy exporters in the world. Net oil-importing and non-oil-energy-exporting countries like Australia face distinct economic consequences when confronted by oil supply shocks, compared to other developed economies (Peersman and Van Robays, 2012).

In response to recent oil price surges, in March 2022 the Australian government imposed a temporary 50% fuel excise cut.[2] This debt-financed cut cost about AUD$5.7 billion in foregone revenue (Commonwealth of Australia, 2022). This policy was accompanied by public debate over whether the Australian government should strengthen its existing system of petroleum resource rent taxation or introduce a tax on windfall gains made by energy companies.

In this paper, we compare the economic impact of two fiscal policy responses to temporary oil price shocks: (i) a temporary 50% fuel excise cut; and, (ii) a temporary 25% energy profits levy. Using a dynamic computable general equilibrium (CGE) model of Australia with high levels of fiscal and industry detail, we unpack the channels through which oil supply shocks impact oil-importing and non-oil-energy-exporting economies like Australia, and study the effectiveness of the two policies to damp these channels. While many countries responded to the 2022 oil price shock in similar fashion, the magnitude of the fuel excise cut and energy profits levy we impose are predicated on the responses in Australia and the UK, respectively. Henceforth, for brevity we refer to the fuel excise cut as FEC and the energy profits levy as EPL.

Our study is structured as follows. To begin, we describe the economic consequences of a one-year oil price spike in Australia, both at the aggregate macroeconomic and sectoral levels. In so doing, we disentangle the impacts of the increase in imported crude oil prices, from the effect of higher LNG export prices for Australia. Our modelling approach facilitates an analysis of the dynamic adjustment path: regarding the direct impacts of the oil price rise, we find that a 50% oil price shock generates a shock-year 0.29 percentage point rise in Australia's unemployment rate relative to baseline. This translates to a fall in private consumption of 0.51%, and a contraction in real GDP of 0.24% relative to baseline. The damage is damped by real currency depreciation and an increase in net exports. The improvement in international competitiveness suggests that export-oriented industries, such as Australia's mining sector, benefit from oil price shocks, while the impact on other industries is dependent on their level of energy intensity. Ceteris paribus, as the shock unwinds, so too do the economic impacts, with the return to baseline influenced by short-run investment shortfalls relative to baseline.

We then examine the degree to which higher LNG export prices might alleviate the adverse impacts on the Australian economy of an oil price shock. When LNG export prices are linked to crude oil prices, two countervailing forces affect Australia's terms of trade. On the one hand, higher global crude oil prices drive up Australian import prices, putting downward pressure on the terms of trade. On the other hand, higher LNG export prices act to offset this effect, improving the terms of trade.

The gain to national income from this latter effect is however diluted, for three reasons: (1) the relatively low labour intensity of the LNG industry, which damps the degree to which higher LNG prices translate to real wage gains; (2) the LNG industry is largely foreign-owned, and hence higher profits manifest as increased foreign capital income outflows rather than higher real national income; and, (3) higher domestic gas prices, which, in the presence of high foreign ownership, essentially act as a negative terms of trade shock [see Giesecke et al. (2021b)].

Building on the oil price shock scenario, we present policy scenarios modelling two alternative fiscal policy responses: FEC and EPL.

We find that an FEC can assist in reducing the impact of an oil price shock on real GDP, but the effect on private consumption depends on how the policy is financed. If households bear the fiscal costs of a budget-neutral policy (FEC-BN), for example via temporary increases in direct taxation or reduction in welfare payments, the policy will not be effective in easing the cost-of-living pressure for households. In contrast, a deficit-financed fuel excise cut (FEC-DF) cushions the short-term impact of the temporary oil supply shock on private consumption, but at the cost of higher future interest payments and a dampened economic recovery path.

To complement the analysis, we examine the merit of an FEC from an allocative efficiency perspective. Following Nassios et al. (2019b), we derive the "marginal excess burden" (MEB), a common measure of the economic damage of a tax, and find the efficiency gain from an FEC is relatively small. As Australian fuel excise is a specific tax levied at a fixed rate per litre of fuel, higher oil prices act as an implicit self-cut in its ad-valorem equivalent tax rate, diminishing the efficiency gain of an FEC. Our findings highlight that, on standard tax efficiency grounds, the argument for lowering fuel excise is weaker when oil prices are higher.

In contrast to our analysis of an FEC, we find increased direct payments to households financed via an EPL on the oil, gas and LNG industries would effectively smooth the damage of the oil price shock for households without costing the budget, reorienting part of the windfall financial gains due to high energy prices from foreign-owned LNG producers to domestic households. To account for different perspectives on the potential impact of the EPL, we explore two scenarios with different investment assumptions: one where energy sector investment remains unresponsive to the temporary oil and policy shocks, and another where energy sector investment is return-sensitive. From an economic welfare perspective, our study suggests an EPL could serve as a valuable tool for policymakers seeking to respond to surges in world energy prices.

This paper contributes to the literature in several ways. First, we advance the understanding of how a country's energy demand-and-supply profile can lead to distinctive economic consequences during times of oil price shocks. Second, we elucidate the channels through which fiscal measures alleviate the damage to the economy and households caused by oil price shocks. Third, this study adds to the literature on taxation efficiency by estimating the MEB of fuel excises.

The remainder of this paper is organised as follows. Section 2 reviews the literature. Section 3 outlines the model and scenarios. Section 4 presents and discusses the main results. Section 5 concludes.

2. Literature review

Following the influential work by Hamilton (1983), an extensive body of literature discusses the impact of oil price shocks from the demand- and supply-side, and highlights the importance of understanding the causes of such shocks [see, for example, Kilian (2009), Aastveit et al. (2015), Bastianin et al. (2016), Cunado et al. (2015) and Peersman and Van Robays (2012)]. Kilian (2009) uses a structural vector autoregressive (VAR) model and finds that unanticipated oil price rises can lead to distinct economic consequences conditional on the source of a shock. Cunado et al. (2015) extend such findings to four Asian countries: Japan, Korea, India and Indonesia. Aastveit et al. (2015) use a

[2] From 30 March 2022, Australia's federal government halved the fuel excise rates for petrol, diesel and all other fuel and petroleum-based products except aviation fuels, reducing the excise rate from 44.2 cents to 22.1 cents per litre for six months.

factor-augmented vector autoregressive (FAVAR) model and examine the effects of structural oil shocks on 33 countries, including 18 developed and 15 emerging countries. They find that different geographical regions respond differently to oil market shocks that raise oil prices.

Previous studies of oil price shocks predominantly focus on modelling macroeconomies, with the above-mentioned studies relying on VAR and extended VAR models.[3] However, the interpretation of findings in these papers often references the structure of the energy industry, indicating that a more thorough investigation of the industrial dimension is warranted. For example, Peersman and Van Robays (2012) use a structural VAR model and find substantial asymmetrical effects of oil supply shocks across industrialised countries, highlighting the importance of industry structure. Cunado et al. (2015) discuss their findings on the impact of oil shocks in Korea and Japan, referring to changes in energy structure. Their modelling is however largely silent on industry details. We unpack this by employing a dynamic CGE model with rich industry detail. Using this industry detail, we highlight how country-specific energy structure not only shapes an economy's responses to an oil price shock, but also dictates which fiscal measures might be potentially available and beneficial.

CGE models, with their emphasis on industry detail, have a long history in the realm of government policy assessment (Dixon and Rimmer, 2016). Early applications date back to the 1970s, e.g., Dixon (1977), Shoven (1976) and Shoven and Whalley (1972), and have continuously evolved since then to embrace expanding degrees of geographical, industrial, household, policy and other detail. Perhaps the most widely used model of this type is GTAP (Global Trade Analysis Project). Primarily used to investigate trade policy issues, GTAP distinguishes each region as an economy in its own right, linked with other regions via commodity-specific trade in goods and services (Hertel, 2013). However, the model's high level of regional disaggregation comes at the expense of more limited industrial and sub-national regional detail.

In contrast, country-specific models typically carry either high levels of intra-country regional disaggregation, e.g., The Enormous Regional Model (TERM) [Horridge (2012); Wittwer (2017)], which distinguishes hundreds of sub-national regions, or high levels of industry detail, e.g., the single-country USAGE model of the US economy, which distinguishes about 500 sectors [Dixon and Rimmer (2010)].[4] Trade-offs exist between the level of regional and industry detail, because computational resources are limited (Horridge et al., 2013). Another stream of general equilibrium models includes the G-Cubed multi-country models and their variants, whose applications often focus on studying environmental economics and related policy issues; see McKibbin and Wilcoxen (2013) for an overview.

Our study employs the dynamic multi-regional CGE model VURMTAX (Victoria University Regional Model with Taxation detail). This model carries both high levels of industry detail and high levels of sub-national regional detail. It features sufficient sub-national granularity to incorporate fiscal accounts and tax instrument detail at both the federal and state levels, together with a high level of sectoral detail, particularly for the energy sector. These features facilitate analysis of the impact of fiscal responses to the oil shock scenario, distinguishing it from the other CGE models described above and underpinning its suitability for this study. The overview of the model's specifics and our enhancements for the present application are described in Section 3.1.

Our paper extends the approach of a recent study by Turco et al. (2023), who explore the impact of oil shocks and policy responses in European countries. First, our modelling emphasises energy commodity detail, whereas Turco et al. (2023) treat all fossil fuels as a homogenous, foreign-owned sector. In contrast, we disaggregate upstream fossil fuel industries, e.g., crude oil, gas, and coal, from associated downstream industries, e.g., refined petroleum and LNG, both in terms of their sales and cost structures. This facilitates our recognition of the oil-indexed LNG pricing mechanism, discussed by Cassidy and Kosev (2015) and unique to the Asian gas market. Country-specific energy structure of this kind shapes the economic response to oil price shocks, as well as the implications of fiscal responses. Following Adams and Parmenter (2013), energy demand by domestic user and region is also distinct.[5] We also account for industry-specific local and foreign ownership of capital. This facilitates our analysis of the impact on national income of the oil shock and associated policy responses.

3. Methods and scenarios

3.1. Model and data

We use a CGE model with high levels of tax detail (VURMTAX), which we enhance for the specific needs of this study. Originally developed by Nassios et al. (2019a) to study tax system efficiency, VURMTAX is a multi-regional, multi-sectoral and dynamic CGE model of the Australian economy in which are embedded and modelled the individual characteristics of 33 state and federal tax instrument types, including region-specific differences in the details of individual state and territory taxes.[6]

Applications of VURMTAX include analyses of the excess burden of taxation in Australia [Nassios et al. (2019a)], the goods and services tax (GST) [Giesecke and Tran (2018); Giesecke et al. (2021a)], company tax [Dixon and Nassios (2018)], state land tax and local council rates [Nassios et al. (2019a)], property transfer duties and housing prices [(Nassios and Giesecke (2022a)], and personal income taxes and insurance duties [Nassios and Giesecke (2022b)]. Because many indirect taxes are associated with specific commodities, industries and economic agents, the model has a high level of commodity and industry detail, with 91 industries and 98 commodities in its standard implementation.[7]

We enhance the core VURMTAX model in several ways to facilitate an analysis of both an oil price rise, and associated tax policy responses.

First, we recognise Australia's status as an oil importer and an LNG exporter. Crude oil and refined petroleum products are both largely imported and modelled as distinct commodities, while LNG is entirely exported and relies on natural gas extracted from domestic sources as a key intermediate input. The domestic gas market competes for natural gas with the LNG sector, while both natural gas extraction and the LNG sector are largely foreign owned.

VURMTAX is parametrised using data from various sources, including the Australia's Bureau of Statistics (ABS) Census, Agricultural

[3] Another stream of research tools within the realm of oil shock studies includes DSGE (Dynamic Stochastic General Equilibrium) models, which are frequently used to study the macroeconomic impact of oil price shocks and to model monetary policy responses from a theoretical perspective [for example, Carlstrom and Fuerst (2006) and Natal (2012)]. It is also worth noting that financial CGE models have been employed to explore the impacts of oil shocks and monetary policy responses at the industry level; see, for example, the study by Liu et al. (2015) on the Chinese economy.

[4] The TERM methodology has also been applied to construct multi-country CGE models such as EuroTERM and GlobeTERM (Wittwer, 2022a, 2022b).

[5] Specifically, electricity generation is distinguished from natural gas and refined petroleum demand, with four electricity generation technologies, each with their own fuel input (coal, gas, hydro, and other renewable energies).

[6] For example, payroll tax (one of the 33 taxes modelled in VURMTAX) is implemented by each of the 8 Australian states and territories, but state-specific implementations differ considerably in terms of tax rates, thresholds and concessions. We model these region-specific differences in the implementation of all state and territory taxes. Hence, given that 10 of the tax instruments in VURMTAX are federal, VURMTAX effectively contains modelling of approximately 200 different taxes (≈ (33–10) *8 + 10).

[7] VURMTAX is described in Nassios et al. (2019a). VURMTAX is an extension of the Victoria University Regional Model (VURM) enriched with tax detail. A full description of VURM is provided by Adams et al. (2015).

Census, State accounts, and international trade data. The core model is based on the 2017/18 input-output data [ABS (2020)], national and state accounts aggregates, together with the ABS Government Financial Statistics [ABS (2019)], and data from various state government budget papers.

Second, VURMTAX contains detailed tax-specific features that enable us to accurately model the two fiscal policy responses: an FEC and an EPL.

Our analysis of an FEC required careful calibration of fuel excise collections across households and industries, and recognition of Australia's fuel tax credit (FTC) scheme.[8] To derive matrices for fuel excises paid by industry, we rely on ABS Input-Output Table data to disaggregate fuel excises paid on the purchase of petroleum products by end-user, either industries or households. We disaggregate this by region using existing regional purchase shares for each industry.

Like many international peers, e.g., the USA, Australia operates an FTC scheme, which rebates excise included in the price of fuel to a subset of industries. To derive FTC claims by industry, we use Taxation Statistics data which provides a 20-industry disaggregation of FTCs claimed. We cross-validate this using industry-specific fuel excise payments data, to ensure FTCs are no greater than fuel excises paid. The result is a set of revised fuel excise and FTCs, which track collections and credits by industry and region nationwide.

Fig. 1 plots the top seven industries where fuel excises are collected and includes any claimed fuel tax credits. As shown in Fig. 1, the private transport industry accounts for the largest share of fuel excise collections.[9] FTCs are largely claimed by the road freight and mining industries, of which the latter are largely foreign-owned and modelled as such in VURMTAX.

VURMTAX contains several detailed tax-specific features which facilitate modelling of Australian direct taxes. Notably, VURMTAX distinguishes between local and foreign investors in modelling Australia's dividend imputation system.[10] We utilise this enhancement to model the EPL as a rise in the corporate tax rate faced by the Australian LNG industry, which falls largely on the foreign investor class.

Since both an FEC and an EPL are federal instruments, our focus is on examining the impact of these policies at both the macroeconomic level and the sectoral level. Regional impacts are outside the scope of this paper.[11] In what follows we briefly describe the key agents in VURMTAX and the optimisation problems that govern their price-sensitive decision-making.

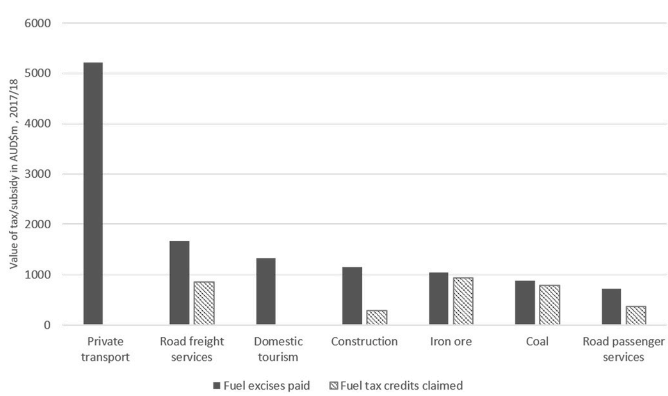

Fig. 1. Fuel excise and fuel tax credits claimed across a selection of industries, 2017/18.

Each region in VURMTAX has a single representative household and a single state and local government agent, with regions connected via interregional trade, migration, and capital movements. The foreign sector is described by export demand and import supply curves for each region. Supply and demand for each regionally produced commodity is the outcome of optimising behaviour. Regional industries are assumed to use intermediate inputs, labour, capital, and land in a cost-minimising way, while operating in competitive markets. Region-specific representative households purchase utility-maximising bundles of goods, subject to given prices and disposable income.

Within VURMTAX's fiscal federal framework, two government levels are identified: federal and state. State governments impose region-specific taxes such as council rates, land tax, payroll tax, conveyancing duties and other state and local government taxes. A federal government operates nationwide and levies a range of federal taxes including those relevant to this paper, such as fuel excise and corporate tax, and other federal taxes such as personal income tax and a value-added tax, the GST.

Investment in each regional industry is assumed to be positively related to expected rates of return on capital in each regional industry. Capital creators assemble units of industry-specific physical capital for each regional industry in a cost-minimising manner.

The ownership status of industry- and region-specific capital stocks in VURMTAX follows Dixon and Nassios (2018). We identify two classes of capital owner: foreign and domestic. Foreign ownership is heavily concentrated in export-oriented resource industries, e.g., LNG, coal, and iron ore, in line with Connolly and Orsmond (2011).[12] We assume that pre-tax rates of return are equal for domestic and foreign owners of capital, in any given industry and region, i.e., domestic and foreign investors own the same type of industry- and region-specific capital. However, post-tax rates of return differ for foreign and local investors, in line with Australia's system of income taxation. This means that foreign financing shares for each unit of industry- and region-specific capital are sensitive to changes in relative tax rates between the two investor classes.

This specification allows VURMTAX to capture three features of Australia's economy relevant to the present application. First, post-tax profits earned by foreign owners on their Australian investments (such as in the LNG industry) fall outside the national income umbrella. Second, our results reflect Australia's dividend imputation system of corporate income taxation, which is incident largely on foreign equity owners. Third, foreign ownership shares are endogenous, decreasing functions of Australian capital taxation rates on capital income accruing to foreign owners relative to domestic owners.

VURMTAX is dynamic and provides results for economic variables on a year-on-year basis. The results for a particular year are used to update the database from the previous period. As detailed more specifically in Nassios et al. (2019a), the model contains a series of equations connecting capital stocks to past-year capital stocks and net investment. Similarly, debt is linked to past and present borrowing/saving.

[8] ABS Input-Output data is largely silent on the latter of these points.

[9] The private transport industry is modelled as a dummy industry which takes motor vehicle capital, and intermediate inputs in the form of fuel, electrical componentry and repair services and supplies its output entirely to households.

[10] In VURMTAX, local investors claim franking credits and are largely shielded from corporate taxes but must pay personal income tax. Foreign investors cannot claim franking credits and thus pay corporate income tax, but do not pay personal income tax. For a detailed description of this innovation, we refer the reader to Dixon and Nassios (2018).

[11] Nevertheless, the VURMTAX model contains the desirable properties required of a multi-regional model, as discussed by Giesecke and Madden (2013).

[12] We estimate the foreign ownership of the Australian LNG industry to be 87% based on the estimation of the Tax Justice Network in 2017. This number is very close to the estimation of approximately 88% of the LNG industry in Western Australia being foreign-owned by Conservation Council of Western Australia (2019).

3.2. Model closure

We undertake two parallel model runs in solving the model: a baseline business-as-usual (BAU) simulation, and a counterfactual simulation which is identical to the baseline except for the added shocks we aim to investigate. We report results as percentage (for the unemployment rate, percentage point) deviations in the value of the variables in each year of the counterfactual simulation, away from their baseline values.[13]

The counterfactual simulations are conducted under the following closure assumptions:

1. Labour markets are characterised by short-run wage stickiness, with endogenous unemployment rates, transitioning to a long-run environment of wage flexibility with unemployment rates returning to baseline.
2. Participation rates adjust to deviations in real consumer wages consistent with household labour/leisure choice decision making [Giesecke et al. (2021a)].
3. Household private consumption is modelled as a given proportion of household disposable income, implying a constant household savings rate.
4. Real public consumption spending by state and local governments exogenously tracks baseline levels throughout the counterfactual simulations.
5. State and federal government borrowing requirements track baseline values throughout the counterfactual simulations. This budget-neutrality assumption is implemented via endogenous state and federal direct taxes on households, but is relaxed in Scenario 4 for assessing FEC-DF.
6. For the oil, petrol refining, gas and LNG industries, we explore two alternative investment assumptions. First, we assume that investment in these industries follows their baseline paths, unresponsive to the unexpected and temporary energy shocks (Scenarios 1–4; see Table 1). Then, we test if allowing investment in these sectors to endogenously respond to both the energy price shock and the energy profits tax significantly affects our simulation results (Scenarios 5 and 1A; see Table 1).

Regarding the last closure item above, our core assumption regarding energy sector investment in our counterfactual analysis (i.e., in Scenarios 1–4), is that investors in these industries that directly benefit from the energy price spike are unresponsive to both the oil price shock and tax policy responses. In our simulation, higher global oil prices are caused by temporary disruptions due to geopolitical tensions. Therefore, we assume the standard model-generated investment responses for the Australian oil and refined petroleum industries, and the gas and LNG industries that have export prices linked to oil prices, remain unchanged from their corresponding baseline values in each year. This assumption reflects our expectation that business investment does not flow into these industries in response to a temporary oil price shock or associated policy responses.

Typically, companies take many years to realise profits from substantial investments in building gas and LNG plants.[14] As a result, investors might be expected to recognise the temporary nature of the shocks and not change their investment behaviour accordingly. To test whether conclusions that emerge from our modelling are sensitive to this core industry-specific investment closure, we relax the assumption in Scenarios 5 and 1A. In these scenarios, investment in these energy industries responds to movements in rates of return generated by the temporary changes in energy prices and tax policy instruments.

3.3. Baseline forecast and scenario description

3.3.1. Baseline forecast

In our baseline forecast, year-on-year movements in the oil price are aligned to the reference oil price projection from the Annual Energy Outlook (2022) by the EIA (2022). Counterfactual scenarios are understood as deviations from this baseline forecast. The attributes of these scenarios are summarised in Table 1. All counterfactual scenarios share the same set of shocks describing an environment of elevated global energy prices due to a temporary oil supply shortage. Scenarios are distinguished in terms of: (a) policy responses: an FEC or an EPL; (b) model closure assumptions, relating to the financing of government budget deficits, and whether energy-industry-specific investment is fixed at its baseline level or free to respond to the temporary energy and policy shocks. In sections 3.3.2–3.3.5, we describe each of the scenarios in Table 1.

3.3.2. Scenario 1: oil price shock

Scenario 1 describes the economic impact of a temporary, one-year spike of 50% in world crude oil prices faced by Australia. The shock's size and duration are based on Brent crude oil market responses in 2022, which were mainly driven by supply disruptions due to geopolitical conflicts.[15]

Crude oil, the primary raw material in the production of refined petrol, accounts for about 32% of the total costs of Australian petrol refineries (ABS, 2020). Ceteris paribus, in studying the macroeconomic impacts of oil price increases, we anticipate that a 50% increase in crude oil prices globally causes a corresponding 16% increase in refined petroleum prices. Fig. 2 illustrates this by plotting the foreign refined petroleum price response in Scenario 1 alongside the 50% crude oil price shock.

Fig. 2 also showcases the LNG price response for Scenario 1, reflecting the oil-gas price linkage described in Section 1. As discussed, Australia's primary overseas market for LNG exports is the Asian gas market, which predominantly operates on long-term contracts (Cassidy and Kosev, 2015). These contracts link Australian LNG export prices to global crude oil prices. Based on the study of Zhang et al. (2018) on regional gas markets, oil price changes are the most important contributor to natural gas price dynamics in Japan.[16]

This oil-gas price linkage has implications for Australian households, which are captured in our modelling. When oil prices surge, Australia's LNG exporters experience windfall gains. However, domestic gas users, particularly households, pay the higher world gas price. The 25%

[13] See Dixon and Rimmer (2002) for a thorough review of the construction of baseline and policy simulations with a detailed CGE model.

[14] For example, the Gorgon Project, one of the world's largest LNG projects, began construction in 2009 in Western Australia and saw its first LNG cargo depart in March 2016. Domestic gas supply to the Western Australian market commenced later, in December 2016. Average lead times between commencement of construction and output generation are thus in excess of one year. See "An Australian Icon: The Gorgon Project" at https://australia.chevron.com/our-businesses/gorgon-project.

[15] During the first half of 2022, Brent crude oil spot prices increased significantly, rising by around 54%, from USD$78 per barrel on January 3rd to USD $120 per barrel on June 30th. This surge was primarily due to escalating geopolitical tensions between Russia and Ukraine, culminating in Russia's invasion of Ukraine in February. In the second half of 2022, crude oil prices gradually declined due to higher global crude oil supply from the US and the International Strategic Petroleum Reserve release program, which addressed concerns of supply shortages. By the end of 2022, the Brent crude oil price had fallen to USD$83 per barrel.

[16] Zhang et al. (2018) construct a VAR system that incorporates supply and demand side factors, oil prices, and global economic conditions. They investigate how much oil prices and market fundamentals contribute to natural gas prices in three major regional gas markets: Japan, the US, and Germany. They find that oil price changes alone account for 30% of the variation of gas price changes in Japan.

Table 1
Summary of scenarios.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 1A
	Oil price shock	FEC-BN	FEC-DF	EPL	EPL (endogenous investment)	Oil price shock (endogenous investment)
Shocks describing a global oil price shock in Australia						
Elevated foreign oil prices	*	*	*	*	*	*
Elevated foreign refined petroleum prices	*	*	*	*	*	*
Elevated foreign LNG prices	*	*	*	*	*	*
Elevation of international prices of other imports and exports	*	*	*	*	*	*
Policy response						
Fuel excise cut (FEC)		*	*			
Energy profits levy (EPL)				*	*	
Policy financing						
Budget neutral		*		*	*	
Debt financed			*			
Key modelling assumption						
Exogenous industry investment for oil, refined petrol, gas and LNG	*	*	*	*		

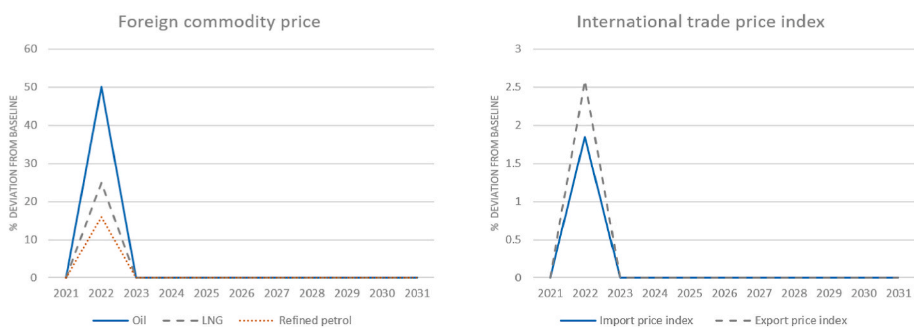

Fig. 2. Movements in foreign currency import prices and vertical positions of export demand schedules (% deviation from baseline).

increase in foreign LNG prices in Fig. 2 is based on an assumed 50% pass-through from foreign oil price movements to Asian-market LNG prices, following Ji et al. (2014).

As a single-country model, foreign currency import prices and positions of foreign demand schedules for other commodities are assumed to remain exogenous. While exogenous, we impose shocks on foreign currency import prices and positions of foreign demand schedules to reflect the pass-through of world energy prices into the international prices of the commodities Australia imports and exports. To evaluate the sizes of these shocks, we use the extensive industry-specific cost structures implicit in the VURMTAX model, and assume that global unit cost functions match those in Australia. This allows us to use domestic commodity price responses to infer foreign commodity price responses for all goods other than crude oil, LNG and refined petroleum. Our final shocks to the foreign currency import and export prices for these goods thus account for their varying energy intensities in production.[17] This is also illustrated in Fig. 2.[18]

3.3.3. Scenario 2 & 3: fuel excise cut (FEC)

Scenarios 2 and 3 are variations of Scenario 1, in which we overlay a temporary 50% FEC upon the temporary oil price shock. FTCs received by industry are linked to fuel excises paid by industry, hence FTCs fall proportionally. As the implementation of an FEC comes with fiscal costs, Scenarios 2 and 3 differ according to the federal government's financing choice. In Scenario 2 (FEC-BN), the federal government maintains budget neutrality via a direct tax on households.[19] In Scenario 3 (FEC-DF), the government funds the revenue shortfall caused by the fuel excise cut through debt-financing. This debt is not repaid over the course of the simulation but rather, adds to the nation's interest bill, thus damping GNI and real consumption.

3.3.4. Scenario 4: an energy profits levy (EPL)

Australia, while being small relative to international peers in oil production, is a major global gas producer and LNG exporter, with about 80% of its gas industry output exported as LNG. When global oil prices rise, the price of Australian LNG exports also rise via the oil-gas price linkage. This poses two challenges. First, because this sector is largely foreign-owned, the rise in LNG export income largely flows offshore, unless some portion of the super-profits accruing to the industry are

[17] This implicitly assumes that there is not material difference between domestic and foreign production structures, particularly in energy intensity. Given the high level of industrial disaggregation in VURMTAX (with 91 industries) and the model's industry-specificity in differentiated production structures, we are comfortable with this assumption.

[18] Because VURMTAX carries detail for 98 distinct commodities, plotting all the commodity price shocks imposed is not feasible here. However, taken together, we can plot value-weighted indices of all the price shocks we deliver. This is the approach adopted in Fig. 2, where we see that these shocks cause a 1.85% increase in the aggregate import price index, and a 2.59% increase in the aggregate export price index.

[19] The idea of maintaining budget neutrality through a direct tax on households serves two purposes. First, by ensuring the policy measure is financed, it allows focused and clear interpretation of the impact of the specific policy measure by avoiding overlaying an additional macroeconomic story of general fiscal expansion. Second, by using a direct tax as the revenue-neutralising instrument, we avoid introducing a new and potentially distorting tax instrument. This approach ensures that the tax burden is not simply shifted from fuel excise to another tax with distorting allocative efficiency consequences.

taxed. Second, because domestically-produced gas is both an intermediate input to LNG production and a key source of energy for Australian industries and households, domestic gas prices rise, reducing real wages.

In this context, a revenue-neutral EPL might go some way to mitigating both these issues; super-profits in the LNG industry would fall under the umbrella of Australian national income and be recycled to households to boost real income.

Scenario 4 is a variation of Scenario 1. We assume that instead of responding to the oil price rise via an FEC, Australia responds by imposing a temporary, one-year 25% EPL on the oil, gas and LNG industries, aligning to the quantum and industry coverage of the UK Energy Profits Levy.[20] The EPL is revenue-neutral, with the proceeds being distributed to households as direct transfers, once again mirroring the UK's policy, which used tax revenue to fund welfare payments.

3.3.5. Scenario 5: an energy profits levy with endogenous energy investment

Scenario 5 is a variation of Scenario 4, in which we relax the Scenario 4 assumption that held real investment in the oil, gas and LNG sectors at their baseline forecast levels. One argument in debates about the introduction of a temporary tax on windfall profits in the energy sector is that such a tax might damage the economy by discouraging investment. To explore this further, in Scenario 5 we allow investment in these sectors to respond endogenously to post-tax rates of return, like other sectors in the model. We then revisit the implications of an EPL by comparing Scenario 5 with an alternative version of Scenario 1 (hereafter, Scenario 1A), both set in an environment where energy sector investment is return-sensitive.

4. Results and discussion: oil price shock and fiscal policy responses

4.1. Scenario 1: global oil price shock

4.1.1. Macroeconomic impacts and the role of oil-gas price linkage

Fig. 3 illustrates the effects of Scenario 1 on macro variables, measured as deviations from the baseline forecast. The bars in each graph show the separate contributions of higher LNG prices and higher oil and petrol prices to the Scenario 1 results.[21]

As an oil-importing and gas-exporting economy, an oil price shock that raises foreign prices of oil, petrol and LNG is essentially a mixed term of trade shock. On the one hand, a rise in foreign crude oil and refined petroleum prices drives Australian import prices up, and the terms of trade down. On the other hand, the oil-gas price linkage leads to higher LNG export prices, which improves the terms of trade. Overall, the terms of trade appreciate by about 0.7%, indicating that the positive effects of higher LNG export prices outweigh the negative effects of higher oil and petrol import prices.

Australia's LNG sector is largely foreign-owned. The gains from the rise in the terms of trade caused by higher LNG export prices primarily benefit foreign capital owners as higher post-tax profits. Only a portion of the gains flow directly to Australian households, either through increased tax receipts or capital income for domestic owners of LNG capital. Since this industry is highly capital intensive, its expansion does not help generate demand for labour overall. Instead, the labour market is adversely affected by the oil-gas price linkage.

Specifically, this represents the net impact of two countervailing effects. First, the oil-gas price linkage will increase taxation revenue from largely foreign-owned industries, increasing national income, and reducing short-run unemployment when recycled tax revenue is spent by households. LNG production expansion also raises labour demand, but this effect is small because of its low labour intensity. Second, the oil-gas price linkage will raise domestic gas prices, flowing through into domestic production costs. This lowers the value of the marginal product of labour, causing short-run unemployment to rise in the presence of sticky wages. The second effect dominates, as shown in Fig. 3, contributing to a rise in unemployment. Upon impact, the oil price shock results in a 0.29 percentage point increase in the national unemployment rate relative to baseline.[22] This, in turn, leads to a decrease in real wages by 0.15%.

Capital stocks cannot adjust in the first year of the simulation. Hence, the weakened labour market causes the capital-labour ratio to rise. Consequently, capital rentals fall relative to construction costs, causing rates of return to fall below their baseline forecast level. As real investment is an increasing function of the rate of return on capital in VURMTAX, real aggregate investment declines, by 0.34% relative to baseline.

With employment depressed in the shock-year, real GDP also falls, by 0.15% relative to baseline. The impact decomposition shows the oil-gas price linkage has little effect in mitigating the negative impact of higher oil and petrol prices on Australia's GDP.

Real private consumption falls by 0.43% relative to baseline in 2022, due in part to higher energy prices faced by consumers and increased unemployment. While the oil-gas price linkage helps damp its initial decline, its cushioning effect is limited relative to the size of the contribution it makes to the improvement in the terms of trade. Multiple factors contribute to this outcome.

First, the LNG industry is highly capital intensive. This mutes the direct impact of LNG output expansion on the labour market. In addition, with LNG investment held exogenous, as mentioned in Section 3.2, there are no indirect effects on employment via a rise in LNG investment.

Second, the substantial foreign ownership of the Australian LNG industry dilutes the contribution of the improvement in the terms of trade to national income, as also noted by Cassidy and Kosev (2015). The effect is opposite in sign but functionally similar to the effect noted by Giesecke et al. (2021b). In their study, a Chinese ban on imports of Australian coal causes a reduction in Australian coal prices, which lowers the terms of trade. The Australian coal industry is however largely foreign owned, so the resulting domestic price fall is mostly a gain for domestic agents.

In contrast, the rise in LNG prices leads to a loss for domestic agents, due to higher domestic gas prices. Domestically produced gas is consumed by households and other industries as intermediate goods. This analysis finds that the 25% higher LNG export prices cause domestic gas prices to rise by 9%, weakening household purchasing power and elevating production costs for industries. Nonetheless, the results show the boost in LNG sector profits moderates some of the damage to real private consumption, as corporate income tax receipts rise, and some LNG producer capital is domestically owned.

With real investment and private consumption down relative to real GDP upon impact, real GNE falls relative to real GDP. The balance of trade thus moves towards surplus, with real export volumes rising by 0.38% relative to baseline, and real imports falling by 0.52%. This shift is aided by real depreciation, making domestically produced goods more

[20] On 26th May 2022, the British government announced an Energy Profits Levy on oil and gas companies operating in the UK, to help raise funds for direct payments to UK households to ease the impact of higher household energy prices. The Levy is an additional 25% tax on UK oil and gas industry profits, on top of the existing 40% headline rate of tax, taking the combined rate of tax on profits to 65%. The levy is intended to be temporary and will be phased out when energy prices return to historical norms.

[21] As noted in reference to Fig. 2, the effect of higher energy prices on the international prices of Australia's non-energy imports and exports exerts only a minor net effect on Australia's terms of trade. Hence, we do not report this as a third decomposition factor in Fig. 3. The effect of movements in the international prices of non-energy imports and exports are however included in the overall "Scenario 1" results reported in Fig. 3.

[22] This means, for example, that if the baseline forecast unemployment rate is 3.5% in 2022, then the oil price shock causes the 2022 unemployment rate to rise to 3.79%.

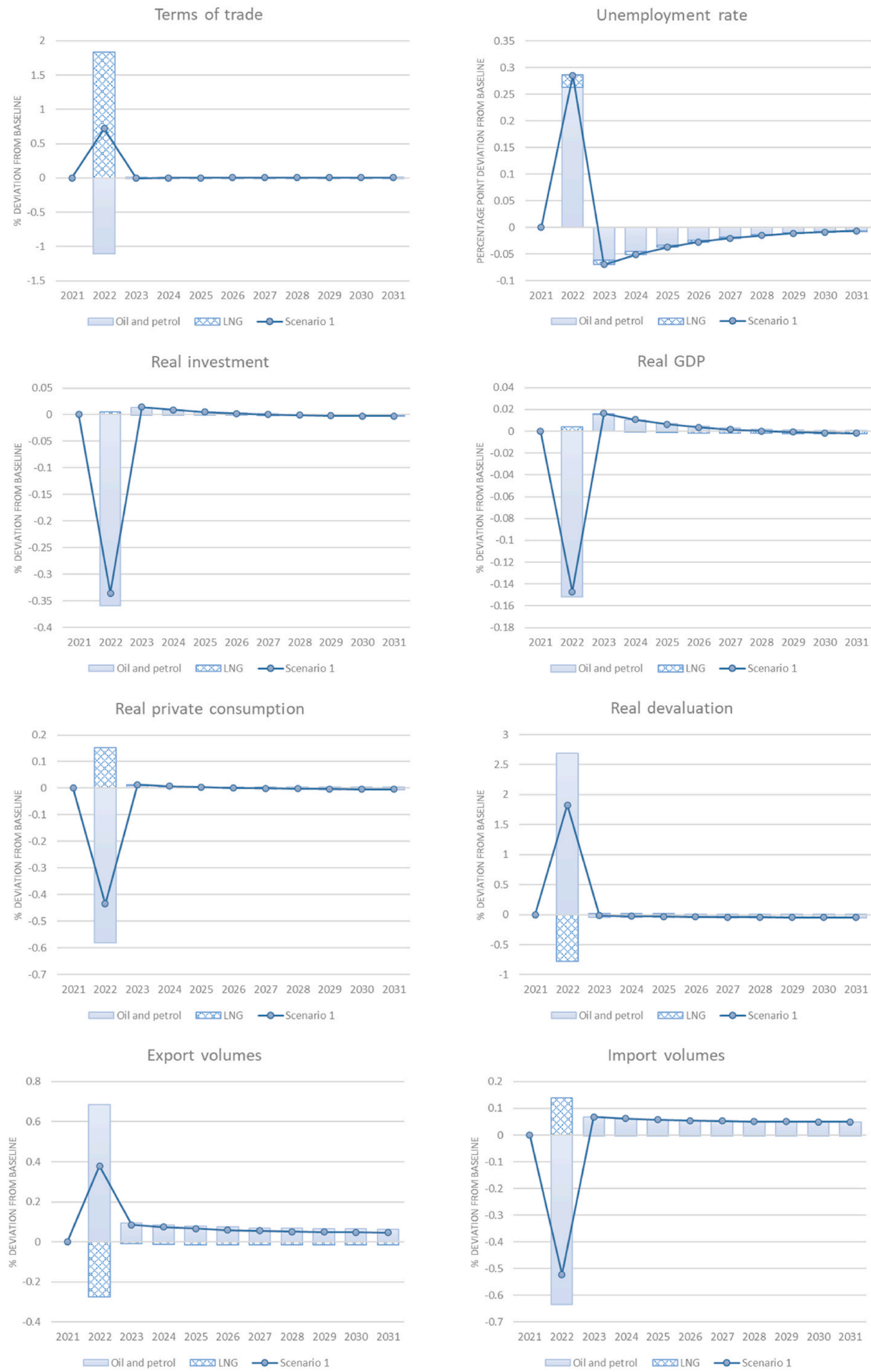

Fig. 3. Temporary 50% oil price shock (Scenario 1), deviation from baseline.

competitive internationally. We thus see expansions in Australian exports as foreign purchasers substitute towards cheaper Australian-produced goods.

4.1.2. *Industry impacts*

Fig. 4 illustrates the sectoral shock-year impact of the oil price shock in Scenario 1.[23] The mining industry benefits from the oil price shock, with output increasing by 0.51%. This reflects the LNG industry's presence in this sector, and also the impact of real depreciation on other

[23] To facilitate the presentation of results and aid our discussion, we have aggregated the results for the 98 commodities identified by VURMTAX into 20 broad categories that align closely with the Australian Bureau of Statistics ANZSIC level 1 industry aggregation.

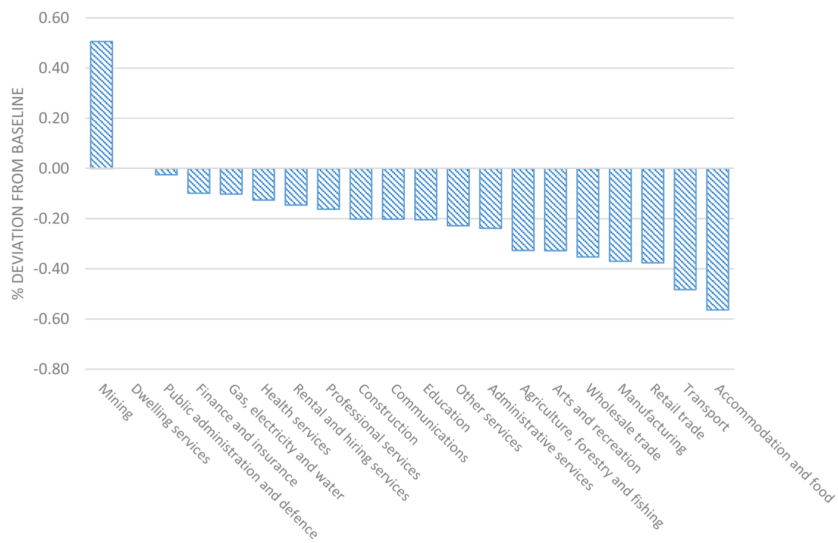

Fig. 4. Industry output: shock-year impact.

export-oriented mining industries.

Output of dwelling services, which is heavily capital and land intensive, remains unchanged in the shock-year. This reflects the fixity of dwellings capital in the short-run and exogenous land stocks throughout the simulation.

Industries that largely supply to the public sector, such as public administration and defence, remain largely unaffected, as they are heavily reliant on government spending. This is a direct consequence of our closure assumption, which holds federal and state government real consumption unchanged from baseline values.

All other sectors experience output declines. The accommodation and food industries are the most affected, with an output decrease of 0.56% relative to baseline due to increased costs associated with transportation and logistics, together with the fall in real private consumption, which is an important market for this sector. The transport industry, heavily reliant on refined petroleum, also sees a relatively large output fall (−0.48%).

With relatively low energy dependence, service industries are generally less affected compared to other more energy-intensive industries. While higher energy and transportation costs cause output contraction in many industries, sectors like retail trade and arts and recreation, which each sell a relatively large share of output to households, also suffer from reduced household consumption.

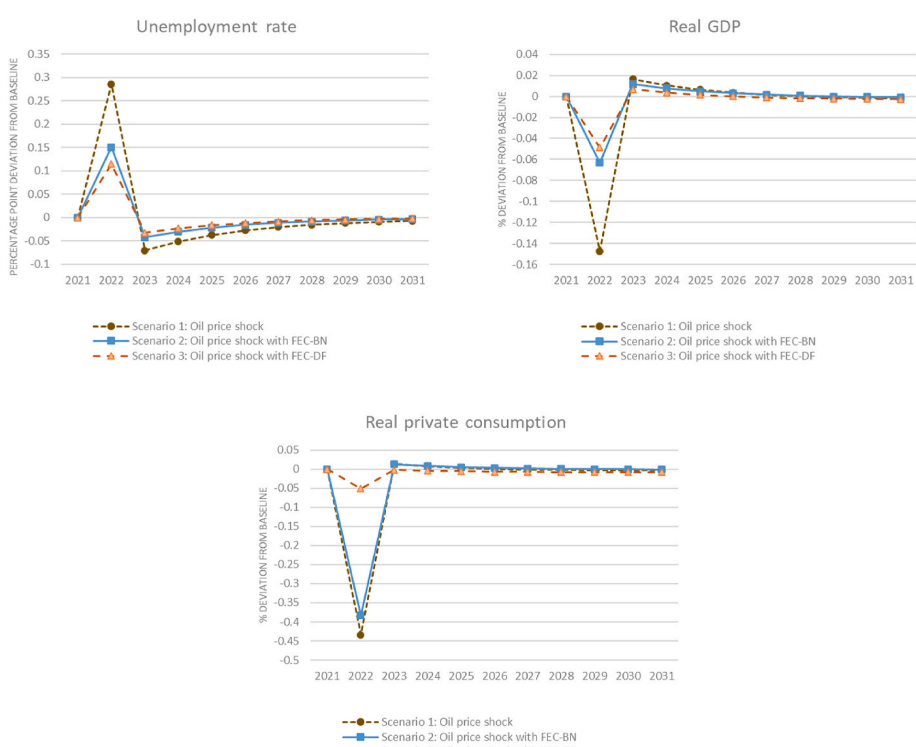

Fig. 5. Oil price shock (Scenario 1) and fuel tax policies (Scenario 2 and 3), deviation from baseline.

4.2. Scenario 2 & 3: policy response - fuel excise cut (FEC)

In this section, we examine the capacity of a 50% FEC to reduce the economic damage of the oil price shock. As described in Section 3.3.3, we explore two funding models for this policy: (1) FEC-BN, where the budget-neutral FEC is funded via a direct tax on households (Scenario 2); (2) FEC-DF, in which this deficit-financed policy is funded via increased public debt (Scenario 3). Fig. 5 reports the impacts of both an FEC-BN and an FEC-DF, and compares these with selected results from Scenario 1 (in which there is no policy response).

4.2.1. Scenario 2: budget-neutral policy

Comparing Scenario 1 and 2 reveals that a 50% FEC-BN helps damp the short-run impact of the oil price shock on the unemployment rate. In the shock-year, the size of the unemployment deviation falls, from +0.29 percentage points (Scenario 1) to +0.15 percentage points (Scenario 2). This curbs the negative real GDP deviation, reducing the downturn from −0.15% (Scenario 1) to −0.06% (Scenario 2).

FEC-BN makes a relatively smaller contribution to the household consumption response, with real private consumption falling 0.38% below the baseline in 2022, slightly less than the 0.43% decline in Scenario 1. The improvement in the real consumption outcome (0.05 percentage points) is small because households pay for the foregone excise revenue via a lump-sum tax under FEC-BN.

4.2.2. Scenario 3: deficit-financed policy

Scenario 3 revisits the financing assumption for the FEC studied in Section 4.2.1. Unlike Scenario 2, Scenario 3 assumes the federal government finances the FEC via borrowing, resulting in the federal budget position moving towards deficit and hence net public debt rising. Households immediately benefit from the lower fuel excise without paying for its costs in the shock-year. As Fig. 5 shows, under FEC-DF the short-run damage of the oil price shock to real private consumption is largely neutralized, with private consumption falling by a smaller 0.05% relative to baseline in the shock-year.

Supported by stronger real private consumption, the short-run negative impact of the global oil price shock on the labour market and real GDP are further mitigated compared to the budget-neutral case. Compared to Scenario 2, the rise in the unemployment rate caused by the shock is damped by 0.03 percentage points, from 0.15 percentage points in Scenario 2 to 0.12% in Scenario 3. The real GDP downturn in Scenario 3 is −0.05% relative to baseline, which reflects an improvement of 0.01 percentage points relative to Scenario 2. This indicates that the FEC-DF provides a slightly stronger stimulus to the overall economy than FEC-BN.

While the FEC-DF smooths the negative consequences of high oil prices on the economy in the shock-year, interest payments on the higher net debt position rise thereafter, damping the post-shock recovery path. Compared to Scenario 2, the short-run damage to private consumption in Scenario 3 is largely mitigated. Herein, the government tax-finances interest payments on the higher public debt incurred in the shock-year, which damps the recovery path for private consumption.

4.2.3. Excess burden evaluation of fuel tax policy

Australia's fuel excise is a specific tax levied at a fixed rate per litre of fuel. As oil prices rise, the value of 1 L of fuel increases while the tax paid on 1 L of fuel remains fixed, reducing the ad valorem rate of fuel excise. The economic distortion caused by fuel excise thus falls as oil prices rise, weakening the case for an FEC on pure tax efficiency grounds.

To explore this further, we evaluate the marginal excess burden (MEB) of fuel excise against two baseline forecasts: (i) the BAU oil price forecast as described in Section 3.3.1; and (ii) in the presence of 50% rise in oil prices relative to the BAU forecast as detailed in Section 3.3.2.

Following Nassios et al. (2019a,b), we define the excess burden of a marginal change in the rate of a particular tax as the ratio of: (a) the change in leisure-adjusted real national income caused by the tax rate change, to (b) the value of the real government lump-sum transfer to households that can be funded by the tax rate change. Specifically, the efficiency loss caused by a tax policy package in year t (MEB_t) at the national level is evaluated according to the formula:

$$MEB_t = -100\left(\frac{\Delta GNI_t + \Delta VLEIS_t}{\Delta LST_t}\right) \quad (1)$$

ΔGNI_t is the deviation in real gross national income (GNI) in year t expressed as the difference between the counterfactual simulation and baseline simulation values for GNI in year t. $\Delta VLEIS_t$ is the deviation in the value of leisure at time t, which is calculated as the product of the real consumer wage, and the proportion of the working population that is not participating in the labour force. ΔLST_t is the deviation in revenue-neutral lump-sum transfer in year t.

Since the FEC implementation aligns with the duration of the temporary oil price shock, our assessment of the allocative efficiency change is made by comparing the MEBs in the year 2022.

In the BAU case, the 50% FEC generates an economic gain of 15 cents per dollar of tax revenue foregone by 2022. This is small when compared to some other Australian taxes, e.g., property transfer duty, which carries a MEB of 82 cents per dollar estimated by Nassios and Giesecke (2022a). This suggests the deadweight loss of the fuel excise is small.

As expected, the allocative efficiency gain is lower when oil prices are elevated, with the simulated MEB equal to 14.4 cents per dollar of tax revenue foregone when the foreign-currency price of crude oil is 50% higher than the BAU forecast level in 2022.

Overall, the assessment of the excess burden of FEC indicates only a small efficiency gain compared to other taxes. Moreover, higher oil prices further reduce the merit of FEC and weaken its capacity to reduce tax distortions from an efficiency standpoint.

4.3. Scenario 4: policy response - an energy profits levy (EPL)

As described in Section 3.3.4, this section explores the impact of an alternative policy response: a 25% EPL on the Australian oil, gas and LNG industries in response to the oil price shock. Fig. 6 illustrates the policy impact, by comparing the deviations of selected macro variables between Scenario 1 (oil price shock only) and Scenario 4 (oil price shock with EPL). The dynamic responses are primarily driven by the levy on the gas and LNG industries.[24]

Our findings suggest implementing this policy can mitigate the negative impact of the oil price shock on private consumption. Specifically, our results show that the temporary 25% EPL could reduce the extent of the real consumption loss in the shock-year from 0.43% (Scenario 1) to 0.1% (Scenario 4): a damage mitigation factor ([0.43–0.1]/0.43) of about 77%. This is achieved by directing some of the super-profits that accrued under Scenario 1 to (largely) foreign owners of gas and LNG producers, to domestic households via a lump-sum transfer funded by the EPL.

Due to the policy's specific focus on oil, gas, and LNG producers, which have lower labour intensity compared to other sectors, its short-term effect on the broader labour market and, consequently, real GDP is positive but small.

An important caveat to this is the potential response by energy investors. In this section our modelling assumes investors are unresponsive to both the temporary price spike and the associated temporary tax, since both were unexpected. In the next section we relax this assumption.

[24] The size of Australia's oil production industry is small, so the impact of taxing its excess profits is negligible at the macro level. Nevertheless, in our analysis we include the oil production industry as one of the targets of the EPL.

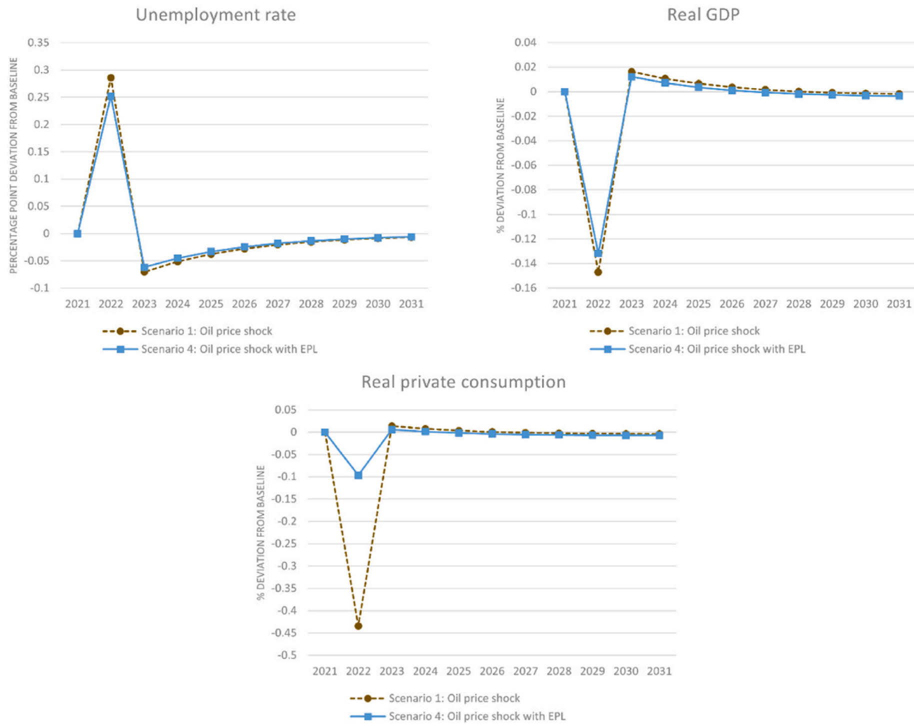

Fig. 6. Oil price shock (Scenario 1) and an Energy Profits Levy (Scenario 4), deviation from baseline.

4.4. Scenario 5: oil price shock and EPL with endogenous energy-sector investment

In the previous section, we studied the impact of an EPL by comparing the results from Scenarios 1 and 4. Each of these scenarios assumed investment in key energy sectors targeted by the EPL (oil, gas and LNG) were exogenous, in response to both the oil price shock and the EPL. In this section we revisit our analysis, relaxing this assumption. This leads to two new scenarios: (1) Scenario 1A, which is an alternative oil price shock scenario that describes this return-sensitive energy investment environment; and, (2) Scenario 5, where the oil price shock is simulated alongside the EPL scenario under return-sensitive energy investment. Our results comparison is shown in Fig. 7.

In response to higher energy prices and rates of return in the energy sectors in the shock-year, investment in the gas and LNG industries is stimulated, leading to a positive deviation of 0.14% in national investment (Scenario 1A). The impact of the EPL on LNG investment is smaller compared to its impact on gas investment. In what follows, we unpack this further.

Despite higher oil-indexed LNG export prices, foreign demand for Australian LNG expands due to improved Australian international competitiveness.[25] With the LNG industry exporting all its output, it experiences a significant windfall gain as both prices and output rise. Our results find a 60% increase in post-tax profits for the LNG industry in the shock-year, relative to baseline. This profit expansion drives a rise in the rate of return on capital in the LNG industry, which in turn reduces the elasticity of investment to changes in the rate of return.[26] Consequently, LNG investment is largely insensitive to an EPL.

This contrasts with the upstream gas industry, whose profit expands by a more modest 11% in the shock-year. Domestic gas profits are a function of LNG industry output (which expands when oil price rises), as well as output of other industry demanders, and household demand.[27] While a rise in LNG output increases the demand for gas by the LNG industry, pushing gas prices upward, this effect is partly offset by reduced demand from other gas-using industries and households. Consequently, the expansion in profitability of gas producers is smaller than that realised by LNG exporters. Hence gas investment remains more elastic to changes in rates of return, and an EPL thus has a greater impact on gas industry investment than its impact on LNG industry investment.

The short-run damage caused by the oil price shock to private consumption is largely offset by the EPL. Similar to the findings in Section 4.3, our results also suggest the EPL has a small impact on the labour market and real GDP, when comparing Scenario 1A to Scenario 5.

5. Conclusion and policy implications

This paper investigates the impact of a temporary global oil price shock on the Australian economy and studies the effects of two temporary fiscal policy responses: a fuel excise cut (FEC) and an energy profits levy (EPL).

We begin by studying the impact of a 50% oil price shock on Australia, with the model applied fully reflective of Australia's oil-importing and gas-exporting energy structure, and the oil-gas price linkage of its LNG export market. Our analysis elucidates what a shock of this nature means for the labour market, real GDP, household consumption and industry prospects. We find that two characteristics of the LNG industry (its high foreign ownership share, and its capital intensity) limit the capacity of the terms of trade gain, which stems from the rise in the oil-indexed LNG export price, to raise national income. That is, windfall LNG profits primarily accrue to foreign capital owners, while domestic households and firms face inflationary pressures due to elevated gas prices.

[25] The export-demand elasticity for Australia in the model is −4, which is derived by Dixon and Rimmer (2009).

[26] In VURMTAX, the elasticity of investment with respect to the rate of return on capital is itself a decreasing function of the rate of return. This mechanism follows Dixon and Rimmer (2002).

[27] In VURMTAX, industry demands for intermediate inputs are determined by a Leontief production function specification, i.e., intermediate inputs are consumed in fixed proportions to output.

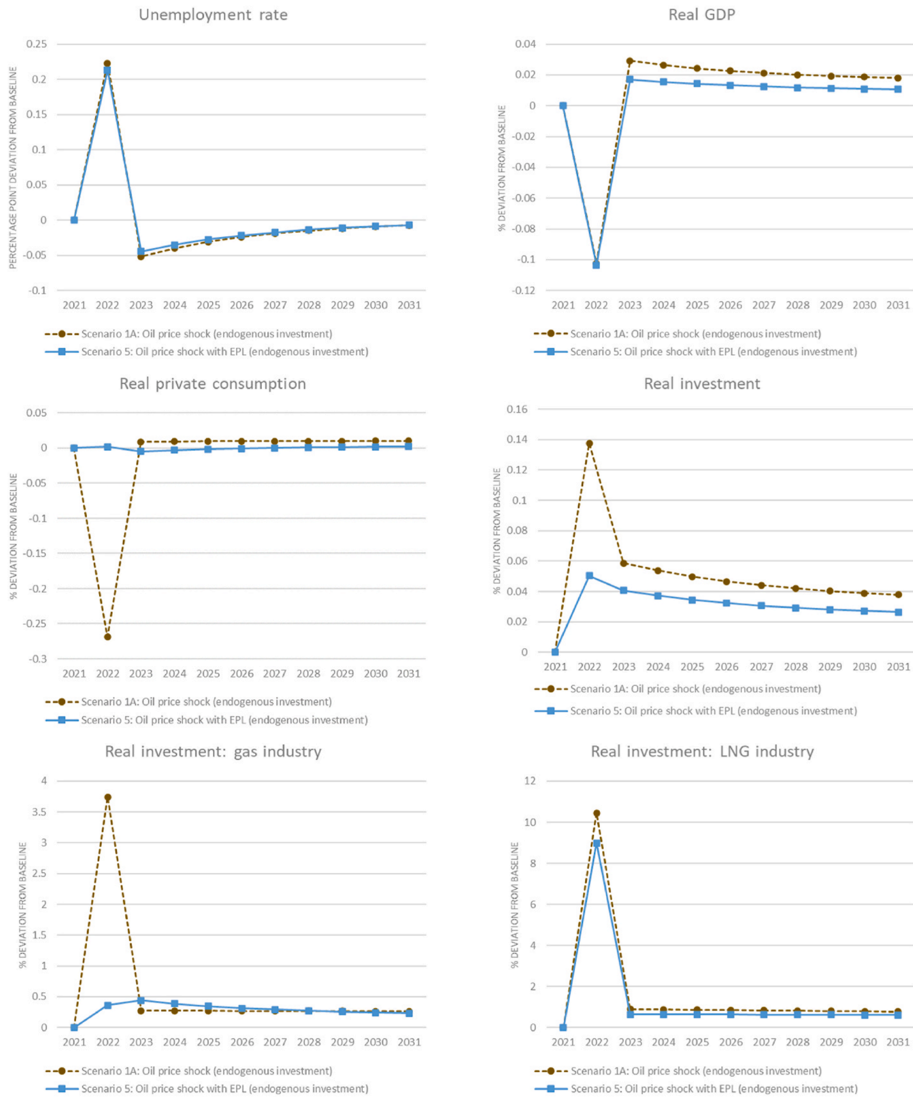

Fig. 7. Oil price shock (Scenario 1A) and an Energy Profits Levy (Scenario 5), rate of return sensitive industry-specific investment, deviation from baseline.

We then investigate and compare the capacity of two policy responses, a 50% FEC and a 25% EPL, to attenuate the adverse economic impacts of the oil price shock. We find that an FEC stimulates economic activity, but it is costly and thus drives a revenue shortfall. As expected, the funding mechanism adopted has implications for household consumption. Hence, the capacity of an FEC to smooth household consumption depends on whether the government has the fiscal capacity to run a deficit-financed tax cut. Policymakers must also consider the long-term cost of a deficit-financed FEC, which results in an increased national debt burden.

Additionally, by calculating the excess burden, we conclude that the allocative efficiency gain from an FEC is relatively small, and increased oil prices further compromise the merit of an FEC because it is a specific tax. Oil price spikes function as a self-cut in the ad-valorem equivalent fuel excise rate, diminishing its allocative inefficiency.

Finally, we examine the impact of an EPL on the mostly foreign-owned oil, gas and LNG industries as an alternate response to an FEC. We adopt two seperate assumptions regarding the endogeneity of oil, gas and LNG sector investment. By reorienting part of the windfall gains due to high energy prices from largely foreign-owned energy producers to domestic households, we find that an EPL could help households cope with the financial hardship caused by higher energy prices, without costing the budget. Our findings suggest that an EPL would be a useful addition to the taxation toolbox for policymakers in energy-exporting countries, particularly in cases where largely foreign-owned sectors experience windfall gains. Nevertheless, we restrict our focus to analysing the key resource redistribution mechanism of such a policy within a CGE modelling framework. Various other potential implications and difficulties that arise when considering its practical implementation, which are beyond the scope of this paper, will need to be taken into account by policymakers.

With regard to limitations and future work, our study was motivated by the dynamics of global oil prices in 2022, and thus we restrict the scope of our fiscal response assessment to temporary oil price increases caused by unexpected oil supply shortages. Over the last decade, the international oil market has also experienced periods of significant price reduction, driven by various factors. For example, the large oil price declines since mid-2014 were mainly caused by negative demand-side shocks (Baumeister and Kilian, 2016). Oil prices also fell significantly in 2020, driven by both demand contraction and supply stimulus. On the demand side, the Covid-19 pandemic slowed global economic growth. This coincided with a boost to oil supply arising from the Russia-Saudi Arabia oil price war (Ma et al., 2021). In these periods, falls in global oil prices created fiscal challenges for oil-exporting countries, which faced revenue losses, while governments of oil-importing countries gained fiscal space to consider how best to use the windfall gains from lower oil prices. Asymmetries in oil shock scenarios and policy responses are, however, beyond the scope of the present paper.

Secondly, our fiscal policy assessment is based on the case study of Australia, an oil-importing country characterised by an energy market with oil-gas price linkages and a largely foreign-owned LNG sector. With this structure in place, this study provides valuable insights for policymakers in Australia and other resource-rich, oil-importing countries. We emphasise the importance of appropriate recognition of industry and energy sector details when considering energy shocks and their economic consequences. We thus caution against direct transposition of our findings to countries with significantly different energy market structures, import demands, and foreign ownership patterns. Our study does not propose a set of one-size-fits-all policy suggestions. Instead, we underscore the importance for policymakers to devise fiscal measures that are tailored to an economy's specific energy and industry profile.

Furthermore, policy consistency is one significant practical challenge when it comes to crafting the actual implementation of an energy profits levy, or any measure that aims to redistribute excess profits made by resource producers and exporters from temporary higher prices. To minimise concerns, a clear perspective for windfall profits taxes should be set out, so its role within the broader taxation system is well understood. Reactionary tax mix changes may compound uncertainty, impairing investor confidence both in the short- and long-run. In this regard, much depends on how energy investors form their ex-ante expectations of future energy prices and their volatility. Price spikes, offset by price slumps, might be embedded in such expectations, in which case a tax on "unexpected" profits might well damp investment permanently, if it is not symmetrically matched by tax offsets in situations of "unexpected" profit slumps. Finally, solid monitoring and regulation might be necessary to ensure a temporary profit tax is not passed to domestic consumers.

CRediT authorship contribution statement

Xianglong Locky Liu: Conceptualization, Methodology, Data curation, Software, Formal analysis, Visualization, Writing – original draft. **Jason Nassios:** Conceptualization, Methodology, Data curation, Formal analysis, Validation, Writing – review & editing. **James Giesecke:** Methodology, Investigation, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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