What is the effect of an oil price decrease on the Norwegian economy?*

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Abstract

In this note we summarize the effect of a fall in oil prices on a small oil producer; Norway. The results are based on the model put forward in Bjørnland and Thorsrud (2014). We separate between two orthogonal shocks that can drive oil prices; A global activity (i.e., demand) shock and a commodity specific price (i.e., supply) shock. We first briefly explain the main implications of the model, before tracing out the effects of a fall in oil prices of 25 percent. In the end we compare the results with some previous studies analysing the effects of an oil price shock on the Norwegian economy.

Our results show that if oil prices fall by 25 percent due to a decline in global activity, the Norwegian economy may be quite severely affected, as both demand for petroleum and global demand for goods and services decline. In this case we could expect GDP (mainland economy) in Norway to fall by 2-2.5 percent. If, however, the decrease in oil prices is due to increased supply of petroleum in the world market, oil importers benefit from the lower oil price, so that demand for other products increase. Hence, in this case, the negative impact on the Norwegian economy is less severe, and GDP Mainland economy could fall by only 0.5 percent.

JEL-codes: C32, E32, F41, Q33

Keywords: Resource boom, commodity prices, Dutch disease, learning by doing, two-speed economy, Bayesian Dynamic Factor Model (BDFM)

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1 Introduction

Norway is a small open economy, but a significant exporter of oil and gas. According to the Ministry of Petroleum and Energy, Norway is today the 7th largest producer of oil and the 3rd largest producer of gas in the world. The petroleum industry is also Norway's largest industry. It represented more than 23 per cent of the country's total value creation in 2012. The revenues from the petroleum sector constitute 30 percent of the state revenues.[1]

Being a major oil and gas exporter, one would expect that a substantial decline in oil prices, like the one witnessed so far this year, may eventually hit the Norwegian economy hard. Looking at simple correlations in Table 1 however, indicates only a weak (although significant) positive correlation between (the growth rate) in oil prices and economic activity in Norway. Similar results are also found for resource rich Australia, although the correlation is even smaller (and not significant for aggregate output), most likely as their resource sector is more diverse.

Table 1. Correlations with commodity price

Country	**Variable**			
	Y	**YR**	**M**	**ME**
Norway	0.28 (0.02)	0.08 (0.53)	0.38 (0.00)	-0.09 (0.47)
Australia	0.14 (0.21)	0.05 (0.63)	0.23 (0.03)	-0.09 (0.41)

Note: The table reports the contemporaneous correlations coefficients (p-value in parenthesis) between commodity prices and non-resource GDP (y), resource GDP (YR), value added in Manufacturing (M), and employment in Manufacturing (ME). The raw data is measured as four-quarter logarithmic changes. The sample is 1991:Q1 - 2012:Q4 and 1996:Q1 - 2012:Q4, for Australia and Norway, respectively

Correlations, however, do not provide the full answer. Recent studies suggest that the sources driving oil prices are important when assessing the effect of an oil price shock on the global economy,[2] and we expect, ultimately also on the Norwegian economy. In particular, if the decrease in oil prices is due to increased supply of petroleum in the world market, oil importers may actually benefit from the lower oil price, so that demand for other products increase. Hence, in this case, the negative impact on the Norwegian economy may be less severe, suggesting also smaller correlation (in absolute value) between oil prices and economic activity in Norway. However, if the fall in oil prices is due to a decline in global activity, the Norwegian economy may be more severely affected as now both demand for petroleum and global demand for goods and services decline.

[1] Oil has been produced on the Norwegian continental shelf since the Ekofisk field opened 9 June 1971. So far Norway has produced about 42 percent of our resources, according to the Ministry of Petroleum and Energy. Thus there is still a huge potential for value creation on the Norwegian continental shelf. The Ekofisk field is still one of the largest Norwegian oil producing fields and the production will continue until 2050.

[2] See Hamilton (1983, 2009), Barsky and Kilian (2002), Kilian (2009) and Aastveit et al. (2014) for discussions on this issue.

In Bjørnland and Thorsrud (2014), we examine the implication of these different shocks for the Norwegian economy and confirm the hypothesis from above. In particular, when a change (i.e. rise) in the commodity price is associated with an increase in global demand, there is a large and positive spillover effects on the Norwegian economy, and vice versa when global demand falls. However, commodity price increases/decreases unrelated to global activity have smaller effect on the Norwegian economy, in part because of substantial real exchange rate appreciation/depreciation and reduced/increased competitiveness.

In addition to the two shocks affecting oil prices, we also identify a shock related to the activity in the resource sector, which is contemporaneously unrelated to domestic activity. Activity in the petroleum sector may change due to, say, new technology or the discovery of new resources, see eg. Corden (1984). Our results show that shocks to the booming resource sector has implied significant and positive productivity spillovers on non-resource sectors, effects that have not been captured by previous analyses.[3] While we do not focus on the implications of a resource boom shock in this note, we claim that the identification of the shock is important to properly capture the interaction between the resource sectors and the different branches of the economy.

Below we will briefly summarize the model and data used in Bjørnland and Thorsrud (2014), before spelling out in more detail, in Chapter 4, how a commodity price (i.e. supply) shock and a global activity (i.e. demand) shock implied by the model affect the Norwegian economy. For simplicity, we first look at responses to shocks that are normalized to increase the oil price (as in Bjørnland and Thorsrud (2014)). In some of the graphs, we compare results to another resource rich country; Australia. In Chapter 5, we turn the responses on their head, and specifically ask: What are the effects of a 25 percent fall in oil prices on the Norwegian economy due to i) A fall in global demand or ii) A commodity specific price shock due to say an increase in supply of oil. Chapter 6 finally compares the results with some previous studies analysing the effects of an oil price shock on the Norwegian economy, including Bjørnland (2000) and Peersman and Van Robays (2012).

2 The model

The traditional literature on the Dutch disease typically predicts an inverse long run relationship between the exploitation of natural resources and the development in the traded sector (i.e., manufacturing), see Corden (1984) for an overview of the literature. The negative effect comes about from a movement of resources out of the traded and non-traded sector and into the booming sector that extracts the natural resource (*Resource Movement Effect*). There will also be indirect (secondary) effects of increased demand by the sectors that produce goods and services for the booming sector (*Spending Effect*). This will cause a real appreciation that will hurt the traded sectors.

[3] More than 35 percent of the business cycles and about 50 percent of the productivity changes in the mainland economy are explained by activity in the resource sector. What is more, value added and employment both increase in the non-traded relative to the traded sectors, suggesting a two-speed transmission phase. The most positively affected sectors are construction, business services, and real estate.

A limitation of the traditional Dutch disease literature is that is assumes productivity to be exogenous to the model. However, in some resource-rich countries, the exploitation of natural resources could have substantial productivity spillovers to the other sectors in the economy. For example, as the development of offshore oil often demands complicated technical solutions, this could in itself generate positive knowledge externalities that benefit some sectors. If these sectors trade with other industries in the economy, then there are likely to be learning-by-doing spillovers to the overall economy.

In Bjørnland and Thorsrud (2014), we develop a model that allows for direct productivity spillovers from the natural resource sector to both the traded and non-traded sector. In addition, we assume there is learning by doing (LBD) in the traded and non-traded sectors, as well as learning spillovers between these sectors. While the introduction of the direct productivity spillover is new, the LBD mechanism is similar to that developed in Torvik (2001). Our model has two implications for the dynamic adjustment after a resource boom. First, when the resource boom crowds in productivity spillovers in the non-resource sectors, productivity (and production) in the overall economy will increase. Second, learning-by-doing spillovers between the traded and non-traded sectors may enforce this mechanism, by allowing productivity in the non-traded sector to increase relative to the traded sector. Hence, we could expect to see a two-speed adjustment in the process, with the non-traded sectors growing at a faster pace than the traded sector.

In the model set up, we assume that a shock to the resource sector (resource boom) can be thought of as happening as either an (unpredicted) technical improvement in the booming sector, represented by a favourable shift in the production function, or, as a windfall discovery of new resources. In addition we will also allow real commodity prices to potentially affect activity in the resource sector (either through a shock to global demand or to supply). Hence, we separate between a windfall gain due to activity and prices, and let the data decide on the relative importance of these shocks in estimating Norwegian business cycle fluctuations.

3 Theory meets empirical model

The empirical analysis uses a Bayesian Dynamic Factor model. The dynamic factor model includes four factors with associated shocks that have the potential to affect all sectors of the economy. Two shocks will be related directly to the Dutch disease literature: a *resource boom/activity shock* and a *commodity price shock* (we use the terms resource booms and resource activity shocks interchangeably). Here, the former is similar to the exogenous shocks to activity in the resource sector, while the latter is what is commonly used in the empirical (time series) literature on Dutch disease. In addition, we allow for a *global activity shock* and *domestic (non-resource) activity shock*. The global activity shock controls for higher economic activity driven by international developments. Importantly, the global shock also allows for higher commodity prices due to increased global demand for commodities. As such, the commodity price shocks themselves should be interpreted as shocks unrelated to global activity, that can change the commodity price on impact. Lastly, the domestic activity shock controls for the remaining domestic impulses (tradable

and non-tradable) contemporaneously unrelated to the resource sector.

The factors and shocks will be linearly related to a large panel of domestic variables, including both tradable and non-tradable sectors of the economy. Generally, within the DFM framework, the factors are latent. In our application two of the factors are treated as observables, namely global activity and the real commodity price. The two domestic factors are treated as unobservable and have to be estimated based on the available data.

3.1 Data

To accommodate resource movement and spending effects, we include a broad range of sectoral employment and production series. Although we can construct labour productivity estimates directly from our model estimates (since we include both production and employment at the sectoral level), we also include productivity as an observable variable. Naturally, we also include the real exchange rate, which is a core variable in the Dutch disease literature. To account for wealth effects, and to facilitate the interpretation and identification of the structural shocks, we also include wage and investment series, the terms of trade, stock prices, consumer and producer prices, and the short term interest rate.

In Norway, the real commodity price is the real price of oil, which is constructed on the basis of Brent Crude oil prices (U.S. dollars). In Australia we use the Reserve Bank of Australia's (RBA) Index of Commodity Prices (U.S. dollars). Both commodity prices are deflated using the U.S. CPI. For Norway, we measure global or world activity as the simple mean of four-quarter logarithmic changes in real GDP in Denmark, Germany, the Netherlands, Sweden, the UK, Japan, China, and the U.S. This set of countries includes Norway's most important trading partners and the largest economies in the world. For the same reason we use for Australia: New Zealand, Singapore, the UK, Korea, India, Japan, China, and the U.S.

In sum, this gives a panel of roughly 50 international and domestic data series (for each country), covering a sample period from 1991:Q1 to 2012:Q4 (Australia), and 1996:Q1 to 2012:Q4 (Norway).[4] See Table 2 for details on data and abbreviations.

4 Results

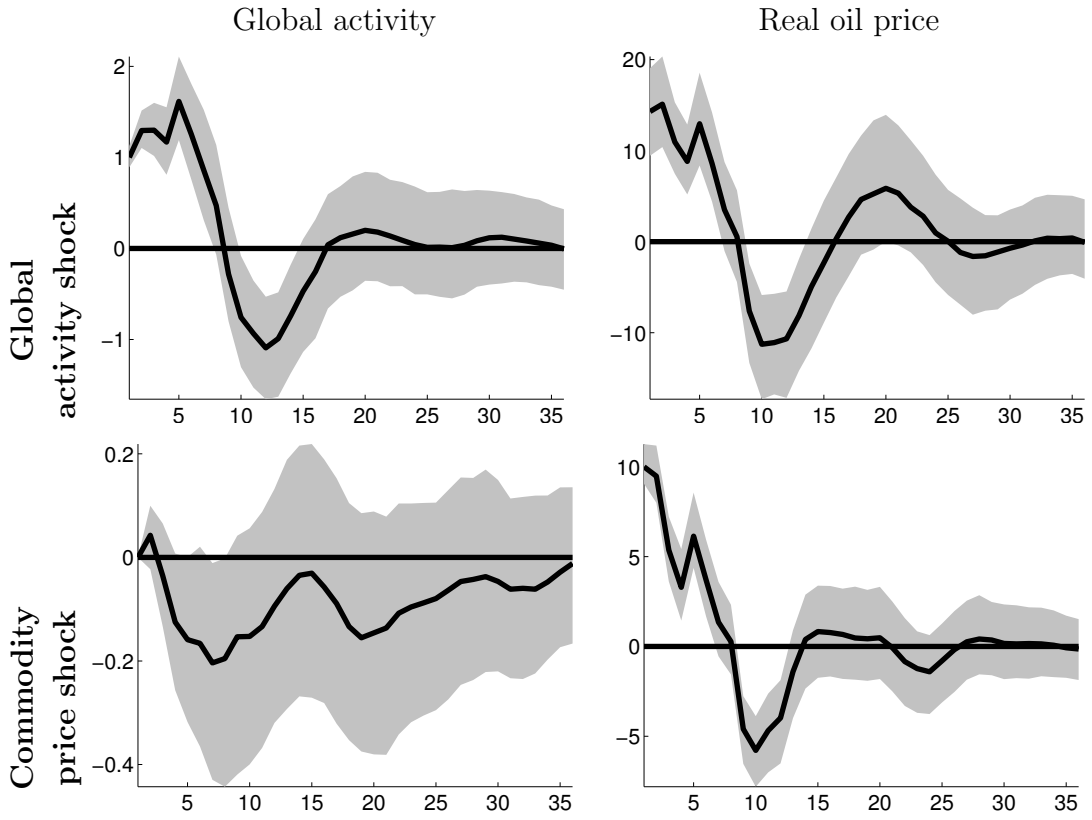
In this section we first present the international impulse responses to the global activity shock and the commodity (i.e., oil) price shock, before investigating the main propagation mechanisms into the Norwegian economy. Finally, we examine sectoral reallocation following the commodity price shock. For comparison, the results for Australia are included in some of the graphs. Note that when presenting the results we follow Bjørnland and Thorsrud (2014) and normalise the shocks to increase oil prices. In Section 5 we will turn the results on the head, and calculate the consequences of a fall in oil prices of 25 percent.

[4]The sample periods reflect the longest possible time period for which a full panel of observables is available for the two countries respectively.

4.1 Global shocks and real oil prices

In Figure 1 we report the impulse responses associated with the international part of the model. As seen there, the international shocks in the model are well identified. That is, the global activity shock increases both the activity level and real commodity prices. In particular, a one percent increase in global activity, increases the real oil price with 12-13 percent initially, for so to die gradually out (after two years). The unexpected commodity price shock, however, generates a temporary inverse relationship between commodity prices and global activity. A ten percent increase in real oil prices, reduces real activity gradually by 0.2 percent.

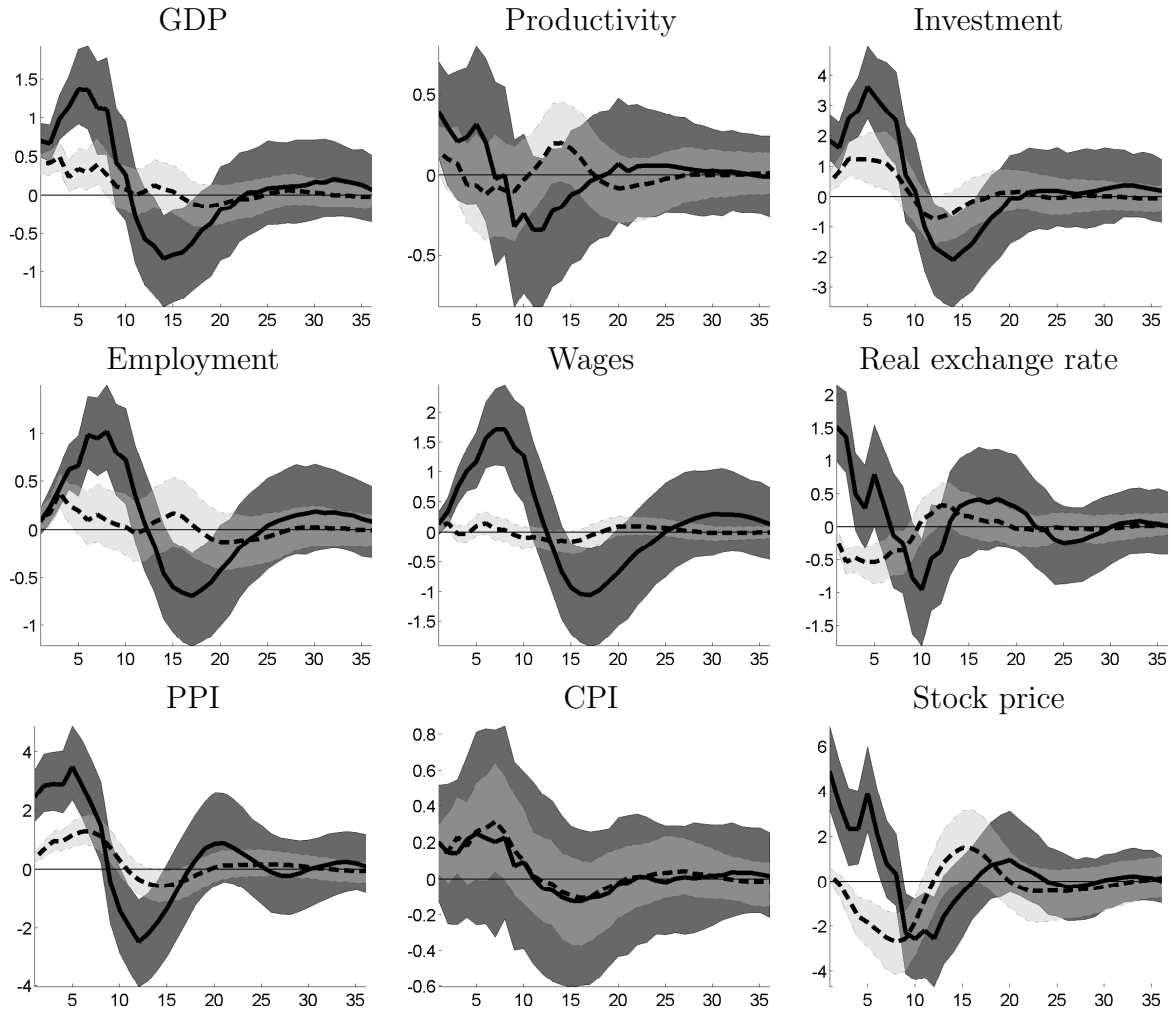
Figure 1. Global impulse responses



Note: The plots display impulse responses in levels. The Global activity shock is normalized to increase global activity by 1 percent, while the commodity price shock is normalized to increase the real price of oil with 10 percent. The black solid lines are median estimates. The grey shaded areas are 68 percent probability bands

The temporary inverse relationship between commodity prices and the international economy (lower left frame) is in line with Hamilton (2009), and the results of a positive link between global demand and commodity prices (upper right frame) is consistent with Kilian (2009), Lippi and Nobili (2012) and Aastveit et al. (2014) among many others.

Figure 2. Norway and Australia. The effect of an increase in commodity prices due to a global activity shock, percent



Note: In each plot, Norway (Australia) is the solid (dotted) line with the associated dark (light) grey probability bands. The global activity shock is normalized to increase the global activity factor by 1 percent. In each plot, Norway (Australia) is the solid (dotted) line with the associated dark (light) grey probability bands.

4.2 Global activity, real oil prices and domestic responses

There are two structural shocks that increase commodity prices, a global activity shock and a commodity (specific) price shock. When the increase in commodity prices is due to a global activity shock, the effect on the domestic economy is primarily positive, as GDP, productivity and employment rise for a prolonged period of time in both countries, see Figure 2. The results for GDP are in line with what others have also found, see e.g., Aastveit et al. (2014). What is interesting to note here, is the large positive effect on the Norwegian economy relative to Australia. As documented in Table 4, global activity shocks explain roughly 55 and 25 percent of the variation in overall activity in Norway and Australia, respectively. This is perfectly in match with the fact that Norway is close to twice as open as Australia by conventional estimates. It is also in line with

the fact that since global demand boosts commodity prices, this may have benefited the more resource rich economy, Norway, to a larger extent. Norway also experienced a temporary appreciation of the real exchange rate following this shock. This may have contributed to keep the inflation rate low. Producer pricer (PPI), on the other hand, increases substantially, as cost of production (including wages) increases. The finding that foreign factors are important, but to varying degrees, for small open economies is also well documented in, e.g., Aastveit et al. (2015) and Furlanetto et al. (2013).

4.3 Commodity prices and domestic responses

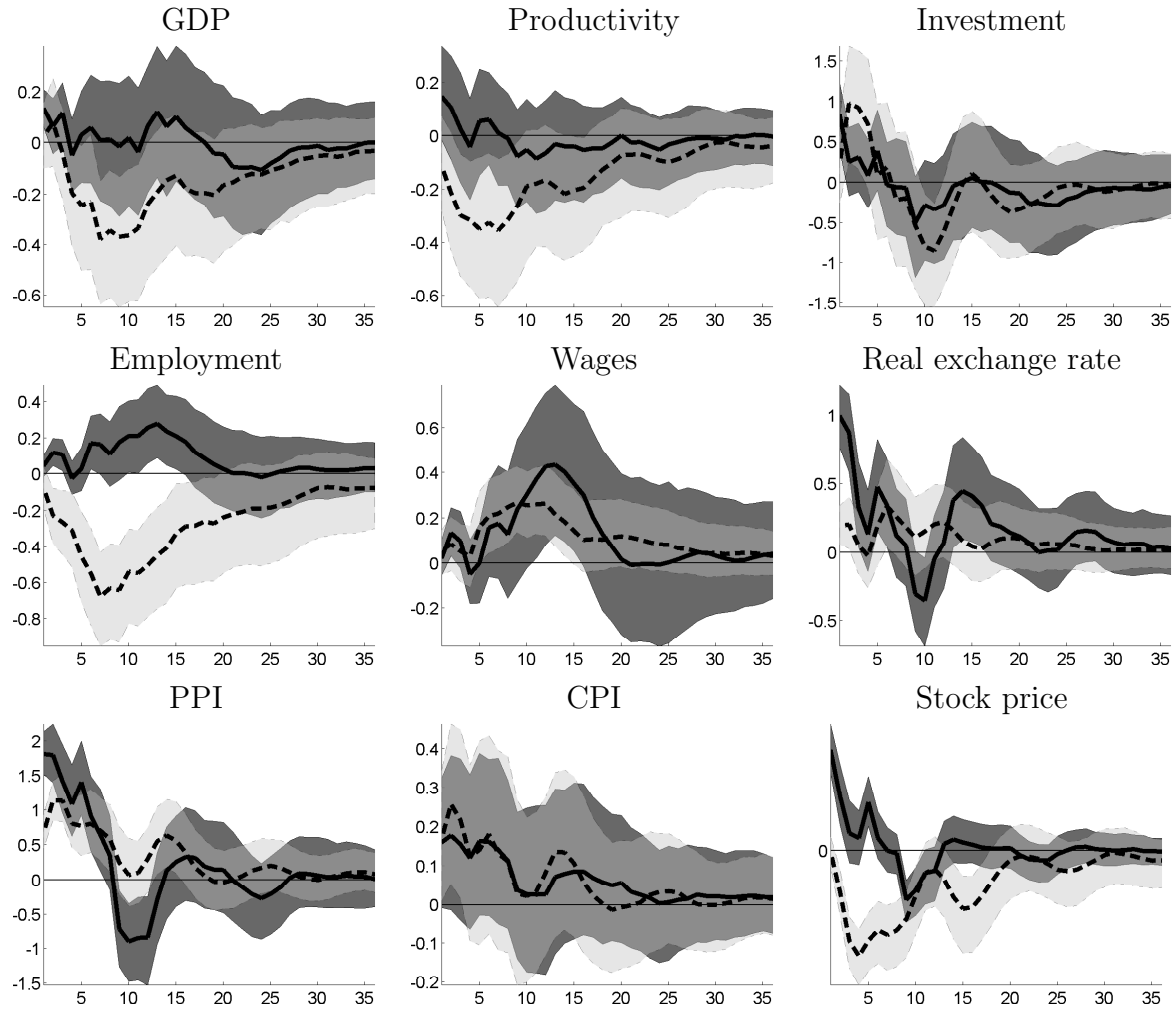
We now turn to the commodity (specific) price shock, which is the shock typically analysed in the empirical Dutch disease literature. An increase in commodity prices due to this shock will be contemporaneously unrelated to global activity. Figure 3 reports the key responses.[5] We note that the effect of a commodity price shock is less favourable. In particular, a commodity price shock has either no effect on productivity (Norway), or affects productivity negatively (Australia).

Furthermore, in Norway, the commodity price increase is strongly associated with a real exchange rate appreciation. Over 60 percent of the variation in the real exchange rate is explained by this shock. The strong appreciation increases cost and reduces competitiveness, and will potentially hurt the sectors exposed to foreign competition. As a consequence, output and employment only increase marginally following this shock. In Australia the commodity shock explains much less of the variation in the exchange rate. Still, the negative productivity effects and modest appreciation of the exchange rate are also coupled with a large drop in employment and production. Our result of an appreciating exchange rate is well in line with the other empirical studies of commodity currencies, see, e.g., Chen and Rogoff (2003).

Finally, investment, in particular, increases temporarily in both countries, most likely as petroleum and mining investment also rise and because the exchange rate appreciates. As discussed in Spatafora and Warner (1999), a commodity price shock can lead to a reduction in the relative price of investment goods, which are predominantly tradable, implying a positive correlation between commodity prices and investment. Wages also gradually increase, suggesting there are spending effects owing to the windfall gains associated with increased commodity prices. The responses in investments, wages, PPI, and CPI are remarkably similar across the two countries. The rise in consumer and producer costs erodes the real effect of spending, and may explain why the commodity price shock has less stimulating effects on the economy (or in the case of Australia, a negative effect). The stock market responses are in line with the fact that the shock has a positive effect on overall activity level in the Norwegian economy, but a negative effect on the Australian economy. While the fall in the stock price index for Australia might seem surprising, it is also found in, e.g., Ratti and Hasan (2013). Moreover, asset prices

[5]Following the standard convention in the oil market literature we have normalized the commodity price shock to an initial 10 percent increase in the real price of oil (Norway). Since the standard deviation of the commodity price index is half the size of the real price of oil, we have normalized the shock to the commodity price index to an initial 5 percent increase.

Figure 3. Norway and Australia. The effect of an increase in commodity prices due to a commodity specific price (i.e. supply) shock, percent



Note: In each plot, Norway (Australia) is the solid (dotted) line with the associated dark (light) grey probability bands. The commodity price shock is normalized to increase the real price of oil (commodity price index) with 10 (5) percent.

are the present discounted values of the future net earnings of the firms in the economy. Unexpected commodity price shocks that increase (decrease) the production possibilities for the whole economy should be positively (negatively) related to stock returns.

To sum up, the commodity price shock affects costs and wages across the two countries in the same manner, but has a clear negative effect on production and employment in Australia. This is evidence of more classical Dutch disease-like symptoms. In Norway, however, the responses are more positive, and as shown below, suggesting a two speed development rather than Dutch disease.

4.4 Dutch disease or two-speed boom?

In Figure 4 we display the detailed responses in value added and employment across a large panel of sectors to a commodity price shock in Norway.[6]

Figure 4. Norway: Sectoral responses

Note: Each plot displays the quarterly average of each sector i's response (in levels) to the different shocks. The averages are computed over horizons 1 to 12. The resource activity shock is normalizes to increase the resource activity factor by 1 percent, while the commodity price shock is normalized to increase the real price of oil by 10 percent. White bars indicate that the shock explains less than 10 percent of the variation in the sector

Overall, the results presented in the figure show that the commodity price shock have contributed to turn Norway into a two-speed economy, with some industries growing at a fast speed and others growing more slowly, or in fact declining. Sectors such as scientific services and manufacturing are among the most positively affected. This is interesting, as these sectors are also technology intensive and enjoy spillovers from the significant boost in petroleum investments following from the commodity price shock. As offshore oil often demands complicated technical solutions, the shock generated positive knowledge externalities that benefited employment in these sectors in particular. Furthermore, the public sector is also positively affected, suggesting the presence of a substantial spending effect. In light of the higher commodity prices of the past decade, this can have worked to boost demand in the Norwegian economy relative to other oil-importing countries. However, the increased spending could also suggest why cost competitiveness has declined and may be a concern in the long run.[7]

Finally, a natural question arises after reading these results: Why does a commodity price shock affect the two commodity exporting countries so differently? One suggestion, is that offshore oil may demand complicated technical solutions, a process which generates

[6]The figure displays the quarterly average of each sector's response (in levels), while white bars indicate that the shock explains less than 10 percent of the variation in that sector.

[7]Note that much of Norway's petroleum income is directly managed by the Norwegian Petroleum Fund, a specially created body with the express purpose of shielding the domestic economy from potential spending effects caused by the resource endowment. A fiscal rule, however, permits the government to spend approximately 4 percent of the fund (expected return) every year.

positive knowledge externalities. This may have benefited petroleum producer Norway to a larger extent than mining abundant Australia.

Another possible answer to this question is the role of the governmental sector. As seen from Figure 4, value added and employment in the public sector responds positively to a commodity price shock. In fact, almost 50 percent of the fluctuations in the activity in the public sector and 20 percent of the fluctuations in employment in the public sector in Norway can be explained by the commodity price shock, see Table 6 for the exact numbers. In Australia, however, value added in the public sector falls slightly following the same shock, suggesting a more contracyclical pattern (see Bjørnland and Thorsrud (2014) for details on Australia). Measuring the size of the public sector as the number of persons employed relative to the total population, we find that the governmental sector in Australia is only one fifth the size of Norway's.[8] Thus, the governmental sector might work as a shock absorber in Norway, simply by virtue of its size. In addition, Norway has a generous welfare system that distributes wealth across the country, as well as a sovereign wealth fund, explicitly funded by petroleum revenues, which allows for extra spending of petroleum income when business cycles turn bad (as it does internationally after a commodity price shock).

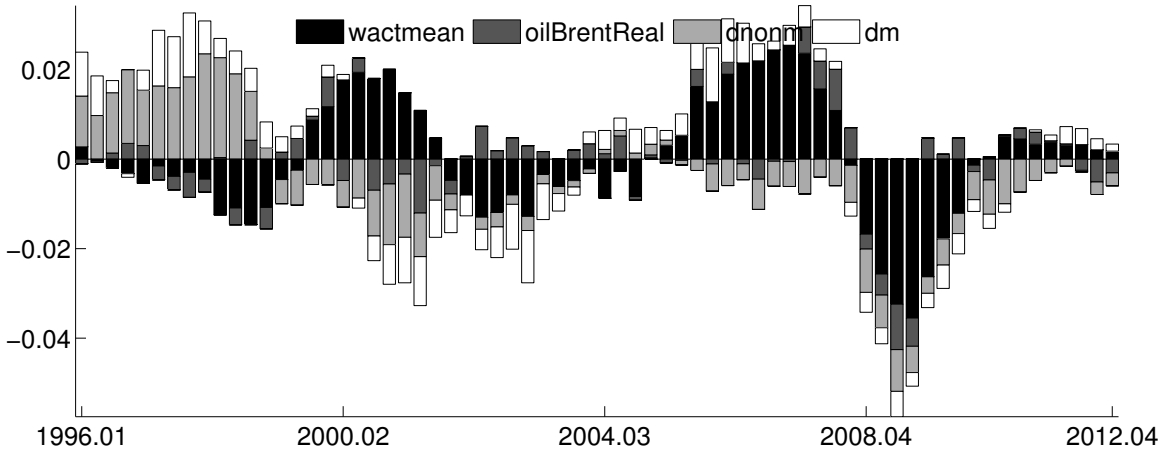
4.5 Historical decompostion

The results presented thus far reflect average responses over the sample analyzed. In Figure 5, we show that the structural shocks are also well identified in terms of timing. In particular, the figure displays the model's historical decomposition of the domestic factor representing the non-oil economy. As seen in the figure, oil activity shocks stimulated the Norwegian economy, particularly from the middle of the 1990s and until 2000 (after which there was a temporary cyclical decline in oil activity), and again during the economic upswing beginning around 2004. However, while the period of high economic growth in the middle and late 1990s can in large part be explained by increased oil activity, the high growth period predating the financial crisis was primarily driven by increased global demand and oil specific shocks, which both drove up oil prices. The windfall gain from higher oil prices stimulated investment in the petroleum sector and thereby also the mainland economy through spillover effects. However, by the end of 2008, Norway was affected by the financial crisis. The subsequent downturn was primarily caused by negative global demand as well as by oil specific shocks (that lowered oil prices) and oil activity shocks. The return to trend growth was gradual, with positive contributions from oil specific shocks. From 2011, global demand again contributed positively to the mainland economy (again via higher oil prices).

For the reader with detailed knowledge of the Norwegian economy, Figure 5 presents a reasonable story of a country that has benefited from increased activities in the North Sea, albeit with cyclical up and downturns. However, the negative or only mildly positive contribution from the oil activity shocks since 2006/2007 provides some cause for concern. To the extent that an oil boom is associated with productivity dynamics (that positively

[8]The same holds if we compare the number of persons employed in this sector to the total number of persons employed.

Figure 5. Historical shock decomposition: Non-oil activity Norway



Note: The figures report the accumulated contribution of each structural shock to the growth in the non-oil activity factor. wactmean = global activity (i.e, demand) shocks, oilBrentReal = commodity price (i.e. supply) shocks, dnonm = resource activity shocks and dm = domestic activity shocks.

affect value added in the overall economy), the muted role of these shocks suggests that that productivity spillovers have declined recently. This is consistent with the view portrayed in Olsen (2013) of a slow down in productivity growth since 2005. Furthermore, labor input per hour worked has also declined in recent years relative to Norway's trading partners. Thus, while the enhanced linkages from both the oil sector and energy prices have been positive for growth and employment in the Norwegian economy for nearly two decades, the declining productivity spillovers coupled with increased costs could be a major concern in the long run.

5 What happens if the oil price falls by 25 percent?

The results reported above were normalised to increase the oil price. Now we trace out the effect of a fall in oil prices. In particular, we normalise the shock to decrease the real oil price with 25 percent. So far this year, Brent crude oil prices have fallen with 22 percent (nominal terms), from 110 USD per barrel in January, to just above 85 USD in October.

To analyse what such a decline will imply for the Norwegian economy, we again separate between a decline in oil prices that is due to (i) a shock that reduces global activity, and, (ii) a negative commodity specific shock. We emphasize that the estimates are uncertain and that we below only report the median estimates. We first summarize the responses, before graphing some impulses in the end.

Starting with the effects of a decline in oil prices due to a contraction in global activity, we find that they may have a substantial effect on the Norwegian economy.

The effect of a global activity shock (fall in global activity of 1.5-2 percent) that reduces oil prices with 25 percent:

- Reduce investment in mainland economy with 4-6 percent after two years
- Reduce employment in mainland economy with 1.5-2 percent after two years
- Reduce wages in the mainland economy with 2.5-3 percent after two years
- Depreciate the real exchange rate with 2.5-3 percent on impact
- Decrease the stock price with 8-9 percent on impact
- Reduce GDP in the mainland economy with 2-2.5 percent after two years
- Reduce CPI inflation with 0.4-0.5 percentage points after 1-2 years

If, however, the fall in oil prices is due to a commodity price shock (e.g., increase in supply of the resource), the effects on the Norwegian economy will be less negative, as now the international economy (in particular oil importers), will be stimulated by the decline in oil prices.

The effect of commodity price shock (e.g., increase in supply of the resource) that reduces oil prices with 25 percent:

- Reduce investment in mainland economy with 1.5-2 percent (the first year)
- Reduce employment in mainland economy with 0.9 percent after 2-3 years
  - In particular, employment in scientific services, manufacturing, and accommodation and food service activities (hotel etc).
- Reduce wages in the mainland economy with 1 percent after 2-3 years
- Depreciate the real exchange rate with 2.5 percent on impact
- Decrease the stock price with 7-8 percent on impact
- Reduce GDP in the mainland economy with 0.5 percent after two years
  - In particular, value added in scientific services
- Reduce CPI inflation with 0.3-0.5 percentage points after 1-2 years

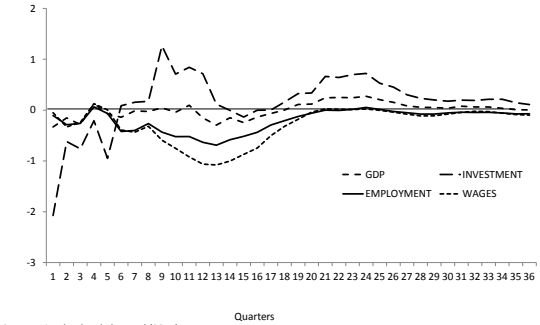
Figure 6 displays the responses to some domestic variables in the mainland economy (GDP, investment, employment and real wages) to the global activity and oil price shocks, while Figure 7 displays the responses in the real exchange rate and stock price to the same two shocks. As summarized above, it is interesting to observe that while the real economy variables respond differently to the two shocks, the financial variables respond more similarly to the two shocks. In particular, independent of what shock reduces oil prices with 25 percent, the stock price falls by approximately 8 percent on impact, while

Figure 6. The effect on the **mainland economy** of a 25 percent temporary decline in oil prices due to global activity and oil price shocks, percent

a) Global activity (i.e., demand) shock

Source: Bjørnland and Thorsrud (2014)

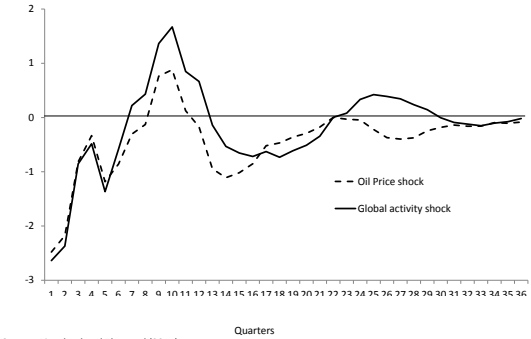
b) Oil price (i.e., supply) shock



Source: Bjørnland and Thorsrud (2014)

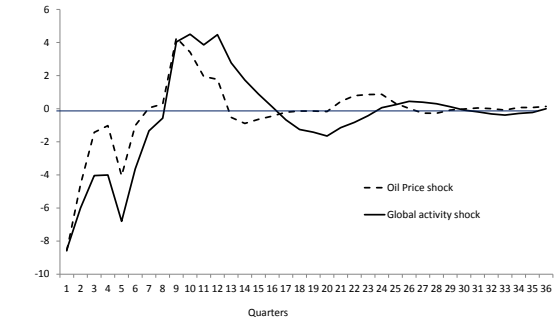
Figure 7. The effect on the **real exchange rate** and **stock prices** of a 25 percent temporary decline in oil prices due to global activity (i.e., demand) and oil price (i.e. supply) shocks, percent

a) Real exchange rate



Source: Bjørnland and Thorsrud (2014)

b) Stock price



Source: Bjørnland and Thorsrud (2014)

the real exchange rate depreciates with 2.5-3 percent. The effect on the domestic economy, however, will be more delayed, and will depend on how the global economy respond.

Finally, note that the effects reported above are average responses to the identified shocks over the last 18 years. If history repeats itself, these are the responses one can expect to observe on average. Uncertainty bands reported in the figures, however, suggest that the responses are dispersed, in particular following the oil price (i.e., supply) shock.

Other factors

Going forward, there could be additional factors that can imply milder or more severe effects from oil price shocks on the Norwegian economy relative to the average responses reported. Below we provide a brief discussion. The list is not exhaustive.

- A decline in oil prices may have less negative effect on the Norwegian economy, at least in the short run, if, for instance, monetary and fiscal policy become more expansionary in the recession than they have been on average in the past. This could increase domestic demand and spending temporarily. However, the long term effects of such expansionary policy are more uncertain. Fiscal and, in part, monetary policy have been expansionary since 2008, suggesting there is not too much added effect on the domestic economy from the additional stimulus. In addition, cost in the mainland economy is already high, and may quickly erode the real effect of the extra spending. Also, if the inflow to the Petroleum fund declines (with lower oil prices), this could imply a strain on return and public spending going forward. This latter effect will of course depend on the sources of shocks hitting the global economy and the investment strategy of the fund.

- Real wages and the real exchange rate have responded quite substantially in the past to shocks to the oil pries. Much of the adjustment, however, has been in a period when oil prices have increased, implying an appreciated exchange rate and higher wage growth. With a fall in oil prices, the model will assume that the real exchange rate will depreciate on impact while real wages will eventually drop. While the exchange rate has already adjusted substantially (NOK has depreciated by more than 6 percent relative to many of its trading partners so far in 2014), wages may be more rigid adjusting downwards. In this case, purchasing power and domestic demand may not contract by as much as we suggested above. On the other hand, competitiveness may not improve as much either, which will hurt the tradeable sector, and eventually, the whole economy.

- In the data, a commodity price shock decreases the oil price for 1.5-2 years on average, before the effect has died out. If the decline in oil prices will be more permanent, as some market analysts think, we may expect to see more persistent negative effects also on the Norwegian economy in the adjustment process that follows. The planned exploration of new fields may also be postponed/terminated. This effect is hard to quantify.

- Finally, in the analysis above, we have examined the effects of different shocks separately. Clearly, more than one shock can happen at the same time, as seen in the historical decomposition in Figure 5. For instance, a decline in demand (from China) can reduce oil prices, but so could also increased production of shale oil in the US (and added production from Libya).

  On top of that, we could observe a decline in investment activity in the petroleum sector, driven by the current high cost. Plans for 2015 suggest a substantial contraction in oil exploration. If this comes on top of the decline in oil price, the effect

on the Norwegian economy could be severe. Figure 5, however, suggests that the productivity spillovers from activity in the North Sea have already declined somewhat. Instead, much of the recent stimulus to the economy has come though higher oil prices that have contributed to increase cost. A process that improves cost competitiveness and productivity could therefore actually turn out to be beneficial for the petroleum sector, and, potentially also the mainland economy, at least in the medium to long run. The development of the new gigantic oil field Johan Sverdrup in the North Sea the next few years, could be a test in that regard.

6 What do other studies find

Bjørnland (2000) analyses the effect of an oil price shock in the period 1967-1995. She finds that a decrease in oil prices of 25 percent, will reduce GDP in mainland economy in Norway by approximately 0.8-1.0 percent after one year, which is slightly higher than our results (to the oil (supply) price shock). The difference could be due to the fact that the period in Bjørnland (2000) starts in the late 1960s, including then relative more supply shocks than our sample, in particular the supply driven oil price booms in the 1970s, and the severe decline in 1986 (recall that our estimation period is 1996-2012). Her study compares Norway to the UK, Germany and the US, and shows that the other countries behave as oil importers, where activity increases significantly following an oil price decrease. This is also in line with our results. The study allows global demand (in the model for the US) to affect oil prices with a lag, but does not examine explicitly the effect of such a demand shock for the development of the Norwegian economy. This could be another reason why she finds stronger effects of the supply shock on the Norwegian economy, at least compared to this study that allows for both demand and supply shocks to affect oil prices instantaneously, and hence also the Norwegian economy.

Using a more recent sample and a battery of linear and non-linear specifications, Jiménez-Rodríguez and Sanchez (2005) also finds that the Norwegian economy is procyclical with oil prices, and the results are in line with ours (for supply shocks): An exogenous fall in oil prices of 25 percent, will decrease mainland GDP with 0.5-0.8 percent, depending of the exact specification.

Bjørnland (2009) focuses on the effect of an (exogenous) oil price shock on the stock price during the period 1993-2006, and finds that a 25 percent fall in oil prices will imply an instantaneous drop in the stock price (measures by OSEBX) of 7.5-9 percent. Focusing on a more recent sample starting in 1999, the effect is even larger, as the stock price will fall by 10-13 percent following a 25 percent decline in oil prices.

Peersman and Van Robays (2012) separate between different sources of oil price changes, and find that a 25 percent (persistent) decrease in oil prices due to increased oil supply will reduce GDP in Norway with 0.8 percent, while the exchange rate will depreciate with 2.5 percent. These results are also quite similar to the results we have reported, and emphasise again the difference between the petroleum exporter Norway and the European oil importers, where GDP is stimulated by the fall in oil prices.

Further, Peersman and Van Robays (2012) find that a 25 percent decrease in oil prices

due to global demand, decreases GDP in Norway by 0.8 percent, while the exchange rate depreciates by 2.2 percent. The effect on the exchange rate is in line with our results following a similar shock, while the effect on GDP is somewhat smaller. This latter finding may be due to the fact that the sample in Peersman and Van Robays (2012) starts in 1986, including a period where demand shocks have been less prevalent in the oil market. Also, as the study does not control for the extent of spillovers between the petroleum sector and the rest of the economy, the results may underestimate the full effect of the global demand shock on the Norwegian economy (while capturing well the instant response in the exchange rate as we also do).

7 Conclusion

Recent studies have suggested that the sources driving oil prices are important when assessing the effect of an oil price shock on the global economy, and thus also on a petroleum producer such as the Norwegian economy.

We show that if oil prices fall by 25 percent due to a decline in global activity, the Norwegian economy may be quite severely affected, as both demand for petroleum and global demand for goods and services decline. In this case we could expect GDP (mainland economy) in Norway to fall by 2-2.5 percent. If, however, the decrease in oil prices is due to increased supply of petroleum in the world market, oil importers benefit from the lower oil price, so that demand for other products increase. Hence, in this case, the negative impact on the Norwegian economy is less severe, and GDP Mainland economy could fall by only 0.5 percent.

In both cases, however, both the exchange rate and the stock prices adjust on impact; The exchange rate depreciates by approximately 2.5-3 percent and the stock price falls by 7-9 percent.

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Appendices

Appendix A Data and Sources

Table 2. Descriptive statistics

	Sector	Norway		Australia		Variable in National Accounts
		Mean	Std.	Mean	Std.	
GDP	Res. extraction	-0.63	6.28	3.73	4.10	Oil and natural gas extraction/mining
	Res. service	6.89	25.65	4.25	12.84	Service activities in oil and gas/mining
	Manufacturing	1.56	3.53	1.03	3.44	Manufacturing
	Construction	3.04	5.02	4.37	7.44	Construction
	Retail	4.39	3.46	3.64	2.18	Wholesale and retail trade
	Transp. ocean	-5.32	16.22			Ocean transport
	Transportation	1.03	5.26	3.66	3.25	Transport activities excl. ocean transport
	Hotel and food	1.76	4.84	2.70	3.80	Accommodation and food service activities
	Financial	3.90	7.88	4.70	3.77	Financial and insurance activities
	Real estate	9.20	10.81	2.66	4.46	Real estate activities
	Scientific	4.12	4.75	4.96	4.43	Professional, scientific and technical activities
	Business	6.79	6.91	3.49	5.29	Administrative and support service activities
	Non-resource	2.79	1.95	3.12	1.73	Total excl. oil and gas extraction/mining
	Public	1.64	1.46	2.65	2.89	General government
Employment	Res. extraction	2.43	5.32	4.69	9.98	See above
	Res. service	11.14	14.30			
	Manufacturing	-0.59	3.35	-0.57	3.14	
	Construction	3.95	4.05	2.81	4.77	
	Retail	1.28	1.99	1.72	2.75	
	Transp. ocean	0.91	2.79			
	Transportation	0.70	2.22	1.50	4.36	
	Hotel and food	1.10	2.70	2.52	3.79	
	Financial	-0.13	2.92	0.85	4.47	
	Real estate	5.98	6.61	2.53	7.25	
	Scientific	3.61	3.75	4.00	5.12	
	Business	5.66	6.32	3.65	6.36	
	Non-resource	1.33	1.54	1.66	1.70	
	Public	1.33	0.92	2.29	4.25	
Other	Wages resource	9.90	6.87	5.13	3.00	Wages petroleum sector/mining
	Wages public	6.04	1.77	4.16	1.40	Wages public
	Wages non-res.	6.06	2.38	4.20	1.55	Total excl. wages to petroleum sector/mining
	Invest. res.	4.52	22.62	12.01	25.47	Investment petroleum sector/mining
	Invest. non-res.	4.06	8.60	5.60	12.43	Total excl. invest. in petroleum sector/mining
	Exchange rate	0.57	4.79	0.11	2.05	BIS effective exchange rate index, broad basket
Int.	World activity	2.78	1.90	4.54	2.10	See text, Section 3.1
	Com. Price	9.01	33.11	2.89	15.64	Commodity price. See text, Section 3.1

Note: The table lists the core variables used in the benchmark model. All activity, investment, wages and employment series are collected from the Quarterly National Accounts database of Statistics Norway and Statistics Australia, respectively. The international series are from Datastream. The real exchange rates are from the Bank of International Settlements (BIS). The moments are computed based on the transformed variables, i.e. $log(x_{i,t}) - log(x_{i,t-4})) \times 100$. *See Section 3.1 for the details.*

Appendix B Additional figures and tables

Table 3. Variance decompositions: Resource sector

		Shock			
	Variable	**Resource activity**	**Commodity price**	**Global activity**	**Domestic activity**
	& Horizon	**4, 8**	**4, 8**	**4, 8**	**4, 8**
Norway	GDP - oil and gas	0.86, 0.65	0.07, 0.09	0.02, 0.15	0.05, 0.10
	Employment - oil and gas	0.59, 0.58	0.33, 0.34	0.07, 0.05	0.01, 0.03
	Wages - oil and gas	0.47, 0.34	0.33, 0.25	0.15, 0.23	0.05, 0.18

Note: Each row-column intersection reports median variance decompositions for horizons 4 (left) and 8 (right)

Table 4. Norway. Resource gifts and domestic variance decompositions

		Shock			
	Variable	**Resource activity**	**Commodity price**	**Global activity**	**Domestic activity**
	& Horizon	**4, 8**	**4, 8**	**4, 8**	**4, 8**
Norway	GDP	0.23, 0.30	0.05, 0.02	0.56, 0.54	0.16, 0.14
	Productivity	0.43, 0.50	0.18, 0.14	0.25, 0.23	0.13, 0.13
	Employment	0.06, 0.09	0.09, 0.07	0.31, 0.44	0.53, 0.39
	Real exchange rate	0.08, 0.16	0.69, 0.63	0.24, 0.21	0.00, 0.00

Note: See Table 3

Table 5. Norway: Wealth, cost and investment variance decompositions

	Variable & Horizon	Shock: Resource activity 4, 8	Commodity price 4, 8	Global activity 4, 8	Domestic activity 4, 8
Norway	PPI	0.01, 0.02	0.67, 0.59	0.31, 0.38	0.01, 0.01
	CPI	0.04, 0.05	0.70, 0.61	0.14, 0.16	0.12, 0.17
	Stock price	0.01, 0.04	0.69, 0.63	0.29, 0.33	0.01, 0.01
	Terms of trade	0.04, 0.07	0.53, 0.41	0.42, 0.50	0.02, 0.02
	Investment non-resource	0.16, 0.28	0.17, 0.07	0.60, 0.60	0.06, 0.05
	Wages non-resource	0.11, 0.11	0.05, 0.03	0.40, 0.54	0.44, 0.32

Note: See Table 3

Table 6. Variance decompositions: Non-resource Sectors

	Variable	Sector & Horizon	Shock: Resource activity 4, 8	Commodity price 4, 8	Global activity 4, 8	Domestic activity 4, 8
Norway	GDP	Construction	0.24, 0.34	0.02, 0.01	0.57, 0.54	0.16, 0.11
		Business	0.24, 0.35	0.13, 0.05	0.51, 0.50	0.12, 0.10
		Hotel and food	0.06, 0.18	0.09, 0.03	0.67, 0.64	0.17, 0.14
		Retail	0.66, 0.72	0.02, 0.03	0.27, 0.22	0.05, 0.03
		Transportation	0.14, 0.24	0.13, 0.06	0.67, 0.65	0.06, 0.06
		Financial	0.33, 0.46	0.45, 0.33	0.20, 0.17	0.02, 0.04
		Scientific	0.06, 0.04	0.42, 0.27	0.44, 0.58	0.08, 0.11
		Real estate	0.08, 0.11	0.78, 0.74	0.14, 0.15	0.00, 0.00
		Manufacturing	0.06, 0.11	0.22, 0.12	0.69, 0.74	0.03, 0.03
		Public	0.03, 0.02	0.49, 0.40	0.07, 0.12	0.41, 0.46
	Employment	Construction	0.21, 0.33	0.15, 0.08	0.50, 0.47	0.14, 0.11
		Business	0.07, 0.13	0.11, 0.04	0.65, 0.68	0.17, 0.14
		Hotel and food	0.26, 0.12	0.13, 0.12	0.34, 0.48	0.27, 0.29
		Retail	0.37, 0.39	0.05, 0.02	0.37, 0.44	0.22, 0.15
		Transportation	0.34, 0.16	0.13, 0.09	0.05, 0.27	0.49, 0.48
		Financial	0.31, 0.33	0.15, 0.11	0.53, 0.51	0.02, 0.05
		Scientific	0.23, 0.10	0.02, 0.06	0.23, 0.45	0.52, 0.39
		Real estate	0.17, 0.19	0.17, 0.05	0.51, 0.62	0.15, 0.13
		Manufacturing	0.09, 0.07	0.15, 0.14	0.26, 0.40	0.50, 0.39
		Public	0.28, 0.16	0.19, 0.18	0.08, 0.15	0.45, 0.51

Note: Each row-column intersection reports median variance decompositions for horizons 4 (left) and 8 (right)