

ECONOMIC COMMENTARIES

The petroleum sector and the Norwegian economy

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Economic developments in Norway between 2000 and 2014 were marked by the steep rise in oil prices in the same period. Demand from oil companies operating on both the Norwegian continental shelf and in the rest of the world increased sharply, contributing to rapid market growth for Norwegian firms specialising in deliveries to the petroleum sector. In 2014, around 300 000 jobs in the Norwegian economy were likely linked to the petroleum sector, nearly twice as many as at the turn of the millennium. In addition, increased petroleum revenues have provided room for higher consumption. In sum, this has boosted revenue growth for Norwegian firms and pushed up wage growth to a level that has been considerably higher than among Norway's trading partners. At the same time, developments have been weak for many firms that are exposed to foreign competition, but that do not supply goods and services to the petroleum sector.

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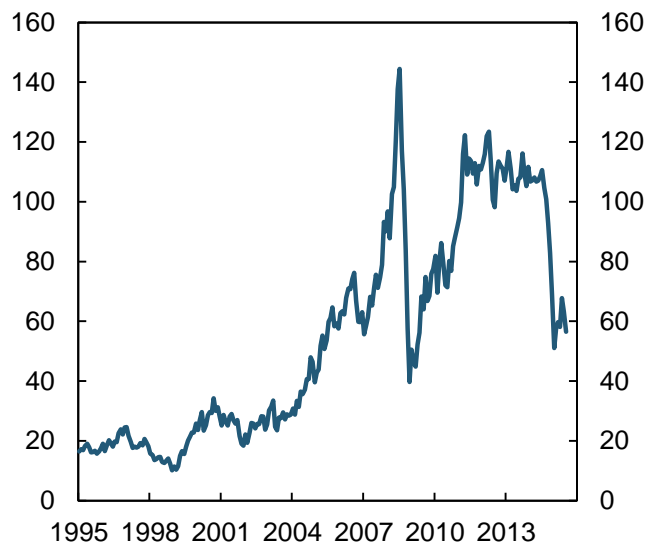
Towards the end of the 1990s, oil prices were below USD 10 per barrel at their lowest. Up until prices began to fall in summer 2014, Norway's most important export commodity had for several years been trading at just over USD 100 per barrel (see Chart 1). To ascertain the impact this price decline will have on the Norwegian economy, a clear understanding of how the preceding years' price rise affected the economy will be useful. The aim of this commentary is to contribute to such an understanding.

First, a simple theoretical framework is outlined, the central point of which is that two types of effects of a higher oil price can be distinguished. First, oil companies' demand for labour and other factor inputs will increase. Second, the overall income level will rise, with an expected increase in consumption. Since not all of this can be covered by imports, firms that produce goods and services that cannot be imported will require more labour. These two effects are discussed in turn. In conclusion, we assess consistency between actual developments in the Norwegian economy and the predictions based on this simple theory.

Theoretical framework

We use the theoretical framework in Cordon and Neary (1982) as presented below. They analyse a small open economy comprising three sectors, each producing its own good.² Two of the goods are

Chart 1: Oil price (Brent Blend). USD per barrel



Source: Thomson Reuters

¹ The authors would like to thank Joakim Blix Prestmo, Kåre Hagelund, Kjetil Olsen, Bjørn Naug, Øystein Sjølie, Ingrid Solberg, Nikka Husom Vonen and Birger Vikøren for useful comments and input. All errors and omissions are exclusively the responsibility of the authors. The text was translated from Norwegian into English by Norman Spencer, staff translator at Norges Bank.

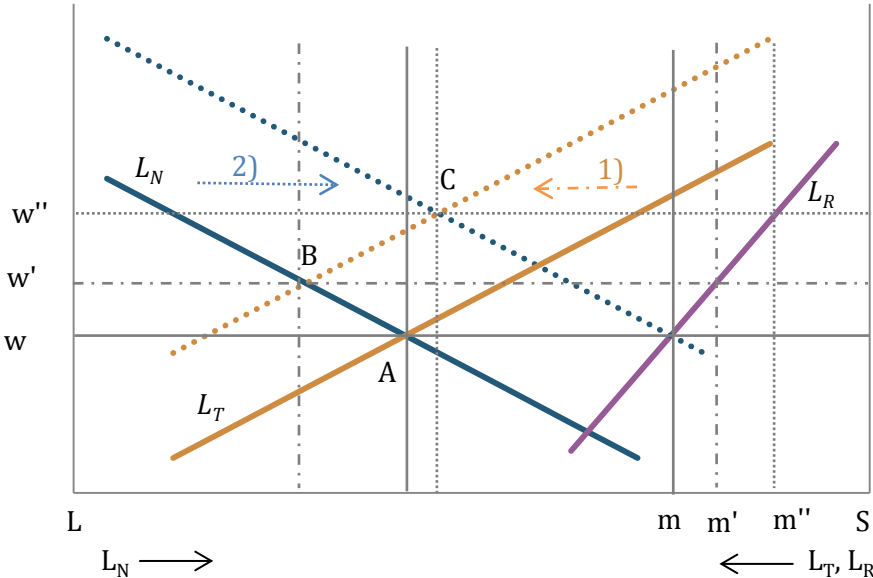
² Such a framework is also used in Torvik (2015), who discusses the formulation of monetary policy in an oil economy.

traded in the world market at given prices, while the third good cannot be imported. Consequently, the price of this non-traded good will be determined by domestic market supply and demand.

The firms in the various sectors compete for a given supply of labour, which is mobile between the sectors. Hence, the wage level must be the same across sectors. It is further assumed that firms in the various sectors will demand less labour as the wage level rises.

The allocation of labour among the sectors and the determination of the wage level in this economy are illustrated in Chart 2. The length of the diagram – line segment LS – represents total labour supply. Labour demand in the *non-tradable sector* is shown by the solid blue line L_N , which slopes downward from left to right in the diagram. The solid orange line L_T , which slopes downward from right to left, represents total demand from the two tradable sectors.

Chart 2: Effects on wages and employment of a boom in the oil-related sector



The wage level, w , is shown at the point where these two lines intersect. The marginal return on labour employed must be equal in the various sectors. Of total labour supply LS , the share from L to the point of intersection A will work in the *non-tradable sector*, while the remainder, the share from A to S , will be employed in the two tradable sectors.

In the original article, it is assumed that one tradable sector produces energy goods, e.g. oil, while the other sector produces manufactured goods. As the authors emphasise, however, a number of interpretations are possible. The distinction will hereafter be between firms linked to the oil sector and other tradable sector businesses. *The oil-related sector* includes not only companies that extract oil and gas, but also all mainland firms that deliver goods and services to oil companies, both on the Norwegian continental shelf and in other countries. Subcontractors of firms that have oil companies for customers are also considered to be part of *the oil-related sector*.

The other tradable sector firms are hereafter referred to as *the traditional T-sector*. In Chart 2, labour demand from this sector will be shown by the purple line L_R . The *traditional T-sector* will employ the share from S to m – the point where the sector’s demand curve is equal to the general wage level, while the share from m to A will be employed in *the oil-related sector*.

Cordon and Neary (1982) study the effects of a boom in the sector that produces energy goods. The source of the boom is assumed to be higher productivity in this sector. However, as long as the economy in question is a net exporter of the good concerned, the effects of a price increase will be fully consistent.

A key point of the analysis is that the effects of the boom can be split in two.

1. First, there will be a *resource movement effect*. With a higher oil price, the return on the factors of production used in *the oil related sector* will be higher. For a given wage level, the demand for labour will rise. In the chart this is expressed by the shift of the orange line to the left. Demand from *the traditional T-sector* is unchanged. If this were the only effect that mattered, the new equilibrium would be at point B, with the higher wage level w' . The share employed in the non-tradable sector will decline to LB, while employment in *the traditional T-sector* will fall to $m'S$. The remainder – the share from B to m' – will be employed in *the oil-related sector*. Consequently, this sector will expand at the expense of the other two.
2. Second, there will be a *spending effect*. The higher oil price results in higher income. This provides a basis for increasing imports, but normally demand for products from *the non-tradable sector* will also rise. Thus, this sector will require more labour. In the chart, the blue line will shift to the right, pulling in the direction of an even higher wage level. Now it is the non-tradable sector that is growing at the expense of the other two. The new equilibrium will be at point C, with wage level w'' . The share from L to C will be employed in *the non-tradable sector*. In the chart, the share employed in *the non-tradable sector* is somewhat higher than it was at the outset, but since the *resource movement* and *spending effects* pull employment in different directions, the theory does not produce an unambiguous result regarding the total effect on employment. Unless the *spending effect* clearly predominates, there is reason to believe that employment in *the oil-related sector* will increase. In the chart this is reflected by the fact that the final employment share in this sector, from C to m'' , is larger than the original, from A to m. For *the traditional T-sector*, both *resource movement* and *spending effects* pull in the direction of lower employment. Employment in this sector (the share from m'' to S) will therefore be clearly lower than prior to the oil-driven boom.

The predicted scaling back of *the traditional T-sector* is often referred to as “Dutch disease”. But to consider this trend a symptom of illness may be misleading. On the contrary, strong growth in one industry would have to be at the expense of other industries in an economy with a given availability of factors of production.

The model outlined is very simple. Several of the assumptions are readily criticised. For example, in a Norwegian context, the assumption of a given supply of labour does not appear to be particularly accurate. Since the EU enlargement in 2004, total net migration to Norway has been nearly 400 000 persons. As long as higher wages are necessary to increase the total supply of labour, the general conclusion that a higher oil price results in a scaling back of *the traditional T-sector* stands. When labour becomes more expensive, firms facing given market prices will be forced to reduce employment. However, the increase in wages and the scaling back of *the traditional T-sector* will be less pronounced than in a situation where the total supply of labour cannot be increased. A three-sector model in which a boom in the petroleum sector results in higher immigration is discussed in detail in Allcott and Keniston (2014).

The relative strength of the *resource movement effect* and the *spending effect* will depend on the resource-intensity of oil extraction. The direct demand for labour from companies operating on the Norwegian continental shelf remains fairly limited, but these companies' demand for goods and services is considerable, the largest share of which is delivered by mainland firms. In recent years, many of the oil service firms have also won international contracts, amplifying the resource movement effect.

Resource movement effect

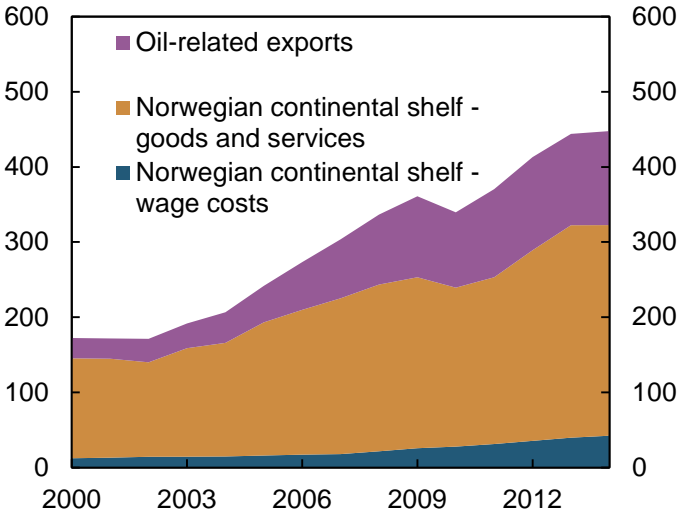
Demand from the Norwegian continental shelf

According to the national accounts, 32 000 persons were employed in the production of crude oil and natural gas on the Norwegian continental shelf in 2014. Since 2000, employment in this industry has risen by 75 percent, while its share of total employment in the Norwegian economy is still no higher than slightly above 1 percent. Total labour costs in the industry were NOK 42 billion in 2014, less than 2 percent of mainland GDP and less than one-tenth of total oil-related demand (see Chart 3).

The demand for goods and services from companies on the continental shelf is far more extensive. In 2014, this demand – the sum of what the national accounts refer to as gross fixed capital formation and intermediate consumption – totalled NOK 280 billion (see Chart 3), equivalent to 11 percent of mainland GDP. Except for a temporary decline following the financial crisis, oil company purchases of goods and services have grown without interruption since the early 2000s. In constant prices, the demand was twice as high in 2014 as in 2000. Up until the financial crisis, intermediate consumption showed the strongest growth. Since then, the increase is due to higher investment.

A substantial portion of oil companies' demand is covered by imports, but deliveries to the continental shelf are nevertheless of considerable importance for many mainland firms. Estimates by Statistics Norway indicate that around 60 percent of the value recorded in the national accounts as intermediate consumption or fixed capital formation in oil and gas extraction is added in the mainland economy.³

Chart 3: Demand from the oil sector. In billions of 2014 NOK



Sources: Statistics Norway, Mellbye et al. (2012), Heum et al. (2006) and Norges Bank

³ The estimates are documented in Blix Prestmo et al. (2015).

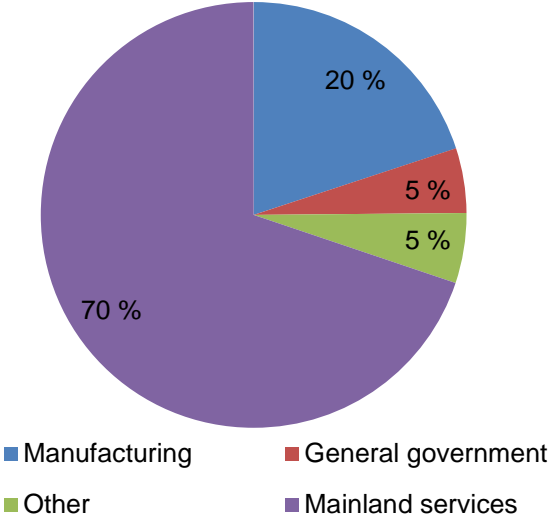
Private mainland service providers primarily account for this value added. When both direct deliveries and deliveries from subcontractors are counted, Statistics Norway’s estimates indicate that private service providers accounted for 70 percent of total mainland deliveries to the Norwegian continental shelf in 2012 (see Chart 4). Deliveries from manufacturing did not represent more than one-fifth of total deliveries, but relative to total value added in manufacturing, these deliveries are relatively important. This is particularly true for shipbuilding and machinery (see Chart 5). Activity in other manufacturing is not especially oriented towards the petroleum sector. In private services, the difference between industries is less pronounced. These deliveries make up the largest share of value added in other private services, which include professional and technical services, but a considerable portion of activity in finance and transport is also based on deliveries to the petroleum sector.

The number of jobs in the mainland economy linked to deliveries to the Norwegian continental shelf cannot be determined directly. These deliveries are made by an assortment of industries, and even if individual firms in the various industries may be highly dependent on activity on the continental shelf, it is less the case for entire industries. By assuming that the labour intensity is the same for all deliveries from an industry, Statistics Norway has concluded that around 200 000 of the jobs in the mainland economy in 2014 are based on deliveries to the continental shelf.⁴

Global demand

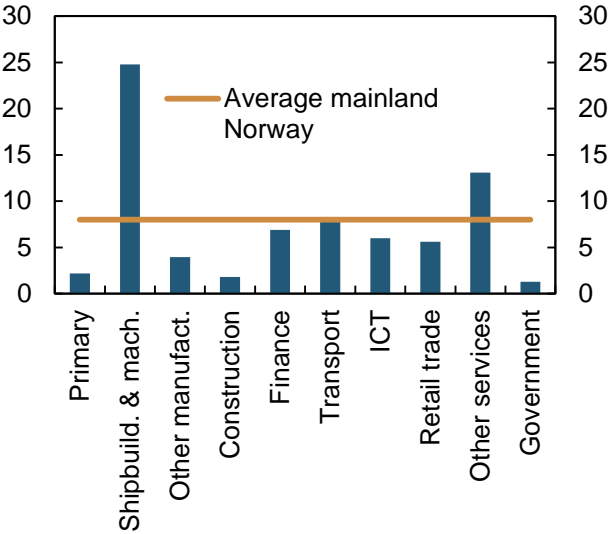
In recent years, the Norwegian oil service industry has seen robust growth beyond the country’s borders. The proximity to and demand from the Norwegian continental shelf has laid the basis for the development of an industry that is globally competitive. At the same time, market growth abroad has been very high. Figures from Rystad Energy and the IMF indicate that global oil investment more than

Chart 4: Deliveries to the Norwegian continental shelf by sector 2012. Percent of total



Source: Blix Prestmo et al. (2015)

Chart 5: Deliveries to the Norwegian continental shelf in selected industries. Percent of value added in the industry



Source: Blix Prestmo et al. (2015)

⁴ See Blix Prestmo et al. (2015) for details. Statistics Norway estimated that 207 000 jobs could be linked to the continental shelf, but since this estimate was made, the national accounts data for capital goods and intermediate consumption in the petroleum sector in 2014 have been revised down somewhat.

quadrupled in the period between 2000 and 2014 (see Chart 6). Growth on a worldwide basis has thus been twice as strong as on the Norwegian continental shelf.

The national accounts provide precise figures for resource use on the Norwegian continental shelf, but give little indication of the share of exports excluding oil and gas that are linked to the petroleum sector. The more recent studies of this focus on the oil service industry’s international turnover. Rystad Energy (2014) found that this turnover was NOK 206 billion in 2013, but this also includes sales from subsidiaries outside Norway. Mellbye et al. (2012) provided a historical breakdown of international turnover between exports and turnover in foreign subsidiaries up until and including 2011. The series for oil-related exports shown in Charts 3 and 6 are based on these figures.⁵

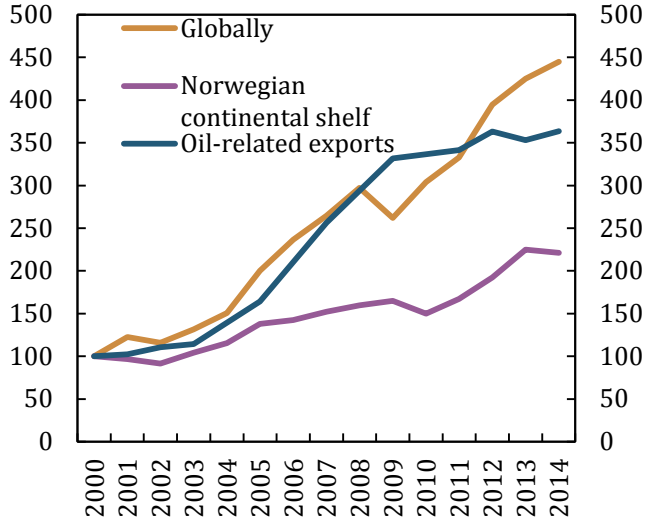
The constructed series indicates that oil-related exports more than tripled in the years between 2000 and 2009 (see Chart 6), but export growth was not as strong in later years. The oil service industry’s international turnover appears to track to a fair degree the growth in global oil investment. Much of the turnover growth in recent years has probably come via subsidiaries in other countries. Relatively high cost growth in Norway may be an explanation.

In 2014, oil-related exports can be estimated at around NOK 125 billion, or 5 percent of mainland GDP, making it Norway’s second largest export industry, after sales of oil and gas. Oil-related exports accounted for just under one-fourth of mainland exports in 2014.

Total demand from the Norwegian continental shelf and global demand from the Norwegian petroleum sector in 2015 may be estimated at around NOK 450 billion, or 18 percent of mainland GDP. In constant prices, oil-related demand has nearly doubled since the turn of the millennium.

Blomgren et al. (2015) have estimated that in 2014, around 70 000 jobs in the mainland economy were based on oil-related exports. This estimate is based on the assumption that value added per employee is somewhat higher among those supplying other countries than for average deliveries to the Norwegian continental shelf. Norwegian oil service companies have a considerable global market share in the seismic, drilling technology, maritime services and subsea production system markets. These are more capital- and knowledge-intensive product categories than e.g. modification and maintenance, which account for a substantial portion of demand from the Norwegian continental shelf.

Chart 6: Oil investment globally and on the Norwegian continental shelf and oil-related exports from mainland Norway. Volume. Index. 2000 = 100



Sources: Rystad Energy, IMF, Statistics Norway, Mellbye et al. (2012), Heum et al. (2006) and Norges Bank

⁵ Mellbye et al. (2012) provides data for the period between 2003 and 2011. Data from before that have been taken from Heum et al. (2006). Following Mellbye et al. (2012), it is assumed that oil-related exports account for 70 percent of oil service companies’ international turnover prior to 2003. For the years after 2011, oil-related exports are assumed to grow at the same pace as most oil-related export categories in the national accounts. The specific figures are found in the Special Feature “Lower exports from the oil service industry ahead”, p. 57 in the June 2015 *Monetary Policy Report* (2/15). In the estimation of a series in constant 2014 prices, the price developments for oil-related exports are assumed to be the same as for intermediate consumption and capital goods on the Norwegian continental shelf.

With just over 30 000 persons employed in oil and gas production, around 200 000 employed in deliveries to the Norwegian continental shelf and around 70 000 employed in connection with oil-related exports, total oil-related employment in Norway in 2014 can be estimated at 300 000 persons.⁶ This corresponds to around one in nine of all jobs in the Norwegian economy in that year. Nine out of ten oil-related jobs were in the mainland economy.

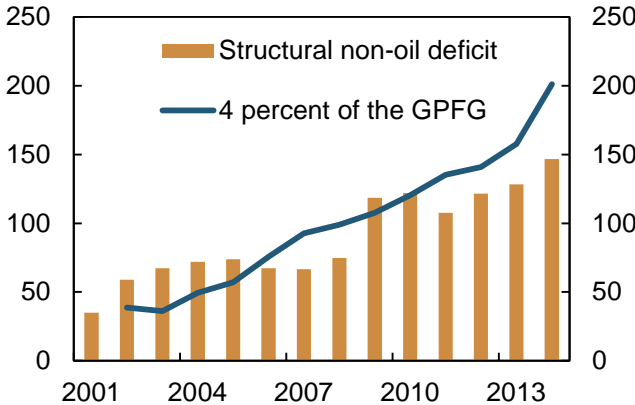
On the basis of the estimated data for oil-related demand, oil-related employment in 2000 can be estimated at around 150 000 persons.⁷ This means that oil-related employment has approximately doubled since that time.

Spending effect – domestic demand

The discussion concerning petroleum revenue spending usually focuses on spending over the central government budget. This reflects the fact that petroleum sector profits are largely channelled to the government in the form of a special tax on oil companies. This revenue is transferred to the Government Pension Fund Global (GPFG). Over time, annual petroleum revenue spending is to be limited to four percent of the value of the GPFG, the expected real return, and is thus independent of actual oil revenue during the fiscal year.

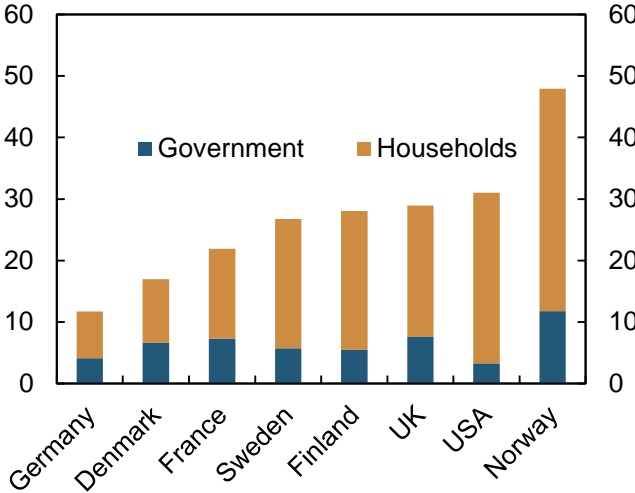
In recent years, petroleum revenue spending has been lower than the four percent path (see Chart 7). Nevertheless, spending has increased markedly. In 2014, the structural non-oil budget deficit, which is an indicator of underlying petroleum revenue spending, was NOK 147 billion, or 5.8 percent of mainland GDP. In the period between 2000 and 2014, petroleum revenue spending increased by NOK 114 billion at constant 2014 prices. By comparison, demand from companies on the Norwegian continental

Chart 7: Four percent of the GPFG and structural petroleum revenue spending over the central government budget. In billions of 2014 NOK



Source: Ministry of Finance

Chart 8: Growth in total consumption between 2000 and 2014 in selected countries. Volume. Percent



Source: Eurostat

⁶ Blomgren et al. (2015) have estimated that 330 000 of the jobs in Norway are related to the petroleum sector. In addition to deliveries to the Norwegian continental shelf and petroleum activities in other countries, which are counted here, they also include investment in mainland firms that supply the petroleum sector. At the same time, the most recent national accounts figures indicate that demand from the Norwegian continental shelf in 2014 was somewhat lower than Statistics Norway’s original estimates were based on and on which Blomgren et al. (2015) based their estimate.

⁷ This estimate is based on the assumption that the import shares of the various demand components and the breakdown of deliveries among the various industries are the same over time. Blix Prestmo et al. (2015) show that the import share for oil investment has remained fairly stable since the early 2000s, and Eika et al. (2010) found broadly the same import share for intermediate consumption in 2006 that Blix Prestmo et al. (2015) found in national accounts figures for 2012.

shelf and oil-related exports together rose by NOK 275 billion in the same period. Demand from the Norwegian continental shelf alone grew by NOK 177 billion.

In the assessment of the *spending effect*, however, it is not sufficient only to look at petroleum revenue spending over the central government budget. Insofar as the general wage level is pulled up, much of the effect may take the form of higher household demand.⁸ Growth in overall consumption in the Norwegian economy – the sum of private and public consumption – has been far higher than in other traditional advanced countries since the turn of the millennium (see Chart 8). Strongest in this period has been growth in private consumption. Determining how private consumption would have developed absent the vigorous growth in petroleum sector activity is difficult. But if private consumption in Norway had grown at the same pace as in Sweden since 2000, private consumption in 2014 would have been NOK 177 billion lower than it actually was.

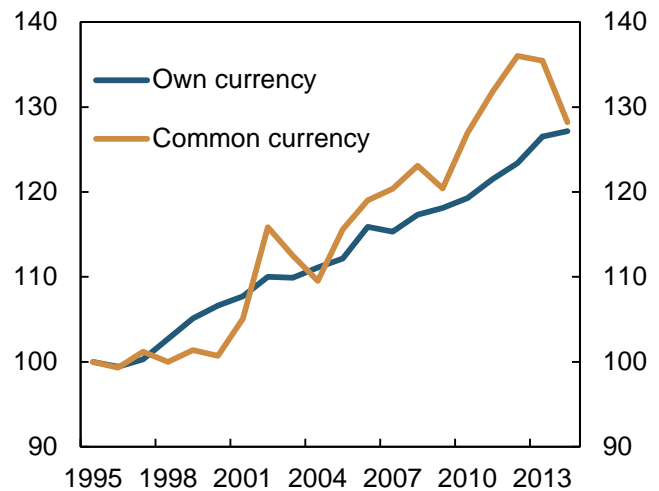
Have economic developments been as expected?

The most important conclusions in the theoretical section was that an oil price boom would pull up the relative wage level and promote a scaling back of *the traditional T-sector*, with contributions from both the resource movement effect and the spending effect. The resource movement effect is distinguished by growth in *the oil-related sector* relative to *the traditional T-sector*.

Compared with the most important trading partners, labour costs in Norwegian manufacturing have risen markedly since 2000 (see Chart 9). On this point, actual developments have been well in line with the theory.

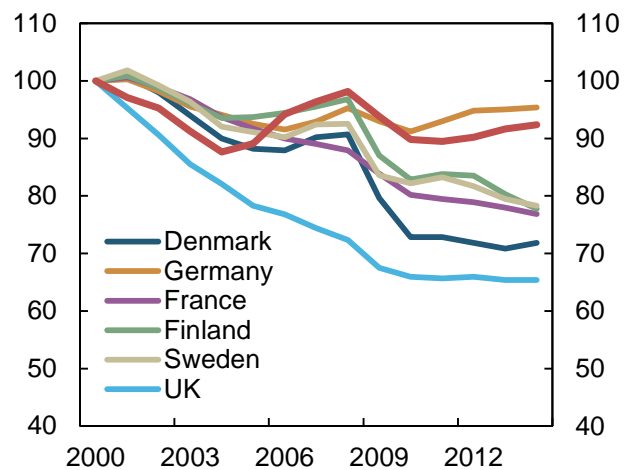
In practice, a clear delineation between *the non-tradable sector*, *the oil-related sector* and *the traditional T-sector* is difficult. It may be simpler to identify individual industries that may be representative for the various sectors. As mentioned, deliveries to companies on the continental shelf represent a substantial share of production in the *shipbuilding and machinery industry*. Firms in this industry also have substantial sales to other countries, a sizeable

Chart 9: Labour costs in Norwegian manufacturing relative to trading partners. Index. 1995 = 100



Source: Technical Reporting Committee on Income Settlements

Chart 10: Manufacturing employment in selected countries. Index. 2000 = 100



Source: Eurostat

⁸ If it is the case that households largely reduce their own saving in response to increased public saving – so-called Ricardian equivalence – it may indicate that this channel is even more important.

portion of which is probably oil-related. By comparison, firms in *other manufacturing* tend not to have oil companies as customers, but most of these firms face considerable competition from other countries. It is therefore reasonable to consider these firms to be a part of *the traditional T-sector*.⁹

The trend has been for more and more kinds of firms to be exposed to global competition, and most deliveries to the petroleum sector come from industries other than shipbuilding and machinery. Nevertheless, what follows is a closer examination of developments in these two manufacturing sectors. Even if there is considerable uncertainty, this is likely to provide an accurate picture of overall developments in *the oil-related sector* and *the traditional T-sector*.

Despite relatively strong cost growth, developments for Norwegian manufacturing so far this century overall have been fairly positive. To be sure, manufacturing employment in 2014 was 20 000 persons lower than in 2000, a decline of 8 percent, but manufacturing employment has fallen substantially more in many comparable countries (see Chart 10).

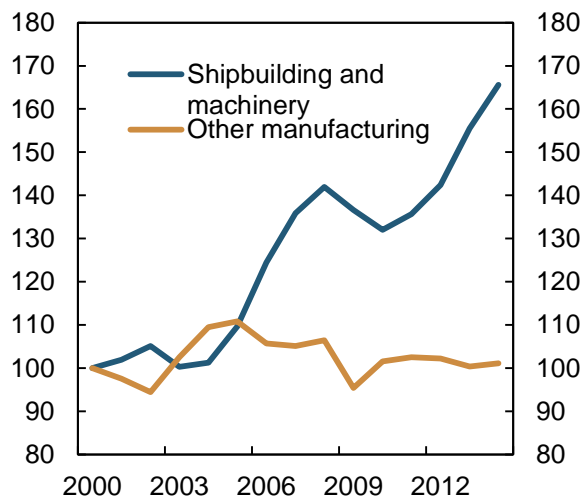
However, developments in the various manufacturing sectors have diverged. In manufacturing excluding shipbuilding and machinery, output has remained broadly unchanged since 2000 (see Chart 11), and profitability has fallen considerably in recent years. Operating profit as a share of total factor income¹⁰ has declined from a level of around 30 percent to around 10 percent in recent years (see Chart 12). Employment has been reduced by 37 000 persons, a 22 percent decline (see Chart 13). Because overall employment in the Norwegian economy grew considerably in the period, the decline in the share employed in other manufacturing was consequently even more pronounced, at 34 percent (see Chart 14).

Developments in the shipbuilding and machinery industry have been far more positive. Output has risen by 65 percent since 2000, with profitability gradually improving. Employment has risen by 16 000 persons since 2000, growth of 14 percent. Growth in overall employment in the Norwegian economy in this period was 18 percent. Owing to relatively high productivity growth in the shipbuilding and machinery industry, it was possible to meet the demand from oil companies without laying claim to a larger share of available labour. Even so, within manufacturing there has been a clear shift towards shipbuilding and machinery. In 2000, 50 percent more persons were employed in other manufacturing, while in 2014, the number employed in the two manufacturing sectors was approximately equal (see Charts 13 and 14).

⁹ Manufacturing is generally considered to be among the sectors most exposed to competition (see e.g. Eika et al. (2013)).

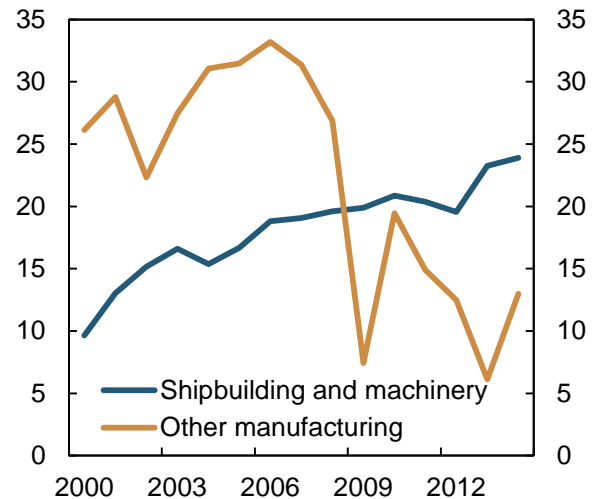
¹⁰ Operating profit as a share of labour costs and operating profit in the sector.

Chart 11: Value added in constant prices. Index. 2000 = 100



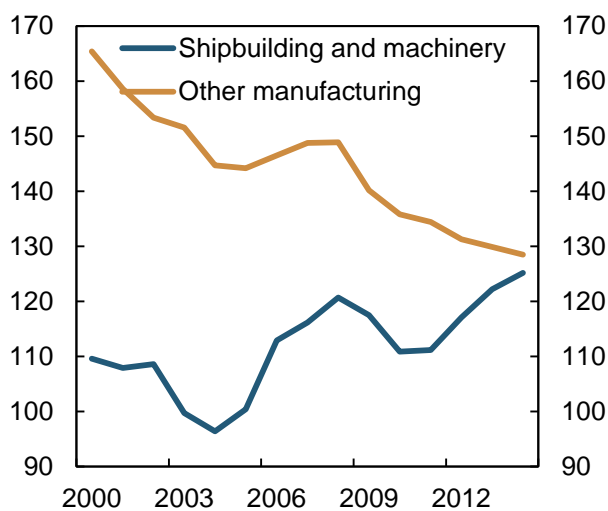
Source: Statistics Norway

Chart 12: Operating profit as a share of total factor income. Percent



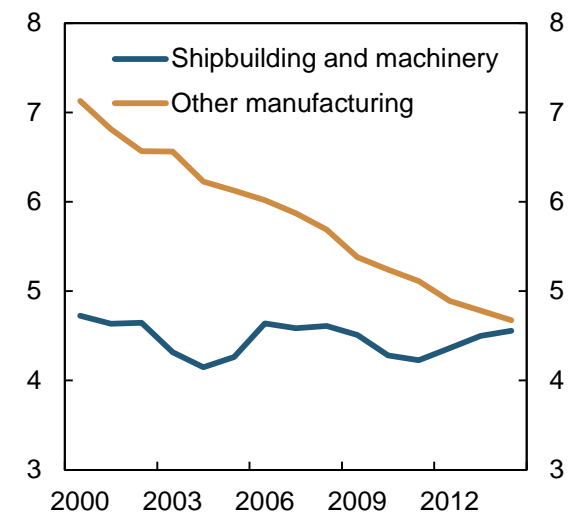
Source: Statistics Norway

Chart 13: Employment. In thousands of persons



Source: Statistics Norway

Chart 14: Employment. Share of total employment. Percent



Source: Statistics Norway

Summary

The theoretical framework in Cordon and Neary (1982) appears well suited to explaining important developments in the Norwegian economy since 2000. The oil price rise has resulted in higher demand both from oil companies and from households and the public sector. This has contributed to higher wage growth in Norway than among its trading partners and an increased orientation among mainland firms towards the petroleum sector. In 2014, one out of nine jobs in the Norwegian economy was linked to the petroleum sector, and nine out of ten of these oil-related jobs were in the mainland economy. On the other hand, developments have been weak for many tradable sector firms that do not deliver goods and services to the petroleum sector. The *resource movement effect* is illustrated by the particularly robust growth and improved profitability in the manufacturing segments that supply the petroleum sector, while output has remained broadly unchanged and profitability and employment

have fallen in other manufacturing segments. The *spending effect* is illustrated by considerably higher growth in total consumption in the Norwegian economy – the sum of private and public consumption – than in other traditional advanced economies since the turn of the millennium.

The most relevant question at present is what the consequences for the Norwegian economy will be if the decline in oil prices since summer 2014 proves to be persistent. Using the model presented here, the implications are clear. The demand curves for both *the non-tradable sector* and *the oil-related sector* will shift closer to their original positions. This implies a lower relative wage level and a need for a larger portion of available labour to find jobs in *the traditional T-sector*.

This simple model provides little information about how this restructuring will proceed. Norwegian firms have been proficient at utilising the opportunities provided by the increased demand from the petroleum sector, but proximity to the continental shelf has given them an added advantage and growth in the relevant markets has been unusually strong. Building up traditional export industries or cultivating new ones will likely be more difficult than the shift towards deliveries to the petroleum sector that has characterised the Norwegian economy over the past 10-15 years. However, the krone depreciation that has accompanied the fall in oil prices has made it somewhat easier for Norwegian firms to gain entry into highly competitive global markets. The weaker krone reduces relative labour costs. Without a currency of its own, Norway would face a considerably more painful adjustment of wage levels.

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