



BANK OF CANADA  
BANQUE DU CANADA

Discussion Paper/Document d'analyse  
2009-9

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July 2009

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## **Acknowledgements**

The authors would like to thank their colleagues at the Bank of Canada: Robert Lafrance, René Lalonde, James Rossiter, Eric Santor, and seminar participants for helpful feedback. This paper also benefited from helpful discussions with several industry experts.

## Abstract

The dramatic reduction in global demand, and the decline in the spot price of crude oil in the second half of last year, may have significant implications for the future supply of oil. Investments in conventional methods of extraction have been constrained, since easily accessible oil reserves are typically concentrated in countries with geopolitical uncertainty and/or state-run oil companies. Moreover, nearly half of all global oil production, and roughly 75 per cent of proven reserves, are accounted for by the Organization of the Petroleum Exporting Countries (OPEC). In this paper, the authors assess the implications of recent developments for the future supply of oil. They find that (i) the OPEC cuts announced in December 2008 could provide important support for prices in the coming year, and (ii) low prices have depressed, and may continue to depress, oil infrastructure investment, and thus could amplify existing supply constraints.

*JEL classification: Q41, Q43*

*Bank classification: Business fluctuations and cycles; Inflation and prices; International topics*

## Résumé

La forte diminution de la demande mondiale et le recul des cours du pétrole brut survenu au deuxième semestre de 2008 pourraient avoir des effets importants sur la production future d'or noir. Les investissements dans les installations classiques de forage sont aujourd'hui réduits, car les réserves facilement accessibles sont concentrées dans des pays qui sont géopolitiquement instables ou dont l'industrie pétrolière est entre les mains de l'État. En outre, près de la moitié de la production mondiale provient de l'Organisation des pays exportateurs de pétrole (OPEP), lesquels possèdent environ 75 % des réserves prouvées. Les auteurs analysent les implications de l'évolution récente pour l'offre future de pétrole. Ils estiment 1) que la baisse de la production annoncée par l'OPEP en décembre 2008 pourrait contribuer à soutenir les prix durant la prochaine année; 2) que le faible niveau des prix pourrait continuer de peser sur l'investissement en infrastructures et ainsi amplifier les contraintes de production existantes.

*Classification JEL : Q41, Q43*

*Classification de la Banque : Cycles et fluctuations économiques; Inflation et prix; Questions internationales*

# 1 Introduction

The growth of oil production has slowed in recent years, driven mainly by continued declines in non-OPEC production. Tight supply conditions, coupled with robust demand from emerging-market economies (EMEs), translated into several years of steadily increasing prices for crude oil. The intensification of the global financial crisis in the autumn of 2008 led to a dramatic reduction in global demand for oil, rapid declines in the spot price, and a fall in oil sector investment. The aim of this study is to assess the implications of these developments for the supply of oil in the medium term, and to determine the effect this will have on oil prices.

Our analysis suggests that constraints on the supply of oil pose a risk for oil prices in the medium term. More specifically, the large cuts announced by the Organization of the Petroleum Exporting Countries (OPEC) could provide important support for prices in the coming year if members continue their high degree of compliance.<sup>1</sup> Furthermore, the sharp decline in oil prices observed in the second half of 2008 has delayed oil exploration and infrastructure investment projects, and thus could amplify the existing supply constraints.

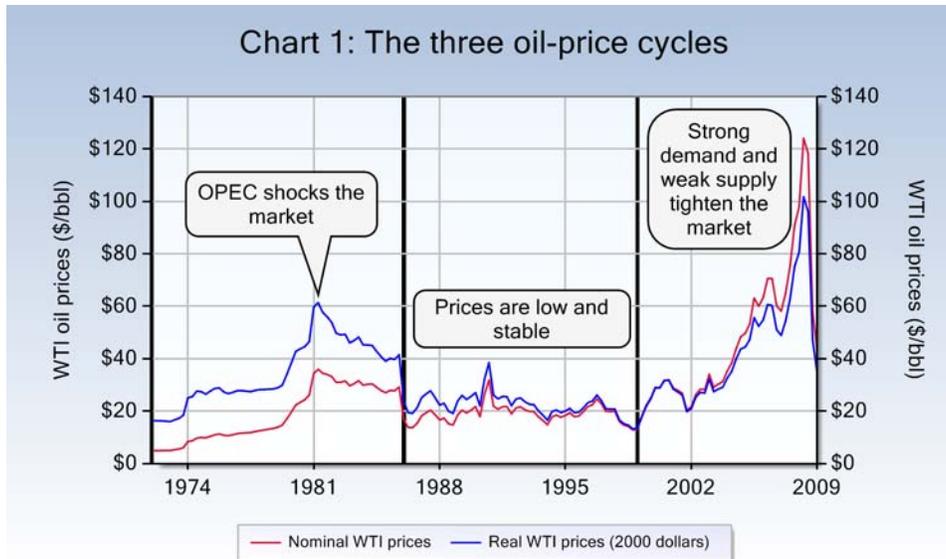
The paper proceeds as follows. Section 2 describes significant oil-price cycles that the world has experienced over the past 30 years. Section 3 compares OPEC's current oil-production cycle with three previous production cycles. Section 4 discusses the future of oil supply and section 5 explains the implications and risks for Canadian oil production. Section 6 describes the outlook for investment, supply, and prices.

## 2 Oil-Price Cycles

Over the past 30 years, the world has experienced three significant oil-price cycles: 1973 to 1985, 1986 to 1999, and 2000 to today (Chart 1).

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1. For OPEC's announcement, see OPEC (2008). Note, however, that recent evidence from the International Energy Agency suggests that OPEC members have increased oil production slightly (IEA 2009 June).



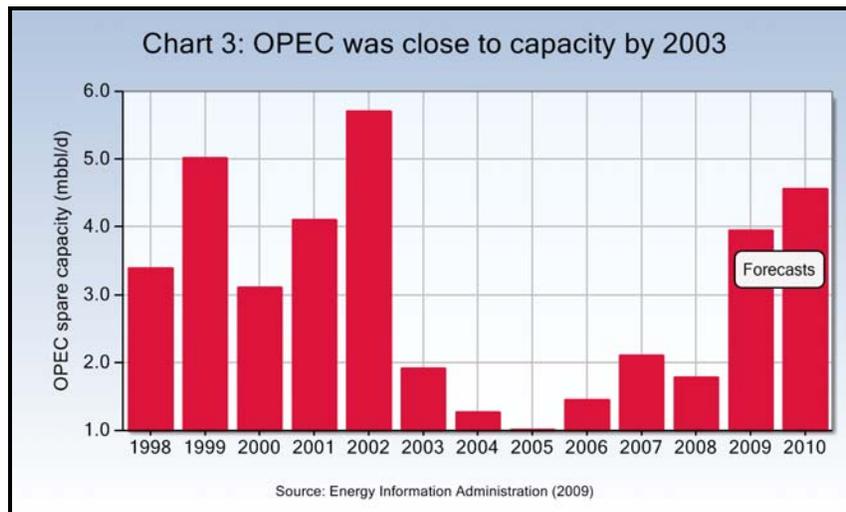
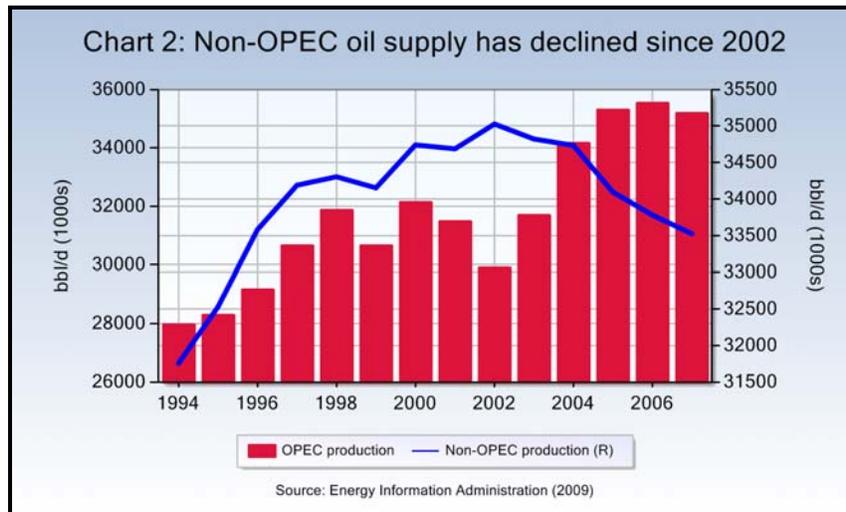
The first oil-price cycle was the result of a significant reduction in the available supply from OPEC. Following this initial reduction in supply, OPEC administered a series of price increases between 1973 and 1978, but prices spiked even more dramatically following the Iranian revolution in 1979. By 1981, however, crude oil prices began to fall in response to the reduction in demand caused by higher prices, conservation, and the emergence of significant surplus production capability as investment in the oil sector increased.

The second oil-price cycle, which occurred between 1986 and 1999, was mainly characterized by an abundance of spare OPEC capacity. West Texas Intermediate (WTI) spot prices remained low, resulting in very low levels of infrastructure investment – but these lower prices eventually stimulated demand.

In the most recent cycle, which began in 2000, crude oil prices rose steadily, as robust demand from EMEs outpaced the growth of supply. Oil prices peaked at \$147/barrel (bbl) in the summer of 2008, but fell dramatically after the intensification of the financial crisis later that autumn. Since the beginning of the current cycle, the global oil supply has grown by roughly 3 per cent (Chart 2), almost entirely as the result of increased production by OPEC and countries of the former Soviet Union (FSU). Non-OPEC production has declined over this period, with much of the reduction in output coming from mature oil fields, such as those in Mexico and the North Sea. Investment in conventional oil has also been constrained, since accessible reserves are typically concentrated in countries characterized by geopolitical uncertainty and/or state-run oil companies, which often limits the incentive to boost production. Nearly 60 per cent of global oil production and 86 per cent of proven reserves are in OPEC and the FSU. Although OPEC spare capacity has rebounded recently, studies suggest that these gains have been primarily in heavy crude oils, which are more difficult and costly to refine (Chart 3).<sup>2</sup> At the same time,

2. See Brown, Virmani, and Alm (2008).

conventional oil sources in more “market-friendly” jurisdictions are often more technically demanding in terms of extraction. For instance, since 2000, oil production in the United States has declined, despite an increase in oil rig counts, which suggests a declining rate of productivity in the conventional oil extraction sector.



The recent decline in non-OPEC production has been partly offset by increases in production from non-conventional oil sources, such as oil sands, or oil fields that require non-traditional drilling techniques.<sup>3</sup> However, the International Energy Agency (IEA) estimates that non-conventional oil contributed only 5 per cent of the total increase in oil production over the 2000 to 2007 period (IEA 2008). The small increase in non-conventional production is surprising, given the substantial investment that has occurred in this sector. Rising costs associated with this

3. For a detailed discussion of alternative extraction techniques, such as offshore and deep sea drilling and oil sand extraction, see IEA (2008).

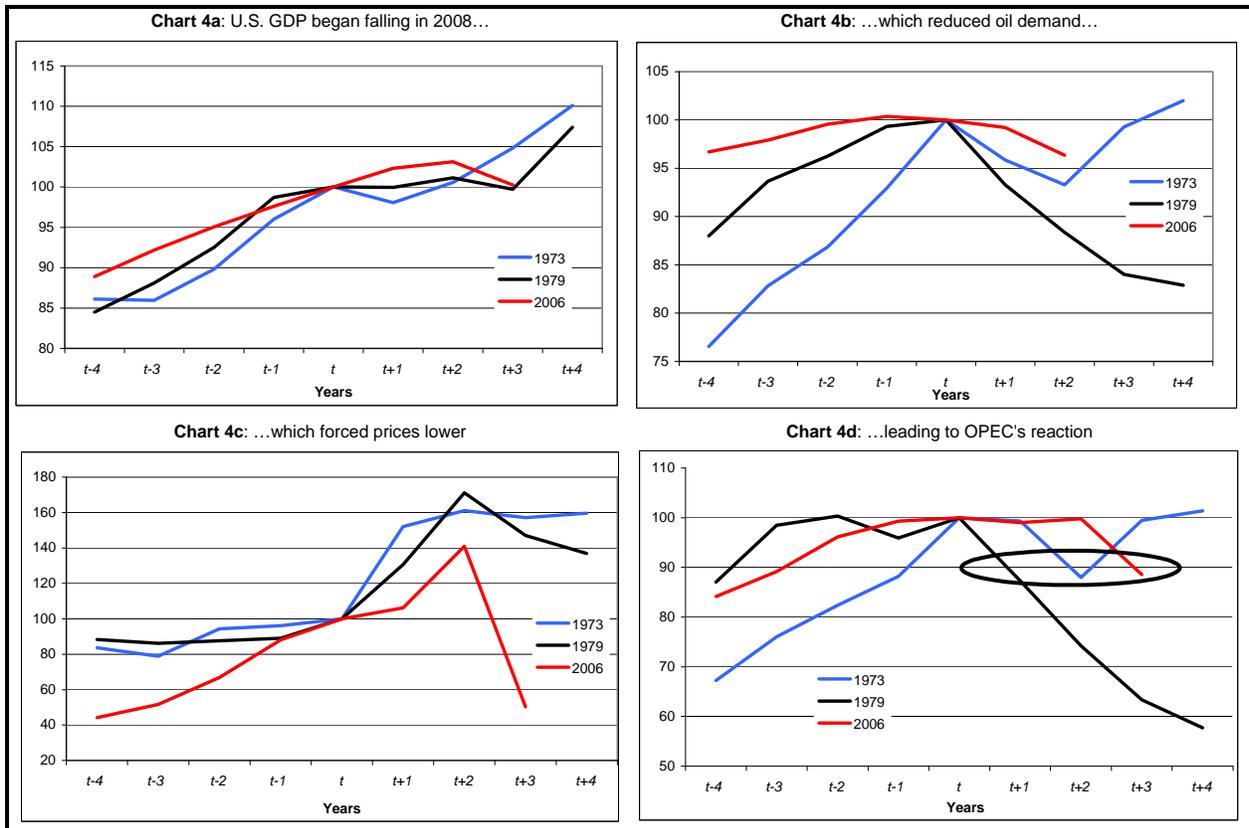
type of oil extraction (for labour, capital, and raw materials), however, has meant that real investment increased at a slower pace. According to Morgan Stanley, marginal costs increased from about \$20/bbl in 2000 to \$70/bbl in 2007 (Morgan Stanley 2009). Consequently, the low price of oil observed earlier this year may have moved below the “break-even” point for many oil sands projects. One potential offsetting factor could have been a decline in input costs.

While it is difficult to determine how much of the weakness in prices in early 2009 is attributable to cyclical declines in demand, overshooting, or credit tightness, these low prices are affecting investment in oil exploration and infrastructure, and have prompted OPEC to take action. At their December 2008 meeting, OPEC agreed to establish a production cut in 2009 totalling four million barrels per day (mmbbl/d) (OPEC 2008). In the next section, we assess the magnitude and importance of these production cuts by comparing them with previous cuts.

### **3 Comparing OPEC’s Current Oil-Production Cycle with Previous Cycles**

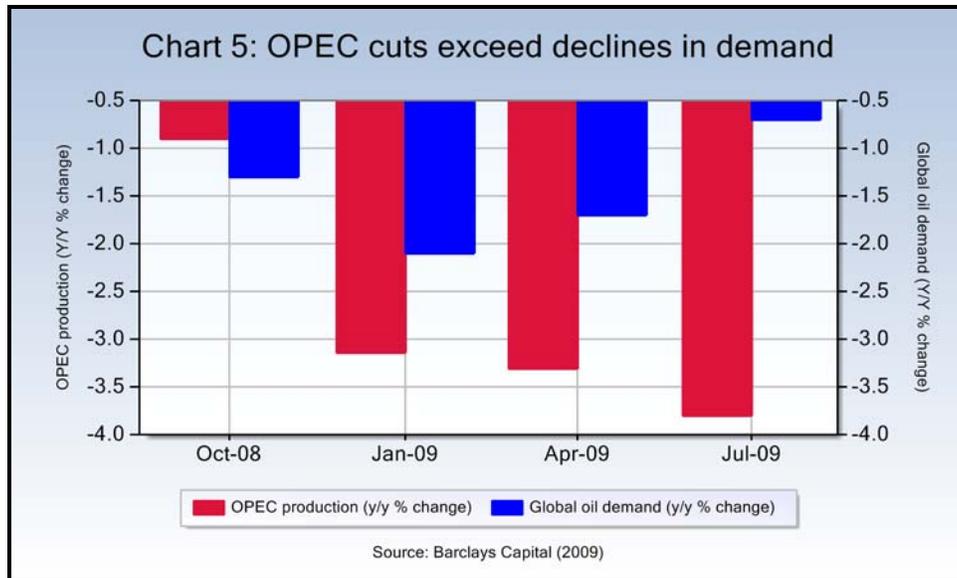
Charts 4a to d compare the movements of economic growth (U.S. GDP), oil consumption, oil prices, and OPEC oil production across three previous key production cycles. We standardize these charts to coincide with the cyclical peak in OPEC production for the years 1973, 1979, and 2006. The charts are indexed to 100 at the time of the OPEC oil production peak, and show that the latest OPEC cuts appear to be as large as those made in 1973, but less than the 1979 production cuts (Chart 4d). This drastic cut is aimed at offsetting the large decline in prices (Chart 4c), rather than being the cause of the increase in prices, as appeared to be the case in previous cycles.

While the U.S. economy and OECD oil consumption tended to decline simultaneously in previous phases, we have observed recently a decline in OECD consumption without a dramatic slowing in global economic growth until the very end of the current phase (Charts 4a and b). This could point to the growing importance of EMEs, which have been significant marginal demanders in the global oil market since 2005 (Cheung and Morin 2007). Consequently, once the global economy emerges from the current recession, EME oil demand is expected to pick up strongly. For example, the IMF expects China to overtake the United States as the largest car market in the world by 2016 (IMF 2008). It is also important to note that the recent decline in crude oil prices is similar to 1979, a period in which the global recession had depressed oil prices.



Note: In these charts, U.S. GDP is assumed to fall by 2.8% as forecasted by the IMF (2009).

The magnitude of the OPEC supply cuts far exceeds the expected declines in oil demand in 2009 (Chart 5), which suggests that the cuts are an explicit attempt to increase crude oil prices. The main caveat, however, is the unknown future compliance rate of OPEC members. Several reports released earlier this year stated that compliance with the current round of cuts has been higher than in any previous cut (e.g., IEA 2009 March). In March 2009, Saudi Arabia committed itself publicly to cut production in order to reach a price of \$70/bbl (Commodity Research Bureau 2009). Nevertheless, the incentives among OPEC members to cheat remain in place. In fact, very recent evidence (IEA 2009 June) suggests that OPEC members have increased oil production slightly.



The current cycle shares some characteristics with the period surrounding the 1981 recession in which oil prices remained low for a considerable amount of time. However, the latest OPEC cuts are large and are likely to support prices. Moreover, given the important role of the EMEs, it is not unreasonable to suggest that the oil supply will remain tight following the end of the recession. The obvious risk to this outlook is that global oil demand may remain weak and OPEC compliance could dwindle over time. In the next section, we examine the future of oil supply by analyzing global investment in oil production and its implication for non-OPEC production.

## 4 Oil Supply and Investment

Earlier this year, some observers suggested that the decline in oil prices had overshot on the downside, as evidenced in the sharp upward slope of the futures curve. Nevertheless, the rapid decline in oil prices has had a negative impact on upcoming energy investment projects, including many in Alberta. The key question is how these developments will affect oil investment over the medium and long term.

The IEA, in their base case, projects that world oil supply will increase from 84 to 106 mbb/d by 2030 (Table 1). Consequently, nearly 26 trillion (2007) dollars in investment in energy infrastructure is required over the next 20 years. This high level of investment is rooted in the fact that most investment funds go towards exploring for, and developing, high-cost reserves. The IEA asserts that about half of this investment is needed simply to maintain the current level of supply capacity. Conventional oil supply is expected to contribute only 5 mbb/d of the expected increase of 22 mbb/d, since nearly all additional capacity from new oil fields is offset by declining output from mature oil fields. The bulk of the increase in the projected supply is either from non-conventional sources (such as the Canadian oil sands) or liquefied natural gas.

The IEA notes that the projected increase in global oil output hinges on a substantial increase in investment in the oil sector, and that 64 mbb/d of additional gross capacity – the equivalent of almost six times Saudi Arabia’s current capacity – needs to be added over the next 20 years. Thus, we estimate that the probability of an oil-supply crunch in the medium term is high.

**Table 1**  
**World Oil Production in the 2008 IEA Reference Scenario (mbbl/d)**

	<b>2000</b>	<b>2007</b>	<b>2015</b>	<b>2030</b>
<b>Crude oil</b>	66	70.2	73	75.2
OPEC	29	31.1	35.9	38.9
Offshore	6.7	9.2	10.8	7.4
Non-OPEC	37	39.1	37.1	36.3
Offshore	15.9	15.2	15.4	16.3
<b>Natural gas liquids</b>	7.8	10.5	14.4	19.8
OPEC	3	4.7	8.1	13.2
Non-OPEC	4.9	5.7	6.4	6.6
<b>Non-conventional oil</b>	1.2	1.6	4.6	8.8
OPEC	0.2	0.1	0.4	0.9
Non-OPEC	1.1	1.5	4.2	7.9
<i>Total</i>	<i>75</i>	<i>82.3</i>	<i>92</i>	<i>103.8</i>
<i>OPEC market share</i>	<i>43%</i>	<i>44%</i>	<i>48%</i>	<i>51%</i>

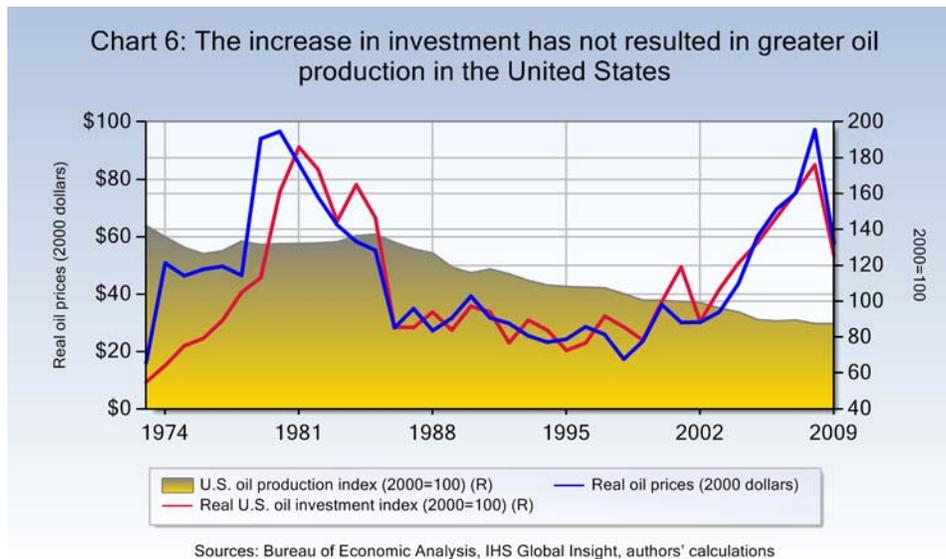
Source: Adapted from the IEA (2008)

## 4.1 Investment and supply

Given the decline in prices observed earlier this year, ideally one would examine global investment and production measures to understand the implications for the future path of the oil supply. Unfortunately, data for global petroleum investment do not exist; in fact, reliable, disaggregated data are available only for the United States. Nevertheless, a closer examination of U.S. investment behaviour may provide some insight into investment behaviour in the global oil sector.

Chart 6 shows the relationship between real oil extraction investment in the United States and the evolution of real oil prices.<sup>4</sup> This relationship is clearly positive, and reveals that the recent fall in prices could pose a risk to future investment projects. In fact, there may be a fall in investment similar to the one observed in the mid-80s, since the decline in prices, and global economic conditions, are quite similar.

4. We use U.S. investment mainly due to data availability. However, the United States is the third largest oil producer in the world, and accounts for about 20 per cent of non-OPEC production, has a highly capital intensive production complex, and its investments are not controlled by state-owned companies. U.S. investment movements are likely to be correlated with non-OPEC investment decisions.

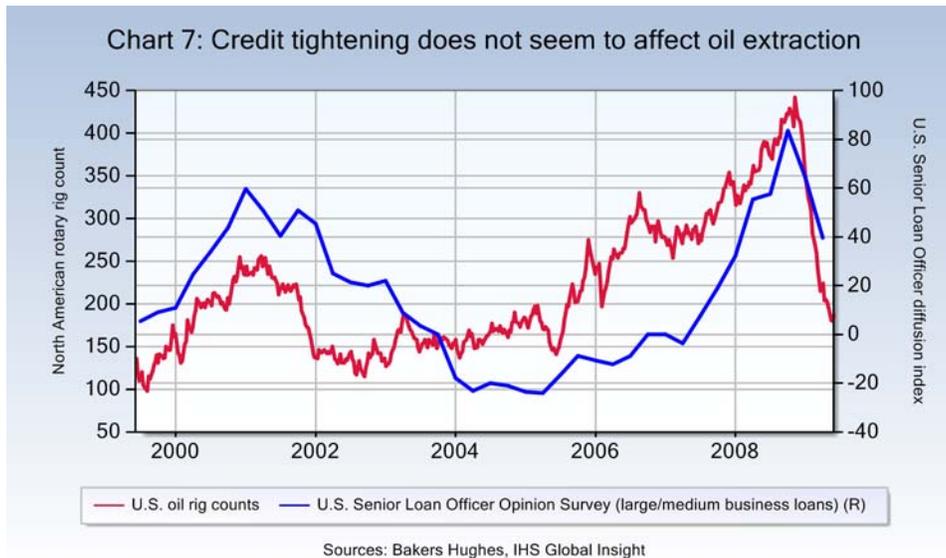


The implication of this relationship for the oil supply becomes clearer when one examines the correlation between U.S. oil investment and production. Chart 6 also shows that, despite an increase in investment since 1998, U.S. oil production continues to fall. It is possible that even with this added investment, however, one may observe only a slight increase in production given the increased extraction costs in the oil sector.<sup>5</sup> Furthermore, if a similar relationship for oil investment and production exists for the remaining non-OPEC countries, then these supplies may also be constrained going forward.<sup>6</sup>

Another plausible explanation for the decline in investment is related to the tightening of credit conditions, and, as such, investment will rebound once financial conditions normalize. But, as Chart 7 suggests, credit tightening, as measured by the Federal Reserve Senior Loan Officer Opinion Survey, does not seem to have influenced oil-field development over the past 10 years.

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5. Since mature fields are producing fewer and fewer barrels of oil, more investment is needed to produce the marginal barrel of oil.  
 6. Some analysts, however, suggest that, once newly completed projects come online, oil production may actually increase slightly.



## 5 Implication and Risks for Canadian Oil Production

Until the dramatic fall in oil prices, profitability in the oil sands sector was high. The National Energy Board (NEB) estimated that, at a world price of US\$50 per barrel, an integrated oil sands mining operation could earn a rate of return of over 20 per cent. As prices rose dramatically between 2006 and 2008, investment plans also accelerated. Announced oil sands capital expenditures for the period 2006 to 2015 were expected to exceed \$100 billion (Canadian) dollars, which was twice the amount projected by the NEB in 2004 (NEB 2006). As a result of recent price declines, in December of 2008 the Canadian Association of Petroleum Producers (CAPP) revised its 2008–20 crude oil forecasts to account for project cancellations and cutbacks. Canadian oil sands production is expected to continue to grow, but at a slower rate (CAPP 2008). While there will be minimal impact on production over the short run, by 2020 it could be substantially lower than previous forecasts.<sup>7</sup>

The importance of oil sands production should not be underestimated: IEA estimates published as recently as November 2008 suggest that Canada will account for nearly 70 per cent of the increase in non-conventional oil production between 2009 and 2030. Recent price declines, however, imply that some producers may not be able to recover their capital costs, and thus investment may fall. In fact, CAPP has already lowered its 2009 investment forecast three times to \$10 billion, from an initial forecast of \$20 billion (CBC News 2009). That said, large oil companies are generally well financed and can tolerate long periods of low prices. In fact, in one

7. CAPP estimates that Canadian oil production will be 300,000 bbl/d lower than prior predictions. Canadian oil sands production is predicted to increase from 1.2 mbbbl/d in 2008 to 3.3 mbbbl/d in 2020, with total Canadian oil production growing from 2.7 mbbbl/d to roughly 4 mbbbl/d in 2020.

reported case, a large Canadian oil producer increased its investment intentions, citing reduced input costs as a positive factor (VanderKlippe 2009).

## **6 Conclusion**

The recent drop in oil prices has already had an impact on investment in the oil sector. A growing number of investment projects are suffering from delays and cancellations. The weak investment outlook will likely result in further declines in non-OPEC oil production and could put upward pressure on prices. Furthermore, the magnitude of the recent OPEC supply cuts far exceeds the expected declines in oil demand in 2009, which suggests that the cuts are an explicit attempt to increase crude oil prices. At the end of the recession, global demand for oil is expected to increase, and non-OPEC investment projects may not have enough of an impact on the oil supply to offset robust demand. Even if the situation appears to resemble that of 1981, where oil prices remained low for a long period, we expect that the increase in emerging-market demand, coupled with the tepid supply response, could result in oil prices reaching \$80–\$100/bbl by 2011.

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