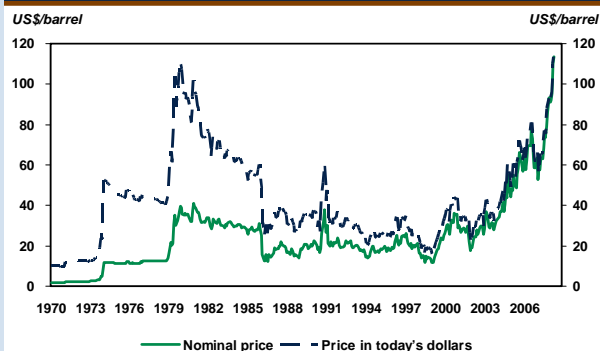


## Are current oil prices justified?

The high level of oil prices has raised many concerns over the past few weeks. After increasing more than five-fold in six years, the price of a barrel of WTI (West Texas Intermediate) has risen further in recent months. The barrel is now edging toward US\$120, a new historic high, even when inflation is taken into account (graph 1).

Graph 1 – Oil has never been as expensive, even in real terms



Sources: Datastream and Desjardins, Economic Studies

The rise in oil prices is increasingly reflected in gas and heating oil prices, which puts added pressure on economic growth. And yet the slowdown in demand we have seen since Q4 2007 should have led to a drop in oil prices. What is behind the current frenzy over oil prices?

The strong growth in oil consumption in emerging countries over the past few years, coupled with limited development of new oil production capacities, has certainly played an important role in the rising value of black gold. That said, many are blaming speculation and geopolitical tensions for this situation, factors which seem particularly relevant of late.

In this *Economic Viewpoint*, we will be modelling oil prices to determine the equilibrium level. It seems clear that the current

level is not justified, based on fundamental factors that determine price. We estimate a premium of at least US\$20 tied to speculation and expectations of an additional correction in the U.S. dollar. However, while we anticipate a short-term drop in prices, structural changes suggest that oil prices will remain high for the next few years. The scenarios we have developed based on our model show that prices could rise even further.

### ESTIMATING THE PRICE OF OIL BASED ON FUNDAMENTAL FACTORS

Our model tracks the development of WTI prices since 1990 (see Technical box for more details). Several variables can explain the movements in oil prices; however, we have opted to focus on the most significant variables from a statistical standpoint. We also selected a model format that allows us to use variables tied to adjustments over longer and shorter terms.

### Oil production and consumption

Over a long period, we observed that production, related to supply, and consumption, related to demand, are determining factors in the setting of oil prices. All things being equal, an increase (decrease) in production lowers (increases) prices while an increase (decrease) in consumption increases (reduces) prices. We are using data on global crude oil production and on global consumption published by the U.S. Department of Energy. However, there is a gap between the two sets of numbers since consumption also includes

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**NOTE TO READERS:** The letters **k**, **M** and **B** are used in texts and tables to refer to thousands, millions and billions respectively.

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**Technical box**

The model we used to determine the price oil is an error correction model that consolidates long-term and short-term adjustments concurrently. Estimates are based on the generalized method of moments (GMM) and the model is summarized by the following formula:

$$\begin{aligned} \Delta p_t = & c + seas1 + seas2 + seas4 + \alpha(p_{t-1} - \eta_1 s_{t-1} - \eta_2 d_{t-1}) + (\theta_{OECD})_t \beta_1 \Delta d_{OECD}_t \\ & + (1 - \theta_{OECD})_t \beta_2 \Delta d_{nonOECD}_t + (1 - \theta_{OPEC})_t \beta_3 \Delta s_{nonOPEC}_t + \beta_4 \Delta Stock_{OECD}_t \\ & + \beta_5 Gap_{OPEC}_t + \beta_6 WES_t + \varepsilon_t \end{aligned}$$

Where:

p represents the real price of a barrel of WTI oil;

s, global oil production;

d, global oil consumption;

dOECD, consumption from OECD countries;

dnonOECD, consumption from non-OECD countries;

$\theta_{OECD}$ , global portion of demand for oil from OECD countries;

snonOPEC, oil production in non-OPEC countries;

$\theta_{OPEC}$ , global portion of oil production in OPEC member countries (excluding Iraq);

StockOECD, volume of oil inventories in OECD countries;

GapOPEC, gap in percentage of OPEC production vs. set quotas;

WES, indicator of the global economic climate published by Ifo.

With the exception of the WES value, all the other variables were subject to a logarithmic transformation. The symbol  $\Delta$  represents a change in percentage over a given period. The variables c, seas1, seas2 and seas4 represent a constant and seasonal variables, respectively, and  $\varepsilon$  is a random variable. Worldwide production and consumption of oil are variables used when modelling long-term adjustments using an error correction process while the other variables are used for short-term adjustments. A frequency of quarterly data were used. The estimated coefficients are presented in the table below.

**Estimated coefficients**

Coefficient	Estimated value	P-value*
$\alpha$	-0.129086	0.0047
$\eta_1$	-13.76624	0.0530
$\eta_2$	15.15172	0.0225
$\beta_1$	3.684419	0.0242
$\beta_2$	6.906556	0.0000
$\beta_3$	-8.021974	0.0069
$\beta_4$	-1.997360	0.0019
$\beta_5$	-0.496513	0.0181
$\beta_6$	0.003258	0.0048

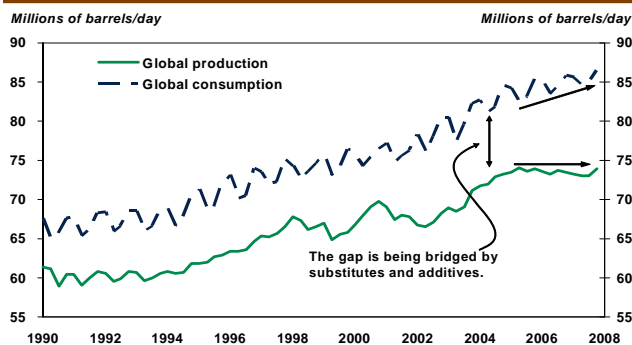
\* Probability of error of rejecting the null hypothesis. A coefficient is significantly different than zero at the 5% threshold if the p-value is less than or equal to 0.05.

### Technical box (continued)

The coefficients  $\eta_1$  and  $\eta_2$  represent, respectively, the long-term elasticity of the real price of oil relative to the quantity of oil consumed and produced. There is little price change if both variables progress proportionally in time, since the sum of elasticities would be almost equal to zero. The coefficient  $\alpha$  is a measure of the speed of the long-term adjustment in the quantity produced and consumed on price. Three or four quarters are needed for half of the long-term adjustments to be transmitted to prices. The other coefficients measure short-term effects, in other words, impacts that are directly observed on the quarterly variation in crude prices. Among other things, we have noted that, over the short term, the variation in demand for oil from non-OECD countries has a greater influence on the price of crude than demand from OECD countries.

additives added to crude oil as well as substitutes (for example, ethanol and liquefied natural gas). Since 2005, we have noted that this gap is widening – the impact of stagnation in the extraction of crude oil (graph 2). It is becoming increasingly difficult to meet the demand for oil, which partly explains why prices have more than doubled in three years. Alternatives to conventional crude oil are usually more expensive.

**Graph 2 – Oil production and consumption: meeting demand is becoming increasingly difficult**

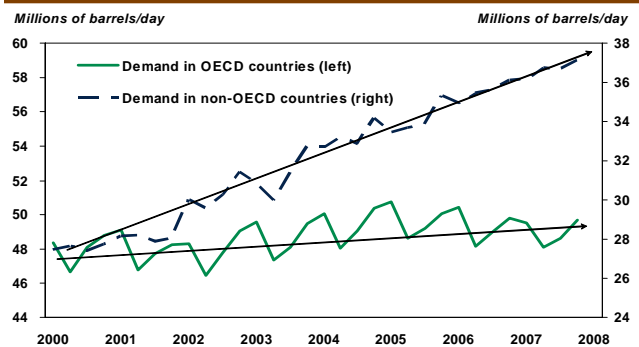


Sources: U.S. Department of Energy and Desjardins, Economic Studies

### Oil consumption in OECD and emerging countries

A significant gap exists between the growth in demand for oil from OECD (Organization for Economic Cooperation and Development) countries and non-OECD countries. Since 2000, demand has barely increased in OECD countries whereas demand has jumped 35% in non-OECD countries (graph 3). In the short term, instead of using the global variation in the demand for oil, it is more significant, from a statistical standpoint, to deal with the effects of the variation in demand from OECD and non-OECD countries separately to explain the growth in crude oil prices. In the next few decades, demand for oil from emerging countries is expected to continue to grow, which will put added pressure on prices. Speculators are relying on this to justify current price increases. Demand from emerging countries is also upsetting the oil distribution channels that have been in place for decades, which can lead to even higher price hikes.

**Graph 3 – Oil demand increase is mainly from emerging countries**



Sources: U.S. Department of Energy and Desjardins, Economic Studies

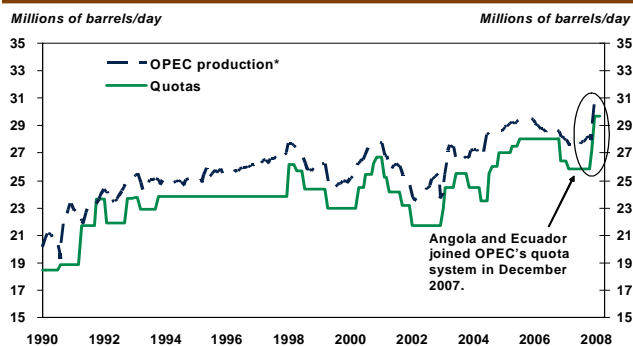
### Compliance with quotas set by OPEC

The Organization of the Petroleum Exporting Countries (OPEC) is a cartel whose objective is to limit the quantity of oil on the market and maintain prices above the levels we would see in a competitive market. While this sounds rewarding in theory, it is difficult to apply. Despite the quotas imposed, production that is consistently above fixed levels is tolerated. In fact, some member countries are constantly seeking to increase their market share, which further complicates the setting of quotas. Our model uses a variable that measures the gap between set quotas and production in OPEC member countries to explain short-term price fluctuations. The more countries produce above their set quota, the more prices tend to decline, and vice versa. This variable is also an indicator of OPEC's excess production capacity. This gap narrows when the majority of oil producing countries is no longer able to increase their production, regardless of their quotas, and widens when the quotas become truly restrictive. At the end of 2007, the gap between production and quotas narrowed (graphs 4 and 5) and oil prices increased.

### Oil production in non-OPEC countries

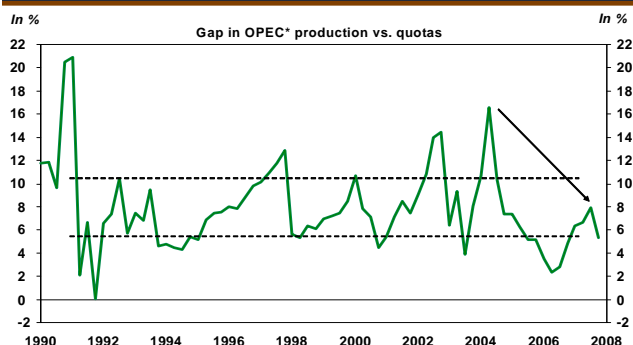
In the short term, it is preferable to track the variation in oil production in non-OPEC member countries separately. The net effect on prices is not the same since countries that are

**Graph 4 – Strict compliance with OPEC quotas influences oil prices**



\*Data on OPEC production and quotas, excluding Iraq.  
Sources: U.S. Department of Energy, Bloomberg and Desjardins, Economic Studies

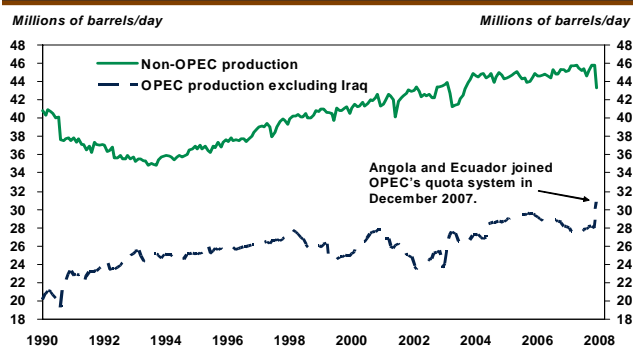
**Graph 5 – Gap between OPEC production and set quotas has declined lately**



\*Data on OPEC production and quotas, excluding Iraq.  
Sources: U.S. Department of Energy, Bloomberg and Desjardins, Economic Studies

not members of the cartel do not adjust as much their production based on price developments in the market. Production in non-OPEC countries has been relatively stable over the past few years (graph 6), but many exploration projects currently in development allow us to foresee good production growth in this market sector in the coming years, and, by extension, downward pressures on prices. In December 2007, Angola and Ecuador joined the OPEC quota system, which automatically reduced production in non-OPEC countries. The

**Graph 6 – Oil production in non-OPEC vs. OPEC countries**



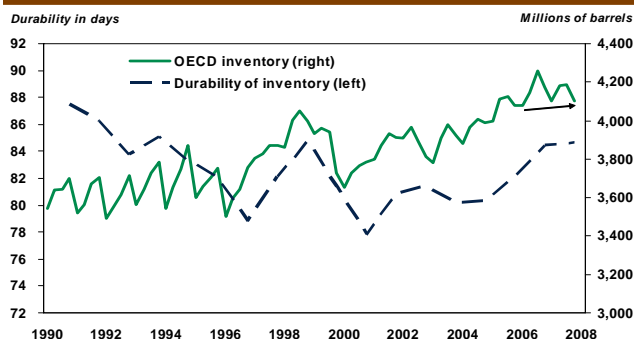
Sources: U.S. Department of Energy and Desjardins, Economic Studies

cartel's production was, however, raised proportionally to prevent any global reduction in the production of crude oil.

### Oil inventories in OECD countries

The variation in oil inventories in OECD countries is a good indicator of short-term market imbalances. An increase in inventories suggests a production surplus vs. demand, which lowers prices. Conversely, a reduction in inventories signals a supply shortage relative to demand, which increases prices. Inventories were up slightly in 2007 compared to 2006 (graph 7). During 2008, the slowdown in demand should increase oil inventories more quickly and exert downward pressure on oil prices. The rising trend in inventories since 2002 is due in part to a higher financial demand and has not loosened the oil market.

**Graph 7 – Oil inventories in OECD countries**



Sources: U.S. Department of Energy and Desjardins, Economic Studies

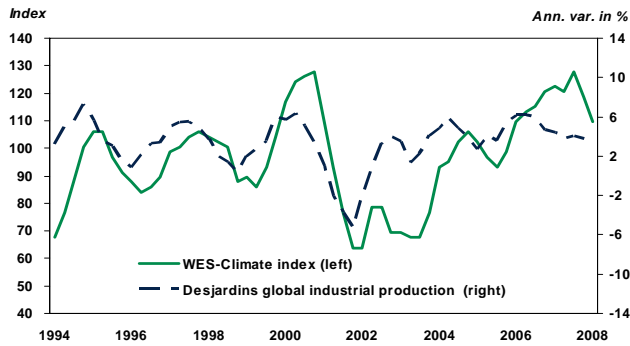
### Worldwide economic climate indicator

When economic activity is running smoothly, we expect increases in oil demand and the resulting increases in oil prices. During economic downturns, oil prices tend to edge downward or rise less rapidly. The Ifo indicator (Institute for Economic Research) is used in our model to capture the effect of the global economic situation on oil prices. This index, which evolves in line with global industrial production (graph 8), has a long enough history to be integrated into our econometric model, and it also provides us with data on the current quarter quickly. It signals a slowdown in Q4 2007 and in Q1 2008.

### THE CURRENT PRICE OF A BARREL OF OIL DEFLECTS FROM MODEL ESTIMATES

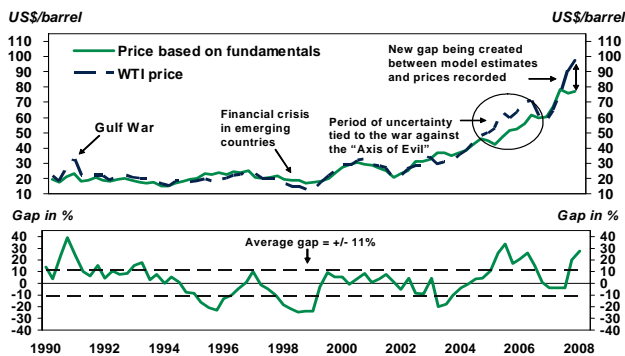
Overall, our model captures quite well the movements in the price of a barrel of WTI between 1990 and 2007 (graph 9). In a few instances, we note major gaps between the model's estimates and prices seen, but these are explained by temporary incidents that are often difficult to forecast or model. For example, the Gulf War in Iraq 1991 saw the price of oil rise above its estimated value. In 1998 during the financial crisis in

**Graph 8 – Movement in the WES-Climate index tied to global industrial production**



Sources: Ifo Institute for Economic Research, Datastream and Desjardins, Economic Studies

**Graph 9 – Since Q4 2007, oil prices have exceeded our econometric model's expectations**



Sources: Datastream and Desjardins, Economic Studies

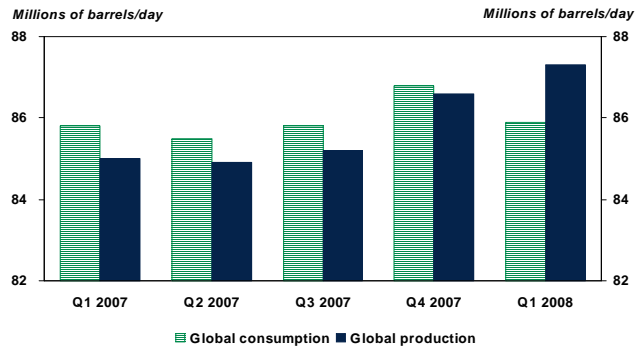
emerging countries, oil prices were lower than expected, given that we had speculated in favour of a sharp drop in the demand for oil. Between 2004 and 2006, a risk premium tied to the war on terrorism, speculation on the invasion of other rogue states (the "Axis of Evil" as stated by U.S. President George W. Bush) and rumours of retaliation from Iran (the blockade of the Strait of Hormuz) kept oil prices overly inflated.

At the end of 2006 and for the first three quarters of 2007, the price of crude oil moved in close alignment with our model's estimates. That said, since Q4 2007, a new gap has been growing. The average price of \$98 a barrel seen in the first quarter of 2008 surpasses the equilibrium value in our model by about \$20. With the price increases we have seen in April, this gap will surely widen in the second quarter.

**WHY IS OIL STRAYING FROM FORECASTS BASED ON FUNDAMENTALS?**

Contrary to what we saw from 2002 to 2007, the recent increases in oil prices are not explained by a narrowing of the balance between supply and the global demand for oil (graph 10). Most of the fundamental variables instead justify a drop in prices: deterioration of the economic climate, slower

**Graph 10 – Production\* has caught up with consumption**

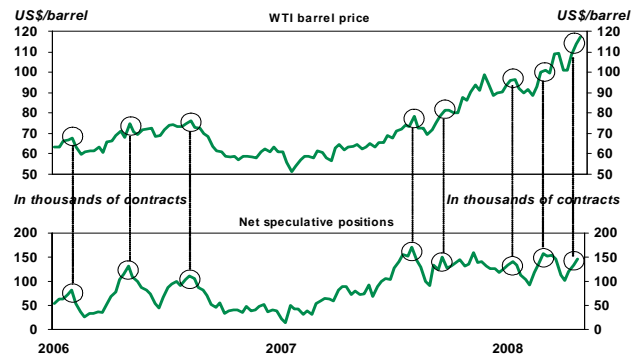


\*Production also includes additives and crude oil substitutes like ethanol.  
Sources: Energy Intelligence and Desjardins, Economic Studies

demand and increased inventories. The anticipated acceleration of the supply in non-OPEC countries should also exert downward pressure on prices. However, many investors and some analysts are worried that growth in the supply in non-OPEC countries will continue to disappoint, especially since the latest statistics show that production in Russia is levelling off.

After several months of relative calm, geopolitical tensions have intensified in the past few weeks. Certain incidents in Nigeria in particular raised concerns among investors, which contributed to bringing the cost of a barrel of oil to over US\$115. Most of the oil prices jump came a little earlier however, during a period of relative calm. This could be explained by increased demand from investors seeking superior financial results. Data gathered by the CFTC (Commodity Futures Trading Commission) clearly demonstrate this reality while the net speculative positions on oil increased by approximately 60% between mid-February and mid-March (graph 11), during which the price of oil jumped by US\$20.

**Graph 11 – Sharp increase in speculation usually leads to a temporary spike in crude prices**

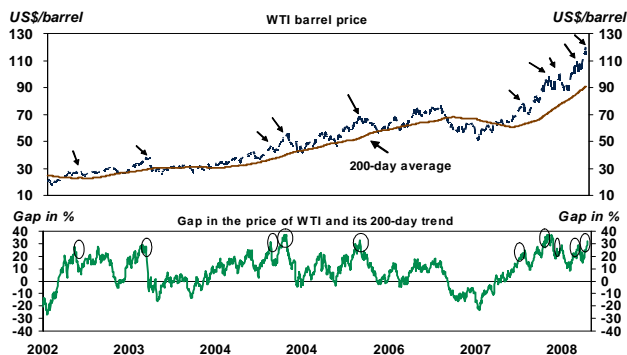


Sources: Datastream, Bloomberg and Desjardins, Economic Studies

The sudden rise in the price of crude oil is beginning to look like a speculative bubble while investors seem to be completely

ignoring developments that do not favour increases in oil prices. The price of a barrel WTI has now surpassed its long-term trend by about 30%, signalling that a correction could occur at any time (graph 12).

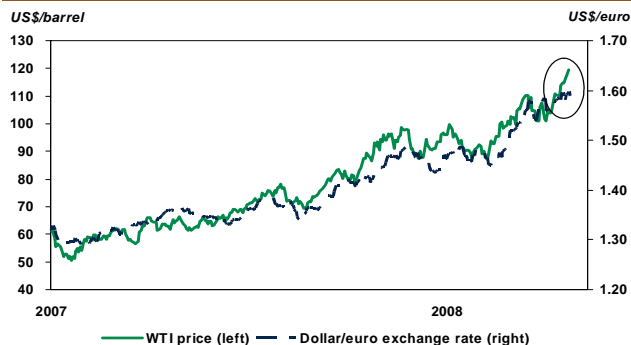
**Graph 12 – Price of a barrel has largely deviated from its trend, which could foretell a correction**



Sources: Datastream and Desjardins, Economic Studies

The weakness of the U.S. dollar has also contributed to the recent rise in oil prices. It comes as no surprise that oil closed at US\$120 for the first time at the same time as the greenback hit a new low vs. the euro (graph 13). Since oil prices are negotiated in dollars, any major depreciation in the greenback's value would lead to a drop in the purchasing power of oil producing countries if prices were not adjusted upward. If we measure the price of a barrel of oil in other currencies, the current run-up in oil prices is less spectacular (graph 14).

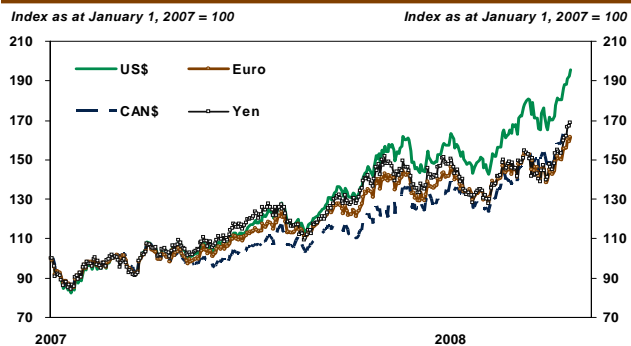
**Graph 13 – The price of an oil barrel and the euro hit historic highs at the same time**



Sources: Datastream and Desjardins, Economic Studies

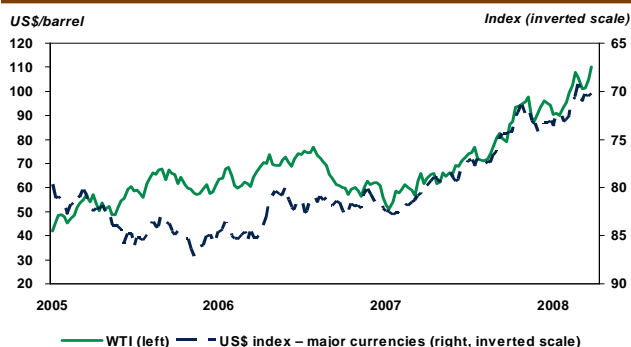
The effect of movements in the U.S. dollar on oil prices is usually less marked, however. In addition, the relation between these two variables tends to vary widely over time (graph 15), which is why we excluded the U.S. dollar from our model. For some time now, we have noticed that the correlation between the price of a barrel of oil and the greenback has become extremely strong (graph 16). The widespread speculation we have seen in the raw materials market could explain this

**Graph 14 – Oil has increased in all currencies, but less so vs. the U.S. dollar**



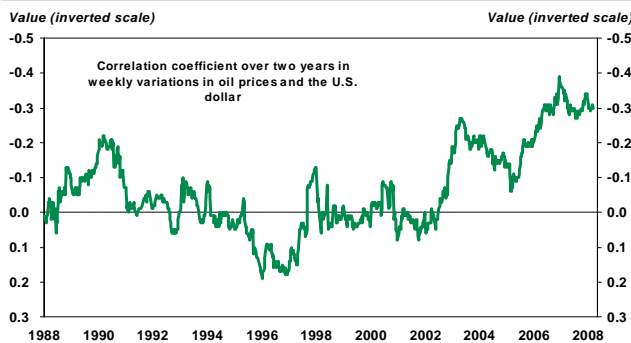
Sources: Datastream and Desjardins, Economic Studies

**Graph 15 – Since the start of 2007, the price of oil is reaping more benefits from a lower greenback**



Sources: Datastream and Desjardins, Economic Studies

**Graph 16 – Movements in oil prices increasingly negatively correlated to the U.S. dollar**



Sources: Datastream and Desjardins, Economic Studies

increase, which we believe is temporary. However, if several major stakeholders in the global oil markets, especially OPEC, believe that the U.S. dollar could lose more value on a permanent scale, the greenback's fluctuations could continue to have a major impact on crude prices.

Speculators can have a major impact on oil prices in the short term, but it usually do not last for very long. It would be

surprising if oil prices continued to deflect away from their equilibrium value for long. As long as tensions stemming from liquidity and credit problems remain in financial markets, we must expect that the prices of oil will be highly volatile.

#### HOW WILL PRICES DEVELOP OVER THE MEDIUM TERM?

Seeing oil prices rise at the same time that we expect the production of crude oil to increase and demand weaken due to the slowdown in the U.S. economy defies all economic laws. That said, the future is rarely easy to predict and we can imagine various scenarios that could have wide ranging impacts on oil prices. Forecasts in the medium term have been calculated based on the econometric model presented in the previous section, based on three scenarios: a base scenario, another that foresees higher oil prices and a final scenario that calls for weaker oil prices. A description follows:

##### Base scenario

- An economic slowdown takes place in the U.S. and in several OECD countries in 2008, with a rebound in 2009. The demand for oil in these countries is affected accordingly.
- Emerging countries are slightly affected by this economic slowdown and demand for oil in these countries continues to grow at a sustained pace.
- OPEC considers lowering its oil production, but maintains its quotas for several months due to the economic troubles in the United States and high oil prices. OPEC finally lowers production.
- Production in non-OPEC countries progresses as expected as a result of investments made over the past few years.
- Oil inventories do not experience any major fluctuations since supply and demand are developing at a balanced pace.

##### Scenario favouring higher prices

- The economic slowdown in the United States and in other industrialized countries is less severe than expected, which has a less negative impact on the demand for oil.
- As a result of decoupling, the industrialization of developing Asian countries continues unabated. China is just getting started in terms of its oil consumption and the increase in the global production of crude oil is struggling to keep up with this new demand.
- OPEC is not producing enough oil to meet the stronger than expected demand and revises its quotas upwards in the second half of 2008. However, real production is not adjusted instantly since the production capacity in

some OPEC countries is limited: the shrinking gap in production favours price increases.

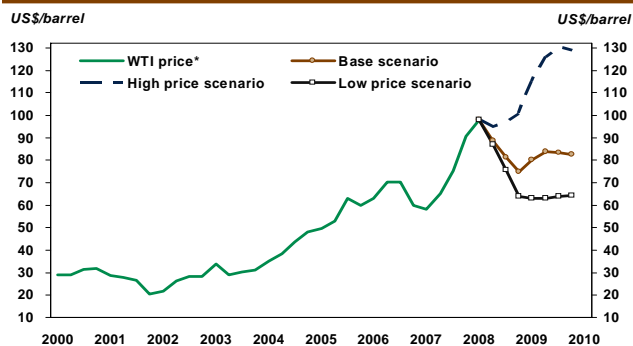
- Production in non-OPEC countries is not increasing as expected. New investments and production capacities are unable to compensate for the depletion of other oil supply sources.
- No alternative technology appears ready to replace oil in the short term, which keeps the demand for crude oil high.
- Oil inventories in OECD countries are falling due to higher consumption and production that cannot keep pace with demand.

##### Scenario favouring lower prices

- The economic slowdown in the United States is more severe than expected and the global economy – including emerging countries, albeit a few months behind – is vacillating. This economic downslide extends into the first half of 2009.
- Affected by the global economic downturn, the demand for oil stagnates in 2008 and shows a weak increase in the first half of 2009.
- OPEC produces too much oil relative to demand that is weaker than expected. Quotas are revised downwards in the second half of 2008, but the cartel's member countries delay making any real adjustments to production to benefit from high oil revenues for as long as possible, which favours price reductions.
- Production in non-OPEC countries increases slightly faster than expected. The public authorities care little about environmental issues and continue to encourage the exploration and exploitation of new oil deposits, despite the ecological costs.
- In return, we are also encouraging the saving of energy and the development and marketing of alternative technologies to oil (ethanol, hybrid cars), which limits worldwide demand for crude oil, especially as of 2009.
- Increased production and weaker demand contribute to increasing the oil inventories held by OECD.

The base scenario suggests that the price of a barrel of oil should fluctuate at close to US\$85 in two years vs. US\$130 for the higher-price scenario and US\$65 for the lower price scenario (graph 17). Note: These forecasts do not take into account the impact of an increase in purely speculative demand or of the weakness of the U.S. dollar on the price of crude. On that subject, we anticipate the value of the U.S. dollar to grow as of the third quarter of 2008. All that will remain is the premium tied to speculation that could still

**Graph 17 – Forecasts based on three different scenarios**



\*Average quarterly price.  
Sources: Desjardins, Economic Studies

fluctuate sharply to reflect developments in geopolitical tensions or concerns about the ever-increasing demand in emerging countries, among others. In the worst scenarios, oil prices could even reach US\$150 per barrel. It is difficult to forecast when the euphoria for oil and raw materials will end, but the price of a barrel of oil should gradually get closer to the equilibrium level calculated by our model.

We are comfortable with the base scenario's forecast; however, given the market's current frenzy and a certain upsurge in geopolitical risks, we anticipate that the price will remain above the value forecast by our model throughout 2008.

It bears mentioning that the high price scenario demonstrates the extent to which prices could quickly climb in situations where demand would continue to outstrip supply. This scenario explains why some speculators are betting on an oil shortage, pinning their hopes on new price hikes despite the fact that the current level appears to be overvalued already. However, a scenario where a shortage occurs seems improbable in the short term given the economic slowdown and the expected increase in oil production.

**CONCLUSION**

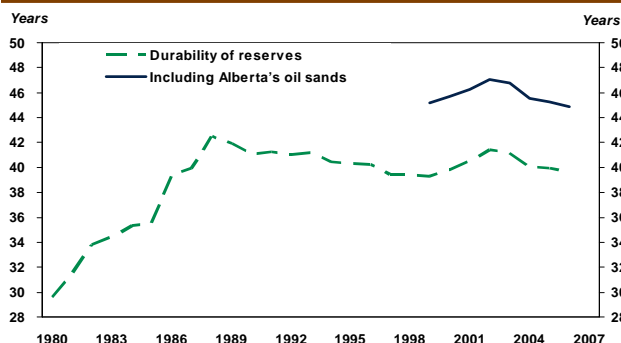
We estimate that the current price does not reflect the market fundamentals that determine it. According to our model, within a two-year horizon, prices should fall back to the \$85 a barrel range. In a bleaker scenario for the economy, prices could fall as low as \$65 whereas in a more optimistic scenario, with weak growth in production worldwide, prices could rise sharply before the end of 2009, closing in on \$130 a barrel, or even more. This last scenario appears to us to be less probable, but could represent what the more distant future holds.

The increase in oil prices has many people concerned. In a context where the risks of a vacillating global economy are high, surging energy costs is not of good help to stimulate

consumption or to reduce business costs. However, the current context is much different than that of the 70s and early 80s. The current price hikes are not the same as those we saw during the oil shocks and are less harmful now than they were then. With this in mind, there is no need to panic.<sup>1</sup>

High oil prices obviously lead to higher prices for gas and other oil-based products, which, by extension, lead to higher inflation. Yet the trend upward that began in 2002 has not been entirely negative. High oil prices stimulate exploration for oil and investment in production capacities. This has actually helped us push back the threshold of a genuine oil shortage by a few years, perhaps even decades, that would see prices explode to stratospheric levels (graph 18). This pessimistic vision of the future assumes that, despite the motivation fuelled by high oil prices, technological advances will not be enough to reduce our dependence on black gold.

**Graph 18 – Discovery of new exploitable oil reserves delays onset of serious shortage**



\*Quantity of reserves in the current year divided by the quantity consumed during this same year.  
Sources: British Petroleum and Desjardins, Economic Studies

Indeed, we often consider oil demand nearly non-elastic to oil prices, but in a context where high prices are rising rapidly, the demand for oil could be adjusted in a meaningful way. Cost increases make us reassess our energy consumption and allow us to make important efficiency gains in this regard. High prices also encourage us to develop renewable energy sources that would ideally be less damaging to the planet and to the socioeconomic balance. Yes, we will have to deal with high oil prices over the next decade, but a significant adjustment in the demand is in the cards, which would enable the global economy to prosper while decreasing our dependence on oil.

**Mathieu D'Anjou**  
Senior Economist

**Hendrix Vachon**  
Economist

<sup>1</sup> See the *Economic Viewpoint* of January 3, 2008: "Oil at US\$100: worrisome but not disastrous. 10 reasons why there is no need to panic".