ELSEVIER

Energy Policy 31 (2003) 485–489

ENERGY POLICY

www.elsevier.com/locate/enpol

Viewpoint

Oil supply and oil politics: Déjà Vu all over again

Cutler J. Cleveland*, Robert K. Kaufmann

Department of Geography, Center for Energy and Environmental Studies, Boston University, 675 Commonwealth Avenue, Boston, MA 02215, USA

Abstract

President Bush has identified US dependence on imported oil as an urgent energy, economic, and national security concern. The President's energy plan promotes the development of domestic resources, based on the assumption that economic incentives and the opening of frontier areas for exploration will increase domestic production. If realized, this will reduce dependence on imported oil and reduce OPEC's ability to affect aggregate oil supply and price. The evidence suggests, however, that this policy will not increase significantly US production of crude oil, will not reduce significantly OPEC's influence, and it will distort the US macroeconomy. Even if allowed, production from the Arctic National Wildlife Refuge will have a negligible impact on the world oil markets. Further subsidies to the oil industry will divert resources from other more productive investments. Conservation and energy efficiency merit greater emphasis in US energy policy given their ability to reduce the use of cost-effective and environmentally beneficial ways.

Keywords: Energy policy; Oil production

1. Introduction

Following his four predecessors, President Bush has identified US dependence on imported oil as an urgent energy, economic, and national security concern (National Energy Policy Development Group, 2001). Imports now supply more than 50 percent of US oil consumption: by 2020 dependence on imports is forecast to reach 64 percent (US DOE, 2000b). To close this 'supply gap' the President's energy plan promotes the development of domestic resources, based on the assumption that economic incentives and the opening of frontier areas for exploration will increase domestic production. If realized, this will reduce dependence on imported oil and reduce OPEC's ability to affect aggregate oil supply and price. Reducing OPEC's influence would reduce the probability of oil price shocks, which have a recessionary and inflationary effect on the economy.

The evidence suggests, however, that this policy will not increase significantly the US production of crude oil, will not reduce significantly OPEC's influence, and it will distort the US macroeconomy. These outcomes are caused by a policy that is not consistent with the depleted state of the domestic oil resource base and with the economics of the international oil market.

2. Oil prices and oil production

The Bush energy policy is based on a seemingly reasonable economic premise: economic incentives to the oil industry will stimulate drilling, which will increase supply. But US oil production does not behave as predicted by economic theory (Krautkraemer, 1998). In fact, production and prices move in opposite directions (Fig. 1). Despite a general decline in real prices between the end of WWII and the early 1970s, production nearly doubled. Conversely, production declined nearly 20 percent between the early 1970s and 1985, despite a tripling in real oil prices. Since 1985, both prices and production have declined.

The principal reason for the seemingly anomalous relation between prices and outputs is that the price of oil is only one of many forces that shape production decisions. There is a compelling body of evidence that oil production in the US is determined by the interplay of geologic, institutional and economic forces (Kaufmann, 1991; Pesaran and Samiei, 1995; Moroney and Berg, 1999). These include regulations issued by the Texas Railroad Commission, the cost of producing oil, and an asymmetric response of production to the oil

*Corresponding author. Tel. : +1-617-353-3083; fax: +1-617-353-5986.

E-mail address: cutler@bu.edu (C.J. Cleveland).

0301-4215/03/$ - see front matter
PII: S0301-4215(02)00099-X

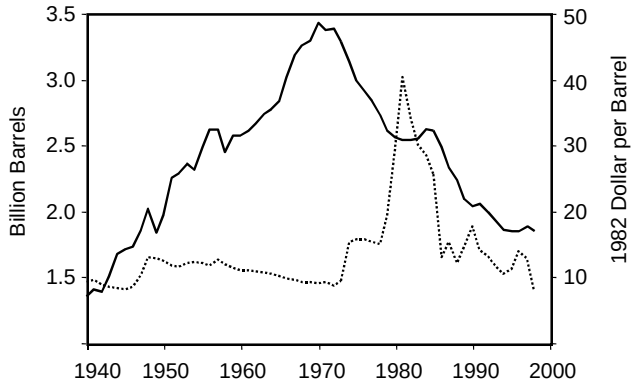

Fig. 1. Real oil prices and annual rates of oil production in the lower 48 US.

price (Kaufmann and Cleveland, 2001). Most importantly, the cost of producing oil can overwhelm any price incentive. The cost of producing a barrel of oil declined between the late 1930s and the mid-1960s, allowing production to increase even while prices declined. Beginning in the late 1960s, the cost of producing a barrel rose sharply, causing production to decline despite the increase in prices (Cleveland, 1991). This history implies that large price incentives are needed to increase production while the costs of production are rising.

There is a good reason to believe that the cost of producing oil in the lower 48 states will continue to rise. The cost of producing oil is determined by two opposing factors, technological change and resource depletion. Technological change tends to reduce production costs while resource depletion tends to increase costs. Costs declined during the early phase of US production because technical change overwhelmed the effects of resource depletion. This balance reversed after the mid-1960s. Since then, resource depletion caused production costs to rise, despite the ongoing improvements in technology.

A lot has been made of the effect of new technologies in the oil patch on the 'success rate' of new wells (Forbes and Zampelli, 2000). Success rate typically reflects the fraction of exploratory wells drilled that yield commercially viable quantities of oil. Success rates are up, but ultimately what is important is the quantity of oil discovered per well and in toto. This productivity of drilling is measured by the quantity of crude oil discovered or added to reserves per foot of well drilled, or yield per effort (YPE). Here we find that the YPE is determined by the same interplay between technology, depletion, and prices. YPE is measured at two stages of the supply chain: discovery and addition to proved reserves. The YPE for discoveries increased in the early decades of the 20th century when advances in geology and geophysics enabled firms to identify formations that hold the largest accumulations of oil. Since the 1930s, YPE generally has declined due to the depletion of the resource base (Cleveland and Kaufmann, 1991). The short run fluctuations around this decline are determined by 'highgrading' behavior and real oil prices. Highgrading describes a behavior in which firms rank prospects annually and drill the most promising first. As a result, high rates of drilling force firms to explore increasingly marginal prospects, which lowers YPE. The opposite happens at low rates of drilling. YPE also is affected by real oil prices, which determine how much of the oil identified by the drill can be produced in an economically viable manner.

The economic determinants of the YPE for discoveries reinforce the geological constraints on a policy, that seeks to increase production through subsidies such as tax relief to encourage drilling. During the 1970s and 1980s, annual rates of drilling tripled relative to previous decades. But these dramatic increases were not sufficient to offset the decline in YPE associated with the on-going effects of resource depletion and the short run effects of high drilling rates. As a result, the discovery of new oil declined.

This decline in YPE for discoveries spills over to a decline in proved reserves. Smaller discoveries reduce the quantity of oil that supplies extensions and revisions, which now constitute the greatest source of additions to proved reserves. The decline in the YPE for reserve additions determined by the same interplay between depletion, innovation, and short run forces (Cleveland, 1992). As a result, proved reserves generally have declined since their peak in 1970 despite the drilling boom. Because proved reserves impose an 'upper limit' on annual rates of production, the decline in proved reserves reinforces the decline in production associated with higher production costs.

3. Opening the Arctic National Wildlife Refuge for exploration

Another cornerstone of the Bush energy plan is to allow exploration in areas that previously have been off limits. In theory, this could reverse the increase in the cost of production and the decline in the productivity of drilling. The most visible new frontier lies beneath the Arctic National Wildlife Refuge (ANWR) in Alaska. Here, the US Geological Survey estimates that about 7.8 billion barrels of oil are technically recoverable (USGS, 1999). This is a mean estimate—there is a 5 percent chance that 11.8 billion barrels of oil could be recovered. In either case, such a field would be comparable to the largest discovery in the US since 1968.

To what extent could oil from ANWR reduce the nation's dependence on imported oil, and reduce OPEC's ability to influence prices? The answer is not much, due largely to the magnitude and timing of

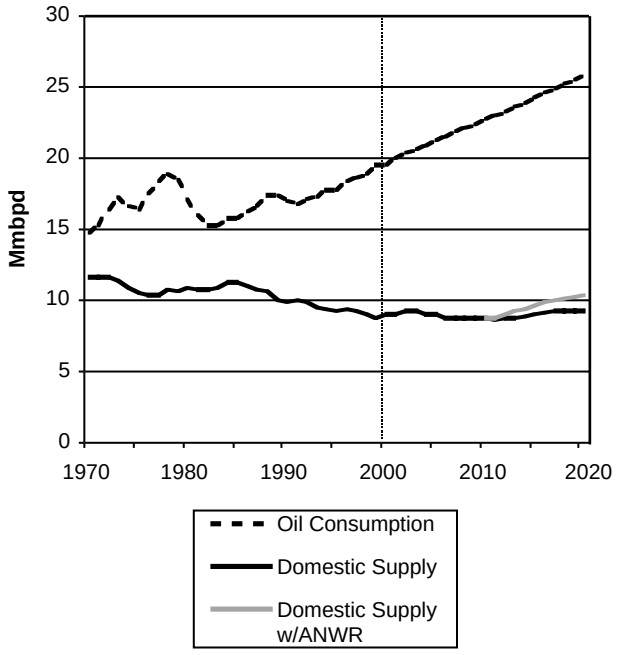

Fig. 2. Oil consumption and domestic oil production in the US. Forecasts for future production, consumption, and output from the ANWR are from Energy Information Administration (2000a, b).

production from ANWR relative to world production (Fig. 2). If development started today, it would take about 12 years for production to reach 1 million barrels per day (mbd); in another 6 years production would peak at about 1.3 mbd, and 5 years later, production would drop below 1 mbd (mean case) (EIA, 2000). For the 5 percent best case scenario, production would reach 1 mbd in 8 years, peak at 1.9 mbd in 22 years, and drop below 1 mbd in another 7 years. These long lead times imply that production from the ANWR will not contribute significantly to US supply for more than a decade.

This schedule of production from the ANWR will have relatively little effect on prices. Prices in the world oil market are determined by a combination of geological, institutional, and economic factors (Kaufmann, 1995). One of the critical factors is OPEC of capacity utilization: the amount of oil produced by OPEC relative to the amount it has the capacity to produce at any point in time. Since OPEC acts as the swing producer in the world oil market, a higher capacity utilization tightens the balance between supply and demand, and thus puts upward pressure on prices.

In theory, increased production from the ANWR could reduce prices by reducing capacity utilization by OPEC, and thus its share of the world oil market. In any plausible scenario, however, the actual effect will be close to zero. If OPEC correctly anticipates production from the ANWR, which would not be difficult given its long lead times, OPEC could slow additions to capacity very modestly such that its utilization rate (and its effect on price) would be unchanged relative to a scenario in which no oil is produced from the ANWR. The effect on price in this case would be negligible. In the unlikely case that OPEC acts with no foresight, an extra 1–2 mbd of production from the ANWR would reduce the capacity utilization by at most 2–3 percent. (In their base case, the US Department of Energy forecasts that OPEC will produce 62.4 mbd of the world's demand of 122.4 mbd in 2020.) Regardless of OPEC's behavior, the 1–2 mbd from the ANWR would reduce the OPEC's share of the world oil market by 2–3 percent. Such a change would be virtually undetectable given the large fluctuations in crude oil prices.

4. Macroeconomic effects

The effects of the ANWR aside, the Bush energy plan is based on the assumption that it *always* is better to develop domestic resources of oil and have the economic benefits accrue to US firms rather than overseas producers. This argument ignores the economic opportunity costs associated with efforts to increase domestic production. Such costs are illustrated by the macroeconomic distortions caused by the boom in US exploration and development from the mid-1970s to the mid-1980s (Kaufmann and Cleveland, 1991). Between 1973 and 1980, the total footage of wells drilled increased three fold (Fig. 3). Concurrent with this increase, the fraction of gross private capital formation consumed by the crude oil and natural gas production sector increased from about 3 percent in 1974 to 7 percent during the early 1980s. This increase is not surprising—the oil and gas sector is capital intensive relative to most other sectors. The surprise (disappointment) lies with the outcome of this investment. During this same period, US production declined 7 percent and the oil and gas sector share of GDP declined to below 2

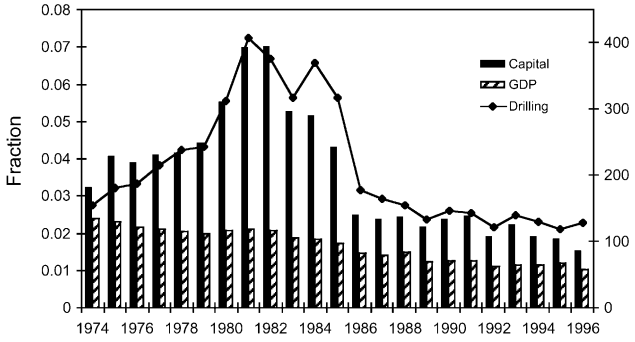

Fig. 3. The percentage of gross fixed capital formation by the oil and gas sector (solid bars), the percentage of GDP that originates in the oil and gas sector (shaded bars), and the total footage of wells drilled (solid line).

percent. The resultant 'gap' between investment and production indicates that the huge diversion of investment would have produced greater economic benefits had it been directed to other sectors.

The gap is caused by geologic limits on the ability to increase domestic production, regardless of economic incentives to increase production. When drilling declined to levels consistent with the depleted resource base in 1986, the gap between output and investment disappeared and has remained absent through the present. Nearly 20 years later, there is every reason to believe that the same failures and macroeconomic distortions will re-appear should the policy stimulate efforts to increase production beyond levels that can be supported by the depleted resource base.

It's the Oil, Stupid

The Bush energy presumes that a reduction in US import dependence no matter the size of that cut will help insulate the economy from the deleterious effects of oil price increases. But this too is a false premise. Nearly every recession in the post-WWII period has been preceded by an increase in the price of oil (Hamilton, 1983). The recessions associated with the 1973–74 and 1979–80 price shocks are well known. On the eve of the second oil price shock the US imported 46 percent of its oil. But at the time of the price increases that contributed to the recessions in the 1950s and 1960s, the US imported less than 20 percent of its oil.

The lesson here is clear. It is not dependence on imported oil per se that makes the economy vulnerable to price swings, but the dependence on oil itself. Oil is the lifeblood of industrial civilization, both as a fuel and as a chemical feedstock. Nearly every human activity in industrial nations uses oil directly and/or indirectly. It should be no surprise that the production of GDP, price levels, unemployment, and other important barometers of economic well being are tethered to the price of oil.

A reduction in our vulnerability to swings in the price of oil requires a reduction in our use of oil, regardless of where on the planet it is produced. Coal and natural gas are relatively abundant, but in a greenhouse world these fuels may carry an increasingly heavy price. There have been impressive recent cost declines for renewable energy systems such as wind and photovoltaics, but most forecasts for the near term project only modest penetration of these technologies (IEA, DOE). This could change with more aggressive policies that target these energy systems.

The efficient use of energy could help reduce our dependence on oil. Unfortunately, Vice-President Cheney has openly displayed disdain for this path, claiming that energy efficiency may be a laudable 'personal virtue', but it should not be a centerpiece of energy policy. This view is based on the outdated vision of efficiency as a return to the Stone Age, conjuring images of people huddling in the cold of their living rooms in front of lifeless TVs. But in reality, just the opposite is the case. In the last 20 years some of the world's best scientists and engineers have produced great innovations in the efficient use of energy. Cars that get 70 or more miles per gallon, appliances that use half the energy they did 10 years ago, lighting fixtures that last for years at a fraction of the energy cost, and new homes that heat and cool with modest amounts of energy are proven winners in energy and economic terms. Just a 3 mile-per-gallon increase in the fuel efficiency of SUVs alone would reduce the US oil consumption more than ANWR could supply (ACEEE, 2001). A study by five national laboratories concluded that a government-led efficiency program emphasizing research and incentives to adopt new technologies could reduce the growth in electricity demand by as much as 47 percent (Interlaboratory Working Group, 2000). This would drastically reduce our need to build new power plants. Of course, these technologies have costs and benefits just as oil development in ANWR does. What is lacking in the Bush plan is a sober comparison across technology and policy options.

The text of the Bush energy plan plays substantial lip service to renewables and efficiency. But in the case of all issues politic, you need to follow the money. The budgets proposed by the Administration do not substantially increase funds to develop, deploy and otherwise encourage renewable energy and efficiency. Indeed, the budgets would do just the opposite, further tilting the playing field towards conventional fuels through tax breaks and other subsidies. This will do little to advance the goal of 'energy independence', and in the process it will harm the economy and the environment.

References

American Council for an Energy-efficient Economy, 2001. Vehicle fuel economy standards: big energy savings at a modest cost. http:www.aceee.org.

Cleveland, C.J., 1991. Physical and economic aspects of oil production: the cost of oil supply in the lower 48 US, 1936–1987. Resources and Energy 13, 163–188.

Cleveland, C.J., 1992. Yield per effort for additions to crude oil reserves in the lower 48 US, 1946–1989. AAPG Bulletin 76, 948–958.

Cleveland, C.J., Kaufmann, R.K., 1991. Forecasting ultimate oil recovery and its rate of production: incorporating economic forces into the models of M. King Hubbert. The Energy Journal 12, 17–46.

Energy Information Administration, 2000a. Potential oil production from the coastal plain of the Arctic National Wildlife Refuge: updated assessment, SR/O&G/2000-02.

Energy Information Administration, 2000b. Annual Energy Outlook.

Forbes, K.F., Zampelli, E.M., 2000. Technology and the exploratory success rate in the US offshore. Energy Journal 21, 109–120.

Interlaboratory Working Group, 2000. Scenarios for a Clean Energy Future (Oak Ridge, TN; Oak Ridge National Laboratory and

Berkeley, CA; Lawrence Berkeley National Laboratory), ORNL/CON-476 and LBNL-44029, November.

International Energy Agency, 2000. World Energy Outlook.

Kaufmann, R.K., 1995. A model of the world oil market for Project LINK: integrating economics, geology, and politics. Economic Modeling 12 (2), 165–178.

Kaufmann, R.K., Cleveland, C.J., 1991. Policies to increase US oil production: likely to fail, damage the economy, and damage the environment. Annual Review of Energy and the Environment 16, 379–400.

Kaufmann, R.K., Cleveland, C.J., 2001. Oil production in the lower 48 states: economic, geological, and institutional determinants. Energy Journal 22, 27–49.

Krautkraemer, J.A., 1998. Nonrenewable resource scarcity. Journal of Economic Literature 36, 2065–2107.

Moroney, J.R., Berg, M.D., 1999. An integrated model of oil production. The Energy Journal 20 (1), 105–124.

National Energy Policy Development Group, 2001. Reliable, affordable, and environmentally sound energy for America's future. The White House, Washington, DC, 2001.

Pesaran, M., Samiei, H., 1995. Forecasting ultimate resource recovery. International Journal of Forecasting 11, 543–555.

United States Geological Survey, 1999. The oil and gas resource potential of the Arctic National Wildlife Refuge 1002 Area, Alaska, Open File Report 98-34.