Regime Building as a Prime Mover of Technological Progress: The Energy Sector in the Central Asia-Caspian Region

Mikhail A. Molchanov [*]
Yuri Yevdokimov[**]

Introduction

If the United States is an engine of global economy, the Central Asian-Caspian region is one of its fuel tanks. It is among the richest in the world in energy resources, which surpass that of Western Europe and are equivalent to the reserves of Central and South America, as well as North America. Several countries, including Azerbaijan, Russia, USA, Britain, Turkey, and Iran, and some of the largest transnational corporations compete for the right to develop the region's oil and gas reserves. International institutions have also become involved. A recent example is the decision by the International Finance Corporation (IFC), the World Bank's arms-length institution, to invest $3.6 billion in the construction of the Baku-Ceyhan pipeline that will connect Azerbaijan's oilfields with the sea port in southern Turkey. International civil society, as represented by transnational environmental groups and other non-governmental organizations (NGOs), takes keen interest in the area, while protesting ecological hazards brought about by increased exploitation of the region's energy resources.

There is little agreement among the many industry-related parties and stakeholders. Although de-jure allocation of property rights on the Caspian sea shelf has recently been accomplished, in reality they are still subject to contestation. Both regional security and sustainable development of the already proven deposits of oil and gas are at risk. Capital stock is by and large outdated and requires urgent modernization. Labor productivity is low, and the living standards in all countries of the region are currently below their respective 1990 levels. Only a mutually

[*] Department of Political Science, St. Thomas University, Canada. Email: molchan@stu.ca.
[**] Departments of Civil Engineering and Economics, University of New Brunswick, Canada. Email: yuri@unb.ca.

agreeable and functioning regime of international cooperation in development of the region's energy sector can address these issues. At the moment, such a regime is missing.

Regime building and technological spillovers

While international regimes have been studied from a variety of angles (e.g., Gilpin, 2001; Keohane and Nye, 2001; Krasner, 1983; Rittberger, 1993), much remains to be said about regime as an instrument of cumulative technological innovation. The purpose of this paper is to argue that establishment of a cooperative energy regime in the region will be not only diplomatic, but also a significant technological breakthrough. Cooperation increases productivity and leads to technological transfers that become prime movers of technological progress in less developed countries. A cooperative political-economic regime will have a potential to enhance foreign direct investment in the region, thus bringing about fundamental changes in the organization of production process in the energy sector of such countries as Azerbaijan, Turkmenistan, or Kazakhstan. Since energy is a major production input, advances in energy sector will drive technological progress in all other sectors. Cooperation in the field of energy will inevitably cause further spillover effects on other sectors of regional and international economy.

Because of systemic effects it will cause to political economy of the region, institution of a cooperative regime in the development of energy resources of the Caspian can be regarded as an example of introduction of a General Purpose Technology (GPT), i.e. a technology that opens new opportunities in production, organization of work and innovative process (Helpman, 1998). GPT is characterized by pervasiveness, inherent potential for technical improvements and innovational complementarities, which give rise to large economies of scale (Bresnahan and Trajtenberg, 1995). It is not just a simple continuous improvement in production technology, but rather a one-time large positive technological development with persistent consequences. As GPT gradually diffuses, it affects the development of the entire economy.

The literature on GPTs tends to identify one sector as critical for fostering technical advance in a wide range of user industries, and to trace multiple impacts of technological change in this sector on the economy at large (Grossman and Helpman, 1991). But what leads to a technological breakthrough in the energy sector itself? In two words, science and politics, with the latter often mobilizing and directing the former. A conflictual, "beggar-thy-neighbor" politics suppresses technological transfers. On the other hand, cooperation in trade – as in science – enables innovation and promotes development. As a new form of organizational technology, a cooperative regime in the energy sector of the Central Asia-Caspian region will promote sharing of know-how and technological transfer between national oil and gas industries of the participating countries, as well as rapid domestication of progressive methods of work brought by foreign investors. In pure economic sense, such a regime will reduce transaction costs and initiate economies of scale in energy sector leading to a decreasing unit cost of energy. It will also cause spillovers on other sectors of the economy, primarily agriculture and manufacturing, which are both severely underdeveloped throughout the region. A cooperative regime in energy trade and development will help strengthen security and sustainability in the area. In addition to its overall positive role for the region, it could also enhance profit margins of the transnational oil and gas companies currently engaged in a cut-throat competition for the shares in the extremely lucrative market.

The scramble for the Caspian

Geographically, the Central Asia-Caspian region includes several countries of the former Soviet Union (FSU): Azerbaijan, Turkmenistan, Kazakhstan, Uzbekistan, Tajikistan, and Kyrgyzstan, as well as the adjacent coastal areas of Russia and Iran and the neighboring Xinjiang province of China. Among powerful external interests, the USA, NATO, and the European Union (EU) should be named first. The convergence of Russian, European, Chinese, and American interests in the region makes it into one of the few remaining sites of global geopolitical

competition. Intense economic rivalry over production and distribution of the region's hydrocarbon resources is complicated by the fact that this geographic area is also a source of concern to the NATO system of treaties and the US-led alliance engaged in the war on terror. The region can potentially become a bone of contention between existing and aspiring nuclear powers. In addition to that, Central Asia is an important part of an Islamic world caught in the throes of turmoil, and therefore subject to the potential destabilizing forces of political Islam. This holds true for Xinjiang province of China no less than for the former Soviet Union.

At present, the region is becoming the locus of a new geostrategic "game" that may define political and economic developments in the world for decades ahead. The players are: (i) nation-states of the region; (ii) key regional powers (Iran, Turkey, Russia, and China); (iii) global powers and international organizations (USA, European Union); and (iv) transnational corporations. Each of these players has a vital stake in accessing the region's energy resources.

Russia and the USA are the key players, with Russia aiming to offset the influence of the USA in the region. If Russia can re-establish control over the Central Asian-Caspian region through a network of international treaties, its position as a "strategic intermediary," or focal point for energy supply from the Caspian littoral countries to the EU will be consolidated. Russia is leery of a US military presence in Georgia, Uzbekistan, and Kyrgyzstan, although committed to common security objectives with respect to terrorism and vigilance towards Islamic fundamentalist movements. Russian energy interests, as represented by such companies as an oil giant Lukoil, are clearly at loggerheads with the American and British interests in the region.

Transnational and para-statal companies involved in the Caspian oil development and transportation essentially compete against each other, and so do the states that are backing them up. An ideological consensus that underpins official support for these "free market" policies in the USA draws on the legacy of the Cold War and containment to no lesser extent that on the more recent

designs of the "New American Century" and the peculiar understanding of America's "manifest destiny" exhibited by the George W. Bush administration. Advocates of the new American "empire" are in many instances indebted to the cold warriors of the old.

A key figure among the latter, Zbigniew Brzezinski (1997: 30) has called the Central Asia-Caspian region "the chief geopolitical prize" in the ongoing competition for international supremacy, while arguing that "America's global primacy is directly dependent on how long and how effectively its preponderance on the Eurasian continent is sustained." This view, which is representative of the realist school in international relations theory, assumes that effective functioning of an international regime can only be secured on the basis of unconditional political hegemony by one country. Accordingly, US leaders are urged to engage into neo-imperialist pursuits, particularly with regards to the resource-rich countries, such as Azerbaijan, Uzbekistan, or, for that matter, Iraq and Iran. Conservative think tanks in the USA are actively promoting the idea that hegemonic leadership, which is presently supplied by the United States, should be maintained and reinforced. In this theoretical and ideological context, the USA is pictured as a country that is "bound to lead" the world political economy, just as it leads global anti-terrorist efforts (Nye, 1990). International trade, according to a number of neo-realist studies, is inexorably linked to the national security imperatives of the hegemonic power (Gowa, 1993).

American preponderance in the Central Asia-Caspian region can be sustained by a number of instruments, of which economic involvement is but one. U.S. companies Amoco, Chevron, and ExxonMobil have invested billions of dollars in oil and gas exploration and development in Azerbaijan. ExxonMobil is also a key player in Turkmenistan. Since 1997, Amoco Corporation in particular has dramatically extended its operations in the Caspian Sea littoral. It has also become a key lobbyist for the US oil interests in the area, and, judging by some accounts, a power broker with direct stakes in local politics.

Amoco Corp. is a central member of the Azerbaijan's oil drilling International Operating Company (AIOC). As a holder of a 30-percent interest in the Ashrafi-Dan Ulduzu production sharing agreement (PSA), it also carries the largest interest in the Azerbaijan-based North Absheron Operating Company (NAOC). None other but Amoco executives focused White House's attention on the strategic value of Azerbaijan oil deposits, securing the state approval of a controversial visit of the late Azeri dictator Heidar Aliev to Washington in August 1997. The state visit was crowned with signing of a new Amoco oil exploration deal. The Exploration, Development and Production Sharing Agreement (EDPSA) of July 1998 gave the company a 25 percent stake in the Caspian Sea oil exploration consortium led by the Azeri state company SOCAR, in addition to the previously held 17 percent interest in the Azeri-Chirag-Deepwater Guinashli PSA. Amicable relations between the company and the Azeri government continued after Heidar Aliev's death, with presidential succession of his son and former SOCAR's vice president Ilham.

By 1998, multinational oil companies had invested more than $2 billion in the three former Soviet republics with most of the Caspian's oil and gas: Azerbaijan, Kazakhstan, and Turkmenistan (Morgan & Ottaway, 1998). All three states are presently run by more or less authoritarian governments, while two of the three – Azerbaijan and Turkmenistan – approximate full-blown dictatorships and are also included on the list of most corrupt governments of the world. Nonetheless, or perhaps, in no small part because of this unfortunate circumstance, investment moneys were coming fast. In Azerbaijan alone, foreign direct investment (FDI) rose by 16 times, from $330 million in 1995 to $5,354 million in 2002. More than 70 per cent of all FDI inflows were in the oil and gas industry. By 2001, the annual foreign direct investment in Azerbaijan reached $227 million. The next year, it jumped 6 times, to $1,392 million in 2002 (UNCTAD, 2003).

At the moment, competition among the foreign firms involved in the Caspian oil and gas development projects is intense. FDI in the Azeri economy soared by 70 percent in 2003. The 2004

budget of the AIOC, the Azerbaijan International Operating Company, where Amoco had its 25 percent stake in 1998, reached $2.454 billion. Exxon alone has invested $1.5 billion and expanded its offshore exploration drilling to include the Zafar-Mashal project. The BP-led consortium is busy building the $2.95 billion Baku-Tbilisi-Ceyhan (BTC) export pipeline that would allow western companies to bypass Russian territory and boycott the existing Russian oil and gas transportation infrastructure. By the end of this year, a total of 50 million tonnes of oil are to be pumped through the pipeline, which, compared to the annual average of 6.2 million tonnes passing through the earlier built Baku-Supsa pipeline in 2003-2004, will represent a significant boost in exports from the region. By comparison, only about 2.5 million tonnes of Azeri oil are slanted to go through the Russia-controlled Baku-Novorossiisk pipeline in 2004. The fact that this figure remains unchanged since 2002 reveals Russia's recent marginalization in the Caspian oil market, particularly as relates to transportation infrastructure and services.

France's Total is buying into the joint Lukoil-SOCAR venture offshore North Azerbaijan and negotiated interest in the fields between the Russian and Kazakh sectors of the Caspian Sea. Meanwhile, Russian Lukoil reached an agreement with Kazakh KazMunaiGaz on joint development in the central sector of the Kazakh sector of the Caspian Sea. Western countries with active interest in the Caspian gas and oil included USA, UK, France, Germany, Italy, Norway, and Finland (Caspian Oil and Gas 2004).

As western interests collided with Russian interests in the area, transnational companies became active lobbyists on behalf of the authoritarian governments of such countries as Azerbaijan, Turkmenistan, Uzbekistan, and Kazakhstan. In the post-September 11 world, the US- and UK-based transnationals ensured US military presence in the region with the opening of military bases in Uzbekistan, Kyrgyzstan, and Georgia. Strategic interest of the key western powers in exploration of the Caspian energy resources was recently expressed in the official report to the US President and

the UK Prime Minister, known as the US-UK energy dialogue. The report, written in July 2003 by Don Evans, the US commerce secretary, and Spencer Abraham, the US energy secretary, acknowledges that both western countries "have noted the huge energy potential of Russia, Central Asia, and the Caspian." Accordingly, both governments gave strong backing to the BP-led Baku-Ceyhan project, just as ten years ago they both supported the World Bank's loan to enable construction of a major oil export pipeline from Baku, Azerbaijan, to Supsa on Georgia's Black Sea coast (*Guardian Weekly,* November 20-26, 2003, p. 10).

The necessity of cooperation

At the moment, American energy companies suppress development of an independent local production capacity in the Central Asia-Caspian region. The US-based multinationals also compete with Russian and European business interests in the area. Bilateral agreements concluded between foreign companies and host governments of the region tend to contradict each other and implicitly increase possibility of future conflicts. It does not have to be this way, however. The region's oil and gas reserves can be seen as either a bone of contention or a common resource shared by all these players. In the interests of global security, it is important to advance the idea of a cooperative regime in the area. Such a regime, implemented in the form of a socio-economic network, will not only diffuse the economies of scale effects throughout the region, but will also result in manifold spillover impacts on other economic sectors.

Until a cooperative international regime for the development of the region's energy resources is created, individual interests of the consumers and producers of energy involved in the Central Asian-Caspian region will continue to be pursued in a haphazard and inherently conflictual manner. Bilateral negotiations will undermine multilateral efforts. Business practices will not be bound by negotiated agreements. Both energy production and trade will remain hostage to the short-term interests of political elites and transnational corporations. Because of that, there will be no

sharing of progressive technologies, and technological transfer owing to FDI will be kept to a minimum. Production outputs will remain at suboptimal levels. On the other hand, a cooperative framework will boost investors' confidence, propelling the currently moderate levels of FDI to new heights.

Cooperation requires that all interested parties in the region agree on a common set of rules and norms that would guide "recognized patterns of practice around which expectations converge" (Young, 1980). We intend to define basic properties of the prospective regime from a systemic viewpoint. The key step here is to outline a detailed framework and rationale for a cooperative international regime. This study subscribes to a liberal-institutionalist idea of cooperation without hegemony, while emphasizing the importance of a normative basis for a would-be international energy regime to be lasting and viable. Neo-liberal institutionalists argue that international institutions can "facilitate such cooperation by reducing transaction costs, providing information, and constructing rules of thumb to guide bureaucracies in making routine decisions" (Keohane, 1984). Cooperation in the absence of hegemony does not require anyone to play the role of "rules enforcer," nor is it premised on the assumption of coincidence of interests among the participants. What is needed, instead, is simple compliance with a set of rules and norms that apply equally to every participant, and a reciprocal desire to adjust policies to accommodate trading partners' needs on a consensual or quid-pro-quo basis.

Globalization calls forth a new international ethics of sharing, which is bound to replace the "winner-takes-all" reasoning of the old-time geopolitical thinkers. Development of cooperative international regimes in various "hot zones" of the world and with regards to potentially conflictual issue-areas of international political economy is the way of the future. As a form of technological change manifested through introduction of GPT, such a regime will open up the "enabling technologies" and usher in new opportunities in other sectors of economy (Bresnahan and

Trajtenberg, 1995). Once individual member-countries assimilate the new opportunities, they start thinking about the region as a common wealth shared with other member-countries. The regime itself becomes a new public good that leads to a wiser utilization of natural resources, improves labor productivity, and enhances social equity.

Toward a future cooperative regime

Among experts on international competition policy regimes, at least three basic types of such regimes are discussed (Budzinski, 2004):

- Anarchy:
- Harmonization;
- Policy Coordination

In this context, anarchy is associated with the self-interested behaviour of different countries – national states. Harmonization favours more or less uniform international policy regime with an international law enforced by an international agency. Policy coordination favours systematic international policy coordination via systematic multilateral cooperation or rules to define non-conflicting jurisdictions in trans-border issues. It can be regarded as a soft path via minimum standards, agreements on non-controversy subjects in order to provide a playing field for international markets.

The WTO path has always been synonymous to substantial harmonization. Cooperative regime in the form of socio-economic network proposed in this study is more of the third type. It is associated with the statement that one main goal of the network approach is the improvement of voluntary cooperation through systematic and permanent interaction. An advantage of this approach lies in the efficiency-enhancing convergence of individual national policies to the best available amongst the network participants.

A cooperative energy regime in the Central Asia-Caspian region may lead to a technological breakthrough in both energy and related sectors. International cooperation will boost productivity and help to avoid recurrences of the so-called Dutch disease which, as many observers note, already plagues fledgling postcommunist economies of such countries as Azerbaijan or Turkmenistan. With the introduction of a cooperative regime in energy production and distribution, politico-economic adjustments will snowball throughout the region's economies, allowing them to accomplish what IMF preached nut was unable to implement – structural reforms affecting significant productivity growth in the area. Since energy is the key production input, we anticipate that this immediate impact will give rise to technological advances in all energy-dependent sectors.

With respect to technology, Joseph Shumpeter (1934) defined five types of innovation:

(i) introduction of a new product;

(ii) introduction of a new process innovative to an industry;

(iii) opening of a new market;

(iv) development of a new source of supply for raw materials or other inputs;

(v) change in industrial organization.

Introduction of a socio-economic network of cooperating agents is of the fifth type. It is a new form of industrial organization on a larger scale. The snowballing, cross-sectoral effect of cooperation will reveal its essential features as that of a General Purpose Technology. Political cooperation will dramatically increase productivity and ultimately will lead to technological improvements in other related industries, thus raising national GDPs and overall standards of living. Regime building will allow addressing and overcoming problems of access to new technologies by developing nations, as international cooperation itself will become a prime mover for technological advances as shown later in simulation exercise.

As a form of a "technological prime mover", international regime must feature a set of optimal rules of collective behavior for all parties involved. Introduction of a cooperative energy regime will represent a major technological change in organization of all political and economic activities related to extraction, production and distribution of regional energy resources. Moreover, as a form of GPT, it will bring more than just a pure technological change, which is generally defined as incremental improvement in methods of production. First, such a regime must include a new form of organization of interstate relations, international trade, and flows of capital, labor and technology. Second, it should open up new avenues for innovative process, particularly as manifested in R&D activities. Third, to be genuinely beneficial for all parties, such a regime must involve seamless integration of individual technological, economic and intellectual networks, thus generating positive effects in sectors other than energy sector.

A network of cooperating agents in a regional energy sector entails large potential for technological improvements and innovational complementarities within and between individual member-countries. This is similar to a rapid diffusion of communication technology as a result of the development of computer networks, which led, first, to a decreased unit cost in the industry and, second, to new technological developments elsewhere (see Zacher, 1996). As a type of socio-economic network, a cooperative regime will produce a higher critical mass of intellectual and organizational potential in the region, on the one hand, and positive network spillovers, on the other (Wasserman and Faust, 1994).

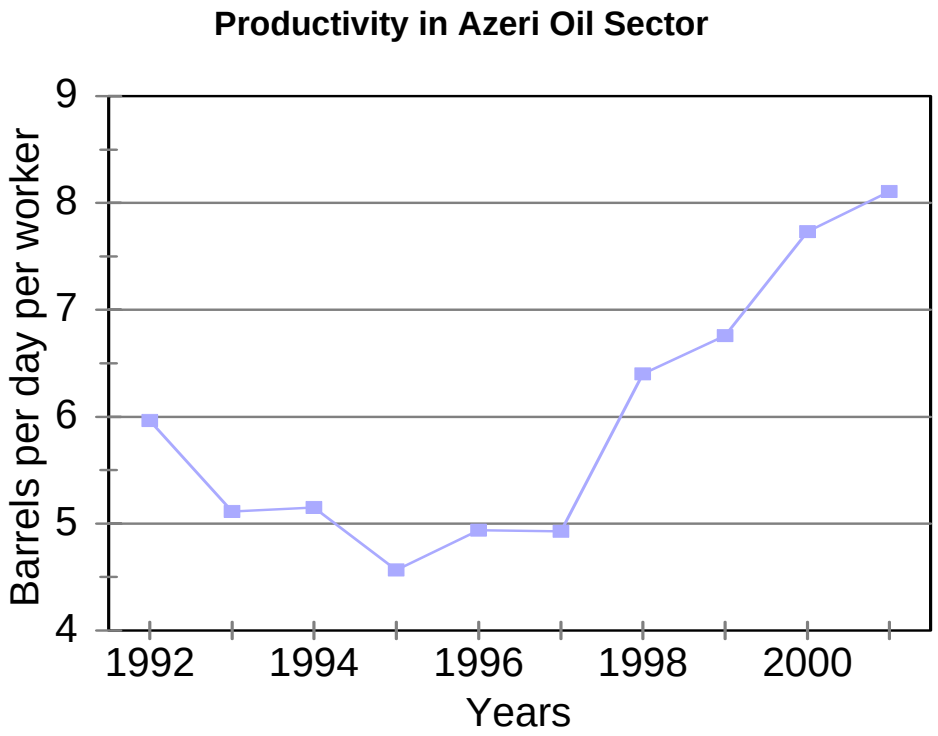
Productivity as a measure of technological change

Technological change can manifest itself through (i) marginal continuous increase in productivity, or (ii) one-time "jump" in productivity. Productivity in general is expressed in terms of labour productivity and/or total factor productivity (TFP) sometimes called multi-factor productivity (MFP). Labour productivity is measured in units of output per worker or worker's

hour. TFP is measured as output per unit cost where unit cost is associated with total cost of production. At the level of an industry, labour productivity can be defined as the ratio of the value added by the industry to the value of labour. TFP is the ratio of the value added by the industry to the total cost of production.

Furthermore, according to neo-classical growth theory, developed by Solow (1957), labour productivity can be decomposed into increases in the amount of capital per worker, improvements in quality of labour and growth in TFP. Therefore, if we were able to derive changes in labour productivity in a given industry or sector, we would be able to derive TFP and analyse it from a standpoint of marginal versus one-time changes. By definition, dramatic one-time change in TFP would point at technological breakthrough.

At this point, we can only speculate that introduction of a network of cooperating agents in the Central Asia-Caspian energy sector will lead to such a breakthrough. However, there are some signs that this is exactly the case. For example, let us take a look at oil production in Azerbaijan. We derived labour productivity in the Azeri petroleum sector during years of independence. Figure 1 shows the time series:



As the figure shows, labour productivity has fluctuated between 4.5-8 barrels per day per worker (BDW) over 1992-2001 period. Just for comparison, this indicator is 8.8 BDW in Russia, 18.8 BDW in Canada and 24.3 BDW in USA. Therefore, if, for example, Russia, USA and Azerbaijan became members of the same socio-economic network of cooperating agents, then the productivity of the network as a whole would increase dramatically, which is technological breakthrough by definition.

Simulation exercise

The following simulation shows that under some specific conditions a network of cooperating agents leads to a higher productivity with an improvement in welfare of all participating agents. Moreover, since according to economic theory national and international welfare do not generally represent a trade-off, the increase in national welfare may lead to an increase in international welfare.

Suppose there are three countries in a region subject to the following initial conditions:

1. Country A owns a deposit of an energy resource. As well, the country has infrastructure in place to deliver the resource to the world market. Moreover, in order to maintain the existing infrastructure a fixed amount F is needed every year.
2. Country B is located nearby, while country C is geographically distant. Both B and C have interests in country's A energy sector. They possess technologies to extract the energy resource. These technologies can be expressed in terms of total cost functions $C_B(Q_B)$ and $C_C(Q_C)$ as functions of output Q. Suppose that country C has a more advanced technology meaning that $MC_B > MC_C$ or marginal cost of the technology B exceeds marginal cost of technology C at any level of output.
3. Countries B and C have to pay exactly amount F to country A to extract the resource and deliver it to the world market.
4. The energy resource can be sold at world price P.
5. Country B knows about amount extracted by country C and vice versa

The first scenario is developed under the anarchy alternative: each of the three countries acts in its self-interests and maximizes its own profit.

Country A: $Profit = Total\ Revenue - Total\ Cost = 2F - F$

Country B: $Profit = Total\ Revenue - Total\ Cost = PQ_B - C_B(Q_B) - F$

Country C: $Profit = Total\ Revenue - Total\ Cost = PQ_C - C_C(Q_C) - F$

Profit maximization leads to the following condition:

$$P = MC(Q_B^*) = MC(Q_C^*)$$

which produces individual optimal levels of extraction Q_B^* and Q_C^*. Total output of the region therefore is:

$Q = Q_B^* + Q_C^*$

New scenario is the one associated with the network of cooperating agents. Suppose that these three countries form a network under the following conditions:

1. Countries B and C pull their technologies together to establish aggregate technology, characterized by the cost function *C(Q).*
2. Country A contributes its infrastructure.
3. The network as a whole is a profit maximizing unit
4. Profits are divided in a pre-negotiated way according to the each country's contribution to the network.

Network's profit maximization is:

Total Revenue – Total Cost = PQ – C(Q) – F

and the following condition arises:

$P = MC(Q^*)$

where Q^* is the network's profit maximizing output. Since the world price P is the same, we can write

$MC(Q^*) = MC(Q_B^*) = MC(Q_C^*)$

This condition is known as equi-marginal principle, which means that each of the producing countries produces at equal marginal cost. This condition can only be achieved if the producing countries agree to cooperate. It assures that under aggregate technology total cost is minimized. The network of cooperating agents with aggregate technology subject to the equi-marginal principle will produce the energy resource at a lower cost, which implies higher TFP. In addition, aggregate technology can better exercise the economies of scale arising from more efficient use of the existing infrastructure. In the end, these two effects lead to a significant increase in TFP.

In order to illustrate these conclusions, the following numerical exercise was performed. Suppose that:

P = \$30/unit

$MC_B = 12 + Q_B$

$MC_C = 10 + 0.5Q_C$

$F = 20$

In order to satisfy the equi-marginal principle, aggregate technology can be derived via the so-called horizontal summation of the two marginal cost functions MC_B and MC_C given above. It produces:

$$MC = \frac{22}{3} + \frac{Q}{3}$$

The following table summarizes our calculations:

Economic Indicator	***Without cooperation***	***Cooperation***
Total Output	$Q_B^* + Q_C^* = 58$	$Q^* = 68$
Total Revenue	$P(Q_B^* + Q_C^*) + 2F = \$1{,}780$	$PQ^* = \$2{,}040$
Total Cost	$C_B(Q_B^*) + C_C(Q_C^*) + F = \$1{,}218$	$C(Q^*) + F = \$1{,}289.4$
Gross Profit = Total Revenue – Total Cost	\$562	\$750
TFP = Output/Total Cost	Technology B = 0.045 Technology C = 0.049	Aggregate technology = 0.053

As a result, aggregate technology of the network has total factor productivity of 8% higher than technology of the country C and 17% higher than technology of the country B. It means that the network of cooperating agents can produce a technological breakthrough if conditions for

cooperation are honoured and the equi-marginal principle is achieved. This is a direct (short-run) effect from cooperation regarding technology.

However, since unit cost of producing energy decreases under cooperation (i.e. Total Cost/Output = $18.96/unit against $21/unit without cooperation), and energy is a major input in producing all other goods and services, there will be a secondary spillover effect on other sectors of the regional economy. With passage of time, this effect can give rise to further (long-run) technological improvements.

Conclusion

As demonstrated above the network of cooperating agents will achieve a significant rise in productivity in the region's energy sector, and hence, a technological breakthrough in the sector with anticipated spillover effects across the economy. Creation of the network of cooperating agents in the Central Asia-Caspian energy sector will include such participants as nation-states and transnational corporations involved in exploration, extraction and transportation of the region's energy resources. Cooperation amongst these agents will lead to the increased welfare of the network as a whole. As our simulation showed, if certain conditions are met, individual welfare of the participants can be improved as well.

References

Bresnahan, T. and Trajtenberg, M. 1995. "General Purpose Technologies: 'Engines of Growth'?" *Journal of Econometrics*, 65: 83-108.

Budzinski, Oliver, The international competition network, Policy Paper, Phillips University of Marburg, Germany, 2004

Caspian Oil and Gas 2004. Press Release. Retrieved February 20, 2004, from the World Wide Web: http://www.caspianoilgas.co.uk/Press/04Feb2004.asp.

Gilpin, Robert. 2001. *Global Political Economy: Understanding the International Economic Order*. Princeton, N.J.: Princeton University Press

Grossman, G. M. and Helpman, E. 1991. *Innovation and Growth in the Global Economy*. Cambridge: MIT Press.

Helpman, E. 1998. *General Purpose Technologies and Economic Growth*. Cambridge: MIT Press.

Keohane, R. O. 1984. *After Hegemony: Cooperation and Discord in the World Political Economy.* Princeton, NJ: Princeton University Press.

Keohane, R. O. and Nye, J.S. 2001. *Power and Interdependence.* 3rd ed. New York: Longman.

Krasner, S. D., ed. 1983. *International Regimes*. Ithaca: Cornell University Press.

Milner, H. V. 1998. "International Political Economy: Beyond Hegemonic Stability." *Foreign Policy,* 110: 112-124.

Morgan, D., and Ottaway, D. B. 1998. "Azerbaijan's Riches Alter the Chessboard". *Washington Post*, October 4, 1998; Page A1.

Nye, J. S. 1990. Bound to Lead*: The Changing Nature of American Power*. New York: Basic Books.

Preston, Lee E., and Windsor, Duane. 1997. *The Rules of the Game in the Global Economy: Policy Regimes for International Business.* 2nd ed. Boston: Kluwer Academic Publishers.

Rittberger, Volker, ed. 1993. *Regime Theory and International Relations*. New York: Oxford University Press.

Solow, Robert, Technical change and the aggregate production function, Review of Economics and Statistics, 39, 1957, pp. 65-94

UNCTAD. 2003. FDI in brief: Azerbaijan. Retrieved December 5, 2003, from the World Wide Web: http://r0.unctad.org/en/subsites/dite/fdistats_files/pdfs/Azerbaijan_brief.pdf.

Wasserman, Stanley, and Faust, Katherine. 1994. *Social Network Analysis: Methods and Applications.* Cambridge; New York: Cambridge University Press.

Young, Oran R. 1980. "International Regimes: Problems of Concept Formation." *World Politics,* 32: 331-56.

Zacher, Mark W., with Brent A. Sutton. 1996. *Governing Global Networks: International Regimes for Transportation and Communications.* Cambridge; New York: Cambridge University Press.

Shumpeter, J., The theory of economic development, Cambridge, Mass.: Harvard University Press, 1934