

SUSTAINABLE ECONOMIC GROWTH: LONG TERM

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Sustainable long term economic growth has to be goal of every nation. Stable or declining economic output is unacceptable in countries experiencing population growth. Either would result in declining standards of living that would lead to widespread hardship, societal upheavals, and political unrest. In the short term, even the intermediate term, indigent people can be given temporary food aid. However, in the long term, alleviating poverty becomes a priority because people must generate sufficient income to purchase the basics of life and they have a felt need to grow wealth to improve their circumstances. Resource scarcity becomes the major issue, for without critical resources it is impossible to grow an economy, expand the supply of the basics of life, or create the jobs people must have to afford to buy them. This paper, the third in a series, will examine the major constraint to sustainable economic growth.

Economic Growth

Economic growth was explained in classical economics by the aggregate production function where national output, Gross Domestic Product (GDP), was a function of land, labor, and capital; all of which were assumed to be immobile and scarce in the age of agrarian economies. Later, economists identified another economic factor of production – entrepreneurship - the ability to provide innovative leadership and management skills to garner the factors of production, develop technology, and take the risks necessary to undertake ventures that contributed greatly to economic growth. While land or natural resources posed limits to economic growth because of their fixed or depleting natures, the possibilities of generating income and creating wealth gave entrepreneurs incentives to innovate around resource deficits.

The land resource limitation to economic growth was overcome when entrepreneurs shifted attention from growing commodities to manufacturing products, some of which

were used to improve productivity of the fixed land resource. Minimally trained workers were employed to perform simple, repetitive tasks in the manufacture of goods using muscle power; and agrarian-based economies gave way to industrial manufacturing economies. Economic output was greatly increased by coupling labor with technologically enhanced capital goods; man-made factors of production - machines powered by steam, internal combustion engines, and, later, electricity. Capital goods soon surpassed labor as the most critical resource and the technical training of workers became the key to improving productivity. As economies developed even more, the critical resource became intellectual capital, the ability of an employee to use his or her intellect to perform highly technical or creative work. Developed countries around the world expanded their economies to also produce services.

A New Production Function

The classical economic factors of production are neither as immobile nor as scarce as was once assumed. All countries seek to employ the available land, labor, and capital to produce commodities and manufactured products. But if a country lacks those resources, it can import commodities and products. In a world of about 6.7 billion people, outsourcing - sending work, and usually capital goods - to a location of low cost labor has become widespread. In the age of service economies, land, labor, and capital have become less relevant.

Resources critical to economic growth change over time. For example, energy was considered a minor economic factor of production when it was abundant and cheap. High energy prices and the threat of supply disruptions have changed that perception so that now energy can be considered *the* critical resource in economic development and growth. The redefined aggregate production can be written as follows:

$$\text{GDP} = f(\text{energy, intellectual capital, money, entrepreneurial ability})$$

Many U.S. companies have developed strategic competitive advantages by organizing to implement business models based on this GDP growth equation. By aggressively applying imagination to problem solving in risk taking situations, U.S. companies have been able to maintain relevancy and compete profitably in the global marketplace.

Countries experiencing rapid population growth need not suffer a reduction in the standard of living if the intellectual capital of people can be increased and put to work. A country's intellectual capital resource base depends on the degree of education and training available as well as the ability to fully employ people with intellect. In too many cases, intellectual capital is underutilized or not employed at all. Although anecdotal comments from global managers point to a current shortage of trained knowledge workers, the deficiencies can be overcome. A country's quantity and quality of intellectual capital can be expanded by allowing immigration of knowledge workers, by developing corporate internal training programs, and by increasing enrollment in technical schools and universities.

Although money or venture capital might have been considered scarce at one time, it is no longer. Before the credit crunch, the global economy was awash in it and money can be transmitted almost anywhere in the world at electronic speed. Entrepreneurial ability was once thought to be thinly distributed among any population. But as has been amply demonstrated, if individuals are given opportunities and the freedom to pursue profit and wealth unfettered by social boundaries or government restrictions, entrepreneurial ability is widely distributed. Education and training can further add to a country's base of entrepreneurial talent.

If one accepts the premise that money is not scarce and the resources of intellectual capital and entrepreneurship can be expanded to fill the needs for them, the only practical limit to sustained economic growth is an abundant supply of reasonably priced energy.

Energy comes in many forms, can be shipped or transmitted where needed, and need not be considered limited in supply as will be explained later in this paper. But economic

performance suffers with less than optimal amounts of electrical and transportation energy; a cut-off of energy supplies results in a shut-down of economic activity.

Energy in its conventional forms is not as scarce as prices would lead one to believe. The world is not in imminent danger of running out of fossil fuels. The global inventory includes approximately 1,278 billion barrels of oil, 955 billion barrels oil equivalent (BBOE) of tar sands and oil shale, 1,239 BBOE of natural gas, and 4,786 BBOE of coal. At the current rate of usage of 30 BBOE per year, that is an estimated 275 year supply. There are problems that put that estimate in doubt: not all is physically recoverable with present-day technology; some of that supply is not economically recoverable; there are ecological problems with the extraction, transporting, and burning of those energy sources. More reserves are being found around the world as discovery techniques become more sophisticated. But new discoveries, in most cases, are in places that make extraction and transportation expensive. Although the largest deposits of coal in the world are in the U.S., China, and Russia, coal deposits are widely distributed around the world. Not so for petroleum. About eighty percent of the world's oil deposits are under Eastern Hemisphere countries: Saudi Arabia, Iran, Nigeria, Iraq, Algeria, Kuwait, Libya, United Arab Emirates, Qatar, and countries of the Former Soviet Union.

Commodity prices cycle as market forces attempt to match supply to demand. For agricultural commodities, producers' efforts to expand or contract supply are often thwarted by the weather. However, weather induced supply disruptions are usually corrected in one or two crop production cycles. Mineral commodity producers must deal with long lead times; it can take many years to develop a new oil field, for example. Therefore, it can take a long time to moderate oil price spikes by adjusting supply to meet demand needs.

A major difference between agricultural commodities and mineral commodities is the ability to control supply. Because of weather variations, the large number of agricultural commodity producers around the world have very little ability to control supply, even if they could agree to cooperate. The significantly smaller number of individual oil

producers around the world have control over extraction rates, which, if they act in concert, can give them near stranglehold control over global supply. Put into other words, competitive market forces are prevented from balancing supply and demand in the normal way.

The Oil Producing Exporting Countries (OPEC) cartel worked very well in the mid-1970s to restrict global exportable oil supply, but for most of its existence it has been plagued by the problems common to all cartels – difficulty in making joint decisions, cheating by members, and incomplete control over supply. Several factors have all but eliminated those problems. First, oil producing nations have taken control of their oil resources. Eighty percent of the world's oil is now state owned or controlled. The large, international oil companies, while still owning some reserves, have been relegated, for the most part, to middlemen processors and distributors. They continue to generate large profits simply because of the huge volumes they handle; however, their market power has been severely eroded. Secondly, rapidly growing global demand for oil and petroleum products has taken up excess pumping capacity so that demand has expanded faster than supply, which has caused oil price to rise to historically high levels. OPEC members sell all the oil they can produce at astounding prices. There is no incentive for them to cheat. Thirdly, OPEC recently expanded to thirteen countries, producing about 35 percent of the world's oil. Although, Indonesia will leave at the end of 2008, Sudan has been invited to join. Fourthly, Russia, while not a member of OPEC, acts in concert with OPEC. The countries of the FSU, produce about 15 percent of the world's oil. Russia, the world's second largest oil producing nation, is rebuilding its economy and revitalizing its military capabilities on revenues from oil sales in order to reestablish its global power position. This gives the OPEC-Russian Combine effective control over enough of the world's exportable oil that they can squeeze oil importing nations.

At the top of the list of oil importing countries; ten of the twelve largest developed and developing economies in the world, is the United States. Even though the U.S. is the third largest oil producer in the world, it has become the world's largest importer of oil; now importing about 70 percent of annual needs. Oil production in the lower 48 states peaked

in about 1970; the Alaskan oil fields peaked in about 1987. Exploration efforts and new oil field development have, for all practical purposes, been put on hold for the past 25 years. For all the talk about oil self-sufficiency and energy security, the country is moving in the opposite direction and as a result is becoming more vulnerable by the day.

In 2008, the United States will spend about \$700 billion to buy imported oil. It is estimated that over the next ten years the U.S. will spend ten trillion dollars for imported oil; one trillion dollars per year. Sending dollars overseas to buy oil acts as a drag on the economy by pulling GDP growth down. The recent run-up in oil and energy prices has put the budgets of consumers and businesses under extreme pressure; the U.S. balance of payments have been negatively skewed; the previously strong inflow of offsetting petrodollars has slowed as rich oil exporting nations direct investments elsewhere in order to avoid the uncertain aftermath of the U.S. subprime mortgage debacle and Federal Reserve Bank induced low interest rates; and in what seems to be a contradiction, at least in the short term, oil-powered sovereign wealth funds are attempting to gobble up U.S. hard assets.

The vulnerability of oil importing nations is being exploited in more insidious ways by member nations of the OPEC-Russian Combine. Nomadic tribal leaders, who within one or two generations have become some of the wealthiest and most powerful men in the world, and former Russian bureaucrats, newly empowered and enriched, find themselves able to use oil as a strategic instrument of international geo-political power. Thinly-veiled threats and actual reductions of oil shipments have been used in coercive attempts to influence policies of oil importing nations. Some oil exporting nations have threatened to use the denial of oil - blockage of ocean shipping lanes and even the outright destruction of Middle Eastern oil fields - as a weapon to disrupt or destroy the economies of Western democratic nations and specifically the countries of Israel and the United States. There is evidence to suggest oil exporting nations support terrorist activities, in some cases for ideological reasons, but more importantly for this discussion, to maintain a climate of uncertainty which raises the risk premium component of the price of each barrel of oil.

Most economists predicted a U.S. and global recession if oil price reached \$30 per barrel. OPEC officially announced a price band goal below \$30. When oil price zoomed through the \$30 ceiling with no visible effect on economic growth, economists raised their ‘dooms-day’ oil price thresholds. OPEC officials remained quiet; watching and learning while their major national assets, stored securely underground, became more and more valuable. Even \$100 per barrel oil didn’t seem to dampen economic growth. All the while, OPEC countries raked in billions of oil dollars. They were benefiting from a real-world demonstration of price inelasticity. The demand for oil and products made from oil, such as gasoline and diesel fuel, is extremely price inelastic. As price rises, even to unheard of levels, quantity demanded doesn’t decline much and revenues to sellers soar. For such products, a seller would never willingly expand supply to lower price because his revenues would fall. Hence, only half-hearted attempts to increase the amount of oil pumped from existing wells and underinvestment in new oil fields. Some oil exporting countries are investing in refinery capacity. Once in operation, international sales of fuels and other refined products will give oil exporters even more revenue and further strengthen their effective control over global energy markets.

In free-market capitalistic systems, profit is the incentive to adjust supply in order to satisfy user and consumer demand. Given a critical resource characterized by price inelastic demand and colluding sellers with a high degree of control over supply, the market for oil could easily enter a state of failure. One could argue that it is in the oil exporting countries’ best interest to manage oil exports to keep the economies of the oil importing nations healthy. In other words, keep the price of oil reasonable so as to not kill the geese that are laying the golden eggs. That is true until up to the point that the oil exporting countries accumulate enough wealth, develop alternative industries in their own countries, and gain control over enough foreign assets to sustain them when their oil fields go into decline or high price destroys demand from oil importing nations. Viewed in this light, oil appears to be the fulcrum for leveraging a new world order involving an unprecedented transfer of wealth and shift in global power.

Two things could disrupt the global wealth and power grab by the OPEC-Russian Combine: increased oil production by non-OPEC countries and the development of substitute energy sources. A high price for a commodity usually stimulates increased production which causes price to fall. But many non-OPEC producing nations can not pump more oil because mature fields are in decline; past peak production. New oil and natural gas deposits are found each year, but it takes time to develop reserves in hard-to-reach locations or in costly-to-extract formations such as oil shale and tar sands. And investors are hesitant to commit funding when such high cost sources of oil and gas might be put out of business quickly if the OPEC-Russian Combine should decide to strategically drop the price of oil to get rid of the competition, although there is doubt about their ability to increase oil production enough at present to do that.

Alternative energies in aggregate can reduce - perhaps break, the monopolistic power of the OPEC-Russian Combine. By definition not part of alternative energies, but a contributing factor that can help to break the stranglehold, is energy conservation. There is no doubt energy consumption can be reduced dramatically by the intelligent application of conservation measures. But beyond some point, energy conservation becomes a limiting factor to economic growth. Long term, the United States must develop alternative energies.

High oil and electricity prices and government policies, have stimulated development of alternative energy production. Biofuels, wind, solar, geothermal, hydro, nuclear, and other alternative energies are attracting entrepreneurial attention and investment dollars. Full development of these energy sources will take a long time and require large amounts of money. Nearly all have drawbacks.

The development of biofuels, ethanol and biodiesel, made technical and economic sense when feedstocks were abundant and low cost. In terms of energy out versus energy required to produce them, biofuels are much more energy efficient than fuels made from oil. Ethanol is twice as energy efficient as gasoline and biodiesel is four times as energy efficient as petrol-diesel. Gasoline and petrol-diesel require 17 to 19 percent more energy

to make than can be extracted from the final products. The major drawback of biofuels is the competition for raw materials. Ethanol and biodiesel production are constrained by the high prices of feedgrains and vegetable oils, which are also used for livestock feed and direct human consumption. In the United States, currently about five percent of the gasoline sold is ethanol, which because of the price inelasticity of consumer demand for gasoline reduces the pump price of gasoline by 10 or 12 percent. Although the production of corn and soybeans will increase over time, it will be difficult to expand U.S. biofuel production greatly beyond current levels. Cellulosic ethanol holds some promise, but is not commercially viable at present. Even when the process can be scaled up to commercial proportions, feedstock cost and availability may constrain production quantities. Production of cellulosic materials will have to compete for cropland, the cost of logistics will drive up the feedstock costs, and seasonality will make production scheduling impossible without the added expense of a massive storage infrastructure.

The Great Plains, the area in the middle of the United States stretching from Texas northward to the Canadian border, may have the greatest potential for wind-powered energy generation of any place on earth. The velocity and consistency of air flows make wind energy economically viable. A large number of wind generating units have already been erected in Great Plains states, but the number is minuscule in comparison to the potential. There are detractors, who for one reason or another, want to limit or stop the building of wind generators. But the energy in wind not captured at the moment by an electrical generator is lost forever.

The energy stored in fossil fuel and in plant materials converted to biofuels originally came from the sun. The energy conversion ratio of sunlight striking the earth to plant material is very small compared to the efficiency that can be achieved converting sunlight to electricity by photovoltaic cells or by heat concentration devices to power steam-electric generators. Solar electricity can only be produced during daylight hours and requires intense sunlight. The U.S. Bureau of Land Management has received more than 100 applications to build large array solar collectors on about one million acres of government owned land in the Desert Southwest. The Bureau has been very slow to

conduct impact studies and has not issued the first permit. Some states have tax credit incentives for installation of solar electricity panels. Individual homeowners and businesses are taking advantage of state energy tax credits. As they do, the cost of photovoltaic devices is coming down as manufacturers achieve economies of size by ramping-up production.

There are two forms of geothermal energy that are being developed: shallow geothermal wells which take advantage of constant soil temperature for heating and cooling structures such as homes, office buildings, schools, etc. and deep wells used to capture the extreme heat from the earth's crust to generate large amounts of electricity. Once the initial investment in wells and equipment is made, the energy can be captured and converted at low marginal cost. If these energy sources are located close to points of use, the cost of distribution will be minimal.

It would be nearly impossible to obtain the permits required to dam a river for a new large-scale hydroelectric project. However, newly developed technology is being tested to place submergible hydroelectric generators in fast moving rivers and to capture the energy in off-shore ocean wave action by various innovative means.

An alternative source with the potential to produce perhaps the greatest amount of non-fossil fuel electrical energy is nuclear generation. France generates about 80 percent of its electricity needs with nuclear energy, compared to only about 20 percent in the United States. However, no new nuclear plants have been built in the U.S. for more than 25 years. The NRC just approved the construction of two new plants and it is evaluating a number of other proposed plants. Improved plant design has virtually eliminated the risk of plant failure although the difficult issue of nuclear waste disposal remains. A national nuclear waste containment site has been built at Yucca Mountain, Nevada, but no material has been deposited awaiting the outcome of protest legal filings.

The energy business model used for the past 150 years to justify huge infrastructure investments has led to concentrated production of energy; almost exclusively from fossil

fuels, to capture economies of size in extraction, transportation, processing, and distribution of energy to cities, regions, and countries. Besides creating environmental concerns, the model is proving to be increasingly costly as discovery, extraction, and transportation costs rise; as well as being increasingly vulnerable to disruption by natural disasters, terrorist attacks, and acts of war; and increasingly subject to manipulation by energy exporting countries.

A national effort to become less dependent on imported oil by developing sources of non-depleting solar, wind, hydro, and geothermal energies along with nuclear energy, as well as next generation electric vehicles, may lead to an alternative energy business model based on distributed energy production optimally sized for homes, office buildings, shopping malls, manufacturing plants, villages, cities, etc. The distributed nature of this approach could greatly reduce the vulnerability to imported oil or terrorist acts thereby improving a country's energy security. This model also lends itself well to economic development in parts of the world lacking access to imported fossil fuels or where frequent energy interruptions hinder daily life and disrupt business operations.