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Article 1.

The National Interest

Understanding Iran's Nuclear Breakout Options

Thomas Saether

October 21, 2013 -- In the UN General Assembly on October 1, Israeli prime minister Benjamin Netanyahu described Iran's strategy as to retain "sufficient nuclear material and sufficient nuclear infrastructure to race to the bomb at a time it chooses to do so." In general, there are three main conditions that will need to be present in order for Iran to develop a nuclear weapon. First, Iran would need the technical capacity to produce a critical mass of the uranium isotope U-235 (about 25 kg of uranium enriched to 90%) or the plutonium isotope Pu-239 (about 8 kg of weapons-grade plutonium), develop a detonation mechanism, and a delivery method. Secondly, Iran would need to make a political decision to militarize the nuclear program. And third, no external actor must succeed with halting, delaying or destroying the nuclear program with neither military nor other means. The U.S. and Israel are the only two countries that have

signaled willingness to conduct a military operation against Iran's nuclear program.

Given the first two conditions, one critical question should be examined to derive Iran's strategy to “race to the bomb at a time it chooses to do so”: How can Iran reduce the probability that a military operation would succeed (or even undertaken) after it has made the decision to break out for the bomb?

Iran can reduce the expected time frame between when the militarization process begins and when a nuclear bomb is produced, thereby reducing the time available to the International Atomic Energy Agency (IAEA) and Western intelligence agencies to detect the militarization and for political decision makers to undertake actions to stop it. Iran can reduce the time frame needed to acquire critical mass of enriched uranium to a minimum by stockpiling a large amount of uranium enriched to a level of near 20% and install more advanced and effective centrifuges. A small time frame would also have an internal effect on the Iranian decision-making and decision-undertaking. When the time from breakout to bomb is large, it is difficult to keep knowledge of the breakout secret within a limited group. It would then be time available for oppositionists in the regime (or workers at the facilities) to mobilize against the decision (or alert external actors). The opposite would be the case when the time frame is limited.

A successful Israeli military operation would in part rely on the ability to achieve surprise. However, since an Israeli operation might be triggered by the breakout itself, Iran would be able to dictate the terms. By reducing the time needed to produce critical mass of enriched uranium and coordinate the breakout

with a larger military exercise, Israel's ability to achieve the element of surprise would be reduced—and Israel would thus have an incentive to launch an attack before the breakout.

Iran can also reduce the utility of an intervention by finishing the heavy-water reactor in Arak and start operating it. A fully operational plutonium-producing reactor would be a politically sensitive target for any interventionist, since the civilian—and thus political—costs of bombing such a reactor would be quite large. If a military operation would leave the Arak reactor intact and only focus on the three other critical facilities in Natanz, Fordow and Isfahan, Iran could use the reactor for producing material for a nuclear bomb in the aftermath of the attack. In practice, this means that if a military operation is to be deployed, it should be conducted before the Arak reactor is operative. The attack on the Syrian al-Kibar reactor was reportedly triggered by similar concerns. Given the prize of achieving the immunizing effect of an operative reactor, Iran might be willing to temporarily suspend the enrichment program (or part of it) if a military intervention seems probable. In particular, a negotiated agreement where Iran is required to suspend its enrichment activity in Natanz and Fordow might be acceptable for the regime as long as the construction of the heavy water reactor in Arak is allowed to continue. An agreement of this kind might also provide Iran with more time to continue possible research concerning a detonation mechanism, warhead design, and delivery method. However, an interventionist would have an incentive to launch an attack before the reactor is operational, which means that its start-up date might trigger an operation against the other facilities as well. Iran's strategists are probably thinking hard about how to make the reactor operative without

anybody finding out until after its start-up date.

Iran would have an incentive to delay the construction of a reprocessing facility. Such a facility would be necessary to extract plutonium from the fuel rods used in the reactor. Iran has currently no known such facility with the capability to serve the Arak reactor, but would have an incentive to construct it after the reactor has gone critical. Constructing it now would just cause unnecessary friction with Western countries due to its probable military purpose.

Iran would also have an incentive to delay the breakout if it expects new defensive military means to be acquired or developed within a certain time frame. New acquisitions would increase Iran's general defensive capacity, thereby reducing an interventionist's ability to achieve a successful military operation. Iran has previously voiced its interest in the Russian-made S-300 anti-aircraft battery, though the Russians chose to halt the transfer of the system. Iran could be expected to delay the breakout if Russia would signal renewed interest in transferring this system or similar ones.

Lastly, Iran could choose to delay the breakout until the Syrian civil war is stabilized. Hezbollah, its main proxy against Israel, is currently participating in the conflict on the regime's side. Should Israel undertake a military operation against the nuclear facilities at the current time, Iran would need to decide whether Hezbollah should focus on the Syrian civil war or a reprisal attack on Israel. By delaying the breakout until Hezbollah once again can focus its firepower on its southern enemy, Iran's deterrence vis-à-vis Israel would be restored.

If Iran's goal is to have the ability to produce nuclear weapons sometime in the future, it has several incentives to make concessions in the ongoing negotiations with the P5+1 countries. Careful thought should be given to what Iran's breakout strategy might be—and how to obstruct it.

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Article 2.

Financial Times

Iran's diplomacy shows a recognition of its decline

Katerina Dalacoura

October 20 - Iran's positive attitude in its negotiations with the US, Britain, France, Germany, China and Russia over its nuclear programme marks a clear shift in policy.

This welcome development, seen during the past week in talks in Geneva, follows Tehran's willingness to go along with the Russian-initiated deal on chemical weapons in Syria – where Iran is backing the Assad regime. The Islamic Republic appears

to be softening its longstanding policies in favour of a more conciliatory approach. The shift is caused by the country's long-term decline in the Middle East – and Tehran's recognition that it must act on this decline. Iran's stance will hold the key to a number of interlocking regional conflicts, so identifying its cause helps shape policy responses to it. High quality global journalism requires investment. Please share this article with others using the link below, do not cut & paste the article. If an agreement with Iran does come to pass, many will argue that economic sanctions, imposed by the UN Security Council, the EU and the US, have achieved their objective. President Hassan Rouhani was elected this year with a mandate to ease the economic plight of his people. Ali Khamenei, the supreme leader, has at least partly conceded that the country needs to achieve this by proffering an olive branch to the international community, and the US in particular. But the economic factor is only part of a bigger picture.

Iran is slowly but perceptibly losing the struggle for power in the Middle East. The messages it has propagated in various forms since the 1979 revolution are sounding tired and losing popularity at home and abroad. Its attempts to lead anti-western and anti-Israeli resistance fail to excite as they used to. The Sunni-Shia conflict, which now seems to permeate the politics of the region, has reduced Shia Iran to the status of a sectarian power. Ayatollah Ruhollah Khomeini, the leader of the revolution whose vision was of Iran at the forefront of the entire Islamic world, would be turning in his grave.

The Assad regime is being shaken to its foundations. If it falls, the core of Iran regional policy – which rests on its decades-long alliance with Syria – will disintegrate. Admittedly, Iran's

position in Nouri al-Maliki's Iraq is assured – although that regime is being rocked by an almost daily string of murderous attacks.

But Iran's failing fortunes in the region should not be gauged only in material terms. Its bid for regional leadership has never rested solely on such crude measures. At its core was a self-appointed role as Islamic champion of the anti-western camp, forged in the 1979 revolution. It is on this most crucial ideological front that Iran is losing out.

The Arab uprisings of 2011 revealed this most poignantly to anyone in Tehran who cared to look. When the revolts broke out, the Iranian leadership hoped that they signified a popular turn to Islamism as they understood it. However, it soon became clear that the rebellious youth were neither driven by an anti-western animus nor by a desire for an Islamist system. In Egypt and Tunisia, Islamist movements capitalised on the fall of presidents Hosni Mubarak and Zine al-Abidine Ben Ali. However, even in these countries (especially Egypt), their popularity declined rapidly.

As the impact of the Arab uprisings reverberated through the Middle East, the Islamic Republic continued to lose out. The Assad regime's brutal tactics have delegitimised it in the eyes of many in the region, even those who had sympathised with its longstanding anti-western, anti-Israeli stand. Hizbollah's support of the Assad regime has similarly dented its legitimacy. Gone are the days when Hassan Nasrallah, its secretary-general, was the hero of the Arab street – Sunni and Shia – for his position at the forefront of the struggle against Israel. If anyone has taken over that role, at least until recently, it is Recep Tayyip

Erdogan, Turkey's prime minister. Iran's appeal has been tainted by the brutal tactics of its allies, in Damascus and Beirut, who may remain strong materially but have lost out in terms of image and ideas.

The long-term decline of the Islamic Republic in the Middle East presents an opportunity for peace in the region, particularly in Syria. However, when it comes to the nuclear issue, it may prove a double-edged sword: opting for nuclear weapons can be seen as the only way to avoid being pushed into a corner. Preventing this scenario depends on the skill of the negotiating teams in Geneva and, ultimately, on the ability of the administration of US President Barack Obama to overcome resistance by Congress and offer a meaningful deal to Tehran.

The writer is an associate professor of international relations at the London School of Economics.

Article 3.

Politico

Iran's diplomatic thaw with the West

Joel Rubin

October 20 - Congratulations, Congress. Your Iran strategy is working. Now what?

The diplomatic thaw between Iran and the West is advancing, and faster than most of us had imagined. This is the result of years of painstaking efforts by the Obama administration and lawmakers to pressure the Islamic Republic into deciding whether it's in Iran's interest to pursue diplomacy or to continue suffering under crushing economic sanctions and international isolation. Now that Iran has made a clear decision to engage seriously in diplomatic negotiations with the West over its nuclear program, its intentions should be tested. Members of Congress should be open to seizing this opportunity by making strategic decisions on sanctions policy. The economic sanctions against Iran that are in place have damaged the Iranian economy. A credible military threat — with more than 40,000 American troops in the Persian Gulf — stands on alert. International inspectors are closely monitoring Iran's every nuclear move. Iran has not yet made a decision to build a bomb, does not have enough medium-enriched uranium to convert to weapons grade material for one bomb and has neither a workable nuclear warhead nor a means to deliver it at long ranges. If Iran were to make a dash for a bomb, the U.S. intelligence community estimates that it would take roughly one to two years to do so.

Congress, with its power to authorize sanctions relief, plays a crucial role in deciding whether a deal will be achieved. This gives Congress the opportunity to be a partner in what could potentially be a stunning success in advancing our country's security interests without firing a shot.

Consider the alternative: If the administration negotiates a deal that Congress blocks, and Congress becomes a spoiler, Iran will most likely continue to accelerate its nuclear program. Then lawmakers would be left with a stark choice: either acquiesce to

an unconstrained Iranian nuclear program and a potential Iranian bomb or endorse the use of force to attempt to stop it. Most military experts rate the odds of a successful bombing campaign low and worry that failed strikes would push Iran to get the bomb outright. Iran and the United States need a political solution to this conflict. Now is the time to test the Iranians at the negotiating table, not push them away.

Congress is also being tested, but the conventional wisdom holds that lawmakers won't show the flexibility required to make a deal. Such thinking misses the political volatility just beneath the surface: Americans simply don't support another war in the Middle East, as the congressional debate over Syria made crystal clear. Would they back much riskier military action in Iran? Fortunately for Congress, President Barack Obama was agile enough to seize the diplomatic route and begin to eliminate Syria's chemical weapons. These results are advancing U.S. security interests. And members of Congress breathed a collective sigh of relief as well as they didn't have to either vote to undercut the commander in chief on a security issue or stick a finger in the eye of their constituents.

The same can happen on Iran. By pursuing a deal, Obama can provide Congress with an escape hatch, where it won't have to end up supporting unpopular military action or have to explain to its constituents why it failed to block an Iranian bomb. A verifiable deal with Iran that would prevent it from acquiring a nuclear weapon would require sanctions relief from Congress. But that's an opportunity to claim victory, not a burden. And it would make Congress a partner with the president on a core security issue. Congress could then say, with legitimacy, that its tough sanctions on Iran worked — and did so without starting

another unpopular American war in the Middle East.

Isn't it time Congress had a win, for once?

Joel Rubin is director of policy and government affairs at the Ploughshares Fund.

Article 4.

NYT

China's Arms Industry Makes Global Inroads

Edward Wong and Nicola Clark

October 20, 2013 -- Beijing — From the moment Turkey announced plans two years ago to acquire a long-range missile defense system, the multibillion-dollar contract from a key NATO member appeared to be an American company's to lose.

For years, Turkey's military had relied on NATO-supplied Patriot missiles, built by the American companies Raytheon and Lockheed Martin, to defend its skies, and the system was fully compatible with the air-defense platforms operated by other members of the alliance.

There were other contenders for the deal, of course. Rival

manufacturers in Russia and Europe made bids. Turkey rejected those — but not in favor of the American companies. Its selection last month of a little-known Chinese defense company, China Precision Machinery Export-Import Corp oration, stunned the military-industrial establishment in Washington and Brussels.

The sale was especially unusual because the Chinese missile defense system, known as the HQ-9, would be difficult to integrate with existing NATO equipment. China Precision is also subject to sanctions from the United States for selling technologies that the United States says could help Iran, Syria and North Korea develop unconventional weapons. A State Department spokeswoman said this month that American officials had expressed to the Turkish government "serious concerns" about the deal, which has not yet been signed.

Industry executives and arms-sales analysts say the Chinese probably beat out their more established rivals by significantly undercutting them on price, offering their system at $3 billion. Nonetheless, Turkey's selection of a Chinese state-owned manufacturer is a breakthrough for China, a nation that has set its sights on moving up the value chain in arms technology and establishing itself as a credible competitor in the global weapons market.

"This is a remarkable win for the Chinese arms industry," said Pieter Wezeman, a senior researcher at the Stockholm International Peace Research Institute, which tracks arms sales and transfers.

In the past, Chinese companies have been known mainly as

suppliers of small arms, but that is changing quickly. From drones to frigates to fighter jets, the companies are aggressively pushing foreign sales of high-tech hardware, mostly in the developing world. Russian companies are feeling the greatest pressure, but American and other Western companies are also increasingly running into the Chinese.

"China will be competing with us in many, many domains, and in the high end," said Marwan Lahoud, the head of strategy and marketing at European Aeronautic Defense and Space, Europe's largest aerospace company. "Out of 100 campaigns, that is, the commercial prospects we have, we may have the Chinese in front of us among the competitors in about three or four. They have the full range of capabilities, and they are offering them."

The Stockholm institute released a report this year on global weapons transfers that found the volume of Chinese conventional weapons exports — which included high-end aircraft, missiles, ships and artillery — jumped by 162 percent from 2008 to 2012, compared with the previous five years. Pakistan is the leading customer. The institute now estimates that China is the fifth-largest arms exporter in the world, ahead of Britain. From 2003 to 2007, China ranked eighth.

China's foreign arms sales are also rising fast in dollar terms. According to IHS Jane's, an industry consulting and analysis company, Chinese exports have nearly doubled over the past five years to $2.2 billion, surpassing Canada and Sweden, and making China the world's eighth-largest exporter by value.

The total global arms trade revenue in 2012 was estimated to be $73.5 billion, and the United States had a 39 percent share, according to IHS Jane's.

Xu Guangyu, a retired major general in the People's Liberation Army and director of the China Arms Control and Disarmament Association, said in an interview that the push by Chinese companies to develop and sell higher-tech arms was "a very normal phenomenon."

"In arms manufacturing, China is trying to increase the quality and reduce price," he said. "We're driven by competition."

Mr. Xu said that besides pricing, Chinese companies had another advantage: they do not "make demands over other governments' status and internal policies." He added: "Our policy of noninterference applies here. Whoever is in the government, whoever has diplomatic status with us, we can talk about arms sales with them."

Chinese officials know that China's encroachment on Western-dominated military markets raises concerns. When asked about the missile-defense sale to Turkey, a Chinese Foreign Ministry spokeswoman said, "China's military exports do no harm to peace, security and stability," and do not "interfere with the internal affairs of recipient countries."

The largest Chinese arms production companies, all state-owned, declined interview requests. Their finances are opaque, though there are some statistics on their Web sites and in the state news media.

The China North Industries Group Corporation, or the Norinco Group, said on its Web site that its profits in 2012 were 9.81 billion renminbi, or about $1.6 billion, a 45 percent increase from 2010. Its revenues in 2012 were 361.6 billion renminbi, or about $59 billion, a 53 percent increase over 2010. Another

company, the China South Industries Group Corporation, or CSGC, said on its Web site that it had profits of about $1 billion in 2011, on revenue of about $45 billion, both big increases over 2008.

China's investment has been heaviest in fighter planes — both traditional and stealth versions — as well as in jet engines, an area in which China had until now been dependent on Western and Russian partners, said Guy Anderson, a senior military industry analyst in London with IHS Jane's.

"China has been throwing billions and billions of dollars at research and development," he said. "They also have a strategy of using the gains they get from foreign partnerships to benefit their industrial sector. So they should not have any trouble catching up with their Western competitors over the medium term, and certainly over the long term."

He estimated that China was still a decade away from competing head-to-head with Western nations on the technology itself. But Chinese equipment is priced lower and could become popular in emerging markets, including in African and Latin American nations.

"We are in an era of 'good enough' — the 90 percent solution that will do the job at the best possible price," Mr. Anderson said. "In some cases, that may even mean buying commercial equipment, upgrading it slightly and painting it khaki."

New customers for Chinese equipment include Argentina, which in 2011 signed a deal with the Chinese company Avicopter to build Z-11 light helicopters under license. Mass production for the Argentine military began this year, and 40 helicopters are

expected to be built over the next several years. The value of the contract has not been made public.

Companies selling drones, another focal point in the Chinese arms industry, are ubiquitous at arms and aviation shows. At an aviation exposition in Beijing in late September, one Chinese company, China Aerospace Science and Technology Corporation, had on display a model of a CH-4 reconnaissance and combat drone, with four models of missiles next to it.

Though the drone had been "designed for export," one company representative said, there were no foreign buyers yet. The company was still being licensed by the government to sell the aircraft abroad. He added that the drone was not yet up to par with some foreign models, and that the engine was a foreign make, though other parts — including the missiles — had been developed in China.

The Aviation Industry Corporation of China, or AVIC, had on display a model of a Wing Loong, the best-known Chinese drone export, which sells for about $1 million, less than similar American and Israeli drone models. An article in People's Daily said the export certificate for the Wing Loong, or Pterodactyl, was approved in June 2009, and it was first exported in 2011.

At the Paris Air Show in June, Ma Zhiping, president of the China National Aero-Technology Import and Export Corporation, told Global Times, another state-run newspaper, that "quite a few countries" had bought the Wing Loong, which resembles the American-made Predator. Clients were in Africa and Asia, he said.

Two fighter jets made by Chinese companies are being closely

watched by industry analysts and foreign companies for their export potential. One is Shenyang Aircraft's J-31, a fighter jet that Chinese officials say has stealth abilities. A People's Daily report last month said that the J-31 was being made by Shenyang, an AVIC subsidiary, mostly for export, citing an interview with Zhang Zhaozhong, a rear admiral in the Chinese Navy. In March, the airplane's chief designer, Sun Cong, told People's Daily that the J-31 could become China's main next-generation carrier-borne fighter jet.

The other jet is the JF-17, a less-sophisticated aircraft that an American official said had been in the works for about two decades in an "on-again, off-again" project. The jet was ostensibly the product of a joint venture between Pakistan Aeronautical Complex and China's Chengdu Aircraft Industry Corporation, also an AVIC subsidiary, but China did the real work, said the official, who spoke on the condition of anonymity because of the secrecy surrounding military projects. So far, Pakistan is the only client, and the official said he believed Pakistan had made a "political decision" to buy it.

China is Pakistan's biggest ally, and each relies on the other to help counter India. Besides the JF-17, the two nations have had official joint production agreements on a frigate, a battle tank and a small aircraft.

A defense official from Japan, a territorial rival of China that monitors its arms trade closely, said Chinese jets still had big shortcomings that could hurt international sales; most notably, China cannot make reliable engines or avionics, he said. The JF-17 uses a Russian engine.

“I believe they can make a few very good engines in the laboratory, but they can’t make it in the factory, kind of mass produce it in factories, because of lack of quality control and maybe experience,” he said.

He added that Chinese engineers had been trying to develop an engine, the WS-10, a copy of a Russian model, but had been having problems.

It is not uncommon for customers to overcome weaknesses in Chinese manufacturing by buying Chinese platforms and outfitting them with better Western equipment. Algeria placed an order last year for three Chinese corvettes, but is outfitting the ships with radar and communications equipment from Thales Nederland, a unit of the Thales Group, based in France. Thailand has been awarding contracts to the Saab Group, based in Sweden, to upgrade Chinese-built frigates, said Ben Moores, a senior analyst at IHS Jane’s.

This year, a Chinese company was competing against foreign counterparts, including at least one American company, for a $1 billion Thai contract for naval frigates, but lost to Daewoo of South Korea.

As China moves to catch up with established Western rivals, competing not only on price but also with comparable technology, Hakan Buskhe, chief executive of Saab, said his company and others would be likely to find themselves under pressure to cut their own research and development costs to lower pricing — a trend that could benefit North American and European governments looking to squeeze more ability out of shrinking defense budgets.

"We need to be able to develop more for less," he said.

Edward Wong reported from Beijing and Tokyo, and Nicola Clark from Paris. Gerry Doyle contributed reporting from Hong Kong. Patrick Zuo and Bree Feng contributed research from Beijing.

Article 5.

NYT

An Exit Strategy From Afghanistan

Editorial

October 20, 2013 -- As it winds down its 12-year-old military commitment in Afghanistan, the United States is still looking for a face-saving way out of a conflict that seems headed, at best, for a stalemate. The new bilateral security agreement between the two nations is part of that exit strategy. So is a hoped-for political settlement with the Taliban, on which there has been no progress, and a 2014 presidential election process that is also having problems.

Hamid Karzai, the Afghan president, and Secretary of State John Kerry announced on Oct. 12 that they had agreed on key elements of a security deal that could keep some American troops in Afghanistan once the current NATO combat mission

ends after 2014. Even so, they did not reveal details and there are reasons to wonder if Mr. Karzai would want a post-2014 security agreement on terms that Washington would accept.

A major sticking point is legal jurisdiction over American forces who could be assigned to Afghanistan after next year when the 51,000 troops there now have departed. The administration, which thought the issue had been resolved, has insisted that the troops have immunity from prosecution under Afghan law and that any troops accused of crimes be tried in the United States.

Both sides have raised the stakes — the Americans, by warning that all troops could be withdrawn if the immunity issue is not resolved in their favor; Mr. Karzai, by delegating a final decision on the issue to an unpredictable tribal council and Parliament, instead of making it himself. The United States has set a deadline of Oct. 31 for a deal, but the talks could collapse, much as they did in Iraq, where the failure to agree on an immunity deal hastened the withdrawal of all American troops.

President Obama has not formally committed to deploying a residual force or said how big it might be. Nor has he or Mr. Kerry made a compelling case for why such a force would be necessary, though they have suggested that it would focus on training Afghan security forces and preventing a resurgence of Al Qaeda. Ideally, all troops would come home as soon as possible, but Mr. Obama's argument, if he has one, deserves a hearing.

News reports say many Afghans fear that the Kabul government could collapse and the country could return to civil war. The Taliban, through a spokesman, claimed responsibility for a

suicide bomb attack on Friday near a residential compound on the outskirts of Kabul.

Even in Washington, officials acknowledge that once American forces depart, the Taliban likely will gain ground, at least in rural areas. And the competence of Afghanistan's 350,000-member security force remains in doubt, even after a $40 billion investment in American weaponry and training. Although Afghan forces appear to have mostly held their own against the insurgency in the recent fighting season, they made no significant gains and suffered what some officials said were heavy casualties.

American commanders concluded some time ago that the war could end only with a negotiated settlement, not a military victory. But talks with the Taliban collapsed before they were to open last June and are not expected to start until after the Afghan presidential election in April. Proponents of a residual force say it is needed to protect Kabul and to pressure the Taliban to negotiate a settlement. They also argue that Congress is unlikely to keep paying for the Afghan Army and police, at a cost that could range from $4 billion to $6 billion, unless Americans are deployed there.

These arguments might be convincing if Mr. Karzai and his cronies were leaders who had used the last decade, and billions of dollars in international assistance, to build a government committed to delivering services and to winning the loyalty of the people. Instead, they fostered a corrupt system that has allowed the Taliban to remain a viable alternative force.

Now, just when the country needs to elect and unite around a

new president, the political process, which is controlled to a large extent by Mr. Karzai, seems as vulnerable to corruption as ever. According to Reuters reports, voter cards, which are used to cast ballots, "have become a form of currency," selling for about $5 each. American troops, no matter how long they stay, cannot compensate for this kind of self-inflicted damage.

Article 6.

NYT

Yes, Economics Is a Science

Raj Chetty

October 20, 2013 -- THERE'S an old lament about my profession: if you ask three economists a question, you'll get three different answers.

This saying came to mind last week, when the Nobel Memorial Prize in Economic Science was awarded to three economists, two of whom, Robert J. Shiller of Yale and Eugene F. Fama of the University of Chicago, might be seen as having conflicting views about the workings of financial markets. At first blush, Mr. Shiller's thinking about the role of "irrational exuberance" in stock markets and housing markets appears to contradict Mr. Fama's work showing that such markets efficiently incorporate news into prices.

What kind of science, people wondered, bestows its most

distinguished honor on scholars with opposing ideas? “They should make these politically balanced awards in physics, chemistry and medicine, too,” the Duke sociologist Kieran Healy wrote sardonically on Twitter.

But the headline-grabbing differences between the findings of these Nobel laureates are less significant than the profound agreement in their scientific approach to economic questions, which is characterized by formulating and testing precise hypotheses. I’m troubled by the sense among skeptics that disagreements about the answers to certain questions suggest that economics is a confused discipline, a fake science whose findings cannot be a useful basis for making policy decisions.

That view is unfair and uninformed. It makes demands on economics that are not made of other empirical disciplines, like medicine, and it ignores an emerging body of work, building on the scientific approach of last week’s winners, that is transforming economics into a field firmly grounded in fact.

It is true that the answers to many “big picture” macroeconomic questions — like the causes of recessions or the determinants of growth — remain elusive. But in this respect, the challenges faced by economists are no different from those encountered in medicine and public health. Health researchers have worked for more than a century to understand the “big picture” questions of how diet and lifestyle affect health and aging, yet they still do not have a full scientific understanding of these connections. Some studies tell us to consume more coffee, wine and chocolate; others recommend the opposite. But few people would argue that medicine should not be approached as a science or that doctors should not make decisions based on the

best available evidence.

As is the case with epidemiologists, the fundamental challenge faced by economists — and a root cause of many disagreements in the field — is our limited ability to run experiments. If we could randomize policy decisions and then observe what happens to the economy and people's lives, we would be able to get a precise understanding of how the economy works and how to improve policy. But the practical and ethical costs of such experiments preclude this sort of approach. (Surely we don't want to create more financial crises just to understand how they work.)

Nonetheless, economists have recently begun to overcome these challenges by developing tools that approximate scientific experiments to obtain compelling answers to specific policy questions. In previous decades the most prominent economists were typically theorists like Paul Krugman and Janet L. Yellen, whose models continue to guide economic thinking. Today, the most prominent economists are often empiricists like David Card of the University of California, Berkeley, and Esther Duflo of the Massachusetts Institute of Technology, who focus on testing old theories and formulating new ones that fit the evidence.

This kind of empirical work in economics might be compared to the "micro" advances in medicine (like research on therapies for heart disease) that have contributed enormously to increasing longevity and quality of life, even as the "macro" questions of the determinants of health remain contested.

Consider the politically charged question of whether extending

unemployment benefits increases unemployment rates by reducing workers' incentives to return to work. Nearly a dozen economic studies have analyzed this question by comparing unemployment rates in states that have extended unemployment benefits with those in states that do not. These studies approximate medical experiments in which some groups receive a treatment — in this case, extended unemployment benefits — while "control" groups don't.

These studies have uniformly found that a 10-week extension in unemployment benefits raises the average amount of time people spend out of work by at most one week. This simple, unassailable finding implies that policy makers can extend unemployment benefits to provide assistance to those out of work without substantially increasing unemployment rates.

Other economic studies have taken advantage of the constraints inherent in a particular policy to obtain scientific evidence. An excellent recent example concerned health insurance in Oregon. In 2008, the state of Oregon decided to expand its state health insurance program to cover additional low-income individuals, but it had funding to cover only a small fraction of the eligible families. In collaboration with economics researchers, the state designed a lottery procedure by which individuals who received the insurance could be compared with those who did not, creating in effect a first-rate randomized experiment.

The study found that getting insurance coverage increased the use of health care, reduced financial strain and improved well-being — results that now provide invaluable guidance in understanding what we should expect from the Affordable Care Act.

Even when such experiments are unfeasible, there are ways to use "big data" to help answer policy questions. In a study that I conducted with two colleagues, we analyzed the impacts of high-quality elementary school teachers on their students' outcomes as adults. You might think that it would be nearly impossible to isolate the causal effect of a third-grade teacher while accounting for all the other factors that affect a child's life outcomes. Yet we were able to develop methods to identify the causal effect of teachers by comparing students in consecutive cohorts within a school. Suppose, for example, that an excellent teacher taught third grade in a given school in 1995 but then went on maternity leave in 1996. Since the teacher's maternity leave is essentially a random event, by comparing the outcomes of students who happened to reach third grade in 1995 versus 1996, we are able to isolate the causal effect of teacher quality on students' outcomes.

Using a data set with anonymous records on 2.5 million students, we found that high-quality teachers significantly improved their students' performance on standardized tests and, more important, increased their earnings and college attendance rates, and reduced their risk of teenage pregnancy. These findings — which have since been replicated in other school districts — provide policy makers with guidance on how to measure and improve teacher quality.

These examples are not anomalous. And as the availability of data increases, economics will continue to become a more empirical, scientific field. In the meantime, it is simplistic and irresponsible to use disagreements among economists on a handful of difficult questions as an excuse to ignore the field's many topics of consensus and its ability to inform policy

decisions on the basis of evidence instead of ideology.

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