# 1

#### The standard is maximizing expecting well being.

#### 1] Actor specificity

#### ---A] Aggregation – every policy benefits some and harms others, which also means side constraints freeze action.

#### ---B] No act-omission distinction – choosing to omit is an act itself – governments actively decide not to act so there is no omission

#### 2] Util is a lexical pre-requisite to any other framework: Threats to life preclude the ability for moral actors to effectively utilize and act upon other moral theories since they are in a constant state of crisis – that inhibits the ideal moral conditions which other theories presuppose.

#### 3] Extinction matters under any framework:

#### ---A] It precludes the possibility of any kind of moral value – we can’t confer value onto anything if we’re not alive.

#### ---B] Future generations means infinite magnitude – we have to look towards future lives too

All util indites are about pleasure, not well being, doesn’t apply.

# 2

#### Medical innovation high now

Austin et al 21, David Austin and Tamara Hayford Joseph Kile, Lyle Nelson, and Julie Topoleski. Christopher Adams, Pranav Bhandarkar, and David Wylie, April 2021, “Research and Development in the Pharmaceutical Industry”

The pharmaceutical industry devoted $83 billion to R&D expenditures in 2019. Those expenditures covered a variety of activities, including discovering and testing new drugs, developing incremental innovations such as product extensions, and clinical testing for safety-monitoring or marketing purposes. That amount is about 10 times what the industry spent per year in the 1980s, after adjusting for the effects of inflation. The share of revenues that drug companies devote to R&D has also grown: On average, pharmaceutical companies spent about one-quarter of their revenues (net of expenses and buyer rebates) on R&D expenses in 2019, which is almost twice as large a share of revenues as they spent in 2000. That revenue share is larger than that for other knowledge-based industries, such as semiconductors, technology hardware, and software. The number of new drugs approved each year has also grown over the past decade. On average, the Food and Drug Administration (FDA) approved 38 new drugs per year from 2010 through 2019 (with a peak of 59 in 2018), which is 60 percent more than the yearly average over the previous decade. Many of the drugs that have been approved in recent years are “specialty drugs.” Specialty drugs generally treat chronic, complex, or rare conditions, and they may also require special handling or monitoring of patients. Many specialty drugs are biologics (large-molecule drugs based on living cell lines), which are costly to develop, hard to imitate, and frequently have high prices. Previously, most drugs were small-molecule drugs based on chemical compounds. Even while they were under patent, those drugs had lower prices than recent specialty drugs have. Information about the kinds of drugs in current clinical trials indicates that much of the industry’s innovative activity is focused on specialty drugs that would provide new cancer therapies and treatments for nervous-system disorders, such as Alzheimer’s disease and Parkinson’s disease.

#### IP protections motivate innovators to take risks – that means long term development and prolif

Bacchus '20 (James Bacchus; James Bacchus is a member of the Herbert A. Stiefel Center for Trade Policy Studies, the Distinguished University Professor of Global Affairs and director of the Center for Global Economic and Environmental Opportunity at the University of Central Florida. He was a founding judge and was twice the chairman—the chief judge—of the highest court of world trade, the Appellate Body of the World Trade Organization in Geneva, Switzerland.; 12-16-2020; "An Unnecessary Proposal: A WTO Waiver of Intellectual Property Rights for COVID-19 Vaccines"; https://www.cato.org/free-trade-bulletin/unnecessary-proposal-wto-waiver-intellectual-property-rights-covid-19-vaccines#, Cato Institute, accessed 7-21-2021; JPark)

With the belief that medicines should be “public goods,” there is literally no support in some quarters for the application of the WTO TRIPS Agreement to IP rights in medicines. Any protection of the IP rights in such goods is viewed as a violation of human rights and of the overall public interest. This view, though, does not reflect the practical reality of a world in which many medicines would simply not exist if it were not for the existence of IP rights and the protections they are afforded. Technically, IP rights are exceptions to free trade. A long‐​standing general discussion in the WTO has been about when these exceptions to free trade should be allowed and how far they should be extended. The continuing debate over IP rights in medicines is only the most emotional part of this overall conversation. Because developed countries have, historically, been the principal sources of IP rights, this lengthy WTO dispute has largely been between developed countries trying to uphold IP rights and developing countries trying to limit them. The debate over the discovery and the distribution of vaccines for COVID-19 is but the latest global occasion for this ongoing discussion. The primary justification for granting and protecting IP rights is that they are incentives for innovation, which is the main source for long‐​term economic growth and enhancements in the quality of human life. IP rights spark innovation by “enabling innovators to capture enough of the benefits of their own innovative activity to justify taking considerable risks.”18 The knowledge from innovations inspired by IP rights spills over to inspire other innovations. The protection of IP rights promotes the diffusion, domestically and internationally, of innovative technologies and new know‐​how. Historically, the principal factors of production have been land, labor, and capital. In the new pandemic world, perhaps an even more vital factor is the creation of knowledge, which adds enormously to “the wealth of nations.” Digital and other economic growth in the 21st century is increasingly ideas‐​based and knowledge intensive. Without IP rights as incentives, there would be less new knowledge and thus less innovation. In the short term, undermining private IP rights may accelerate distribution of goods and services—where the novel knowledge that went into making them already exists. But in the long term, undermining private IP rights would eliminate the incentives that inspire innovation, thus preventing the discovery and development of knowledge for new goods and services that the world needs. This widespread dismissal of the link between private IP rights and innovation is perhaps best reflected in the fact that although the United Nations Sustainable Development Goals for 2030 aspire to “foster innovation,” they make no mention of IP rights.19

#### Antimicrobial resistance triggers extinction.

Srivatsa ’17 (Kadiyali; specialist in pediatric intensive and critical care medicine in the UK. Invented the bacterial identification tool ‘MAYA’; 1-12-2017; "Superbug Pandemics and How to Prevent Them", American Interest; https://www.the-american-interest.com/2017/01/12/superbug-pandemics-and-how-to-prevent-them/, Accessed: 8-31-2021; AU)

It is by now no secret that the human species is locked in a race of its own making with “superbugs.” Indeed, if popular science fiction is a measure of awareness, the theme has pervaded English-language literature from Michael Crichton’s 1969 Andromeda Strain all the way to Emily St. John Mandel’s 2014 Station Eleven and beyond. By a combination of massive inadvertence and what can only be called stupidity, we must now invent new and effective antibiotics faster than deadly bacteria evolve—and regrettably, they are rapidly doing so with our help. I do not exclude the possibility that bad actors might deliberately engineer deadly superbugs.1 But even if that does not happen, humanity faces an existential threat largely of its own making in the absence of malign intentions. As threats go, this one is entirely predictable. The concept of a “black swan,” Nassim Nicholas Taleb’s term for low-probability but high-impact events, has become widely known in recent years. Taleb did not invent the concept; he only gave it a catchy name to help mainly business executives who know little of statistics or probability. Many have embraced the “black swan” label the way children embrace holiday gifts, which are often bobbles of little value, except to them. But the threat of inadvertent pandemics is not a “black swan” because its probability is not low. If one likes catchy labels, it better fits the term “gray rhino,” which, explains Michele Wucker, is a high-probability, high-impact event that people manage to ignore anyway for a raft of social-psychological reasons.2 A pandemic is a quintessential gray rhino, for it is no longer a matter of if but of when it will challenge us—and of how prepared we are to deal with it when it happens. We have certainly been warned. The curse we have created was understood as a possibility from the very outset, when seventy years ago Sir Alexander Fleming, the discoverer of penicillin, predicted antibiotic resistance. When interviewed for a 2015 article, “The Most Predictable Disaster in the History of the Human Race,” Bill Gates pointed out that one of the costliest disasters of the 20th century, worse even than World War I, was the Spanish Flu pandemic of 1918-19. As the author of the article, Ezra Klein, put it: “No one can say we weren’t warned. And warned. And warned. A pandemic disease is the most predictable catastrophe in the history of the human race, if only because it has happened to the human race so many, many times before.”3 Even with effective new medicines, if we can devise them, we must contain outbreaks of bacterial disease fast, lest they get out of control. In other words, we have a social-organizational challenge before us as well as a strictly medical one. That means getting sufficient amounts of medicine into the right hands and in the right places, but it also means educating people and enabling them to communicate with each other to prevent any outbreak from spreading widely. Responsible governments and cooperative organizations have options in that regard, but even individuals can contribute something. To that end, as a medical doctor I have created a computer app that promises to be useful in that regard—of which more in a moment. But first let us review the situation, for while it has become well known to many people, there is a general resistance to acknowledging the severity and imminence of the danger. What Are the Problems? Bacteria are among the oldest living things on the planet. They are masters of survival and can be found everywhere. Billions of them live on and in every one of us, many of them helping our bodies to run smoothly and stay healthy. Most bacteria that are not helpful to us are at least harmless, but some are not. They invade our cells, spread quickly, and cause havoc that we refer to generically as disease. Millions of people used to die every year as a result of bacterial infections, until we developed antibiotics. These wonder drugs revolutionized medicine, but one can have too much of a good thing. Doctors have used antibiotics recklessly, prescribing them for just about everything, and in the process helped to create strains of bacteria that are resistant to the medicines we have. We even give antibiotics to cattle that are not sick and use them to fatten chickens. Companies large and small still mindlessly market antimicrobial products for hands and home, claiming that they kill bacteria and viruses. They do more harm than good because the low concentrations of antimicrobials that these products contain tend to kill friendly bacteria (not viruses at all), and so clear the way for the mass multiplication of surviving unfriendly bacteria. Perhaps even worse, hospitals have deployed antimicrobial products on an industrial scale for a long time now, the result being a sharp rise in iatrogenic bacterial illnesses. Overuse of antibiotics and commercial products containing them has helped superbugs to evolve. We now increasingly face microorganisms that cannot be killed by antibiotics, antifungals, antivirals, or any other chemical weapon we throw at them. Pandemics are the major risk we run as a result, but it is not the only one. Overuse of antibiotics by doctors, homemakers, and hospital managers could mean that, in the not-too-distant future, something as simple as a minor cut could again become life-threatening if it becomes infected. Few non-medical professionals are aware that antibiotics are the foundation on which nearly all of modern medicine rests. Cancer therapy, organ transplants, surgeries minor and major, and even childbirth all rely on antibiotics to prevent infections. If infections become untreatable we stand to lose most of the medical advances we have made over the past fifty years.

# 3

#### Counterplan: The member states of the world trade organization except for the United States ought to reduce intellectual property protections for medicines, and the WTO ought to increase US intellectual property protections.

#### Without IP there is no incentive for anyone in America to work towards the production of medicines

GIPC 19

Global Innovation Policy Center 2019 “A New Congress Must Prioritize Intellectual Property” https://www.theglobalipcenter.com/a-new-congress-must-prioritize-intellectual-property/

The 2018 election was certainly exciting, focusing on many key issues for Americans including the economy, healthcare, and jobs. Record numbers of voters throughout the country voiced their opinions by heading to the polls, and the newly-elected Congress will hit now the ground running on January 3, 2019. As Members, new and tenured, begin to frame their priorities for the next few years, it’s critical they keep intellectual property (IP) rights top of mind. IP is critical to nearly every aspect of our lives, and it’s the bedrock of innovation. It’s present in every industry, crucial to every American business, and it advances global economic and cultural prosperity. In the U.S. alone, IP-intensive industries employ more than 40 million Americans and account for 74 percent of exports and $5.8 trillion in GDP. Importantly, the average worker in an IP industry earns about 46 percent more than his or her counterpart in a non-IP industry. It doesn’t matter whether it’s Silicon Valley, the Texas oil fields, or the South Carolina craft beer industry, all companies rely upon IP frameworks and the assurance of patents, trademarks, and copyrights to create businesses and bolster domestic employment. Members of Congress looking for their state-specific IP employment data can find it in our [Employing Innovation Across America](https://www.theglobalipcenter.com/ip-employs-innovation/) study. IP is also critical to the breakthrough solutions that keep us healthy and make our lives easier. The U.S leads the world in research and development and continuously discovers new medicines, technologies, and equipment. The pharmaceutical industry, in particular, has pioneered cutting-edge treatment options and life-saving medicines. One example is UC San Diego Moores Cancer Center’s recent partnership with the La Jolla Institute of Allergy and Immunology to test a vaccine that specifically targets cancer cells. This feat wouldn’t be possible if our lawmakers and representatives didn’t consistently promote an IP environment that fosters innovation and incentivizes risk-takers. Beyond job creation and research and development, we rely on IP for consumer safety. Strong IP rights protect consumers, inventors, and manufacturers alike, and hold bad actors accountable. Recent trends show a new era of counterfeits, especially online, pose serious threats to American consumers. No longer limited to footwear, accessories, and apparel, illicit operations sell falsified products ranging from cosmetics to auto parts, electronics, and beyond. While lower prices can often seem appealing to consumers, these products are made without any quality or safety assurance. Accordingly, we’ve all seen reports of malfunctioning automotive parts, exploding electronics, cosmetics that cause skin reactions, and pharmaceuticals with toxic ingredients. Properly enforced IP rights are the only way to ensure that the products consumers buy are authentic and safe and promise confidence and reliability. Globally, America leads the world in [IP standard](https://www.theglobalipcenter.com/ipindex2018/), and it’s imperative we remain an IP leader that other countries can look to. During the 116th Congress, lawmakers will be presented with opportunities to not only bolster domestic IP law, but also international IP frameworks with many of our trading partners – and they must capitalize. As trade deal negotiations continue throughout 2019, most immediately the United States-Mexico-Canada-Agreement (USMCA), Congress should prioritize high-standard IP provisions that better represent modern economies and support global innovation. The political discourse has grown to be increasingly heated, but IP can serve as a bipartisan and unifying force for Members spanning both ends of the political spectrum. More than ever, Congress should work together to reach consensus agreements that safeguard IP and fuel American innovation.

#### The US funds world innovation by producing the most cutting edge drugs and selling them at lower prices

Ryan Huber, 3-29-2017, "U.S. Health Care Reality Check #1: Pharmaceutical Innovation," Medium, https://medium.com/arc-digital/u-s-health-care-reality-check-1-pharmaceutical-innovation-574241fb80ba

There are several important reasons why health care is so expensive in the United States, and Grossman points out perhaps the most important: the United States effectively subsidizes research and development of drugs and medical devices for the rest of the world. As Grossman notes, other advanced nations “clamp down” on the profit motive in various ways, meaning that people who would normally make more money in a free market through developing new medical devices, medications, or procedures to produce better health care outcomes and perhaps drive down prices through competition have less incentive to do so in these more government-controlled health care systems. That is, despite the many regulations and laws aimed at consumer protection and safety that do exist in the United States, our health care market is relatively freer and more dynamic than those of other developed countries. This leads to a high rate of medical and pharmaceutical innovation that ends up benefiting the rest of the world, particularly other rich countries, in a similar way that NATO nations, for example, benefit from close military alliance with the United States. In short and somewhat reductive terms: we spend more money so everyone else can be healthier. But this doesn’t make total sense at first. If the United States is developing more innovative medicines, devices, and procedures than every other advanced economy, why aren’t we making money by selling these medical innovations to others for a hefty profit? Why aren’t there many more billions of dollars of revenue coming into the United States Treasury because of our status as a medical innovator? The answer is complicated, but here are some facts you need to know: First, pharmaceutical companies which innovate in the United States charge their domestic customers much more than they do their customers abroad. This is because, if countries don’t like the prices charged by a given pharmaceutical company for a certain drug, [they will simply ignore the patent](http://www.economist.com/blogs/schumpeter/2013/04/drug-patents) that company holds for their drug in the United States or elsewhere. Novartis spent nearly 15 years seeking a patent in India for Glivec, a medicine for chronic myeloid leukemia. That quest reached its dead end, at last. India’s [Supreme Court](http://supremecourtofindia.nic.in/outtoday/patent.pdf) rejected the Swiss drugmaker’s patent application. Glivec (marketed in America as “Gleevec”) is a blockbuster, earning the Swiss drugmaker [$4.7 billion](http://www.novartis.com/downloads/investors/reports/novartis-annual-report-2012-en.pdf) last year. Its prospects in India are now zilch. Although in this example Novartis happens to be a Swiss drug company, the ruling sends the same clear message to drug makers in the United States: Give us your drugs for next to nothing or you’ll get exactly nothing. Second, and relatedly, notice that there seems to be a correlation between how much a country spends on prescription drugs and the percentage of NMEs (New Molecular Entities) produced by that country. If you combine points 1 and 2, you start to understand that the high spending of health care consumers in the United States is arguably funding not only global pharmaceutical innovation but is also facilitating the availability of new medicines to other countries at much lower prices than domestic consumers pay. There is a third factor that might help explain why health care, especially with regard to pharmaceutical innovation, is so much more expensive in the United States: our massive regulatory agency of all things drugs and food, also known as the FDA, is significantly more burdensome for medical innovation than the analogous agency for all of Europe, the EMA (European Medicines Agency). The EMA doesn’t get the final say on whether a drug gets approved for sale in the EU, and perhaps even more significantly, they don’t breathe down their drug companies’ necks during clinical trials. It’s understandable that, given limited resources, the regulatory process can’t be automatic, or even fast-tracked, for all applicants. But if the FDA can put a medication on a path where an evaluation can be made “quickly and efficiently,” does that mean the normal course of action is to proceed slowly and inefficiently? If so, this could represent a needless driver of health care costs. We need to be able to ask this question: Is there something going wrong with the drug development process to have the costs so high and climbing higher every year? Looking at a cost breakdown of Big Pharma companies from 2014, a big chunk of their costs, almost equal to the sum of the entire first and second phase of their clinical trials, come from the 4th phase of clinical trials, which is often referred to as “post-marketing surveillance.” This is the phase of a drug’s life that takes place after its approval for sale on the U.S. market, in which the FDA requires continued and ongoing studies to validate the drug’s safety and efficacy using data generated from every phase of clinical trials leading up to its approval in the first place. It’s in this phase of a drug’s life where, after spending large amounts of money to get the drug approved, companies can still watch as the FDA rescinds a drug’s approval status, which leads to the drug getting withdrawn from the market, in many cases never to be seen again. So, not only is almost a fourth of a drug’s average R & D cost attributable to legislative constraints the government imposes on pharmaceutical companies to police their own products even after they’ve been approved based on incredibly high standards of safety and testing, but also, compared to less developed countries, we’re more likely to pull drugs off the market and revoke their status as a result of anecdotal case reports of adverse effects that generally go unverified. We consistently decide to err on the side of safety, even if it means pulling the plug on a 10–15-year-long investment (the average length of development for a drug), which helps clarify how aspiring for safer and more effective drugs begins to preclude cheaper drugs. So the United States produces the most novel and cutting edge therapeutic compounds despite the most expensive and stringent approval process and sells them to other countries at much lower prices than we do at home. In doing this, we are indeed subsidizing research and development of drugs and medical devices for the rest of the world. This subsidized medical innovation is a major contributing factor to the out-of-control health care costs in the United States, and losing this innovation will be one of the sacrifices we make if we move toward a more cost-controlled or government-run health care system over the next several years.

#### The U.S. is the most important state for innovation of non-molecular entities that means their uniquely k2 innovation

[Keyhani](https://www.ncbi.nlm.nih.gov/pubmed/?term=Keyhani%20S%5BAuthor%5D&cauthor=true&cauthor_uid=20403883) et al 10

[Salomeh Keyhani](https://www.ncbi.nlm.nih.gov/pubmed/?term=Keyhani%20S%5BAuthor%5D&cauthor=true&cauthor_uid=20403883), MD, MPH,corresponding author [Steven Wang](https://www.ncbi.nlm.nih.gov/pubmed/?term=Wang%20S%5BAuthor%5D&cauthor=true&cauthor_uid=20403883), MD, [Paul Hebert](https://www.ncbi.nlm.nih.gov/pubmed/?term=Hebert%20P%5BAuthor%5D&cauthor=true&cauthor_uid=20403883), PhD, [Daniel Carpenter](https://www.ncbi.nlm.nih.gov/pubmed/?term=Carpenter%20D%5BAuthor%5D&cauthor=true&cauthor_uid=20403883), PhD, and [Gerard Anderson](https://www.ncbi.nlm.nih.gov/pubmed/?term=Anderson%20G%5BAuthor%5D&cauthor=true&cauthor_uid=20403883), PhD, June 2010, “US Pharmaceutical Innovation in an International Context” https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/

Thirty-six percent of all NMEs were developed in the United States ([Figure 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig1/)). The United Kingdom was the next largest source of NME development (10.4%). Examination of drugs with patents (n = 288) revealed that 126 (43.7%) of the NMEs had their earliest patent filed by inventors in the United States. Of the 288 drugs with patents in force at the time of FDA approval, 28 (10%) had more than 1 country listed as the home country of the patent holder. The distribution of inventor countries did not appreciably change if we assigned the second country listed on the patent as the inventor (data not shown).

[[Chart, pie chart

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[Open in a separate window](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig1/?report=objectonly) [FIGURE 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig1/) Source of pharmaceutical innovation classified by location of the company headquarters by (a) country of the inventor and (b) patent assignees: 1992–2004. Note. Data based on drugs approved between 1992 and 2004. The sample size was N = 346. Other includes Denmark, Spain, Norway, Austria, Korea, Czechoslovakia, and Australia. Percentages do not add up to 100% because of rounding, Innovation as a Function of Company Location Overall, 171 companies were listed as the assignees for 288 NMEs with patents. Examination of the patents revealed that 33% of the assignees had company headquarters located in the United States, and 10% had company headquarters in the United Kingdom ([Figure 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig1/)). However, further examination showed that most companies were multinationals with facilities located in 2 or more countries ([Figure 2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig2/)).

[Open in a separate window](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig2/?report=objectonly) [FIGURE 2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig2/) Pharmaceutical patent assignees, by type of company: 1992–2004. Note. Data based on drugs approved between 1992 and 2004. The sample size was N = 346. Relations With Gross Domestic Product and Prescription Drug Spending The relationship between the proportion of each country's GDP to the total GDP among all countries and the proportion of NME development is shown in [Figure 3](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig3/). Similarly, the relationship between the proportion of each country's prescription drug spending and their respective proportion of NME development is depicted in [Figure 4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig4/). In both figures, countries above the 45 degree line innovate more in relation to their prescription drug spending and GDP, and countries below the line innovate less. As shown in [Figures 3](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig3/) and [​and4,4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig4/), the United States accounted for roughly 42% of prescription drug spending and 40% of the GDP among NME innovator countries and was responsible for the development of 43.7% of the NMEs. The US contribution to global discovery of NMEs was roughly proportional to its contribution to global wealth and prescription drug spending. The United Kingdom was responsible for the development of 12.5% of the NMEs and accounted for 4.7% of prescription drug spending and 5.9% of the GDP among innovator countries. In contrast, Japan was responsible for the development of 9.7% of the NMEs and accounted for 18.9% of prescription drug spending and 19.1% of the GDP among innovator countries. Similarly, Switzerland, Belgium, and a few other countries innovated proportionally more than their contribution to the GDP or prescription drug spending and Spain, Korea, Australia, and Italy innovated proportionally less.

[[Chart

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[Open in a separate window](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig3/?report=objectonly) [FIGURE 3](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig3/) Pharmaceutical innovation as a function of gross domestic product (N = 288): 2000. Note. GDP = gross domestic product; NME = new molecular entity. Axes are on a log scale. The United States almost falls on the 45 degree line where contribution to GDP and NME development is roughly proportional. Countries above the line develop a higher percentage of drugs compared with their percentage contribution to GDP. For example, the United States accounted for 40% of the GDP among NME innovator countries and was responsible for the development of 43.7% of the NMEs. The UK contributed proportionally more NMEs than its national income would indicate, and Australia and Japan proportionally less.

[Open in a separate window](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig4/?report=objectonly) [FIGURE 4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/figure/fig4/) Pharmaceutical innovation (development of NMEs) as a function of prescription drug spending (N = 288): 2000. Note. NME = new molecular entity. Axes are on a log scale. Countries above the line develop a higher percentage of drugs compared with their percentage contribution to prescription drug spending. [Go to:](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/) DISCUSSION Pharmaceutical innovation is an international enterprise. Although the United States is an important contributor to pharmaceutical innovation, we found that more than 20 countries contributed to the development of the 288 NMEs with patents at the time of approval. More than 171 companies were involved in the development of these NMEs, and the vast majority of companies were multinationals with facilities located in more than 2 countries. We also found that the United Kingdom, Switzerland, Belgium, and a few other countries innovated proportionally more than their contribution to the global GDP or prescription drug spending, whereas Japan, Spain, Australia, and Italy innovated less. In contrast with the United States, all other countries investigated had instituted at least 1 form of drug pricing regulation.[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib1) Critics of drug price regulation argue that free market pricing strategies and higher prices in the United States are instrumental to innovation.[20](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib20),[21](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib21) One might therefore expect the United States to be the most innovative given that it is the only country with a predominantly unregulated pharmaceutical market. However, US pharmaceutical innovation appeared to be roughly proportional to its national wealth and prescription drug spending. Our data suggest that the United States is important but not disproportionate in its contribution to pharmaceutical innovation. Interestingly, some countries with direct price control, profit control, or reference drug pricing appeared to innovate proportionally more than their contribution to the global GDP or prescription drug spending. There are 3 general types of price regulation strategies that are implemented in OECD countries: (1) direct control of prices, (2) reference pricing and generic substitution, and (3) profit control (an indirect form of price control in which a country limits the profits generated by a company within its territory).[20](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib20),[22](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib22) The United Kingdom, Spain, and South Korea[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib1) use profit control to lower drug costs.[23](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib23) Canada uses a mixture of measures to control drug prices in different provinces.[24](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib24) Denmark, Germany, the Netherlands, Italy, Norway, Spain have all implemented a form of reference drug pricing.[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib1) Belgium, Switzerland, Sweden, Italy, Austria, and Finland set the manufacturer price, the reimbursement price, or both.[1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib1) Although many researchers[20](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib20),[21](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib21),[25](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib25) have speculated that reference drug pricing in the United States would have dire consequences for innovation, our data suggest that the pharmaceutical innovation of countries with reference drug pricing is more or less what one would expect given their prescription drug spending or even the general size of their economies. Many countries with significant price regulation were important innovators of pharmaceuticals; therefore, our data suggest that country-specific pricing policies probably do not affect country-specific innovation. For example, although prices in the United Kingdom are much less than are prices in the United States, the industry continues to be very profitable and innovative.[11](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib11) In Canada, income from domestic sales of brand name companies is, on average, about 10 times greater than is research and development costs, even in the face of prices that are approximately 40% lower than in the United States.[11](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib11) In addition, companies in the United Kingdom invest proportionately more revenue from domestic sales into research and development activity than do their US counterparts.[11](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib11) Despite the above average profitability of US-based companies,[26](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib26) the higher prices paid by US consumers are not rewarded by more than expected domestic innovation. US consumers pay disproportionately higher prices for brand name drugs,[6](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866602/#bib6) but the United States is not disproportionately innovative.

# 4

Interpretation: the aff must defend the resolution and only the resolution.

Standard

Neg ground

Fairness and education

# Case

Cap good

Cap defense

#### Capitalism’s inevitable – there’s no left to do the aff and capitalism’s crises only retrench it.

Jones 11(Owen, Masters at Oxford, named one of the Daily Telegraph's 'Top 100 Most Influential People on the Left' for 2011, author of "Chavs: The Demonization of the Working Class", The Independent, UK, "Owen Jones: Protest without politics will change nothing", 2011, [www.independent.co.uk/opinion/commentators/owen-jones-protest-without-politics-will-change-nothing-2373612.ht](http://www.independent.co.uk/opinion/commentators/owen-jones-protest-without-politics-will-change-nothing-2373612.ht))

My first experience of police kettling was aged 16. It was May Day 2001, and the anti-globalisation movement was at its peak. The turn-of-the-century anti-capitalist movement feels largely forgotten today, but it was a big deal at the time. To a left-wing teenager growing up in an age of unchallenged neo-liberal triumphalism, just to have "anti-capitalism" flash up in the headlines was thrilling. Thousands of apparently unstoppable protesters chased the world's rulers from IMF to World Bank summits – from Seattle to Prague to Genoa – and the authorities were rattled.¶ Today, as protesters in nearly a thousand cities across the world follow the example set by the Occupy Wall Street protests, it's worth pondering what happened to the anti-globalisation movement. Its activists did not lack passion or determination. But they did lack a coherent alternative to the neo-liberal project. With no clear political direction, the movement was easily swept away by the jingoism and turmoil that followed 9/11, just two months after Genoa.¶ Don't get me wrong: the Occupy movement is a glimmer of sanity amid today's economic madness. By descending on the West's financial epicentres, it reminds us of how a crisis caused by the banks (a sentence that needs to be repeated until it becomes a cliché) has been cynically transformed into a crisis of public spending. The founding statement of Occupy London puts it succinctly: "We refuse to pay for the banks' crisis." The Occupiers direct their fire at the top 1 per cent, and rightly so – as US billionaire Warren Buffett confessed: "There's class warfare, all right, but it's my class, the rich class, that's making war, and we're winning."¶ The Occupy movement has provoked fury from senior US Republicans such as Presidential contender Herman Cain who – predictably – labelled it "anti-American". They're right to be worried: those camping outside banks threaten to refocus attention on the real villains, and to act as a catalyst for wider dissent. But a coherent alternative to the tottering global economic order remains, it seems, as distant as ever.¶ Neo-liberalism crashes around, half-dead, with no-one to administer the killer blow.¶ There's always a presumption that a crisis of capitalism is good news for the left. Yet in the Great Depression, fascism consumed much of Europe. The economic crisis of the 1970s did lead to a resurgence of radicalism on both left and right. But, spearheaded by Thatcherism and Reaganism, the New Right definitively crushed its opposition in the 1980s.This time round, there doesn't even seem to be an alternative for the right to defeat. That's not the fault of the protesters. In truth, the left has never recovered from being virtually smothered out of existence. It was the victim of a perfect storm: the rise of the New Right; neo-liberal globalisation; and the repeated defeats suffered by the trade union movement.¶ But, above all, it was the aftermath of the collapse of Communism that did for the left. As US neo-conservative Midge Decter triumphantly put it: "It's time to say: We've won. Goodbye." From the British Labour Party to the African National Congress, left-wing movements across the world hurtled to the right in an almost synchronised fashion. It was as though the left wing of the global political spectrum had been sliced off. That's why, although we live in an age of revolt, there remains no left to give it direction and purpose.

Turn, IP specifically motivates people to be more creative thinkers. Leads to innovation.

Still exists in other forms of patenting that the aff can’t solve for.

#### Capitalism solves nanotech—K-waves incentivize structural innovation—all the leading countries in nanotech R&D are capitalist

Tuncel and Polat 16 [Cem Okan Tuncel, Uludag University, Turkey. Ayda Polat, Uludag University, Turkey. Tuncel, Cem Okan, and Ayda Polat. “Nanotechnology, Long Waves, and Future of Manufacturing Industry: Comparative Analysis of European Union, East Asian Newly Industrialized Countries, and MENA Region.” *Handbook of Research on Comparative Economic Development Perspectives on Europe and the MENA Region*, edited by M. Mustafa Erdoğdu and Bryan Christiansen, IGI Global, 2016, pp. 351–77, doi:[10.4018/978-1-4666-9548-1.ch015](https://doi.org/10.4018/978-1-4666-9548-1.ch015).]//Anton

K-waves: Kondratiev wave is long termed fluctuations that can be considered to have consisted of four main periods as improvement, well-being, shrinkage, and crisis. It is claimed that the period of the wave ranges from forty to sixty years.

This debate that is ongoing in academic circles is related to how capitalism will get out from the ongoing stagnant conjecture and how a stable and sustainable economic growth would be ensured in the world’s economy by reducing uncertainties after the crisis. While understanding the fact that the stagnancy caused by the crisis, which commenced in the global financial markets and dominated the real economy by expanding in a short period, would last for an extended period caused a questioning of the current industry policies, it accelerated the new industry policy searches that constitute an alternative for such policies as well. Countries are in search of a new industry policy for the revitalization of the industry and for recapturing permanent growth. In today’s world where the demands for reindustrialization are increased, this priority is set to render the country’s industry policies with the growth targets and base them on a sustainable growth strategy (OECD, 2013). The moving force of this new industrialization process will be the new generic technologies. In the OECD countries, share of the manufacture industry within the national production-added value and employment has been diminishing for the last thirty years. While the industry is losing its competitiveness, service sectors are growing more rapidly. The findings of UNIDO from the data that involve 90 countries in the 1950-2005 period, showed the proportion of the manufacturing industry within the GDP presents the fact that this proportion varied between 25 and 40 percent in the period subsequent to the Second World War in the early industrializing countries and exhibited a tendency toward a rapid decrease after 1980. The findings show that the regression in the proportion of the manufacturing industry in the GDP encountered since the 1980s are being experienced in developing countries (UNIDO, 2013). It is clear that the crucial factor determining underlying competitiveness and economic growth is innovation. The growth of the GDP is positively related to the growth of the manufacturing sector and the productivity of the manufacturing sector is positively related to the growth of the manufacturing sector as well (Kaldor, 1967; Verdoorn, 1993).1 Various studies in economic growth and development literature have shown that there is a robust and positive correlation between economic growth and technological capabilities of economy, export performance and industrial productivity (e.g. Stern et. al. 2000; Fagerberg & Verspagen, 2007; Fagerberg, 1987, 1996, 2005). It is important to understand that manufacturing industry is not only the main driving factor of economic growth but also the main source of technological development. After new technologies are firstly applied in manufacturing, they diffuse to other sectors such as services, construction, and agriculture (McKinsey, 2012). Hence surplus economies owing to their own industrial infrastructure have become more resistant against the crisis tides. For this reason, the European Commission recommended reinstalling industrialization plans to reverse the declining role of the manufacturing industry and increase its share of European Union GDP in 2011 as a preventative measure to the crisis (European Commission, 2012). The future of European manufacturing industry debate has underlined the necessity and importance of supporting generic technology research areas such as nanotechnology, green technology, and biotechnology. While growing literature on recent crises focuses on financial market failure, bad governance and wrong policy, few scholars have taken account of the structural roots of global crises (e.g. Šmihula, 2009; Gore, 2010; Devezas, 2010; Korotayev & Tsirel, 2010; Perez, 2009). Indeed; financial boom-bust cycles stemming from financial market failures or lack of sufficient regulations on the market is the conclusion of the crises rather than the cause. Actually, the structural roots of the recent crises should be searched for within long run development dynamics of capitalist economy. Long wave theory is the main way to explain this long run development dynamics. This approach was postulated by the seminal work of the Soviet economist Nikolai Kondratieff. He observed longterm economic fluctuations in cycles of 40 to 60 years (Kondratieff, 1935). This approach was transformed to an analytical and theoretical framework for understanding technological evolution and social change in historic times by Schumpeter and his followers. This study aims to analyze the impact of nanotechnology on the manufacturing industry. Advances in science and technology, especially in material science, microelectronics, information technology, biotechnology and nanotechnology will profoundly affect manufacturing. Our research tries to review how nanotechnology contributes to economic growth and changes the structure of the manufacturing industry on the eve of the sixth Kondratieff wave. This framework is investigated by using a comparative case study of European Union (EU), East Asian newly industrialized countries (NICs) and Middle East and North African (MENA) countries. This paper will be organized as follows: In the first section, long wave theory from neoSchumpeterian perspective will be examined. In the second section, the potential impact of nanotechnology on industry and its opportunity window will be drawn. In the third section, the role of nanotechnology research on industrialization strategy will be discussed via the comparative case study of the EU, the East Asian economies and MENA countries. LONG WAVES THEORY OF CAPITALIST DEVELOPMENT AND SCHUMPETER’S CONTRIBUTION The theories that try to explain the capitalist development on the basis of long waves that are rising and falling into the stagnancy and crisis environment in connection with the termination of the postwar expansion period after the 1970s are gradually attracting the attentions of more and more economists. Different from the short term fluctuations referred to as the business cycles, development dynamics of the capitalist economy defined as long waves have become a rapidly growing field of research. According to the fundamental results reached by these different studies, economic development in capitalism forms as the consecutive big waves and the impacts and results of each of these waves expand within an entire period and leave its place in time for the subsequent waves of progress. The conjecture theories asserting that economy navigates with long termed fluctuations with ups and downs and that it has waves consisting of improvement, well-being, shrinkage, and crisis stages that have 40 to 50 years of life were presented for the first time in the article entitled “Long Waves in Economic Life” published by N. D. Kondratieff in 1919 (O’Hara, 1994). These long termed fluctuations can be considered to have consisted of four main periods which are improvement, well-being, shrinkage, and crisis. In 1939, Joseph Schumpeter suggested naming the cycles “Kondratieff waves (K-wave)” in his honor (Schumpeter, 1939). Since the late 18th century, economists have empirically proven five Kondratieff waves. The fifth Kondratieff wave ended with the turn of this century, while a new long cycle, the sixth Kondratieff, has begun (Linstone & Devezas, 2012). The sixth wave will likely be focused on emerging research areas such biotechnology, “bioelectronics”, nanotechnology and new material sciences (Perez, 2008; Klein, 2005). Long wave theory was progressed by contribution of Joseph Schumpeter, one of the original social scientist of the twenty century (Fagerberg, 2003, p. 127). He developed an original approach focusing on the role of innovation and entrepreneur in economic life (Schumpeter, 1934). Economic development had to be seen as a process of qualitative change which is determined by innovation in Schumpeter’s opinion. Innovation, in his view, as a new combination of existing resource was realized by entrepreneur. Schumpeter’s dynamic theory used analyzing long run development of economy as well. According to his theory, K-wave begins with technological innovations, which then become the cornerstones of a prolonged economic upturn (McCraw, 2006). Innovations have clustered in certain industry and trigger new bursts of productivity throughout the entire economy. Productivity of whole economy began to decline because booster impact of innovations ran out. This periodic upward-downward motion of economic activities, so-called long wave, in world economy mainly has been determined by clustering innovation. Schumpeter has scrutinized the capitalist system within the framework of the non-balance evolutionary process instead of the neoclassic stable fixed state balance approach. Innovation underlies the foundation of Schumpeter’s this change dynamic, which is internal with its capitalist development. Innovation is defined as the presentation of the current resources as the new amalgamations (Schumpeter, 1934, p. 66). There are five basic innovation forms that are the source of an economic change. 1. New consumables: development of the new products qualified as the product innovation. 2. New production methods: use of the new techniques in the production qualified as the process innovation. 3. New markets: development of the new markets or new marketing possibilities. 4. New raw material resources: start of utilizing of new resources. 5. New industrial organizations: changes in the form of business conduct qualified as organizational innovation. Those who realize innovations are the entrepreneurs. An entrepreneur is the person who pursues new products, who is in new searches in terms of the management of the firm, and who explores new markets. The role of an entrepreneur is to renew and remedy a production system by means of utilizing an invention or a technique that has never been used in general (Schumpeter, 1942, p. 202). Schumpeter’s entrepreneurs do not come from a certain class; they constitute a talented minority (Heilbroner, 1999). This elite human type exhibit talent differences within itself. Differentiation of the agents, which ensure technological development, within themselves, constitutes the engine of the technological diversity and evolutionist development. The motive that activates an entrepreneur is profit. Profit is the gain of conducting innovation and obtained by entrepreneurs. In the appearance of innovation, bank loan plays a central role. In addition to the creative entrepreneur, risk-undertaking banker is the most significant element of an economic development (Hanusch & Pyka, 2007, p. 282). There is an inseparable union between the entrepreneur and the banker. According to Schumpeter, internal change dynamics of a capitalist economy is “innovation (reason)”, “entrepreneur (subject)” and “bank loan (instrument)” (Gürkan, 2007, p. 254). Schumpeter defines capitalist economy as an unending “creative destruction” process. Every firm within the capitalist system try to increase its market share, and to have a dominant state by means of finding a new design, cost reducing endeavor, a new product, and new inputs as well as of developing new production methods. However, each innovation destroys the monopolist power preceding itself. This creative destruction waves constitute the basic dynamic of the long term development of the capitalist economy. Basic factor underlying the long fluctuations following a trend of decrease and increase in the capitalist development is that while new sectors where the profit shares and investment opportunities are extremely high depending on the innovation aggregations are appearing, the sectors based on the current matured technologies are disappearing in line with their loss of their profitability ratios. From this time, the topic of the causes of long waves remains central in the agenda of the neo-Schumpeterian tradition which is placed itself opposite to neoclassical economics, based on maximization behavior of rational economic agents. This analytical framework has been developed via contributions of neo-Schumpeterian scholars since the beginning of the 1980s. NEO-SCHUMPETERIAN TECHNOECONOMIC PARADIGM APPROACH The Neo-Schumpeterian approach expounds the long waves of capitalist development within the framework of the scientific advancement model developed by Thomas Samuel Kuhn, an American physicist, historian, and philosopher of science. According to Kuhn, a stable period that is referred to as a normal scientific period is interrupted by a crisis period and this crisis period allows the inauguration of a new normal scientific period by causing the appearance of a scientific revolution (Kuhn, 1962). The current scientific paradigm defines the rules, standards, and scientific research methods shared by scientists, and create an ambiance of reconciliation for the continuation of the research tradition. Neo-Schumpeterian theory, or the technoeconomic paradigm approach, is a theory that combines Kondratieff’s long waves theory with Schumpeter’s economic development theory and that focuses within the capitalist development process on technological change (Taymaz, 1993, p. 14). Techno-economic paradigm approach which focused on long run socioeconomic and institutional change dynamics of capitalistic economy by using K-wave framework was based on this neo-Schumpeterian tradition. Dosi (1982) defines technology paradigm as a “model and pattern of solution of selected technological problems based on selected principle from the natural science and on selected material technologies” (p. 150). This conceptual analysis provides framework to understand how technology change in specific direction, and why this direction transforms. The paradigm thus limits the possible directions technological development may take. According to this approach, institutional environment is itself endogenous factor which is determined by technological development. Moreover technoeconomic paradigm approach provides theoretical background for analyses long wave in economy and understanding the groundbreaking transformation in society. Changes in techno-economic paradigms may be said to redefine the trajectory not only of the technological and economic spheres but also of the social sphere (Perez, 2008). Each technoeconomic paradigm requires a new infrastructure allowing the new technologies to be diffused throughout the economic system while the dominant characteristics of the production system are restructured to incorporate processes that allow new products to be created and distributed. For each paradigm, there are common denominators that influence the behavior of the relative costs, supply and diffusion of new technologies and the organization of production processes (Dosi, 1984). Thus the notions of trajectory or paradigm highlight the importance of incremental innovations in the growth path following each radical innovation. Though it is true that major innovations have a central role in determining new investment and economic growth, expansion depends on incremental innovation (Perez, 1983, 1985, 2002). According to Schumpeter, every long wave is unique because of the technological newness differences in that period on one hand and of the difference of the historical events such as wars, discovery of gold mines, or famine on the other. However, in the explanation of this long term fluctuations, the most important factor is innovations, which is the engine of capitalist growth source of the profits of the entrepreneurs (Freeman & Soete, 1997). The expression of technoeconomic paradigm contains, as a meaning, the economical selection process among a range of innovations that can be technically realized. In reality, a new paradigm’s becoming clear takes relatively a long time (a few decades); expansion of this within the entire system takes longer. This expansion contains an interaction process where, among the technological, economic, and political forces, corporate innovations (or corporate renewals) gain utmost importance (Freeman, 1989, p. 89). For understanding the technoeconomic paradigm change, basic analysis level is the innovations also highlighted by Schumpeter. Some changes stemming from the innovations in their technological systems are so long-ranged in terms of the results they create that they have a substantial impact on functioning of entire economy. These changes form the phenomenon that Schumpeter names as “creative gales of destruction” that constitutes the main axis of his “long cycles in the economic development.” Basic power underlying such creative destruction gales is the innovations that intensify in a certain historical period. Innovations are analyzed under four headings (Freeman & Perez, 1988, pp. 45-47): 1. Incremental Innovations: They are the minor technological changes that are encountered in the industry and services, that take place in different rations among industries from country to country, and that provide very little continuation. They are the innovations that mainly take place not as a result of the R&D studies but depending on the learning-by-practicing processes and the improvement of the engineering activities taking part in the production process or through the impressions and recommendations of the users. 2. Radical Innovations: They are the important and effective technological changes that appear as a result of the R&D activities, that do not exhibit a continuous feature, and that take place unequal among sectors. Even though the radical innovations such as nylon create significant structural changes, their impacts on the generality of the economy are relatively small and local. 3. Technological System Changes: Deeprooted technological changes causing the formation of the new sectors that affect the different sectors in economy. It stems from the amalgamation of the radical and incremental innovations in the manner that it will cover the organizational innovations affecting one or multiple firms. Synthetic substance innovations, petro-chemistry in- novations, and internal combustion motor innovations can be exemplified for such changes. 4. Techno-Economic Paradigm Changes (Technological Revolutions): Some technological system changes have substantial impacts on the entire behavior of economy. These types of changes take place by way of the aggregation of the radical and incremental innovations and joint appearance of numerous technological systems as a result of it. Characteristic feature of a technological revolution is not its widespread impact on every branches of economy, not only on some products, services or sectors. Technological revolutions or creative destruction gales create significant changes on the social structure. In order for these changes to expand along the entire economy, fundamental transformations in the manner of organization of production must be realized. Such technological revolutions cause the occurrence of rapidly shifting production functions for both the old and the new products. The extent of savings to be obtained in the labor or capital cannot be initially estimated completely; but the general economic and technical benefit in the design of the products and production method by means of using new technology become visible well by increasing gradually and new practical rules are also developed gradually. Such shifts in the paradigm make it possible to make a significant spurt in the potential productivity but such spurt takes place initially only in a few leading sectors. These gains cannot generally take place without organizational and social changes in other sectors (Freeman, 1989, p. 90). In order for the new economic paradigm to be superior over the old paradigm, it has to have the factor that can be defined as a group of key inputs that are unique to the new paradigm. These factors must have the following conditions (Freeman & Perez, 1988, p. 48): 1. Low and rapidly decreasing production costs; 2. Possibilities of supply that seem to be endless in the long term; 3. In the entire economy, potential of use in many products and processes After the new technoeconomic paradigm dominates, it develops beneath a new orbit. Even though technological diversity grows rapidly as a result of the technological revolution, the productivity increase that will appear among the sectors based on the newly emerging technologies has a limit. As long as the possibilities of the new technological paradigm are consumed, profits will fall one by one as the sectors will come down to the level of growth and productivity increase speed will slow down (Taymaz, 1993, p. 15). Loss of productivity by the current paradigm will push economy toward the search of a new paradigm and the system will transit to a new technological paradigm. According to the neo-Schumpeterian approach, capitalist development process consists of five Kondratieff waves that are consecutive to date. Paradigm transitions have impact on the developing countries’ industrialization dynamics. In the period of which the current technoeconomic paradigm is stable, corporate constructs will contribute to the development of the system harmonious with the dominant technological structure. Capitalist development’s stagnation depending on the technology matured within the current technoeconomic paradigm will cause that a longwave will enter a regression path decreasing the profit ratios. In the regression stage of the long wave, financialization appears as a historical resort with the purpose of getting rid of the tendency of stagnancy encountered in economy. In this financialization period, in order to overcome the structural stagnancy by means of financial speculation and indebtedness, partial demand expansions are created. These demand expansion waves bring about problems as it is unable to constitute a sustainable growth. These problems expand toward high unemployment, incomplete employment, frequently encountered recessions, collapse of the stock exchange, and deflation. Deepening of the crisis will ensure the transformation of a technological system for the commencement of new increase waves. With the 2008 crisis, the debates regarding the structural roots of the crisis bring the fact that whether we are in the beginning of a new Kondratieff wave into the agenda of the economic arguments. In this context, the impacts of the crisis, the future of the manufacture industry, and whether a re-growth trend based on new technologies exists or not have become an important subject of debate. Another matter of debate is about the countries that might make use of the opportunity windows that will be opened in such a technological paradigm transition period. Hence, in the following section, the opportunity windows opened by the techno economic paradigm changes and the situation of the countries that made use of it in the transition period before the opportunity (microelectronic revolution) and that are referred to as the Asian Tigers (Taiwan, South Korea, Hong Kong, Singapore) will be briefly presented and their position within the current paradigm change process will be scrutinized in comparison with the EU countries and other developed countries. Technoeconomic Paradigm Changes and Opportunity Windows: Rise of Asian Tigers Perez and Soete’s (1988) argument that new technological revolutions and paradigm changes open windows of opportunity that allow developing economies to catch up. These authors propose that the early entry into new techno-economic paradigm is the crucial point for the process of catching up. Within the technoeconomic paradigms, there are the product cycles presented by Vernon that affect developing countries’ industrial developments and that make it possible for them to catch up to the developed countries. Depending on the standardization of product technology, comparative superiority will develop for the benefit of the developing countries. In this process, current standard products will be started to be manufactured by the developing countries’ industries and this industrial output will open opportunity windows for the countries whose increased potential is developing (Shin, 1996, p. 18). Perez and Soete (1988) assert that the actual opportunity windows that will be a solution for the developing countries’ development problems will appear within the technoeconomic paradigm change period. According to the authors, being the one that enters first into the technoeconomic paradigm has critical importance for the developing countries in order to capture what is developed. The crisis encountered in the 1970s caused the experience of a substantial shrinkage in the developed countries’ manufacture industries. This shrinkage intensified especially within the heavy industry sectors. In the developed countries, this deindustrialization phenomenon caused the increase of these countries’ export from the developing countries to increase especially in the labor-intense industries (Dicken, 2007; Piore & Sabel, 1984). The phenomenon of deindustrialization within these central countries created an impact toward the development of the industries of the developing countries. Impact of this phenomenon on the spatial distribution of the global production system took place differently. Developing countries exhibited a substantial spurt in these industries as a result of the loss of productivity in the labor intensive sectors within the central countries. While the economic depression within the central countries in general were affecting the developing countries negatively, the NICs of Eastern Asia (Asian Tigers) found the opportunity to develop their own industries by gaining particular advantages in the world’s market within the global shrinkage age. Depending on the regional integration of labor in Eastern Asia, Japan became the country that had the most dynamic and competitive economy in the 1970s among the developed countries. NICs of Asia were added to the economy centered from Japan and they gained significant advantages in terms of production and growth. On this phenomenon referred to as the “East Asian Exceptionalism”, geopolitical features of the world’s system in addition to these countries’ industry and technology policies they applied were effective. According to the East Asian Exceptionalism approach, economic slow-down and industrial increase on global regional, national level are differentiating. For example, the economies referred to as the Asian Tigers exhibited a substantial development in exports in the 1960-1988 period and export commodity compositions were transferred to the technology intense goods in the manner that it is not encountered in the other developing countries (Yoo, 1999, pp. 76-77). In this context, behind the process referred to as the East Asian exceptionalism, underlies the fact that they successfully applied corporate arrangements that will support the newly emerging microelectronic-based technologies by making use of the “opportunity windows” created by a Technoeconomic paradigm transition age (Perez, 1985). Especially, South Korea (hence after Korea) terminated the import substitution stage earlier and adopted an export-led development strategy in the 1970s and entered the process of a rapid industrialization with the technology, education, and economy policies managed by a developmental state. In this region, in addition to Korea, Taiwan and Singapore has adopted this strategy and created the miracle of the Asian Tigers. Within the industrialization process, learning is the result of the integration of an overt and covert knowledge. Learning is first stage copycat imitation within the firm. The basic products manufactured at this stage are the products such as textiles, toys, and household goods that are labor intensive but with low technology. This stage basically has four knowledge accumulating mechanisms. These are training, direct foreign capital investments, grand-scale firm constitutions, and experienced technical workforce. Korea started this stage in the 1960s. Second stage is the “creative imitation stage” and shows itself with the expansion of the knowledge-based production. At this stage, knowledge has five basic sources. Formal technology transfer, reverse brain drain, integrated R&D, and universities and public research institutions. Korea started this stage in the 1980s. Exports of consumer electronics, automotive, semi-conductor technology products increased during these years. The final stage is “the innovation stage”. In the previous stages, knowledge or technology can be used by transferring or purchasing. However, at this stage, creation of knowledge and technology are necessary. At this stage, creation of technology has five fundamental mechanisms. The basic researches at the universities and implementation of the programs for the target by the public research institutions have accelerated the learning process. Between the years of 1980 and 2000, developing countries’ industrial product export growth speed and added value’s growth speed they obtained from the world manufacture industry navigated above the world’s average. Developing countries’ share in the manufacture industry added value, which was 13.3% in 1980, increased to 23.8% in 2000 (Lall, 2004, p. 8). The countries group that increased its share most is the Eastern Asian countries that are expressed to have created a development miracle. The Asian countries that focused on the technoeconomic transition age on the establishment and development of microelectronic based industries did know how to make use of the opportunity windows created by the transition age. Hence, while their share they received from the world’s manufacture industry production is increasing continually and the competitive power increased in the industries based on the information and communication technologies, especially in Korea and Taiwan. On the other hand, as presented in the Vernon product cycle theory, the Latin American countries and the countries like Turkey that applied the export of the products with matured technologies whose production was given up by the developed central countries by producing them through the advantages created by the low labor costs failed to make use of the opportunities created by this age of transition. In order to make use of the opportunities to be created by the New Technoeconomic paradigm; the standards of judgment based on the old paradigm, research practices, and business conduct models are expected to be rendered harmonious with the requirements of the new paradigm. The countries that fulfill this requirements and having a scientific infrastructure focused on the production of technology will make use of the possible opportunity windows that will be opened in this paradigm transition process. SIXTH KONDRATIEFF DEBATES: NANOTECHNOLOGY AND FUTURE OF MANUFACTURE INDUSTRY Nanotechnology, one of the generic technologies at the beginning of sixth Kondratieff, has great potential for economic growth. Some authors has suggested that the nanotechnologies will be part of the next technological revolution because they have the potential to create big changes in technologies, products and industries, with social and economical implications to long term (Perez, 2002). Few new technologies have been accompanied by such expansive promises of their potential to change the world as nanotechnology (Wonglimpiyarat, 2005). Nanotechnology has important implications for most sectors namely medicine, information, energy, materials, manufacturing, instrumentation, food, water, the environment and security as key areas (Kostoff et al. 2007). Nanotechnology presents a new revolutionist approach in the fundamental researches (Wonglimpiyarat, 2005; Nefidow, 2002). Investment on the technologies in nano-scale will drive the technological conventionalization defined in macro and micro levels toward the nano-systems. A new paradigm change will reveal the requirement that the old systems must be designed again as a whole. In order to create a sustainable and information-based industry system, it will be obligatory to create a nanoscience-based new research paradigm. Even though nanotechnology is principally similar with molecular manufacture, it is an applied science focusing on studying the innovations of the nanodimensional matters resulting from the dimensionbased phenomena (Roco, 2003). Nanotechnology is related to the real-life implementations of the findings of nanoscience Nanotechnology’s impact is so widespread that an excessively absolute definition can be illustrated in the manner that its actual scope is not realistic. Nanotechnology is the total of multiple technologies, processes, and techniques rather than a specific field of science or engineering (Roure, 2013). The fact that nanotechnology is an interdisciplinary science and its domination of the different areas brought together the cooperation of the scientists from different disciplines and has the potential to impact many areas fundamentally in view of its outcomes.2 In the forthcoming years, indispensableness of nanotechnology for many fields will be understood better. The added value that will be obtained especially in health, defense, textiles, energy, electronics, and photonics will take part in the market of high products and are expected to pave the way for new sectors (Roco, 2005). Countries’ industries will rise on the technologies and products that are obtained as a result of the rapid nanotechnology researches. In the nanotechnology field, the largest investment in the world is made by the USA. In the USA, national nanotechnology investment was 710 million dollars for 2003, which was increased to 850 million dollars for the first half of 2005. The US is followed by Japan with 650 million dollars and the European Union (EU) with 400 million dollars. Nanotechnology has become a sector that is growing in the entire world like an avalanche. In this field, 20 thousand researchers are studying worldwide at present. According to the estimations of the American National Science Academy, the number of the workers who will be working in the nanotechnology production sector in the forthcoming 15 years will be 2 million. The fact that nanotechnology is in the early stage creates substantial growth potential for the countries that will produce and develop this technology (Perez & Dominique, 2008). Nanotechnology’s evolution as a technologic system is presented in the Table 3. While the 2001- 2010 period marks a period in which nanotechnology is used more indirectly, it is seen that its use for improving the current products and processes is widespread also in this period. In the period that started subsequent to 2011, we witness that nanotechnology has transcendent the improvement of current product process or industries and started to create new product processes and industries. In this period, the transformation impact of nanotechnology on the industry is gradually increasing (Roco, 2011, p. 433). When the basic indicators are reviewed about nanotechnology in Table 4, it is seen that the US is the banner-bearer in terms of this technology. And a significant growth in every indicator appears to have been realized from the scrutiny of the basic indicators of the technology in the 2000-2008 periods. The biggest growth takes place in the R&D investments in this technology field and in the patents received (Roco, 2011, p. 429). In the evaluation of the countries’ current statuses in terms of the nanotechnology, the superiority of the developed countries stands out. In the Table 5, Nanotechnology R&D expenditures in the business sector are presented. According to the data given in the table, the countries that spent most for R&D are the US, Germany, Japan, and Russia. Mexico and South Africa, which will be evaluated later on within the developing countries category, are the countries that make investment on nanotechnology as well. Belgium, Italy, Switzerland, and Czech Republic within the EU are also conducting R&D activities. In the Table 6, the number of firms active in nanotechnology is presented. The countries where the nanotechnology firms are most intense are the US, Germany, France, Japan, and Switzerland. These countries are also spearheading in terms of the number of the dedicated nanotechnology firms. The USA and Germany, France, Switzerland, Italy Belgium, and Denmark in the EU and specifically Japan in Asia seem to be the countries that have succeeded to establish nanotechnologybased business sector. In the Figure 1, share of the countries in nanotechnology patents filed under PCT are presented. When examined in terms of the countries and country groups, the USA is by far superior in regards to nanotechnology patents. In terms of the country groups, the EU is listed second. Within the EU, the leading country in terms of the nanotechnology patents is Germany. Within the Asian countries, Japan and Korea are the countries that stand out. The countries group referred to as the BRICS (Brazil, Russia, India, China, and South Africa) countries is rated five in terms of number of patents. Within the EU, the countries producing technology in the field of nanotechnology after Germany are France, the United Kingdom (UK), and the Netherlands. Among the developing countries (DCs), China is the leading country in regards to the number of the nanotechnology patents. In the Figure 2, “Revealed Technological Advantage” in nanotechnologies is presented. Thanks to an index, technological advantages of countries in nanotechnology and the relative change of these advantages are presented for the 1998-2000 and 2008-2010 periods. According to the results of this index, within the meaning of the country groups, OECD countries and the EU countries are protecting their nanotechnology advantage they obtained in 1998 to 2000. BRICS countries seem to have lost their advantage they had in the 1998- 2000 period. On country level, the Asian countries like Singapore and Korea and the EU countries like Ireland, Spain, Norway, Italy, Finland, and the Netherlands increased their nanotechnology advantage, compared to the previous year. The countries like Japan, Israel, Denmark, and China seem to have lost their technological advantages compared to the 1998-2000 period. The USA, Germany, and Russia have protected their technology superiority in terms of nanotechnology. The countries exhibiting most development between the two sub-periods compared are the countries referred to as the Asian Tigers, such as Korea and Singapore, and Spain, Ireland, Belgium, and Finland. Being within the developing countries category, South Africa and Brazil have become the countries that are developing their technological advantage. The technological advantage of these countries that are among the BRICS countries has developed stems from the relative recession of the superiority of the BRICS countries as a whole and from the decrease of technology investments in China and India. On the subject of nanotechnology, having a role of technological superiority depends on imposed national scale state policies on technology based development. Taking these national programs aimed for the nanotechnology area very dedicatedly starting with a budget is extremely important. There are national research programs in the countries that make technological effort on the topic of nanotechnology. According to European Commission strategy document nanotechnology open up the possibility of important developments, trend breaks, for a sustainable European manufacturing future. For this reason nanotechnology is accepted as the key manufacturing technology by policy maker in the EU (European Commission, 2003). Over the last decade the EU has established a strong knowledge base in nanosciences. Several EU countries have dedicated research programs from the mid to late 1990s. Despite the fact that some countries do not have specific nanotechnology initiatives, relevant R&D is often embedded within other programs such as the Framework Program (FP). Within the EU, however, Germany and France implement specific national programs aimed for nanotechnology based technological development. Numerous collaborative research projects and other initiatives have already been supported via the EU Framework Programs. While the fourth and fifth Framework Programs have already funded a good number of nanotechnology projects, only in the sixth one nanotechnology has been identified as one of the major priorities (European Commission, 2004, p. 8). USA is a pioneer country on this technology established a special program called ‘National Nanotechnology Initiative’. Brazil and India as a ‘developing countries’ have special program for nanotechnology as well. R&D programs of several countries were presented in Table 7. In the period when world industrial production has shifted from west to east in order to attain the objective of re-industrialization which has been proclaimed by European Commission in 2011, Europe should base their industrial infrastructure on the new technologies particularly on nanotechnology. Asian Tigers well evaluated opportunities opened by techno-economic paradigm’s process of change in the end of 1970s, which is Fifth Kondratieff’s period of rise. Nowadays industrialized Asian countries like Korea, Taiwan, Singapore and particularly Japan using their opportunity utilization experience value a lot investment in technology based researches. The research facilities of Asian countries in nanotechnology were summarized in Table 8. On the other hand, as the last debt crisis in the EU revealed, based on industrial production between the northern industry decline and southern structural problems are seen as the biggest obstacles in front of the goal of re-industrialization. However, there is no particular united technology program for nanotechnology in the EU. Especially Germany and France, within the EU, promote research activities on the subject of nanotechnol ogy. After these countries, Netherlands, Finland, Belgium, Spain are the countries that invest in nanotechnology.

#### Nanotech k2 Atomically Precise Manufacturing---solves every impact

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1. Introduction Atomically precise manufacturing (APM) is the assembly of materials with atomic precision. APM is also known as molecular assembly or molecular manufacturing, and is a form of molecular [nanotechnology](https://www-sciencedirect-com.offcampus.lib.washington.edu/topics/social-sciences/nanotechnology). APM does not currently exist, and some nanotechnology researchers doubt that it is feasible (e.g., [Smalley, 2001](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0425)), but those who believe it is feasible anticipate a wide range of transformative [societal impacts](https://www-sciencedirect-com.offcampus.lib.washington.edu/topics/social-sciences/societal-impact) (e.g., [Drexler, 2013a](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0120)). The best-case scenarios are incredible, featuring benefits on par with the industrial and computer revolutions. Worst-case scenarios are catastrophic, with harms up to and including human extinction. The uncertain feasibility of APM and the wide range of potential impacts make for a difficult governance challenge. It is hard to know whether APM research and development (R&D) should be encouraged, discouraged, or simply ignored. Thus [Marchant, Sylvester, and Abbott (2008)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0310) argue that traditional risk management approaches cannot be applied to APM. For example, the precautionary principle could suggest that APM R&D should be discouraged until it is clear that APM could not cause [catastrophe](https://www-sciencedirect-com.offcampus.lib.washington.edu/topics/social-sciences/catastrophe), or it could suggest that APM R&D should be encouraged on grounds that it could help prevent other catastrophes. To the extent that prudent risk management demands a full accounting of the risks, and, more generally, that prudent governance demands a full accounting of the relevant factors and issues, it is not readily clear what society should do about APM. In order to bring some clarity to the issue, this paper characterizes the potential societal impacts of APM if it is developed. The paper examines impacts across the wide range of sectors that APM could affect, including the environment, the military, surveillance, computing, space travel, and general material wealth. It seeks to understand what the net impacts on society would be, in particular whether they would be positive or negative, and by how much. The impacts are not quantified with any significant precision, as would be unwarranted for such a complex and uncertain future technology. However, a broad and imprecise analysis can nonetheless shed some light on the impacts of APM. The paper is motivated by the question of whether society should invest in APM R&D. Greater APM R&D investment could bring APM into existence sooner (if APM would have been developed anyway) or with higher probability (if APM might not have otherwise been developed). Whether society should invest in APM R&D depends in part on what the net societal impacts of APM would be. If the net impacts would be negative, then arguably there should be no R&D investment. If net impacts would be positive, then there may be a case for R&D investment, though it would also depend on other factors, including the size of the net impacts, the cost of APM R&D, and the attractiveness of alternative investment opportunities. Thus, while this paper’s analysis can inform APM R&D investment decisions, it cannot give definitive answers to how such decisions should be made. This interest in APM R&D decisions is a reason for the paper’s breadth across the range of APM impacts. One might object that this breadth makes for shallow and thus lackluster research. However, decisions like whether to invest in APM R&D depend on the full breadth of impacts. Thus, there is a need for synthesis across the potential impacts. Such synthesis additionally can identify important points of uncertainty where more narrow research would be of greatest value. This paper considers prior literature on APM impacts (e.g., [Altmann, 2006](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0005); [Drexler, 2013a](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0120); [Freitas, 2006](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0170), [Freitas, 2007](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0175); [Hughes, 2007](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0240); [Timmermans, Zhao, & van den Hoven, 2011](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0440)) and extends this literature with original analysis on each major sector of APM impacts in order to make progress on the question of net societal impacts and key areas of uncertainty. The prior literature on APM was mostly written over 10 years ago, [Drexler (2013a)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0120) being a notable exception. Much has changed since then, both in the world at large and the relevant literature available from other fields. This paper therefore offers important updates from the prior literature, in addition to its original contribution from aggregating a broad spectrum analysis across multiple sectors. More fundamentally, one might object that APM is too speculative and not imminent enough to merit attention. Indeed, while the prospect of APM was central to the establishment of nanotechnology as a research topic, the nanotechnology scientific community has more recently downplayed APM in favor of more modest and immediately achievable forms of nanotechnology ([Selin, 2007](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0405)). Additionally, some ethicists argue that APM does not merit ethical analysis because it displaces attention from analysis of near-term nanotechnology and gives credibility to speculative future scenarios that may not come to be (e.g., [Grunwald, 2010](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0210); [Jones, Whitaker, & King, 2011](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0250); [Nordmann, 2007](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0345); [Nordmann & Rip, 2009](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0340)). One response to these concerns is that APM is perhaps not so speculative after all. As proof of principle, APM already exists in nature in the form of biomolecules such as ribosomes, which “manufacture” protein molecules as per the “instructions” they read from RNA molecules ([Drexler, 1986](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0110); [Freitas & Merkle, 2004](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0155); [Jones, 2004](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0255)). Additionally, rudimentary forms of artificial APM are now possible via scanning tunneling microscopy and atomic force microscopy, which are both capable of accurately analyzing and determining the atomic structure of samples. In fact, scanning tunneling microscopes can even move atoms to precise locations, building elemental atomic structures, an important step towards APM (e.g., [Farrell & Levinson, 1985](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0135); [Gomer, 1986](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0200); [Møller et al., 2017](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0300)). Progress towards APM can also be seen in the 2016 Nobel Prize in Chemistry, which was awarded to Jean-Pierre Sauvage, Sir J. Fraser Stoddart and Bernard L. Feringa for their work on controllable molecules. While these advances fall short of the advanced APM discussed in this paper, they do suggest its feasibility. It still remains possible that APM may never be built, but the possibility should not be dismissed. [Roache (2008)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0370) provides two additional reasons for early attention to speculative future technologies like APM. First, analysis of the merits of R&D can be of particular value while the science and technology remain immature and thus more governable. Once a field of science and technology grows large, it gains inertia in the form of institutional buildup and scientists’ and technologists’ professional investment. This makes it harder to restrict, even if analysis finds it to be dangerous. To be sure, early analysis is also more ambiguous, since important details of the science and technology have not yet been established. This is the well-known Collingridge dilemma between information about a technology and the power to control it ([Collingridge, 1980](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0090)). This underscores the importance of early analysis of the potential impacts of a technology: to the extent that information can be obtained early, it is especially valuable. Second, [Roache (2008)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0370) argues that seemingly unlikely future scenarios can still be worth attention if their potential consequences are large enough. Similarly, [Ćirković (2012)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0085) argues that improbable theories can merit attention when they would have high stakes if they turn out to be true. As noted above and discussed in detail throughout this paper, the potential consequences of APM could be quite large indeed. The combination of APM being potentially feasible, at an early stage of R&D, and potentially highly impactful render it a worthy focus of research, especially for research that is, such as this paper, oriented towards assessing its overall merits. In order to determine the net social impacts of APM, this paper aggregates the net impacts that APM has to various spheres. First, the value that APM has to general society, particularly the social impacts of APM generated abundance. Secondly, how APM affects the environment, most notably how APM can be used in carbon dioxide removal and the fabrication of photovoltaics. Thirdly, the impacts of APM on the military and the manufacturing of new weapons systems will be analyzed. Fourthly, the value of APM to other surveillance technologies like cameras and mass surveillance networks will be discussed. Finally, the impact that APM has on the development of artificial intelligence (AI) as well as space travel will also be looked at in order to determine whether or not APM merits further investment and R&D.

#### APM solves space colonization

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3.6. The value of APM to space travel and colonization (S) There is the potential for APM to contribute to space travel and space [colonization](https://www-sciencedirect-com.offcampus.lib.washington.edu/topics/social-sciences/colonization). Space travel is not an urgent issue for human society in the same sense that (for instance) the environment or military affairs are. However, it is of enormous significance to the long-term fate of human civilization. The opportunities of space travel are quite literally astronomical. Furthermore, space travel remains heavily technology-limited; hence, innovation in the spheres of small, lightweight and highly affordable manufacturing systems could be of astronomical value. Currently, the cost of space travel is enormous, and space missions are correspondingly limited. With existing technology, the cost of bringing materials into space is far too great to rationalize using them for colonization ([McKendree et al., 2005](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0320)). APM could change this. APM could create materials that cost less, weigh less, and are more durable for space travel ([Drexler, 2013a](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0120)). APM could also enhance asteroid mining, which would further lower costs and expand opportunities by enabling space missions to harvest resources in nearby space locations rather than transporting them from Earth. Likewise, APM may enable the creation of energy sources that are more efficient, and more powerful, and better able to withstand the conditions of space travel. This could go a long way towards enabling human travel in outer space. APM could also be of great benefit for what humanity does when it arrives at new planets and other extraterrestrial destinations. One of the more ambitious proposals is to engage in terraforming, which is the creation of livable environments on otherwise inhospitable extraterrestrial planets and other bodies of mass ([Fogg, 1995](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0145), [Fogg, 1998](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0150); [Graham, 2004](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0205); [McKay & Marinova, 2001](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0315)). Terraforming proposals involve approaches such as using photosynthetic organisms to create an oxygen-rich atmosphere ([Friedmann & Ocampo-Friedmann, 1995](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0185); [Hiscox & Thomas, 1995](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0235)), heating polar ice caps, such as the water-and-CO2 ice cap on Mars, to create a greenhouse gas atmosphere to warm the planet ([Mole, 1995](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0330); [Sagan, 1973](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0380); but see [Fogg, 1995](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0145), [Fogg, 1998](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0150)), and putting megascale mirrors in a planet’s orbit to reflect more radiation towards it and warm it ([Birch, 1992](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "bib0050)). For each of these approaches, it is generally assumed that the process would take at least several hundred years to create an adequate environment. An exception is the [Birch (1992)](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0050) proposal for megascale mirrors, which is claimed to require as few as 50 years, but this proposal would require an engineering capacity that is well beyond what is currently available. APM could dramatically reduce the time and costs for each of the methods. APM would achieve this via its ability to make materials of small size that can be programmed to complete complex tasks autonomously ([Drexler, 1986](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908#bib0110)). Likewise, small sized APM terraforming systems would make them easier and less expensive to transport. The overall value of APM to space travel appears to be positive and quite large. APM shows promise to overcome some major technological hurdles that, at present, greatly constrain space travel. However, space travel is arguably less urgent than the threats to human survival that APM could affect, as discussed in Sections [3.2](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "sec0025)–[3.5](https://www-sciencedirect-com.offcampus.lib.washington.edu/science/article/pii/S0016328717301908" \l "sec0040). Indeed, a single one of these catastrophes could harm human civilization so much that it would preclude any further space travel. Nonetheless, value of APM to space travel does offer a reason for APM R&D investment.

#### a] There is a 7-6-time skew after NC, negs get 1 less minute b] They get new 2AR responses to 2NR counter-interps, that makes theory irresolvable because I don’t have a 3NR, and they win every theory debate because I can’t answer their responses c] AC spikes solve there aren’t that many theory issues d] deters 1NC abuse checking because of meta-theory, that means 6 minutes of aff abuse e] infinite abuse doesn’t exist, 1] 7 minutes if finite, 2] resolvability is a pre-req to checking abuse, you cant check abuse on a irresolvable issue f] 1AR theory is drop the arg the rectifies the abusive arg and sets norms—that arg was a waste of time for me g] 1AR theory is yes RVI the 2NR has to overcover it for a chance of closing doors