ARTIC ECONOMICS: A FRAMEWORK FOR ACADEMIC STUDY

WORKING DRAFT FOR DISCUSSION

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Introduction

For most of human existence, much of the Earth's resources – such as clean air and biodiversity – have been considered "free" public goods since they were abundant (not scarce), took little to no effort on the part of humans to produce, and were seemingly infinite. As humans and human activity expanded to cover more and more of the world, it became apparent that these resources, while abundant, were finite. Recently, contemporary economics has expanded the meaning of value to include things not traded in the marketplace such as clean water, biodiversity or natural habitats. Different methodologies are used to estimate the values for market and non-market values so that losses of natural resources and services that provide the foundations for the market system can be included in estimates of value and cost. In the case of emerging economies, unique qualities sometimes make special demands on economic research seeking to value market and non-market values.[1] Some of the most interesting, intriguing, and difficult economic questions arise at the intersection of both market and non-market economics, particularly for previously undeveloped areas undergoing notable change.

Here, we examine economic research related to the Arctic, an area of the globe undergoing some of the most rapid environmental and social changes. Due to its remoteness and extreme conditions, until recently the Arctic has been relatively undeveloped, unsullied, un-traversed, under-populated, and, as a result, relatively understudied as an economic area. The need for consideration and study of Arctic economic issues is increasing, as the Arctic undergoes unprecedented changes in scale and scope during a unique time and place in history. A new ocean is emerging, attracting commercial interests from around the globe in a place where minimal development has occurred in the past. Shorelines once covered by frozen tundra are being uncovered and the terrain impassable once melting has occurred. In addition, climatic disruptions threaten a relatively pristine environment, subjecting the Arctic to increased fragility in the face of increasing human development pressures, as economic opportunities arise.

[1] Different parts of the world and different economic questions have different mixes of these issues. In some developed markets, much of the valuation uses more data from traded goods and services, while for other questions other methods of value are used.

Carefully balanced management of the inherent trade-offs between the natural environment and economic development requires rigorous economic thought, data, and analysis. Yet, economic information and realistic paradigms to inform management decisions by a range of institutions (particularly the Arctic Council) affecting the eight Arctic and subarctic bordering nations, indigenous tribes, and observer nations, are weak and still evolving.[2] With few economic publications and until recently little informative data, citizens, policymakers, and business people have insufficient information or analyses on which to base decisions.

To put the current state of Arctic economic thought into context, we provide the results of a literature and conference presentation review of academic Arctic economic research, providing an annotated bibliography of Arctic Economic research, 1998-2017, conducted in Fall 2017. We also examine funding sources, topics, data used, types of publication, and which authors had economics degrees and which did not.

I. State of Arctic Economic Research: Lawyers, Policy Analysts, Statisticians, Sociologists, or traditional academic economic research?

Previously the Arctic was static – cold, harsh, and unchanging – economic activity was limited or at the subsistence level. The rapid change, along with the still harsh and variable environment, results in new opportunities and new risks. The changing Arctic makes it ripe for studying economics under uncertainty. The large transaction costs (due to battling extreme cold, for example) involved in Arctic exploration and development could inhibit investment or increase barriers to entry and increase monopoly power. These are traditional academic economic issues, so economic research in the Arctic could inform and develop economics as it informs Arctic development.

A review by the National Ocean Economics Program for the past two years (as its team sought economic data on the Arctic to post to its website: www.oceaneconomics.org), indicated a relatively random and sparse set of studies with little data to offer except for The Economy of the North Reports (ECONOR 1-III)[3]. Much of what was found at that time had been authored by government statisticians, policy and security analysts, anthropologists or lawyers. The vast majority of economic studies found earlier focused on particular activities such as fisheries, transportation, tourism, or offshore oil (Buixadé Farré et al., 2014; Goldsmith, Hill, & Hull,

[2] The Arctic Council, a high-level intergovernmental body, created by the 1996 Ottawa Declaration, encourages collaboration, and acts as a forum for the 5 Arctic boundary nations, 3 sub Arctic nations, indigenous tribes and observers.

[3] "The purpose of the ECONOR project provides an updated overview of economy, living conditions and environment in the circumpolar Arctic, with data and knowledge provided by the circumpolar ECONOR network of statisticians and researchers." https://www.ssb.no/en/forskning/energi-og-miljookonomi/baerekraftig-utvikling/econor-the-economy-of-the-north , http://www.cicero.uio.no/en/posts/single/econor-iii-the-economy-of-the-north-2015.

1998; Government of Greenland, 2012; Wilson & Stammler, 2016). Most were limited in geographic and temporal scope, making broader comparisons over time and across regions very difficult. Few looked at an Arctic economy with its own dynamics and interactions with society and the environment.

In our preliminary search, there appeared to be relatively few credentialed economists among most of the authors of these studies, suggesting the absence of fundamental economic thinking and economic methodologies. Instead, the literature primarily contained anecdotal stories, surveys, a few case studies, and applied policy studies that included an economic perspective.[4]

While not exhaustive, our current, more comprehensive and methodical review focused specifically on economists. This review is reasonably representative of what can be found with an internet search for economic studies about the Arctic written in English between 1998 and the present and can provide significant information regarding the state of Arctic economic research. Currently, this review only represents the first layer of publications found (without including an examination of the citations found in each publication listed). We decided to also search conference presentations as well, because in the previous NOEP work, few conferences and journals featured economics about the Arctic.

Research Results

The highlights of our literature and conference presentation search follows with some brief and relevant discussions of each point.

Verifying our concern at the dearth of publications on the Arctic by economists, our search of the literature between 1998 and 2017, produced 43 publications by authors with economics degrees compared to approximately 80 additional publications related to arctic economics by non-economists.

Of those publications by economists, 24 were peer-reviewed journal articles, 6 were reports, mostly by national and international government agencies from Norway, Canada and the United States, and the three ECONOR Reports (which we labeled “books” and which were carried out by international teams representing governments and private research institutes), as well as some other literature which included several feature articles in journals, a magazine article, and working/discussion papers.

The one PEW Foundation- sponsored study was the only foundation source we identified. This funding source data also appear to verify another of our concerns which is that outside funding sources for academic economic research is limited to governments and local university- funded programs. Industry-funding may have been overlooked because we did not go into the grey literature on industry sites, but we did not find it for any of the publications we compiled. Unlike

[4] An annotated bibliography is attached

other disciplines where outside academic funding is available from private foundations and other NGO sources, this field does not appear to have these benefits, which might very well explain why economists are not taking on arctic economic research.

Nine of the studies focused on non-market valuation of ecosystems and natural capital. The next largest segment of our collection represented resource economics, and the others included subsistence economics, regional/development economics, including risk, transportation economics, and political economy. The natural resource studies included climate change, energy, and more general natural resource management topics.

We also noted that there were very few repeat authors over that period, indicating one of several reasons perhaps: 1) a large number of the publications occurred over the past 5 years, and thus follow up studies have not reached publication stages yet; 2) there was not enough activity in the Arctic to warrant a second look; or 3) lack of funding to move forward, especially since working in the Arctic can be expensive.

We found only one conference presentation in 2014 that actually addressed economics specifically, and that focused on ecosystem valuation. Of the other three identified, they were much more general, interspersing rare economic information with societal issues. Again, we wonder if economics has not been seen as relevant to the several Arctic or many economic conferences that are held, or if there just aren't economists to submit proposals for consideration.

It is possible that the paucity could be an indication of slowly expanding interest by economists of a fertile area of study, about to take off. Alternatively, this situation could also be due to lack of interest, lack of awareness, lack of outlets appropriate for the field (or recognized in promotion or tenure) or lack of funding opportunities.

A small survey sample of economists indicates that economic research in general is not widely funded by outside sources in academia (except for student fellowships). This lack of funding is unusual compared to other disciplines and could provide some insight into the small volume of literature by economists that we have found, although it has not inhibited other forms of economic research as there is a thriving economic academic literature. Unlike other areas of economic data, for the Arctic there is a relative lack of the type standardized economic datasets on which most academic economic studies rely. This lack of readily and easily available data suggests travel to find or collect data may be necessary. However, given the remote and harsh nature of the Arctic, research travel is expensive and may not be affordable for research funded only from university budgets. As a result, economists wanting to study the Arctic may need to undertake the same search for funding as do other natural and social sciences. While governments, industry, and advocacy groups have ready sources of internal funding, such external funding is critical for academics, because funding drives research. Unfortunately, there has been a dearth of Arctic economic funding, since most funding targets the natural sciences and a notably lower amount funds research on anthropology of indigenous cultures and

international governance. Although economics is integral to topically-funded Arctic areas of social science such as climate change, indigenous economies, cultures, etc., economics of the Arctic has been generally overlooked.

Below, we address why and how economics can and should become a larger part of the conversation about the Arctic through literature, at conferences and in the policy arena. Since economics is often the foundation for the aforementioned disciplines, integral to these discussions is identifying links among economics, governance, policy, and ecological systems in the Arctic as a means to deepen and broaden an economic research agenda for this complex region of the world.

II Why the Arctic is different – A Multiplicity of Interests, Environments and Nations in a Remote, Hostile, Rapidly Changing Environment

> "One thing does seem certain, though. Whether the Arctic Ocean's awakening is for good, or ill, or both, it is unstoppable. That makes understanding it, and anticipating its effects, essential."[5]

The changing Arctic sea and land area may be the last new opening of underexplored (and unexploited) geography on the Earth's surface to substantial economic activity (Bert, 2012; IPCC Group II, 2007 to current reports). Perhaps the last example of such an opening that caused large change in global economics was the opening of the North American continent to the economic activities of European nations 400 years ago (Lovecraft and Eicken, 2016)[6]. The opening of the New World was mostly caused by human expansion, while the environment stayed relatively constant, the warming of temperatures and changes in snow and ice cover in the Arctic will cause changes in the type and kind of economic activity possible. As a result, the Arctic's incomparably rapid rate of environmental change due to shifts in climate patterns and increased ice melt make the opening of the Arctic unlike the gradual changes that occurred during the opening of the New World. Furthermore, the variance in changes to the climate regime and weather patterns at different scales will add notable uncertainty to economic undertakings. The melting of the Arctic sea ice is akin to the opening of an entirely new ocean.

Change is occurring throughout the Arctic. Economic activities (local and commercial) are becoming more difficult on land as permafrost thaws and the seasonal duration of travel on frozen ground diminishes. The Arctic is resource-rich and an important part of the biodiversity and global ecosystem. It is also mineral-rich, with greater access being unveiled as the melting continues. The economic opportunities for investment as well as the risks faced in this dynamic polar location are of interest to many economic actors (e.g. corporate CEOs, national

[5] The Economist, "The Arctic Ocean Awakening" Feb 12, 2015

[6] Prof. Amy Lovecraft, communication, October 4, 2016.

governments, and tribal corporations). The Arctic is also home to a sparse human population of about four million people throughout the Arctic nations, who have a natural interest in new economic development which could provide new opportunities for wealth, or destroy their current socio-economic equilibrium, or both. A changing Arctic presents an enormous challenge for policymakers and economic decision-makers attempting to balance economic development, safety, equity regarding indigenous cultures, and ecological issues in a formerly inaccessible area of ocean becoming available *de novo*.

Studying economic issues in the Arctic also requires a knowledge of ongoing social-environmental differences. The Arctic crosses many international borders and thus affects a variety of national, regional, and local economies in different jurisdictions, resulting in different rules (and languages). While providing opportunities for cross-sectional results, these differences could also act as a barrier, or a transaction cost of doing business, or to Arctic economic research.

Opportunities abound, however, and not just for resource extraction. Transportation and shipping may result in the connection of Europe and Asia without going through the Suez Canal, the Middle East, and the South Indian Ocean, resulting in notable cost savings. Of course, in the near term such a transit has its own risks, both natural (from sea ice) and political. As the Northern Passage opens, some of the transportation connecting two major economic powerhouses (Europe and China/Japan/Korea) will need to travel through or near Russian waters, but within 30 years it is projected that sea ice will melt sufficiently that direct routes over the North Pole may be possible (Bekkers, Francois, & Rojas-romagosa, 2015; Østreng et al., 2013).

With relatively low economic development in this region to date, increased economic activity in the Arctic and sub-Arctic will require nations and corporations to work together at different scales. Academic economic work could help develop the framework for a global model for a Sustainable Blue Economy for the Arctic Ocean and a Sustainable land economy for the thawing tundra.

An important academic question is *whether new models are needed for the Arctic, and how applicable are models developed for more southern climates*. While people may act similarly under similar economic incentives around the globe, economics has also demonstrated that regulations, risks and transaction costs, resource accessibility, and culture can also affect economic behavior. To the extent that issues in the Arctic are similar to other remote areas, economic activity may be comparable. However, the rapidly changing nature of the bio-geophysical environment in the Arctic, along with the harsh conditions, could make Arctic economic activities in type, if not in kind, markedly different from economic activity in more temperate climes (Lovecraft, 2013, CAFF, 2015). As a result, the unique issues related to the Arctic and the relative newness of the modernizing Arctic Economy suggest that there are not past models or many benchmarks to use for this unique area.

Notable situational differences result in distinct differences in economic activity in the Arctic. For example, consider natural resource economics: oil extraction in the Arctic as an economic activity is notably different from oil extraction in North Dakota or far off shore Louisiana because of the great uncertainties and high risks involved with severe climatic conditions (Eurasia Group, 2013; Henderson & Loe, 2014). The recent withdrawal of Shell and other major oil companies from the Arctic suggest that the difficulties encountered from unpredictable weather, harsh conditions, and risks from uncertain regulations could not be overcome. Likewise, diamond extraction in the Canadian Arctic is notably different as an economic activity from the diamond mines in Kimberly, South Africa, or Kimberly, Australia due to the high risks and uncertainties stemming from difficulties in building the infrastructure for transportation and energy, among other prerequisites (Beach et al., 2012). Recently, the withdrawal of proposals for an American and a Canadian deep-water port are indications of lack of financial security in the face of risks.

The unique interplay of nature and climate change with economic activity is felt more acutely in the Arctic than other areas if for no other reason than the rate of changes underway and the historic degree of uncertainty. For example, the dependence of many households across the Arctic on mixed subsistence livelihoods directly links people to both natural systems and the cash economy (Aslaksen et al., 2017; Wolfe, 2004). Also, the intermittent and changing presence of cold and ice clearly make a difference for transportation (Sturm et al., 2017). The presence of ever-shifting ice often makes trans-Arctic shipping either difficult or impossible, but this will be changing over the next 20-30 years. Lastly, the behavior of the insurance industry under this uncertainty will dictate the pace and price of many of these opportunities, especially the underlying need for infrastructure, currently a limitation to development. Insurers currently view most major infrastructure projects, such as ports for large ships transiting the region and major mining operations dependent on shipping for markets, with hesitation to cover these costly enterprises until the risks are either better understood over time, or actually decline because of more certainty.

Broadening the sphere of economic concerns, ripe for study, are the governance structures and priorities emanating from treaties, agreements and the Arctic Council, created in 1996,[7]that directly affect the economy of the Arctic that both facilitate and constrain economic activity. These have evolved and shifted over the years from mostly a security focus in the 70s and 80s among three nations,[8] to an ever-changing set of priorities and legal structures over the decades, to the current Arctic, a region that has become a focus of global attention. Economic and social priorities have shifted between sustainable development and managed development without considerations of environmental losses, where the latter has mostly overshadowed the former. The Arctic Ocean, as it opens up, has taken “center stage.” Nations, external to the Arctic in Europe and Asia, now want a seat at the table along with the five Arctic boundary nations, the

[7] The 1996 Ottawa Declaration
[8] The US, Russia and Canada

three Sub-Arctic ones and the indigenous tribes, to decide its fate. It has indeed become a place of "High Politics"[9].

"There is no escaping the fact that the rising pressure to develop the Arctic's resources is driven by global economic imperatives instead of a quest for socioecological resilience within the Arctic itself."[10]….. "What impacts will these developments have on the well-being of both the Arctic's human inhabitants and the region's sensitive ecosystems? Will developments in the Arctic have global consequences?" More specifically, what steps are needed to ensure that the Arctic remains a zone of peace and strong resilience for the region's socioecological systems?[11]

The big question is *how will the rising interest to develop Arctic resources influence and be influenced by global policies and politics, and to what extent will the fragile and important environment play a role in the interplay of economic strategies and governance mechanisms*?

III. The "Arctic Blue Economy"

As environmental issues permeate global politics, the economic importance of coasts and oceans as drivers and recipients of climate impacts grows. Many nations now view oceans as the next growth engine. Both in the Arctic and elsewhere, the introduction of new economic activities along the shoreline and in the ocean has caused the desire for more sustainable strategies to displace "business as usual" for many corporate and national policies. "The potential of our coasts and ocean to meet sustainable development needs is immense. And, if they can be maintained in and/or restored to a healthy and productive state, the ocean will play an even more important role in humanity's future. In many ways, the coasts and ocean are the final on-ramp to merge onto our road to sustainable development."[12] This new importance of oceans has given rise to the idea of a "Blue Economy". "Blue Economy" is still interpreted broadly, but the emerging consensus appears to be one of an ocean and coastal economy that recognizes the importance of healthy ecosystems to support a healthy economy.

The snow-covered land along the coasts in the Arctic that sustain life and deeply affect the ocean, might be referred to as the Blue Coastal Economy. Snow melt as well as ice melt is causing hardship and opportunities. These lands must also be part of a discussion, as well as the entire Arctic and sub-Arctic regions. Since the emerging ocean is the central anchor for the Arctic region, it may be important to consider applying the Blue Economy framework to economic and management considerations.

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[9] Oran Young, "Arctic Politics in an Era of Global Change" Fall/Winter 2012 • volume xix, issue 1 "Brown Journal of World Affairs, 2012.

[10] Ibid.
[11] Ibid.
[12] Ibid.

Due to its historic inaccessibility, the Arctic Ocean and its coastal regions are relatively pristine, with mostly low levels of economic pressures, although fisheries and mining play a significant role in the current economy. It is apparent from both climate observations and climate science projections, however, that the historical inaccessibility that has protected Arctic biodiversity is rapidly diminishing, providing not only opportunities for economic activity, but also opportunities for irreversible ecological degradation (Bekkers et al., 2015; Emmerson & Lahn, 2012). It is clear that ice melt in the Arctic Ocean will open up access to many new opportunities, while the melting tundra along the coasts and inland will block access because ice covered roads will and are becoming soft and impassable and will require major infrastructure investments. Recent changes in US policies portend the opening of portions of the Arctic to economic development, particularly allowing expanded oil exploration[13] in the Arctic Ocean. Sustainable management of the region will not be easy given the wide diversity of perspectives from the many nations bordering, and already using or planning to exploit Arctic resources, and their intersection with indigenous and other local communities which are already finding it difficult to sustain their cultures.

Data on the ecology, geophysics, and chemistry of the Arctic are plentiful and natural science research in these areas is relatively well funded. Understanding the emerging economy of the area and its impacts on people and nature, however, is scarce.

Fortunately, there is an extensive literature on marine and coastal sciences (natural) that has developed over more than a century and a half; many journals and conferences feature this work. In addition, there is a modest literature on governance and social and economic factors of coasts and oceans that had its beginnings in the early 1970s. Almost 50 years ago, the Ford Foundation awarded large grants for two marine policy centers at The Scripps Institution of Oceanography in La Jolla California, and the Woods Hole Oceanographic institution on Cape Cod in Massachusetts, the two foremost oceanographic institutions in the US. These grants mark the beginning of a new field of study, Marine Policy, which has evolved over the decades. At least half a dozen journals and as many conferences now feature this work as well as some interdisciplinary conferences. The evolution of Marine Policy studies during the last half century has occurred in fits and starts, depending heavily on government funding and thus on the propensities of administrations, with miniscule funding compared to the natural sciences.

Even so, while there are now more than 35 foundations that feature funding of marine research, most of the money goes for natural sciences and of those small awards for the social sciences approximately 85% has gone toward fisheries research, leaving an insignificant amount of money for all the rest of the issues related to coasts and oceans including climate-related ones. However, the social sciences were late comers, and have suffered underfunding since inception.

[13] https://www.washingtonpost.com/news/energy-environment/wp/2017/04/28/trump-signs-executive-order-to-expand-offshore-drilling-and-analyze-marine-sanctuaries-oil-and-gas-potential/?utm_term=.b4425366802d

Unfortunately, there is yet another similarity between coastal and ocean research and Arctic research, as one particular field of social sciences is almost totally absent from both: economics. Almost twenty years ago, in 1999, NOAA seeded an ocean economics project, one of 10 Presidential mandates issued by President Bill Clinton during "The International Year of the Oceans" in 1998. This was the first visible recognition that economics was important to understanding the value of the oceans. From that mandate, The National Ocean Economics Program was founded in 1999 and continues to this day, despite the lack of available funding for ocean and coastal economics.

This brief history of the evolution of the field of marine policy is important as context for understanding the current state of what could be perceived as a subset, Arctic social sciences, and particularly Arctic economics, because there are apparently so few economists who do research on this region. It is unclear whether the low attention level to Arctic economic activity is a function of lack of interest, expertise, money, importance, or journal outlets, or a combination of all of these.

Yet the Arctic is changing, and economic activity is increasing and expected to increase further as Arctic ice melts further. Hence the question arises, how can economic research on the Arctic leverage and/or learn from the marine policy experience? Following the trails of research on the Blue Economy, and the possibilities and limitations imposed by governance, national and international policies, and the rapidly changing environment would evoke the necessity for interdisciplinary research that includes economics. Might this research strategy draw attention and accompanying funding and ultimately produce a revolution in management for the Arctic?

IV Economic Perspectives on the Arctic

There are few economists who do research on the Arctic and until recently the data were scattered and unusable. The recent ECONOR 15 Update report partially fills this large hole, in that it provides some sources of reliable, consistent economic data from which to create time series, and thus the foundations for theories or identification of trends in this unique and rapidly changing region. Yet there is so much more data that is missing.

These fields of economics are among those that should be relevant to any discussion of the Arctic economy:

1. **Natural Resource Economics** – The rich natural assets throughout the area, such as the extraordinary living marine life and ecological systems there, as well as the extensive array of minerals, provide unique commercial opportunities and possibilities for economic development (Glomsrød & Aslaksen, 2009). At the same time, some of these opportunities may face trade-offs from one natural resource to another. Understanding the Arctic economy merits greater understanding of risks, trade-offs and value, especially since many of the resources are being sought by enterprises that may see development from a less balanced

perspective. Natural capital needs valuation as much as human and physical capital for balanced and reasonable trade-offs to be made and robust decisions to occur.

2. **Market and Regional Economics** – The significant interests of the commercial and industrial sectors in developing new projects in the Arctic as the ice melts, under unusually uncertain circumstances with high risks and minimal governance institutions, provide fertile ground for extensive economic and interdisciplinary scrutiny. Insurers and other essential support services that enable these enterprises will need to have strong economic incentives, based on hard evidence to make their decisions.

3. **Subsistence/Local Economics** – The relatively large number of indigenous tribes in the Arctic provides an unusual climate for economic development. The desire to sustain subsistence economies by some groups, others advocating for commercial developments to provide jobs and improve their local economies, and the forces of nature that are threatening the lands of some of these indigenous peoples through erosion and flooding, natural resources depletion, etc., pose an enormous challenge not only for tribal governance but for those concerned about the economies and the other transitions that are underway (Aslaksen et al., 2006; Kruse, 2011; Wolfe, 2004). While this appears to be a fertile area for economics, it seems that it has been overlooked by most economists to date and focused on more by anthropologists.

4. **Comparative Economics and Transaction Costs** – How does economic activity in the Arctic compare and contrast with economic activity elsewhere? The basic question of what, if anything, makes economic activity in the Arctic different from economic activity elsewhere should be explored and examined:

    - Are the differences just in kind, or of a notably different type?

    - Is it merely remoteness, so that economic activity in the Arctic is functionally like economic activity in other remote (but not cold) parts of the world?
    - Is it transaction costs and frictions more broadly?
    - Do the interplay of climate change and economic activity, and the rapid speed of change affect economic activity in the Arctic in a different way from other areas?
    - How can/should future risk be assessed in the absence of an economic history beyond subsistence uses?
    - Is Arctic economic "uniqueness" due to a single factor or the combination of factors – remoteness, costs, risks cold, rapid climate variance and the plight of the multitude of indigenous tribes – in the Arctic which might cause sufficient differences in economic activity in non-Arctic locations elsewhere?

Ultimately, the question remains whether Arctic issues and costs are merely more expensive propositions of economic issues elsewhere, or whether there are issues such as harsh conditions and high risk related to economic activity in the Arctic that are notably different from the rest of the world. In addition, natural science explanations, such as the role of cold, and the phase change of water (from ice/snow to water), should be examined. The answer may lie in the fact that the Arctic is undergoing both transformative and additive changes. By adding together so many qualities of the Arctic, it may signal that the location in fact is qualitatively and quantitatively different from other locations.

5. **International Economics** – The Arctic Ocean warrants a deep look at international economic considerations. It is bounded by five nations, the subarctic includes three more nations that sit on the Arctic Council as delegates, and the ocean is used by a growing number of countries. There are notable differences from the international economic issues in other regions especially because the jurisdictional nature of the Arctic is unbalanced with the large national boundary of Russia dominating the shoreline of the ocean. Several extended boundary claims under legal consideration pose potential conflicts, especially as in the near term when the ice extent may force trans-Arctic shipping to transit mostly in Russian territorial waters. These are serious and unique economic and geopolitical questions that will affect economic activity.

   These issues give rise to important questions, including:

   - *How can other multi-national seas provide relevant experience and guidance?*

   - *Does the Arctic provide unique opportunities for interesting comparisons with other areas that are yet to be exploited such as the Himalayas?*

6. **Finance** – Most economic activities are limited by the ability to acquire the funds to develop and/or use the rich trove of resources in the Arctic. Without doubt, uncertainties of predicting climate changes and degrees of locations of ice melt affect insurers, banks and others who influence funding for development, cash flows for the future, and the dynamics of project and systematic risk. Exploring the question of how this differs for the Arctic relative to other areas can possibly demonstrate unique differences. How the world of finance looks at this area, perhaps creating new institutions for development, in a world with emerging governance structures, etc. merits investigation.

In addition, these fertile areas for study may call for new thinking that could lead to new methodologies. Many of these areas could be combined, resulting in interesting intra- and interdisciplinary research. For example, an examination of a sustainable Arctic Economy might mesh regional economic thinking with natural resource and ecological economic thinking, and

possibly with other anthropological and natural science areas as well. Is there a process and structure that could be created to integrate these normally separate areas of economics, possibly in conjunction with the natural sciences?

Compared to many other parts of the world, the Arctic is warming more rapidly, which presses changes on a suite of complex socio-economic and social-environmental systems. Given the rapidity of this change, it may be important that the field of economics become more aggressive about documenting and analyzing the uncertain economy that is emerging. Prior to our going to other celestial bodies, this may be one of the last few times that an entire large area opens up to human economic endeavors, and so *it is reasonable to ask whether rigorous economic analysis should be both part of the planning process as well as documenting and testing hypotheses as these changes occur.*

A related question is *whether these changes and well-formed economic hypotheses might also allow us to shed light on larger economic questions. For example, does the rapid pace of change and larger variance in the Arctic allow economics to answer some larger questions regarding human economic endeavors with a shorter time series than it might take in lower latitudes, or are the questions invariant to the pace and type of change?*

Key Questions that need to be asked: Who will address them?

Based on the literature review, the academic literature on Arctic Economics appears sparse compared to literature from other disciplines. While in the past there was a dearth of traditional economic activity in the Arctic (beyond the native and subsistence economics), the natural system changes in the Arctic strongly suggest that there will be changes in the Arctic economic systems as well, as formerly remote and unavailable areas open as the sea ice retreats.

As we look forward, there are many key questions that arise when thinking about the state of study of Arctic Economics.

Below, we list a few questions that might affect the development of Arctic Economics as an academic sub-field:

1) *What is the quality and quantity of peer-reviewed Arctic economic studies available in the literature and what questions have they addressed?*

2) *What additional questions should be asked that have not thus far been addressed by economists that will need to be answered now and in the next decades?*
   a) *Is there a natural priority to these questions, and if so, what is it?*

3) *What are the most critical Arctic policy issues that require economic information?*

4) *What is the significance of the data compiled and published by the ECONOR III, 2015 Update report and how can these data be optimized to serve both researchers and policy makers?*

5) *What are the current data gaps and future data needs?*

6) *What are the advantages to storing and delivering data to the public over the Internet on a single site?*

7) *Who are the people, institutions, etc. who will study these questions?*
   a) *Who will be the beneficiaries of such studies?*
   b) *What is the natural audience of such studies?*

8) *What structures, institutions and cultures are limiting factors that inhibit more economists from studying the Arctic?*

9) *What are the venues (academic, other) for publishing Arctic Economic work?*

10) *What conferences should start having sessions on Arctic Economics?*
   a) *What is needed to enable these sessions to happen?*

11) *Who will fund this work?*

12) *Who are the appropriate audiences and how will the results be communicated to these appropriate audiences?*
   a) *What are the appropriate dissemination paths for these studies?*
   b) *How will decision-makers (governments, policy makers, businesses) become informed?*

Conclusion

The pace of change and status of the Arctic as an emerging frontier calls for the discipline of economics to focus more effectively and with greater care in relation to the meaning of "economics" in the region, as do other fields such as oceanography, geophysics, ecology, and anthropology.

Economists, corporations, investors, local governments, and policymakers at all levels need the most accurate and timely information about these changes, and the most appropriate economic frameworks through which to evaluate these changes and the new opportunities and trade-offs they bring.

It is important to:

1) understand the linkages between environmental and economic changes;

2) have baselines to understand scope, scale, and rates of economic changes;

3) ground decisions in sound, evidence-based data; and

4) develop frameworks that consider and allow for Arctic sustainability and address equity concerns.

Since environmental impacts are already being felt socially and politically throughout the Arctic and subarctic, we ask if now is the time to develop this research, and if not now, when?