DISSERTATION

THREE ESSAYS IN SOCIAL ECONOMICS: SOCIAL PERSPECTIVES ON INTERNATIONAL ENVIRONMENTAL AGREEMENTS AND SPACE TOURISM

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ABSTRACT

THREE ESSAYS IN SOCIAL ECONOMICS: SOCIAL PERSPECTIVES OF INTERNATIONAL ENVIRONMENTAL AGREEMENTS AND SPACE TOURISM

The social realm is an important locus of insight to understand economic behavior. Social economics recognizes that behavior is a "result of complex social interactions with ethical consequences" (ASE[1], 2023), that not only informs theory, but also broadens the available policy space. Most importantly, it allows for ethical values to enter the study of economics, giving space for considerations such as equity and justice that are inextricably interrelated to economic phenomena and policy outcomes.

One area of study where this interdependence is especially pertinent is in the literature exploring country behavior in global environmental negotiations. The transboundary nature of many environmental issues, especially climate change, warrants international cooperation in the form of international environmental agreements (IEAs). In the field of economics, theoretical models of IEA formation (mostly in the for of non-cooperative game theory) suggest that IEAs should be few and far between. However, the post WWII era, especially the last few decades of the 20th Century, have seen a rapid increase in the number of IEAs ratified and entered into force. In the 1990s alone, over 300 IEAs were signed, and since the turn of the twenty-first century, almost 400 new IEAs have been signed[2].

[1] Association for Social Economics (ASE). (2023). About. *The Association for Social Economics.* Retrieved October 7, 2023 from https://socialeconomics.org/about/

[2] Mitchell, R. B. (2018). International Environmental Agreements (IEA) Database Project (Version 2018.1). [Data set]. Retrieved February 17, 2019 from http://iea.uoregon.edu/ . Calculations by author.

Empirical work has emerged looking to explain why countries sign and ratify IEAs. Chapter 1 expands and contributes to this body of work by taking a closer look at how international ties, in the form of intergovernmental organization membership, formal alliances, and diplomatic exchanges, affect countries' propensity to sign an IEA and by exploring cross-disciplinary theories on the role of socialization in influencing this behavior. Data is compiled from Mitchell's IEA Database along with Correlates of War Project data on the abovementioned international relations metrics. A negative binomial model is fit to a panel of the count of IEA signatures from 151 countries over the years 1960-2005. Results suggest that global relations matter in countries' IEA signature behavior—with intergovernmental organization membership and diplomatic exchanges increasing the number of signatures, while formal (military) alliances have a negative effect.

Looking to inform the theoretical side of the economics of IEAs, Chapter 2 takes a feminist epistemological perspective to critique and expand this area of study. Feminist philosophy, namely feminist standpoint epistemology, points to the epistemic effects of social stratification and highlights the influence of Western, masculinist ideals on the economic study of IEAs and the policy space that it informs. It points to the possible role of geopolitical power relations that favor the global North and their economic and environmental ideologies. As a poignant and timely example, the history of the United Nations Framework Convention on Climate Change is used to demonstrate these points. To conclude and move us "toward a feminist foundation of the economics of IEAs," this chapter explores how feminist philosophy and economics offers a more expansive framework to understand country behavior and power relations in this context. Such approaches allow for salient ethical considerations, like equity and justice, that are increasingly recognized as inextricable from environmental policymaking today.

The final chapter pivots from the discussion of IEAs toward consideration of expanded worldviews associated with the planet as our environment. This chapter explores a unique set of data from the newly established space tourism market. Specifically, it seeks to learn more about potential positive externalities associated with a changed worldview that astronauts reportedly experience. Using "citizen astronaut" data from nonprofit Space for Humanity's 2019 application round for a sponsored trip to space, this chapter employs a probit model to explore the influence of demographics on the propensity for citizen astronauts to choose environmental aims as their focus for humanitarian work. It is shown that there are complex correlations between region, age, and gender that affect these altruistic aims.

The topics explored in this dissertation work together to exemplify the relevance of the social sphere in economics studies. By empirically establishing that global social relations matter (Chapter 1), to exploring how feminist philosophy helps to understand these relationships (Chapter 2), and lastly, by examining prosocial motivations in the space tourism market (Chapter 3), this dissertation represents a key contribution to their respective literatures and to social economics as whole.

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> "'The social' tends to be perceived by philosophers and scientists as a source of obstacles and problems rather than as a generator of resources and promising new pathways." (Harding, 2015, p.4)

The social realm is an important locus of insight to understand economic behavior. Social economics recognizes that behavior is a "result of complex social interactions with ethical consequences" (ASE[3], 2023), that not only informs theory, but also broadens the available policy space. Most importantly, it allows for ethical values to enter the study of economics, giving space for considerations such as equity and justice that are inextricably interrelated to economic phenomena and policy outcomes.

To minimize the influence of society and social behavior on economic agents can be remiss as economic agents are social beings and the market is just as much a space of social interaction as any other. This dissertation endeavors to explore how social forces are influential in economic phenomena. It is a basic tenet of this paper, then, that the social sphere is relevant to understand economics. Indeed, as the leading quote suggests, this paper sees 'the social' - and its study and inclusion in economic study - as not only a source of deeper understanding, but also a foundation for a widening of the policy space.

This dissertation takes on examining how the social sphere might enrich our understanding of international environmental cooperation (in Chapters 1 and 2) and tastes in an emerging market (Chapter 3). The first chapter contributes to the empirical literature on international environmental cooperation. Examining 'the social' at the country level, it explores

[3] Association for Social Economics (ASE). (2023). About. *The Association for Social Economics.* Retrieved October 7, 2023 from https://socialeconomics.org/about/

how global social (relational) determinants affect the likelihood of countries signing an international environmental agreement. Here, by understanding economic agents as embedded and interacting within a social complex, it is possible to capture relevant components of country behavior missed in previous studies.

The second chapter employs the feminist epistemological perspective to incorporate 'the social' in the theoretical literature on international environmental cooperation. Taking a critical eye of the body of literature in the economics of IEAs, this paper argues that the predominance of neoclassical thought in this area has limited the efficacy of the field and even limited the available policies being negotiated. It offers the feminist perspective as a richer source of understanding and policy options. The third chapter seeks to incorporate 'the social' by exploring how prosocial and environmental motivations appear in the emerging market for space tourism. Taking an empirical approach, it seeks to characterize these motivations for participating as a consumer of commercial spaceflight.

The three chapters of this dissertation work together to demonstrate the importance of social considerations in areas where mainstream economics has traditionally minimized them. This is not to *prove* that 'the social' matters but instead to offer examples of how its inclusion enriches our understanding of economic agents' behavior and expands the possibilities for effective policies and pathways forward. The first chapter enriches the understanding of country behaviors in environmental negotiations. By including relational characteristics of countries (and finding that they are relevant to decision-making) it points to the importance of understanding economic agents as embedded in society and furthers the econometric literature specifically pertaining to IEA negotiations. The second chapter contributes to the ever-growing feminist literature in economics and to the economics of IEAs. By working toward a feminist

foundation of the economics of IEAs, it provides a theoretical basis for studies like the first chapter and more. The third chapter contributes to the understanding of prosocial tourism motivations as well as the new literature on the economics of space. Finally, a short section highlighting findings, policy implications, and future research concludes.

Chapter 1 – Relational Determinants of International Environmental Agreements: A panel Analysis[4]

1.1 Introduction

We live in a new geological epoch—the Anthropocene—defined by humanity's profound impact on the Earth (Smith & Zeder, 2013). This impact goes far beyond pollution and resource use. Indeed, human activity contributes to fundamental changes in the Earth system (IPCC, 2014). As the consequences of this become ever more systemic, chaotic, and widespread, boundaries such as national borders and academic disciplines make effective solutions even more difficult. Our most pressing environmental issues transcend standard boundaries. The solutions, too, must do so. Enter the "international environmental agreement" (IEA), a tool in recognition of "Our Common Future" (World Commission on Environment and Development, 1987) and the focus of this paper.

As defined by Mitchell (2003, p. 432), an IEA is "an intergovernmental document intended as legally binding, with a primary stated purpose of preventing or managing human impacts on natural resources." The history of environmental treaty making is lengthy and starts with the first documented IEA in 1885. However, it wasn't until the twentieth century, with waves of environmental agreements following the Second World War and the creation of the United Nations Environment Programme at the 1972 Stockholm Conference, that environmental cooperation burgeoned, tackling not only locally shared resources, but global environmental issues like ozone depletion and climate change (see Figure 1-1). In the 1990s alone, over 300

[4] This paper has benefited greatly from comments from Anita Pena and Steve Pressman as well as participants in a conference on "Putting the Social Back into Economics" at the 16th annual Association of Social Economics World Congress hosted by Colorado State University in June 2018, including Anders Fremstad and Pierre Lacour. I would also like to thank Ronald B. Mitchell for sharing the most recent data.

IEAs were signed, and since the turn of the twenty-first century, almost 400 new IEAs have been signed (Mitchell, 2008).

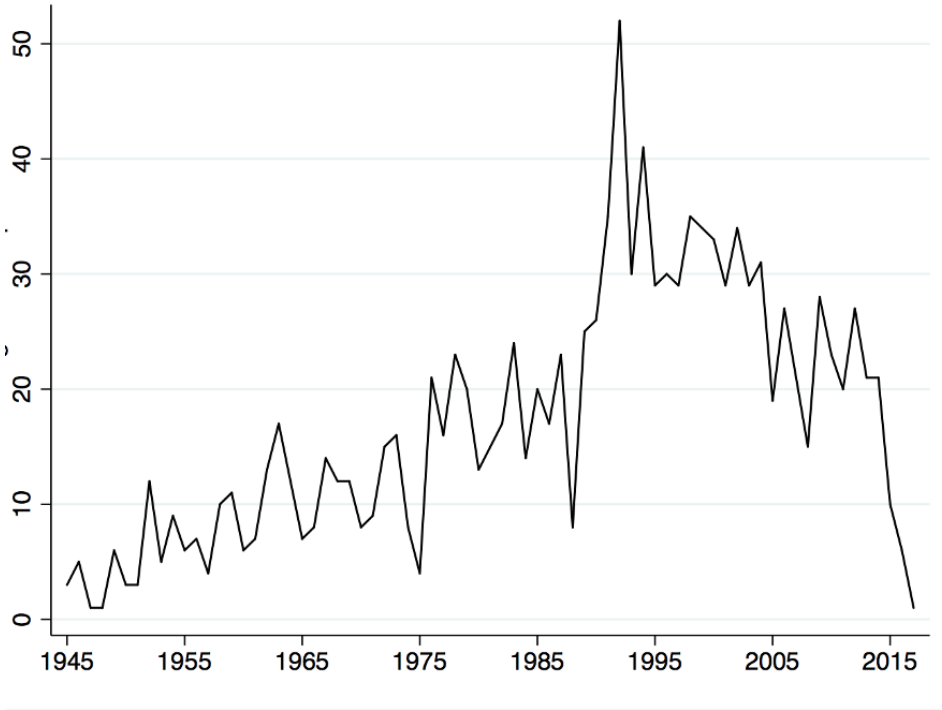

Figure 1-1: Multilateral IEAS per year, 1945-2015
Note: Data from Mitchell (2018). Calculations by author.

The academic study of IEAS has also proliferated, mostly in political science, international law, and economics. From negotiation to outcome, research on IEAs seeks to understand how and why IEAs are formed, as well as their efficacy in achieving the shared environmental objectives they address. This paper focuses on the negotiation and formation stage, in particular, the question of what motivates countries to sign IEAs.

Studying what influences countries to sign an environmental treaty is not new. Researchers have studied the problem, through both theoretical modeling and empirical analysis, since at least the 1990s (see Congleton, 1992). However, research, especially within the field of economics, has largely ignored the role of geopolitics: how a country's standing, history, and

relations within the global community affect its propensity to sign an IEA. This paper brings focus to geopolitics and global relations.

In this paper, I ask, "Does a country's integration into the global community influence its signature behavior?" Section 1.2 outlines the existing literature and knowledge gap I wish to close. Section 1.3 motivates the paper. Section 1.4 performs an empirical analysis on a panel of 151 countries for the years 1960-2005 that analyzes the influence of relational characteristics—intergovernmental organizations (IGOs), formal alliances, and diplomacy—on the number of IEAs signed by a country in a given year (Section 1.5 describes the empirical methodology). Results suggest that these relational characteristics *do* play a role in signature behavior (see Section 1.6), although much research remains to be done to understand their influence. Section 1.7 concludes.

1.2 Literature Review

Along with the number of agreements themselves, research into IEAs has proliferated in the past few decades. This research spans many disciplines, many approaches, and many methodologies. Within the discipline of economics, IEAS are most widely research within the environmental and political economics fields. Important contributions have also been made in the fields of international political science and international relations (IR). For my purposes, understanding the approaches of both economics and IR is useful. Accordingly, a look into the theoretical and empirical economics literature, as well as the IR literature, follows.

Theoretical Economics of IEAs

Explorations of IEAS in the economics literature are found in environmental and political economics (PE). While the environmental approach studies the nature of transboundary

pollution problems and their solutions, PE studies the political context in which both the environmental problems and policy solutions exist. Both fields are relevant to the research here.

As mentioned above, IEAs address the issues of transboundary pollution and resource use (Altamirano-Cabrera et al., 2013). In economics, these issues are conceptualized as either a common-pool resource or a public goods problem. Not surprisingly, most theoretical models of IEAs are game theoretic. A detailed look at the game theory of IEAs is beyond the scope of this paper, but a brief overview is important for understanding IEAs as a subject of study. Finus and Caparrós (2013) provide a useful framework by dividing IEA literature into four categories: (1) agreement stability, (2) cooperative games, (3) dynamic games, and (4) negotiation models.

First, there are models that look at the external and internal stability of voluntary agreements. Given the prevalent use of a two-stage Prisoner's Dilemma in this literature, it's not surprising that noncooperation is the result; thus, treaty formation is shown to be limited. As in the simple Prisoner's Dilemma, rational actors (i.e., nations) choose to defect instead of cooperate. In the context of IEAs, national sovereignty precludes commitment to a Pareto-superior environmental agreement, and free riding on the environmental efforts of others is optimal (see Finus, 2003 for a survey). The cooperative game literature, on the other hand, looks for burden-sharing rules that favor cooperative behavior and deter defection. Konrad and Thum (2018) use an ultimatum game to model negotiations over emissions reductions to study the effect of the Clean Development Mechanism on country incentives. The dynamic approach, which uses cooperative and noncooperative games as well as stability concepts, expands upon the first two approaches by including time and the accumulation of pollution over time (see Calvo & Rubio, 2013).

For the purposes of this chapter, theories that seek to understand the negotiation process itself are relevant. Applying bargaining theory, these approaches seek to understand not only what burden-sharing rules emerge from different bargaining contexts (over a global public good), but also the role of information asymmetry, unilateral commitments, delegation, coalitions, and most importantly here, signature processes in negotiation (see Caparrós 2016). They study how countries interact at the negotiating table, and study relationships.

What stands out about the simple bargaining model, based on the Stahl-Rubinstein noncooperative bargaining model is which agents negotiate to reach an agreement over a shared resource (Rubinstein, 1982), is that the model is optimistic (with the efficient solution reach almost automatically). Extensions of the model, though, are pessimistic. For instance, in Harstad (2016), countries underinvest in green technologies to garner bargaining power prior to negotiations. In the case of asymmetric information, negotiation is delayed in order to gather information about the other parties. Additionally, this body of work shows that coalition building and unilateral actions aren't advantageous to reaching a solution. Furthermore, as Caparrós (2016) points out. These models are limited in their ability to grasp the true complexity of multilateral environmental negotiations like the uncertainty that surrounds most issues IEAs address.

Finally, the PE literature offers a variety of theories specific to how ratification requires involvement by national constituencies (see Wangler et al., 2013). In addition to game theoretic models, voting models have also been used to explain the role of domestic political influences (Roelfsema, 2007). Games are also used, in this context, that incorporate domestic institutions like lobby groups (Haffoudhi, 2005; Klinsky et al., 2016).

The assortment of theories used to understand IEA formation stands in stark contrast to the number of IEAs that have been signed (and continue to be signed). Whether cooperative or not, dynamic or bargaining, these approaches all build upon the key assumption of country rationality (i.e., utility maximization). If anything, social influence on signature decisions goes only as far as a country's voting public and other domestic forces. Therefore, it is no surprise that cooperative behavior is theorized to be scarce. A dissection of this basic economic assumption is beyond the scope of this paper (see Chapter 2). However, the core argument of this chapter is that countries do not make decisions in isolation—that global social relations matter.

Empirical Economics of IEAs

Most significant for this paper is the empirical literature on IEAs. This paper contributes directly to empirical studies of the determinants of IEA signature. PE is where you will find most of the empirical studies of IEAs. Indeed, it makes sense that PE informs these studies as seemingly rational agents often come to inefficient policy decisions. Understanding that political agents are susceptible to influence is key to understanding the positions of countries at the proverbial negotiating table. Accordingly, this literature analyzes both what motivates and what constrains countries (see Wangler et al., 2013 for a complete survey).

Much like the theoretical models, the political economic literature on IEA's focuses on domestic determinants. In short, it takes the stance that national governments are political agents, and political agents are subject to political influence. For the most part, influence comes from domestic political institutions and participants (from constituents, to lobbyists and legislators) as well as from interacting with intergovernmental processes. At the negotiation and ratification stage of IEA formation, then, domestic political pressure is what shapes government

decision makers (Wangler et. al., 2013). Empirical investigations to identify these pressures, consequently, have a predominant focus on domestic influences. Namely, political, economic, and environmental characteristics are the most common determinants found in these studies.

Many different political characteristics have proved important in this literature. For instance, Congleton (1992), a notable early work in the field, studies the correlation between democracy and emissions. Indeed, the importance of democratic institutions and political freedom continues to be established in more recent work (Neumayer, 2002; Fredriksson et al., 2005). Researchers have even gone as far as to study which type of democracies contribute to IEA success, like Fredriksson and Wollschied (2007) who finds that parliamentary democracies lend to better environmental performance. A number of other political determinants of IEA ratification have been researched as well. Fredriksson and colleagues (2005) find that environmental lobbying is influential (also, Fredriksson et al., 2007) and Gleditsch and Sverdrup (2002), the number of domestic environmental groups. Recent work by Spilker and Koubi (2016) also looks into "domestic institutional hurdles" in the realm of national political determinants. Domestic political sway, certainly, has been widely researched in this literature; so too have domestic economic characteristics.

The variety of economic determinants of IEA signature investigated cover trade behavior and composition, national accounts, and competition. For instance, trade openness (Neumayer, 2002) along with trade and investment liberalization (Egger et al., 2011) have been found to be significant. Likewise, Egger et al., found that economic mass (in terms of Gross Domestic Product) is relevant along with membership in the EU. Perrin and Bernauer (2010) also found that trade openness and others' GDP has a positive effect on IEA ratification while population size negatively affects ratification propensity. Lastly, a variety of domestic environmental

characteristics are studied within the literature. Indeed, the logic that domestic environmental quality influences countries' willingness to reduce emissions and ratify IEA's is quite straightforward. Almer and Winkler (2010), for instance, find that countries with higher expected damages from climate change were more likely to sign the Kyoto Protocol. Additionally, many of the abovementioned studies include environmental factors such as carbon emissions per capita and agricultural land (Egger et al., 2011), fossil fuel and chemical exporting (Neumayer, 2002), and oil, coal and gas reserves (Congleton, 1992). Again, the focus remains predominantly on domestic factors.

Political Science Literature

One of the most extensive studies on IEA determinants to date, Roberts' and colleagues (2004), "Who Ratifies Environmental Treaties and Why?[…]", covers these core domestic areas of politics, economics, and environment as well. However, it bridges both the economic literature described above, and the political science literature incorporated in this paper. In seeking to understand the opposing theories in international relations, they run a series of regression analyses that cover each of these domestic categories along with determinants often ignored in the economic literature. Their full model regresses environmental treaty ratification with export diversification (a proxy for colonialism), voice and accountability (domestic political institutions), domestic and international non-governmental organizations (political pressure), ecosystem well-being (Roberts et al., 2004) for 195 countries, for 22 treaties between the years of 1946 and 1994. For sure, international political science plays an important role in the study of IEA's. Following this realization, this paper seeks to integrate some aspects of these studies to not only expand the political economic literature, but also to link it to political science—

somewhere in the realm of international political economy. Thus, a brief review of this literature is in order.

International relations (IR) literature, too, began with a focus on domestic economic, political, and environmental determinants of IEA membership. In terms of IR theory, Roberts et al. (2004) provides a broad overview of the various IR frameworks—which include constructivists, realists, rational choice institutionalists, and world-systems theories—and how they understand IEA state behavior. Constructivists' conception of state behavior is based on the idea of a global social system in which global environmental norms and concerns spread as the global social system does so itself. Indeed, a core tenet of constructivism is that membership in international institutions positively influences IEA ratification. Thus, this approach is similar to the one adopted in this paper.

"Realists" (as they are called in the IR field), on the other hand, argue that power is at the core of nations' international agendas and thus, any participation in an international institution (including IEA's) happens only in the pursuit of power and persuasion. In the context of IEA's, in particular, it holds that powerful states use coercive power only to spread their own environmental policy preferences (Roberts, 2004). The idea of power, too, is incorporated into the analysis in this paper. The IR approach of rational choice institutionalism, which explains voluntary international cooperation as a rational response to collective action problems to increase shared efficiency, shares many similarities to economic theories. Indeed, it conceptualizes IEA membership as a classic prisoner's' dilemma problem as well.

Lastly, there is world systems theory, which takes the world-system itself as the unit of the analysis. There are four pillars of world-systems theory: structural constraints, history and colonialism, material exchange, and global contexts. As Roberts (2004) notes, "realism,

constructivism, and rational choice institutionalism all explain the proximate political reasons for state participation in environmental treaties but leave unanswered the deeper questions of how states came to be in their global positions in the first place" (2004, p. 29). Thus, in this context, the approach looks to pinpoint the structural sources of national preferences and capabilities to better understand states' behavior concerning IEA's.

Scholars in IR have also turned to empirical analysis to test these theories. Just as there are similarities across PE and IR theories, there are many across the determinants chosen in this literature (see Zurn, 1998 for and survey of the emergence of international environmental politics as a study in IR). In fact, around the same time as early papers in political economy of the subject, Roberts (1996) took a world-systems approach and found that poor, highly indebted countries, dependent on few trading partners and with repressive regimes, are the most likely to be non-signatories. Such research has continued into recent years with many commonalities with not only the PE research, but also, within the IR literature itself. In this literature, too, domestic characteristics like trade, polity and natural capital are studied. For example, Elsig and colleagues (2011) find the *new* European democracies, in particular, were more likely to ratify IEA's in the post-Cold War era. And, focusing on treaty design, Koubi et al. (2021) conclude that civil society access and funding mechanisms in IEA's lead to greater likelihood of ratification.

IR literature, though, has been more systematic about incorporating global relations into their analyses. Of particular note is Bernauer et al. (2010), which looks at both internal and external factors affecting ratification. Their empirical model includes a measure of involvement in international organizations, uses trade openness as a measure of integration into the world economy, and, most notably, models "contingent behavior". Namely, they include variables of

how many other countries have ratified a treaty as well as a variable of the percentage of countries in the same geographical region and income group that have already ratified. Additionally, income, polity, power (as measured by population and GDP) and domestic environmental quality are included. Indeed, they conclude that international factors have a stronger effect on cooperative behavior than domestic factors.

1.3 Social Aspects of Global Environmental Cooperation

In examining relational determinants of IEA signature, this paper seeks to understand the role of global, *social* relations. That is, the social influences of nations' IEA signature behavior. Though a full discussion of the extensive literature on cooperation is beyond the scope of this paper, a brief overview is important to understand why such determinants might suggest social relations matter. A discussion of the social aspects of international cooperation, or really any agent which cooperates, can be distilled down to a debate about agency and structure. The "agency-structure" debate runs throughout much of the IR literature (Adler, 2013) and can be seen, as well, in economics in fields like institutional, social, and feminist economics. All the same, the basic division comes down to the oft critiqued assumption in economics (and increasingly, other social sciences) of methodological individualism. The idea is "…that it is necessary to base all accounts of economic interaction on individual behavior" (Arrow, 1994) and further, that individuals' preferences are exogenously determined and fixed. Whereas critics of *homo economicus* (or "rational-agent" models in IR) contend that structure (or institutions, politics, society, etc.) influences agents' choices and, even, that individual preferences can be mutable and endogenous to such structures (Bowles, 1998).

Indeed, much of the game theory covered in Section 1.2 of this paper takes agents' preferences as subjectively determined and fixed. Game theory as a construct for cooperation

theory is found in both economic and political science literatures. This work incorporates the social realm into their analysis via constraints or changes in payoffs (however, preferences remain fixed). These games explore, "under what conditions will cooperation emerge in a world of egoists without central authority?" (Axelrod, 1984, p. 3). When augmented with elements such as asymmetric information or repetition, social elements such as social norms, trust, reciprocity, and reputation play a role in agents' choices. For example, the famous tit-for-tat solution for the repeated Prisoner's Dilemma in Robert Axelrod's tournament (Axelrod & Hamilton, 1984). Such extensions have continued in the theoretical literature on cooperation and in the study of IEA's as well. For example, Lange and Vogt (2001) model IEA formation in a classical Prisoner's Dilemma and include agents' concern for equity, which leads to possible efficient solutions not found in the typical model. Or for instance, Dal Bo' (2002) simulates an infinitely repeated Prisoner's Dilemma in the lab and shows that expectations of continuation of the game lead to higher rates of cooperation.

In economic psychology, experimental, and behavioral economics, social influences are also studied. For example, Biel and Thogersen (2007) study the role of social norms in games as a potential departure from rational choice and argue that context (e.g. how much the game is repeated but also, a particular social domain) influences norm activation to guide agent behavior. An additional example is Belsey and Ghatak's work (2018) that explores the implications of prosocial motivation in agent behavior. Specifically, they study agents in an organization and explore alternative forms of non-pecuniary motivation[5] like commitment to a mission,

[5] Most of the economic models discussed here are based on monetary values of estimable variables and thus, may fail to capture non-monetary benefits and costs of IEA participation fully, if at all. Recent experimental research by Dragone and colleagues (2017) finds that the use of non-monetary mechanisms (sanctions and rewards) leads to more cooperation in groups. Such mechanisms are also present in Ostrom's work on sustainable community management of resources. This work suggests that economic models that rely on strictly monetary measurements could be missing key cooperative mechanisms in the international arena, offering another possible answer to the gap identified in this paper.

conforming to an identity, reputational concerns, status, and altruism. They find similar insights as the famous "warm glow" theory of donation (Andreoni, 1990) in that agents perform prosocial behaviors for egotistical reasons. Lastly, a discussion of cooperation theory is incomplete without mention of the Nobel Prize winning work of Elinor Ostrom[6] on voluntary organization of sustainable resource use (Ostrom, 2000). In these examples (and their larger fields of study), individual egoism is fundamental not only in that it underpins the theoretical models but also, in that it characterizes what is "rational," making prosocial behavior either a departure from rationality or a function of rewards/sanctions to individuals maximizing payoffs.

On the other side of the debate are the structuralists, arguing that agents are, at least in some part, a function of the structures in which they operate. This approach, too, spans the social sciences from sociology to political science to economics. For instance, David John Frank's work in, "The Social Bases of Environmental Treaty Ratification, 1900-1990," makes a strong case for such an approach is postulating that, "at least in the environmental domain, nation-states may be better understood as the constituent parts of a wider world social system, from which they take basic definition and form" (1999, p. 523). Frank's approach holds that nations are not autonomous or independent agents. In actuality, he argues, the culture and norms that dictate international relations are spread within the structure of organizations and agreements. In short, that nations learn their interests in the world stage and as a process of a global social process (Frank, 1999).

In economic literature, Bowles' (1998) well-known work "Endogenous Preferences: The Cultural Consequences of Markets and other Economic Institutions" in title alone exemplifies the structuralist approach. Though focused on economic institutions, the paper presents theories

[6] Ostrom was the first woman to be awarded the Nobel Memorial Prize in Economic Science in 2009.

about how institutions affect preferences (through their influence on situation construal, formation of rewards, the evolution of norms, and learning-by-doing,) including indirectly through cultural transmission. In short (and in stark contrast to the predominance of the economic tradition), preferences can be endogenous (Bowles, 1998). Another notable structuralist is economic sociologist Karl Polanyi who developed the idea of the embedded market economy that posits that all economies are nested in social relations and institutions (Gemici, 2008). Expanding these theories to other kinds of institutions, it is possible to understand international institutions as shaping the evolution of the values, tastes, and preferences of nations. Furthermore, in dictating patterns of interactions among agents (i.e. nations or delegates), it follows that social forces within these institutions play some role. Indeed, Lövbrand and colleagues (2017) analyzed survey results from government delegates and other non-state observers at the United Nations Framework Convention of Climate Change (UNFCCC) and found that "most conference participants show up to network, build interpersonal relationships, learn from each other and foster a sense of community across scales of difference" (Lövbrand et al., 2017, p. 595).

Of course, if social forces *do* play a role in the evolution of countries' preferences, it's important interrogate how they do so. Johnston (2001), in "Treating International Institutions as Social Environments," offers some intriguing insight here by looking at socialization theory as an explanation for cooperation. Their premise is rather simple in that, "...actors who enter into a social interaction rarely emerge the same" (p. 488). Namely, actors' characteristics and identities change through a social process. Johnston identifies two key microprocesses of socialization: persuasion and social influence. Persuasion—changing minds, opinions, and attitudes about causality and affect—leads to common knowledge or homogenization of interests, including

cooperative interests. Social influence, on the other hand, is the distribution of social rewards and punishments that elicit pronorm (or prosocial) behavior. It functions on agents' concerns for status, prestige, honor, conformity and the social tools like shaming, exclusion, etc. Most relevant here, of course, are the arguments as to how international institutions are able to facilitate socialization. Johnston argues that institutions themselves have "identities, traits, missions, normative cores, and official discourses" (2001, p. 508). In these institutions, agents are exposed to arguments and structures whose own ideology emphasizes traits and norms like cooperation or transparency. Thus, he concludes that agents who operate within international institutions have social motivations, putting structure as a major component of international relations. A novel work by a team of researchers (Carattini et al., 2023) explored the structure of the IEA policy space through a network analysis of international environmental cooperation. In this work, co-participation of countries in an IEA represents a "social tie" (p. 3). They found that social cohesion around environmental issues has increased over the past decades lending to a better system for policy coordination and knowledge sharing.

The agent-structure debate has yet to be settled and it is far beyond the scope of this paper to do so. And, like many things, it is likely that nation's behavior in the international arena is a function of both structural and individual characteristics (and an ongoing feedback relationship between the two). But, especially in economics, the idea that international institutions are social[7] environments is enlightening and offers possible insight into why there are more IEA's than traditional economic theory might suggest.

[7] It is necessary to briefly reference sociology literature in this context. In particular, development, environmental and economic sociology are relevant here since participation in IEAs could be a function of such things as colonialism, imperialism, development, and international lending. For example, Roberts and Parks (2006) explore the role of inequality in shaping global climate negotiations and conclude that, "until we recognize that reaching a North-South global climate pact requires addressing larger issues of inequality and striking a global bargain on environment and development… the current policy gridlock will remain unresolved" (Roberts & Parks, 2006).

By studying relational characteristics of countries[8], this paper seeks to further this understanding. The intent is to augment the PE approach by integrating a more global and relational perspective. What differentiates this paper from the PE literature, then, is the greater attention paid to global structures, ala the world-systems analysis and social economics. Indeed, this paper seeks to enfold the approaches of structuralism to expand, not only the understanding of states' IEA behavior, but also, the policy space available to address global environmental issues. In particular, the principle that a, "globalizing world economy creates networks of interdependencies" (O-Brien & Williams, 2013, p. 245) is core to this research. Specifically, I endeavor to understand the role of such international interdependencies in IEA signature.

1.4 Data

The data analyzed in this study varies across 151 countries and 45 years (1960-2005), with the observational unit being, then, the country-year[9]. Table 1-1 provides descriptive statistics for all variables in the econometric model, and figures 1-1 and 1-2 illustrate important characteristics of the dependent variable. To begin, note that the panel is balanced with a total of 4,915 observations for each variable.

Table 1-1: Summary statistics (full sample)

	N	Mean	Std. dev.	Min	Max
Dependent Variable					
IEA Ratifications	4,915	1.760	1.928	0	16
Relational Variables					

[8] It would be remiss to not mention the increasing role that multinational corporations play in global policymaking (Levy & Prakash, 2003; Kim & Milner, 2021). To be sure, exploring the role of non-state actors like corporations offers another fruitful avenue for research beyond this paper.

[9] See Appendix 1.B for a discussion of sample selection. The "full sample" is restricted to the 4,915 observations to balance the dataset in the full specification of the model. A stepwise regression is also performed in the appendix to verify the result's robustness to the loss of country-year observations due to balancing. In particular, the social measures, like diplomatic exchanges, have missing observations and thus restricts the balanced data set to 1960-2005.

Intergovernmental Organizations	4,915	59.56	20.80	7	131
Formal Alliances	4,915	1.611	2.006	0	20
Diplomatic Exchanges	4,915	54.73	35.42	0	177
Control Variables					
Polity	4,915	1.441	7.390	-10	10
log GDP per capita	4,915	8.062	1.512	4.880	11.53
log CO_2 per capita	4,915	0.217	1.780	-4.605	4.206
log Trade Openness	4,915	4.036	0.644	-1.309	6.276

Dependent Variable

The dependent variable in this study is a count of the number of IEA's signed by a country in a given year. This count variable is based on Ronald B. Mitchell's, *International Environmental Agreements Database Project*[10], which broadly defines IEA's as "...an intergovernmental document intended as legally binding, with a primary stated purpose of preventing or managing human impacts on natural resources" (2018). More specifically, Mitchell (2003) breaks the term "international environmental agreement" into its component parts to identify IEA's.

[10] Data from Ronald B. Mitchell. 2002-2018. International Environmental Agreements Database Project (Version 2018.1). Available at: http://iea.uoregon.edu/. Date accessed: 11 February 2018

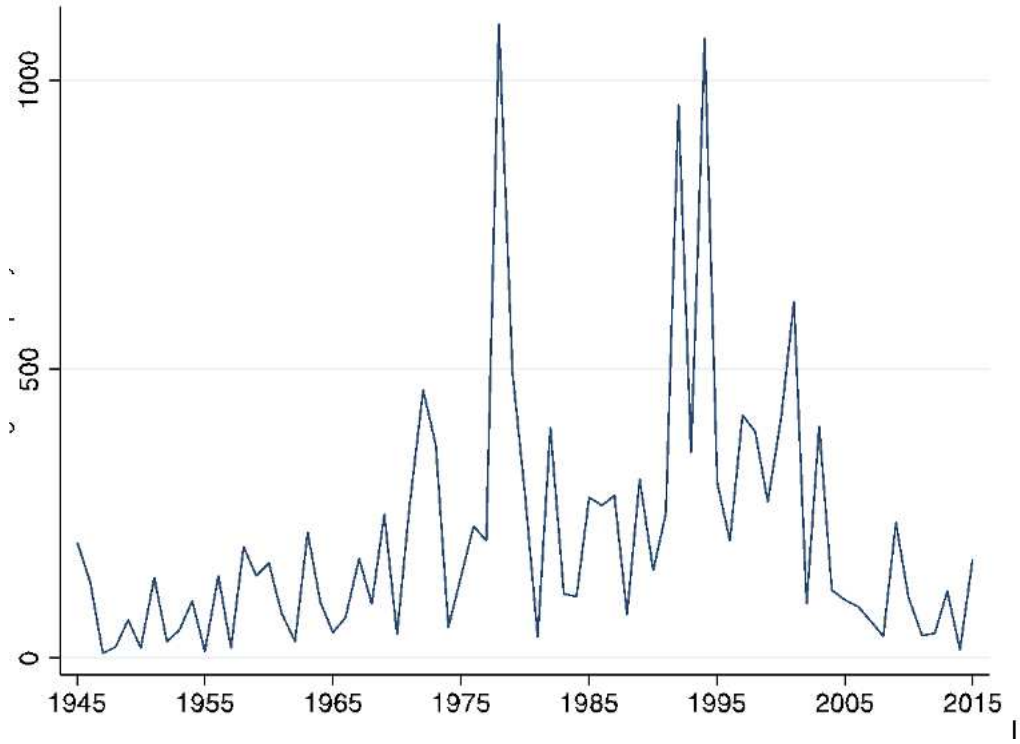

Figure 1-2: Signatures per year, 1945-2015
Note: Data from Mitchell (2018). Calculations by author.

First, "international" includes all agreements to which *governments* have (or have the opportunity to) become a party. In particular, the data used in this research focuses on multilateral IEA's—agreements between 3 or more governments[11] (Mitchell, 2003). Secondly, "agreements" are specified using the *Vienna Convention on the Law of* definition of treaty, which designates a treaty as "an international agreement concluded between States in written form and governed by international law" that includes "consent to be bound" *Treaties*' (United Nations, 1969). Thus, included in the count are treaties, conventions, accords, and modifications of such arrangements. Lastly, an agreement is deemed to be "environmental" if its primary purpose is to manage or prevent human impacts on natural resources. To operationalize this,

[11] Thus, this excludes instruments between governments and non-governmental organizations, international organizations, or corporations.

only agreements with environmental issues in the title, preamble, or in specifically designated agreement goals were included (for more details, see Mitchell 2003).

Figure 1-2 shows the number of IEA's signed each year in the data set and points to some notable historical patterns in international environmental coordination. Notice how the number of multilateral IEA's in the post-WWII period has a general upward trend over time. Indeed, multilateral IEA's were adopted at increasing speeds in this period. According to Mitchell (2003), the prewar rate of one agreement every two years escalated to a rate of seven agreements per year between 1946 and 1972 and increased to 16 agreements per year between 1972 and 1992 and furthermore to a rate of 19 agreements per year between 1993 and 2002 (p. 428).

In the econometric model in particular, a count of these signatures per country-year is regressed. As a count variable, this data is by nature non-negative and takes on only integer values. Furthermore, this data exhibits other common attributes of counts--excess zeros and a fat tail--which will need to be accounted for in the model specification (see Table A-1 in Appendix 1.A for more details). Lastly, the distribution of the dependent variable exhibits overdispersion (i.e. the variance and mean are not equal). Measurement and modeling techniques that account for these characteristics is discussed in the methodology section.

Explanatory Variables

The explanatory variables of studied here aim to capture a country's relational characteristics with respect to the global community. Specifically, the variables *formal alliances*, *international governmental organizations* (IGO's), and *diplomatic exchanges* are the focus of this research as each reflects engagement of a country in the global community. The main source of the data for these relational characteristics is the *Correlates of War Project* (COW), an international relations database (2018).

Formal Alliances is a count of the number of formal alliances a country joined in a given year. Formal alliances are counted if they are "between at least two states that fall into the classes of defense pact, neutrality or non-aggression treaty, or entente agreement" (COW, 2018). The expectation is that the more formal alliances a country is a member of in a given year, the more likely they are to sign an IEA. Thus, the expectation is that there will be a positive coefficient for this variable.

Hypothesis 1: Formal alliances, in capturing a country's engagement in world politics, will positively affect the number of IEA's ratified in a given year.

IGOs is a count of the intergovernmental organizations (IGOs) a country is a member of in a given year. Intergovernmental organizations are defined as, "international organizations that have at least 3 nation-states as their members" (Pevehouse, 2004). The COW project further designates that, to be counted as an IGO the organization must hold regular plenary sessions at least once every ten years and have a permanent secretariat and corresponding headquarters. Such organizations captured and coded in this database, then, range from the level of regional trade organizations such as the African Timber Organization, for example, to the level of the United Nations (Pevehouse, 2004). Thus, a count of membership in these organizations (including associate membership and observer status) reflects not only a country's engagement with the global community, but also its regional integration. It is expected, then, that such integration will lend to higher participation in IEA's.

Hypothesis 2: Membership in IGOs, reflecting a country's cooperative tastes, will positively affect the number of IEA's ratified in a given year.

Diplomatic Exchanges is a count of the number of diplomatic exchanges in which a country engages in a given year. A diplomatic exchange is defined as diplomatic representation

at the level of charge d'affaires, minister, or ambassador in another country (Bayer, 2006). The COW project's Diplomatic Exchange dataset is dyadic between countries and provides a coded binary variable to capture whether or not a country had representation at these levels in another country. Thus, this study takes the summation of binary variable for each country-year, to generate the number of diplomatic exchanges of the country in that year. It is important to note that this particular data set, in the years relevant for this work, report data every five years between 1950-2005. Thus, a linear interpolation was used to create a continuous yearly count. The number of diplomatic exchanges is used to capture the level of a country's engagement in the global community vis-a-vis diplomatic cooperation with another individual country. Again, with the underlying hypothesis of this paper being that more engagement and connection to other countries lends to a higher rate of IEA signature, a positive effect is expected.

Hypothesis 3: The number of diplomatic exchanges, in capturing a country's relationship with other individual countries, positively influences the number of IEA's ratified in a given year.

Control Variables

Following from previous literature, this study also includes controls on domestic political, economic, and environmental characteristics. In regard to domestic politics, the *Polity Project*'s Polity IV is used to measure the type of political regime of a country in a given year. It is the most widely used measure in the literature to capture a country's political regime. The data codes the general, institutionalized authority traits of a country annually with a "Polity Score," which ranges from +10 (strongly democratic) to -10 (strongly autocratic). It has been shown in the literature that democracy contributes to greater IEA participation, and thus this study expects the same (Marshall et. al, 2016).

The last three controls come from the World Bank's *World Development Indicators* (2018). Carbon-dioxide emissions (CO_2) per capita are used to proxy for domestic environmental quality[12]. Gross Domestic Product (GDP) per capita proxies for the economic size of a country in a given year and is measure in constant US dollars to control for inflation. Lastly, *trade openness* (as measured by the ratio of exports and imports to GDP) is controlled for, since it has been shown to contribute to IEA signature in the political economic literature (World Bank, 2018).

1.5 Methodology

To test the relationship between country's global relationships and IEA signature, I empirically analyze a panel of 151 countries over the years 1960 to 2005. As discussed in the previous section, the dependent variable is a count of IEA signatures for each country-year observation. Due to the properties of count variables, standard ordinary-least squares methodologies lead to biased and inconsistent results (Green, 2002). To account for these properties, then, a non-linear count model is used instead. Initial specification tests (see Table A-1 in Appendix 1.A) suggest the best fit for the IEA data calls for a fixed-effects negative binomial (NB) model. In short, controlling for domestic political, economic, and environmental factors, this analysis estimates the effect of global integration (measured by alliances, IGO membership, and diplomacy) on the number of IEA's a country signs in a year.

1.6 Results

The full model presented here uses IEA signature behavior, measured by a count of IEA ratified per country-year, as the dependent variable. Table 1-2 and 1-3 report the empirical

[12] For specifics on the measurement of this data, see http://databank.worldbank.org/data/reports.aspx?source=2&series=EN.ATM.CO2E.PC

results for the relational determinants of IEA signature. Table 1-2 reports the NB model regression coefficients for each specification. Following from model fit, Table 1-3 reports the average marginal effects for each of the explanatory variables. Additional robustness checks are provided in Appendix 1.B.

Table 1-2: Regression Results

Relational Variables	
Intergovernmental Organizations	0.0116***
	(0.00124)
Formal Alliances	-0.0273
	(0.0193)
Diplomatic Exchanges	0.00390***
	(0.000686)
Control Variables	
Polity	0.00472*
	(0.00276)
log (trade openness)	-0.125***
	(0.0409)
log (CO_2 emissions per capita)	0.106**
	(0.0466)
log (GDP per capita)	-0.168***
	(0.0490)
Constant	2.064***
	(0.400)
Observations	4,915
Number of countries	151

Standard errors[13] in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

In general, the NB results show a meaningful relationship between the relational variables and IEA signature (though formal alliances falls just below conventional levels of significance). Additionally, the results on the control variables confirm previous work in the

[13] All standard errors reported in this paper are calculated using the Bootstrap Method.

literature. Because the NB model is nonlinear, however, greater understanding of these relationships is found in the marginal effects.

Table 1-3 presents the average marginal effects for each explanatory variable. These effects are calculated by averaging the marginal effect at every observed value in the data. Thus, they reflect the full distribution, or variability, of the original observed data (Leeper, 2018). It is best to understand these numbers as the predicted number of IEA signatures in a country-year given a 1 unit increase in the explanatory variable.

Table 1-3: Marginal Effects

Relational Variables	
Intergovernmental Organizations	0.0366***
	(0.00461)
Formal Alliances	-0.0862
	(0.0607)
Diplomatic Exchanges	0.0123***
	(0.00237)
Control Variables	
Polity	0.0149*
	(0.00896)
log (trade openness)	-0.395***
	(0.132)
log (CO_2 emissions per capita)	0.334**
	(0.147)
log (GDP per capita)	-0.530***
	(0.164)
Observations	4,915

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As aforementioned, two of the relational variables have a statistically significant (at conventional levels) effect on the number of IEA's a country signs in a particular year. Namely, membership in intergovernmental organizations and diplomatic exchanges have positive and

statistically significant effects, while the number of formal alliances has a negative effect and is not significant at a 10% level. Overall, these results confirm the hypothesis that integration into the international community via global social relations influences the number of IEA's a country ratifies. That is, that a country's cooperative behavior is shaped by their place in the global context.

The positive marginal effect on intergovernmental organizations suggests an increase in the number of IEA signatures from an increase IGO membership. In particular, an average marginal effect of 0.0366 on *intergovernmental organizations* implies that for the countries in this data set, joining another intergovernmental organization increases the number of IEA signature by 0.0366. This finding supports conclusions found in the IR literature. For instance, Bernauer et al. (2010) found a similarly positive coefficient in a binary-time-series-cross-sectional model.

Similarly, an additional diplomatic exchange increases signature by 0.0123 for the average country-year. Notably, this empirical finding is new to both the IR and economics literature and supports the hypothesis in IR's world-systems theory (and of this paper) that countries' preferences are influenced by their global relations.

Interestingly enough, formal alliances have a negative effect on IEA signatures, decreasing signatures by .0862 for every additional formal alliance[14]. Though this is not the expected direction of effect, a deeper look into the nature of these alliances possibly enlightens this relationship. As noted earlier, on the COW data project, formal alliances specifically refer to, "...the classes of defense pact, neutrality or non-aggression treaty, or entente agreement" (COW, 2018) and are thus limited to military alliances. By definition these alliances pertain to

[14] Note also that this correlation loses statistical significance when either GDP or carbon emissions per capita is excluded, though not by much and the direction of this effect remains the same. See Appendix 1.B.

"uncertain" crises in which, "...entanglement [into a conflict] is only a possibility that does not necessarily have to occur" (Bergsmann, 2001). However, if participation in an alliance likely denotes an increase in the possibility of such a crisis and thus, might hinder environmental efforts.

Additionally, these alliances are an integral part of world politics (think, the "Allies" in WWII) and their negative effect on *environmental* agreements might depend on the substitutability, so to speak, between different types of international agreements. That is, it's possible that joining a formal military alliance precludes desire for countries to formally sign environmental protections. Another possibility is that international agreements crowd each other out in that resources invested in signing one agreement (military) might then not be available for another (environmental).

As for the control variables, the marginal effects confirm previous findings and support the inclusion of these variables in the model along with the techniques. domestic politics affects signature in the expected direction and confirms previous findings of a positive effect of democracy on IEA signature (see Section 1.2 for more information). Trade openness, on the other hand, is found to have a negative effect on IEA signature, confirming findings by Egger et al. (2011) and many others.

However, the positive average marginal effect on CO_2 emissions contrasts the conclusions of the Egger paper (which found a negative effect on IEA's and argued that higher pollution reduces a country's willingness to commit to an IEA). However, it is analogous to Bernauer et al.'s (2010) finding that sulfur dioxide emissions per capita have a positive effect on the probability of ratification so the conclusions are not unheard of. Lastly, GDP per capita has a negative marginal effect on the predicted number of IEA signatures. This variable is included

throughout the literature on IEA ratification to represent both affluence or "power" (in terms of economic size) and the conclusions across the literature vary. In this specification, higher GDP per capita leads to a lower number of IEA signatures for a country in a given year.

1.7 Conclusions

We are running out of time to confine global average temperature change to only 1.5 degrees Celsius, the more *aspirational* of the targets set by the international community in the Paris Accord (and the safest, in terms of climactic effects). That "we" is all of us. And it will take action both of individuals, and, most critically, of national governments to change. The Paris Accord is only one of many environmental agreements—both in a historical sense, and in that there are and will be many more global environmental matters that demand shared action.

Ultimately, our ability to combat and cope with these problems depends on global cooperation. And though standard economic theory might suggest that it is not rational for countries to cooperate in such a way, the number of MEAs ratified in the past 80 years say otherwise. Thus, this study seeks to bridge the gap between theory and reality by understanding more deeply what motivates countries to cooperate. Indeed, the analysis here indicates that a country's choice to sign a multilateral IEA is influenced by their relationships with other countries. It suggests that it is not just domestic considerations but also, global pressures that shape a country's tastes, preferences, and ultimately, its behavior.

Granted, it may seem quite obvious that a country's behavior is influenced by their place in the international context. Nonetheless, these global effects are just now being studied in the IR literature and are mostly absent in the economics of IEA's. And thus, there is much work to be done to understand not just *that* they exist, but *why* they do and *how* they operate. For example, it's possible that game theory can shed light on the importance of diplomatic exchange

via repetition or modeling social norms. Or perhaps, producer theory can be applied to understand the substitutability and potential trade-offs between different types of international agreements. It might even be beneficial to dissect the very concept of individualistic rationality and its applicability to country's diplomatic tastes. Answers to these questions, along with many others, indeed warrant further examination.

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Chapter 2 – Toward a Feminist Foundation for the Economics of International Environmental Agreements[15]

2.1 Introduction

We are entering into an era in which climate change is no longer a distant threat, but an everyday reality. As extreme weather events continue to increase in frequency and severity, our lives and livelihoods are put at ever-increasing risk. These risks are especially potent for the world's most vulnerable populations in the Global South. Specifically, women, indigenous peoples, and other socially marginalized communities across the world face distinct threats to their survival from environmental degradation. Effective action, ultimately, entails global cooperation and thus, an international environmental agreement (IEA). More than that, effective action must account for these disparities and engage these communities or it runs the risk not only of overlooking them, but magnifying their vulnerability and endangering their lives.

The preponderance of economic literature that seeks to understand IEAs comes in the form of classical collective action theory and modeling in the form of games that (foreseeably) predict little cooperation around shared environmental issues. In reality however, the world has seen a proliferation of IEAs in the post-WWII era (see Chapter 1). By and large, the economics of IEAs is situated within the mainstream of economics and is thus based largely on neoclassical foundations (Barret, 1994; Carraro & Siniscalco, 1998; Pauw et al., 2022). Taking a feminist epistemological perspective, this paper proposes an alternative foundation for the economics of IEAs founded in feminist philosophy. Instead of a mere examination of the gendered implications of environmental policies, this critique examines the foundations of knowledge

[15] This paper has benefited greatly from comments from and discussions with Anita Pena, Alexandra Bernasek, and Christina Beers.

production in the economics of IEAs as a field of study and the implications of these foundations in the real-world policy space. By analyzing the predominant approaches and the broader paradigms that inform the study and design of IEAs, we are able to uncover hidden biases and gaps in understanding.

With this in mind, this paper will begin with a feminist epistemological critique of the economics of IEAs. Specific attention is paid to the harm that focusing solely on neoclassical theories has on the economic theory of IEAs and the IEA policy space in reality. Next, I will take the case of the United Nations Framework Convention on Climate Change (UNFCCC) as an example IEA to underpin the major points of this critique. Lastly, a discussion on how the feminist perspective can enrich our understanding and improve policies concludes.

2.2 Feminist Epistemological Critique of the Economics of IEAs

Overview: The Economics of IEAs

The majority of IEA studies are founded in the neoclassical tradition, which is most readily apparent in the prevailing use of game theory in the theoretical literature (Wangler et al., 2013). Though a full literature review is beyond the scope of this paper, it is important to note the commonalities throughout the literature that point to the prevalence of neoclassical foundations in the economics of IEAs (see Finus and Capparós, 2015; Marrouch & Chaudhuri, 2015; Pauw et al., 2020 for in depth literature reviews). Namely, the economics of IEAs is characterized by the near ubiquitous use of rational choice theory to model country behavior and highly stylized mathematics to model treaty formation.

IEAs are used to address environmental issues that transcend national boundaries. In the economics of IEAs, these transboundary environmental issues are most commonly represented as property rights issues - that of either a common-pool resource or public goods problem.

Following from this conceptualization, game theory plays a major role in modeling problems where IEA's act as a solution to unclear property rights (Hagen et al., 2020; Pouw et al., 2022).

The standard set-up (or "workhorse model"; Pouw et al., 2022) is a two-stage game in which countries first choose whether or not to join an IEA and secondly, whether to comply and take action (e.g., reduce emissions) (Hagen et al., 2020). A country's welfare is determined by the difference between benefits and costs (or damages) of emissions. Emissions contribute to utility as an input to production and consumption. Damages depend on aggregate emissions from around the world (i.e., there is a global pollutant). That is, emission costs are at a global level in that emissions from one country cause environmental damages in that country *and others*. It is assumed that countries will maximize their own utility based on only their own emissions.

As with most standard noncooperative games, the resulting Nash equilibrium is suboptimal to the fully cooperative outcome. In the cooperative outcome, countries consider the emissions they cause abroad. This globally optimal solution maximizes global welfare and has lower aggregate emissions than the noncooperative Nash equilibrium (Finus, 2000). The lack of a supranational institution comes into play as international law is not binding, and therefore there is no enforcement of cooperation at the global level. Thus, IEAs must be of a voluntary nature, design of the IEA must be agreed upon by consensus, and enforcement of the treaty must be internal to the signatories (Finus, 2000). Hence, the general search for "self-enforcing" IEAs in the literature (Barrett, 1994).

Not surprisingly, these models predict a low number of signatories for IEAs due to free-riding behavior (Peters and Schuler, 2006). Indeed, there are two types of free-riding incentives here - the incentive not to participate and the incentive to shirk responsibilities after signing

(Finus, 2000). Such results mirror another foundational theory in this literature - Olson's classical theory of collective action - that also suggests collective action in larger groups is "very difficult and unlikely" due to rational self-interest (Harris, 2007, p. 195).

Marrouch and Chaudhuri (2015), in an extensive literature review, classify this literature into 6 strands. First, are the "pure IEA" games, "…where signatories' commitment to mitigate emissions generate positive externalities that benefit nonsignatories, reducing individual countries' incentives to participate in the IEA" (Marrouch & Chaudhuri, 2015, 247). These games are the "fundamental building block of the IEA formation literature" (Marrouch & Chaudhuri, 2015, 271). Beginning with early studies of the stability of voluntary agreements (notably Barrett, 1994), the literature has evolved to add varying levels of complexity onto this canonical model such as asymmetric countries, uncertainty, and costly information (Gsottbauer & Van den Bergh, 2013; Marrouch & Chaudhuri, 2015). This particular strand of the IEA literature is quite dismal in that cooperation is either small or shallow amongst agents with a few exceptions (Marrouch & Chaudhuri, 2015). Though markedly less common, frameworks to understand IEAs expanded to cooperative games, dynamic games, and negotiation (i.e., bargaining) models as well (Finus, 2008; Finus and Capparós, 2015).

The second strand identified by Marrouch and Chaudhuri (2015) is that of IEA games with side payments and issue linkages. These models introduce negative externalities for non-signatories in addition to the standard positive ones in the "pure IEA" literature. In other words, they consider carrot or stick mechanisms to incentivize cooperation and punish defection. There are both cooperative and noncooperative games with side payments. Lessmann et al. (2015) presents a meta-analysis of computational IEA models to compare the effect of several different transfer schemes on IEA stability. Overall, the result across such models is that, without

transfers, stable coalitions are small and weak (in terms of welfare improvement) – echoing the general consensus of the "pure IEA" games. Additionally, they find that only transfer schemes that redistribute payoffs within a coalition to make it internally stable are effective. Altogether, the transfer literature's results depend on the design of the transfer scheme and heterogeneity across countries. They can increase cooperation by "buying-in" cooperative behavior, but if self-financed, can destabilize existing coalitions. Interconnected games focus on the concept of issue linkage to achieve coalition stability. In other words, this literature links several sources of externalities among countries within the context of IEA games by linking the public good provision game to a stable club good game in which non-signatories can be excluded from the benefits of club membership. These include games with trade effects, R&D (as if affects the cost of abatement), and reputation effects. Overall, the results in terms of sustaining cooperation are mixed across this literature and heavily dependent on model specifications like the functional forms of benefits and damages from emissions (Marrouch & Chaudhuri, 2015). It is also important to note that the two most notable IEAs in recent history, the Kyoto Protocol and the Paris Agreement, do not link abatement and trade.

The remaining strands of this literature identified by Marrouch & Chaudhuri (2015) are the emerging "novel approaches to the IEA formation problem" (Marrouch & Chaudhuri, 2015, p. 286). These include political economy perspectives, behavioral approaches (both theoretical and experimental), open economies, and models that allow for climate adaptation. The emerging political economic literature here considers intra- and inter- governmental aspects that are important for the design of IEAs (going beyond governments simply maximizing social welfare). These include incentives such as winning votes from elections to satisfying demands from lobbyists that happen at stages in IEA formation outside the negotiation stage. Behavioral

assumptions, which affect the willingness of countries to cooperate, have also been considered in this context. For example, the idea of a focal point ("a salient feature that reduces the dimensionality of the problem", Weitzman, 2014, p. 33) as a way to reduce high transactions costs of multilateral bargaining. Other behavioral examples include models that considered other-regarding preferences (e.g., Hoel and Schneider, 1997), preferences for equity (Peters and Schuler, 2006), and fairness[16] (Jeppesen and Andersen, 1998). Experiments have also been conducted (e.g., McGinty et al., 2012) and reflect the overarching results of the "pure IEA" games that result in small or large and shallow coalitions. Another novel strand of IEA games is those that model open economies which add the additional layer of externalities that interact with the global pollution externality. Lastly, there are IEA games with climate adaptation to understand how it affects the incentive to free ride (Marrouch & Chaudhuri, 2015). These novel approaches represent a useful departure from the canonical IEA games that make up the majority of this literature.

However variegated, what is common across all these approaches is highly stylized modeling of country behavior that predict pessimistic conclusions about the prospects of global environmental cooperation. It all comes down to the foundations. Whether non-cooperative or cooperative, dynamic or bargaining, these models mostly build upon the assumption of a self-interested, atomistic country. Indeed, the story of country behavior in the economics of IEAs is largely the neoclassical story - one of individualized agents maximizing payoffs in isolation. The story of "economic *man*". Even the novel behavioral[17] approaches argue that treaty design

[16] Grüning and Peter's (2010) paper, "Can Justice and Fairness Enlarge International Environmental Agreements?" does show that such preferences can result in an increase in IEA participation, supporting my claim that non-standard assumptions are a step in the right direction. This highly formalized model, though, still assumes economic rationality at thus, the foundations of these approaches are still at issue.

[17] See Sent (2004) for an argument as to why the "new" behavioral economics is situated within the mainstream of economic thought.

must “embody countervailing force(s) against narrow self-interest” (Weitzman, 2015). Pouw et al.’s (2022) recent review of the literature supports these conclusions. It identifies a number of key findings over the last two decades of the economics of IEAs. First and foremost, they conclude that the game theoretical literature finds that universal coalitions have more efficiency gains than fragmented ones but are difficult to negotiate and are unstable due to free-rider incentives (Pouw et al., 2022). Furthermore, they argue for social choice approaches that move beyond the singular aim of efficiency and incorporate equity issues which “have hardly been explored in the domain of IEAs” (Pouw et al., 2022, p. 290). Additionally, they point to the dominance of non-cooperative game theory in this literature and its reliance on rational agents “with few exceptions” as a “narrow perspective on the economy” and a research gap that warrants deeper exploration (Pouw et al., 2022, p. 290).

Feminist Epistemological Critique

This chapter seeks to amend this gap with a philosophical framework well versed in issues of equity – the feminist epistemological perspective. Feminist epistemology developed in the early 1980s in response to positivist methodologies that characterize research in Western-origin social and natural sciences (Harding, 2009; Grasswick, 2021). Such methodologies support masculinist and androcentric biases that affect the knowledge system by influencing the direction of research, gendered assumptions, and gendered language in academia that frame understandings and ultimately, direct policy and practices.

Feminist philosophy highlights the central role of hierarchical, dualistic thinking in modern Western culture and science (Nelson, 1997). Feminist philosophers' work in the 1980s and 90s brought dualisms to the forefront of their critique of this conception of the world. At the core of claims of androcentrism is the understanding that Western philosophy

is built on dualisms that split the world into male and female, in which male aspects are valued over female ones. Philosophers have traced these dualisms through the rise of modern science and the Enlightenment to today's neoclassical orthodoxy. In Nelson's (2009) paper, the author details how feminist economists extended this critique of dualistic thinking to their critique of mainstream economics' definition, models, and methods. These details are shown in Table 2-1.

Table 2-1: Gendered Dualisms in Mainstream Economics[18]

Economics ("Hard")	***Not* Economics ("Soft")**
Definition:	
markets	nonmarket
mental choice	bodily experience
scarcity	abundance
Model:	
individuality	relatedness
autonomy	interdependence
self-interest	other-interest
rationality	emotion
Methods:	
quantitative	qualitative
formal	verbal or intuitive
positive	normative
objective	subjective
general	particular
Gender:	

[18] Copied from Nelson (2009).

masculine	feminine

From these hierarchical dualisms in Table 2-1, it is easy to understand how mainstream economics' preoccupation with "rational," predictive models is formed. In a world that values the "hard" attributes as superior to their "soft" counterparts, it's no wonder that the economics of IEAs has looked solely to game theory to understand complex treaty negotiation. It offers the formal, positive, and generalizable methodologies and conclusions that are most valued in an androcentric world. The commitment to the "rhetoric of prediction" and "tendency to bolt-on behavioral assumptions and other amendments to standard rationalist microfoundations to account for explanatory errors" (Bronk, 2011, p. 3) is a product of these biases and is exactly what we see in the economics of IEAs. Furthermore, the foundation of methodological individualism[19] and its economic partner, rational choice theory, epitomizes the ideals of individuality, self-interest, and autonomy.

In particular, this chapter employs feminist standpoint epistemology and its counterpart, strong objectivity, to work toward an alternative foundation for the economics of IEAs. According to Collins (1997), it exists to illuminate power relations. Feminist standpoint theorists have three central tenets: "(1) Knowledge is socially situated. (2) Marginalized groups are socially situated in ways that make it more possible for them to be aware of things and ask questions than it is for the non-marginalized. (3) Research, particularly that focused on power relations, should begin with the lives of the marginalized" (Bowell, n.d.). Moreover, standpoint theories are normative in that they, "map how a social and political disadvantage can be turned into an epistemic, scientific, and political advantage" (Harding, 2004, pp. 7-8).

[19] Methodological individualism, "...refers to the explanatory and predictive strategies which give primacy to individual action in relation to social phenomena." (Picavet, 2001).

To be clear, a standpoint is based on a "historically shared, group-based experience" (Collins, 1997, p. 375). Stemming from the Marxian notion of the proletariat standpoint on inequality, this understanding has evolved beyond these foundations to include groups beyond social class (like race and gender) and the complexity of discrimination at the intersections of these groups (ala Crenshaw's theory of intersectionality[20]; Columbia Law School, 2017). Standpoint theory calls attention to the social conditions that create socially constructed groups such as those based on race, gender, sexuality, or ability. This is directly in contrast with individual experiences and approaches that center them. Instead, groups have shared histories based on their location in relations of power. "Race, gender, social class, ethnicity, age, and sexuality are not descriptive categories of identity applied to individuals. Instead, these elements of social structure emerge as fundamental devices that foster inequality resulting in groups" (Collins, 1997, p. 376). Groups are "entities with their own reality" (a reality of group-based oppression), not just an accumulation of individuals (Collins, 1997, p. 376). Standpoint theory argues that groups who share placement in hierarchical power relations also share experiences of said power relations. Social location is defined by how you experience "misogyny, White supremacy, imperialism, religious persecution, class struggle and other dynamics of power and oppression" (Poole, 2021). In societies structured by such inequalities, the prevailing knowledge and beliefs tend to represent the interest of the dominant group. Power-based ignorance stems from the "privilege of not knowing or needing to know" (Medina, 2013, p. 32). Indeed, being ignorant of certain topics is normalized in dominant, patriarchal culture. Such "ignorance is not the result of a benign gap in knowledge, but deliberate choices to pursue certain kinds of

[20] Intersectionality holds that "all of us have multiple identities and inhabit multiple locations" (Paradies, 2018) and that discrimination occurs along multiple axes of oppression. An intersectional approach demands us to consider how systems of power (like, racism, colonialism, and patriarchy) interact to oppress people in ways that go beyond a simple additive effect (Cabrera et al., 2020).

knowledge while ignoring others" (Grasswick, 2011, xvii). Dominantly situated knowers possess both the power to ignore and the power to discredit (Poole, 2021).

Conversely, those who occupy a socially underprivileged position have an epistemic advantage in that they are more likely to develop a deeper understanding of the world than those who are socially privileged (Grasswick, 2021). This epistemic advantage is what underlies "strong objectivity". It argues that objective accounts of nature and social relations are found in the daily lives of oppressed groups. By starting off research from an "outside" perspective, one can detect dominant values, interests, and assumptions that serve the most powerful social groups and are often invisible in their ubiquity. For instance, the perception of modern Western science as "universally valid" is an example (Harding, 2019). This notion is based on masculinist and Western ideals of generalizability (i.e., universal truths), objectivity, and positivism. Collins (1989) dubbed this trend "Eurocentric masculinist positivism" and points out that this system of knowledge validation solely reflects the interests of its creators, namely white, Western men (p. 751). By making only generalizable statements of the world valid knowledge, it neglects any sociological consideration in the validation of knowledge. It thus enforces the subjective viewpoint of the dominant knower (men) who can impose their methodologies and frameworks upon everyone else.

Feminist epistemology implies that economics is socially and historically constructed (Nelson, 1995; Woolley, 1993). The topics, methods, and key assumptions in economics are a product of context and power (Nelson, 2001). Specifically, the social and historical context that influences economic thought is that of the Western, white, and masculine. Indeed, "...objectivity, separation, logical consistency, individual accomplishment, mathematics, abstraction, lack of emotion and science itself have long been culturally associated with rigor,

hardness - and masculinity" (Nelson, 2001, p. 94). From its lack of diverse representation (historically, and still today; Bayer & Rouse, 2016) to its blindness to social norms (e.g., gendered norms; Ferber and Nelson, 1993), neoclassical approaches dominate not only the literature, but the policy space as well. It is no secret, but rather a source of pride, that the mainstream economic paradigm strives to be (capital S) Science (Caldwell, 2012).

> "...the mainstream discipline of economics relies on a deeply gendered belief about what makes for good science. Economists like to think of economic life as confined to the market, driven by self-interest and competition, rational and controllable, and intrinsically governed by mathematics and physics like "laws," not because the economy is intrinsically that way but because these ways of seeing it are all associated with masculinity and toughness." (Nelson & Morgan, 2020, p. 148)

Feminist philosophers and economists have worked for decades to make the case that androcentric bias is rampant in modern economic thought. This bias is true for the economics of IEAs too. That is, the economics of IEA's is shaped by the social, cultural, political, and economic context in which it is formed. Thus, far deeper even than the theoretical conclusions themselves, the very approach to understanding IEAs - questions posed, assumptions utilized, methodologies employed - are subject to context and power. The particular context that affects the study of IEAs in economics is one characterized by traditionally 'masculine' traits. Consequently, a central claim of this paper is that the economic study of IEAs is androcentric. Here, androcentrism refers to a system that favors male perspectives, standards, and values. It is a male-centered worldview that positions the male perspective as the default human condition and others as divergent (Hibbs, 2014). This

androcentrism is exemplified in the economics' of IEAs reliance on rational choice theory to model country negotiations and its focus on the independence and sovereignty of countries. Furthermore, highly stylized mathematics constitutes the majority of this literature, reflecting the masculinist preoccupation with formal ways of knowing.

Though assumptions like interdependence and preferences for equity and fairness could be seen as a steps in the "right" (or different) direction, simply "bolt[ing] on" (Bronk, 2011) behavioral assumptions to the standard individualistic microfoundations of game theory fails to address the foundational challenges at issue here. To put it another way, even as these approaches increase in complexity, they take individual country agents as the starting point, and it follows that free riding remains a dominant strategy and the number and size of environmental treaties smaller than empirical evidence suggests. This literature, in its seemingly endless iterations on the canonical model, is moving in the direction of producing "meaningless papers" (Alvesson et al., 2017, p. 12) that are merely mathematical exercises instead of useful frameworks to understand the tangible world of international environmental negotiation. And such papers,

> "…do not merely fail to have any impact with the social changes that urgently confront us, but they spread cynicism and fatalism among the participants and reinforce instrumentalism[21]. They also clutter the sphere of knowledge with noise so that truly original and meaningful publications have less chance of being developed, noticed, discussed, and acted upon." (Alvesson et al., 2017, p. 12)

[21] "Instrumentalism, in the philosophy of science, [is] the view that the value of scientific concepts and theories is determined not by whether they are literally true or correspond to reality in some sense but by the extent to which they help to make accurate empirical predictions or to resolve conceptual problems" (de Neufville, 2020).

The economics of IEAs is dominated not only by the androcentric biases of neoclassical economics oft criticized by feminist economists, but importantly here, the biases of a geopolitical context that favors powerful, Western countries and their way of thinking about economic, political, and environmental problems. That is, the power of the global North in international society has had epistemic effects. Dominant models of country behavior represent the experiences and interests of powerful countries. To be specific, the Euro- or Western-centric approaches that comprise the economics of IEAs stem from an understanding of the world that equates modernization with Westernization. That is, it positions Western industrialization as the "goal" or apotheosis of economic development. First articulated by the founders of social science in the late nineteenth century and then popularized in the 1950s alongside the creation of various international agencies designed and directed by the global North (e.g., the United Nations), this conceptualization for the development of the "Third World" was touted as value-free, autonomously determined science (Harding, 2009).

In point of fact, a key feminist epistemological premise is that sciences and their societies co-create and co-constitute each other. It follows, then, that early modern science was co-created and co-constituted with the new economic, political, social, and technical forms of life that emerged in early modern Europe (Harding, 2020). Harding (2009) refers to this particular body of knowledge as "Northern science" (p. 403). It is the scientific rationality and technical expertise, from the conceptualization, direction and management of which women and other minorities have been historically excluded, that was positioned as the "motor" driving development. Harding points to four themes linking social progress to the spread of the North's scientific rationality and technical expertise, to new kinds of

masculinities, and to the public/private division of social domains (another masculinist conceptualization). First, men are compelled to abandon their "loyalties to women, families, kind, households, and the nature that sustains them" (Harding, 2009, p. 410) for the public sites of modernity. Secondly, economic and political activities must be moved from households to a public sphere (in turn weakening the private sphere of the household). Next, scientific rationality and technological expertise transform men and societal institutions (except the family) into the modern, public sphere. Lastly, this transformation is presented as natural or evolutionary – positioning Western modernity as the 'natural' maturation of any society. This "masculinization of modernization and development" is based on male-supremacy and European/white-supremacy (Harding, 2009, p. 410).

The economics of IEAs is not just androcentric. It is anthropocentric as well. That is, it values humans over (nonhuman) nature. It sees nature as separate and subordinate from humans. Feminists, especially ecofeminists, have been pointing out the similarities of treatment of women and nature in Western philosophy for decades now (Nelson, 2009). In particular, women and nature are treated as resources in neoclassical economics. They are treated as self-regenerating, subject to authority, passive, and exploitable (Zein & Setiawan, 2017). This treatment is embodied in the policy solutions that follow from this literature which are almost exclusively market-based and rely on the commodification of nature (e.g., carbon credit markets). The economics of IEAs has been used to design policies that "made real—installed in social life—only men's points of view" (Harding, 2019, p. 175). Such policies favor Western ideals (such as capitalism, self-interest, and free market economics) and the status quo in terms of power distributions and dynamics (keeping the global South subordinate). Consequently, the consequences of modernization for women and non-Western

men have not been good. Positioned as externals to economies and political systems, their welfare is seen as a drag on economic growth and the global social progress promised by modern Western philosophies actually results in regress for these groups (Harding, 2009).

2.3 How bias limits the economics of IEAs

Though the modern economic paradigm is altogether infatuated with prediction, the economics of IEAs misses the mark when it comes to the outcomes of IEAs in the post-WWII era. The neoclassical story of IEAs principally concludes that cooperation is infrequent, i.e., it predicts there should be few environmental treaties in the policy space. In solely optimizing their own objectives, countries are apt to eschew the costs of environmental protection and free ride on the efforts of others. Nonetheless, in reality, the post-WWII era has seen a proliferation of environmental treaties (see Chapter 1 for a more detailed discussion), suggesting more is at play than what is captured in the current literature. The dominance of neoclassical thought in the economics of IEAs, founded in methodological individualism, rational choice theory, and predictability, limits our understanding of countries' motivations, ignores history and social relations, and discounts the importance of power in the geopolitical arena. In reality, countries are interconnected and interdependent, tradition and history matter to decision-makers, and power plays a significant role in how negotiations play out. Moreover, the current orthodoxy of the economics of IEAs runs counter to that which is needed to solve the multiple global environmental crises we face in the twenty-first century - cooperation. Ultimately, conceiving of countries as interdependent is essential to a future in which humanity comes together to combat our shared environmental issues.

The neoclassical foundations of the economics of IEAs have led to what I like to call the "myth of the separative country". That is, the economics of IEAs erroneously assumes that

countries are atomistic and separate from the cultural, social, and political spheres (not to mention nature itself). The economics of IEAs has simply supplanted a (highly criticized) concept of the separative, rational individual into models purported to explain the behaviors of entire countries. The feminist, among many others, critique of rational choice theory and its protagonist, homo economicus, is well known. As Nelson (1997) would put it, "the agent of neoclassical models is disembodied and disembedded" (p. 160). The neoclassical image of the individual is a product of particular social circumstances (Macmahon, 1997). In the case of the economics of IEAs, those particular social circumstances are one of the global North. The type of autonomy that this conception of countries represents is more likely to be experienced by countries in the Global North who have the unchecked power to act freely. The abstract country of neoclassical economics is "primarily a white, privileged male whose autonomy was predicated on the oppression of women, nature, and non-white persons and the destructive colonization of indigenous peoples' lands" (Macmahon, 1997, p.167).

This myth perpetuates the idea that the economic sphere is wholly separate from those of politics, society, and culture. Likewise, viewing countries as separate from one another ignores their interdependencies. It (almost) goes without saying that countries today are interconnected not only economically, but politically, socially, and culturally as well. The fallacy of the separative country is especially fraught for nations in the global South that suffered histories of colonization and extractive economies[22] which still face challenges today related to those histories. As Harding (2021) points out "modernity and coloniality are two sides of a coin" and modern sciences remain marked by central assumptions and practices of that long entanglement

[22] It would be remiss to not mention dependency theory in this context. That is, the theory that characterizes countries in the global South in the 'periphery' and dependent on the 'core' economies (the global North) demand for their cheap labor and resources as a result of the global capitalist system (Sonntag, 2001).

(p. 40). In addition, colonialism was a "generator of capitalism" which relied on extraction of natural minerals and of labor (Harding, 2021, p. 40). The rise of Western Europe depended on natural resources and labor "forcibly appropriated" from the global South during the colonial period (Hickel et al., 2022). The conventional public narrative of today and dominant perspectives in international development maintain that the world economy functions as a meritocracy. This perspective is reinforced by the rhetoric on neoclassical economics that globalized capitalism has created an "even playing field" and prices reflect the outcome of market mechanism (as opposed to power imbalances in the global political economy) (Hickel et al., 2022). Theories of "unequal exchange" point to a continuation of these dynamics through a "hidden transfer of value" from the global South to the global North (Hickel et al., 2022).

The myth of the separative country also ignores important intergovernmental institutions, like the United Nations (UN) and International Monetary Fund, that connect countries and act as places of coordination, cooperation, and control. Earlier studies (Ecchia and Mariotti, 1998) of supra-national authorities conceptualized these institutions as locations of communication among countries that can facilitate in reaching full cooperation. The former UN Secretary-General, Kofi Annan, wrote in 2005 that in today's globalized world "the threats we face are interconnected" (Annan, 2005, p. 25). There is both cooperative and competitive interdependency among sovereign nations and additionally, transnational corporations, networks of experts, and civil societies to name a few (Jang et al., 2016). Biermann and Pattberg (2008) describe contemporary global environmental governance through the following features: (1) new types of agency and actors in addition to national governments; (2) new mechanisms and institutions of global governance that transcend traditional forms of state-led, treaty-based regimes; and (3) increasing segmentation and fragmentation of the system across levels and functional spheres.

Intergovernmental organizations, like the UN system, expand capacity and access to resources by including private and non-governmental actors and institutions, creating global networks in which intergovernmental organizations shape and support the non-governmental organizations and private enterprises (Jang et al., 2016). According to Jang et al. (2016), power in the current system of global governance has become more diffused. Historically, high-income nations exercised power in institutions of international economic governance like the World Bank and IMF where Northern states hold a majority of votes (Hickel, 2022). With the rise of the BRICs (Brazil, Russia, India, China) and others, the possibility of a reordering in global governance. For example, the BRICs have developed alternative institutions for economic and political collaboration outside of the traditionally Western dominated institutions. Western ideals of privatization, free markets, and open capital accounts are being challenged by state-controlled approaches to development in the global South (Jang et al., 2016). According to Oxford historian Peter Frankopan, we are witnessing the "unraveling of the global order" in which the "Western era is winding down" with the rise of China and development of a multipolar system (Araya, 2022).

Understanding countries and their economic and political behavior as separate from nature itself is especially problematic in the context of *environmental* diplomacy. By denying our embeddedness and dependence on nature, the myth of the separative country perpetuates a way of thinking that undervalues (or even ignores) nonhuman nature that can easily lead to overexploitation and degradation of it as a result. Solutions offered in this conceptual context that *do* account for nature do so by commodification or marketization. Leading examples of such approaches are carbon markets that attempt to put a price on carbon emissions and thus

"internalize" the cost of climate change. Instead of understanding the embeddedness of the economy in the natural system, it tries to fit nature into the neoclassical marketplace.

In the prevailing framework of the neoclassical economics of IEAs, inequality is also not given enough centrality in modeling. This is true for inequality across countries and within them across populations and social groups. Especially important in environmental issues, another important equity issue overlooked is intergenerational equity. As a matter of fact, Marrouch & Chaudhuri (2016) point out the difficulty of accounting for country heterogeneity in the canonical game theoretical framework (and relative lack of country asymmetry in the literature). The oversight is a prime example of the power-based ignorance discussed previously (Poole, 2021). To be specific, the dominantly situated knowers of mainstream economics have made a deliberate choice to exclude the unequal nature of countries' environmental costs and benefits because it is mathematically onerous to fit into the canonical framework[23]. This inattention to inequality, though inequality is a definitive feature of global environmental issues like the climate crisis, is in direct opposition to the realities faced by both countries in the global South and marginalized communities within all nations. Feminist standpoint epistemology holds that inequality has epistemic effects and epistemological questions are ethical ones (Poole, 2021). To put it another way, knowledge is central to maintaining unjust systems of power. The economics of IEAs' lack of attention of inequality, then, is a product of the andro- and anthropo-centric biases that perpetuate knowledge that favors masculinist, Western supremacy.

Likewise, the economics of IEAs altogether ignores power in forms other than strictly monetary means. When power does appear, it is defined on neoclassical foundations that

[23] It is important to note there are a few newer works that account for inequality across countries. Lin (2017), in a laboratory experiment, found that inequality aversion (in self-interested actors) had a positive impact on participation. Distefano & D'Alessandro (2021) models asymmetric countries negotiating international abatement targets and find that, regardless of free-riding, IEAs do not "automatically" produce expected abatement.

conceptualize it in terms of unequal asset distributions, be it wealth, information, or environmental assets (Prates, 2014). Such a conception of power does not negate the core assumption of economic rationality and says little about how power differences came to be or how this power is exercised and why. It also disallows an understanding of the collective exercise of power. Conflict enters only as far as bargaining models, and coercion is altogether absent aside from asset redistribution or cost sharing. As Nancy Folbre (1994) wrote, "bargaining and coordination are important, but what about confrontation, conflict, and organized violence?" (p. 24). Epistemologically, power shapes knowledge (Poole, 2021). It determines "who is believed and why" (Collins, 2000, p. 252). In an androcentric economics of IEAs, neglecting the importance of power relations both across countries and social groups is a deliberate choice to "look the other way" to the injustices that originated these power structures (i.e., colonialism and systematic violence) and that are carried forward by this literature's continued adherence to the neoclassical paradigm.

Modeling countries as isolated utility maximizers limits the understanding of country motivations beyond short-run, monetary self-interest. In reality, countries' motivations are shaped by history, politics, and social relations fraught with power. Histories of colonialism, extractive economies, debt, violence, and collective power assertion are not accounted for in the reigning paradigm. Even the (few) extensions that include aspects like norms or other-regarding behavior still rely on utility maximization and take individual countries as the starting point, thus excluding non-utilitarian motives, non-market relations, and non-monetary transactions. Again, these "bolt-on" approaches still lack the social, cultural, and political dynamics that explain where such preferences might come from. As Nancy Folbre put it: "The mere assertion that rationality is imperfect, however, doesn't say enough about how an individual comes to define

his or her self-interest…A theory that takes individual agents as the starting point (whether they are perfectly rational, imperfectly rational, or simply purposeful) cannot explain how they come to want what they want or whether they are able to get what they want" (Folbre, 1994, pp. 27-28). The neoclassical dominance in this space also disables us from being able to understand or appeal to incentives outside of rational self-interest. This particular constraint effectively disbars motivations like collaboration or coalition building to come into play in policy design, even though there is ample evidence of sustainable cooperation of the commons (Ostrom, 1990).

These limitations–namely, the myth of the separative country and the invisibility of inequality and power–are a product of andro- and anthropo- centric dominance in the economics of IEAs. In the pursuit of representing itself as a rational science, the economics of IEAs misses considerable insights in terms social and historical country relations and power as both a source and deterrent for cooperation. This narrow focus leaves the economics of IEAs ill equipped to analyze phenomena "fraught with connection to others, tradition, and relations of power" (Nelson, 2008, p. 4). However, in the case of global environmental cooperation, this is exactly what we need (see Section 3 for a detailed example).

2.4 The Harm of Bias in IEA Policy-making

The conceptual narrowness discussed above has resulted in an equally narrow global environmental policy space. This restriction is true not only for the policies theorized by economists but also, the policy options considered by governments and their representatives. The gendered concept of (economic) rationality and the ideals of what makes for good science has affected what is deemed to be possible policy. The pervasion of neoclassical ideology into the global environmental policy space is so profound that it affects how officials think, talk, and even act. By shaping the discourse and restricting the policy space to include only market-based

and technology focused solutions, it perpetuates (and even exacerbates) a system that devalues and exploits women, minorities, and nature (see Section 3 for more detailed examples). In a geopolitical arena dominated by the Western, masculinist ideals of the global North, marginalized voices are ignored, and the most vulnerable populations suffer. What's more, it fails to address the underlying issues at the root of global environmental degradation.

Andro- and anthropo- centric understandings of IEAs permeate the social and political spheres and we "...need to appreciate the extent to which economic models of the self have entered popular thinking" (MacMahon, 1997, p. 168). In other words, neoclassical hegemony in the economics of IEAs is so pervasive that it has had epistemic effects. It has shaped knowledge and discourse in global environmental policy-making – how officials conceptualize and think about environmental problems and solutions. In particular, it creates conditions where market-based and ex post facto technological solutions take precedence on the grounds that they are "more economical" (UNFCCC, n.d.d).

Julie Nelson, a renowned feminist economist, proposes that the staunch belief in unfettered growth and profit imperatives was invented by economists to give the profession a "veneer of physics-like scientificity" (Nelson & Morgan, 2020, p. 147). Moreover, she argues that such ideas have changed how policymakers and business leaders think and behave. . It is for these same reasons that economists are increasingly "in the limelight" in policy discussions about the environment, especially those about climate change (Nelson, 2009, p. 2). Nelson asserts that, "orthodox economics thinking has in some ways encouraged the development of thoughtlessly resource-squandering and cruelly inequality encouraging economies" (Nelson & Morgan, 2020, p.147). This perspective applies to IEAs as well and how countries and negotiators act and interact. The global community (in which the capitalist global North has

been dominant for a long time) is biased toward these values. If it is commonly accepted that countries act purely out of self-interest, the very possibility of cooperative or other-regarding behavior is unconsidered. Following Nelson's logic, then, countries and negotiators begin to act out of pure self-interest as such ideas gain ubiquity. The individualistic behavior of neoclassical modeling becomes actuality.

As a result, proposed solutions stay within the traditions of Western, masculinist thought. Such (namely market-based) policies appeal to a materialistic and self-interested agent (i.e., country) through altering their cost/benefit functions. They often involve the commodification of nature, reflecting *man's* mastery over nature and the tendency of neoclassical economists to blithely apply market concepts in non-market spheres. To that end, the efficacy of policies is measured within these ideals–putting efficiency and free markets as the standard against which policies must be measured. Continued economic growth is the goal, and policies that hinder this are dismissed. A central topic in environmental policy discussions is their economic impact and whether a policy will be "bad for the economy" (Nelson, 2009, p. 2).

For example, "green economy" or "green growth" policies use economic rationality and market mechanisms to address environmental degradation. They are modeled to promote growth in the global North, spur development in the global South, and theoretically, sever the ties between economic growth and environmental degradation (McAfee, 2015). Yet, by narrowly focusing on solutions that fit within the neoclassical paradigm, such approaches miss the opportunity to consider other types of policies that are effective. By solely centering economic growth as a metric, it runs the risk of forfeiting goals such as environmental quality and equity in exchange for efficiency and growth. Additionally, by reinforcing dualistic thinking and devaluing things such as care, this paradigm perpetuates injustice (Dengler & Strunk, 2018).

Still further, neoclassical economics and neoliberalism are both products of a context dominated by the masculinist global North. Indeed, many see the patriarchy and capitalism are interrelated forms of dominance (Urban and Purckhauer, 2016). The neoliberal ideals of free markets, limited government, and capitalist globalization are artifacts of a global arena where concepts like autonomy and individuality are most valued. The connection between the neoclassical paradigm and global capitalism is well established (see Dash, 2014). The individualism in the neoclassical orthodoxy is tied to the individual of liberal political theory and rests on dualistic, gendered, and hierarchical structures. Indeed, neoliberal policies rely on a public/private split reminiscent of the gendered dualities presented in Table 2-1 (Waller & Wrenn, 2021).

The geopolitical dominance of androcentric values affects the lives and livelihoods of real people, especially the most vulnerable populations in the global South. Because normative thought is devalued in an androcentric context, the distributional effects of policy are secondary, if not wholly unconsidered. This lack of attention to inequality runs the risk of condoning policies that exacerbate existing inequalities and further marginalizing already vulnerable people. There is an established body of work that substantiates these claims (see Denton, 2002 or Allison, 2017 for studies on the unequal effects of the climate crisis on women). As an example, there is scholarly support of the unequal effects of neoliberal policy. Many feminist scholars link neoliberalist policies in the global South to rising inequality and an increase of the burden of social reproduction onto women and girls (e.g., Braunstein, 2015). Moreover, policies for environmental protection are shown to rely heavily on women's unpaid labor (Nelson et al., 2002). Such burdens are especially true at the intersection of multiple socially marginalized identities. For instance, Csevár (2021) points out that Indigenous women are disproportionately

affected by environmental degradation. In particular, mainstream strategies in the Western intellectual tradition often wind up reinforcing the ideologies and power structures that "[devalue] whatever is associated with women, emotion, animals, nature, and the body, while simultaneously elevating in value those things associated with men, reason, humans, culture, and the mind" (Gaard, 1993, p. 5).

2.5 Case in Point: The UNFCCC

Climate change negotiations under the UNFCCC provide a poignant example of both the epistemic effects and real-world consequences of the Western, androcentric bias in global environmental negotiations. The history of negotiations and current friction at the annual Conferences of Parties (COPs) demonstrates how Western, androcentric values influence IEAs by shaping the discourse, influencing the negotiation process, and limiting the policy space. Additionally, the UNFCCC exemplifies an IEA in which inequality, power, and collective action play a key role at the global environmental negotiating table.

The presence of "economistic" thinking is extensive at the UNFCCC (Nelson & Morgan, 2020, p. 148). The same gendered belief of what makes for good science that dominates mainstream economic thought holds similar standing in the UN. The commonality among these histories is early 19th Century modernization theory (revived in the post-war development of the UN) that "conceptualize[s] scientific rationality and technical expertise as the 'motors' of development policies and their modernization practices[24]" (Harding, 2015, p. 1). These beliefs are so prevalent, they have entered into the rhetoric. For instance, in 2015, then UN Climate Chief, Christiana Figueres, said that "the self-interest of every country is what is behind all these

[24] The connection between industrialization and individualization is often pointed out in feminist literature (e.g., MacMahon, 1997).

measures. It's not because they want to save the planet…humans don't have a stronger guiding force than my own self-interest" (quoted by Nelson & Morgan, 2020, p. 148). In the same vein, at COP9 in Bonn, the United States withdrew citing that the Kyoto Protocol was not in its "economic best interest" (UNFCCC, n.d.b).

The first global stocktake under the Paris Agreement was recently released and will provide the basis for negotiations at COP28[25] at the end of 2023. Used to evaluate progress of climate action at the global level, its major conclusion is that global emissions are "not in line" with the temperature goals of the Paris Agreement (UNFCCC, 2023, p. 5). In fact, current NDCs have a 95% probability of exceeding the 1.5 degree Celsius goal (CAT, 2022). Interestingly, the document calls for "radical decarbonization" (UNFCCC, 2023, p. 20) and "systems transformations…across all sectors and contexts" (UNFCCC, 2023, p. 4). Additionally, it includes language about inclusion, equity, and "just transitions" that support more "robust" outcomes and calls for "economic diversification" like "green industrialization" (UNFCCC, 2023, p. 6). Furthermore, it calls for strategic capacity building support for developing countries, "to address locally determined needs, including on the bases of Indigenous and other traditional knowledge systems" (UNFCCC, 2023, p. 10). Again, the language is there but the policies being considered in the document are market-based and thus, are foundationally antithetical to these aims.

Bias is readily apparent in the policies within the UNFCCC purported to directly address the reduction of carbon emissions. Both under the Kyoto Protocol as well as the Paris Agreement, policy discussions are limited to market-based solutions like a global carbon market

[25] COP28 is being held in the United Arab Emirates and will be led by an oil company CEO, prompting some to question the role of fossil fuel interests in the COPs even further (Kottasová, 2023). It is being touted as the last chance to meet goal of keeping warming to 1.5 degrees Celsius (Freedman, 2023).

and carbon offsets, "green growth" models, "net zero" commitments, and ex post facto technologies. Critics raise equity issues (e.g., Fremstad & Paul, 2019) and argue that such solutions perpetuate the paradigm that favors the status quo, both in terms of geopolitical power, economic inequality, and environmental degradation. These policies individualize the responsibility for mitigating climate change. Supported by historically large emitting countries, they reflect the predominance of the neoclassical framing of viable policy as "rational solution(s) to the problem created by climate externalities" (Nelson, 2009) and the dominance of the global North in framing the policy space. They are touted as good science and hailed by mainstream economists as real solutions. However, their effectiveness at actually reducing emissions and curbing climate change is uncertain at best[26].

The language used in policies is also ambiguous. Take for instance "net zero" commitments, which seek to equalize emissions produced and emissions absorbed. As of now, though countries are claiming their "net zero" commitments, there is no agreed upon definition. These commitments rely on carbon offsetting and technologies like carbon capture and storage that are unproven and "dangerous" (Harvey, 2023). Critics argue that such an approach incentivizes countries and corporations to offset, rather than cut emissions. Additionally, they push investments into "green" energy projects that can further degrade the environment and displace indigenous and local communities. There is also no agreed definition of climate finance, which is currently dominated by loans and includes elements not actually related to carbon emissions (Nature, 2021). The IPCC is clear that fossil fuels must be phased out, however, discussions on such a transition remain off the table (Kottasová, 2023).

[26] A recent assessment by the Berkeley Carbon Trading Project revealed that estimated greenhouse gas reductions in the largest voluntary carbon market were "dramatically exaggerated" (Corbett, 2023).

For instance, carbon markets and carbon capture, use, and storage (CCUS) technology are touted as "key" (UNFCCC, n.d.e) mitigation policies under the UNFCCC, despite much controversy about their provenance and proponents, as well as contentious histories and ineffectuality up to this point. The UNFCCC's reliance on carbon offsets in both the Kyoto Protocol (1997) and Paris Agreement (2015) exemplifies the influence of mainstream economic thought in the global environmental regime. The Kyoto Protocol was the first IEA purported to operationalize the UNFCCC through commitments of industrialized and emerging economies to reduce greenhouse gas emissions to agreed upon targets. The UNFCCC website underscores the importance of the establishment of "flexible market mechanisms" as additional means to meet national emissions targets by creating a carbon market. These mechanisms include the Clean Development Mechanism (CDM), Joint implementation (JI), and emissions trading. In explaining these policies, it employs rhetoric that almost perfectly mirrors the mainstream economic models that form the theoretical basis for such measures. For instance, they argue that market-based mechanisms "ideally" encourage abatement to "start where it is most *cost-effective*, for example, in the developing world" (UNFCCC, n.d.d). Use of terms like efficiency and cost-effectiveness are clear indicators of the pervasiveness of mainstream economic thought in this policy space. Correspondingly, there are benefits in "green" investment and technology transfer in the global South and the inclusion of the private sector to emission reduction efforts (UNFCCC, n.d.d). Beyond rhetoric, emissions trading is foundationally based on the supply and demand model and mainstream assumptions about how markets work.

In particular, carbon offsets through the CDM and JI were touted to ensure that the economic costs of reducing emissions were kept as low as possible. These mechanisms found support from fossil-fuel companies, conservative politicians, and NGOs such as the

Environmental Defense Fund alike who favored "efficiency" over "command-and-control" approaches (Chandrasekhar, 2023). Carbon offsets were "critical to [the Kyoto Protocol's] politics," especially in appealing to the United States (Chandrasekhar, 2023). Nonetheless, the United States subsequently declined to ratify the Kyoto Protocol and Kyoto based carbon markets collapsed in 2012. Though the real emissions reductions from offsets were questionable[27], a mostly unregulated voluntary market developed regardless. Despite these failures, carbon markets were further codified with their inclusion into Article 6 of the Paris Agreement of 2015 that established a new market mechanism to replace CDM and JI, illustrating the obstinacy of market-based solutions in global climate policy-making (Chandrasekhar, 2023).

CCUS has played a major role in the UNFCCC and the IPCC climate scenarios since its introduction in 2005 (Romanak et al., 2021). Opponents of CCUS argue that it is "a way for fossil fuel companies to continue business as usual while appearing to mitigate their emissions" (Romanak et al., 2021, p. 5). The chair of the IPCC in 2014 said that, "with [CCUS] it is entirely possible for fossil fuels to continue to be used on a large scale" (Rajendra Pachauri quoted by Krüger, 2017). On the other hand, proponents argue that it is a "major technology for achieving significant negative emissions" (Romanak et al., 2021, p. 5). In reality, CCUS deployment is lagging to reach Paris Agreement objectives (Romanak et al., 2021). For example in 2022, CCUS technology captured just 0.1% of global emissions (Stapczynki, 2023).

Recent research by Fremstad and Paul (2022) suggests that more neoliberal countries perform worse in addressing climate change. Speaking to the literature, popular and scholarly, that argues neoliberalism is at the root of the United States' and other countries' failure to

[27] A study by the European Commission found "that 85% of projects covered in the analysis and 73% of the potential supply of CDM credits from 2013 to 2020 are unlikely to deliver "real, measurable and additional" emission reductions" (Collet, 2017).

decarbonize, this paper holds that neoliberal ideology constrains the policy space in the United States (similar to the arguments in this paper, but at the national scale). They point to mainstream economists' skepticism of public investments as "inefficient," their "neoliberal blinders," and predilection to "promote carbon pricing as the only rational tool for reducing emissions" (Fremstad & Paul, 2022, p. 3). Specifically, it points to three tenets of neoliberalism that contribute to this constraint: (1) decentralized democracy (i.e., limited government action in exchange for markets); (2) defund public investment (i.e., against the state's ability to provide public goods and address externalities); and (3) deregulate the economy (i.e., minimizing state governments from regulating the economy) (Fremstad & Paul, 2022, p. 3). Ultimately, by diving deeper into how these three tenets work in the U.S., they point to how such philosophies constraint collective action on climate change.

Many scholars connect the prevailing economic system favored by the global North (i.e., globalized capitalism) as inextricably linked to climate change. The same dualistic thinking that underpins the economics of IEAs characterizes capitalism and dominates the UNFCCC. For instance, Shain (2013) points out that market-led approaches are complicit in neocolonialism and uneven development. Moreover, "the tendency under capitalism, state socialism, and colonialism for the powerful to keep coming out better off, and for exploitation of less-powerful people and of nature to accelerate, is the prime driver of climate change" (Perkins, 2019, p. 183). Allison (2017) argues, "the Western inheritances of moral and ethical reasoning are deeply entangled with the patriarchal and Eurocentric norms that have led to climate change" (p. 153). Western colonial legacies, "instead of treating the Earth like a precious entity that gives us life, operate within a paradigm that assumes they can extract its natural resources as much as they want and the Earth will regenerate itself" (Hadeel Assali quoted in Varanasi, 2022). These

histories of countries' interactions, both within the UNFCCC and outside of it, is an important factor in current negotiations. Beyond historical emissions, the history of capitalist globalization and colonialism factor into the global environmental conversation. Such legacies and dynamics are full of power relations both on the part of individual actors and collectives, pointing to inequality and power as important foci of insight in this domain.

Another feature of climate negotiations that has failed to be addressed meaningfully in the current economic paradigm is the influence of non-governmental bodies, namely multinational corporations. In the context of global climate change negotiations, the influence of the fossil fuel industry is of particular concern. At Glasgow in 2021 (COP26), fossil fuel lobbyists made up the biggest delegation at 500 representatives, larger than any single country's delegation (Lakhani, 2021). This presence has continued in subsequent COPs and begs the question of why representatives of fossil fuel interests are so prevalent and how influential these interests are in shaping the discourse and language in the policies.

Climate change is characterized by inequality and deep uncertainty and thus, exemplifies the importance of inequality as inextricable from global environmental policy. There are inequality issues across nations (in responsibility, capacity, and vulnerability), across social groupings, and across generations. These inequalities influence the negotiations and their outcomes in meaningful ways and thus, represent an important feature of global environmental cooperation. For decades now, negotiations have been stymied by debate over who should be held accountable for past and future emissions (McAfee, 2015). While countries are formally equal under the UN, their contribution to historical and future greenhouse gas emissions, development needs, and vulnerability to the effects of climate change vary significantly. Historically, the global North benefited from the use of the climate (i.e., emissions) to

industrialize and grow. In particular, the United States' cumulative carbon dioxide emissions since 1751 makes up 29% of historical emissions (Ritchie et al., 2020). Still today, industrialized nations remain among the largest emitters of carbon dioxide. However, emerging economies like China and India are becoming high emitters, with China's annual greenhouse gas emissions surpassing that of the United States in 2007 (Vidal & Adam, 2007). Developing nations, looking to grow and improve the standards of living for their populations, are now being told they must do so without the benefits of unfettered fossil fuel consumption that industrialized countries enjoyed. The technology to mitigate climate change is expensive and developing countries have less resources to adapt to its effects. On top of that, these effects are predicted to affect developing countries the hardest (IPCC, 2023).

To account for these inequalities, a guiding principle of the UNFCCC is the principle of "common but differentiated responsibilities and respective capabilities" (Bodansky, 2021). These inequalities were effectively recognized by the UN through formal Parties which had differing commitment under the Kyoto Protocol. Annex-1 parties are industrialized countries that were members of the OECD in 1992 and a few "economies in transition" at the time (UNFCCC, n.d.a). Non-Annex I parties, on the other hand, are "mostly developing countries" (UNFCCC, n.d.a). Under the Kyoto Protocol, Annex I countries were legally bound to reduce missions while non-Annex I countries simply had to report emissions.

Today, under the 2015 Paris Agreement, the UNFCCC takes a "more nuanced" approach to differentiation. It establishes the same basic obligations for all parties and allows for "self-differentiation" (Bodansky, 2021) through parties' Nationally Determined Contributions (NDCs). In addition, it offers flexibility for developing countries based on lack of capacity. For instance, Least Developed Countries (LDCs) and Small Island Developing States (SIDS) are

exempt from mitigation requirements. Additionally, Article 4.4 calls for "developed country parties [to] undertake absolute economy-wide emission reduction targets, with developing countries encouraged to move towards such targets over time" (Bodansky, 2021).

Likewise, climate finance obligations (funds to help developing countries invest in mitigation efforts) are only on developed country parties under the Paris Agreement. The history of the UNFCCC's facilitation of such funds is marked by years of obstructionist tactics by developed countries and mistrust from developing countries upon establishment. For instance, in 2009 wealthy countries promised $100 Billion annually by 2020 and yet, have failed to come even close to this target[28] (Abnett, 2023). There seems to be even more conflict with respect to a "loss and damage" fund that would compensate developing countries responding to and recovering from "unavoidable" climate impacts caused by historical emissions (Climate Council, 2022). After 20 years of debate, it was only at the 27th COP in 2022 that it was agreed to establish such a fund. Operationalizing and financing of this fund is set to be negotiated at COP28 in 2023, but "trust is in short supply" (Nature, 2023) given the history of climate finance funding thus far.

The inequality of climate change can also be understood along social lines such as gender and race. The unequal effects of climate change on women and Indigenous peoples across the world has only recently been recognized at the UNFCCC (Denton, 2002; Nelson et al., 2002; Allison, 2017). This recognition follows decades of advocacy and calls for a "seat at the table" for women and Indigenous peoples. Nowadays, the Convention does recognize "constituencies" which include Indigenous peoples' organizations, women and gender groups, along with Youth NGOs (UNFCCC, n.d.a). The UNFCCC describes these groups as "those whose actions are

[28] In the meantime, members of the G20 group's public financial support for fossil fuels more than doubled between 2019 and 2022 (Nature, 2023).

needed to deliver the goals established but who do not have legal obligations arising from the treaty" (UNFCCC, n.d.c). However, they are recognized only as "non-Party stakeholders" and given observer status. The roles such constituencies can perform are limited to the exchange of information with the secretariat, ensuring effective participation, and facilitating interactions at sessions, among others.

Interestingly, the Paris Agreement uses the language of equity and inclusion. The opening language, "affirm[s] these unequal vulnerabilities and policy effects" and recognizes the "specific needs and special circumstances of developing country Parties" (UNFCCC, 2015). Furthermore, "…that Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it" and that,

> "Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as gender equality, empowerment of women, and intergenerational equity." (UNFCCC, 2015)

Despite this language, actual policy tools within the Paris Agreement remain constrained to market-based ideals, giving credence to Greta Thunberg's assertion that, "This is not a conference. This is a Global North greenwash festival" (Democracy Now!, 2021).

Power is also exerted in this geopolitical arena, especially by large emitters whose cooperation is important to reaching global emissions targets. This is exemplified by the actions of both the United States and China over the years. Until 2015, China, though already a top

carbon emitter, refused responsibility as a developing nation on equity lines (Mazzocco, 2021). The position that China "…cannot blindly accept that protecting the climate is humanity's common interest (Yu Qingtai, China's special envoy on climate change, quoted by China Dialogue, 2010) and that common but differentiated responsibilities takes primacy defined China's approach. Now, still positioning itself with the G77, it wants to be a climate leader, especially for developing nations. In 2015 in Paris, for instance, Chinese President Xi Jinping declared climate change "a shared mission of all mankind" and by 2017 said, "Taking the driving seat in international cooperation to respond to climate change, China has become an important participant, contributor, and torchbearer in the global endeavor for ecological civilization" (quoted by Oxford Institute of Energy Studies, n.d.).

The United States' storied history in global climate talks is well known. The fact that "…the U.S. has been the absolute dominant force throughout all of this," (climate negotiations historian, Joanna Depledge quoted by Borenstein, 2022) is no secret either. For many years, it pushed back against binding targets and timetables and lead the disagreements about common but differentiated responsibilities. Its stalling was so ongoing that a delegate from Papua New Guinea famously told the U.S. to "get out of the way" if it doesn't want to lead the international climate response (UNFCCC, n.d.b). In the end, the United States acted as a lead for both the Kyoto Protocol and the Paris Agreement yet backed out of both under a change in administration. Indeed, it wasn't until a side agreement by the United States and China that the Paris Agreement was able to be settled (Borenstein, 2022). Overall, the important role of power relations in global climate negotiations is quite clear.

Many argue that the individualization of climate responsibility serves to diminish collective forms of action and reinforce unequal power relations that underlie the problem (Bee

et al., 2015). Epistemologically, the "the detachment of neoliberal climate governance from everyday spaces and subjectivities ignores and obscures the lived experiences, knowledges, access, responsibilities, and roles that make up the actual subjects and subject positions that are gendered, classed, raced, and otherwise differently situated" (Bee et al, 2015).

Collective action and cooperation between countries is also a defining component of the UNFCCC. Negotiating groups, formed by countries, and formally recognized by the Convention, exist along the development divide. Developing nations work collectively through the "Group of 77 (G-77)" to establish common negotiating positions. China positions itself as a leader in this group and often the shared positions are likened to "speaking for the G-77 and China as a whole" (UNFCCC, 2023). Beyond shared positions, this collective also exhibits shared actions. For example, contention over loss and damage funding lead the G-77's lead negotiators to walk out of negotiations in Warsaw in 2013 (UNFCCC, n.d.b). There are also smaller coalitions within the G-77 such as the African Group, Small Island Developing States (SIDS), and Least Developed Countries (LDCs). SIDS is made up of low-lying islands particularly vulnerable to sea level rise. The LDC group comprises 49 parties characterized by limited capacity to respond and adapt to climate change. Each of these groups serve to communicate the collective interests of their parties and meet outside the annual COPs to determine them (UNFCCC, n.d.a).

The complexities surrounding and within the UNFCCC demonstrate the need for models that can better understand issues of inequality, power, and collective action. Additionally, it demonstrates the pervasiveness of andro- and anthropo- centric biases in the global geopolitical conversation. If these dimensions of inequality and power are not addressed *in meaningful ways*, we risk further stalling negotiations, undermining the efficacy of policies, and further

marginalizing already vulnerable populations (Chinn, 1999; Lakhani, 2021). In fact, these realities point to the real harm continuing down the business-as-usual[29] path can cause. Thus, the next section will explore how feminist philosophy can help to address these complexities and move beyond the techno-scientific, androcentric framing of the climate crisis more thoroughly.

2.6 Toward a Feminist Foundation for the Economics of IEAs

This paper demonstrates the need to understand the contexts (social, political, cultural, and historical) that shape countries' motivations and behaviors on IEAs and points to the need for a broader approach to the economics of IEAs. Feminist philosophy offers a response to the androcentrism of the economics of IEAs described throughout this paper. In particular, understanding IEAs with a feminist lens allows for both a widening of our understanding of country behavior to include non-utilitarian and other-regarding motivations (like power, conflict, and cooperation) and an opening up of the policy space to include non-market solutions, marginalized perspectives, and systematic change. Indeed, the recognition and inclusion of context, values, and ethics enables us to include values like environmental justice and ideas that call for fundamental change that many deem necessary (including the IPCC; IPCC, 2023) to combat today's most pressing environmental issues.

Feminist knowledge emerges from a "...deep skepticism about universal knowledge claims" (Tickner, 2005, p. 4). It holds that Western science and philosophy have elevated and fetishized the objective view into "...a romantic belief in the possibility of connection-free knowledge from an outside-of-nature, perspective-free viewpoint" (Allison, 2017, p. 6). Instead, a central tenet of feminist thought is that knowledge is situated (Anderson, 2020; Grasswick,

[29] "Indeed, the term "business as usual," which the IPCC uses to describe a future in which governments take no collective action to avert the climate crisis, itself represents a neoliberal view of the economy, since it suggests that people are passive particles that respond to economic forces rather than active agents that continuously shape the economy" (Fremstad & Paul, 2022, p. 1).

2011). This concept posits that one's social location (with respect to social constructs like gender but also, race, class, etc.) frames one's knowing. In other words, "what is known, and how it is known, reflects the situation and perspective of the knower" (Anderson, 2020). This "situatedness" (Anderson, 2020) affects access to information and furthermore, the representation, form, attitudes, standards, and authority of knowledge. Along these same lines, power relations are particularly significant. With situated knowledge, power relations matter in that social stratification has epistemic effects (Grasswick, 2011).

It follows, then, that scientific knowledge is situated. Science and its philosophies are a part of their social and historical contexts (Harding, 2015). In other words, science itself is subjective and comes from the point of view of the dominant social group. The central assumptions of philosophy of science that dominate scientific and academic inquiry today are grounded in modernization theory of the late 19th Century. Namely, what dominates science nowadays is the idea of value-free objectivity and rationality; namely, logical empiricism or logical positivism. The dominant social group from which these philosophies originate is Western and characterized by masculinity.

> "The positivism of scientific inquiry, the ideal, would posit the existence of a disinterested, detached, neutral observer is itself reflective of the androcentric nature of knowledge creation. This view of knowledge gained ascendancy because of claims that positivism is science." (May, 2002, p. 56)

Feminist epistemology points out the importance of recognizing that knowledge is never neutral and that the processes by which knowledge is generated and applied are deeply shaped by social and cultural contexts and histories. Accordingly, a significant approach in feminist philosophy is standpoint theory, which begins from the recognition of social inequality (Harding,

1995). Standpoint epistemology holds that not only is knowledge situated and shaped by hierarchical culture, but that the standpoint of the oppressed is particularly perceptive due to its position outside of dominant frameworks. As opposed to the traditional, androcentric notion of "objectivity" as a value-neutral "view from nowhere," feminist epistemologists offer "strong objectivity" as a metric for knowledge. Rooted in standpoint theory, strong objectivity recognizes that objectivity as a concept in itself is not value-free but comes from the point of view of the dominant social group (read: the androcentric global North). Accordingly, it advocates for research to start outside dominant frameworks as, "finding or creating even just a little distance from prevailing assumptions and interests can be sufficient to enable critical perspective to illuminate issues in new ways" (Harding, 2015, p. 35). This can be done by beginning with the daily lives of the oppressed.

Applying this to international environmental negotiations means recognizing that today's sciences are interconnected with everyday social and political policies and practices, "...especially those promoted by corporations, militaries, and nationalisms–by the most powerful forces within states and around the globe" (Harding, 2015, p. 37). A feminist epistemological approach situates the economics of IEAs within this geopolitical context and thus, pays particular attention to inequality's role in shaping the discourse and policy space. In this respect, the marginalized experiences that offer insight include developing countries (especially LDCs and SIDS) and social groups such as Indigenous populations, racial minorities, and women.

Moreover, the concept of country behavior expands to include motivations in addition to self-interest. Foundationally, feminist theory sees the world in terms of social constructions (Lapniewska, 2018). This distinction makes room for theories of country behavior that view countries as socially situated and complexly motivated. We can conceptualize countries as a

"node in a web of relation" (Allison, 2017, p. 153) and institutions (like the UNFCCC) as a complex net of social relations. Furthermore, it allows us to understand IEAs themselves as socially constructed and value-laden within the dominant paradigm. Countries are embedded[30] in social, political, and economic structures (which are not separate) that determine their possible choices (Urban and Purckhauer, 2016). Countries are connected and concerned with the well-being of others. In addition to self-interest, there is other interest (Nelson & Morgan, 2020). Interdependence becomes a core assumption (Lapniewska, 2018). Countries evolve complex systems of norms like reciprocity, fairness, solidarity, and cooperation, allowing for long-run benefits to matter in decision-making (Dash, 2014).

Feminist theory centers power as a central driver of a country's economic and social dynamics. This enables critical issues like income inequality and colonialism to be addressed. Feminist theory also enables the recognition of power relations other than those between countries to matter in the international arena. Notably, it enables the study of actors such as multinational corporations and their interests. Furthermore, power relations across dimensions such as class, race, and gender (and their intersections) are important objects of study. Especially, we can recognize the importance of collective action as a source of power. For instance, research has shown the transformative nature of women's collective action for themselves and their communities (Arora-Jonsson, 2014).

Feminist thought also expands the available policy options. Beyond the dominant paradigm, non-market alternatives can be considered and incentives other than self-interest can be appealed to. It allows for moral considerations like fairness and human rights. In recognizing

[30] The concept of embeddedness was popularized by economic sociologist Karl Polanyi who considered the economy, "...as the institutionalized interaction between human beings and their natural surroundings and with each other in satisfaction of their material wants" (Lacher, 1999, p. 316) and as embedded in social relations and institutions (Gemici, 2007).

the social dimensions of environmental issues, feminist thought can contribute to more just policies that embrace the concerns, perspectives, and practices of marginalized groups. By centering inequality and power, there is less risk of such policies worsening their environmental burdens. Instead, they can harness the (often ignored as illegitimate or inferior) knowledge of local communities that are on the forefront of environmental crises. The same aspects that make women and Indigenous peoples more vulnerable to environmental degradation - reliance on ecosystem services for example- can be envisioned as pathways to environmental policy that promise real results in the lives of the most afflicted.

Feminist philosophy allows for policy objectives beyond economic efficiency and growth. Indeed, it allows us to move beyond the growth paradigm[31] that has perpetuated much of the inequality and environmental issues discussed throughout this paper. Feminist theory goes beyond the mainstream ideal of individual choice and views economics as a study of how societies organize themselves to provide for the survival and flourishing of life (often referred to as provisioning in the literature). In this vein, some propose post- or de- growth economics as a strategy. In these approaches, the very idea of what prosperity means, especially while living within our environmental limits, is redefined. Goals of such approaches go beyond traditional economic indicators and can include health and the human right to a clean environment. These policies, in recentering the focus, could lend to the changes in our mind-sets that many believe are necessary to a sustainable future (Nelson & Morgan, 2020).

Another example is the idea of commoning, often talked about within ecofeminist circles. This idea is not new, of course. Community based sustainable management of resources has

[31] A recent survey of approximately 800 climate policy researchers "reveals widespread skepticism toward the concept in high-income countries, amid mountain literature that the principle may neither be viable nor desirable" (Savin & King, 2023).

been a scholarly topic for quite some time and there are many examples of humans living within such relationships. Elinor Ostrom's works on the commons set out to "illustrate the diversity of solutions that go beyond states and markets" (Ostrom, 1990, p. 2). Collective governance systems under a commoning approach (versus privatization) are said to maintain livelihoods for the communities who rely on commonly held resources and are "increasingly recognized by climate justice activists and scholars as key to equitably meeting the challenges of climate change (Perkins, 2019, p. 184). Indeed, development planners and policymakers have realized that collective management of natural resources can be more efficient and productive for the market than privatization (Federici, 2010).

Another alternative policy framework comes in the "Climate Justice" movement that has gained global prominence in recent years. Many have come to understand climate as an equity issue (Perkins, 2019) and climate and inequality as "inextricably linked" (Fremstad & Paul, 2019, p. 88). Indeed, global climate justice is conceived of as an underlying issue and inequality as an unavoidable part of global climate politics (Schlosberg & Collins, 2014; Yang, 2022). Thus, there are increasing calls for policies that account for the distributive concerns and center marginalized voices. In this movement, humans are seen as embedded in the larger wholes of society and nature. Climate change is "fundamentally an issue of human rights and global justice" (Gach, 2019, p. 2). They see equity as central to creating institutions that will reduce carbon emissions. In this approach, a central goal is to reduce material throughput, changing the fundamental nature of our economic systems. By recognizing the disparities in vulnerabilities, human rights impacts, and social inequalities, many see Climate Justice as key to the politics of addressing climate change (Perkins, 2019).

Most likely, a feminist IEA would approach the problem with an ethical foundation of care (Dengler & Strunk, 2018; Cohen & MacGregor, 2020), accounting for intercountry, intergroup, and intergenerational inequities and extending such care to nonhuman nature (Gaard, 1993). Degrowth policies also call for a recentering of society around care (Dengler & Strunk, 2019). It would develop ethical theories and responses guided by the local, lived experiences of the most vulnerable to the environmental problem at issue (Allison, 2017). An IEA based on the feminist philosophy would, first and foremost, identify the social values, interests, and assumptions being made upfront. It would recognize that there are multiple scientific and technical expertise's (including, for instance, Indigenous knowledge). Such policies would be based on social connectedness and inclusion. They would promote diverse voices and perspectives at the negotiating table *with real voting power*. Additionally, it would recognize the value of unpaid labor and the unequal burden of this labor on women. Altogether, such an approach, in taking a stance that is markedly outside of the current global economic paradigm, would work toward breaking down the predominance of androcentric and anthropocentric Western ideals in the global environmental arena.

2.7 Conclusions

Feminist standpoint epistemology allows us to understand the dominance of neoclassical foundations in the economics of IEAs. By revealing a geopolitical context dominated by the masculinist, Western ideals of the global North of science, individuality, and capitalism, this chapter highlights the limitations and risks of a narrowly focused economic paradigm for global environmental cooperation. Climate change is just one example of these limitations and influence of mainstream economic thought.

Feminist thought offers an expansion of the conceptual space to include ethical considerations that are increasingly important in global environmental negotiations. In fact, by understanding IEAs and countries as socially situated, feminist approaches allow us to address the inequalities that are currently ensnaring global negotiations. Thus, future research to address epistemological biases in environmental policy is warranted. Given the foundation outlined here, this future work should strive to inform a feminist approach to the economics IEAs through deeper research into the inequalities and power relationships present in global environmental issues. Furthermore, researchers should focus on policy solutions informed by these inequities and the lived experiences of the most vulnerable populations.

Activists from across the world have been calling for systemic change for a long time. Indeed, official language from the UN calls for "radical, systematic change" to combat climate change (UNFCCC, 2023). We cannot achieve such change if we do not venture outside the very paradigm that created the problem in the first place. Feminist standpoint philosophy and economics, in its ability to both more accurately explain global environmental negotiation in action as well as inform the design of IEAs in more just ways, offers such a viable alternative.

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Chapter 3 – To Space, For Earth: An Exploration of Prosocial and Environmental Motivations in the Space Tourism Market

3.1 Introduction

"I believe that space travel will one day become as common as airline travel is today."

-Buzz Aldrin[32]

Commercial spaceflight and space-based economic activity are no longer infant industries or fragmented markets. They are quickly culminating into the "space economy[33]" (see Denis, et al. 2020 for an overview of the space economy "ecosystem"). With commercial juggernauts like SpaceX, Virgin Galactic, and Blue Origin testing and launching crewed vehicles monthly and an estimated $464 billion market value for the space economy in 2022 (Euroconsult, 2023), we are likely only a matter of decades away from the future envisioned by Buzz Aldrin (at least to some extent).

The new commercial space economy is not just for professional astronauts. Recent suborbital space flights by Virgin Galactic and Blue Origin founders Richard Branson and Jeff Bezos, are said to be "...kicking off a new era of space travel in which billionaire-backed companies offer the high-flying excursions to anyone who can afford it" (Wattles, 2021). Since then, Bezos' Blue Origin has flown 22 successful flights on its reusable New Shepard vehicle (Blue Origin). Branson's Virgin Galactic flew its first trip with paying customers in August 2023 and has a backlog of around 800 private astronauts to follow (Virgin Galactic; Foust, 2023).

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[32] Aldrin, B. and Abraham, K. (2009). *Magnificent desolation: The long journey home from the moon*. A&C Black, p. 165.

[33] Defined by the OECD as, "...the full range of activities and the use of resources that create value and benefits to human beings in the course of exploring, researching, understanding, managing, and utilizing space" (OECD, 2012)

This particularly interesting portion of the new space economy, the space tourism market, represents an avenue for the everyday human to become a space traveler. The space tourism market represents a remarkable study for economists. For one, it is a wholly new market to study. Furthermore, there are many potential sources of market failures. For instance, space is a gargantuan, common property resource in which there are potentially many negative and positive externalities to account for and in which property rights are ill-defined. Likewise, regulatory frameworks are currently trailing commercial development despite the transition of space exploration from the public to the private sector being well under way.

The focus of this work is on the suborbital space tourism (SST) market. In particular, the emphasis is on what motivates humans to become a space tourist - i.e., push factors of the space tourism market demand curve. This paper looks at a special case of space tourism, that of "Citizen Astronaut" candidates, who applied in 2019 for the chance to fly suborbitally through the nonprofit organization Space for Humanity. This group of space tourists applied with the expressed purpose of using their flight experience "...for good on Earth..." (Space for Humanity) and represents a compelling case of prosocial motivations for space tourism in a market that many consider to be the playing field for only wealthy adventurers.

This paper investigates the influences of these motivations using Citizen Astronaut Program application data. Particular attention is given to the pro-environmental aims of these candidates and how applicants' gender, age, region, and skills shape these motivations. Understanding the motivations and characteristics of space tourists will better help us to understand demand in this market as it matures as well as how regulation might affect the market. Furthermore, this group of space tourists represent a special case of tourists that have an

inclination for environmental and humanitarian motivations for their space flight, pointing to the potential of positive externalities in this market.

With these aims in mind, the paper starts with a brief overview of the economic literature on space economics, tourism economics, and the space tourism market itself. Next, a brief section on Space for Humanity and the Overview Effect provides background for the data being analyzed and the philosophical underpinnings of Space for Humanity's work. Data collection is then described alongside summary statistics of relevant variables. There are two core statistical models used to analyze the data, both described in the methodology section. The next elucidates the results of these models and discusses emerging trends from the data. Lastly, the paper concludes with a discussion of future work in this growing research base. Further information, including the application questions (i.e., the survey), can be found in the appendix.

3.2 Literature Review

In exploring the motivations behind SST from the economic perspective, it is important to position this paper within the surrounding literature. Thus, what follows is a review of the tourism economics literature (providing a conceptual framework), space tourism studies, and a brief overview of the emerging literature in the economics of space. Lastly, a review of the concept of the Overview Effect as it relates to environmental and prosocial motivations concludes this section.

Tourism Economics

Tourism economics has a rich history and established body of literature and thus offers a conceptual framework for new studies in space tourism such as this chapter. Tourism is defined by the United Nations World Tourism Organization as, "...a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual

environment for personal or business/professional purposes" (UNWTO). According to Song et al., "...as far as both its demand and supply are concerned, tourism has distinct characteristics which set it apart from other economic activities" (2012, p. 1). In reviewing the multitude of literature reviews in this field (Khaidi et. al. 2019; Song et al., 2012; Lim, 1997), it can be said that this particular field of economics largely studies tourism demand and supply along with their component parts.

Demand studies make up the largest part of this literature. Following from neoclassical foundations, much of this research studies the budget lines of consumers and prices in the market. Within the empirical literature here, common determinants include the income of origin country/region, the own price of destination, and the substitute prices of alternative destinations. Concurrently, demand elasticities are an important topic as well (Song et al., 2012).

Tourism motivation is another common theme in this literature and the area most related to this work (Pearce, 2014). Defined as, "the sum of biological and sociocultural forces which energize and generate people's behavior...", what motivates consumers to travel in this first place is pertinent to understanding demand. Pearce (2014) points to newer work in psychology that describes motives for tourism based on individuals who seek to maximize their overall state of wellbeing (which involves not only their sensory pleasures but achievements such as respect, status, altruism, zest, etc.). The particular set of individuals studied here represent tourists motivated by prosocial considerations and thus present an interesting case for study.

Space Tourism

Within academic and commercial spaces, there are a number of studies of space tourism which, for the most part, consist of market research in tourism journals and by private companies (Zhang & Wang, 2022). A small subset of this literature takes a conceptual look at the economic

and political implications of a space tourism market. Musselman and Hampton (2020) identify five factors being studied in space tourism literature: demand, ticket cost, motivation and risk, health risk, and policy. Of most interest here are the studies that target motivations and characteristics of potential space tourists. As Reddy et al. (2012) points out, there are essentially two sides (or factors) that influence people's motivation to undertake space travel: push factors (socio-psychological motives) and pull factors (specific product attributes). Given that Space for Humanity is "vehicle agnostic[34]" (Space for Humanity), this paper focuses on push factors.

There are several common themes across these motivation studies, notably with respect to the Overview Effect and adventure. In early research, Barrett (1999) found that viewing Earth from space and looking deeper into space were the key motivations for survey respondents to undertake SST. An early market study also found that a majority of respondents (e.g., 63% of United States respondents) said that viewing Earth from space was the biggest attraction for taking a spaceflight (Beard et al., 2002). Le Goff and Moreau (2013) point to key words in survey responses such as "adventure", "happy", "few" and "new frontier". Reddy et al. (2012) surveyed South England residents on their perceptions of space tourism and also found the need for adventure and exploration as motivational forces in the market. Additionally, they found that over 66% of respondents rated 'vision of Earth from space' as very important in their reasoning for potentially undertaking a space flight. Laing and Frost (2019) note several motivations including thrill-seeking, challenge, curiosity, spirituality, and even a "desire to motivate and assist others".

[34] Space for Humanity is "vehicle agnostic" in that they are not partnered with any particular vehicle or flight provider but instead work with many flight providers (like Blue Origin, Virgin Galactic, Space Perspective, and World View). Thus, a study of pull factors would involve multiple vehicle and flight experiences across the space sector.

Other studies focus on the demographics of space tourists. Overall, demand studies undertaken in Japan, the United States, Canada, Germany, and the UK suggest that around 40-80% of respondents had interest in space travel (Crouch et al., 2009). Crouch et al., (2009), in a stated-preference, discrete choice experiment on different types of space tourism, found that this demand depended on characteristics such as gender, age, risk-taking behavior, and education. They found that females expressed less interest than males, interest declines (at an increasing rate) with age, and previous risk-taking behavior was positively associated with space travel demand. Additionally, respondents with higher educational attainment were more likely to demand SST (Crouch et al., 2009). A recent example in this literature is a meta-analysis performed by Musselman and Hampton (2020). This work looks across various projects that considered demographics (such as country, gender, and wealth) as explanatory variables for SST demand. They find that gender is important, concluding that men are more likely to see SST as "useful". They also find that United States citizens are the most likely participants in the market compared to other countries. They also find that European respondents are more likely to be reluctant to fly due to environmental and safety concerns, while Chinese and American respondents are not affected by these concerns. Similar conclusions about such concerns were also found in Le Goff and Moreau (2013).

Frost and Frost (2022) is of particular interest here as they explore prosocial and environmental motivations of frontier tourists[35]. This paper looks at the juxtaposition of travel motivations and the environmental sustainability of travel. They aim to address the gap of the "deleterious environmental implications of spaceflight and the negative impact that this might

[35] Defined by Frost and Frost (2022) as, "individuals who undertake extraordinary experiences involving travel that is expensive, difficult and high-risk, with a high degree of pre-planning and preparation and in locations that lack established tourist infrastructure and are not geared up for mass tourism" (p. 2255).

have on demand and the economic viability of this industry" (Frost & Frost, 2022, p. 2255). This is not the only research to point to the paradox of space tourism and environmentalism (see Spector & Higham, 2019 for instance). Reddy et al. (2012) found that of those not interested in spaceflight only 9% referenced concerns about the environmental impact of travel to space. However, some did respond with the notion that the view of Earth from space would help build understanding about its environmental problems and noted that "environmental credentials" of space tourism companies are relevant to their consumption decision (Reddy et al., 2012, p. 6). Frost and Frost (2022) discuss the concept of "ambassadorship" in that, "...operators may follow the lead of their counterparts in the Antarctic tourism industry and promote the idea of a space tourist as an 'ambassador' for environmental issues" (p. 2257). This concept is important here due to the source and particular nature of the data studied in this paper (see Section 3). What can be said about this disputed concept[36] is that a deeper understanding through research is needed to determine its efficacy (a motivation for this paper).

In terms of economic literature outside of tourism and space journals, there are few papers thus far that look specifically at space tourism from an economic perspective. Early work in this area mostly consists of studies of the economic feasibility of SST and pricing (Collins & Ashford, 1988; Parkinson, 2006). Of note are some conceptual studies that focus on the macroeconomic benefits of space activities. Collins (2002) investigates the potential contribution of passenger space travel to world economic growth. Taking a markedly anti-government space agency perspective, Collins argues that the commercialization of space, especially passenger space travel, offers a new arena for economic expansion and thus, world economic growth. Likewise, Collins and Autino (2010) argue that the space tourism industry

[36] There is existing controversy in the literature here on whether such heightened environmental attitudes are long-lasting or result in changed behavior (Frost & Frost, 2022).

could be economically (and socially) beneficial through its employment effects in aerospace and related fields.

This study is a unique contribution to the emergent field of space economics. Sitting at the intersection of the space and tourism fields, it explores a unique dataset to understand more deeply what lies behind prosocial and environmental motivations (i.e., a unique push factor) for space tourism. Additionally, it can help us to gain a deeper understanding of the "ambassadorship" model.

The Economics of Space

The economic study of space and space-based activities in general is still in its early stages. Given the level of activity in "New Space[37]" and the projected size[38] of this unique economy, it is surprising how little economic literature exists on the subject. For the most part, studies in economic journals that focus on space study the commercialization of space and the potential for economic benefits that follow from commercialization. An early example comes from Sandler and Schulze (1981) in which they explore 'outer space' as a new natural resource. They define space as a common property resource and note the possibility of allocation issues due to externalities and public goods problems. They also correctly identify the (nonexistent at the time) private space economy as one exhibiting the characteristics of a natural monopoly, pointing to the need for regulation. Lastly, they look at the effect of space activities on Earth's economic growth and distribution of wealth. In a more recent example, Greason and Bennet (2019) discuss the commercial benefits of space-based activities and argue that the move from

[37] New Space is an "...umbrella [term] for a movement and philosophy encompassing, but substantially broader than, an emergent, somewhat more visible and defined, private spaceflight industry" (Martin, 2017).
[38] "Morgan Stanley estimates that the global space industry could generate revenue of more than $1 trillion or more in 2040…" (Morgan Stanley, 2020).

exploration to commercialization will result in higher quality of life and decreased cost of living across the economy.

An emerging theme in the literature is that of market failures. Weinzierl (2018) points out something very important in looking at the transition of space from a centralized to decentralized market - the regulatory landscape. It looks at the sparse regulatory landscape and notes that existing international treaties 'neither endorse nor prohibit" private resource use and procurement in space[39] (p. 189). Rightfully so, Wienzierl expresses concern on the incentives and conflict with overarching societal goals these types of property rights (or lack thereof) create. Another market failure studied in the space economy is externalities. For example, Salter (2015) and Adilov et al. (2015) both examine orbital debris as either a public goods or an externality problem, respectively.

Other studies use economics to explore the feasibility of space-based activities. For example, Webb (2016) looks at the economics of reusable space transportation and Sommariva (2014) tackles asteroid mining. Lastly, it would be remiss to cover the economics of space without mention of Krugman's exercise in trade theory, "The Theory of Interstellar Trade" (2010) in which "two useless but true theorems are proved" with respect to speed-of-light travel. What can be said about the economics of space, as can be seen here, is that it is still in its early stages and thus, quite disjointed and open for researchers interested in a variety of economic phenomena. This work, in focusing on the market failures particular to consumer demand for space tourism (i.e., citizen astronauts), is a new avenue within this space.

The Overview Effect and Environmentalism

[39] Though the 1967 Outer Space Treaty encourages cooperation on the responsible use of space resources, it does not enforce it. Additionally, the United States Commercial Space Launch Competitiveness Act of 2015 gives what I like to call "finders-keepers" rights on planetary bodies. That is, whoever gets there first gets the rights to the resources.

Space for Humanity subscribes to the ambassadorship concept outlined in Frost and Frost (2022). Indeed, it appears that the idea that their citizen astronauts will translate their experience of spaceflight into impact projects is fundamental to their mission. The other fundamental concept that underlies their mission is that of the Overview Effect. According to many space enthusiasts and futurists, a future in which space-based activities are increasing will have far-reaching effects on life on Earth. One of those effects is the Overview Effect - the profound shift in perspective and understanding (reported by many astronauts and cosmonauts) experienced when seeing the planet Earth from space (White, 2014). Take it from Neil Armstrong,

> :"It suddenly struck me that that tiny pea, pretty and blue, was the Earth. I put up my thumb and shut one eye, and my thumb blotted out the planet Earth. I didn't feel like a giant. I felt very, very small (Space Center Houston, 2019)."

The Overview Effect theory was first postulated by space philosopher Frank White in his 1987 work and principal reference on the concept, *The Overview Effect: Space Exploration and Human Evolution.* In the most recent edition of this work, the Overview Effect is defined as

> "…a cognitive shift in awareness reported by some astronauts and cosmonauts during spaceflight, often while viewing the Earth from obit, in transit between the Earth and the moon, or from the lunar surface. It refers to the experience of seeing firsthand the reality that the Earth is in space, a tiny, fragile ball of life, 'hanging in the void,' shielded and nourished by a paper-thin atmosphere. The experience often transforms astronauts' perspective on the planet and humanity's place in the universe. Some common aspects of it are a feeling of awe for the planet, a profound understanding of the interconnection of all life, and a renewed sense of responsibility for taking care of the environment." (White, 2014, p. 2)

Thus, the Overview Effect gives many astronauts what White calls the "Overview Perspective" - that, "the Earth is a living, breathing organism, a whole system of which humanity is a part"[40]. Though not reported by every astronaut, this cognitive shift can be thought of as a change in worldview or identity (Kanas, 2020; Stepanova et al., 2019; White, 2014;). In general terms, a worldview is defined as, "...a paradigm by which the individual or the group interprets reality and acts upon life[41]". One's worldview is the foundational framework upon which beliefs, attitudes, and ultimately, choice and action, are built. Worldviews can be individualistic or collectivistic, depending on the social context and culture in which it is formed. It is connected to one's identity, which too is both individually and socially oriented (Akerlof & Kranton, 2000). The Overview Effect shifts one's worldview from individualistic to more collectivistic through an increased sense of connectedness (Stepanova et al., 2019).

Proponents argue that there is much more to the Overview Effect than just the spaceflight experience. Along with reporting a change in worldview, many astronauts report a compulsion to communicate their new perspective and become environmental stewards upon their return home (Kanas, 2020; Voski, 2020). As Apollo 14 Astronaut Edgar Mitchell said:

> "You develop an instant global consciousness, a people orientation, an intense dissatisfaction with the state of the world, and a compulsion to do something about it. From out there on the moon, international politics look so petty. You want to grab a politician by the scruff of the neck and drag him a quarter of a million miles out and say, 'Look at that, you son of a bitch'." (People, 1974)

[40] This quote comes from a personal interview with Frank White.

[41] Abi-Hasem, N. (2017) The concept of worldview. In Leeming, D. (eds.), *Encyclopedia of Psychology and Religion*. Springer, Berlin. https://doi.org/10.1007/978-3-642-27771-9_9357-6

And it is in these compulsions, and importantly, the communication of this perspective, that proponents believe will result in widespread social change. The introduction of the principal text is quick to point out that, "the impact of the Effect is not limited to space travelers alone; communication of their experiences to others supports social transformation" (White, 2014, p. 3). White proposes that the Overview Effect will ultimately cause a cognitive shift at the planetary level, which he argues follows an exponential curve much like the diffusion of new technology. The core argument White posits is that it is not necessary that every individual experience spaceflight. Instead, the communication of the perspective underlies the potential to affect society (White, 2014). In other words, the theory of the Overview Effect proposes that space travel has hidden positive social value.

Many argue that the modern environmental movement was catalyzed by space exploration. They cite the Apollo Program and the imagery that it produced as influential. Namely, the "Earthrise" and "Blue Marble" images are significant in this respect. "Looking back, it is possible to see that Earthrise marked the tipping point, the moment when the sense of the space age flipped from what it meant for space to what it meant for the Earth" (Poole, 2008, p. 8). Take the "Earthrise" photo, for example. Called "the most influential environmental photograph ever taken…" (MIT Media Lab, 2018), it captures a partially in shadow, swirling blue Earth with the surface of the moon in the forefront. Taken in 1968 during the Apollo 8 mission, this image is recognized as a major factor in spreading the Overview Effect and activating the growing environmental movement of the 1960s (McQuaid, 2010; Poole, 2008).

Therefore, it is not a coincidence that the first Earth Day was celebrated only months after the publishing of this image. Between 1969 and 1972, seven major environmental organizations were founded, environmental lobbying began, and the Environmental Protection

Agency was founded in the United States. The power of this image even made its way to the United Nations where concepts such as "Spaceship Earth" and the convening of the first Earth Summit in 1972 took center stage (Poole, 2008).

Kanas (2020) provides an empirical basis for the Overview Effect by studying differences in pre- and post- spaceflight values of 39 astronauts and cosmonauts and reports "at least some positive change" as a result of flying in space (p. 526). The results suggest that the largest (and statistically significant) change reported was in the perception of Earth, with some reporting a greater sense of interconnectedness and wonder (Kanas, 2020). Yaden et al. (2016), studying the Overview Effect from a psychological perspective, points to the psychological constructs of awe, self-transcendence, and alterations to individuals' self-schema as a characteristic of the effect. In recent work by Shapiro et al. (2019), researchers considered the Overview Effect "....as a potent means of promoting communal mind-set" (Shapiro et al., 2019, p. 2). Looking at the role of identity in large-scale conflict, this work offers the effect (in promoting "identity expansion") to break out of tribal behaviors that often hinder cooperation at this scale. That is, the effect promotes collectivistic, or cooperative, behavior.

Findings and proponents thus confirm the common aspects of awe and interconnection reference in White's (2014) original definition. The last common element, "...a renewed sense of responsibility for taking care of the environment" (White, 2014, p. 2) is also confirmed by Kanas' (2020) study, which reports that changes in the perception of Earth were "significantly correlated with a statement that suggests that respondents became involved in environmental causes after returning home" (Kanas, 2020, p. 525). Moreover, that "...elements of attitude change can translate into behavioral change after astronauts return to Earth" (Kanas, 2020, p.

527). Indeed, another recent psychological study looked deeper into the ecological significance of the Overview Effect (Voski, 2020) and

> "…established that the overview effect phenomenon has an unanticipated and distinguishable ecological significance that has the ability to markedly influence astronauts' [environmental attitudes and behaviors], resulting in a new level of environmental awareness and consciousness that, for the majority of participants, led to a direct elevation in, or enhancement of, [environmental attitudes] post-spaceflight that subsequently contributed, among other terrestrial factors, to gradual and long-term behavioral change; for a few, it led to direct behavioral improvement post-spaceflight." (Voski, 2020, p.7)

Therefore, proponents of the Overview Effect (like Space for Humanity) argue that there is a considerable positive social benefit to space tourism (i.e., a positive externality). This potential externality is what this paper strives to understand in more detail.

3.3 Background

The data used in this study comes directly from Space for Humanity. Space for Humanity is a nonprofit organization that is, "...organizing the planet's first sponsored Citizen Astronaut Program, where leaders [...] can apply for an opportunity to go to space and experience the Overview Effect" (Space for Humanity). With the slogan, "To Space, For Earth," they have a mission to, "cultivate a movement to expand access to space for all of humanity". It has positioned itself as the singular nonprofit in the space sector expressly seeking to sponsor citizen spaceflight.

As mentioned in the quote above, a foundational concept to the Space for Humanity mission is the theory of the Overview Effect. They are looking to "leverage the transformational

power of the Overview Effect to enact positive change here on Earth" (Space for Humanity). This perspective shift is what Space for Humanity seeks to employ to train their astronauts, upon return from their suborbital flight, as humanitarian and philanthropic change-makers.

The primary way they are doing this is through their Citizen Astronaut Program[42]. This program includes a fully sponsored trip on a suborbital space flight, "Overview Leadership" training focused on the Overview Effect, and membership in the "Overview Cohort Network" of leaders and past citizen astronauts. For each citizen astronaut, pre-flight training includes physical and psychological training alongside a leadership training program in which they develop a social impact program. After their spaceflight, citizen astronauts will work collaboratively to integrate and process their experiences and learn how to leverage the Overview Effect for their work on Earth. They will work with Space for Humanity on an ongoing basis and sign a "Life and Leadership Agreement" that sets measurable social impact goals for their projects (Space for Humanity).

3.4 Data

The data used in this research comes from Space for Humanity's 2019 round of Citizen Astronaut Program applications. This round of applications was open from June to November 2019. Applicants were recruited through social media, the Space for Humanity website, and word-of-mouth within the space community. The campaign was world-wide, with ads being

[42] To date, Space for Humanity has flown 2 citizen astronauts on suborbital flights through their partnership with Blue Origin. The first citizen astronaut, Katya Echazarreta, became the first Mexican-born female to fly to space. An electrical and computer engineer, Katya's work seeks to empower women in science through advocacy and education. SPACE FOR HUMANITY's second mission flew Sara Sabry on Blue Origin's New Shepard vehicle, making her the first Egyptian to go to space. A mechanical and biomedical engineer, Sabry's work focuses on her nonprofit, Deep Space Initiative, that addresses accessibility in space research.

translated into 40 different languages (though applications were asked to be in English). There was no cost to apply.

Additional insights and context about this sample of individuals can be gleaned from the language on Space for Humanity's website. For one, the language used throughout the website makes clear that Space for Humanity is looking for "leaders" and "change-makers". A list of application requirements include proficiency in English and that the applicant is "currently serving in a community leadership role". There is also an ample amount of language pertaining to applicants' communication skills and passion for effecting change in the world[43] (Space for Humanity).

There were 4 sections for the application: (1) Basic Information; (2) Written Questions; (3) Social Impact; and (4) Assessments for Research. For the purposes of this study, variables were constructed from the demographic data provided in Section 1 and from Section 3, which elicited information on their intentions for their impact projects. For details of the application, see Appendix 3.B.

The key dependent variables of interest in this study come from Section 3 (Social Impact) and are based on the United Nations' Sustainable Development Goals (SDGs). To elicit their planned area of focus for their impact projects, applicants were asked the question, "Which Sustainable Development Goals would you like to represent as an Ambassador? Choose 3-5." and were also provided information on the SDGs. These 17 goals (detailed in Table 1) are the "heart" of the United Nations' 2030 "Agenda for Sustainable Development" that was adopted in 2015 by all member states (United Nations). A useful schema to understand some of humanity's

[43] For the full list of application requirements see Appendix 3.B.

most pressing global issues, these goals are commonly utilized in the nonprofit and humanitarian world.

Table 3-1: United Nations Sustainable Development Goals

Goal	Description
1	No Poverty - End poverty in all its forms everywhere.
2	Zero Hunger - End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3	Good Health and Well-Being - Ensure healthy lives and promote well-being for all at all ages
4	Quality Education - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5	Gender Equality - Achieve gender equality and empower all women and girls.
6	Clean Water and Sanitation - Ensure availability and sustainable management of water and sanitation for all.
7	Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy for all.
8	Decent Work and Economic Growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9	Industry, Innovation and Infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10	Reduced Inequalities - Reduce inequality within and among countries.
11	Sustainable Cities and Communities - Make cities and human settlements inclusive, safe, resilient and sustainable.
12	Responsible Consumption and Production - Ensure sustainable consumption and production patterns.
13	Climate Action - Take urgent action ot combat climate change and its impacts.
14	Life Below Water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15	Life on Land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reserve land degradation and halt biodiversity loss.
16	Peace, Justice and Strong Institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17	Partnerships for the Goals - Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Note. Retrieved from https://sdgs.un.org/goals

17 indicator variables were constructed (one for each SDG), taking a value of 1 if the applicant chose the particular SDG and 0 otherwise. Of particular interest here are citizen astronauts' environmental aims. Thus, a composite indicator, called *environmental sdg indicator*, was constructed. This binary variable takes a value of 1 if an applicant chose any of the environmental SDGs (which were identified to be SDGs 6-7 and 11-15). This variable is thus used to signal applicants' specific interest in environmental issues.

All demographic information, which function as the explanatory variables in this analysis, were constructed from information provided by applicants in Section 1. Applicants were asked both their nationality and their current country of residence. This research focuses on the current country of residence to proxy for their region of the world. The question asked here was, "What is your current country of residence?" From this information, countries were coded into regional indicators based on the United Nations geoscheme (see Appendix 3.A for a list). Applicants were also asked the question, "What is your year of birth?". Applicants' age was then approximated as the difference between 2019 and their reported birth year, giving us the demographic variable *age*. Applicants were then asked their gender and given 3 options - male, female, or other. These answers were coded into the *female* variable which takes the value of 1 if the applicant chose female and 0 if male[44]. Lastly, applicants were asked, "Select the following that best describe your skills or background which may apply to your ambassadorship.". They were able to choose 1-3 of these "skills" categories. From this information, indicator variables were constructed. Table 2 summarizes all the variables studied.

Table 3-2: Variable Descriptions

Variable	Description

[44] No applicants in this round chose the option "other" for their gender.

environmental sdg indicator	A binary indicator variable in which 1 indicates the applicant chose one or more of the environmental SDGs on their application.
female	A binary indicator variable in which 0 denotes a male applicant and 1 denotes a female applicant.
age	A numerical variable indicating the approximate age of the applicant in 2019 as the difference between 2019 and their birth year.
Americas	A binary indicator variable in which a value of 1 indicates the applicant responded with a country in the Americas.
Asia	A binary indicator variable in which a value of 1 indicates the applicant responded with a country in Asia.
Europe	A binary indicator variable in which a value of 1 indicates the applicant responded with a country in Europe.
Oceania	A binary indicator variable in which a value of 1 indicates the applicant responded with a country in Oceania.
Africa	A binary indicator variable in which a value of 1 indicates the applicant responded with a country in Africa.
business	A binary indicator in which a value of 1 indicates the respondent designated "business" as their skills and background.
science	A binary indicator in which a value of 1 indicates the respondent designated "science" as their skills and background.
language	A binary indicator in which a value of 1 indicates the respondent designated "language & literature" as their skills and background.
creative	A binary indicator in which a value of 1 indicates the respondent designated "creative arts" as their skills and background.
engineer	A binary indicator in which a value of 1 indicates the respondent designated "engineering" as their skills and background.
culture	A binary indicator in which a value of 1 indicates the respondent designated "culture" as their skills and background.
tech	A binary indicator in which a value of 1 indicates the respondent designated "technology" as their skills and background.
other	A binary indicator in which a value of 1 indicates the respondent designated "other" as their skills and background.

There are 2 central models studied here. The first investigates applicant's environmental aims, taking *environmental sdg indicator* as the dependent variable and examining its relationship with the demographic variables. Summary statistics for this variable and the full dataset of demographic variables are provided in Table 3. In total, there were 3,177 responses

completed for this round of applications. After cleaning the data for missing values and repetition, 2,913 applicants remained from 134 countries in total.

Table 3-3: Summary Statistics

	Full Dataset		environmental sdg indicator = 0		environmental sdg indicator = 1	
	mean	sd	mean	sd	mean	sd
environmental sdg indicator	0.795	0.403	--	--	--	--
female	0.281	0.449	0.277	0.448	0.281	0.45
age	24.66	7.82	25.54	8.9	24.439	7.503
americas	0.261	0.439	0.195	0.396	0.278	0.448
asia	0.311	0.463	0.347	0.477	0.31	0.463
europe	0.188	0.391	0.141	0.348	0.202	0.401
oceania	0.00549	0.0739	0.003	0.058	0.006	0.078
africa	0.227	0.419	0.314	0.464	0.205	0.404
business	0.221	0.415	0.221	0.416	0.221	0.425
science	0.51	0.5	0.361	0.481	0.549	0.5
language	0.246	0.431	0.19	0.392	0.261	0.44
creative	0.285	0.451	0.27	0.444	0.288	0.453
engineer	0.319	0.466	0.257	0.437	0.335	0.472
culture	0.369	0.483	0.361	0.481	0.371	0.483
tech	0.344	0.475	0.277	0.448	0.361	0.48
other	0.08	0.271	0.116	0.32	0.071	0.257
	(n=2,913)		(n=596)		(n=2,317)	

The summary statistics show that almost 80% of the responses were environmental SDGs, indicating a considerable interest in environmental projects in this sample. Only approximately 28% of respondents are female, which tracks well with conclusions found in the literature about SST (Musselman and Hampton, 2020). The average age of the dataset skews low, at around 25 years of age in 2019. Asia makes up the biggest proportion of respondents (similar to actual world population). In comparison to its actual share of the world population (59.5%), it is underrepresented here. Oceania makes up the least at .5% which is proportionate

to its actual share of the world population[45]. In comparison to actual share, European respondents are overrepresented here at 18.8% (almost double the actual share of world population of 9.6%). Not surprisingly, the Americas are overrepresented in this sample (26.1% versus current 13.1% in actuality). African respondents in this sample make up 22.7% which is slightly higher than their share of world population (17.2%). Of the skills categories, "culture" makes up the largest proportion of respondents' self-reported skills, followed closely by "technology", "engineering" and then "creative" skills. The smallest skills category represented (aside from the "other" choice) are those who reported skills in "business".

To begin to understand these relationships, summary statistics were calculated for when the environmental SDG indicator variable is "on or off". That is, this second portion of Table 3-3 reports summary statistics for all applicants that did not choose an environmental aim and the third portion of the table, for those that did. What can be seen is that there is little difference in the representation of female respondents between environmental and non-environmental SDG choices. Age is also about the same across these 2 sub-samples. Across regions, there is a greater amount of representation in the environmental SDGs for all regions except Asia and Africa. Of the skills categories across these 2 sub-populations, the largest difference is seen in the "science" variable with 54.9% of those who reported "science" as a skill choosing an environmental SDG.

3.5 Methodology

This is an exploratory study on a novel data set. As the dependent variables are all binary indicators, a probit model of regression is utilized. The first model to be explored will estimate

[45]Worldometer. (2023). Regions in the world by population. *Worldometer.* Retrieved 22 September, 2023 from https://www.worldometers.info/world-population/population-by-region/

the relationship of the *environmental SDG indicator* indicator described above with the available demographic information of the candidates. Taking the *environmental SDG indicator* dummy variable as the dependent, Y_i ,

$$Pr(Y_i = 1) = \beta_0 + \beta_1 female_i + \beta_2 age2019_i + \beta_3 americas_i + \beta_4 asia_i + \beta_5 europe_i + \beta_6 africa_i + \beta_7 business_i + \beta_8 science_i + \beta_9 language_i + \beta_{10} creative_i + \beta_{11} engineer_i + \beta_{12} culture_i + \beta_{13} tech_i + \beta_{14} other_i + u_i$$

For these explanatory variables, all but *age* are binary indicators. Thus, interpretation of the coefficients is not so straightforward. With this in mind, marginal effects are reported in the results section. Specifically, the marginal probability effects (the partial effects of each explanatory variable on the probability that the observed dependent variable $Y_i = 1$) are calculated. For the continuous explanatory variable, *age*, the marginal probability effect is

$$\frac{\partial Pr\,(Y_i = 1)}{\partial age2019_i} = \frac{\partial \Phi(x_i^T \beta)}{\partial age2019_i}$$

For all the other explanatory variables, the marginal probability equals the difference between the value of $\Phi(x_i^T \beta)$ when $X_{ij} = 1$ (and the other regressors equal fixed values) and the value of $\Phi(x_i^T \beta)$ when $X_{ij} = 0$ (and the other regressions equal the same fixed values) (Abbott, 2021). That is, the marginal probability effect of X_j is

$$\Phi(x_{1i}^T \beta) - \Phi(x_{0i}^T \beta).$$

The second section of this analysis looks at the relationship between the demographic variables and each SDG choice. I apply a probit model to each individual SDG indicator in which Y_i is the dependent, for a total of 17 regressions that take the form,

$$Pr(Y_i = 1) = \beta_0 + \beta_1 female_i + \beta_2 age2019_i + \beta_3 americas_i + \beta_4 asia_i + \beta_5 europe_i + \beta_6 africa_i + \beta_7 business_i + \beta_8 science_i + \beta_9 language_i + \beta_{10} creative_i + \beta_{11} engineer_i + \beta_{12} culture_i + \beta_{13} tech_i + \beta_{14} other_i + u_i$$

Marginal effects are reported in Section 6 and are calculated and interpreted as explained above.

3.6 Results

Results for these models are reported below. The first section outlines the results for the environmental SDG indicator as the dependent variable. The following section takes each individual SDG as the dependent. Finally, the last section discusses these results in more detail.

Initial Model: Environmental SDGs in General and Demographics

Marginal probability effects for the initial model testing the relationship between the *environmental SDG indicator* and demographic explanatory variables are reported in Table 6 below.

Table 3-4: Marginal Effects for Environmental Indicator

female	0.00183	-0.00256	-0.00837
	(0.0167)	(0.0165)	(0.0164)
age	-0.00273***	-0.00427***	-0.00377***
	(0.000915)	(0.000933)	(0.000916)
africa		-0.143***	-0.135***
		(0.0211)	(0.0207)
asia		-0.0932***	-0.0827***
		(0.0203)	(0.0198)
europe		-0.00672	0.000434
		(0.0238)	(0.0230)
oceania		0.0416	0.0173
		(0.118)	(0.114)
business			0.0669***
			(0.0178)
science			0.141***
			(0.0149)
language			0.108***
			(0.0180)
creative			0.0536***
			(0.0170)
engineer			0.0828***
			(0.0172)
culture			0.0578***
			(0.0161)
tech			0.0796***
			(0.0164)
other			-0.0172
			(0.0259)
Observations	2,913	2,913	2,913

Americas is the base category for region and is thus dropped.

An applicant's age at the time of the application has a significant and negative effect. Thus, as age increases, the likelihood of choosing an environmental SDG decrease. Of the regional indicators (taking the Americas as the base category[46]), applicants' location in Africa and Asia has significant and negative effects on the probability of choosing an environmental SDG as a focal project. If an applicant was in Africa at the time of application, the probability of choosing one of the environmental SDGs decreased by 0.135. If an applicant was in Asia at the time of submission, this probability decreases by 0.0827. Each of the occupational indicators are positive and significant except the "other" category. Thus, each of these occupational specifications, in their own respect, increase the likelihood of environmental SDGs being the focus of the astronaut applicant's endeavor.

Individual SDGs

The second study in this work examines the relationship of the demographic explanatory variables with each individual SDG choice. Results for the environmental SDG regressions are reported in Table 7. Results for the models that take non-environmental SDGs as dependent are reported in Table 8. These results are detailed accordingly, starting with environmental SDGs and followed by non-environmental SDGs.

Environmental SDGs

The probability of choosing SDG 6 (clean water and sanitation) as a focal issue is positively affected by respondents' identification as female. None of the regional variables show significant effects here. Of the skills variables, only science is significant, increasing the probability of choosing this SDG by .0606. If a respondent is female, this decreases the probability of choosing SDG 7 (affordable and clean energy) by 0.1. Location in either Africa or

[46] In taking Americas as the base category, its results are dropped from the regression results.

Asia decreases the probability of choosing energy as a focal issue. Of the skills, science, creativity, engineering, and tech all have positive and significant effects on the probability of choosing SDG 7.

SDG 11 (Sustainable cities and communities) had neither age nor gendered effects. However regionally, a respondent's location in either Africa, Asia, or Europe decreased the likelihood of choosing sustainable cities and communities as a focal issue (by 0.179, 0.152, and 0.0732, respectively). Each of the skill variables, except the "other" choice, had positive effects on the probability of choosing sustainable cities and communities as a focal issue.

Table 3-5: Marginal effects by environmental SDG indicator

	sdg6	sdg7	sdg11	sdg12	sdg13	sdg14	sdg15
female	0.0368**	-0.100***	-0.0205	0.00909	0.0545***	0.0178	-0.00690
	(0.0183)	(0.0202)	(0.0171)	(0.0147)	(0.0206)	(0.0129)	(0.0140)
age	-0.000980	-0.000770	0.00125	0.000227	-0.00358***	-0.00167**	-0.000751
	(0.00107)	(0.00115)	(0.000899)	(0.000772)	(0.00119)	(0.000782)	(0.000796)
africa	-0.0223	-0.109***	-0.179***	-0.155***	-0.104***	-0.00631	-0.0104
	(0.0234)	(0.0252)	(0.0211)	(0.0204)	(0.0263)	(0.0169)	(0.0177)
asia	0.0196	-0.0870***	-0.152***	-0.0705***	-0.0130	0.0171	-0.000403
	(0.0214)	(0.0234)	(0.0191)	(0.0169)	(0.0245)	(0.0153)	(0.0163)
europe	-0.0371	0.0158	-0.0732***	5.73e-05	0.0409	0.00910	-0.00280
	(0.0244)	(0.0257)	(0.0207)	(0.0179)	(0.0270)	(0.0173)	(0.0184)
oceania	-0.161	0.148	-0.0778	0.0607	0.171	-0.0485	0.0572
	(0.131)	(0.119)	(0.0948)	(0.0745)	(0.121)	(0.0919)	(0.0738)
business	0.0269	-0.0115	0.0921***	0.0380**	0.0429*	0.00808	-0.0108
	(0.0204)	(0.0224)	(0.0185)	(0.0167)	(0.0230)	(0.0149)	(0.0159)
science	0.0606***	0.115***	0.0628***	0.0340**	0.137***	0.0388***	0.0196
	(0.0173)	(0.0184)	(0.0161)	(0.0144)	(0.0190)	(0.0126)	(0.0130)
language	-0.00401	0.0338	0.0454**	0.0592***	0.0786***	0.0382***	0.00626
	(0.0202)	(0.0219)	(0.0186)	(0.0160)	(0.0224)	(0.0141)	(0.0151)
creative	0.0197	0.0357*	0.0566***	0.0332**	0.0532**	0.0363***	0.00434
	(0.0193)	(0.0210)	(0.0177)	(0.0157)	(0.0215)	(0.0135)	(0.0145)
engineer	0.0228	0.117***	0.0550***	0.0416***	0.0508**	0.0217	-0.00162
	(0.0192)	(0.0204)	(0.0180)	(0.0160)	(0.0217)	(0.0143)	(0.0146)
culture	0.0182	0.00999	0.0765***	0.0414***	0.0563***	0.0217*	-0.00391
	(0.0185)	(0.0200)	(0.0170)	(0.0150)	(0.0207)	(0.0131)	(0.0138)
tech	0.00273	0.0751***	0.0748***	0.0111	0.0353*	0.0150	0.0134
	(0.0186)	(0.0196)	(0.0169)	(0.0153)	(0.0208)	(0.0131)	(0.0136)
other	-0.0239	-0.0162	0.0246	0.0102	-0.0344	-0.00910	0.0162
	(0.0318)	(0.0343)	(0.0293)	(0.0251)	(0.0355)	(0.0239)	(0.0230)

Observations	2,913	2,913	2,913	2,913	2,913	2,913	2,913

Robust standard errors in parentheses; Americas is the base category for region and is thus dropped.
*** p<0.01, ** p<0.05, * p<0.1

SDG 12 (responsible consumption and production) has neither gender nor age effects. However, location in Africa and Asia both decrease the likelihood of choosing this SDG by 0.155 and 0.0705, respectively. Reporting skills in business, science, language, creativity, engineering, and culture all increased the probability of choosing this SDG. SDG 13 (Climate action) presents an interesting case. Relative to all other SDGs, the probability of selecting climate action as an issue is affected by gender, age, region, and skills in some significant way. A respondent being female increased the probability of choosing climate action by 0.0545. Age, on the other hand, had a negative effect on this probability. Of the regional variables, only Africa had a significant effect, decreasing the likelihood of choosing climate as an issue by 0.104. Reporting skills in any of the categories, except "other" had a positive effect on the probability of choosing climate as a focal issue.

SDG 14 (life below water) has no gender effect. No regional variables significantly affect the choice of this SDG. Reported skills in science, language, creativity, and culture all positively affect the probability of choosing "life below water" as a focal issue. SDG 15 (life on land) had no significant relationship to the demographic explanatory variables.

Non-environmental SDGs

Marginal effects for nonenvironmental SDG indicators are provided in Table 3-6. For SDG 1 (no poverty), being in the African region increases the probability of choosing SDG 1 by 0.147, while being in Oceania increases the probability by 0.30. A respondent's location in Asia too is significant and positive, increasing the probability of choosing poverty as an issue by .108. Having language or tech skills increases the probability of choosing poverty as an issue by .0469

or .0716, respectively. For SDG 2 (zero hunger), a respondent's location in Africa or Asia has a positive and significant effect on the probability of choosing SDG 2. Business and language skills are relevant and increase the probability of choosing this particular SDG.

For SDG 3 (good health and well-being), Africa and Asia have positive and significant effects. Skills in either engineering, culture, or tech are significant here. Interestingly, engineering skills have a negative effect on the probability of choosing this SDG, while culture and tech are both positive. SDG 4 (quality education) presents an interesting case. Here, being a female respondent increases the probability of choosing quality education as a focal issue by .0.0439. Of the regional variables, only location in Africa is significant, increasing the probability of choice by 0.0556. Of the skills variables, all positively and significantly affect the probability of choosing education except business and creativity.

Female respondents were more likely to choose SDG 5 (gender equality) as a focal issue. Indeed, if a respondent is female, they increase the probability of choosing SDG 5 by .176. Age, too, is significant and positive for the choice of SDG 5 (though it is a relatively small effect at .00224). Location in Asia has a positive effect on the probability of choosing gender equality as an issue. Of the skills categories, language, creativity, engineering, culture, and "other" all have positive effects on the probability of choice.

Female respondents were less likely to choose "decent work and economic growth" (SDG 8[47]) as a focus of their ambassadorship. Of the skills variables, business and science are relevant with reported skills in business increasing the probability of choice, while science skills decrease it. SDG 9 (Industry, Innovation, and Infrastructure) is negatively affected by female

[47] Note that SDG 8 is a special case for the regional variables. Oceania (n=16) was dropped from this particular regression because all 16 observations predict failure perfectly. That is, none of the respondents from Oceania chose "decent work and economic growth" as a focal issue.

Table 3-6: Marginal effects of nonenvironmental SDGs

	sdg1	sdg2	sdg3	sdg4	sdg5	sdg8	sdg9	sdg10	sdg16	sdg17
female	-0.00705	-0.0182	0.000648	0.0349**	0.176***	-0.0293**	-0.0522***	-0.0522***	0.0127	-0.0213
	(0l0178)	(0.0186)	(0.0186)	(0.0211)	(0.0148)	(0.0143)	(0.0184)	(0.0142)	(0.0194)	(0.0152)
age2019	0.000488	-0.00172	0.00471***	-0.000828	0.00224**	-0.00146*	0.000702	0.00174**	-0.00163	0.00155**
	(0.00103)	(0.00114)	(0.00107)	(0.00120)	(0.000927)	(0.000868)	(0.000985)	(0.000767)	(0.00117)	(0.000787)
africa	0.147***	0.0538**	0.0633***	0.0556**	0.0330	-0.0105	-0.0391*	-0.0544***	0.0762***	-0.0106
	(0.0221)	(0.0235)	(0.0243)	(0.0266)	(0.0211)	(0.0174)	(0.0224)	(0.0186)	(0.0244)	(0.0185)
asia	0.108***	0.0774***	0.0535**	0.0354	0.0457**	-0.0268	-0.0708***	-0.0307*	0.0477**	-0.0328*
	(0.0212)	(0.0218)	(0.0228)	(0.0249)	(0.0197)	(0.0166)	(0.0211)	(0.0170)	(0.0231)	(0.0175)
europe	0.0224	0.0162	-0.00466	-0.0437	0.0130	-0.0108	-0.0156	-0.0122	0.0433*	0.0214
	(0.0245)	(0.0249)	(0.0257)	(0.0275)	(0.0216)	(0.0180)	(0.0231)	(0.0185)	(0.0256)	(0.0183)
oceania	0.300***	0.106	-0.120	-0.106	0.105		0.0114	0.0812	-0.00752	0.0131
	(0.0903)	(0.105)	(0.130)	(0.128)	(0.0783)		(0.103)	(0.0729)	(0.122)	(0.0848)
business	0.0252	0.0341*	0.00954	0.0248	0.0120	0.0781***	0.116***	0.00504	0.00648	0.0432***
	(0.0193)	(0.0203)	(0.0213)	(0.0233)	(0.0184)	(0.0143)	(0.0194)	)0.0164)	(0.0216)	(0.0159)
science	-0.00390	0.0234	0.0294	0.0973***	0.00661	-0.0261**	0.0561***	0.00724	-0.0267	0.00383
	(0.0163)	(0.0172)	(0.0181)	(0.0194)	(0.0155)	(0.0130)	(0.0168)	(0.0138)	(0.0182)	(0.0140)
language	0.0469**	0.0601***	0.00170	0.116***	0.0684***	-0.0117	0.00955	0.0505***	0.0666***	0.00378
	(0.0191)	(0.0198)	(0.0210)	(0.0227)	(0.0174)	(0.0153)	(0.0201)	(0.0154)	(0.0208)	(0.0163)
creative	0.0250	0.0302	0.0132	0.00570	0.0590***	-0.0181	0.0321*	0.00377	0.0128	0.0195
	(0.0184)	(0.0193)	(0.0203)	(0.0219)	(0.0171)	(0.0150)	(0.0191)	(0.0156)	(0.0204)	(0.0155)
engineer	-0.0152	-0.009944	-0.0768***	0.0465**	0.0310*	-0.0167	0.164***	0.0198	0.0198	0.0395**
	(0.0188)	(0.0195)	(0.0206)	(0.0220)	(0.0180)	(0.0149)	(0.0179)	(0.0159)	(0.0205)	(0.0159)
culture	0.0271	0.0143	0.0412**	0.0452**	0.0510***	0.000589	0.00607	0.0650***	0.0839***	0.0724***
	(0.0174)	(0.0185)	(0.0190)	(0.0209)	(0.0162)	(0.0137)	(0.0183)	(0.0145)	(0.0191)	(0.0144)
tech	0.0716***	0.0230	0.0394**	0.0929***	0.0147	0.0109	0.0960***	0.0268*	0.0338*	0.0200
	(0.0174)	(0.0184)	(0.0193)	(0.0208)	(0.0171)	(0.0137)	(0.0175)	(0.0149)	(0.0194)	(0.0148)
other	0.0285	0.0257	0.0362	0.0617*	0.109***	0.0292	0.000302	0.0629***	0.0825***	0.0915***
	(0.0292)	(0.0309)	(0.0321)	(0.0354)	(0.0255)	(0.0223)	(0.0318)	(0.0232)	(0.0314)	(0.0228)
Observations	2,913	2,913	2,913	2,913	2,913	2,897	2,913	2,913	2,913	2,913

Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p,0.1

respondents. If a respondent is female, the probability of choosing this as a focal issue decreases by .0522. Location in Africa and Asia both have negative probability effects on this SDG choice. Reported skills in business, science, creativity, engineering, and tech all have positive effects on the probability of choosing this particular SDG.

Female respondents were more likely to choose SDG 10 (Reduced inequalities) at a rate of increasing the probability of this choice by .0522. Location in either Africa or Asia had both had significant, negative effects on choosing SDG 10 as a focal issue (relative to Americas). Skills in language, culture, tech, and "other" skills all had positive probability effects on the choice of SDG 10. The probability of choosing SDG 16 (peace, justice, and strong institutions) as a focal issue is increased by a respondent's location in Africa and Europe by 0.0762 and 0.0433 respectively. Location in Asia decreased the probability of choosing this SDG by .0477. Reported skills in language, culture, and "other" also had positive effects on the probability of choosing "peace, justice, and strong institutions" as a focal issue. The probability of choosing SDG 17 (Partnerships for the goals) was negatively affected by a respondent's location in Asia. Reported skills in business, engineering, culture, and "other" all have positive effects on the probability of choosing this variable.

3.7 Discussion

The results outlined above warrant further discussion and exploration. Though it is not possible to compare across magnitudes between these tables, we can learn from the general trends and direction.

Gender

Overall, in exploring this data, gender had significant though variegated effects on Citizen Astronaut's choices for focal issues. The overall makeup of the dataset, with only 28.1%

being female applicants, reflects earlier conclusions in the literature (Musselman and Hampton, 2020) that suggest men see space tourism as more "useful" (p. 2) than women. In the *environment* model, there is no gender correlation. However, for the individual SDG regressions, a respondent being female increases the probability of choosing 4 (Quality Education), 5 (Gender Equality), 6 (Clean Water and Sanitation), 10 (Reduced Inequalities), and 13 (Climate Action) while decreasing the probability of choosing 7 (Affordable and Clean Energy), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure). It is well documented in the literature that women are more likely to exhibit environmentalist attitudes (Zelenzy et al., 2000; Franzen and Vogl, 2013). For the most part, we see hints of this trend in the data here with the exception of the issue of affordable and clean energy.

Age

In the *environmental SDG indicator* model, age has a significantly negative relationship. At age 20, the probability of choosing an environmental SDG is .8134, while at age 70, the probability decreases to .5887. This reflects perfectly the literature on "the age hypothesis" (Van Liere and Dunlap, 1980, p. 182) that shows a negative relationship between age and environmental concerns (Franzen and Vogl, 2013).

Within the individual SDG regressions, aging increases the probability of choosing SDG 3 (Good Health and Well-Being), 5 (Gender Equality), 10 (Reduced Inequalities), and 17 (Partnerships for the Goals). The results with SDG 3 could reflect increased concern for health from aging. The probability of choosing SDG 8 (Decent Work and Economic Growth), 13 (Climate Action), 14 (Life Below Water) decreases with age. The negative relationship of age with SDG 8 could be due to respondents aging out of the workforce. The results for SDG 13 further reflect the literature on the "global warming age gap" (Ballew et al., 2019).

Region

A consistent trend in these results is the predominantly negative relationship being located in Asia and Africa seems to have on SDG choice, especially environmental ones. In the *environmental SDG indicator* model, being located in Asia and Africa both had statistically significant and negative results on choosing an environmental SDG.

A respondent's location in Africa increased the probability of choosing SDG 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 4 (Quality Education), and 16 (Peace, Justice and Strong Institutions) while decreasing the probability of choosing 7 (Affordable and Clean Energy), 9 (Industry, Innovation, and Infrastructure), 10 (Reduced Inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action).

A respondent's location in Asia increased the probability of choosing SDG 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 5 (Gender Equality), and 16 (Peace, Justice, and Strong Institutions) while decreasing the probability of choosing SDG 7 (Affordable and Clean Energy), 9 (Industry, Innovation, and Infrastructure), 10 (Reduced Inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production) and 17 (Partnerships for the Goals).

Being in Europe increased the probability of choosing SDG 16 (Peace, Justice, and Strong Institutions) and decreased the probability of choosing SDG 11 (Sustainable Cities and Communities). Being in Oceania increased the likelihood of choosing SDG 1 (No Poverty) and "perfectly" predicts not choosing SDG 8 (Decent Work and Economic Growth) as a focal issue.

It can be hypothesized that some of this regional variation could be related to exposures and life experiences that vary across the world. Research has shown that GDP per capita

exhibits a positive relationship to environmental concerns (Franzen and Vogl, 2013). Country GDP is also a common determinant in tourism economics. This could be driving some of these results and warrants deeper study in future work. Individual income also is important. Given that this sample includes 134 countries of which many are developing nations, it is also important to note that we are capturing a sample of the population within these nations that has access to the internet and a computer or smart phone. Presumably as well, we are looking at a population that is engaged in social media. As of 2023, there is still around ⅓ of the world population without access to the internet (Petrosyan, 2023). This lack of access is especially prevalent in parts of Asia and Africa (Petrosyan, 2023). Thus, it is appropriate to assume that we are looking at a more affluent subsection of developing nations' populations.

Skills

Self-reporting skills in business positively affected the probability of choosing SDG 2 (Zero Hunger), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action) and 17 (Partnerships for the Goals) and did not have any significant negative impacts on the probability of choosing a particular SDG.

Reporting skills in science positively affected the probability of choosing SDG 4 (Quality Education), 6 (Clean Water and Sanitation), 7 (Affordable and Clean Energy), 9 (Industry, Innovation, and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), and negatively affected the probability of choosing SDG 8 (Decent Work and Economic Growth).

Reporting skills in language positively affected the probability of choosing SDG 1 (No Poverty), 2 (Zero Hunger), 4 (Quality Education), 5 (Gender Equality), 10 (Reduced

Inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), 16 (Peace, Justice and Strong Institutions) and choosing this skill had no significant negative correlation on any SDG choice.

Reporting creativity as a skill positively affected the probability of choosing 5 (Gender Equality), 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water) and did not negatively affect the probability of choosing one of the SDGs.

Reporting skills in engineering positively affected the probability of choosing 4 (Quality Education), 5 (Gender Equality), 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), 16 (Peace, Justice, and Strong Institutions), 17 (Partnerships for the Goals) and negatively affected the probability of choosing 3 (Good Health and Well-Being).

Reporting skills in culture positively affected the probability of choosing SDG 3 (Good Health and Well-Being), 4 (Quality Education), 5 (Gender Equality), 10 (Reduced Inequalities), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), 16 (Peace, Justice and Strong Institutions) and 17 (Partnerships for the Goals) and did not negatively affect any SDG choice.

Reporting skills in technology positively affected the probability of choosing SDG 1 (No Poverty), 3 (Good Health and Well-Being), 4 (Quality Education), 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 10 (Reduced Inequalities), 11 (Sustainable

Cities and Communities), 13 (Climate Action), 16 (Peace, Justice and Strong Institutions) and did not negatively affect any choice.

Choosing "other" as one's skill category positively affected the probability of choosing SDG 4 (Quality Education), 5 (Gender Equality), 10 (Reduced Inequalities), 16 (Peace, Justice and Strong Institutions), 17 (Partnerships for the Goals) and negatively affected none.

Further Discussion

There are 2 important demographics missing from this data that are shown to be strong determinants of environmental concern in the literature - education and income (Franzen and Vogl, 2013). Education has been shown to have a positive effect on environmental concern owing to increased knowledge of environmental issues. Income is said to increase environmental concern as well through 2 mechanisms. First, wealthier individuals have more opportunity (because they are less worried about economic problems) to be concerned about the environment. Second, wealthier individuals' willingness and ability to pay for public goods is higher as they tend to demand more of public goods (Franzen and Vogl, 2013). There are also macro effects not captured here, including the GDP of a country which is shown to be significant for individuals' preferences for environmental concerns (Franzen and Vogl, 2013). It is postulated that countries with higher GDP have better quality and quantity public goods, contributing to individual wealth.

3.8 Conclusions

This paper presents a novel dataset of a subset of space tourists who are motivated by prosocial and environmental pursuits. Given the mission and marketing of Space for Humanity, it could even be said that these motivations are altruistic. This particular push factor for space tourism is markedly different from the more common motivations in high-end adventure tourism

such as prestige and novelty. Tourism economics has been studying what motivates people to travel for quite a while. Space tourism is a wholly new market in which a deeper understanding of what drives people to take such a trip, especially given the risks and cost, is important to understanding this emerging market. Looking more deeply into this data resulted in a better understanding of the space tourists who make up this group. This paper has paid particular interest to their environmental aims given the theory of the Overview Effect and its importance to the Space for Humanity mission. It shows that prosocial motivations in space tourists exist and are variegated, with demographics such as region, age, and gender affecting the particularities of these motivations.

Undoubtedly, the insights here are limited by the nature in which the data was collected. It is by no means a random or unbiased sample. However, it provides a glimpse into the emerging space tourism market, represents an interesting case study on the ambassadorship concept, and bolsters earlier conclusions on the literature of environmental attitudes across populations.

Though there are a variety of market studies from private organizations and papers exploring the "economics" of space tourism in tourism journals, there are very few decidedly economic approaches to this emerging market. This suggests a potential for fruitful research in the future. Furthermore, with Blue Origin and Virgin Galactic gearing up for more and more SST flights, there will soon be a population of space tourists to survey and understand through deeper research. Given the work in this paper, future research into the motivations and characteristics of space tourists should consider altruism as a potential motivation.

This consideration is especially interesting with respect to the ambassadorship concept. It is clear that Space for Humanity subscribes to this theory (Frost and Frost, 2022). Indeed, it

appears that the idea that their citizen astronauts will translate their experience of spaceflight into impact projects on Earth is fundamental to their mission. Space for Humanity and its cohort of Citizen Astronaut candidates represent a tangible representation of the ambassadorship model. Whether or not these motivations result in real behavioral change and impact (especially with respect to the personal and environmental costs of SST) still warrants further study. Indeed, Space for Humanity will need to demonstrate its impact on Earth in the future as its cohort of citizen astronauts grows.

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Conclusions

The preceding chapters of this dissertation worked to demonstrate the importance of 'the social' in economic theory and practice. Each chapter approached this endeavor with a unique perspective and highlighted the need for further research. This investigation considered geopolitical forces, feminist philosophy, and prosocial motivations in markets. Each of these studies contributes to the argument that the social sphere is a source of insight in economic thought. They represent unique contributions to their respective literatures and to the broader literature in social economics that regards agent behavior as socially constructed and ethically consequential.

Chapter 1 examines the role of global social relations in a country's decision to sign an IEA. Finding that intergovernmental organization membership, diplomacy, and alliances affect the propensity to sign an IEA demonstrates the importance of understanding countries as situated in a complex web of social relations. These conclusions represent a new avenue for empirical studies in the economics of IEAs which historically focused on only domestic determinants. Further work is warranted to explore other possible relational determinants that might be relevant to country decision-making. Likewise, research into *how* these forces function to shape country behavior is called for.

Chapter 2 seeks to philosophically inform Chapter 1 and the broader literature in the economics of IEAs by critiquing the neoclassical dominance of the economics of IEAs and exploring how feminist philosophy can help to expand our understanding of geopolitical dynamics and effective policy. This chapter highlights the usefulness of feminist philosophy to characterize the environmental problems of today as thick with complex issues of inequality, power relations, and social forces. The increasing

recognition of global environmental issues as interlinked with inequity further motivates such an approach. This work generates a rich avenue for further research to delve into how feminist philosophy can help to deepen our understanding of global environmental policymaking. Additionally, it can inform policymakers on the importance of understanding the differing effects such policies have on the real lives of people, especially marginalized groups.

Chapter 3 pivots from the discussion of IEAs toward consideration of expanded worldviews associated with the planet as our environment. This chapter explores a unique set of data from the newly established space tourism market. Specifically, it seeks to learn more about potential positive externalities associated with a changed worldview that astronauts reportedly experience. It shows that there are complex correlations between region, age, and gender that affect these altruistic aims. As more and more tourists fly to space, the available data to study these unique consumers will lend to further insights into their motivations and characteristics. Likewise, as the cohort of Space for Humanity's citizen astronauts grows, the validity of the ambassadorship model can be investigated more deeply. Likewise, studying the scale of the externality created by the overview effect is a promising strand of research.

Overall, the work in this dissertation contributes to the literature of social economics. By factoring in social forces, each work also advances the literature in their respective areas of study. Chapter 1 establishes a promising new path in the empirical study of IEAs that includes international social forces as an important factor to be studied. Chapter 2 lays the foundations of an alternative approach to the theoretical economics of IEAs that deals directly with issues of equity and justice. Chapter 3 demonstrates the significance of the space tourism market as a

focus of economic inquiry. This dissertation demonstrates that 'the social' is a powerful source of insight in economics.

Appendix

Appendix 1.A Model Specification

This appendix presents and discusses the details of the econometric analysis in this paper, including the overdispersion of the dependent variable and model specification and thus, the use of fixed-effects negative binomial model in estimation.

Econometric Model

The benchmark count model is the Poisson, however, because the dependent variable data is also overdispersed, a negative binomial (NB) model is used for estimation. The dual of duration models, count models look at the probability of an event (or number of events) occurring in a fixed period of time. In the Poisson model, the probability of a nonnegative integer count number, y_{it}, in a unit internal is given by the Poisson process,

$$P(\mu_{it}) = \frac{e^{-\mu_{it}}(\mu_{it})^{y_{it}}}{y_{it}!}, y_{it} = 0, 1, 2, \ldots$$

where μ_{it} is the instance "arrival rate" or "intensity parameter" (Hsiao, 2014). The Poisson regression model, then, assumes that the observed count for observation *i* in time *t* is drawn from a Poisson distribution with mean μ_{it}, which is estimated from observed characteristics. Thus,

$$\mu_{it} = E(x_{it}) = e^{x_{it}\beta} = Var(y_{it})$$

where x_{it} is a vector of covariates. An implication of this being that the Poisson model requires equidispersion (equality between mean and variance).

Unlike the Poisson model, though, the NB model does not require equidispersion. Instead, it accommodates dispersion (in this case, overdispersion in IEA data) with an additional

parameter, δ_i , that reflects unobserved heterogeneity among observations (Long and Freese, 2001). Indeed, the ratio of the variance to the mean in the NB model is,

$$\frac{Var(y_{it})}{E(y_{it})} = \{1 + \delta_i E(y_{it})\}$$

where a value of zero for δ_i yields the Poisson model and thus, δ_i is the "dispersion parameter" (Stata, 2017). Assuming a gamma distribution $\mu_{it}|\delta_i \sim gamma(\lambda_{it}, \delta_i)$ with $\lambda_{it} = e^{x_{it}\beta + offset_{it}}$, the NB model then has the probability specification,

$$P(x_{it}, \delta_i) = \frac{\Gamma(\lambda_{it}+y_{it})}{\Gamma(\lambda_{it})\Gamma(1+y_{it})}\left(\frac{1}{1+\delta_i}\right)^{\lambda_{it}}\left(\frac{\delta_i}{1+\delta_i}\right)^{y_{it}}$$

which gives us a NB model for the ith group with dispersion equal to $1 + \delta_i$.

Initial specification tests (see Table A-1 below) suggest the best fit for the IEA data specifically calls for a *fixed-effects* NB model. Note that, in the case of the NB model, the fixed effects refer specifically to the dispersion parameter (δ_i). Thus, the dispersion is the same across each group, i, and can take on any value.

Specifically, for the relational determinants of IEA signature, i denotes the country and t the year. Then, conditioning the joint probability of the counts of IEA signatures for each country on the sum of the IEA counts for the country (i.e. the observed $\sum_{t=1}^{n_i} IEAs_{it}$) yields the conditional log likelihood to be maximized,

$$lnL = \sum_{i=1}^{n} w_i \left[ln\Gamma\left(\sum_{t=1}^{n_i}\lambda_{it}\right) + ln\Gamma\left(\sum_{t=1}^{n_i} y_{it} + 1\right) - ln\Gamma\left(\sum_{t=1}^{n_i}\lambda_{it} + \sum_{t=1}^{n_i} y_{it}\right) + \sum_{t=1}^{n_i}\{ln\Gamma(\lambda_{it} + y_{it}) - ln\Gamma(\lambda_{it}) - ln\Gamma(y_{it} + 1)\}\right]$$

where w_i is the weight for the ith country (see Hausman, Hall, and Griliches, 1984 for a full derivation of the fixed-effects NB model). Furthermore, x_{it} is the vector of both the relational and control data for each country-year observation,

$$x_{it} = (formal\ alliances, intergovernmental\ organizations, diplomatic\ exchanges, controls)$$

That is, controlling for domestic political, economic, and environmental factors, this analysis estimates the effect of global integration (measured by alliances, IGO membership, and diplomacy) on the number of IEA's a country signs in a year.

Overdispersion of the Dependent Variable

As discussed briefly in the methodology section, the Poisson model underestimates the amount of dispersion in the outcome. Poisson estimates thus, if there is overdispersion, are inefficient with lower standard errors. Specifically, overdispersion is the inequity of mean and variance. Thus, a simple preliminary test, the dispersion rate, gives us initial insight into this issue by taking the ratio of the variance to the mean (Long and Freese, 2001). For the data used in the full model, the mean of IEA count is 1.760 while the variation is 3.716, giving us a dispersion rate of 2.111. The variance is more than double the mean, clearly indicating overdispersion.

Furthermore, in running the NB model in Stata, a likelihood ratio test that the dispersion parameter, $\delta = 0$ as the NM collapses to the Poisson as the dispersion parameter is zero (Long and Freese, 2001). Results here strongly reject the null hypothesis that errors do not exhibit overdispersion. That is, $\chi^2 = 766.46$ and thus $p < .01$.

Lastly, Figure A.1 plots the frequency of observations of the dependent variable, IEA count. It is clear, even at a glance, that this data is overdispersed (in particular, it exhibits zero-inflation).

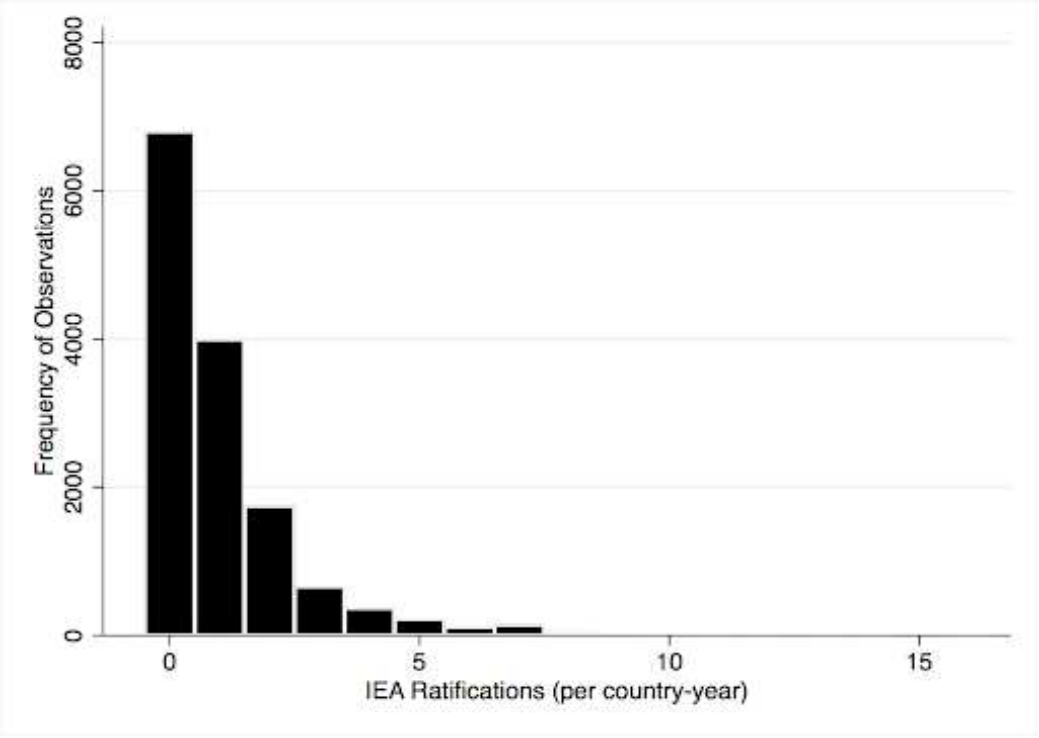


Figure A-1: Histogram of Dependent Variable

Model Specification: Fixed Effects

In addition to using the NB model to account for overdispersion, I use the fixed-effects NB model. In this specification, the fixed effects apply to the distribution of the dispersion parameter itself (Stata, 2018). That is, the dispersion is the same for all observations in the same panel and thus, the dispersion parameter in a group (here, country) can take on any value.

To test whether to use the random or fixed -effects specification, I run a Hausman specification test with the fixed and random effects models. The Null hypothesis that difference in coefficients is not systematic is rejected with a $\chi^2 = 65.25$ and thus $p < .01$. Table A-1

reports these results for each of the explanatory variables. These results motivate the use of a fixed effects NB model.

Table A-1: Hausman Test Results

	Fixed Effects	Random Effects	Difference	Std. Error
Intergovernmental Organizations	0.0115778	0.0090441	0.0025337	0.0006549
Formal Alliances	-0.0272895	0.0077677	-0.0350571	0.0103515
Diplomatic Exchanges	0.0039046	0.0021511	0.0017535	0.0006413
Polity Index	0.0047218	0.0110764	-0.0063546	0.0022057
log (Trade Openness)	-0.1251366	0.0045233	-0.1296599	0.0367184
log (CO_2 per capita)	0.1057325	0.1380189	-0.0322865	0.0300524
log (GDP per capita)	-0.1679902	-0.1006111	-0.0673791	0.0391311

Appendix 1.B Robustness Checks and Other Statistical Analysis

This appendix discusses and provides details of the regression results and marginal effects estimated in the full model presented in the results section. In particular, the robustness of these results to multicollinearity and sample selection issues are addressed.

Correlation of the Explanatory Variables

Table B-1 presents the correlation matrix for the explanatory variables in the full model. The correlation that needs further exploration (due to the high correlation of .8965 in Table B-1) is that of log CO_2 per capita and log GDP per capita. We want to ensure that this correlation is not systematic (linear) and, most importantly, does not affect the results and conclusions.

Table B-1: Correlation Matrix of Explanatory Variables

	Intergovernmental Organizations	Formal Alliances	Diplomatic Exchanges	Polity Index	log GDP per capita	log CO2 per capita	log Trade Openness
Intergovernmental Organizations	1						
Formal Alliances	0.2573	1					
Diplomatic Exchanges	0.6704	0.4154	1				
Polity	0.4707	0.0912	0.3169	1			
log GDP per capita	0.5368	0.2066	0.5451	0.5231	1		
log CO_2 per capita	0.4414	0.3264	0.537	0.4529	0.8965	1	
log Trade Openness	-0.0322	-0.1542	-0.2562	0.0451	0.2153	0.2514	1

Robustness Check: Correlation of Explanatory Variables

Therefore, to test the robustness of the model to the possibility of multicollinearity, I run 2 additional specifications of the model. The results of these regressions and their marginal effects are reported in columns (1) and (2) of Table B-2 and B-3. Each of these specifications drops either log CO_2 per capita and log GDP per capita.

Table B-2: Regression Results

	(1)	(2)	(3)
Intergovernmental Organizations	0.0116***	0.0114***	0.0105***
	(0.00107)	(0.00118)	(0.00105)
Formal Alliances	-0.0273	-0.0197	-0.0198
	(0.0230)	(0.0204)	(0.0160)
Diplomatic Exchanges	0.00390***	0.00416***	0.00336***
	(0.000630)	(0.000840)	(0.000800)
Polity	0.00472	0.00563	0.00449
	(0.00347)	(0.00350)	(0.00296)
log (Trade Openness)	-0.125**	-0.109***	-0.140***
	(0.0491)	(0.0415)	(0.0457)
log (CO_2 per capita)	0.106**		0.0184
	(0.0517)		(0.0324)
log (GDP per capita)	-0.168***	-0.0824**	
	(0.0556)	(0.0375)	
Constant	2.064***	1.316***	0.850***
	(0.443)	(0.281)	(0.201)
Observations	4,915	4,915	4,915
Number of countries	151	151	151

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

The results in Table B-2 and B-3 are consistent with the full model in both direction and strength of effects, suggesting robustness to concerns of multicollinearity. It is important to note that CO_2 per capita loses statistical significance when GDP per capita is dropped, though the direction of this effect remains the same. Given the high correlation between GDP per capita and CO_2 per capita, though, it's possible this variable is capturing something other than environmental quality.

Table B-3: Marginal Effects

	(1)	(2)	(3)
Intergovernmental Organizations	0.0366***	0.0362***	0.0328***
	(0.00432)	(0.00511)	(0.00351)
Formal Alliances	-0.0862	-0.0621	-0.0618

	(0.0566)	(0.0669)	(0.0621)
Diplomatic Exchanges	0.0123***	0.0132***	0.0105***
	(0.00240)	(0.00268)	(0.00213)
Polity	0.0149	0.0178	0.0140
	(0.0119)	(0.0111)	(0.00974)
log (Trade Openness)	-0.395***	-0.346**	-0.437***
	(0.145)	(0.152)	(0.138)
log (CO_2 per capita)	0.334**		0.0575
	(0.137)		(0.0785)
log (GDP per capita)	-0.530***	-0.260*	
	(0.169)	(0.136)	
Observations	4,915	4,915	4,915

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

Sample Selection

In order to model a balanced panel, 49 countries were dropped from the full dataset available (Mitchell, 2018). This is a large number of countries, so a discussion and robustness checks of the empirical results are in order.

Listed in Table B-4 are all 200 countries for which data on IEA signature is available (Mitchell, 2018). The 151 country names in bold are those included in the full specification of the model presented in the body of the paper. In Table B-4, countries are further characterized by regional grouping and status as a least developed country (LDC), landlocked developing country (LLDC), or small-island developing states (SIDS)[48].

Table B-4: Countries in Dataset

Country	Regional Group	UN Specification
Afghanistan	Central and Southern Asia	LDC, LLDC
Albania	Europe and N. America	
Algeria	N. Africa and W. Asia	
Andorra	Europe and N. America	
Angola	Sub-Saharan Africa	LDC
Antigua and Barbuda	Latin America and Caribbean	SIDS

[48] For more information about these classifications, visit https://unstats.un.org/sdgs/indicators/regional-groups/

Argentina	Latin America and Caribbean	
Armenia	N. Africa and W. Asia	LLDC
Aruba	Latin America and Caribbean	SIDS
Australia	Oceania	
Austria	Europe and N. America	
Azerbaijan	N. Africa and W. Asia	LLDC
Bahamas	Latin America and Caribbean	SIDS
Bahrain	N. Africa and W. Asia	
Bangladesh	Central and Southern Asia	LDC
Barbados	Latin America and Caribbean	SIDS
Belarus	Europe and N. America	
Belgium	Europe and N. America	
Belize	Latin America and Caribbean	SIDS
Benin	Sub-Saharan Africa	LDC
Bhutan	Central and Southern Asia	LDC, LLDC
Bolivia	Latin America and Caribbean	LLDC
Bosnia and Herzegovina	Europe and N. America	
Botswana	Sub-Saharan Africa	LLDC
Brazil	Latin America and Caribbean	
Brunei Darussalam	East and S. East Asia	
Bulgaria	Europe and N. America	
Burkina Faso	Sub-Saharan Africa	LDC, LLDC
Burundi	Sub-Saharan Africa	LDC, LLDC
Cambodia	East and S. East Asia	LDC
Cameroon	Sub-Saharan Africa	
Canada	N. Africa and W. Asia	
Cape Verde	Sub-Saharan Africa	SIDS
Central African Republic	Sub-Saharan Africa	LDC, LLDC
Chad	Sub-Saharan Africa	LDC, LLDC
Chile	Latin America and Caribbean	
China	East and S. East Asia	
Colombia	Latin America and Caribbean	
Comoros	Sub-Saharan Africa	LDC, SIDS
Congo, Democratic Republic of	Sub-Saharan Africa	LDC
Congo, Republic of the	Sub-Saharan Africa	
Cook Islands	Oceania	SIDS
Costa Rica	Latin America and Caribbean	
Cote d'Ivoire	Sub-Saharan Africa	
Croatia	Europe and N. America	
Cuba	Latin America and Caribbean	SIDS

Curacao	Latin America and Caribbean	SIDS
Cyprus	N. Africa and W. Asia	
Czech Republic	Europe and N. America	
Denmark	Europe and N. America	
Djibouti	Sub-Saharan Africa	LDC
Dominica	Latin America and Caribbean	SIDS
Dominican Republic	Latin America and Caribbean	SIDS
Ecuador	Latin America and Caribbean	
Egypt	N. Africa and W. Asia	
El Salvador	Latin America and Caribbean	
Equatorial Guinea	Sub-Saharan Africa	LDC
Eritrea	Sub-Saharan Africa	LDC
Estonia	Europe and N. America	
Ethiopia	Sub-Saharan Africa	LDC, LLDC
Fiji	Oceania	SIDS
Finland	Europe and N. America	
France	Europe and N. America	
Gabon	Sub-Saharan Africa	
Gambia	Sub-Saharan Africa	LDC
Georgia	N. Africa and W. Asia	
Germany	Europe and N. America	
Ghana	Sub-Saharan Africa	
Greece	Europe and N. America	
Grenada	Latin America and Caribbean	SIDS
Guatemala	Latin America and Caribbean	
Guinea	Sub-Saharan Africa	LDC
Guinea-Bissau	Sub-Saharan Africa	LDC, SIDS
Guyana	Latin America and Caribbean	SIDS
Haiti	Latin America and Caribbean	LDC, SIDS
Holy See		
Honduras	Latin America and Caribbean	
Hungary	Europe and N. America	
Iceland	Europe and N. America	
India	Central and Southern Asia	
Indonesia	East and S. East Asia	
Iran	Central and Southern Asia	
Iraq	N. Africa and W. Asia	
Ireland	Europe and N. America	
Israel	N. Africa and W. Asia	
Italy	Europe and N. America	

Jamaica	Latin America and Caribbean	SIDS
Japan	East and S. East Asia	
Jordan	N. Africa and W. Asia	
Kazakhstan	Central and Southern Asia	
Kenya	Sub-Saharan Africa	
Kiribati	Oceania	LDC, SIDS
Korea, Democratic People's Republic	East and S. East Asia	
Korea, Republic of	East and S. East Asia	
Kuwait	N. Africa and W. Asia	
Kyrgyzstan	Central and Southern Asia	LLDC
Laos	East and S. East Asia	LDC, LLDC
Latvia	Europe and N. America	
Lebanon	N. Africa and W. Asia	
Lesotho	Sub-Saharan Africa	LDC, LLDC
Liberia	Sub-Saharan Africa	LDC
Libya	N. Africa and W. Asia	
Liechtenstein	Europe and N. America	
Lithuania	Europe and N. America	
Luxembourg	Europe and N. America	
Macedonia	Europe and N. America	LLDC
Madagascar	Sub-Saharan Africa	LDC
Malawi	Sub-Saharan Africa	LDC, LLDC
Malaysia	East and S. East Asia	
Maldives	Central and Southern Asia	SIDS
Mali	Sub-Saharan Africa	LDC, LLDC
Malta	Europe and N. America	
Marshall Islands	Oceania	SIDS
Mauritania	Sub-Saharan Africa	LDC
Mauritius	Sub-Saharan Africa	SIDS
Mexico	Latin America and Caribbean	
Micronesia	Oceania	SIDS
Moldova	Europe and N. America	LLDC
Monaco	Europe and N. America	
Mongolia	East and S. East Asia	LLDC
Montenegro	Europe and N. America	
Morocco	N. Africa and W. Asia	
Mozambique	Sub-Saharan Africa	LDC
Myanmar	East and S. East Asia	LDC
Namibia	Sub-Saharan Africa	
Nauru	Oceania	SIDS

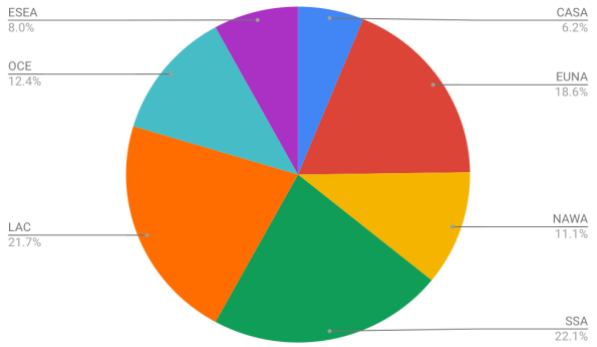
Nepal	Central and Southern Asia	LDC, LLDC
Netherlands	Europe and N. America	
Netherlands Antilles	Latin America and Caribbean	
New Zealand	Oceania	
Nicaragua	Latin America and Caribbean	
Niger	Sub-Saharan Africa	LDC, LLDC
Nigeria	Sub-Saharan Africa	
Niue	Oceania	SIDS
Norway	Europe and N. America	
Oman	N. Africa and W. Asia	
Pakistan	Central and Southern Asia	
Palau	Oceania	SIDS
Panama	Latin America and Caribbean	
Papua New Guinea	Oceania	SIDS
Paraguay	Latin America and Caribbean	LLDC
Peru	Latin America and Caribbean	
Philippines	East and S. East Asia	
Poland	Europe and N. America	
Portugal	Europe and N. America	
Qatar	N. Africa and W. Asia	
Romania	Europe and N. America	
Russian Federation	Europe and N. America	
Rwanda	Sub-Saharan Africa	LDC, LLDC
Saint Kitts and Nevis	Latin America and Caribbean	SIDS
Saint Lucia	Latin America and Caribbean	SIDS
Saint Vincent and the Grenadines	Latin America and Caribbean	SIDS
Samoa	Oceania	SIDS
San Marino	Europe and N. America	
Sao Tome and Principe	Sub-Saharan Africa	LDC, SIDS
Saudi Arabia	N. Africa and W. Asia	
Senegal	Sub-Saharan Africa	LDC
Serbia	Europe and N. America	
Seychelles	Sub-Saharan Africa	SIDS
Sierra Leone	Sub-Saharan Africa	LDC
Singapore	East and S. East Asia	SIDS
Slovakia	Europe and N. America	
Slovenia	Europe and N. America	
Solomon Islands	Oceania	LDC, SIDS
Somalia	Sub-Saharan Africa	LDC
South Africa	Sub-Saharan Africa	

South Sudan	Sub-Saharan Africa	LLDC
Spain	Europe and N. America	
Sri Lanka	Central and Southern Asia	
Sudan	N. Africa and W. Asia	LDC
Suriname	Latin America and Caribbean	SIDS
Swaziland	Sub-Saharan Africa	LLDC
Sweden	Europe and N. America	
Switzerland	Europe and N. America	
Syria	N. Africa and W. Asia	
Taiwan	East and S. East Asia	
Tajikistan	Central and Southern Asia	LLDC
Tanzania	Sub-Saharan Africa	LDC
Thailand	East and S. East Asia	
Timor-Leste	East and S. East Asia	LDC, SIDS
Togo	Sub-Saharan Africa	LDC
Tonga	Oceania	SIDS
Trinidad and Tobago	Latin America and Caribbean	SIDS
Tunisia	N. Africa and W. Asia	
Turkey	N. Africa and W. Asia	
Turkmenistan	Central and Southern Asia	LLDC
Tuvalu	Oceania	LDC, SIDS
Uganda	Sub-Saharan Africa	LDC, LLDC
Ukraine	Europe and N. America	
United Arab Emirates	N. Africa and W. Asia	
United Kingdom	Europe and N. America	
United States	N. Africa and W. Asia	
Uruguay	Latin America and Caribbean	
Uzbekistan	Central and Southern Asia	LLDC
Vanuatu	Oceania	LDC, SIDS
Venezuela	Latin America and Caribbean	
Viet Nam	East and S. East Asia	
Yemen	N. Africa and W. Asia	LDC
Zambia	Sub-Saharan Africa	LDC, LLDC
Zimbabwe	Sub-Saharan Africa	LLDC

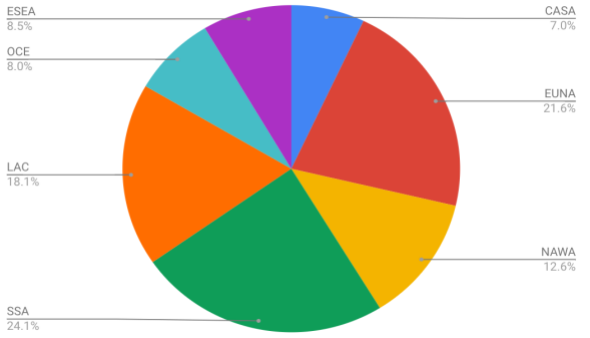
To verify the representativeness of the sample, I compare the proportions of these characterizations (region, LDC, LLDC, and SIDS) in the 151 countries modeled to both the full dataset of 200 and also, the UN statistics on these characteristics. These results are presented as

pie charts in Figures B-1 and B-2. Comparing across the charts in Figure B-1, it is apparent the representation of countries from each major regional group is consistent with both larger datasets. Figure B-2 demonstrates that the proportions of LDC's and LLDC's is comparable. The only difference to note is that small-island developing states are underrepresented.

United Nations



Full Data Set (200 countries)



Model Data (151 countries)

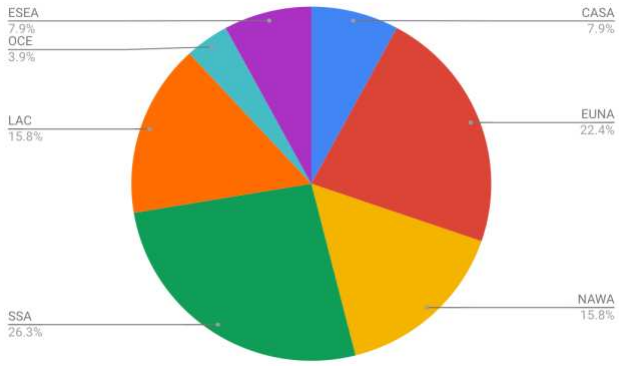
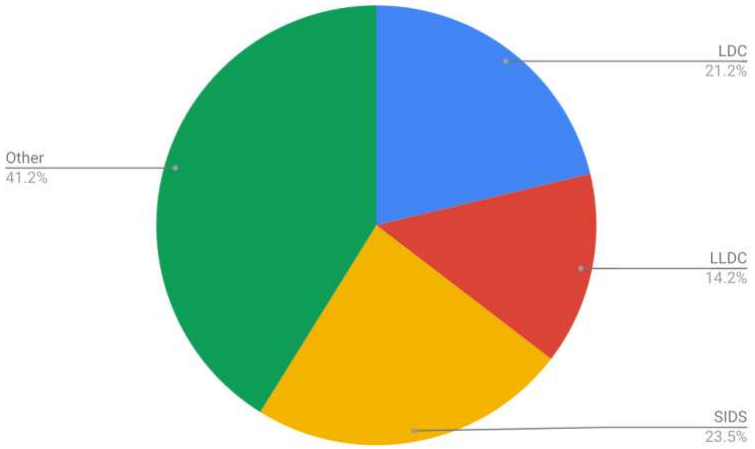
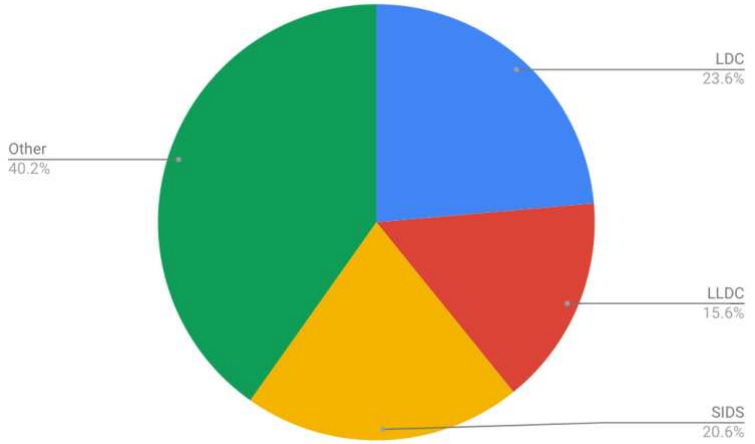


Figure B-1: Distribution of Regional Groups

United Nations



Full Data Set (n=200)



Model Data (n=151)

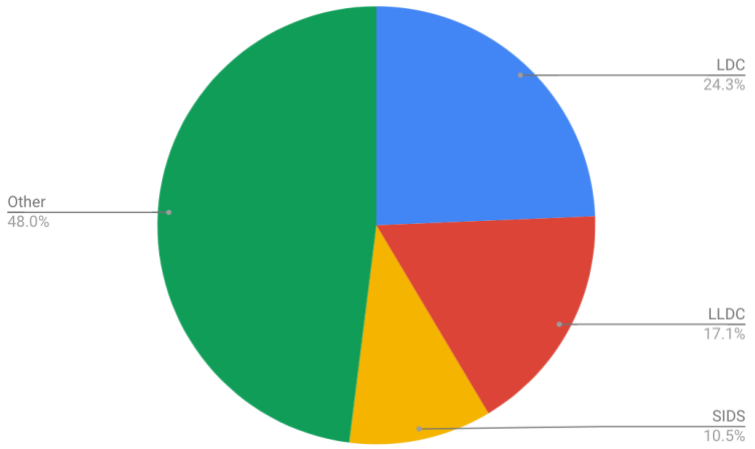


Figure B-2: Distribution by UN Specification

Robustness Check: Sample Selection

It is also prudent to check the robustness of the empirical results to the sample selection issues described above. To do so, I ran a 2 stepwise regression models, both with IEA count as the dependent variable and the same specifications of the full model. The first (results and marginal effects presented in Table B-5 and B-6, respectively) allows sample size to vary with the availability of balanced data available. The order of the variable additions is in terms of decreasing availability of (balanced) data (so the first regression has 190 countries, then reduces all the way to the 151 in the model sample in column 7). The second model (results and marginal effects presented in Table B-7 and B-8) follow the same stepwise procedure; however, the dataset is restricted to the 151 countries in the full model to aid in comparability.

Table B-5: Stepwise Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intergovernmental Organizations	0.0182***	0.0183***	0.0132***	0.0109***	0.0115***	0.0111***	0.0116***
	(0.000913)	(0.00130)	(0.00131)	(0.00113)	(0.00118)	(0.000976)	(0.00129)
Formal Alliances		-0.00850	-0.0217	-0.0379**	-0.0376**	-0.0353**	-0.0273
		(0.0158)	(0.0158)	(0.0156)	(0.0175)	(0.0164)	(0.0181)
Diplomatic Exchanges			0.00639***	0.00406***	0.00383***	0.00373***	0.00390***
			(0.00126)	(0.000752)	(0.000712)	(0.000683)	(0.000777)
log (CO_2 emissions per capita)				0.0478**	0.108**	0.121***	0.106**
				(0.0229)	(0.0429)	(0.0434)	(0.0532)
log (GDP per capita)					-0.185***	-0.169***	-0.168***
					(0.0502)	(0.0487)	(0.0535)
log (Trade Openness)						-0.103**	-0.125***
						(0.0480)	(0.0385)
Polity							0.00472
							(0.00329)
Constant	-0.0697	-0.0601	-0.0235	0.197***	1.751***	2.084***	2.064***
	(0.0566)	(0.0673)	(0.0648)	(0.0662)	(0.420)	(0.398)	(0.460)
Observations	9,281	9,281	8,770	6,921	5,859	5,439	4,915
Number of Countries	190	190	189	182	179	171	151

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

Table B-5 and B-6 demonstrate that the direction and degree of the regression results and marginal effects do not change significantly as the number of observations drops to the data set modeled.

Table B-6: Stepwise Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intergovernmental Organizations	0.0432***	0.0436***	0.0351***	0.0294***	0.0352***	0.0351***	0.0366***
	(0.00369)	(0.00310)	(0.00444)	(0.00362)	(0.00376)	(0.00341)	(0.00336)
Formal Alliances		-0.0203	-0.0577	-0.102**	-0.115*	-0.111**	-0.0862
		(0.0351)	(0.0491)	(0.0502)	(0.0586)	(0.0528)	(0.0630)
Diplomatic Exchanges			0.0170***	0.0110***	0.0117***	0.0118***	0.0123***
			(0.00341)	(0.00266)	(0.00220)	(0.00204)	(0.00278)
log (CO_2 emissions per capita)				0.129**	0.329***	0.380***	0.334***
				(0.0648)	(0.126)	(0.123)	(0.127)
log (GDP per capita)					-0.563***	-0.534***	-0.530***
					(0.147)	(0.158)	(0.125)
log (Trade Openness)						-0.326**	-0.395***
						(0.160)	(0.149)
Polity							0.0149**
							(0.00714)
Observations	9,281	9,281	8,770	6,921	5,859	5,439	4,915

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

Table B-7 and B-8 further demonstrate the robustness of the model's results as, within the restricted set, the change in direction and degree are even less pronounced with each addition of an explanatory variable.

Table B-7: Stepwise Regression Results (Full model dataset)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intergovernmental Organizations	0.0117***	0.0118***	0.0102***	0.0101***	0.0114***	0.0121***	0.0116***
	(0.000638)	(0.000769)	(0.000805)	(0.00104)	(0.00105)	(0.00114)	(0.00117)
Formal Alliances		-0.0158	-0.0185	-0.0188	-0.0267	-0.0283	-0.0273
		(0.0177)	(0.0250)	(0.0168)	(0.0190)	(0.0183)	(0.0178)
Diplomatic Exchanges			0.00334***	0.00329***	0.00386***	0.00375***	0.00390***
			(0.000680)	(0.000758)	(0.000672)	(0.000664)	(0.000701)
log (CO_2 emissions per capita)				0.00478	0.0992**	0.111***	0.106***
				(0.0307)	(0.0499)	(0.0400)	(0.0396)
log (GDP per capita)					-0.176***	-0.167***	-0.168***
					(0.0566)	(0.0442)	(0.0557)
log (Trade Openness)						-0.124**	-0.125***
						(0.0484)	(0.0416)
Polity							0.00472
							(0.00312)
Constant	0.360***	0.388***	0.311***	0.316***	1.648***	2.032***	2.064***
	(0.0643)	(0.0783)	(0.0772)	(0.0859)	(0.457)	(0.382)	(0.398)
Observations	4,915	4,915	4,915	4,915	4,915	4,915	4,915
Number of countries	151	151	151	151	151	151	151

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

Table B-8: Stepwise Marginal Effects (Full model dataset)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intergovernmental Organizations	0.0345*** (0.00259)	0.0351*** (0.00226)	0.0309*** (0.00254)	0.0308*** (0.00326)	0.0353*** (0.00408)	0.0382*** (0.00388)	0.0366*** (0.00403)
Formal Alliances		-0.0471 (0.0618)	-0.0563 (0.0672)	-0.0572 (0.0663)	-0.0832 (0.0671)	-0.0892 (0.0672)	-0.0862 (0.0623)
Diplomatic Exchanges			0.0102*** (0.00201)	0.0100*** (0.00249)	0.0120*** (0.00258)	0.0118*** (0.00299)	0.0123*** (0.00266)
log (CO_2 emissions per capita)				0.0146 (0.0788)	0.309*** (0.112)	0.350** (0.164)	0.334** (0.135)
log (GDP per capita)					-0.548*** (0.160)	-0.526*** (0.157)	-0.530*** (0.177)
log (Trade Openness)						-0.391*** (0.131)	-0.395** (0.162)
Polity							0.0149 (0.0104)
Observations	4,915	4,915	4,915	4,915	4,915	4,915	4,915

Standard errors in parentheses; Fixed effects are used.
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1.B demonstrates that the model presented is robust to both issues of multicollinearity and sample selection. The conclusion, then, is that the model fit and resulting conclusions are consistent and representative of the population.

Appendix 3.A: Additional Notes

This appendix presents the United Nations Geoscheme that was used to classify respondents' region of the world depending on their current country of residence at the time of the survey.

Table 3-A-1: United Nations Geoscheme

Region	Sub-region	Countries and Territories
Africa	Northern Africa	Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, Western Sahara
	Eastern Africa	British Indian Ocean Territory, Burundi, Comoros, Djibouti, Eritrea, Ethiopia, French Southern Territories, Kenya, Madagascar, Malawi, Mauritius, Mayotte, Mozambique, Réunion, Rwanda, Seychelles, Somalia, South Sudan, Uganda, United Republic of Tanzania, Zambia, Zimbabwe

	Middle Africa	Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe
	Southern Africa	Botswana, Eswatini, Lesotho, Namibia, South Africa
	Western Africa	Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Saint Helena, Senegal, Sierra Leone, Togo
America s	Latin America and the Caribbean	*Caribbean*: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bonaire, Sint Eustatius and Saba, British Virgin Islands, Cayman Islands, Cuba, Curaçao, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin (French Part), Saint Vincent and the Grenadines, Sint Maarten (Dutch part), Trinidad and Tobago, Turks and Caicos Islands, United States Virgin Islands *Central America*: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama *South America*: Argentina, Bolivia (Plurinational State of), Bouvet Island, Brazil, Chile, Colombia, Ecuador, Falkland Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, South Georgia and the South Sandwich Islands, Suriname, Uruguay, Venezuela (Bolivarian Republic of)
	Northern America	Bermuda, Canada, Greenland, Saint Pierre and Miquelon, United States of America
Asia	Central Asia	Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
	Eastern Asia	China, China - Hong Kong Special Administrative Region, China - Macao Special Administrative Region, Democratic People's Republic of Korea, Japan, Mongolia, Republic of Korea
	Southeaster n Asia	Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Viet Nam
	Southern Asia	Afghanistan, Bangladesh, Bhutan, India, Iran, (Islamic Republic of), Maldives, Nepal, Pakistan, Sri Lanka
	Western Asia	Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, State of Palestine, Syrian Arab Republic, Turkey, United Arab Emirates, Yemen

Europe	Eastern Europe	Belarus, Bulgaria, Czech Republic, Hungary, Poland, Republic of Moldova, Romania, Russian Federation, Slovakia, Ukraine
	Northern Europe	Åland Islands, Channel Islands (Guernsey, Jersey, Sark), Denmark, Estonia, Faroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Svalbard and Jan Mayen Islands, Sweden, United Kingdom of Great Britain and Northern Ireland
	Southern Europe	Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See, Italy, Malta, Montenegro, Portugal, San Marino, Serbia, Slovenia, Spain, The former Yugoslav Republic of Macedonia
	Western Europe	Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland
Oceania	Australia and New Zealand	Australia, Christmas Island, Cocos (Keeling) Islands, Heard Island and McDonald Islands, New Zealand, Norfolk Island
	Melanesia	Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu
	Micronesia	Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, Northern Mariana Islands, Palau, United States Minor Outlying Islands

Appendix 3.B: Citizen Astronaut Program Details

In this appendix, further details about Space for Humanity's Citizen Astronaut Program are included. Section 3.B.1 presents the application requirements respondents see on Space for Humanity's website. Section 3.B.2 is the full text of the Citizen Astronaut Application questions and thus represents the survey design for this research. The third and final section provides additional metrics.

Application Requirements

The following are the application requirements as they are shown on Space for Humanity's website.

The application requirements (are):

18+ years old.

Proficient in English.

Passion for humanity and a desire to positively impact the world.

Currently serving in a community leadership role.

Clear understanding and commitment to Space for Humanity mission.

Demonstrated leadership and effective communication skills.

Effect and compelling communicator.

Self-motivated problem solver.

Authentic, open and empathetic.

Survey (Citizen Astronaut Application) Questions

Below are pertinent excerpts of the 2019 Space for Humanity Citizen Astronaut application are provided below. The original application was administered through Typeform online software through the Space for Humanity website.

Application Section 1. Basic Information

Section 1 of the application will not be used as selection criteria for your application, we simply want to learn more about you.

1. What is your First Name?

Given Name

2. Thank you, [First Name]. What is your Last Name?

Surname or Family Name

3. What is your Nationality?

4. What is your current Country of Residence?

5. What is your Year of Birth?

6. What is your Gender?

a. Male

b. Female

c. Other

Application Section 2. Written Questions

Thank you, [First Name]. The next portion of the application is in long-form. The following questions are meant to be open-ended, allowing you to share your story.

7. Why is our mission important to you?

The Mission of Space for Humanity is to cultivate a global community of citizen astronauts who transform the world as social impact ambassadors.

8. Why do you want to go to space as a Citizen Astronaut?

9. Is there anything else you want to tell us about yourself?

Application Section 3. Social Impact

Each of our citizen astronauts will be supported in either creating a social impact venture or expanding an existing venture. The goal of this section is to apply the spaceflight perspective (the overview effect) to global challenges that we are facing. We want to see your vision and ideas in answering the following questions.

10. Which Sustainable Development Goals would you like to represent as an Ambassador? *Click here to learn more about the UN-SDGs.*

Make between 1 and 5 choices.

a. No Poverty (1)

b. Zero Hunger (2)

c. Good Health & Wellbeing (3)

d. Quality Education (4)

e. Gender Equality (5)

f. Clean Water & Sanitation (6)

g. Affordable & Clean Energy (7)

h. Decent Work & Economic Growth (8)

i. Industry, Innovation & Infrastructure (9)

j. Reduced Inequalities (10)

k. Sustainable Cities & Communities (11)

l. Responsible Consumption and Production (12)

m. Climate Action (13)

n. Life Below Water (14)

o. Life on Land (15)

p. Peace, Justice and Strong Institutions (16)

q. Partnerships for the Goals (17)

11. Select the following that best describe your skills or background which may apply to your ambassadorship.

Make between 1 and 3 choices.

a. Business

b. Science

c. Language & Literature

d. Creative Arts

e. Engineering

f. Culture

g. Technology

h. Other

12. Describe the social impact venture that you would like to launch or support.

The goal of this section is to get to know you, your passions, and how you want to impact the world around you. If you don't have a clear plan at this moment – no problem. Here are some questions to help guide your answer.

WHO will your initiative impact?

WHAT will your initiative accomplish?

WHEN will you see results from your work?

WHERE will your initiative take place?

WHY is your vision important?

Application Section 4. Assessments for Research

We are interested in getting to know you better. While responding to the following questions, please be honest in your responses. Also, there is no need to overthink them, just respond with the answer that feels the most accurate about yourself.

Note: These following sections of the application are left out as they were not used in this analysis. I have included the section headers and descriptions to provide context.

Application Section 4.1. Personality

Here are a number of characteristics that may or may not apply to you. Please indicate the extent to which you agree or disagree with that statement.

Application Section 4.2. Dispositional Awe

Here are a number of characteristics that may or may not apply to you. Please indicate the extent to which you agree or disagree with that statement.

Application Section 4.3. Satisfaction with Life

Below are five statements that you may agree or disagree with. Please be open and honest in your responding.

Application Section 4.4. Positive & Negative Experiences

Please think about what you have been doing and experiencing during the past four weeks. Then report how much you experienced each of the following feelings, using the scale below.

80. How did you hear about Space for Humanity?

    a. Facebook

    b. Instagram

    c. LinkedIn

    d. Twitter

e. Google

f. A Friend or Colleague

g. Other

81. Would you like to share your social media handles? (Facebook, Instagram, LinkedIn, etc.)

82. Are you interested in contributing your time to participate in community feedback sessions, managed by Space for Humanity?

Y. Yes

N. No

83. How many hours per week would be able to contribute in community feedback sessions?

84. Thank you, [First Name]! Please enter your email.

Your email is required to follow-up with your application.

85. By submitting this application, you acknowledge that you are at least 18 years old and agree to Space for Humanity 's Terms of Service and Privacy Policy.

Terms of Service

Privacy Policy

a. I accept

b. I don't accept

86. Do we have your permission to post contents from this application anonymously on Social Media?

a. I accept

b. I don't accept

Appendix 3.C: Additional Metrics

The second major portion of this work runs 17 separate regressions, taking each individual SDG indicator as dependent on the demographic variables. Table 3-C-1 provides summary statistics on the 17 SDG indicators. It shows that the largest proportion of the dataset is interested in SDG 4 (quality education). SDG 13 (Climate Action) is the next most popular choice, followed by SDG 7 (affordable and clean energy). The least chosen SDG is SDG 14 (life below water).

Table 3-C-1: Summary Statistics for SDG Indicators

	mean	sd
sdg1	0.224	0.417
sdg2	0.251	0.434
sdg3	0.296	0.456
sdg4	0.541	0.498
sdg5	0.207	0.405
sdg6	0.25	0.433
sdg7	0.368	0.482
sdg8	0.123	0.328
sdg9	0.253	0.435
sdg10	0.141	0.348
sdg11	0.211	0.408
sdg12	0.152	0.359
sdg13	0.429	0.495
sdg14	0.107	0.31
sdg15	0.122	0.327
sdg16	0.3	0.459
sdg17	0.142	0.35

(n-2,913)