

# Second-Order Knowledge Intermediaries and Multi-Country Entrepreneurial Entry into a Nascent Industry

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**Abstract.** How can a knowledge intermediary support industry development and entrepreneurial entry in countries where it is not present? This study introduces a two-stage model of multi-country entrepreneurial entry via second-order knowledge intermediaries (SOKIs). In Stage 1, SOKIs acquire and develop industry-building knowledge and capabilities from engagement with the activities of carrying, co-creating, capacity building, and convening of a first-order knowledge intermediary (FOKI). In Stage 2, motivated SOKIs implement these activities in secondary countries, supporting local industry development. The model is developed in the context of the clean cookstove industry, which addresses global health and environmental challenges among low-income populations. Qualitative evidence from 25 interviews and archival data were used to describe how SOKIs learned transferable knowledge and capabilities in primary countries. A quantitative analysis of data derived from 1,996 clean cookstove organizations operating across 113 countries (2013–2019) was conducted to assess whether a greater number of SOKIs in secondary countries was associated with increased entrepreneurial entries. Results support the model; more SOKIs were associated with more entrepreneurial entries, and this relationship was weakened when company and nonprofit SOKIs were imbalanced and when more domestic industry actors possessed overlapping knowledge. This study contributes to the literature on industry emergence by introducing a mechanism of non-firm-led, cross-border knowledge diffusion in mission-oriented industries. It also shows how local entrepreneurs in under-resourced contexts can access global knowledge—not through firms or FOKIs but through SOKIs that extend the FOKIs' work.

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## 1. Introduction

Scholars of nascent industries have studied how the accumulation of an industry's knowledge base contributes to entrepreneurial entry (Moeen 2017, Moeen and Agarwal 2017, Moeen and Mitchell 2020). A critical mechanism of knowledge accumulation is through ecosystem partnerships (e.g., Hannah and Eisenhardt 2018) and collective action (Lee et al. 2018). Although firms typically pioneer these activities, knowledge intermediaries may also "provide a supporting role for collaboration between two or more parties" (De Silva et al. 2018, p. 70). As the industry knowledge base develops, uncertainties are reduced, which lowers entrepreneurs' costs of developing and acquiring knowledge for entering the industry (Gort and Klepper 1982). Entrepreneurial entry is a necessary step toward the milestone of firm takeoff in the industry emergence process (Agarwal and Bayus 2002).

However, in mission-oriented industries (Agarwal et al. 2021), like those providing clean drinking water and off-grid energy to low-income customers (e.g.,

Christensen et al. 2015, Uppari et al. 2024), firms are unlikely to pioneer knowledge-building efforts because of weak commercial incentives. In these contexts, knowledge intermediaries may initiate early industry development but often lack the capacity to operate across all geographies where such needs are most acute. Although cross-border industry knowledge diffusion is commonly theorized as led by firms (Johanson and Vahlne 2009, Wormald et al. 2021), much less is known about how non-firm actors, like knowledge intermediaries, contribute to industry emergence beyond their immediate contexts. This raises an important question: Can knowledge intermediaries contribute to industry development and emergence in countries where they are not directly present? If so, through what mechanisms?

This study addresses these questions by introducing a two-stage model of multi-country entrepreneurial entry focused on the activities of knowledge intermediaries. In Stage 1, a knowledge intermediary directly supports early industry development in a limited set of primary

countries. These actors are referred to as first-order knowledge intermediaries (FOKIs; an acronym pronounced "foh-kees" throughout the paper). Through the activities of carrying, co-creating, capacity building, and convening, the FOKI accumulates industry knowledge. In Stage 2, a different set of organizations (second-order knowledge intermediaries (SOKIs; an acronym pronounced "soh-kees" throughout the paper)) transfers the knowledge and capabilities that they developed through FOKI engagement to carry out the same activities in secondary countries. This recursive process suggests one way in which industry knowledge may diffuse across borders and support entrepreneurial entry in countries where the FOKI is not directly active.

The proposed model is developed and tested in the context of the clean cookstove industry, which aims to address environmental, social, health, and gender-related challenges associated with cooking with polluting technologies in developing countries (Bruce et al. 2000, Bailis et al. 2009). In 2010, the Global Alliance for Clean Cookstoves (also referred to as the Alliance) began serving as the industry's FOKI in eight primary countries. For Stage 1, interviews and archival data showed how SOKIs, organizations that were active in both the industry's primary and secondary countries, acquired industry-building knowledge and capabilities through engagement with the Alliance. Motivated SOKIs brought that knowledge to secondary countries where the FOKI was not directly active. For Stage 2, a set of hypotheses was developed to test whether the presence of SOKIs in secondary countries was associated with entrepreneurial entry. These hypotheses were tested using a data set derived from the Alliance's partner directory comprising 1,996 organizations operating across 113 countries between 2013 and 2019. Results supported the primary hypothesis; countries with more SOKIs experienced more entrepreneurial entry. This relationship was weaker where company and non-profit SOKIs were imbalanced and where a higher proportion of domestic industry actors possessed categorically overlapping industry knowledge, suggesting that SOKIs were most effective when their knowledge contributions were complementary among themselves and in relation to local actors.

This research contributes to theory on industry emergence by introducing a novel mechanism through which knowledge intermediaries influence multi-country entrepreneurial entry in nascent industries. It complements "born global" perspectives of industry emergence (Wormald et al. 2021, p. 1460, see also Oviatt and McDougall 1994) and highlights the role of an understudied non-firm actor in the creation of new industries, building on Agarwal et al. (2025). This study further contributes to the literature on institutional intermediaries (Armanios et al. 2017) by showing how intermediaries can address multiple dimensions of uncertainty, not just institutional uncertainty (Moeen et al. 2020). Lastly, this research deepens

our understanding of how local entrepreneurs in under-resourced contexts access global knowledge, not through firms or direct FOKI presence but through SOKIs that act as knowledge "carriers" (Scott 2003, p. 879). Insights from this study also offer practical implications for policymakers, funders, and leaders of knowledge intermediaries seeking to catalyze industry emergence across countries. Strategic, concentrated investment in a FOKI in a limited set of countries can yield broader global impact when SOKIs are equipped with multidimensional industry knowledge and enabled to apply industry-building capabilities across borders.

## 2. Literature Review

### 2.1. Industry Knowledge Accumulation, Knowledge Intermediaries, and Entrepreneurial Entry

Scholars of nascent industries conceptualize industry uncertainties along four dimensions: technology, demand, ecosystems, and institutions (Moeen and Agarwal 2017, Moeen et al. 2020). Technological uncertainty refers to incomplete information about technical designs and components within an architecture (Tushman and Anderson 1986). Demand uncertainty concerns the unknown or partial understanding of customer demand and preferences (Santos and Eisenhardt 2009). Ecosystem uncertainty involves uncertainty around the configuration of ecosystem activities, including those among suppliers, distributors, or complementors (Hannah and Eisenhardt 2018, Moeen and Mitchell 2020). Institutional uncertainty refers to incomplete knowledge about formal and social institutions that govern how an industry's offerings are exchanged (Gao and McDonald 2022).

Achieving industry emergence requires addressing these uncertainties by gradually accumulating knowledge into the industry's knowledge base (Kirsch et al. 2013, Moeen et al. 2020).<sup>1</sup> Knowledge accumulation occurs through the recursive processes of knowledge generation and knowledge aggregation. During knowledge generation, industry actors develop knowledge that addresses uncertainties by leveraging their existing resources and capabilities. During knowledge aggregation, industry actors combine their disjointed but complementary knowledge. For instance, Moeen and Mitchell (2020) show that pre-entrants in the U.S. agricultural biotechnology industry accessed technical capabilities through alliances and complementary assets through acquisitions. Firms also aggregate knowledge through collaborations with ecosystem partners (Wormald et al. 2023) and collective efforts with diverse industry actors, resulting in industry knowledge, such as technology standards, policy, consolidated identities, and clearly defined category boundaries (Lee et al. 2018).

It cannot be assumed, however, that knowledge accumulation always occurs. For instance, industry actors

may withhold their knowledge contributions if they provide low returns (Lee et al. 2018) or be accustomed to acting in isolation (e.g., DiMaggio 1991). They may have significant knowledge gaps that limit partnership opportunities (e.g., Lin et al. 2020) or misaligned goals that prevent collective decision making. For example, Ozcan and Santos (2015) describe how the early mobile payments industry failed to emerge because industry actors that were historically dominant in their respective industries were unable to reach a consensus on the new industry's architecture.

Where knowledge accumulation fails to occur, knowledge intermediaries can support it by “provid[ing] a supporting role for collaboration between two or more parties” (De Silva et al. 2018, p. 70).<sup>2</sup> Knowledge intermediaries’ activities extend well beyond simple intermediation and brokering and include the following: assisting with knowledge processing and recombination (Howells 2006), building knowledge-generating capabilities (Lin et al. 2020), sharing knowledge (Hargadon and Sutton 1997), investing in the provision of public goods (Stankiewicz 1995), and orchestrating collective action (Giudici et al. 2018). Within a country, the emergence of an industry may hinge on what is termed a first-order knowledge intermediary (FOKI), which is a knowledge intermediary that directly enables knowledge accumulation among local industry actors.<sup>3</sup> For example, the Chilean FOKI, Fundación Chile, played a key role in the country’s nascent salmon farming industry by disseminating global production know-how to small Chilean firms through industry publications, seminars, and technical assistance (Katz 2006). Similarly, Finland’s electronic prescription industry actors benefited from a FOKI that set visionary goals, convened regular meetings, built common ground, coordinated knowledge, and managed participation through mutual agreements (Aarikka-Stenroos et al. 2017).

As a FOKI enables knowledge accumulation into the industry knowledge base, entrepreneurs face lower costs of acquiring knowledge. Entrepreneurs without well-formed technical capabilities (Klepper and Simons 2000), complementary assets (Mitchell 1989), and integrative capabilities (Moeen 2017) can leverage the industry knowledge base for entry (Gort and Klepper 1982), which is the first step toward the critical milestone of firm take-off (i.e., the sharp increase in firm entry) in the industry emergence process (Agarwal and Bayus 2002).

## 2.2. Industry Knowledge Diffusion Across Borders and Limitations in Industries Addressing Global Societal Needs

Although the process of accumulating industry knowledge is typically studied within a single country, scholars have also recognized that this process can occur across multiple countries (Bingham 2009, Bingham and Davis 2012). This is especially important for industries

addressing urgent, unmet health and environmental needs in multiple developing countries (e.g., Uppari et al. 2024), where cross-border knowledge diffusion may be able to stimulate entrepreneurial entry and industry development.

From a classic international business perspective, multinational corporations (MNCs) drive the diffusion of industry knowledge from a “lead” market, where an innovation is first developed, introduced to consumers, and gains traction, to “lag” markets, where it is later adopted (Bartlett and Ghoshal 1990, Beise 2004, Beise and Cleff 2004). MNCs accumulate knowledge in lead countries and, recognizing its potential to create value elsewhere, transfer it to units in lag countries (Buckley and Casson 1976, Hymer 1976, Johanson and Vahlne 1977, Ghoshal and Bartlett 1988). Although the diffusion of technology and its associated knowledge has traditionally been viewed as a trickle-down process from mature industries in developed countries to nascent industries in developing countries (Vernon 1966, Kedia and Bhagat 1988), scholars have also recognized that it can occur early in an industry’s life cycle through entrepreneurial firms that rapidly accumulate and diffuse knowledge across multiple countries (Oviatt and McDougall 1994, Johanson and Vahlne 2009). For instance, in the global mobile money industry, pioneering firms developed and accumulated ecosystem and demand knowledge by jointly launching platforms in primary countries and then, quickly leveraged this knowledge to “scale impact by launching subsequent platforms, often with the same partner, in other countries” (Wormald et al. 2023, p. 1687).

Although useful in explaining the role of firms in diffusing industry knowledge, such conceptualizations fall short of explaining the transfer of knowledge for industries aimed at addressing pressing societal needs, such as those promoting technological solutions for clean energy, health, and sanitation for low-income customers. In such industries, the assumptions that underpin classic models of diffusion—namely, that innovations diffuse from established industries in developed countries to less-established industries in developing countries via firms—often do not hold.

There are at least four reasons for this. First, these innovations rarely originate in developed countries because there is little local demand (Fosfuri et al. 2016). As a result, there are few, if any, firms in lead markets that can accumulate and transfer industry knowledge. Second, even though societal needs are significant, the commercial potential of these markets is often unclear and unproven. Despite the proposition that firms can profitably sell innovative products to low-income customers (Prahalad 2006), the obstacles to doing so are significant (Simanis 2012, Jue-Rajasinhg and Siegel 2022). As a result, firms may hesitate to pioneer these industries, which are perceived as mission-driven but not

sufficiently profitable to justify early private-sector investment. Third, the knowledge required to build industries addressing societal goals does not reside within a single firm but is fragmented (and often siloed) among cross-sector actors, including nonprofits, government bodies, development agencies, universities, and social enterprises (Agarwal et al. 2021, 2025). Finally, for these innovations to be successfully adopted by low-income consumers at scale, they need to be infused with “microlevel insights about them, their life circumstances, their social networks, [and] how they purchase products” (Jagtap 2019, p. 43). Even if knowledge diffusion were led by firms, it would be insufficient to develop businesses and industries without collaboration with local actors (London 2016).

Hence, traditional models of firm-led cross-border knowledge diffusion are often ill-suited to industries addressing global societal issues. FOKIs can be especially effective in developing these nascent industries, at least in countries where they actively aggregate industry knowledge by, for example, making early investments in the industry’s public goods and working across sectors to accumulate knowledge from siloed actors. However, a FOKI typically operates in a single geographic location and does not internationalize like firms (e.g., Katz 2006, Aarikka-Stenroos et al. 2017), limiting its ability to diffuse knowledge across borders. This raises an important yet underexplored question. Can a first-order knowledge intermediary support entrepreneurial entry and industry development in other countries, even where it is not physically present? If so, how—and under what conditions? This study explores how a FOKI, despite its lack of global presence, may still support entrepreneurial entry and industry development abroad, thereby offering an alternative model of cross-border knowledge diffusion in mission-driven industries.

### 3. A Two-Stage Model of Second-Order Knowledge Intermediaries and Entrepreneurial Entry

To explain how industry development and entrepreneurial entry can occur in countries lacking the presence of a first-order knowledge intermediary, this study introduces a two-stage model centered on second-order knowledge intermediaries (SOKIs).<sup>4</sup> Although prior work has focused on FOKIs operating in primary countries,<sup>5</sup> this model theorizes how SOKIs—organizations that engage with FOKIs to acquire industry knowledge and develop industry-building capabilities—can diffuse that knowledge to support entrepreneurial entry in secondary countries.

The two-stage model unfolds as follows (Figure 1). In Stage 1, the FOKI accumulates knowledge into the industry knowledge base in primary countries by supporting collaboration among local actors. SOKIs

participate in the FOKI’s knowledge intermediary activities, gaining exposure to industry knowledge and developing capabilities to support similar processes elsewhere. In Stage 2, SOKIs transfer what they have learned to secondary countries, implementing analogous knowledge intermediary activities. These activities are characterized as knowledge-centric (i.e., carrying and co-creating) and actor-centric (i.e., capacity building and convening), and they lower the costs for local entrepreneurs to acquire and develop industry knowledge. Through this two-stage model, knowledge accumulation and diffusion unfold in an ongoing, recursive manner, enabling industry development and entrepreneurial entry across multiple geographies.

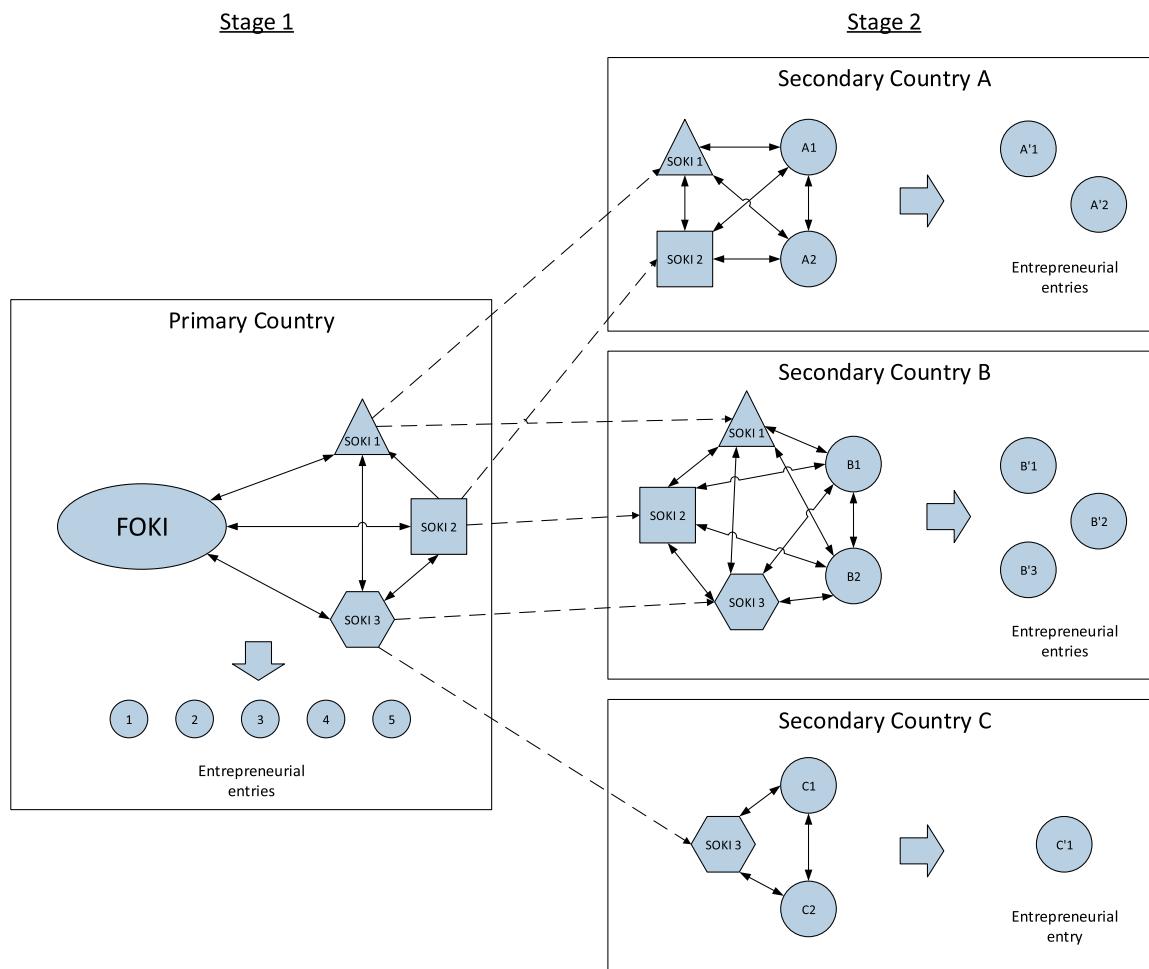
The clean cookstove industry provides a theoretically relevant context for developing and illustrating this two-stage model. This industry is marked by high uncertainty, fragmented knowledge, and considerable crosscountry variation in entrepreneurial entry. It also aligns closely with the profile of mission-driven industries, where cross-border knowledge diffusion is not firm-led.

To inform the model, qualitative data were collected from 25 interviews with 18 clean cookstove organizations (Table 1) alongside reports, news articles, and company websites. These data provided insight into how the FOKI supported knowledge accumulation in primary countries and how SOKIs engaged with the FOKI to acquire transferable knowledge and capabilities in Stage 1. These findings also informed the development of hypotheses for Stage 2. The central hypothesis proposes that countries with more SOKIs will experience greater entrepreneurial entry. As illustrated in Figure 1, for instance, a secondary country with three SOKIs (e.g., Country B) would be expected to exhibit more entry than countries with fewer (e.g., Country A or C). Additional hypotheses examine how the relationship is moderated by the characteristics of SOKIs and secondary countries.

### 4. Context: The Clean Cookstoves Sector

In 2010, approximately 42% of the world’s population—and 69% of the world’s rural population—still utilized polluting fuels, like biomass and kerosene, as their primary sources of energy for cooking.<sup>6</sup> When burned indoors in open fires on poorly functioning traditional stoves, these fuels exposed vulnerable populations, primarily women and children, to high levels of indoor air pollution (Bruce et al. 2000), leading to respiratory illness, stroke, heart disease, and lung cancer and causing 4.3 million premature deaths annually (World Health Organization 2016). Polluting fuels and traditional stoves were also associated with major concerns, like gender inequality and climate change (Smith et al. 2009).

**Figure 1.** (Color online) Two-Stage Model of SOKIs and Multi-Country Entrepreneurial Entry



*Notes.* In Stage 1 (primary country), the FOKI implements knowledge intermediary activities with SOKIs that not only contribute to local entrepreneurial entry but also provide SOKIs with industry-building knowledge and capabilities. In Stage 2 (secondary countries), motivated SOKIs diffuse industry-building knowledge and capabilities to implement knowledge intermediary activities, contributing to distant entrepreneurial entry.

A proposed solution to these problems was “clean” cookstoves (Bailis et al. 2009, p. 1694), which were designed to lower emissions and lessen fuel requirements compared with traditional stoves (USAID and Winrock International 2017). Clean cookstoves have existed since the 1950s and were initially implemented as nonprofit projects (Smith and Sagar 2014, p. 411). Designs spread globally, and in the 1980s and 1990s, clean cookstove programs were widely implemented by various government and nonprofit development agencies (Gifford 2010). These short-term, project-based initiatives focused on training local artisans to manufacture and distribute clean cookstoves. By 2010, some social enterprises attempted to commercialize clean cookstoves, but they were not financially sustainable (Shrimali et al. 2011).

At this time, the clean cookstoves sector was characterized by many uncertainties. In terms of technological uncertainty, hundreds of stove designs varied by

technological design (e.g., top-lit updraft gasifiers, rocket stoves), fuel source (e.g., charcoal, biogas), and price (Penumetcha 2015). Meanwhile, robust evidence was lacking about whether existing technologies could achieve the desired health benefits (U.S. Department of Energy 2011). There was also demand uncertainty; clean cookstoves had been heavily subsidized, willingness to pay was unknown, and producers did not know how to encourage behavior change away from traditional cooking methods. Ecosystem uncertainty was pervasive as a lack of distributors and financiers for heavy, durable products to geographically dispersed low-income customers constrained sector growth. Lastly, the clean cookstove industry was characterized by institutional uncertainty. Formal institutions, like high import duties and sales tax on clean cookstoves, increased costs to producers and customers, and a lack of technological standards failed to instill confidence in the products.

**Table 1.** Interviews with Clean Cookstove Industry Actors

Interview	Organization	Organization type	Knowledge intermediary type
#1	A	Company producer	SOKI
#2, #7, #21, #24	B	Company producer	SOKI
#3	C	Nonprofit producer	SOKI
#4	D	Public-private partnership	FOKI
#5	E	Nonprofit distributor	SOKI
#6	F	Company distributor	Non-SOKI
#8, #18	G	Government development agency	SOKI
#9	H	Company producer	SOKI
#10	I	Company producer	SOKI
#11, #12, #15	J	Nonprofit development agency	SOKI
#13	K	Company producer	Non-SOKI
#14	L	Nonprofit funder	SOKI
#16	M	Company producer	SOKI
#17, #22	N	Company producer	SOKI
#19	O	Multilateral	SOKI
#20	P	Nonprofit producer	SOKI
#23	Q	Multilateral	SOKI
#25	R	Nonprofit distributor	SOKI

*Note.* Interviews were conducted by phone, by Zoom, and in-country (in person), mostly between 2018 and 2019.

Even though there were many actors in the sector, knowledge accumulation progressed slowly. Many sector actors lacked sufficient resources and capabilities for knowledge generation. For instance, producers had limited funding and few effective partners for downstream activities, and they tried to “shoulder the entire burden of inventory financing and working capital needs on behalf of their sales intermediaries” (The World Bank 2015, p. 3). This challenge was reflected in interviews. One producer, for example, used to do “truck sales,” which involved driving around the country in a truck to sell its products. At this time, its focus on downstream activities prevented it from investing in product innovation and scaling up manufacturing (Interview #3).

Collaboration that would have helped accumulate industry knowledge did not occur. The implementation of clean cookstove initiatives was described as “scattered, led by different development partners or by the government without a continuous kind of intervention” (Interview #15). Not only were actors unaware of what others were doing, but they had misaligned goals that made coordination difficult. According to a government development agency, “[a]ll of the different actors within the sector have different mandates, so it’s part of the challenge when trying to streamline things” (Interview #18). Meanwhile, there was little private-sector support for the clean cookstove sector, which was viewed primarily as a “donor-funded initiative” (Interview #8) that was driven by nonprofit organizations “mainly focused on providing the necessary capacity to artisans or the local technicians to be able to manufacture or produce” lower-quality clean cookstoves on a project basis (Interview #4).

Recognizing these obstacles to industry development, the Global Alliance for Clean Cookstoves (the FOKI in

this study) was launched in September 2010 by Secretary of State Hillary Rodham Clinton at the Clinton Global Initiative forum. The Alliance was a public-private partnership initiated by multiple government agencies (e.g., U.S. Department of State), sponsored by philanthropic foundations (e.g., Shell Foundation), and hosted by the United Nations Foundation. It was established to implement “a concerted and coordinated strategy to develop a thriving market for clean cookstoves and fuels” (Global Alliance for Clean Cookstoves 2011a, p. 9). Within one year, it raised over \$78 million in funding from the philanthropic, private, and public sectors (Global Alliance for Clean Cookstoves 2011b), which was a previously unheard of sum in the clean cookstoves sector.

Although the Alliance was headquartered in Washington, DC, it aimed to “maximize impact and strengthen national markets for clean cooking” (Global Alliance for Clean Cookstoves 2016, p. 18). To do so, it selected eight primary countries to “coordinate on-the-ground activities and develop the local partnership ecosystem” (London and Fay 2018): Bangladesh, China, Ghana, Guatemala, India, Kenya, Nigeria, and Uganda.

## 5. Stage 1: SOKIs Learn from the FOKI’s Activities in Primary Countries

### 5.1. The FOKI’s Knowledge Intermediary Activities in Primary Countries

Like first-order knowledge intermediaries in prior research (e.g., Howells 2006), the Alliance implemented activities that enabled collaboration, knowledge accumulation, and entrepreneurial entry in primary countries. Qualitative data highlighted two sets of related, often overlapping activities that catalyzed the development of the local industry knowledge base. The first

centered on knowledge content: *carrying* knowledge and *co-creating* knowledge. The second centered on industry actors: *capacity building* and *convening*.<sup>7</sup>

**5.1.1. Knowledge-Centric Activities: Carrying and Co-creating.** *Carrying* refers to holding, managing, and conveying industry knowledge. FOKIs often act as “knowledge repositories” (De Silva et al. 2018, p. 71) that handle complex knowledge while making it accessible to external organizational actors (e.g., Hargadon and Sutton 1997, Armanios and Eesley 2021). In the clean cookstove sector, the Alliance carried industry-level strategies, frameworks, and data. For instance, in 2011, the FOKI published a blueprint for global industry development (Global Alliance for Clean Cookstoves 2011a). The document emphasized two main ideas: (1) developing a *market-based* clean cookstove industry (as opposed to one reliant on donor funding) and (2) enabling *collaboration* to achieve this goal. It also included other knowledge, such as plans for public awareness campaigns and strategies for improving last-mile distribution. In each primary country, the FOKI’s knowledge was conveyed and embedded into Country Action Plans, which served as national blueprints for local industry development (London and Fay 2018).

*Co-creating* refers to the collaborative generation of new industry knowledge. FOKIs may act like “co-creator[s] and enabler[s] of collective knowledge creation” (Agogué et al. 2013, p. 2) by deeply engaging in knowledge generation processes with other actors (Stewart and Hyysalo 2008). These efforts provide direct benefits to collaborators while also contributing to the broader development of the industry’s knowledge base. One important way in which the Alliance co-created new knowledge was by facilitating partnerships explicitly aimed at developing new knowledge. For instance, the FOKI funded a pilot between a nonprofit distributor, a solar energy company, and a clean cookstove manufacturer for “testing and evaluating the performance of a variety of distribution channels in order to create an evidence base of best practices for the scale-up of cookstove distribution” (Global Alliance for Clean Cookstoves 2013, p. 2). Although this knowledge was privately beneficial to the organizations involved, it was also publicly beneficial to the industry. These partnerships became sites of collaborative learning that contributed to the emerging industry knowledge base.

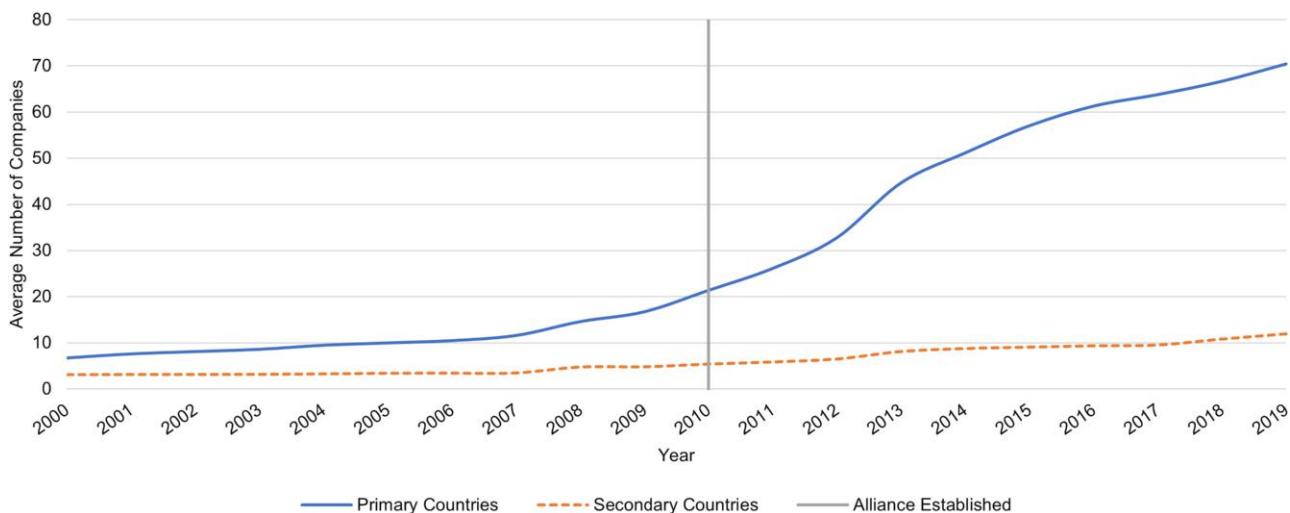
**5.1.2. Actor-Centric Activities: Capacity Building and Convening.** *Capacity building* refers to efforts that enhance individual actors’ ability to absorb and apply existing industry knowledge by strengthening their technical, organizational, and business capabilities. In emerging economies, FOKIs play a critical role in this process through interventions like technical assistance, business skills training, financing, and brokering

relationships (Klerkx et al. 2009, Kokshagina et al. 2017). The Alliance implemented these and other activities for clean cookstove organizations in primary countries by, for example, selecting firms to receive grants that enabled them to scale up manufacturing and test marketing strategies (Interview #1). It also supported initiatives such as results-based financing, which built local actors’ capacity to engage in structured, performance-driven market models. Participation in these programs required organizations to meet reporting requirements, adopt quality standards, and align distribution efforts with consumer demand, which were practices that improved their operational and financial readiness (Interview #11). Through these efforts, the FOKI enabled local actors to participate more effectively in the emerging clean cookstove industry.

*Convening* refers to the process of bringing together dissimilar actors to align around shared knowledge and mobilize toward collective action. In nascent industries, convening activities often involve intentional gatherings, like conferences and workshops (Mair and Hehenberger 2014), through which knowledge intermediaries help surface common goals, reduce fragmentation, and coordinate efforts across sectors. In primary countries, the Alliance organized national stakeholder meetings that brought together diverse and siloed industry actors. It also founded local industry associations that were essential to “bringing the stakeholders together and impacting on them to ensure they had a common policy if there [were] issues or sector challenges” (Interview #4). Once alignment was established, the FOKI helped mobilize industry actors toward collective action that would “advance the cause of the Global Alliance” in primary countries (Clean Cooking Alliance 2024), providing light-touch coordination to pursue initiatives like lobbying for policy change, adapting global standards to local conditions, and launching joint marketing initiatives.

The FOKI’s activities—*carrying*, *co-creating*, *capacity building*, and *convening*—were critical to industry knowledge accumulation. These activities reduced uncertainty and lowered two key knowledge-related costs for entrepreneurs. *Carrying* and *capacity building* made it easier for entrepreneurs to *acquire* existing industry knowledge through, for example, dissemination and training. *Co-creating* and *convening*, by contrast, made it easier for entrepreneurs to *develop* new knowledge, whether through collaborative problem-solving or cross-sector coordination. Together, these efforts expanded the industry knowledge base and reduced the costs of both acquiring and developing knowledge, which enabled entrepreneurial entry. When the Alliance was established in 2010, the eight primary countries hosted an average of 21.4 companies each. By 2019, that number had increased to 70.4. In contrast, countries without the FOKI grew more modestly from 5.4 to 11.9 companies on average (Figure 2).

**Figure 2.** (Color online) Average Number of Clean Cookstove Companies in Primary and Secondary Countries



Source. Global Alliance for Clean Cookstoves Partnership Directory.

Notes. In the Global Alliance for Clean Cookstoves Partnership Directory, founding years were determined by incorporation, domain name registration, self-reporting on company website or social media, or directory joining. Figure includes organizations categorized as “small or medium enterprise” or “national or multinational company.” It does not include closures. There were 113 secondary countries in the data set.

## 5.2. SOKIs’ Learning in Primary Countries

Although the FOKI directly supported entrepreneurial entry in primary countries, its activities also created an environment in which multinational organizations learned how to build the industry. By participating in these efforts, these actors developed two key forms of transferable knowledge: (1) industry knowledge that addressed industry uncertainties (e.g., technologies, business models, ecosystem partnerships, and policies) and (2) industry-building capabilities (i.e., knowing how to carry knowledge, co-create knowledge, build industry actors’ capacity, and convene industry actors). Without the FOKI’s catalyzing efforts, such learning would have been far less likely. These multinational organizations (typically companies and nonprofits) soon emerged as second-order knowledge intermediaries equipped to carry forward both industry knowledge and the capabilities to build the industry knowledge base in new contexts.

One key form of learning involved adopting the FOKI’s market-based framing of the clean cookstove sector. Through exposure to the Alliance’s knowledge carrying, SOKIs began to shift away from a donor-driven view of cookstoves as a humanitarian intervention and toward a commercial logic rooted in market responsiveness and scale. For example, a nonprofit SOKI that had previously supported small-scale rural artisans began promoting high-volume, market-oriented distribution strategies: “We don’t want to give these companies some money so that they can do sensitizing and all that. We wanted it to be a market-based approach where the market catalyzes itself, and it’s a market that shows whether there’s a demand for this

product or not” (Interview #11). A company SOKI echoed this shift, describing its operations like those of a conventional business.

[W]e just got into marketing relatively early on, as if it were like a normal for-profit business functioning on commercial operations. We were going to market this as if you would market Colgate products or Cadbury products or something, and not in the realm of the nonprofit world and [nongovernmental organizations], who are just going to do basic humanitarian initiatives. —Interview #2

Second, SOKIs gained hands-on experience co-creating new industry knowledge alongside the FOKI and other actors. These efforts often involved piloting new partnership models, which were collaborative experiments that generated knowledge about how to structure relationships within the emerging ecosystem. Company SOKIs worked with the FOKI and other partners to develop contract templates, marketing support tools, product feedback channels, and staged plans for building commitment (Interviews #2, #6, and #22). This collaborative experience not only enhanced SOKIs’ ability to manage partnerships but also contributed to shared knowledge of tools and practices that were useful to other industry actors. As one distributor explained, early partnerships served as valuable learning experiences that strengthened both their organizational capability and the ecosystem of the broader industry.

I think we’ve got a lot more years of experience just knowing for ourselves like what does and doesn’t work. Instead of early on, we were like, “We don’t know what works, but we’d be willing to work with

you to help find out." And that's a lot to ask out of a partnership. Whereas now, we've got a lot more experience behind this one. I think we can say, "Hey, this is what works. We've tried that other thing that you're suggesting and it doesn't work for these reasons. But we know this will work [instead], and if we structured it like this, we can partner with you."

—Interview #5

Third, SOKIs learned how to build the capacity of other actors in the industry, particularly by implementing initiatives supported by the FOKI. These experiences taught nonprofit SOKIs how to design and deliver programs that enabled local actors, which were often under-resourced, to absorb and apply market-based industry knowledge. For example, while rolling out results-based financing programs, SOKIs had to translate the funding model to local conditions, design incentive structures, and support partners in meeting technical and reporting standards (Interviews #8, #11, and #18). One nonprofit SOKI explained: "[B]ecause [the program] was a new concept, it took time even for us to understand how we would structure all these things, how we were going to report, and then how we were going to translate the same to the beneficiaries [partners]" (Interview #11). Through these efforts, SOKIs developed the capability to enable others to productively engage with existing industry knowledge, deepening local participation in the emerging clean cookstove sector.

Fourth, through the FOKI's convening activities, SOKIs learned how to align dissimilar actors and coordinate collective efforts across the industry. Nonprofit SOKIs often assumed leadership roles in local industry associations, where they gained experience organizing working groups, convening annual industry-wide meetings, coordinating industry-wide consumer awareness and behavior change efforts, and generally establishing systems for "a lot of communication from the Secretariat to the members" (Interview #8). Company SOKIs also learned how to participate in collective efforts, sometimes serving as key representatives in advocacy efforts. One company SOKI described how it worked with industry actors to successfully remove value-added tax on cookstoves in a primary country.

For the [value-added tax] removal in [primary country], we worked very closely with [the local industry association]. It was us plus our competitors, us manufacturers, and other interested parties in cookstoves. It was a group effort, so we could go to [the government] and say that there's a logical reason to remove [value-added tax]. —Interview #2

Hence, the FOKI's carrying, co-creating, capacity building, and convening not only enabled knowledge accumulation in primary countries but also, created a collaborative learning environment in which SOKIs

gained knowledge and capabilities through engagement with the FOKI and each other (Brown and Duguid 1991). As one SOKI reflected, industry development was not driven by a single actor but was a shared effort across diverse industry actors.

It is a combination of a lot of things, actually, which I don't think would be right to attribute to one organization. Because each person brings a new strength into the discussion ... [Even] for the big players in the industry who are coming up with the industrial manufactured stove—they benefited a lot from the experiences which have been gained from the artisanal stove market. —Interview #8

These learning experiences equipped SOKIs with both industry knowledge and the capabilities to carry, co-create, build capacity, and convene to accumulate the industry knowledge base in new contexts. In the next stage of the model, these SOKIs became central actors in extending the FOKI's influence, facilitating industry development and entrepreneurial entry in secondary countries where the FOKI itself was not directly active.

## 6. Stage 2: SOKIs Support Entrepreneurial Entry in Secondary Countries

### 6.1. SOKI Motivations, Knowledge Intermediary Activities, and Entrepreneurial Entry

Although SOKIs possess knowledge and capabilities that could support entrepreneurial entry in secondary countries, the decision to act as knowledge intermediaries is not automatic. Transferring knowledge across borders is costly (Teece 1977), particularly when that knowledge is directed toward a nascent industry where uncertainty remains high (Lee et al. 2018). SOKIs must be sufficiently motivated to transfer knowledge and implement knowledge-building capabilities in new contexts (Szulanski 1996, Gupta and Govindarajan 2000).

As shown in Stage 1, SOKIs learn by participating in the FOKI's carrying, co-creating, capacity building, and convening activities. These experiences not only equip SOKIs with knowledge and capabilities but also motivate their transfer, in line with prior research that suggests that accumulated experience in similar and diverse contexts increases the likelihood of cross-border activity (Barkema and Vermeulen 1998; Delios and Henisz 2000, 2003). Moreover, SOKIs' success in prior countries marks these locations as "centers of excellence" such that knowledge embodied in these markets becomes recognized as valuable across multiple geographies (Frost et al. 2002, p. 997), also motivating knowledge transfer from primary to secondary countries. The collective, community-based learning process described in Stage 1 further motivates SOKIs to seek opportunities to "re-embed" that

knowledge in new settings among new collaborators (Zhao et al. 2004, p. 147).

In the clean cookstove industry, secondary countries were perceived as “way behind” (Interview #10) and “embryonic” (Interview#15), suffering from the multiple dimensions of uncertainty that characterized the pre-FOKI industry in primary countries. Yet, despite the risks, many SOKIs were motivated to act as knowledge intermediaries. For instance, one company SOKI expressed confidence in accumulated experience from a primary country: “We’ve done it so many times—we’re not perfect yet, but we can probably mitigate the first 60% of mistakes that people get into” (Interview #2). In another example, a nonprofit SOKI’s prior success in a primary country reinforced its conviction that a market-based approach would work in a secondary country: “It’s a challenging sector, but I believe if there is enough investment, it can become like any other sector” (Interview #15).

Equipped and motivated to implement knowledge intermediary activities, SOKIs accumulate knowledge into secondary countries’ industry knowledge bases, reduce uncertainties, and enable entrepreneurial entry. Yet, in contrast to the more centralized role played by a single FOKI in primary countries, industry development in secondary countries depends on the efforts of multiple independent SOKIs to achieve industry-wide goals (Powell et al. 1996). No single SOKI typically possesses sufficient motivation and capabilities to fully enact the depth and range of necessary knowledge intermediary activities on their own, and a greater number of SOKIs enables them to effectively function as a “distributed team of [knowledge] champions” (Klerkx and Aarts 2013, p. 209). Because these SOKIs are already aligned on industry goals, they are more likely to act in concert instead of in opposition (e.g., Li et al. 2023). As their numbers grow, SOKIs’ efforts reinforce one another, strengthening knowledge accumulation and enabling greater entrepreneurial entry. Therefore, as a baseline hypothesis, Hypothesis 1 is presented.

**Hypothesis 1.** *In secondary countries, more second-order knowledge intermediaries are associated with more entrepreneurial entries into the nascent industry.*

## 6.2. SOKI Characteristics: SOKI-Type Imbalance and Geographic Dispersion

SOKIs’ organizational form affects entrepreneurial entry in different ways, stemming from characteristics that influence both motivation and relative capability advantages (Agarwal et al. 2025). Although all SOKIs engage in carrying, co-creating, capacity building, and convening, because of their organizational structures, company SOKIs tend to specialize in those that are knowledge-centric (carrying and co-creating), and

nonprofit SOKIs tend to specialize in those that are actor-centric (capacity building and convening).

Company SOKIs primarily carry knowledge from primary countries and co-create knowledge with local actors, focusing on the technological, demand, and ecosystem dimensions of knowledge (e.g., product designs, business models, marketing campaigns, and partnership management). With organizational forms characterized by commercial incentives and internal knowledge management capabilities (Argote and Ingram 2000), company SOKIs possess a capability advantage in efficiently carrying and co-creating knowledge that is both valuable to the firm and to the broader industry. This occurs through commercial co-specialization, where the accumulation of shared industry knowledge is most efficiently achieved when co-specialized with a firm’s focal commercial activity because of shared economies of scope (Luo and Kaul 2019, p. 485). The alignment of private incentives and public benefits enables company SOKIs to implement knowledge-centric knowledge intermediary activities: carrying knowledge that lowers entrepreneurs’ acquisition costs and co-creating knowledge that reduces their development costs.

In the clean cookstove industry, company SOKIs carried knowledge about stove technologies, distribution and marketing strategies, business models, and partnership models, which they acquired or developed in primary countries. For instance, after receiving substantial financial support from the Alliance to establish a manufacturing facility in a primary country, one company SOKI was able to focus on developing partnerships with distributors to make their products more accessible. In a secondary country, its entry was anticipated because of its “holistic approach” that “also involves local people, lets them become distributors” (Interview #15). This company SOKI carried and co-created knowledge.

What we do is we try to find a local distributor. We send over a container, give them some training, and have somebody that's there as that country's manager

... They're providing support for these distributors to try it out and see what happens ... [We] try to understand and do that market research on? Who's doing the sales? Where are they working? Where are they not working? —Interview #24

Nonprofit SOKIs contribute to the industry knowledge base in secondary countries primarily through capacity building and convening, focusing on the institutional, ecosystem, and demand dimensions of knowledge (e.g., organizing for collective action, brokering relationships, and public awareness campaigns). In nascent industries, the knowledge base functions as a collective good that is often underprovided because of low perceived returns, low excludability, low

attributability, and high coordination costs (Olson 1965, Marwell and Oliver 1993, Heckathorn 1996, Lee et al. 2018). Yet, nonprofit SOKIs are well positioned to make initial knowledge contributions benefiting all industry actors because of their form. Nonprofits are mission-driven actors that play a fiduciary role, representing the interests of marginalized groups (Luo and Kaul 2019, pp. 481–482). They are bound by the nondistribution constraint, which ensures that the value that nonprofits create is in service to their cause and cannot be distributed to individuals who control the organization (Hansmann 1980). Because they derive their legitimacy from demonstrating meaningful impact (Baum and Oliver 1996), nonprofits' focus on a single cause encourages the development of specialized knowledge and ongoing advocacy for industries that align with their values (e.g., Sine and Lee 2009). These qualities characterize nonprofit SOKIs as trustworthy and knowledgeable experts that contribute the "human networks, loyalty, trust, organizing skills, and other assets" (Greve et al. 2006, p. 811) to industry development, making them ideal implementers of actor-centric knowledge intermediary activities: capacity building that lowers entrepreneurs' knowledge acquisition costs and convening that lowers their knowledge development costs.

In the clean cookstove industry's secondary countries, SOKIs built the capacity of local actors in ways that supported the industry's shift toward the FOKI's market-driven approach. For example, one nonprofit SOKI had the goal of "upskilling" local cookstove producers through funding market-oriented activities, training in business skills, and brokering relationships so that the small businesses (and potentially, future entrepreneurs) could more fully participate in the industry.

There's not enough money, time, and effort invested in marketing, getting their names out there, [and] doing publicity campaigns. No one is really working on the sales part of the organization. We also try to fund that because we realize that if these organizations are going to be sustainable, they need someone selling them ... They need a market presence.

They [also] need to be at the table when decisions are being made about development in their country. So they need to formalize. They need to be just as good as they are on the ground in the community, in the boardroom selling their organization and their capacity. So, we really try to fund a lot of that upskilling ... just getting people through doors, bringing them to meetings, and having them speak and share their perspective. —Interview #20 (emphasis added)

Nonprofit SOKIs also convened and mobilized local industry actors toward the collective goals of advancing supportive policies and adapting technical standards. For instance, SNV, which had engaged in industry associations co-created by the Alliance in the primary

countries of Kenya and Uganda, became a central coordinator of the ICS Taskforce in the secondary country of Tanzania. Like the FOKI in primary countries, the nonprofit SOKI worked to "develop the sector through multistakeholder processes" and led the development of Tanzania's first country action plan in 2014 (ICS Taskforce 2014, p. ii). Similarly, Project Gaia, a nonprofit SOKI that received a 2017 grant from the Alliance in the primary country of Nigeria, later became an executive committee member of the clean cooking industry association in the secondary country of Ethiopia, which was established in 2019 (Ethiopian Clean Cooking Alliance 2023).

Although both company and nonprofit SOKIs contribute to industry development, they do so in complementary ways. Company SOKIs primarily implement knowledge-centric activities and accumulate industry knowledge related to technology, demand, and ecosystems. Nonprofit SOKIs primarily implement actor-centric activities, supporting the accumulation of institutional, demand, and ecosystem knowledge. Neither SOKI type can address the full range of uncertainty in the nascent industry's knowledge base on its own.

When one organizational form dominates, this imbalance may hinder the holistic development of the industry knowledge base. In countries where company SOKIs dominate, key forms of institutional knowledge (e.g., coordinated policy advocacy and shared technical standards) may be underdeveloped because of limited capabilities for convening and mobilizing collective efforts. Limited support for under-resourced local actors may also constrain their participation and knowledge contributions. Conversely, in countries where nonprofit SOKIs dominate, technological knowledge and commercially-oriented knowledge (e.g., viable business models, effective marketing and distribution strategies) may be underdeveloped as there may be less of this knowledge carried into the country and fewer capabilities to co-create it with local industry actors. In both cases, SOKI-type imbalance narrows the scope and usefulness of the industry knowledge base, weakening its ability to support entrepreneurial entry. Based on this reasoning, Hypothesis 2 is proposed.

**Hypothesis 2.** *In secondary countries, more imbalance between the number of company and nonprofit second-order knowledge intermediaries weakens the association between second-order knowledge intermediaries and entrepreneurial entries.*

SOKIs' effectiveness as knowledge intermediaries could also vary based on their geographic dispersion or the number of countries in which SOKIs operate. Although operating in more countries could provide SOKIs with access to more knowledge sources and improve global performance (e.g., Delios and Henisz 2003), not all sources of knowledge are equally valuable

for building an industry's knowledge base. Knowledge sourced from primary countries would be more advantageous than knowledge sourced from secondary countries. However, if SOKIs are very geographically dispersed, their knowledge would be sourced from both primary and secondary countries. Because of information overload, coordination costs, and communication costs (Schilling et al. 2003), highly geographically dispersed SOKIs may not be able to recognize, appropriately interpret, and prioritize knowledge from primary countries.

Furthermore, even if SOKIs recognize the value of knowledge from primary countries, high geographic dispersion limits their ability to transfer knowledge across borders. Knowledge transfer within organizations is affected by the "richness of transmission channels" (Gupta and Govindarajan 2000, p. 478) that are shaped by frequent and extensive in-person exchanges and face-to-face interactions (Kogut and Zander 1992, Szulanski 1996). SOKIs that are less geographically dispersed could more easily transmit knowledge by, for example, sending primary country team members to train team members in secondary countries. As geographic dispersion increases, team members have fewer opportunities to exchange rich communication, thus reducing coordination, trust, and cross-border knowledge transfer.

Last, highly geographically dispersed SOKIs are typically larger and more established, indicating that they may be more rigid (Le Mens et al. 2015). Inflexibility may limit their collaboration with local industry actors in secondary countries as they prefer to exploit existing knowledge instead of exploring knowledge recombination (Levinthal and March 1993). For instance, in the clean cookstove industry, a producer SOKI worked with local distributors' feedback to adapt the technological design of its clean cookstoves to address cooking styles in secondary countries: "Because we were a small company, we could respond quickly to customers' needs ... And obviously, that's harder the bigger you get. You get to a point where even just changing packaging is a challenge in itself" (Interview #10). Hence, the following hypothesis is presented.

**Hypothesis 3.** *In secondary countries, higher geographic dispersion of second-order knowledge intermediaries weakens the association between second-order knowledge intermediaries and entrepreneurial entries.*

### 6.3. Country Characteristics: Domestic Actors with Categorically Overlapping Knowledge

SOKIs' relationship with entrepreneurial entry in secondary countries also depends on the presence of domestic industry actors, which operate solely within a single country and also accumulate local industry knowledge. In secondary countries where domestic industry actors are prevalent (because of, for example,

historical circumstances), the industry knowledge base may already be somewhat developed, albeit with content that differs from that in primary countries. In such contexts, SOKIs' industry-building knowledge and capabilities may be perceived as misaligned with the local industry knowledge base. This misalignment can limit the perceived local relevance of SOKIs' foreign knowledge (Frenkel 2008), constraining its integration into the local industry knowledge base and its association with entrepreneurial entry. Domestic industry actors may even resist SOKIs' knowledge because of cognitive biases in knowledge transfer, such as "not-invented-here" syndrome, or a negative attitude toward knowledge derived from an external source because of social identity concerns (Antons and Piller 2015, p.193). Hence, SOKIs' foreign knowledge may be seen as irrelevant or even threatening to local industry knowledge, especially if it is categorically overlapping or similar to what is already known (Galunic and Rodan 1998, Hussinger and Wastyn 2016).

This dynamic was evident in the clean cookstove industry. A company SOKI representative commented on the increasing number of SOKIs entering a country with many domestic industry actors, highlighting their perceived irrelevance: "There's no way [domestic industry actors] will feel bad because these are very different products, very different prices ... They won't see that affecting them ... [because] the imported stoves are way different from theirs" (Interview #17). A government development agency representative had a more negative view as SOKIs' knowledge was seen as competing against domestic industry actors' knowledge.

Some of [domestic industry actors] are not interested in having that influx of higher-tiered stoves. They're saying that signals that the government is putting less support toward local companies. If you put in place all these policies and frameworks that encourage more of those types of companies, it means less support or less infrastructure, less enabling policy frameworks that are put in place for the local ones. —Interview #18

Thus, more domestic industry actors with knowledge that categorically overlaps with SOKIs' knowledge are likely to weaken the association between SOKIs and entrepreneurial entries in secondary countries.

**Hypothesis 4.** *In secondary countries, more domestic industry actors with categorically overlapping industry knowledge weaken the association between second-order knowledge intermediaries and entrepreneurial entries.*

## 7. Data and Methods

The data used for hypothesis testing were sourced from the publicly available Global Alliance for Clean Cookstoves online partner directory, which, as of January

2023, contained 2,371 partners. This partner directory is considered the most comprehensive database of clean cookstove industry actors by multiple international development programs, including the World Bank's Energy Sector Assistance Program and the Partnership for Clean Indoor Air (PCIA). The Alliance's online partner directory included information such as organization name, country where the organization was based, country (countries) where the organization was operating, organization type,<sup>8</sup> whether the organization worked in specific industry roles,<sup>9</sup> technologies and fuels that the organization was involved with, organizational expertise, description of the organizational mission, description of the organization's clean cooking activities, description in the type of partnership that the organization was interested in, primary and secondary points of contact, and website. The directory was scraped using R in the order that the organizations were added.

The year that an organization joined the Alliance was determined using 64 web pages on which the Alliance announced new members. Announcements began in October 2012 and were made periodically until July 2019. Organizations listed multiple times but with different countries of operations were combined into a single organization, and organizations that listed duplicate information were removed. Organizations that did not record a country of operation could not be assigned to any country-year observation, so they were removed. Unless they were newly founded companies, organizations that joined the Alliance in or after 2019 were additionally removed from the data set because they were outside of the date range of the analysis. This left 1,996 distinct organizations that were used to create the data set for this study.

From here, country-year observations were created. Because the only secondary countries of interest were those where there was potential demand for clean cookstoves, the sample included only secondary countries in which (1) over 5% of the country's population used solid fuels according to data maintained by the Alliance as of 2018 (Global Alliance for Clean Cookstoves 2018) or (2) at least 5% of the country's population primarily relied on polluting fuels and technologies for cooking in 2010 (World Health Organization 2022). This resulted in 113 countries (Online Appendix A) over seven years (2013–2019). The final data set had 791 country-year observations, and each observation contained information about country  $i$  for year  $t$  and  $t - 1$ . Observations with missing data were excluded from the analysis sample, leaving 676 observations.

### 7.1. Dependent Variable

The dependent variable, *entrepreneurial entries* ( $Entries_{it}$ ), was measured as the number of domestic clean cookstove companies entering country  $i$  in year  $t$ . Organizations were included if listed in the Alliance partner

directory as a "small or medium enterprise" or "national or multinational company," indicated cookstove or fuel "work" on their profile, only operated the focal country, and were founded in or after 2013.<sup>10</sup> Depending on data availability, the founding year was determined as (1) incorporation year according to the Orbis or Open Corporates database, (2) domain name registration date from the WHOXML or WHOXY database, (3) self-reported founding year on the company's social media or website, or (4) the year that the organization joined the Alliance partner directory. Founding years were required to be earlier than or equal to the year that the company joined the Alliance partner directory.

### 7.2. Explanatory Variable

The explanatory variable for all hypotheses, *second-order knowledge intermediaries* ( $SOKIs_{i,t-1}$ ), was measured as the count of SOKIs operating in country  $i$  in year  $t - 1$ . A SOKI was defined as an organization operating in both country  $i$  and at least one primary country in year  $t - 1$ . The first year in which a SOKI was counted as operating in a country was determined by its appearance in the Alliance's partner directory.

### 7.3. Moderator Variables

For Hypothesis 2, the moderator was *SOKI-type imbalance* ( $Imbalance_{i,t-1}$ ), calculated as the absolute value of the difference between the number of company SOKIs and nonprofit SOKIs operating in country  $i$  in year  $t - 1$ . Organization types were based on self-reported classifications: "small or medium enterprise" or "national or multinational company" for company SOKIs and "nongovernmental organization" for nonprofit SOKIs. For Hypothesis 3, the moderator was *SOKI geographic dispersion* ( $GeogDispersion_{i,t-1}$ ), defined as the average number of countries in which SOKIs operating in country  $i$  were active in year  $t - 1$ . For Hypothesis 4, the moderator was the *percentage of domestic industry actors with clean cookstove knowledge* ( $PctDomStoveKnow_{i,t-1}$ ). This was calculated as the number of domestic organizations in country  $i$  in year  $t - 1$  reporting work as "cookstove design/manufacture/assembly" or "cookstove distribution/retail/consumer finance" divided by the total number of domestic industry actors in the country in year  $t - 1$  multiplied by 100. If no domestic industry actors were present, a value of zero was imputed to reflect the absence of local cookstove-related knowledge.

### 7.4. Control Variables

Several control variables were selected to account for industry dynamics, global diffusion pathways, and country-level factors while minimizing multicollinearity among variables.

Industry-specific controls were primarily derived from the Alliance partner directory. First, to capture the

presence of multinational industry actors that did *not* operate in primary countries, the *percentage of industry actors that were non-SOKIs* was included ( $PctNonSOKIs_{i,t-1}$ ). This variable was calculated as the number of multinational organizations that worked in country  $i$  and at least one other secondary country in year  $t-1$  divided by the total number of industry actors in country  $i$  in year  $t-1$  multiplied by 100. Second, to account for the proportion of industry actors engaged specifically in clean cookstove and fuels work, the *percentage of industry actors that worked in cookstoves or fuels* was included ( $PctStoveFuel_{i,t-1}$ ). This was calculated as the number of industry actors in country  $i$  in year  $t-1$  that listed at least one of four cookstoves or fuel “work” options in their profile divided by the total number of industry actors in country  $i$  in year  $t-1$  multiplied by 100. Third, to account for the proportion of industry actors that operate only domestically, regardless of their cookstove knowledge, the *percentage of industry actors that were domestic* was added as a control ( $PctDomestic_{i,t-1}$ ). This was calculated as the number of domestic industry actors in country  $i$  in year  $t-1$  divided by the total number of industry actors in country  $i$  in year  $t-1$  multiplied by 100. Fourth, to control for SOKIs’ professionalism, which may have influenced their ability to attract and manage partnerships, the *log of the average SOKI profile character count* was included, denoted as  $\log(AvgProfileChar_{i,t-1})$ . This variable was based on the average number of characters in the “Mission,” “Clean Cooking Activities” and “Desired Partnerships” sections of the Alliance partner profile across all SOKIs in country  $i$  in year  $t-1$ . Lastly,  $PriorProgram_i$  was included as a binary indicator for the presence of a prior cookstove program in country  $i$  before 2010. These data were compiled for a University of California Berkeley thesis and shared by the author (Gifford 2010).

Global diffusion controls included two variables related to transnational knowledge flows. First, because intergovernmental organizations (IGOs) have been shown to support the diffusion of norms (Ingram and Torfason 2010), the *log of joint IGO memberships* between country  $i$  and all primary countries in 2014 was included, denoted as  $\log(JointIGO_i)$ . These data were from the Correlates of War Project (Pevehouse et al. 2019). Second,  $English_i$  was added as a binary indicator equal to one if English was spoken in country  $i$  and zero otherwise according to the U.S.’s Central Intelligence Agency (CIA) World FactBook. This variable accounts for the fact that Alliance materials were predominantly produced in English and may have been more accessible to English-speaking entrepreneurs.

Country-level controls accounted for contextual conditions influencing cookstove adoption and entrepreneurial entry. The *log of country i’s rural population* in year  $t-1$ , denoted as  $\log(RuralPop_{i,t-1})$ , reflected

evidence that rural areas had a higher reliance on polluting cooking fuels (Bailis et al. 2009). In addition, the *total summed magnitude of all major societal episodes of political violence* in country  $i$  in year  $t-1$  was included ( $MEPV_{i,t-1}$ ). Based on data from the Center for Systemic Peace’s Major Episodes of Political Violence, this measure aggregated the magnitude of all major episodes of political violence (i.e., civil violence, civil warfare, ethnic violence, and ethnic warfare), which may have caused disruptions affecting entrepreneurial entry (Ault and Spicer 2014).

## 7.5. Analysis

Because the dependent variable was count data, Poisson pseudomaximum likelihood regressions were estimated for country-year observations using the `ppmlhdfe` function in Stata.<sup>11</sup> These models estimated the expected number of entrepreneurial entries conditional on covariates. Year fixed effects were included to account for global shocks or historical trends that may affect entrepreneurial entries in a given year. The full model is specified as

$$\begin{aligned} E[Entries_{it}] = \exp(\beta_0 + \beta_1 SOKIs_{i,t-1} + \beta_2 Imbalance_{i,t-1} \\ + \beta_3 (SOKIs_{i,t-1} \times Imbalance_{i,t-1}) \\ + \beta_4 GeogDispersion_{i,t-1} \\ + \beta_5 (SOKIs_{i,t-1} \times GeogDispersion_{i,t-1}) \\ + \beta_6 PctDomStoveKnow_{i,t-1} \\ + \beta_7 (SOKIs_{i,t-1} \times PctDomStoveKnow_{i,t-1}) \\ + \gamma' Controls_{i,t-1} + \lambda_t), \end{aligned} \quad (1)$$

where  $Entries_{it}$ ,  $SOKIs_{i,t-1}$ ,  $Imbalance_{i,t-1}$ ,  $GeogDispersion_{i,t-1}$ , and  $PctDomStoveKnow_{i,t-1}$  are as previously defined;  $Controls_{i,t-1}$  is a vector of control variables as previously listed; and  $\lambda_t$  are year fixed effects. Standard errors are clustered at the country level to account for heteroskedasticity and within-country correlation over time.

## 8. Results

### 8.1. Descriptive Statistics and Pair-Wise Correlations

Table 2 depicts descriptive statistics for all variables that were included in the analyzed sample of 676 country-year observations for which there was full data (97 countries over seven years; of the 791 country-year observations in the final data set, 115 were dropped because of missing data on control variables). Table 3 shows pair-wise correlations for all variables in the analyzed sample. None exceeded 0.56, suggesting that multicollinearity because of correlated variables was not a major concern (Dormann et al. 2013).

Table 4 reports descriptive statistics for the number and share of company and nonprofit SOKIs per country-year observation. On average, nonprofit SOKIs

**Table 2.** Descriptive Statistics

Variable	Mean	Median	Standard deviation	Min	Max
(1) entrepreneurial entries <sub>it</sub>	0.1	0.0	0.40	0.0	4.0
(2) SOKIs <sub>i,t-1</sub>	30.5	24.0	21.09	1.0	105.0
(3) SOKI-type imbalance <sub>i,t-1</sub>	5.7	5.0	4.32	0.0	25.0
(4) SOKIs' geographic dispersion <sub>i,t-1</sub>	79.6	73.1	32.35	17.0	199.4
(5) % of domestic industry actors with cookstove knowledge <sub>i,t-1</sub>	26.0	0.0	33.88	0.0	100.0
(6) % of industry actors that were non-SOKIs <sub>i,t-1</sub>	6.6	6.2	5.88	0.0	33.3
(7) % of industry actors that worked in cookstoves or fuels <sub>i,t-1</sub>	29.4	30.4	12.82	0.0	71.4
(8) % of industry actors that were domestic <sub>i,t-1</sub>	5.8	3.3	7.58	0.0	58.8
(9) log(avg SOKI profile char count <sub>i,t-1</sub> )	6.8	6.8	0.15	6.4	7.3
(10) prior cookstove program <sub>i</sub>	0.4	0.0	0.48	0.0	1.0
(11) log(joint IGO memberships <sub>i</sub> )	5.8	5.8	0.17	5.1	6.1
(12) English <sub>i</sub>	0.4	0.0	0.49	0.0	1.0
(13) log(rural population <sub>i,t-1</sub> )	15.3	15.5	1.55	12.1	18.7
(14) tot summed magnitude of all societal MEPV <sub>i,t-1</sub>	0.7	0.0	1.61	0.0	6.0
Observations	676				

were more prevalent than company SOKIs across the sample. Other SOKI types were also present but are not the focus of this analysis. The country-year variance in SOKI-type count and composition, as seen in relatively high standard deviations, raises the possibility that SOKI types were not randomly distributed but may have selectively operated in countries where they were better positioned to pursue their objectives, introducing potential endogeneity in the observed relationships (i.e., selection effects). At the same time, this variance may also reflect a pattern of sequential entry, whereby company SOKIs became more prevalent as the industry developed. Figure B in Online Appendix B supports this

interpretation, showing that the share of company SOKIs increased as the total number of cookstove organizations in a country-year rose. An analysis of the majority SOKI type per country-year reveals that fewer than 1% of observations had a majority of company SOKIs and that about 19% had a majority of nonprofit SOKIs, whereas in approximately 81% of observations, no single organizational form constituted a majority. These patterns suggest that selection effects may be present, although selection alone is unlikely to fully explain the observed relationships. Although the hypotheses and analysis are correlational, the empirical patterns are consistent with the theorized mechanisms.

**Table 3.** Pair-Wise Correlations

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) entrepreneurial entries <sub>it</sub>	1.00						
(2) SOKIs <sub>i,t-1</sub>	0.24*	1.00					
(3) SOKI-type imbalance <sub>i,t-1</sub>	0.05	0.55*	1.00				
(4) SOKIs' geographic dispersion <sub>i,t-1</sub>	-0.28*	-0.48*	-0.33*	1.00			
(5) % of domestic industry actors with cookstove knowledge <sub>i,t-1</sub>	0.15*	0.52*	0.24*	-0.33*	1.00		
(6) % of industry actors that were non-SOKIs <sub>i,t-1</sub>	0.01	0.02	0.01	-0.16*	0.14*	1.00	
(7) % of industry actors that worked in cookstoves or fuels <sub>i,t-1</sub>	0.18*	0.45*	0.09	-0.28*	0.54*	0.38*	1.00
(8) % of industry actors that were domestic <sub>i,t-1</sub>	0.36*	0.50*	0.30*	-0.49*	0.43*	0.11*	0.43*
(9) log(avg SOKI profile char count <sub>i,t-1</sub> )	0.06	0.27*	-0.03	0.00	0.26*	0.02	0.42*
(10) prior cookstove program <sub>i</sub>	0.27*	0.55*	0.25*	-0.55*	0.37*	0.11*	0.34*
(11) log(joint IGO memberships <sub>i</sub> )	0.22*	0.39*	0.13*	-0.45*	0.21*	0.26*	0.25*
(12) English <sub>i</sub>	0.15*	0.27*	0.18*	-0.30*	0.23*	-0.05	0.24*
(13) log(rural population <sub>i,t-1</sub> )	0.27*	0.49*	0.31*	-0.52*	0.27*	0.03	0.33*
(14) tot summed magnitude of all societal MEPV <sub>i,t-1</sub>	0.05	0.05	0.08	-0.11*	0.11*	-0.02	0.12*
Variable	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(8) % of industry actors that were domestic <sub>i,t-1</sub>	1.00						
(9) log(avg SOKI profile char count <sub>i,t-1</sub> )	0.22*	1.00					
(10) prior cookstove program <sub>i</sub>	0.53*	0.11*	1.00				
(11) log(joint IGO memberships <sub>i</sub> )	0.37*	0.04	0.41*	1.00			
(12) English <sub>i</sub>	0.32*	0.14*	0.14*	0.19*	1.00		
(13) log(rural population <sub>i,t-1</sub> )	0.56*	0.22*	0.39*	0.36*	0.22*	1.00	
(14) tot summed magnitude of all societal MEPV <sub>i,t-1</sub>	0.29*	0.06	0.08	-0.07	0.10	0.44*	1.00

\*p < 0.1.

**Table 4.** Descriptive Statistics for Company, Nonprofit, and All Other SOKIs

SOKI type	Mean	Median	Standard deviation	Min	Max
Company SOKIs	6.35	4.00	5.41	0.00	27.00
Nonprofit SOKIs	11.97	10.00	7.97	0.00	43.00
All other SOKIs	12.22	10.00	8.73	0.00	47.00
Share of company SOKIs	0.19	0.19	0.08	0.00	0.50
Share of nonprofit SOKIs	0.41	0.40	0.12	0.00	1.00
Share of all other SOKIs	0.40	0.40	0.11	0.00	0.75
Observations	676				

Notes. Shares represent the proportion of each SOKI type relative to total SOKIs per country-year. “Other SOKIs” include the sum of carbon asset/project developers, consultants, foundations, government entities, investors, multilateral organizations, research institutions, and organizations listed as “other” in the Alliance’s partner directory. Summary statistics for other SOKI types are provided for completeness and transparency, but as these SOKI types are not the focus of this study, they are not disaggregated here.

## 8.2. Hypothesis Testing

Table 5 presents Poisson regression results for all hypotheses. Models were estimated sequentially, with each model introducing additional moderator variables and interaction terms to test Hypotheses 2–4. The full model estimating Equation (1) is presented in Model (7) in Table 5.

Hypothesis 1 predicted that in a secondary country, more SOKIs in the prior year would be positively associated with entrepreneurial entries. This hypothesis was strongly supported. Across Models (1)–(7) in Table 5, the coefficient for prior-year SOKIs was consistently positive and statistically significant ( $p < 0.05$  to  $p < 0.01$ ). The full model with all moderators, interaction terms, and control variables (Model (7) in Table 5) is used for interpretation. In a Poisson regression, the log of the expected count is modeled as a function of the explanatory variables. The estimated coefficient on  $SOKIs_{i,t-1}$  is 0.071 ( $p = 0.000$ ), indicating that each additional SOKI was associated with an increase in entrepreneurial entries by a factor of approximately 1.074 (i.e.,  $e^{\hat{\beta}} = e^{0.071} \approx 1.074$ ) or about 7.4% more entrepreneurial entries into the nascent industry in secondary countries. The increase in the estimated coefficient across models reflected the inclusion of moderator variables and interaction terms. Notably, prior-year non-SOKIs—multinational organizations not in primary countries—were *not* positively associated with entrepreneurial entries, highlighting the FOKI’s indirect role in fostering second-order, multi-country entrepreneurial entry.

Although a 7.4% increase in entrepreneurial entries may seem modest, it is fitting for the nascent stages of industry development. Clean cookstove industries in secondary countries were in the incubation and prefirm takeoff stages when firm entry is limited (Moeen et al. 2020, p. 220). When entrepreneurial entry occurred, the average entry rate was approximately 25%, equivalent to an increase from three to four companies (Online Appendix C). Although relatively rare, each instance of entrepreneurial entry represented an important step toward the next milestone in developing the clean cookstove industry in secondary countries and reflected

SOKIs’ efforts to build the industry knowledge base. Moreover, a piecewise analysis to assess the relationship between SOKIs and entrepreneurial entries reveals that this relationship was most robust between ~20 and ~70 SOKIs (Online Appendix D).

Hypothesis 2 proposed that imbalance between company and nonprofit SOKIs would weaken the positive association between SOKIs and entrepreneurial entries in secondary countries. This hypothesis was supported. The coefficient on the interaction term between prior-year SOKIs and SOKI-type imbalance was negative ( $\hat{\beta} = -0.004$  to  $-0.003$ ) and statistically significant across all models (e.g., Model (3) in Table 5:  $p = 0.027$ ; Model (7) in Table 5:  $p = 0.004$ ). The coefficient of  $-0.004$  in Model (7) in Table 5 implies that for each one-unit increase in imbalance (reflecting a greater divergence between the number of company and nonprofit SOKIs), the relationship between SOKIs and entrepreneurial entries weakened by approximately 0.4% ( $e^{-0.004} \approx 0.996$ ). These results suggest that the positive relationship between SOKIs and entrepreneurial entry was diminished in secondary countries where the SOKI landscape was dominated by one type of organizational form (company or nonprofit) rather than characterized by a more balanced composition.

Hypothesis 3 predicted that SOKIs’ geographic dispersion would weaken their positive association with entrepreneurial entries. This hypothesis was not supported. Contrary to expectations, the coefficient on the interaction term between prior-year SOKIs and SOKIs’ geographic dispersion was positive ( $\hat{\beta} = 0.001$ ) and statistically significant across all models (e.g., Model (5) in Table 5:  $p = 0.002$ ; Model (6) in Table 5:  $p = 0.002$ ; Model (7) in Table 5 = 0.014). This suggests that, on average, the relationship between the number of SOKIs and entrepreneurial entries was strengthened by approximately 0.1% ( $e^{0.001} \approx 1.001$ ) for each one-country increase in the median number of countries where those SOKIs operate. Hence, results indicate that the relationship between SOKIs and entrepreneurial entries strengthened (rather than weakened) as SOKIs operated in more countries, contrary to Hypothesis 3. Although this hypothesis was not supported on average using a linear moderation model,

**Table 5.** Poisson Regression Analyses for Hypotheses 1–4

Dependent variable: <i>entrepreneurial entries<sub>it</sub></i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SOKIs <sub>i,t-1</sub>	0.041*** (0.011)	0.042*** (0.011)	0.052*** (0.011)	0.059*** (0.015)	0.030* (0.015)	0.030* (0.015)	0.071*** (0.019)
SOKI-type imbalance <sub>i,t-1</sub>		-0.003 (0.027)	0.156* (0.077)	0.158* (0.076)	0.162* (0.078)	0.161* (0.075)	0.146* (0.072)
SOKIs <sub>i,t-1</sub> × SOKI-type imbalance <sub>i,t-1</sub>			-0.003* (0.001)	-0.003* (0.001)	-0.004** (0.001)	-0.004** (0.001)	-0.004** (0.001)
SOKIs' geographic dispersion <sub>i,t-1</sub>				0.011 (0.011)	0.001 (0.014)	0.001 (0.014)	0.005 (0.012)
SOKIs <sub>i,t-1</sub> × SOKIs' geographic dispersion <sub>i,t-1</sub>					0.001** (0.000)	0.001** (0.000)	0.001* (0.000)
% of domestic industry actors with cookstove knowledge <sub>i,t-1</sub>						0.001 (0.006)	0.018* (0.008)
SOKIs <sub>i,t-1</sub> × % of domestic industry actors with cookstove knowledge <sub>i,t-1</sub>							-0.001* (0.000)
% of industry actors that were non-SOKIs <sub>i,t-1</sub>	-0.037 <sup>+</sup> (0.021)	-0.036 <sup>+</sup> (0.022)	-0.031 (0.022)	-0.033 (0.023)	-0.046 (0.028)	-0.047 (0.029)	-0.044 (0.030)
% of industry actors that worked in cookstoves or fuels <sub>i,t-1</sub>	0.063*** (0.015)	0.062*** (0.017)	0.069*** (0.017)	0.072*** (0.017)	0.094*** (0.021)	0.093*** (0.021)	0.094*** (0.023)
% of industry actors that were domestic <sub>i,t-1</sub>	0.031* (0.014)	0.031* (0.015)	0.038* (0.015)	0.041* (0.016)	0.056*** (0.017)	0.056*** (0.016)	0.055*** (0.016)
log(avg SOKI profile char count <sub>i,t-1</sub> )	-0.268 (1.635)	-0.263 (1.634)	-0.341 (1.379)	-0.277 (1.366)	-0.584 (1.354)	-0.590 (1.348)	-0.330 (1.496)
prior cookstove program <sub>i</sub>	0.031 (0.398)	0.031 (0.398)	0.015 (0.409)	0.070 (0.408)	-0.114 (0.405)	-0.111 (0.404)	-0.172 (0.399)
log(joint IGO memberships <sub>i</sub> )	3.168** (1.173)	3.137** (1.148)	2.860** (1.074)	2.878** (1.060)	2.156* (1.016)	2.151* (1.021)	2.168* (1.074)
English <sub>i</sub>	-0.266 (0.260)	-0.262 (0.265)	-0.262 (0.280)	-0.280 (0.277)	-0.337 (0.262)	-0.339 (0.261)	-0.258 (0.258)
log(rural population <sub>i,t-1</sub> )	0.183 (0.156)	0.181 (0.156)	0.147 (0.153)	0.163 (0.148)	0.173 (0.140)	0.175 (0.136)	0.149 (0.135)
tot summed magnitude of all societal MEPV <sub>i,t-1</sub>	0.050 (0.066)	0.051 (0.067)	0.040 (0.073)	0.028 (0.075)	0.013 (0.073)	0.012 (0.075)	0.049 (0.085)
Constant	-25.411*** (7.337)	-25.192** (7.756)	-23.397** (7.554)	-25.263*** (7.533)	-20.872** (7.487)	-20.799** (7.471)	-23.227** (7.984)
Observations	676	676	676	676	676	676	676
Pseudo- <i>R</i> <sup>2</sup>	0.328	0.328	0.339	0.340	0.352	0.352	0.361

Note. The table includes year fixed effects and clustered standard errors by country (in parentheses).

\**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001; <sup>+</sup>*p* < 0.10.

exploratory analyses using tertiles of SOKIs' geographic dispersion (using a median-based specification) (Table E2 in Online Appendix E) and restricted samples based on geographic dispersion level (Table E5 in Online Appendix E) revealed a more nuanced pattern; SOKIs were more strongly associated with entrepreneurial entries when their geographic dispersion was low, and this association diminished at higher levels of dispersion.

Hypothesis 4 proposed that the presence of domestic industry actors with overlapping cookstove-related knowledge would weaken the relationship between SOKIs and entrepreneurial entries. This hypothesis

was supported. In Model (7) in Table 5, the coefficient on the interaction term between prior-year SOKIs and the percentage of domestic industry actors with cookstove knowledge was negative ( $\hat{\beta} = -0.001$ ) and statistically significant ( $p = 0.011$ ). This implies that for each one-percentage-point increase in the share of domestic industry actors with cookstove-related knowledge, the relationship between SOKIs and entrepreneurial entry weakened by approximately 0.1% ( $e^{-0.001} \approx 0.999$ ), suggesting that when more knowledgeable domestic industry actors were present, the association between SOKIs and entrepreneurial entries declined.

### 8.3. Sensitivity Analyses and Additional Exploratory Analyses

In line with recommendations to make the presence of potential multicollinearity between the independent variable and moderators as well as between moderators more transparent (e.g., Echambadi and Hess 2007), the main text reports results from regression models using uncentered variables. As a sensitivity check, all regression models were re-estimated using mean-centered variables for continuous variables (Online Appendix F).<sup>12</sup> Across the variables of interest, the results were consistent in direction and statistical significance, with only modest differences in coefficient magnitudes. For example, in Model (7) in Table 5, the coefficient for mean-centered  $SOKIs_{i,t-1}$  was 0.138 compared with 0.071 for uncentered specification. These findings support the robustness of the results. Because mean centering improves the interpretability of the coefficients on the interaction terms and helps reduce collinearity between interaction terms and their component variables, all regression models in the online appendices, including those previously mentioned, used mean-centered variables.

To address concerns about country selection, models were rerun to include country-year observations that were originally excluded because of limited relevance to the clean cookstove market (i.e., countries where less than 5% of the population used solid or polluting fuels) (Online Appendix G). To address concerns about dropped country-year observations because of missing values on certain control variables, models omitting those variables were re-estimated (Online Appendix H). Finally, to account for potential self-reporting bias in the Alliance's partner directory, particularly with respect to the overrepresentation of globally dispersed organizations following the initiative's launch, models that progressively restrict the sample based on organizations' geographic dispersion were run (Online Appendix I). Across all analyses, results remained consistent with the findings reported in Table 5.

Additionally, an exploratory analysis in Online Appendix J was conducted to examine whether SOKIs became less associated with entrepreneurial entries following the Alliance's strategic shift in 2018 when it began promoting cleaner fuels, like liquefied petroleum gas (LPG) and electricity (i.e., new knowledge). When FOKI-promoted knowledge shifts, SOKIs may transfer new and old knowledge inconsistently or even contentiously (e.g., the unequal promotion of novel and established technologies in Sine et al. 2005), weakening their overall relationship with entrepreneurial entries. For this analysis, the number of SOKIs was interacted with a postshift indicator for years 2018 and 2019. In simpler models, the coefficient on the interaction term was negative and statistically significant ( $p < 0.001$ ), consistent with the idea that SOKIs were less effective after the FOKI's shift in knowledge. In the full model, however,

the coefficient on the interaction term was negative but not statistically significant at the 5% level. This weakening statistical significance may reflect overlapping explanatory variance with the moderators and their interactions included in the full specification.

In Online Appendix K, an alternative explanation for SOKIs' association with entrepreneurial entries (namely, that primary countries were already more developed and that entrepreneurial entries would have occurred regardless) was explored. Membership data from the Alliance's predecessor, the PCIA, were leveraged to identify secondary countries with similar levels of industry development prior to the Alliance's establishment. Poisson regressions showed that SOKIs operating in the top four primary countries (i.e., where there was a relatively high level of PCIA activity) were positively associated with entrepreneurial entries as expected. SOKIs operating in the bottom four primary countries (i.e., where there was a relatively lower level of PCIA activity) were also positively associated with entrepreneurial entries, although to a lesser magnitude. This relationship was marginally significant in simpler models and statistically nonsignificant in more complex models. Multinational actors operating in secondary countries with PCIA activity similar to the bottom four primary countries showed no association with entrepreneurial entries. Although not definitive because of multinational actors that work across primary and secondary countries, the results offer suggestive evidence that the FOKI played an important role in shaping conditions for entrepreneurial entry through SOKIs.

## 9. Discussion

This study set out to investigate how a geographically bound first-order knowledge intermediary might nonetheless contribute to the development of a nascent industry across multiple countries. Although prior research has shown that FOKIs play a vital role in enabling entrepreneurial entry and industry emergence within a single primary country context, their global influence remained understudied. This research proposed that a FOKI's influence may extend across borders through second-order knowledge intermediaries, which are organizations that operate in both the industry's primary and secondary countries. In secondary countries, SOKIs carry forward the industry-building knowledge and capabilities that they learned from the FOKI in primary countries.

In the context of the clean cookstove industry, these findings are consistent with a two-stage model of multi-country entrepreneurial entry via SOKIs' knowledge diffusion. In Stage 1, SOKIs develop industry-building knowledge and capabilities from the FOKI's knowledge

intermediary activities in primary countries. In Stage 2, motivated SOKIs transfer their knowledge and capabilities to secondary countries, where they implement similar activities to build the industry knowledge base. Results from hypothesis testing support that more SOKIs in secondary countries were positively associated with more entrepreneurial entries in these places—a second-order outcome of the FOKI's knowledge intermediary activities. Furthermore, this relationship weakened when company and nonprofit SOKIs were imbalanced and when there were more domestic actors with categorically overlapping industry knowledge in secondary countries. Contrary to expectations, greater geographic dispersion strengthened the SOKI-entry relationship on average, although exploratory analyses revealed this effect to be potentially nonlinear.

### 9.1. Theoretical Contributions

This study addresses calls to “shed light on how nascent industries in developing and global contexts may require different processes … in which uncertainty dimensions are addressed” (Moeen et al. 2020, p. 240). It advances the literature on nascent industries by highlighting a novel mechanism by which industries addressing global societal needs can internationalize. Existing research has largely focused on firm-led expansion into global markets once industries are mature (e.g., Johanson and Vahlne 1977). In contrast, this research proposes how first-order knowledge intermediaries may indirectly support industry knowledge base development and entrepreneurial entry by activating second-order knowledge intermediaries, even before the industry is fully established in primary countries, thus extending conceptualizations of how industries are “born global” (Wormald et al. 2021, p. 1460). The two-stage model presented in this article is a multi-country, organization-level version of the Mostafa and Klepper (2018) concept of “industry knowledge seeding” (p. 613), in which an initiating actor (in this case, the FOKI) catalyzes the development of secondary countries’ industries by propagating industry-specific knowledge to “secondary sources of transmitters” (Mostafa and Klepper 2018, p. 618)—the second-order knowledge intermediaries—through proximal interactions (Assenova 2020).

This research also highlights the role of non-firm actors in pioneering industries, building on recent work by Agarwal et al. (2025). Although prior work emphasizes the motivations and capabilities of pioneering firms (e.g., Wormald et al. 2021, 2023), this study sheds light on knowledge intermediaries’ contributions to industry development. Specifically, compared with firms, non-firm FOKIs have unique motives and capabilities that enable them to pioneer industries that address global societal issues (e.g., they are mission-driven and willing to invest where private-sector actors do not; they seek to accumulate knowledge across

different sectors). Additionally, this work proposes that they enable different types of SOKIs—including both companies and nonprofits—to transfer industry knowledge and industry-building capabilities to secondary countries, indirectly building the industry in distant places.

Furthermore, this research contributes to the literature on institutional intermediaries operating in developing countries (e.g., Armanios et al. 2017, Mitchell et al. 2022). Although prior work has emphasized intermediaries’ roles in addressing *institutional* uncertainty by supporting the cognitive, normative, and regulatory institutions that enable commercial activity (Marquis and Raynard 2015, Dutt et al. 2016, Armanios et al. 2017, Armanios and Eesley 2021), knowledge intermediaries address not only institutional but also technological, demand, and ecosystem uncertainty. By tracing how knowledge intermediaries carry, co-create, capacity build, and convene, both locally and across borders, this research extends the conceptualization of institutional intermediaries to encompass multi-context, multidimensional knowledge-related roles that support industry emergence in highly uncertain environments.

Lastly, this study sheds light on how local entrepreneurs in developing countries access global knowledge. SOKIs emerge as critical knowledge carriers that transfer industry-building knowledge “from place to place” (Scott 2003, p. 879), maintaining and refining their interpretations of global knowledge for local contexts. Although FOKIs are geographically constrained to primary countries, it is proposed that their knowledge-focused catalyzation of SOKIs enables them to indirectly bridge the local-global divide and support under-resourced local entrepreneurs in countries that they never directly reach.

### 9.2. Policy Implications

This study offers several implications for policymakers, foundations, and development organizations seeking to scale up the adoption of life-improving technologies. It illustrates a case of charity-push failure and knowledge-push success; countries where market-based industry knowledge was actively developed by the FOKI saw more sustained industry growth and entrepreneurial entry. Importantly, the FOKI’s knowledge building likely extended beyond the primary countries, and second-order outcomes presumably made the FOKI’s efforts more globally influential. Rather than focusing solely on charity-based activities, like product giveaways or nonmarket-oriented skills training, policymakers, foundations, and development organizations should invest in deliberately building market-based industry knowledge. Strategic, concentrated investment in a few countries can yield an outsized global impact, especially when those countries serve as hubs for regionally or globally active organizations that can transfer knowledge and capabilities across borders. Effective knowledge development should also involve

local actors as the most impactful learning often occurs through on-the-ground engagement between multinational and local organizations. Although more complex and resource intensive, this market-driven collaborative approach may result in more scalable and sustainable long-term outcomes. Lastly, the industry knowledge base needs to be developed across multiple dimensions: technology, demand, ecosystems, and institutions. A failure to develop balanced, comprehensive knowledge may present obstacles to industry development.

For those leading FOKIs, this research offers some meaningful strategies for achieving cross-border impact despite limited budgets or geographic constraints. FOKI leaders should strategically select primary countries based not only on local needs but also on the presence of global nonprofit and company actors that operate in countries with few domestic industry actors with overlapping knowledge. Moreover, FOKI leaders should produce codifiable knowledge outputs (e.g., best practices, frameworks, training materials) that also allow for local adaptation and application in secondary countries. Additionally, FOKI leaders should recognize and empower SOKIs not just as local partners but as a team of industry ambassadors. This could involve packaging and providing transferable yet adaptable knowledge; offering opportunities to develop knowledge-building capabilities among local actors; motivating long-term commitment to industry building; and granting legitimacy through awards, recognition, and public endorsements to increase their influence abroad. Together, these strategies can help FOKIs amplify their efforts across countries where they may never directly operate.

### 9.3. Limitations and Future Research

Like all research, this study has limitations that offer valuable opportunities for future work. First, as a single-industry study, the generalizability of these findings may be limited. Although the clean cookstove sector was still early stage when the FOKI's knowledge push began, it was not entirely new. Countries had varying levels of prior exposure to cookstove technologies through decades of donor-driven development programs, which may have shaped local conditions in ways that are difficult to fully account for. Additionally, the Alliance selected primary countries based on their potential for industry emergence to mobilize private-sector participation. As such, the relatively rapid industry acceleration seen in primary countries (and some secondary countries) may not be easily replicated in industries without similar preconditions. Future research could explore an industry that is entirely new to all participating countries to better isolate the dynamics of early-stage knowledge diffusion and entrepreneurial entry and to test whether FOKIs and SOKIs function similarly when starting from a more uniform baseline.

Second, although the database used here is the most comprehensive global data set on clean cookstove industry actors, it relies on self-reported data. This introduces the possibility of missing, inaccurate, or biased information because of the voluntary nature of reporting. Future studies might draw on regional or subnational data sets or administrative records if available (ideally, sources that are not self-reported) to provide a more granular and potentially less biased examination of the mechanisms proposed in this study.

Third, although this study is grounded in a causal theoretical framework, the empirical analysis is correlational, and no causal claims are made. Although the analysis reveals strong associations between SOKIs and entrepreneurial entry, it cannot definitively establish causality because of potential endogeneity, including the possibility that SOKIs selectively enter countries already primed for industry growth. Future research could employ quasi-experimental designs, like matched sample comparisons or instrumental variable approaches, to more rigorously test the proposed causal mechanisms in this industry (if data are available) or a different one. Additionally, future work could more rigorously examine whether variation in SOKI presence reflects selection effects or sequential industry development, with different types entering at different stages rather than selecting into favorable environments.

A fourth limitation involves the potential for multicollinearity in the regression models, particularly because of correlations between the independent variable and moderator variables as well as between the moderators themselves. In models with interaction terms (e.g., Equation (1)), such multicollinearity can inflate standard errors, make it difficult to isolate the distinct effects of interaction terms and their component variables, and lead to unstable or unreliable coefficient estimates. Although mean centering is often used to reduce collinearity between interaction terms and their component variables, it does not address the underlying correlations between variables and may even mask the extent of the problem (Echambadi and Hess 2007). To enhance transparency, the main text presents regression results using uncentered variables, and as a sensitivity check, regression results using mean-centered variables are reported in Online Appendix F. The results were largely consistent between the specifications for the variables of interest, supporting the robustness of the findings. Nonetheless, future research could explore alternative variable specifications or measurement strategies to further address potential multicollinearity concerns.

Lastly, because this study focuses on entrepreneurial entry, future work can examine the longer-term process of local industry development in secondary countries. Although entry is often seen as a critical milestone in industry emergence, it may not be sufficient for sustained industry development, especially when global

and local actors are involved. Future work could examine how industries evolve after local entrepreneurial entry begins to increase. For instance, do SOKIs remain central to building the industry knowledge base over time, or do local entrepreneurs play an increasingly important role in shaping it? How do disparities in funding provided to global and local entrepreneurs (Lall et al. 2019) influence industry development? These are important next steps in understanding how industries addressing global societal challenges develop after their initial emergence.

#### 9.4. Conclusion

This study offers new insight into how entrepreneurial entry unfolds across borders in nascent industries aimed at addressing global societal issues. By tracing how second-order knowledge intermediaries acquire and develop knowledge through interactions with first-order intermediaries, this research suggests a plausible pathway for how industry knowledge diffuses across borders. These findings underscore the importance of designing knowledge-based strategies to accelerate the provision and adoption of technologies addressing global health, environmental, and social challenges. Such strategies will be critical to enabling scalable and sustainable industry development for these solutions.

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#### Endnotes

<sup>1</sup> The industry knowledge base has also been discussed as “industry-level infrastructure” (Van De Ven 1993, p. 339) and “market infrastructure” (Lee et al. 2018, p. 243). Other scholars discuss the importance of “market infrastructure” or “institutional infrastructure” to economic transactions occurring in the external environment (Marquis and Raynard 2015, pp. 308–309; Dutt et al. 2016, p. 819; Armanios and Eesley 2021).

<sup>2</sup> In this study, these organizations are referred to as “knowledge intermediaries” rather than “innovation intermediaries” because they facilitate knowledge accumulation across multiple dimensions beyond just technology and innovation. Additionally, this definition of knowledge intermediaries differs from that in the sociology literature, where market intermediaries refer to aggregators and evaluators (e.g., Sharkey et al. 2023).

<sup>3</sup> This study focuses on an intermediary operating within a single industry, not an intermediary addressing constraints within the broader economic and institutional environment. Examples of the latter, which appear in scholarship about institutions and entrepreneurship, include accelerators (Chan et al. 2020), incubators (Dutt et al. 2016, Assenova 2020), science parks (Armanios et al. 2017), nonprofit organizations (Mair et al. 2012), and research and development centers (Fu et al. 2022). These intermediaries enable market transactions and develop institutions that motivate entrepreneurship across different industries.

<sup>4</sup> The labels “first order” and “second order” distinguish the geographical and temporal stages by which knowledge intermediaries are related to entrepreneurial entry (with the FOKI first enabling knowledge accumulation in primary countries and SOKIs later enabling knowledge accumulation in secondary countries), the relative impact of the knowledge intermediaries on industry emergence (with FOKIs having a stronger association with entrepreneurial entries and SOKIs having a weaker one), and the idea that SOKIs’ development is a direct consequence of the FOKI’s activities. Although labeled “second order,” these outcomes are also important to study (e.g., Hargittai 2001).

<sup>5</sup> The labels “primary countries” and “secondary countries” distinguish where the first-order knowledge intermediary operates. Primary countries are places where the FOKI works directly. Secondary countries are places where the FOKI does not work directly but can still have influence through SOKIs.

<sup>6</sup> This is calculated using the World Health Organization’s Global Health Observatory indicator for “Population with primary reliance on polluting fuels and technologies for cooking (in millions)” and the World Bank’s “rural population” and “total population.”

<sup>7</sup> Although some firms may engage in similar activities, the FOKI differs in that it operates in contexts where commercial incentives are weak, prioritizes the development of a shared industry knowledge base over firm-specific gains, actively aggregates knowledge across fragmented sectors, and collaborates closely with local actors and entrepreneurs to address context-specific challenges.

<sup>8</sup> The organization types are carbon asset/project developer, consultant, foundation, government, investor, multilateral organization, national or multinational enterprise, nongovernmental organization, research, small or medium enterprise, or other.

<sup>9</sup> The organization roles are “cookstove design/manufacture/assembly,” “cookstove distribution/retail/consumer finance,” fuel distribution/retail,” and “fuel production/processing.”

<sup>10</sup> The second condition was added to observe entrepreneurial entries by clean cookstove producers as opposed to, for example, media and consultants that only tangentially worked in the industry. The third condition was added to observe industry development that is localized in the secondary country. These conditions were included to ensure that the proposed mechanisms are being examined, which explains that SOKIs accumulate knowledge into a *local* industry knowledge base that entrepreneurs leverage for entry.

<sup>11</sup> A negative binomial model was also estimated to test for overdispersion in the outcome variable. A likelihood ratio test of the null hypothesis that the dispersion parameter  $\alpha = 0$  failed to reject it ( $-\chi^2(01) = 0.00, p = 0.50$ ). This result indicates no evidence of overdispersion and supports the use of a Poisson specification.

<sup>12</sup> The variable “SOKI imbalance” in the online appendices refers to “SOKI-type imbalance” in the main text and tables.

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