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Scaling up and scaling out of darkness: Elucidating the influences of institutional dysfunction in scaling up solar PV in Sub-Saharan Africa

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ABSTRACT

Although researchers increasingly recognize the significant impact of institutional dysfunction on emerging economies, there remains a major gap regarding its influence on firms' upstream and downstream activities in scaling up renewable efforts. Drawing on data from solar photovoltaic (PV) intermediary business owners/entrepreneurs and regulators in Ghana, this paper examines the mechanisms through which these activities interact to facilitate the scaling-up efforts of renewable energy. The study uncovers three unique interactive processes through which institutional dysfunctions shape scaling-up efforts. Phase 1 focuses on unmasking institutional dysfunctions as impeding forces on both upstream and downstream activities. Phase 2 signifies a paradigm shift towards proactively re-engaging and reshaping institutional dysfunctions. This phase entails a range of organizational actions, including strategic interventions, dismantling ineffective practices, and wider concerted efforts geared towards turning dysfunctional institutions into potential sources of opportunity. Phase 3 represents the final stage in the evolution towards scaling up, focusing on deficiencies in the aftermarket support environment, specifically maintenance and repair services after sales. The insights derived from the study offer valuable implications for practitioners, policymakers, and scholars.

1. Introduction

The world today is confronted with a multitude of environmental and social challenges, including climate change and population growth, which compel businesses and governments to work collaboratively towards scaling up renewables (United Nations Industrial Development Organization, 2009; IRENA (International Renewable Energy Agency), 2020). The winds of change ushered in following the adoption of the Sustainable Development Goals (SDGs) and the Paris Climate Agreement have renewed efforts around the global south towards the adoption of green business practices (IRENA (International Renewable Energy Agency), 2020; United Nations Industrial Development Organization, 2009). Defined as deficiencies or malfunctions pertaining to the function of institutional structures that support the functioning of markets, institutional dysfunctions such as bureaucratic government agencies, weak information disclosure systems, and weak legal enforcement mechanisms remain powerful forces in emerging economies, exerting pervasive influences in all spheres of business life (Barnard & Mamabolo, 2022; Rodgers, Vershinina, Khan, & Stokes, 2022; Ofori-Dankwa & Julian, 2013; Khanna & Palepu, 1997). Past studies indicate that developing economies are characterized by institutional conditions that are often in a state of upheaval (Rodgers et al., 2022). These formal institutional dysfunctions, such as regulations, rules, and government directives, are seen to hamper firms' market competitiveness (Rodgers et al., 2022; Marquis & Raynard, 2015).

Despite the widespread literature in strategy that emphasizes the importance of institutions and their pivotal roles in determining and shaping firms' ability to operate successfully in developing economies (North, 1990; Peng, 2002; Peng, Sun, Pinkham, & Chen, 2009; van Hoorn & Maseland, 2016), there remains a major gap in understanding how institutional dysfunctions shape the scaling-up of renewables. Despite the importance of scaling-up renewables to help meet the grand challenges (DeSantola & Gulati, 2017; Timilsina & Shah, 2016; Palmié, Parida, Mader, & Wincent, 2023; Hasselman et al., 2023), the existing literature has offered very limited insights into the dynamic processes inherent in scaling-up efforts (DeSantola & Gulati, 2017). Scholars have largely sidestepped the pivotal questions of how institutional dysfunction influences emerging-market SMEs' upstream and downstream activities towards scaling-up renewable efforts. Given that no developing-country firm is immune from institutional conditions (Peng, 2002; Ofori-

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Dankwa & Julian, 2013), it is crucial to account for the effects of institutions.

Motivated by the aforementioned deficiencies in the current literature, this study examines the mechanisms through which institutional dysfunctional effects manifest in upstream and downstream activities towards scaling-up renewable efforts. The importance of our focus on solar PV is further amplified by the fact that the success of the Fifth Industrial Revolution (Industry 5.0) is partially predicated on delivering access to power while concurrently delivering on industrial sustainability and harnessing renewable energy sources (Xu, Lu, Vogel-Heuser, & Wang, 2021; Ivanov, 2023). According to IRENA (International Renewable Energy Agency) (2020), around 60 % of sub-Saharan Africa's population lacks access to electricity. Thus, solar photovoltaic (PV) plays a pivotal role, especially in emerging economies in sub-Saharan Africa where the abundance of sun provides ample opportunities to propel green industries and large-scale industrialization.

The study offers several contributions to the literature. First, although the research on institutional differences suggests that institutions matter for emerging-market firms (Amankwah-Amoah, 2023; Peng, Wang, & Jiang, 2008), scholars have largely failed to differentiate and account for the effects of institutions on small firms' upstream and downstream activities towards scaling-up efforts. Building on the literature on institutional dysfunctions (Barnard & Mamabolo, 2022; Ofori-Dankwa & Julian, 2013), this study illuminates the unfolding effects of institutional constraints that hinder solar PV scaling-up efforts in a developing economy. In addition, despite a growing body of literature on scaling-up (DeSantola & Gulati, 2017; Palmié et al., 2023), there has been limited scholarly attention devoted to illuminating how small firms contribute to scaling-up efforts. This study deviates from past studies that have largely examined scaling-up efforts from the perspectives of international organizations such as the World Health Organization (WHO) and non-governmental organizations. The insights and focus on emerging-market SMEs address a key limitation in the current literature as well as deepen scholars' understanding of capturing value from upstream and downstream activities. Besides integrating insights on institutional dysfunctions (Barnard & Mamabolo, 2022) into scaling-up efforts (DeSantola & Gulati, 2017), our analysis also elucidates the processes and mechanisms through which institutional forces shape the dynamics of upstream and downstream activities of emerging market SMEs.

The remainder of the article is structured as follows. First, we present a review of the literature on scaling-up and the effects of institutional dysfunction. This is followed by Section 3, where we examine the approaches adopted in Ghana for data collection and analysis. After presenting the main findings in Section 4, we outline the implications and directions for future research.

2. A conceptual development

Two streams of research represent the theoretical underpinning of this study: scaling up and institutions. Scaling up is defined as the process of mobilizing organizational and societal resources and expertise to increase the adoption of renewables (DeSantola & Gulati, 2017; Palmié et al., 2023; Timilsina & Shah, 2016; Tippmann, Ambos, Del Giudice, Monaghan, & Ringov, 2023). It continues to attract the attention of scholars across diverse academic fields, including development studies, operations, strategy, and entrepreneurship (DeSantola & Gulati, 2017; Palmié et al., 2023; Tippmann et al., 2023). Similarly, DeSantola and Gulati (2017: 641) define scaling as "how to synchronize internal organizing and growth." Inherent in scaling up is the notion of expanding activities through channels such as information dissemination, the number of users or user organizations, resource mobilization, and advocacy beyond the current catchment areas, thereby helping to usher in a green future (see World Health Organization, 2010). These activities may aim to strengthen environmental standards, improve product quality, and upgrade technologies and practices (see World Health Organization, 2010). This approach of accelerating the adoption of renewables over time can facilitate organizational growth (DeSantola & Gulati, 2017; Stallkamp, Hunt, & Schotter, 2022; Tippmann et al., 2023). This process often involves collaboration between different stakeholders focused on capability building of firms, providing incentives to consumers or end-users to change their behaviors, as well as training businesses and citizens.

Institutions can be defined as "the rules of the game in a society or humanly devised constraints that shape human interaction" and encompass both formal and informal constraints (North, 1990, p. 3). Formal institutions include laws, rules, and regulations, whereas informal institutions include norms, culture, and traditions (North, 1990; Peng, 2002). These two formal and informal pillars of institutions define acceptable conduct and socially acceptable behaviors (North, 1990; Scott, 1995) and play a pivotal role in determining firms' market competitiveness (Peng et al., 2008; 2009). An effective and efficient supply chain operates within a set of "rules of the game" that underpin firms' activities (North, 1990).

The institutional dysfunction hypothesis represents a sub-branch of the wider literature on institutions and contends that the absence of market-supporting mechanisms that impede the functioning of markets, such as weak protection of property rights, lack of access to credit, poor process of certifications, and poor legal enforcement, typify developing economies and can constrain firms' activities (Barnard & Mamabolo, 2022; Boso et al., 2023; Khanna & Palepu, 1997; Marano, Tashman, & Kostova, 2017; Harrison, Scheela, Lai, & Vivekarajah, 2018; Peng, 2002). As also observed by scholars (e.g., Khanna & Palepu, 1997; Parmigiani & Rivera-Santos, 2015), when formal institutions such as regulations and laws are weak in a given country or barely enforced, economic and business activities can be impeded, leading to market inefficiencies.

Relative to advanced economies, emerging economies are generally typified by less efficient and weak formal institutions (Chung & Luo, 2008; Ofori-Dankwa & Julian, 2013; Zoogah, Peng, & Woldu, 2015). Previous research into developing economies indicates that financial intermediaries, such as hedge funds, financial analysts, and venture capitalists, are often very weak or absent in fulfilling their vital roles in business development (Li & Atuahene-Gima, 2002; Marquis & Raynard, 2015). Moreover, limited or poor institutional support and government red tape in developing economies often lead to higher costs of doing business (World Bank, 2020; North, 1990). The presence of these institutional constraints in emerging markets can serve as a constraining force, impeding firms' activities (e.g., Khanna & Palepu, 2010), or as a facilitating force, aiding international learning efforts (e.g., Adomako, Amankwah-Amoah, Dankwah, Danso, & Donbesuur, 2019). Leveraging this theory to illuminate scaling up, surmounting institutional forces is pivotal in accelerated scale-up efforts. Therefore, a deep understanding of institutional constraints provides an opportunity to overcome them.

3. Methodology

3.1. Empirical setting

The empirical setting for this study is Ghana. After obtaining independence in 1957, Ghana's history has been punctuated by a mixture of totalitarian regimes and democracy from 1958 to 1993 (Adomako et al., 2019; Akoensi & Amankwah-Amoah, 2023). In recent times, the country has flourished as a thriving democracy with significant public investments in rail and road infrastructure. The government has also sought to foster the development of medium-sized firms and industries through tax incentives.

Given the paucity of scholarly research and the relatively underexplored nature of the mechanisms through which institutional dysfunctional effects manifest in upstream and downstream activities towards scaling up renewable efforts, this research adopted a qualitative approach to provide a more in-depth analysis of the core issue

(Edmondson & McManus, 2007; Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2018). Consistent with suggestions by scholars such as Edmondson and McManus (2007), the adoption of a qualitative approach is further reinforced by the fact that this approach has the potential to yield in-depth insights and foster robust theory development and refinement of processes (Bell, Bryman, & Harley, 2022; Yin, 2018). Unlike the survey and questionnaire approach to data gathering, this semi-structured approach is limited in reaching and gleaning insights

Table 1
List of Top executives/entrepreneurs.

Firm ID	Top executives/ entrepreneurs Informants ID	Title in the organization	Nature of the business and informants' role	Educational Background	Solar industry experience	Related prior industry and expertise.
Firm-K1	M1	Founder and managing director.	Sales and installation of PV	No formal education.	20 years.	Importation, sales and installation of energy backup systems (inverters) to individuals and institutions.
	M2	Co-managing director and engineer.	In charge of Sale, installation and repairs of complete solar PV systems. Coordinating with partners in Germany.	University degree in engineering.	5 years in the industry.	Power systems design and development in Ghana.
Firm-K2	M3	Founder and executive member.	Solar panel sales and distribution.	Basic education.	4 years.	Marketing trade and imports via experiences.
	M4	Executive management assistant/company secretary.	Designing and installation of solar system alongside sales.	University degree.	10 years in this and related industry experience.	Government/civil servant.
Firm-K3	M5	Founder and executive member.	Solar system maintenance and repair.	HND and engineering education.	3–4 years.	Import and export of farming products.
	M6	Manager.	Solar sales, installation and construction company.	University degree.	10 years in the energy industry including solar and other renewables.	Import and export of electric appliances.
	M7	CEO.	Solar installation and repairs.	University degrees.		Worked in government.
Firm-K4	M8	Co-founder and CEO.	Solar panel distribution.	Bsc business.	4–8 years	Trade and store owner.
	M9	Co-founder.	Solar system sales, design and installation.	University degree in business.	4–8 years.	Trader, importing and exporting.
Firm-K5	M10	Founder.	Solar system maintenance and repair.	University degree in business management.	6 years in related industries.	Trader.
	M11	Co-founder.	Solar panel sales and distribution.	University degree in management.	4–8 years.	Trade and store owner.
	M12	Founder.	Solar system design and installation.	University degree in business.	4–8 years in government.	Trade and store owner.
Firm-K6	M13	Top executive.	Solar panel distribution.	University degree in business.	4–8 years.	Worked at a subsidiary of US solar company.
	M14	Founder and executive member.	Solar system maintenance and repair.	University degree in business.	4–8 years.	Construction industry.
Firm-K7	M15	Founder and director managing the company.	Solar and construction company. The company was registered in 2009 but was not in operation for about 3 years.	University degree in Civil engineering with electrical background civil engineering.	4–8 years.	Marketing and sales.
	M16	Founder and executive member.	Solar system design and installation.	University degree in business.	9 years and above.	Electricity power.
	M17	Founder and executive member.	Solar system maintenance and repair.	University degree in Engineering.	10 years and above.	Building and construction.
Firm-K8	M18	Co-founder and executive member.	Solar panel distribution.	University degree in science.	5 years and above.	Environmental management.
	M19	Founder and executive member.	Solar system importation, design and installation.	University degree in engineering.	10 years.	Energy support and promotion of promote solar PV installations.
	M20	Co-founder and executive member.	Solar panel distribution.	University degree in engineering.	10 years and above.	Sales and marketing.
	M21	Founder and executive member.	Solar system and installation.	University degree in engineering.	10 years in the solar industry including PV.	Engineering.
Firm-K9	M22	Executive member.	Solar system maintenance and repair.	University degree in economics.	7 years in the renewable energy sector.	Finance and investment.
	M23	Line manager.	Solar panel distribution.	University degree in business.	10 years and above.	Marketing.
Firm—*K*10	M24	Executive member.	Solar sales, system maintenance and repair.	University degree in HRM.	10 years and above.	Environmental management.
	M25	Top executive.	Sales, installation and maintenance of solar system.	Degree in business.	6 years in related industries.	
	M26	Senior technician.	Sales, installation and maintenance of solar system.	University degree in engineering.	5 years' experience as a researcher of solar panels and solar industry.	Solar panels and solar industry research organization.

from a wider group of informants (see Bell et al., 2022). While utilizing semi-structured interviews has inherent strength in capturing the rich and contextual business conditions and institutional dysfunctional effects in the emerging West African country, the method is limited in gleaning information from informants. This approach also has the potential to lead to bias, as the interviewer may unintentionally direct conversations to particular issues and areas not necessarily germane to the core research area (see Bell et al., 2022). By ensuring similarities in the questions asked and maintaining focus on the interview, the research was able to engender rigor and credibility in the findings.

The study employed semi-structured interviews with solar PV market intermediaries, consisting of business owners/entrepreneurs in the sector specializing in areas such as solar system design and installation, solar panel distribution, businesses linking, and solar system maintenance and repair. These market intermediaries play a vital role in facilitating transactions between local firms/households and foreign manufacturing firms. They help bridge the gap between buyers and sellers in different markets. It is important to note that these intermediary firms are not manufacturers but rather import products and resell them in the market while also providing financing, installations, and aftermarket support services. We utilized industrial contacts and networks in the solar PV industry in Ghana, in combination with snowball sampling and a direct referral approach. Such channels have also been found to be effective in gathering data (Biernacki & Waldorf, 1981; Noy, 2008). We conducted semi-structured interviews from January 2019 to November 2022, followed by follow-ups using platforms such as Zoom, Teams, and telephone calls to clarify certain issues. The interviews lasted on average between 45 min to 1 h and were conducted in English, both in Accra and Kumasi, Ghana.

The interview guide covered different aspects of the operation of solar PV distributors, including their interactions with manufacturers, B2B customers, and households. With the informants' permission, the interviews were recorded, and the "24-hour rule" (Eisenhardt, 1989) was followed to transcribe the interview data. Clarifications were sought from the informants in instances where things were unclear (Gioia & Thomas, 1996). The interview data were triangulated with data from archival sources, including company reports, online information from GhanaWeb, government documents, newspaper clippings, and posters, to develop case stories of each firm and entrepreneur. To complement this data, we proceeded to interview five government officials with key roles in importations to gain a better understanding of the processes and procedures inherent in importing materials such as solar panels. We also interviewed three businesses that have acquired solar panels for their buildings to gain a more complete picture of the solar PV industry. Table 1 summarizes the profile of the business informants, including their prior experiences, education, and industry expertise. In presenting the findings, we employed pseudonyms were used to refer to the informants to help preserve their confidentiality and anonymity. Hence, we utilized pseudonyms, such as "M" for the business informants, "BU" for business solar PV users/customers, and "DC" for domestic solar PV customers/users, to refer to the informants and preserve their anonymity.

3.2. Data analysis

We then followed the analytical approach of Gioia, Corley, and Hamilton (2013) to develop first-order, second-order, and aggregate dimensions (or themes) to advance the interpretation and theorization of the findings. By employing a broader level of analysis and axial coding of the data, several concepts and relationships emerged (Strauss & Corbin, 1990; Gioia, 2021; see also Fleming, Zyglidopoulos, Boura, & Lioukas, 2021). Consistent with Gioia et al. (2013), our aim was to faithfully adhere to informant terms. The first-order dimensions consist of the raw data, representing the actual words spoken by the business owners/entrepreneurs in the solar PV sector. Through line-by-line coding, we identified key themes and concepts from these dimensions. Subsequently, we grouped the first-order themes into broader categories to develop the second-order dimensions, which reflect patterns or concepts that arise from the first-order dimensions.

To illustrate the transition from first-order themes to the second-order themes, we combined insights from the initial coding of the data/quotes. For instance, we integrated quotes such as: Illustrative Quote 1: "when we identified the manufacturers in China, we faced the issue of accessing money… We needed to find banks or family members willing to invest in the business. It was months of struggle, and to this day, we cannot expand beyond Accra." And then Illustrative Quote 2: "Even after my co-founder joined, obtaining the required funds from the agent in China remained a struggle, preventing us from making large purchases." Based on these illustrative quotes from the interview data, we identified the second-order theme of "lack of access to financial credit" as a constraint in the downstream supply chain activities. This constraint also hindered the scaling up of panels in the downstream supply chain to end users, including businesses and households. This process of combining different second-order themes to form aggregate dimensions involved identifying commonalities and differences inherent in the data. Figure 1 illustrates the data structure, wherein concepts captured in the first-order dimension were refined and synthesized to generate second-order dimensions. Ultimately, this process led to the deduction of aggregate dimensions.

4. Findings

Based on the data, it can be deduced that the effects of institutional dysfunction in scaling up renewable efforts manifest in three stages encompassing different upstream and downstream activities. The upstream constraints involve the sourcing of materials from manufacturers and agents primarily based in foreign countries, predominantly China. The downstream partners primarily focus on end users, specifically households and business customers. Table 2 summarizes the institutional dysfunctions and their effects on upstream and downstream activities.

The interaction between upstream and downstream activities sheds light on the evolution of constraints in sourcing materials from foreign markets to distribution and aftermarket services for domestic end users, as demonstrated in Figure 1. Below, we further analyze the distinctive features of each phase and their respective evolutions.

4.1. Phase 1: Unmasking institutional dysfunctions

Our data indicates that this phase is characterized by a robust examination of the nature and effects of prevailing institutional impediments, as well as engagement with stakeholders involved in downstream and upstream activities. Inherent in this phase was a focus on uncovering the nature and effects of institutional dysfunctions on the organization's range of activities. We found several challenges, including limited access to financing and a lack of awareness and education. Regarding the constraints in scaling up related to limited access to financing for importing panels and negotiating with foreign agents/manufacturers, one informant (M15) puts it this way:

> *"That's correct… we used to have zero chance of getting credit or discounts from foreign agents for panels… we were not known or did not have a long relationship with them… this has now changed after six years in the industry, but new firms face the same problem, which means higher panel prices for customers."*

On this matter, one informant (M19), who imports as well as undertakes installations, noted:

> *"You hit the nail on the head. I have met so many folks [entrepreneurs and users] who want solar or want to start a new business, know the benefits but cannot afford the start-up cost… import taxes and shipping*

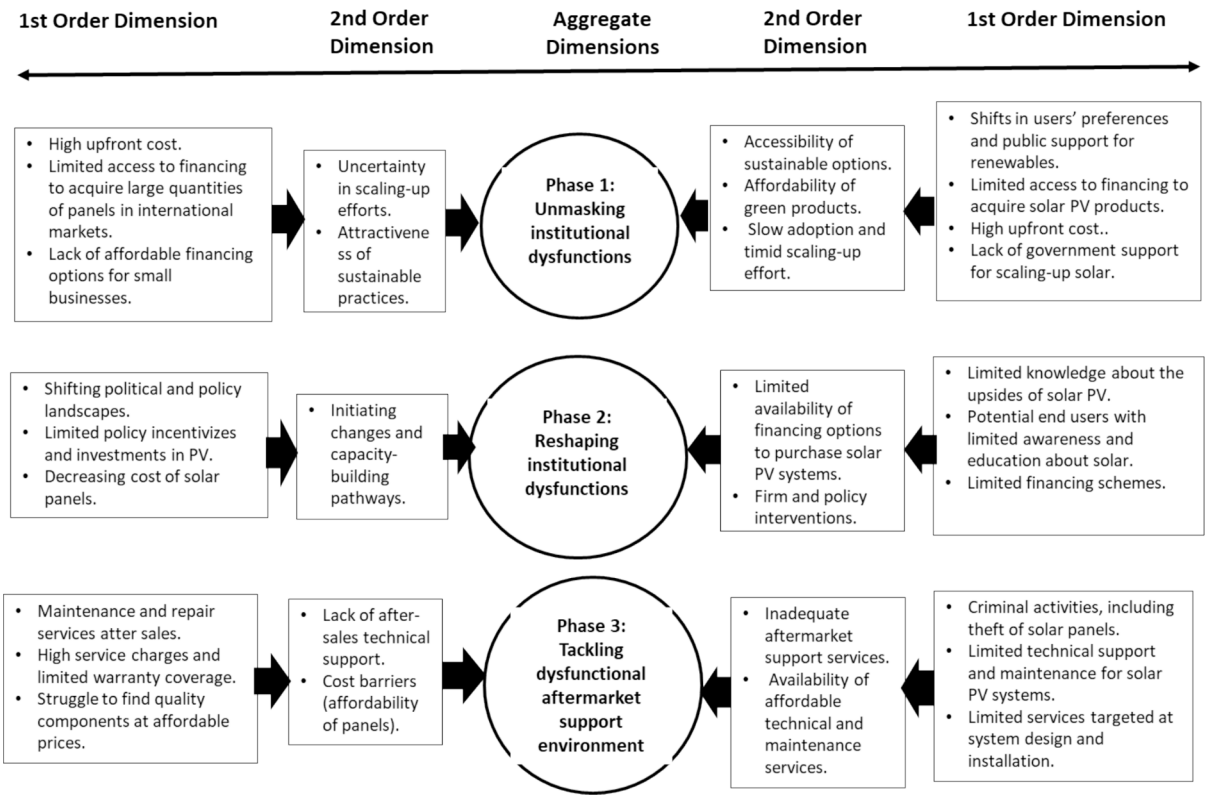

Figure 1. Data structure.

fees must be subsidized or cut for businesses… some even struggle to make ends meet and feed their families."

This problem is further amplified by the fact that there are not many financing options for small businesses and consumers. One owner (Informant M3) shed further light on the inherent difficulties in accessing financing options, which then suppress potential users from installing solar PV systems:

"As a business, we have to travel from bank to bank for months before we are able to get loans… now imagine this for individuals, households, and families… so what I am saying to you is that a typical solar PV system needs money for the start-up upfront capital investment."

One informant asserted that these constraints significantly impact their operations and growth potential:

"As I mentioned earlier, when there is a power outage, there is high demand for solar. However, even if you actively market it to people, it ultimately comes down to finances. That is the main challenge. If a person cannot afford it, no matter how much they desire solar, they simply cannot obtain it, and that remains the primary obstacle." (Informant M7)

Reflecting on these challenges, another informant echoes this sentiment by noting that:

"Unfortunately, most of the clients we deal with already have ECG in their homes, the national grid in their homes, so apart from lamps, rechargeable lamps, or rechargeable fans that we give, we haven't come across any client who was using kerosene or candles. Mostly, they would have been using generators, and because of the noise, fuel cost, and fire hazard, they would want to switch to solar. So we have clients who switch from generators to solar, but not from candles and kerosene to solar. If somebody is already using or is able to afford kerosene and candles based on his financial status, he definitely won't be able to afford solar but would rather go for a lamp, a rechargeable lamp." (Informant M1)

The owner and engineer (Informant M2) explained a different kind of challenge in securing credit and support from international partners traced to the origin of the businesses:

"Well, to them it's cash and carry, but they don't trust Africa. They trust Europeans more, and they trust Americans because they can give them credit. This is due to the image we have portrayed to them that they can't trust us. In principle, they don't trust Africans. Whatever they bring to Africa must be cash and carry." (Informant M20)

In the context of the firms, these constraints then have effects on the affordability of panels and awareness issues, which end up hampering the focal firms' drive towards scaling-up efforts. Our analysis indicates that, besides the import duties, taxes, and shipping fees associated with importing solar panels, this manifests in higher prices for solar PV panels, making the purchase and installation of the system relatively expensive beyond the reach of the majority of the population.

4.1.1. High upfront costs

Our analysis suggests that one of the primary reasons why end-users struggle to afford the upfront costs of solar PV is that the initial investment is often quite substantial. The businesses report that solar PV products, over their lifespan, are often less expensive compared to other energy sources available. Yet, many locals are unaware of the potential gains coupled with misperceptions and high upfront costs. On the potential benefits of transitioning to solar, one informant (M15) puts it this way:

"Yes, so within 2–3 years, you will have recouped your investment. People are paying a significant amount of money to ECG. Have you heard about the potential increase in electricity tariffs? Let's say you invest for 25 years, using the first five years to recover your initial investment. The remaining years are essentially free, allowing you to save and reinvest. Many Ghanaians believe they need loans for cars and houses, but when it comes to solar, they need to save and participate in susu."

Another informant (M3) concurred:

Table 2
Institutional dysfunctions and their effects on upstream and downstream activities.

Constraints	Nature of constraints and challenges	*Representative Quotations*	*Strength of evidence**
Upstream institutional voids			
Lack of access to financial credit and supply chain funding issues.	High upfront capital costs required to set up solar PV projects and businesses, which can be a significant barrier to entry for entrepreneurs. Lack of institutional support and financial credit for domestic firms sourcing panels.	*"I have visited the local and foreign Banks for small loans to buy and import in bulk. It can save us money and will be cheaper for the customers in rule area, but the banks do not want to list to me or my business partners" (Informant M8).* *"We have struggled for months and still have not secure funding for the project. The interest rates offered by some banks is just not possible for us to expand" (Informant M17).* *"It affects it a lot, in that local companies find it difficult to finance our solar projects, especially for commercial and residential purposes. The financing plan or strategy with our banks is limited, as banks are the only institutions providing loans. We don't have access to bonds or other convertible options; it's solely the banks we can turn to. Solar financing differs significantly from the banks' usual financing because solar projects are long-term investments. Our projects typically span from seven to fifteen years or more, while the bank's financing structure typically doesn't extend beyond five years. This puts us at a disadvantage when competing with foreign companies, as they have interesting finance options available through their governments or other avenues". (Informant M7)*	*Very strong*
Government regulatory and compliance issues.	Inadequate regulatory and legal frameworks create uncertainties and hamper investments.	*"We started this in the 6th year with the intention of generating energy using our own finances …During the previous administration (NDC era), we faced hardships and frustrations while trying to obtain the necessary documents and permits to proceed with our project. The investors already have the funds available, but without the proper investment opportunity, we cannot utilize the money… requirements that must be fulfilled before commencing the project, and finding the right people to facilitate the process is an extremely challenging task. We often find ourselves having to go through multiple rounds of meetings, sometimes as many as 345 times, before finally meeting the person who can help us." (Informant M20)*	*Strong*
Imports constraints and cost.	Regulatory barriers, such as taxes, tariffs, and import duties, can increase the cost of solar panels and limit growth.	*"So let's say I'm importing an item that values at 100 Ghana cedis and I have to pay a duty of 52 %, which is around 50 cedis. It's already difficult for someone to afford the unit cost of the item, let alone the additional import duty. However, since the unit cost is higher, adding the import duty becomes a burden. Normally, we try to maintain the minimum margin so that people can afford it." (Informant M20).*	
Downstream Institutional Voids			
Potential domestic and business users' awareness.	Lack of awareness of the potential gains serves as barrier to adoption.	*"We let the customers know that although the upfront cost is that much but any amount that they invest in solar panel today they tend to get back such amount in let's say a year or two. And the benefit is they are no longer going to pay any electricity bill until it gets damaged, which will virtually take let say 20–23 years" (Informant M23).*	*Very strong*
High upfront cost.	The cost of solar panels and associated equipment serves as a disincentive for user investment in panels.	*"Ok, in a way, people who are interested are unable to pay for the service or for the product. Because most of the products are imported, the price is a bit higher. It comes out as a luxury product, so only people who have lots of money. And the banks, only a few banks are also interested in funding their customers*	*Very strong*

(*continued on next page*)

Table 2 (*continued*)

Constraints	Nature of constraints and challenges	*Representative Quotations*	*Strength of evidence**
		to purchase solar, that is how much is affects. So affordability, people are not able to afford to fund." (Informant M1).	
		""As a company, we provide energy efficient solutions to our customers … some of the products are somehow expensive especially the solar PV and thermosiphons are expensive so some people are deterred from buying it and that's the reason they give us why they would like to hold in buying our products." (Informant M13).	
		"Solar is expensive because of this we source funds from banks to carry out the project for customers and we then give them a payment plan. They don't need to pay everything upfront; all the need is to pay 10 % of the total amount and spread the rest over a period of time" (Informant M24).	
	Business users' constraints	*"Even for residential projects, the initial investment is too high for middle-income individuals to afford. We've attempted to convince the banks to arrange financing for their own customers, but we're still exploring this possibility. Credit has been a significant challenge for us, and the financing aspect is the primary hurdle". (Informant M7).*	
Poor aftermarket customer Support.	Inadequate post-sales support including repair services, maintenance, and product warranty coverage.	*"During the XXX Dumsor time [a period of power outages], there were many solar companies who were not in the industry but were trying to take advantage of the situation. Everyone was trying to sell solar, even electrical shops were trying to sell solar when they didn't have the expertise. All those companies are now out of the market. If you happened to buy anything from them during that time and you have a problem now, you can't find them anywhere." (Informant M20)*	*Very strong*
		"because of the gaps in the market for this. We do repairs as part of our services because after supplying a client, [it's] expected when there's a problem, you are there to solve it. So yes, we do repairs. We have been technical guys who do it when there's a technical hitch. Normally the panel itself is not repaired when it gets broken. [If] it's broken, the cells are damaged, so it's either you replace it, but and the battery is to our maintenance free you can't maintain them you can't return repair them when they go bad they go bad but the only thing that you can fix or repair at the electronic components like the inverters and the charge controllers which are also part of the system." (Informant M5).	

*If an observation on Table 2 is noted by all the informants/firms and confirmed by the secondary data sources, the evidence is considered "very strong." If the insights are considered "strong," it is based on the majority of respondents indicating so.

> *"When you go to real estate companies, some think it is too expensive to incorporate it into new houses… it will make the houses more expensive and difficult to sell… for this business, if we can get them {builders} to add panels into new or old buildings, it will be a game-changer for this business."*

Additionally, solar PV systems have a relatively long payback period, meaning that it may take several years for end-users to recoup their initial investment through energy savings. In some cases, financing solutions such as loans or leasing arrangements may be available to end-users. As Informant M7 asserted:

> *"Unfortunately, when ECG consistently provides electricity, the demand for solar decreases, but when ECG's supply is inconsistent, the demand for solar increases. This perception poses a challenge. Educating the people about solar energy is crucial, so they understand that it's not just an alternative due to ECG's unreliability but an additional, reliable power source." (Informant M7)*

Our respondents highlighted a significant knowledge gap among end-users when it comes to understanding the advantages of solar PV as an alternative energy source. This lack of awareness often leads to a misconception that solar PV is too expensive and not cost-effective, making potential end-users reluctant to invest in solar PV systems. As one informant (M4) with diverse expertise in this and related industries asserted:

> *"When our salespeople go to the ground, many report that people think it is too costly, their houses are not designed to offer panels, and solar is not reliable… We have solutions to address these concerns… batteries to store power, but these perceptions are out there."*

Thus, many end-users are not aware of the long-term cost savings and environmental benefits of solar PV, which further contributes to their reluctance to adopt this technology. The lack of awareness and knowledge among end-users about the benefits of solar PV is a significant challenge that impedes the scaling-up of solar PV at the interface between importers/intermediaries and end-users.

4.2. Phase 2: Reshaping institutional dysfunctions

The phase focuses on reshaping the dysfunctions via concerted sets of actions and interventions to deducing meanings and delivering meaningful change. We uncovered, in this phase, a general attempt to understand the issue of awareness and knowledge gaps as channels towards initiating necessary changes and capacity-building pathways. For example, a co-founder and manager (M9) based in the country's second-largest city, Kumasi, expressed it this way:

"We believe that solar PV has the potential to transform the energy landscape in our country… exploring different strategies to promote solar PV systems. We are using door-to-door visits, political donations, and engaging chiefs to showcase what we have to offer."

Addressing this challenge may require targeted education campaigns that provide practical information on the cost savings and environmental benefits of solar PV, as well as clear and concise information on the long-term benefits of investing in solar PV systems.

"This issue, for us, is about educating people we meet or come across who are interested in solar energy. The thing with solar is that the initial investment is high. Let's say we ask you, as the client, to give us the total amount you would pay for your electricity bills over three to five years and invest that amount in solar. It can be challenging for the client to conceptualize this… If we break it down, the cost we are asking you to pay is actually equivalent to your three to five years' worth of electricity bills. Even if we consider the assumption that the electricity tariff remains constant, which we know is not the case, we are still asking for that sum as a one-time payment." (Informant M8)

As one informant noted:

"We tried getting into the same loan scheme for clients, but unfortunately, most of the clients defaulted. So the banks don't want to go into such arrangements. We tried to have an arrangement where it's more like a tripartite agreement between us, the bank, and the client. So the client, who has an account with the bank, will finance it, and you pay it off. Already, some of them have loans they can't service, and we initially tried to give credit directly, and we had our fingers burnt, we almost collapsed because they were not paying." (Informant M1)

Regarding the challenges in supporting financing for end-users, one informant asserted:

"We didn't have expertise in collecting debts, so when the person is supposed to pay, they won't pay. Post-dated cheques would bounce, and when you call, they tell you they have a funeral, so they'll have to present it next month, and that affects your cash flow. Then you run down, you are low on cash, you can't import, and you can't buy new products. Then, you can't service your new clients who want the product, you have a lot of funds locked up in old products you have sold. So, such arrangements almost… in the first place, is something we won't even consider actually. Ghanaians are generally not creditworthy." (Informant M11)

On an innovative solution, one informant asserted:

"For now, we are dealing with small solar products, so when we start producing larger solar products, we will target big businesses. But with the small businesses in the villages, they close early because there is no light. So with the help of solar lights now, they can transact business at night, which they say has increased their sales… We don't allow our customers to pay in full, so we have terms and conditions for them. Some pay weekly, and some also pay monthly for a period of time." (Informant M25)

4.3. Phase 3: Tackling dysfunctional aftermarket support environment

Our fieldwork also revealed patterns indicating that different institutional deficiencies can hamper the functioning of the aftermarket, thereby impeding scaling-up efforts. We found two main findings from the intermediaries' perspectives when dealing with manufacturers/foreign agents for importation, as well as when dealing with end users. From the viewpoint of businesses that have recently acquired solar panels, there is a noticeable gap in the market regarding aftermarket support, maintenance, or repair services, which hinders scaling-up efforts. An informant (M5), who is a founder with an engineering background, explained how this has become a barrier to PV adoption:

"The company was registered in 2009, but it wasn't in operation for about 3 years. That time was crucial for me to equip myself with solar knowledge, you know. So, until we started operations, it became clear to me that we had issues with maintenance, repair, and component replacement for users. We need a network of trained technicians and service providers to support customers and encourage future customers to adopt" (Informant M5).

Due to its relative novelty and the technical expertise required for maintenance and repairs, customers may face difficulties in finding qualified technicians to service their systems. This often leads to prolonged downtime and increased maintenance expenses, ultimately resulting in a diminished return on investment. The lack of quality post-purchase support services for many businesses hinders their scale-up efforts due to potential uncertainty and risk among customers, which may discourage investment in the technology. Therefore, after-sales and aftermarket services play a critical role in the adoption and maintenance of solar PV technology. Another key challenge is the limited availability of after-sales services and support for end users. A business user (BU2) of the panels, who has branches across the country, concurred:

"If we struggle to find someone to fix basic issues in a skilled way, then I will not try to scale to other branches. This is the issue. If we are having this problem in Accra (capital of Ghana), then it will be even worse in our rural branches."

As another business (BU1) that recently acquired panels for their office noted:

"It seems that way. If anything breaks down, it is difficult to find competent individuals who will come fix the problem and not create new problems in the future. We have in the past used a local firm, and then the system broke down a day after we paid them."

Additionally, insufficient technical capacity among end users to maintain and repair solar PV systems was also identified as a barrier. As one intermediary (M8) stated:

"Many end users in remote areas lack the technical knowledge to maintain and repair solar PV systems. They either don't use the system or continue to use it improperly, leading to inefficiencies."

Another persistent problem in scaling-up solar efforts is the issue of panel theft. Criminals are increasingly stealing solar panels. Our data showed that theft also erodes public confidence in solar energy, potentially reducing the adoption rate. This increases the financial burden stemming from replacement costs and/or the need to switch to alternative power sources. The loss of green investment for businesses often leads to delays and disruptions in their activities. This not only disrupts and deprives users of access to panel power services but also reduces confidence in solar power. Reflecting on these challenges, an informant (M2) in Accra observed:

"Some past customers complained to us about this problem and want a solution on how they can fix this problem. We have had recent business customers reporting an urgent need for replacement. You hear 'it is gone, gone, and gone… they have taken it.' We have identified this as a reported problem that the industry needs to address."

By developing innovative financing solutions and raising public awareness about the benefits of solar PV, importers and intermediaries can help make solar energy more accessible and affordable for end users, thereby contributing to the growth of the solar PV industry. In the aftermarket environment, some informants and their organizations have adopted innovative approaches to address the market gap. As one respondent asserted:

"That's a good observation. We found out that in Africa, power outages are very common, and some villages are still deprived of electricity. So, we established this company to provide these villages with electricity. We have various centers across the villages, so when we distribute to those centers, whoever needs one can purchase from them. Similarly, these centers receive faulty products and service them there instead of coming all the way to Accra" (Informant M25).

"Yes, when there's a need to… However, we don't handle the repairs in-house. We have dedicated technicians who specialize in repairing electronic equipment. So, if something breaks down at the client's location, we either send our electricians or the tech experts to perform the repairs. If the item cannot be repaired, we will arrange for a replacement" (Informant M1).

Another informant also noted:

"We provide repair services as part of our offerings because when a client encounters a problem, it is our responsibility to address and solve it. The batteries we use are maintenance-free, meaning they cannot be repaired or returned when they malfunction. When they cease to function properly, they need to be replaced. However, electronic components such as inverters and charge controllers, which are integral parts of the system, can be repaired" (Informant M15).

By providing adequate support and maintenance services and incorporating maintenance and support considerations into the design of solar PV systems, companies can help overcome the challenges faced by customers and contribute to the continued growth of this pivotal technology.

5. Discussion and implications

The study aimed to elucidate the mechanisms through which institutional dysfunction influences upstream and downstream activities of emerging-market firms in their scaling-up efforts. Drawing on data from entrepreneurs and business owners involved in the import and sale of solar PV panels, this study identified three distinct phases that capture the interaction between upstream and downstream constraints. These findings shed light on the evolution of constraints from sourcing from foreign markets to distribution and expansion to domestic end users. Phase 1 focuses on unmasking institutional dysfunctions, shedding light on pre-market institutional conditions that give rise to different upstream and downstream constraints in scaling up solar energy. These constraints include limited affordable financing options for small businesses, limited financing access, and panel affordability. The upstream institutional constraints encompass inconsistent and unfavorable regulatory and policy environments. Phase 2 involves reshaping institutional dysfunctions and encompasses upstream partner and downstream constraints. These constraints include a lack of access to affordable panels, limited knowledge about the benefits of solar PV among end users/potential users, and limited awareness and education about solar energy among potential end users. Phase 3 pertains to tackling a dysfunctional aftermarket support environment. It focuses on the unfolding effects of weak aftermarket support services, such as maintenance and repair services, theft of solar panels, and the availability of spare components. By shedding light on both upstream and downstream activities, our study takes a step forward in disentangling the intricate and evolving processes towards scaling up. It progresses from unmasking institutional dysfunctions (Phase 1) to reshaping those dysfunctions (Phase 2) and ultimately tackling the dysfunctional aftermarket support environment (Phase 3). The transition from Phase 1 to Phase 2 and then Phase 3 illuminates the shift from uncovering, analyzing, reshaping, and tackling institutional dysfunctions in scaling-up efforts.

5.1. Contributions to theory

The study contributes to the existing strategy and management literature in several ways. First, while researchers have gradually begun to recognize the pervasive influence of institutional dysfunction on business activities (Amankwah-Amoah, Debrah, & Acquaah, 2023; Harrison, Scheela, Lai, & Vivekarajah, 2018; Ofori-Dankwa & Julian, 2013; Peng, 2002; Boso et al., 2023), there remains a research gap regarding how institutional constraints related to upstream and downstream activities interact to influence scaling-up efforts. In addition, while previous studies have illuminated the effects of institutional factors on the supply chain in general (Yang, Geng, & Feng, 2020; Cai, Jun, & Yang, 2010), limited scholarly attention has been devoted to elucidating the mechanisms for scaling-up efforts. To address this gap, the study advances an integrative phase model that charts the evolution of constraints and sheds much-needed light on complex challenges related to upstream and downstream constraints affecting scaling-up efforts.

Furthermore, although some scholars have emphasized the importance of capacity development and organizational efforts towards scaling-up (Tippmann et al., 2023), there has been a noticeable limited attempt to account for the effects of institutional impediments in developing economies. Given the relative dearth of scholarly works on constraints on businesses' scaling-up efforts in non-Western contexts, this study contributes to the literature on scaling by providing a deeper scholarly understanding of scaling up solar PV efforts in non-Western contexts.

5.2. Contributions to practice

There are fruitful insights from this study that can be deduced by practicing managers and policymakers. Firstly, the analysis indicates that the transition from the unmasking institutional dysfunctions phase to tackling dysfunctional aftermarket support environments requires collaboration with multiple stakeholders, including importers, manufacturers, governments, and other relevant parties. Such an approach would go a long way in making solar PV more affordable and accessible to a wider group of citizens. The findings also underscore the importance of governments providing subsidies and incentives, increasing public awareness, offering financing solutions, and improving after-sales support for renewable energy. These actions will make solar PV products more affordable for consumers. Furthermore, educating the public about the importance of solar energy and the benefits of solar is more likely to encourage new adoption. Finally, establishing a solar panel registration system to track ownership can help ensure the recovery and return of stolen panels to their rightful owners. These combined efforts would help reduce the theft of solar panels and promote the growth and scalability of solar energy.

5.3. Limitations and directions for future research

Despite the theoretical contributions outlined above, there are inherent limitations that must be noted when interpreting the findings. One limitation of this study is that the sample size of entrepreneurs/business owners and the used of semi-structured interview approach are too limited. Additionally, the study exclusively focused on the solar PV industry, which possesses unique industry characteristics and market

dynamics that restrict the generalizability of the findings. Future research could seek a larger sample of entrepreneurs across multiple industries, including wind and biomass. Another limitation is that the research was confined to the context of a single developing economy, namely Ghana. This suggests the potential for future research to seek a larger sample from multiple countries to better illuminate the applicability of the observations here. Future research could focus on enhancing scholarly understanding of scaling-up renewables in multiple industries. Moreover, incorporating data from other non-Western countries would help alleviate the shortcomings that restrict the generalizability of this study. It is hoped that this study fosters a new quest towards understanding the role of SMEs and large businesses in tackling the global grand challenges.

CRediT authorship contribution statement

Joseph Amankwah-Amoah: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. **Robert E. Hinson:** Data curation, Funding acquisition, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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