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GENDER AND ENERGY: OPPORTUNITIES FOR ALL

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Gender and Entrepreneurship in the Renewable Energy Sector of Rwanda*

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Abstract Until recently, women have not been seen as having the potential for entrepreneurial success. Yet women's engagement in the energy sector could substantially improve energy access for those most underserved. This article examines the role of women as energy entrepreneurs from the perspective of gender inequality within the energy industry. Data from Nuru Energy, a social business focused on providing solar lighting to the ultra-poor, provide insights on how the inclusion of women sales agents can increase sales and how strategic modifications to the social business model can further support female-led businesses. Observational data from over 1,000 rural enterprises show that women, on average, sold significantly more units than men. Women operating in solo firms and leading group-based teams consistently outsold men-led solo and group-based enterprises. Findings further suggest that, when operating in groups, women tend to outperform men even more than when operating sole proprietorships.

Keywords: entrepreneurship, women, business, performance, sales, energy.

1 Introduction

Throughout the world, in both developed and developing countries, women face numerous social restrictions that impede their ability to engage in economic activities successfully. Not only do women carry the burden of household responsibilities in every society, but they also receive less schooling and lower returns for their labour. Further, in some countries, women face social restrictions on public participation, employment, and mobility. In fact, in 18 countries, married women require their husband's approval to take a job (World Bank Group 2015).

In a recent review, Buvinic and Furst-Nichols (2016) conclude that, at the subsistence level, female-operated firms are less profitable than

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male-operated firms primarily owing to these social barriers. Indeed, the 'female underperformance hypothesis' is a crucial point of debate within the field of management studies (e.g. Yousafzai *et al.* 2018; Baker and Welter 2017; Zolin, Stuetzer and Watson 2013; Robb and Watson 2012; Watson 2003; Du Rietz and Henrekson 2000). The findings from these studies are mixed overall, revealing that business performance depends upon the performance measure used and is tied closely to context, such that key controls often explain aggregate gender differences. While much of the research on gender patterns of business performance focuses on companies in highly industrialised countries (Da Vita, Mari and Poggesi 2014), studies on gender patterns in business performance in developing countries also find that women-owned businesses tend to perform favourably in terms of sales, profitability, and job creation when key factors such as industry and business age and size are considered (Ali and Shabir 2017).

Unfortunately, there exist widely held stereotypes of female underperformance that, combined with existing structural barriers, are holding women entrepreneurs back from high levels of economic success in business. Research from the Global Entrepreneurship Monitor (GEM), for example, shows that women entrepreneurs and established business owners (across all countries sampled over 20 years of data collection) tend to perceive fewer opportunities and report a higher fear of failure and less confidence in their start-up skills compared to their male counterparts (Kelley *et al.* 2017; Elam 2008). Moreover, even with the same level of education, women tend to feel less competent than men at entrepreneurship (i.e. starting and managing a new business) (Kelley *et al.* 2017; Thebaud 2010). While prior research has addressed the complex interplay of cultural, psychological, and structural factors in influencing women's participation in entrepreneurship, to our knowledge, no studies to date have compared the performance of female-led and male-led firms in a controlled research design comparing men and women selling the same products under the same terms and in the same cultural context.

In this study, we investigate the business performance of women and men entrepreneurs within a highly specific context – a large social enterprise, Nuru Energy, in the Rwandan renewable energy sector. This study is a small part of a large-scale prospective intervention study, including a randomised controlled trial in 272 rural Rwandan villages where a gender equality programme has been implemented. In this analysis, we compare female and male business performance in two different business models: (1) solo male versus female micro-entrepreneurs (deployed in 868 villages) and (2) female, male or mixed gender teams of four to ten entrepreneurs per village (deployed in 183 villages). Further to this, we use qualitative data to obtain additional insights about women's entrepreneurship-derived benefits that go beyond simple sales performance and consider explicitly personal empowerment achieved through increased household income, social status, and personal agency. Our findings show that females are as successful as

males at selling solar lights, which is encouraging news for empowerment programmes aimed at promoting female entrepreneurship. As a result, this study contributes directly to research on women's entrepreneurship by challenging the female underperformance hypothesis with respect to relative sales performance. It also provides important insights into how social enterprise programming that supports women entrepreneurs in subsistence-level contexts can improve business-level outcomes, such as revenues and profits, and also be personally empowering.

The rest of the article proceeds as follows: Section 2 presents an overview of the context of study, some myths surrounding female underperformance, and theoretical underpinnings and hypotheses. We present the methodology of the research in Section 3. The results of our study are presented and discussed in Section 4. Section 5 concludes.

2 Background

2.1 Female entrepreneurship in the energy sector: the case of Nuru in East Africa

Our study took place within the context of Nuru Energy (Nuru), a large social enterprise working in the African renewable energy sector. Nuru is a for-profit social enterprise, with operations in Rwanda, Burundi, and Kenya, which aims to address the global issue of energy poverty through the provision of low-cost solar recharging centres for mobile phones and lights to off-grid rural communities. Nuru has distributed lights to over 150,000 households in rural Rwanda alone. Its model operates by providing energy in the form of single rechargeable light-emitting diode (LED) lights that are sold by a village-level enterprise according to Nuru's pre-selected business model. Thus, village-level enterprises sell the rechargeable lights just above cost and generate additional revenue by charging small fees for recharging lights and mobile phones using the solar photovoltaic (PV) system provided by Nuru. This business model mimics the way kerosene lamps and battery-powered flashlights are purchased from a central source, with households frequently returning to buy fuel and dry-cell batteries. Selling solar energy as a service, rather than as just an upfront purchase, also spreads out expenditures for low-income households to address affordability issues.

East Africa's focus on promoting gender equity in recent decades presents a potentially attractive environment for female entrepreneurs, particularly for Rwanda with its continuous implementation of gender policies. We argue that the clean energy sector serves as a particularly favourable sector for women rather than men, given women's roles as primary household energy managers and their understanding of the value of clean lighting technologies for the advancement of their children's schooling, especially in situations where the availability of alternative income-generating activities is limited.

For this study, we use existing data from Nuru light sales to estimate the performance of female entrepreneurs in selling lights compared

to their male peers. We also interviewed a subsample of village-level entrepreneurs (VLEs) to unpack the benefits women derive from being an entrepreneur in the Nuru distribution model. We investigate, over and above sales performance, how females are empowered in other ways, including increased personal agency, social status, and time use.

2.2 Myth of female underperformance

Women are consistently underestimated in terms of business leadership and business performance (Ahl 2006; de Bruin, Brush and Welter 2007; Minniti and Naudé 2010; Brush and Cooper 2012). Management scholars have spent decades researching gender differences in business start-up and growth. The results of this body of research are mixed, and the mechanisms are complicated (Ross and Shin 2019; Zolin *et al.* 2013; Hughes *et al.* 2012). Early studies reported that women business owners tend to be less successful than male business owners (Kalleberg and Leicht 1991; Rosa, Carter and Hamilton 1996; Birley 1989). Over time, researchers have dug deeper into available data in countries around the world to uncover explanations for these population differences. Key predictors of business success include business characteristics, such as industry, business age, and size, and individual attributes, such as education and industry experience (Yousafzai *et al.* 2018; Baker and Welter 2017; Zolin *et al.* 2013; Robb and Watson 2012; Watson 2003; Du Rietz and Henrekson 2000). Gender differences across these key predictors are significant and often explain differences in performance observed at the population level.

Indeed, women around the world tend to own/manage very different types of businesses compared to men, with different preferences and motivations for growth (Brush *et al.* 2006; Du Rietz and Henrekson 2000). Research from GEM suggests that women run about one-third of businesses worldwide. According to the most recent global report, only 6 of the 49 economies surveyed reported equal entrepreneurship participation rates between women and men: Indonesia, Thailand, Panama, Qatar, Madagascar, and Angola (Bosma and Kelley 2019). Prior research shows that women are over-represented in the informal sector in every economy and among sole proprietorships (Kelley *et al.* 2017; Klapper and Parker 2011). Women-owned businesses are also over-represented in industry sectors with relatively low barriers to entry but with high levels of competition and lower profit margins, such as textiles/fashion, hospitality/food, and education and health services (Kelley *et al.* 2017). Women-owned firms tend to be small and newer than men-owned businesses and tend to grow more slowly with less access to the resources required for growth (Brush *et al.* 2006; Cliff 1998).

Many of the differences between female-owned and male-owned firms are explained by horizontal segregation across industry sectors (Sappleton 2018; Klapper and Parker 2011; Du Rietz and Henrekson 2000). Businesses in retail and services, for example, are often smaller and newer, serving local markets resulting in smaller profit margins and lower eligibility for either debt or equity financing (Coleman and Robb 2016;

Hughes *et al.* 2012; Brush, de Bruin and Welter 2009). The fact that women tend to start businesses in different industry sectors or sell different types of products within a given industry sector complicates the comparison of male- and female-owned businesses in some significant ways. These fundamental differences in business characteristics have, unfortunately, contributed to negative stereotypes about the abilities of women business owners and managers around the world (Jennings and Brush 2013; Gupta and Turban 2012; Ahl 2006). Not only are women viewed broadly by the general public, investors, and researchers as less successful business leaders, but the hypotheses that drive studies of business performance also tend to start with that same bias.

Research into what scholars have described as the ‘female underperformance hypothesis’ has emerged to directly challenge the assumption by controlling for key factors and testing multiple measures of business performance in large studies around the world. In a study of 4,200 Swedish businesses, Du Rietz and Henrekson (2000) found that, while women-owned firms did tend to underperform men-owned firms at the population level, these differences were primarily explained by business size and industry sector. Men tend to run larger businesses selling to larger customers and more often in the manufacturing sector. Importantly, they also found that men-owned businesses reported significantly more sales on average compared to women-owned businesses, but that there were no gender differences in other performance measures – the number of orders, number of employees, or, notably, profitability. Similarly, in sub-Saharan Africa, Bardasi, Sabarwal and Terrell (2011) found a significant gender gap in the firm size of male- and female-owned businesses. However, a much smaller gender gap is reported for firms’ efficiency and growth. They explain that their observed gender gap was partly due to the overpopulation of women in smaller business operations. In a study of over 4,016 US businesses, Robb and Watson (2012) found no difference in closure rates over four years, no difference in return on assets, and no difference in risk-adjusted profitability, controlling for key demographics, business size, and industry. Using a sample of 183 Australian firms to replicate the Robb and Watson (2012) study, Zolin *et al.* (2013) also found no gender differences in four-year business closure rates, return on assets or risk-adjusted profitability, controlling for key confounding variables such as industry and business size and age. Hence, while men-owned businesses tend to outperform women-owned businesses at the population level, studies that make direct apples-to-apples comparisons find that women are just as capable as men of achieving significant business success. In this study, we extend this stream of research by comparing the business performance of men and women VLEs selling the same products under the same supplier terms in the same country.

2.3 Theoretical frame and hypotheses

The feminist theory includes multiple perspectives with different underlying assumptions, including but not limited to social feminism, radical feminism, Marxist feminism, and socialist feminism. Liberal

feminism argues that gender difference is a false construction and that, *ceteris paribus*, men and women are equally capable both intellectually and physically (Tong 2013). The focus of this perspective is on changing the political and institutional forces that constrain women from participating as equals in private and public spheres. Social feminism posits that men and women are fundamentally different but should be considered equal (Black 1989). The focus of this area of theory is on the centrality of motherhood to the family and society and the unique skills and perspective that women bring to work and politics. Finally, socialist feminism combines the social domination hypothesis of radical feminism (Mackay 2015; Willis 1984) with the economic class oppression hypothesis of Marxist feminism (Vogel 2013) but argues that the root of female oppression lies in class oppression and the economic dependence of women on a male head of household (Gordon 2013).

Recent findings debunking the idea that female-owned businesses underperform male-owned businesses are consistent with a liberal feminist perspective on business performance. Liberal feminism argues that, given a level playing field, women are equal to men and just as likely to perform well in business (Zolin *et al.* 2013; Calás, Smircich and Bourne 2007; Robb and Watson 2012; Fischer, Reuber and Dyke 1993). In other words, given the same product/service offering under the same supplier terms and in the same country, women-led village-level enterprises and men-led village-level enterprises should perform comparably. Accordingly, our hypotheses are that:

H1: Women solo entrepreneurs will perform as well as men entrepreneurs by selling an equal number of lights.

H2: Women-led entrepreneurial teams will perform as well as men-led entrepreneurial teams by selling an equal number of lights.

H3: Access to lighting will confer economic and non-economic benefits on Nuru VLEs.

3 Methodology

Data for this study were drawn from a larger research project that examined the impact of Nuru Energy's solar light and recharging distribution programme in Rwanda. The programme was designed to provide rural households with access to rechargeable lights and recharging services. VLEs were recruited to sell the rechargeable lights and to provide recharging services. We obtained administrative data on 1,047 village enterprises in Rwanda, including the gender of the entrepreneur and the number of lights sold, as depicted in Table 1. Most VLEs were men (81 per cent) with only 19 per cent being women. On average, female VLEs sold 90 lights while men sold 58 lights. These data were collected under two different business models that Nuru rolled out in Rwanda. In the first model, VLEs included one micro-entrepreneur per village across 868 villages in 11 districts in Rwanda, with the majority of participating villages concentrated in Nyamasheke and

Table 1 Summary statistics

	All	Male VLEs	Female VLEs
Number of VLEs	1,047	847	200
Percentage	100%	81%	19%
Average lights sold		58.13	90.97
Standard deviation		78.72	110.99

Source Authors' own, based on Nuru administrative data.

Gicumbi districts. The second model included village-level enterprises of four to ten members per village, in 183 villages covering 14 districts in Rwanda. These enterprises were operative by 30 March 2015 and had at least three months of operations. Although Nuru entered the villages at different points in time, the vast majority of lights are sold during the first couple of weeks from the date when the VLE is set up, so differences in the timing of Nuru's entrance are unlikely to affect the number of lights sold in a village.

We estimated four ordinary least squared (OLS) multivariate linear regression models to study the difference in business performance of female versus male entrepreneurs, across the two Nuru business models (solo VLE vs VLE teams). The dependent variable, representing business performance, is the number of lights sold. We included a specification with the dependent variable in logarithms to address potential measurement error and to facilitate coefficient interpretation (e.g. the percentage difference in lights sold). The key explanatory variable is VLE gender (or gender of the enterprise team leader), which takes the value of 1 if the VLE is a female. We included two controls: district characteristics and number of villages with only men micro-entrepreneurs.

Controlling for district-fixed effects reduces the level of bias in our estimates, as there may be regional differences that may potentially influence the number of lights sold by gender. Owing to data limitations, we were unable to control for other key variables such as entrepreneurs' education and age, which may also influence the number of lights sold. Given these limitations and the non-experimental nature of our data, we do not draw causal conclusions in this article.

To better understand the empowerment potential of including females as energy entrepreneurs for this analysis, we supplemented our quantitative analysis with 30 qualitative interviews with VLEs and community members in 13 sectors of Rulindo in Rwanda. All interviews were conducted in Kinyarwanda, the official local language in Rwanda. Semi-structured interviews with VLEs working in groups of four included open-ended questions covering demographic information, micro-enterprise operations, livelihoods before and after

Table 2 Number of lights sold and gender of the VLE, OLS

	Solo businesses		Businesses with 4–10 entrepreneurs	
	(1) Level	(2) Log	(3) Level	(4) Log
Female	24.855** (8.414)	0.305*** (0.084)	77.832 (46.065)	0.471*** (0.045)
District fixed effects	Yes	Yes	Yes	Yes
Mean lights sold by male entrepreneurs	57.855		73.074	
Number of observations	868	868	183	179
R-squared	0.145	0.198	0.199	0.210

Notes Standard errors clustered at the district level. Statistically significant from zero at the 90(*), 95(**), and 99(***) per cent confidence.

Source Authors' own, based on Nuru data 2016.

becoming an entrepreneur, and general gender awareness. Interviews with community members were conducted using a different interview guide to understand better the context in which these entrepreneurs are working. We further supplemented our interview data with observational data from the daily activities of entrepreneurs. Qualitative data were prepared for analysis by transcription and translation of all questionnaires before coding using a thematic analysis approach.

4 Results

4.1 Empirical analysis of female business performance

Table 2 presents the OLS regression results of the difference in the performance of female versus male entrepreneurs. As shown in column 1, on average, solo female VLEs sell 25 lights more than solo male VLEs, statistically significant at the 95 per cent confidence level.

As shown in column 3, female-led teams sell 77 more lights on average than male-led teams, but with a large standard error (46.1) rendering the finding not statistically significant, due to the relatively small number of observations potentially combined with measurement error in the outcome variable. Columns 2 and 4 show the results of each model with the dependent variables expressed as natural logarithms, reducing the measurement errors and showing large, statistically significant effects for both models. These findings show that female solo VLEs tend to outsell male solo VLEs by 36 per cent and that villages with female-led VLE teams outsell villages with male-led VLE teams by 60 per cent.⁷ Our additional qualitative findings suggest that women are more likely to be available at the shop to serve customers, either because of limited mobility or because they value the position more highly than men and

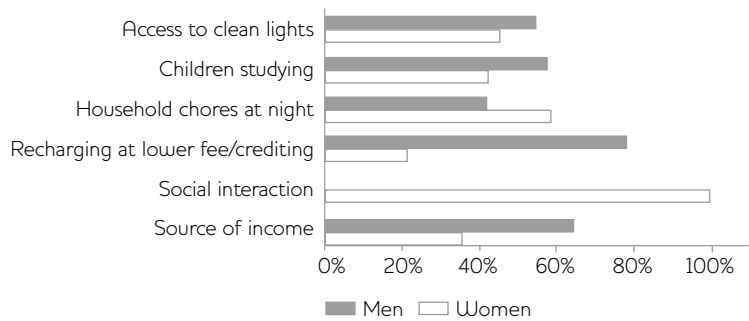
are especially motivated to succeed. This may explain the reason why women in these villages tend to perform better than men.

Our analysis, however, was severely limited by the administrative data available and their non-experimental nature, so we cannot draw causal conclusions with certainty. It is possible that missing variables or other exogenous factors might influence these findings. For example, given high discrimination levels, selection effects may be present where only the most motivated, supported, or capable women ended up as VLEs, and thus their performance is higher than the average male VLE. In addition, men may not be entirely focused on Nuru sales and have other paid work that conflicts with selling Nuru lights and recharging services. The men in these villages bear the responsibility of herding animals, while women's family care duties tend to keep them at home and, as such, are highly compatible with Nuru solar sales. The VLE start date could also influence the number of lights sold; specifically, women-led enterprises may have started selling lights earlier than male-led enterprises. Again, this data point was not available to us. Women entrepreneurs could also be older and more experienced in business than men entrepreneurs. We were unable to control for entrepreneur and business characteristics as the data were not available. Nonetheless, the findings are very compelling and stand in contrast to the conclusions broadly communicated based on prior findings from studies across multiple industries in other countries that find that women-owned businesses tend to see lower sales than men-owned firms. Consistent with previous studies in other countries, when controlling for industry (product/service) and business characteristics (size and age), the female underperformance hypothesis is not supported by the available evidence.

4.2 Qualitative analysis of female entrepreneurship in the energy sector: the potential for women's empowerment

Within the original Nuru programme, many community members – both men and women – were interested in becoming entrepreneurs. However, the final choice of VLEs is left to the village leadership. The result has been that women rarely take on the role of entrepreneurs. Instead, men with senior roles in the village frequently end up running the enterprises. As a result, women run only 19 per cent of village enterprises in the original Nuru model, and only 4 per cent of village enterprises in the newer model are women-led. Qualitative findings further reveal that when women take part in the business, they are usually assigned as the enterprise's secretary or bookkeeper. However, informal discussions with female VLEs suggest this pattern is not due to lack of interest by women in entrepreneurship. Instead, during village- and sector-level presentations on forming Nuru village-level enterprises, women expressed interest and excitement about this prospect of entrepreneurship, and the cause for their exclusion from the enterprises is probably due to traditional gender arrangements and authority structures in their communities.

Figure 1 Benefits of becoming a VLE by gender



Source Authors' own, field data 2017.

Despite the constraints imposed by village-level patriarchy, the results from our qualitative interviews of entrepreneurs in Nuru's entrepreneurial team model (four entrepreneurs per village) suggest that the goal of promoting gender equity in Rwanda presents an attractive environment for female entrepreneurs. Our qualitative analysis shows that, indeed, there are many benefits associated with engaging women as entrepreneurs in the energy sector. First, as shown in Figure 1, both men and women reported the vital benefit of generating family income as VLEs. However, we find that women and men report different use of the income gained. While most women (80 per cent) report spending income from their energy businesses on food and essentials for their households, men tend to spend their extra income on either recreational activities or informal forms of savings.⁸ Thus, an extra income source for women enables them to support their families' basic needs such as food, clothing, and health expenditures.

The importance of entrepreneurship as a source of family income in this study is consistent with previous entrepreneurship studies. For instance, the research of Sharma, Dua and Hatwal (2012) and Sidhu and Kaur (2006) reveals that entrepreneurship is beneficial to rural women compared to wage employment as it enables them to remain close to home while double tasking family duties and work demands as well as contributing to family income. Similarly, Abdo and Kerbage (2012) in their study cited family income as a key benefit of including women as entrepreneurs. A respondent from their study reported 'from the proceeds of selling milk; I am now able to secure regular income for my family' (*ibid.*: 68). These findings provide evidence that empowering women through entrepreneurship cushions women by providing them with an income source that they use to support their family.

A second positive impact for women is that they become recognised in their villages after becoming business owners and gain significant social status. By continually charging lights for customers, women become well known in their various communities. In many cases, they serve as mediators in times of conflict for other community members.

In the words of a female VLE who participated in our qualitative study, ‘because I am a VLE I get to now meet a lot of people, and others come for advice from me. I am trusted, and I think I can now contest for the position of a village leader.’ Non-VLEs also validated this finding as they also agreed that female VLEs were now recognised in the villages owing to the constant engagement with community members at recharging centres. Women are, therefore, able to reap social benefits, such as prestige and societal acceptance, especially in the rural areas where community engagements and a sense of belonging are highly valued. These benefits increase their self-confidence, which motivates them to take on other leadership roles. In line with our findings, Sharma *et al.* (2012), in their study on micro-enterprise development and rural entrepreneurship, clearly outlined status in society, increase in confidence levels, and social identity as key factors when women take on entrepreneurial roles. While attaining social recognition in the villages is very important to female entrepreneurs, no males reported improvement in social status as one of the main benefits of becoming an entrepreneur. It may be that men do not experience a substantial change in their social status since they are already recognised by village members before running the energy micro-enterprises.

Establishing solar recharging businesses in communities with no access to grid connection means that entrepreneurs and the villages in which these micro-enterprises are operating will now have access to clean lights. This benefit is also evident in Figure 1, which shows that most respondents reported access to lights as a benefit of establishing the Nuru energy business model in the area of study. Access to clean portable lights is shown to have health, educational, and economic benefits (Jacobson *et al.* 2013; Zahnd and Kimber 2009; Saghir 2005). In our case, the benefit from access to lights differs between women, men and children. Women often use these lights for domestic activities, which enables them to reduce the time spent on domestic activities such as cooking, collecting firewood or alternative sources of cooking energy and doing other household chores. With solar lighting, women can do other productive activities during the day while shifting house chores to after dark; and with the aid of the lights, women can conduct their domestic chores at night more quickly than before. Thus, access to lights provides women with the flexibility to re-appropriate their time use. As supported by results from Barnes (2007), access to power (clean lighting) can drastically reduce the amount of time women spend on household chores when compared to women who do not have access to electricity (clean lighting).

Qualitative interviews with local stakeholders and local gender specialists further suggest two main reasons behind the success of female VLEs. Women are more likely to be available at the shop to serve customers, either because of limited mobility or because they value the position more highly than men. Also, women who manage to get a spot in the businesses are especially motivated to succeed. We further observed that villages having fewer barriers to the participation

of female VLEs might be less stringent in other forms of gender discrimination. Further research is required to identify the reasons behind these effects.

Overall, our qualitative study indicates that, apart from access to clean lights, which reduces women's time use on domestic activities, becoming an entrepreneur in the energy sector provides additional income that is used by women to support their households in various ways. Also, female VLEs report gains in social status that have given them some level of respect and influence in their communities.

5 Conclusions

Few studies on business performance directly compare men and women entrepreneurs. Their findings are sometimes misinterpreted and can bolster inaccurate stereotypes of women business leaders and lead to biased research hypotheses such as the female underperformance hypothesis. Instead of conforming to habit, we based our hypotheses on liberal feminist theory, arguing that in a true apples-to-apples comparison of the sales performance of women- and men-owned businesses, women entrepreneurs would perform as well as their male counterparts. We further addressed the limitations of prior research by comparing the sales performance of male and female village-level entrepreneurs selling the same products/services based on the same supplier terms under the Nuru Energy solar distribution programme in Rwanda. Much to our surprise, our empirical findings reveal that female solo VLEs tend to outsell male solo VLEs by 36 per cent and that villages with female-led village-level enterprise teams tend to outsell villages with male-led teams by 60 per cent. These findings were further supported by qualitative research findings suggesting that women VLEs not only gain the opportunity to bring in much-needed family income but also gain in social status and confidence and in time efficiencies where domestic chores are concerned.

Overall, these findings suggest that women entrepreneurs make excellent sales agents in the solar energy sector in Rwanda and that social enterprises such as Nuru Energy can achieve higher levels of sales and market reach for renewable energy products by strategically recruiting women entrepreneurs at the village level. However, our qualitative findings also suggest that recruiting programmes for women may receive some pushback from the village patriarchy, necessitating strategic management of stakeholder relationships among village leaders.

Although promising, these data are only suggestive, since they are observational and thus correlational owing to the small percentage of female entrepreneurs in this sample and likely selection effects. Findings from the larger Nuru Energy research project will address whether these correlations are causal and can be consistently observed with larger samples of female enterprises. Our empirical data were minimal, and it is possible that our findings may be influenced by factors not measured in our dataset, including alternative sources of paid work.

Nonetheless, our findings have important implications for practitioners, policymakers, and researchers. Women can be excellent entrepreneurs and sales agents and may be in a position within the household and the village to perform extremely well in solar product/service sales. Serving as VLEs further confers to women important benefits, not reported by men, including an increase in social status, confidence to pursue village leadership roles in addition to family and business roles, and some relief from the time poverty that results from the necessity of completing most domestic duties during daylight hours. Policymakers may take insight from these findings when selecting programmes and policy strategies in support of women's entrepreneurship, economic development, gender equality, and energy access for all. Future studies should address other factors that may influence business performance in subsistence village contexts as well as additional measures of business performance and personal benefits to entrepreneurship for women and families. We see promise in experimental studies showing that women tend to perform better when competing exclusively against other females than when competing against males and females (Gneezy, Niederle and Rustichini 2003; Niederle and Vesterlund 2007). Importantly, the disadvantages that women business owners face is aggravated by the contribution of traditional cultural and social gender norms to important structural barriers to business growth, such as access to credit, which can be constrained by lack of credit history, lack of collateral (Bushell 2008), lack of mentors, and low social approval (Rodríguez and Santos 2009). Finally, we hope that, in the future, more researchers will consider the importance of basing hypothesis development on theoretical propositions supported by rigorous prior findings rather than on spurious preconceived biases against women business leaders.

Notes

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- 7 These figures are obtained from the coefficients in columns 2 and 4, respectively $e^{0.305}-1=0.36$; $e^{0.471}-1=0.60$.
- 8 This is not to say that women do not participate in informal savings, but as far as income from the Nuru business model is concerned men are more likely to save while women spend their income on basic needs for their households.

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