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WHEN DO CLIMATIC CHANGES MATTER? AN INVESTIGATION OF IMPACTS ON PRODUCT MARKET STRATEGIES IN THE WINE INDUSTRY

Jeremy Galbreath

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When do climatic changes matter? An investigation of impacts on product market strategies in the wine industry

Jeremy Galbreath
School of Management/Curtin Graduate School of Business
Curtin University
78 Murray Street, Perth 6000 Western Australia
jeremy.galbreath@gsb.curtin.edu.au
+61 8 9266 3568 (phone)

Abstract: Little empirical research has considered the impact of *physical* changes in the climate on firm behaver nor relied on natural stakeholder-based theory (NSBT) to explore such a relationship. For a sample of 2,348 wine firms operating in Australia, this study captures changes in both temperature and rainfall for the year 2012 relative to the year 1982 (30 years), and finds that these climatic changes are positively associated with organic products. Further, because of their sensitivities to the natural environment and positions of influence, the study predicts that women in leadership will moderate the relationship between climatic changes and organic products. This postulate finds support. The study advances research on climate change and the use of NSBT. Contributions of the findings are discussed along with limitations and future research opportunities.

Introduction

While climatic conditions have varied throughout the history of the world (Pierrehumbert, 2010), recent scientific evidence suggests that since the mid-1970s, the global land surface temperature has warmed at a rate about twice the ocean surface temperature and, measured over the last 50 years, the world has warmed at nearly twice the rate of that of the past 100 years (Intergovernmental Panel on Climate Change [IPCC], 2007). Further, scientific evidence demonstrates that global rainfall is changing from long-term averages, with increases or decreases depending on location (IPCC, 2007). Given such evidence, are firms responding to *physical* changes in the climate?

In light the research question, there is some evidence to suggest that firms are responding to the physical manifestations of climatic changes. For example, anecdotally, global drinks giant Coca-Cola Company claims that as result of climate change, "Increased droughts, more unpredictable [weather] variability, [and] 100-year floods every two years" has been economically disruptive to its operations and that "When we look at our most essential ingredients, we see [climate change events] as threats" (Davenport, 2014, p. A1). Alternatively, in their empirical study, Tashman and Rivera (2016) find that due to the impact of the variation in winter snowpack depth, ski resorts are implementing adaptive measures as a response to ecological uncertainties. Yet, according to Tashman and Rivera (2016, p. 1507), "there has been limited attention given to how nature *directly* influences firm behavior" (italics added). Bergmann, Stechemesser, and Guenther (2016) refer to this as the outside-in perspective of the natural environment, a relatively new concept in management science.

Lack of empirical study on whether or not physical changes in the climate directly influence firm behavior leaves gaps in the literature. First, little theory has been tested that empirically links physical changes in the climate to firm behaviour (Bergmann et al., 2016; Tashman & Rivera, 2016). Hence, there is lack of clarity and understanding around why

physical climatic changes would be expected to impact on firm decisions and actions. Second, scholarly interest in climate change has largely focused on firm actions related to mitigation, or firm reductions in greenhouse gases in production processes (Pinske & Gasbarro, 2016). Such research typically includes pollution control technology, end-of-pipe solutions, or green energy. However, relatively little is known if physical climatic changes are systematically impacting on other aspects of business—when climatic changes are expected to impact on all facets of business (Haigh & Griffiths, 2009; Winn, Kirchgeorg, Griffiths, Linnenluecke, & Günther, 2011). Third, managers are cautious with respect to the real impacts of climate change on their businesses and whether and how they should respond (Galbreath, 2014). Lack of empirical evidence undermines management strategies to effectively address the impacts of physical changes in climate.

Motivated by these research gaps, this study makes three contributions. First, this study relies on natural stakeholder-based theory (Haigh & Griffiths, 2009) to advance the literature and test propositions within the context of changes in temperature and rainfall, two of the most prominent features of the study of climate change (IPCC, 2007). Second, a market-based example (cf. Galbreath, 2009a, b) is explored. More specifically, an assessment is made to determine if changes in temperature and rainfall stimulate the development of a consumer product; namely, organic products. Third, there is reason to believe that sensitivity to climate as well as the introduction of organic products could, in part, be attenuated by human agency; i.e., a firm's leaders (Hambrick & Mason, 1984). Given their sensitivity to the natural environment (Diamantopoulos, Schlegelmilch, Sinkovics, & Bohlen, 2003), this study explores women in leadership to determine if they condition the firm to more readily pay attention to climatic changes such that organic products are developed at a greater rate. Lastly, the study makes managerial contributions. As firms confront the impacts of climatic changes (Linnenluecke & Griffiths, 2012; Winn et al., 2011), they need grounded, empirical evidence

to guide strategic decisions and response (Linnenluecke, Stathakis, & Griffiths, 2011; Pinske and &, 2010). Findings here offer insights into the effects of physical changes in climate, and how firms might respond to these changes.

Theory and background

Theoretical frameworks

Recent research seeking to understand how physical changes in climate influence firm behavior has relied on a few key theoretical frameworks. First, Tashman and Rivera (2016) employ resource dependency theory (RDT) (Pfeffer & Salancik, 1978). The main tenet of RDT is that firms cope with the external environment by adapting to their interdependence with other organizations, and the resources they control. Tashman and Rivera (2016) extend RDT to explain uncertainty caused by firms' direct dependence on nature's resources, such as rainfall needed to produce crops. They find that, in the ski industry, environmental uncertainty (in the form of variation of snowpack depth at ski resorts over a previous 10-year period) does appear to predict the adoption of natural-resource-intensive practices.

In their study, Pinske and Gasbarro (2016) rely on the attention-based view of the firm (ABV) (Ocasio, 1997). The ABV seeks to explain why firms pay attention to some stimuli over others, by exploring the selective focus of attention, situated attention, and the formal and informal organizational structures firms use to allocate attention (Ocasio, 1997). Pinske and Gasbarro (2016) examine how oil and gas firms notice and interpret climate change and respond to adapt. They find that for firms to act, there needs to be awareness of the climate as well as perceived vulnerability to climate stimuli. However, their study did not empirically examine the relationship between actual changes in the climate and firm response.

This study extends previous research by relying on an alternative theory, one developed specifically for climate change; namely, natural stakeholder-based theory (NSBT) (Haigh & Griffiths, 2009). Having roots in Starik's (1995) and Driscoll and Starik's (2004) work on the

natural environment, NSBT posits that climate change should have the standing of a primary stakeholder. Following Freeman (1984) and Clarkson (1995), primary stakeholders are those stakeholders who can directly affect, or be affected by, a firm. Stakeholders therefore generally include shareholders and investors, employees, suppliers, communities, governments, and the natural environment (Clarkson, 1995; Starik, 1995; Driscoll & Starik, 2004; Haigh & Griffiths, 2009). Of particular interest here is the natural environment, and specifically climate change.

To give climate change the standing of a primary stakeholder, Haigh and Griffiths (2009) rely on the arguments outlined by Mitchell, Agle, and Wood (1997): primary stakeholders should have power, legitimacy, and urgency. First, climate change is argued to have power because changes in the climate can be disruptive. For example, as noted, the Coca-Cola Company acknowledges that changes in climate are affecting access to critical ingredients. Nike, the athletic apparel manufacturer, acknowledges in its annual reports the yearly impact of climate changes on water supplies (Davenport, 2014). Second, climate change has legitimacy because, as a group with social power (Stinchcombe, 1968), the scientific community have reached a consensus that the planet is warming, and that human activity is the likely cause. Climate change is rooted in scientific discovery and major scientific bodies generally support the scenario of a human-induced warming of the planet (Australian Academy of Science, 2010; IPCC, 2007; National Academy of Sciences, 2008; The Royal Society, 2010). Lastly, climate change has urgency because climatic events (e.g., prolonged droughts) associated with climate change are already affecting business operations (Davenport, 2014; Fenner, 2009; Wahlquist, 2009), and are predicted to increase in the future (Hätel & Pearman, 2010). Hence, Haigh and Griffiths (2009) argue that climate change is a primary stakeholder, one affecting firm operations.

Organic products

Organic products are those products that serve a specific segment of the consumer market (Delmas and Lessem, 2017). To produce organic products, production practices emphasise the use of renewable resources; conservation of energy, soil and water; and environmental maintenance and enhancement, while producing optimum quantities of products without the use of artificial fertiliser or synthetic chemicals and non-essential food additives and/or processing aids (FSANZ, 2009). There has been an increasing demand for organic and inherently 'green' products in the consumer market recent times, which started with solid growth in the 1990s and continues today (Geier, 2006). This is generally attributed to a couple of key reasons.

First, growing consumer concern over some agricultural production methods and a demand for products that they perceive as cleaner and greener has led to an increased demand for organic products. In a more environmentally conscious environment as seen in recent times, people want to look after not only the planet, but also themselves. Worldwide demand for organic products is reported to be increasing rapidly. By example, in the US, sales of organic foods increased from $13.3 billion in 2005 to an estimated $34.8 billion in 2014 (USDA, 2017).

Second, another key driving force behind the current increase in organic products is policy support (Hills, 2009). Not only has the market for organic food grown very fast, which has an enormous impact on production, but governments are becoming increasingly interested and support schemes are being established for the organic market (Hills, 2009). Many developing countries also see organic markets as a way of gaining access to the European and American markets, the largest consumers of organic products. Given the emphasis on consumer markets, this study seeks to determine if changes in climate are a driver of organic products (Figure 1).

Insert Table 1 about here

Hypotheses

Climatic changes are often discussed in terms of their disruptive implications (Bergmann et al., 2016). For example, crop stress from rising temperatures (e.g., Nicholas & Durham, 2012), decreased winter snowpack for tourism operators (Hoffman, Sprengel, Ziegler, Kolb, & Abegg, 2009), and the negative effects of increased flooding on access to ingredients for consumer products companies (Davenport, 2014). Further, according to Winn et al. (2011), virtually every industry will be negatively impacted by climate change, while Weinhofer and Busch (2013) argue that because of the negative impacts, firms need to robustly manage risks from climate change (e.g., ensuring water supplies). Extending these arguments, this paper seeks to determine if climatic changes stimulate the development of products that meet the demands of the consumer market. Not all changes in climate are negative (Galbreath, 2014), and according to Galbreath (2009a, b) and McWilliams and Siegel (2001), firms can address product strategies arising from social issues, such as climate change. In light of such perspectives, the effects of changes in temperature and rainfall on organic products is examined.

Following the logic of Haigh and Griffiths (2009), climatic changes, as manifested in changes in temperature and rainfall, would be expected to have power. Temperature and rainfall are perhaps two of the most studied aspects of climate change (IPCC, 2007) and are perhaps the two most important dimensions of climate change expected to impact on firms (IPCC, 2007; Winn et al., 2011). Reduced snowpack, believed to be a cause of warming temperatures, has led some ski resorts to make greater use of artificial snowmaking machines (Hoffman et al., 2009). Alternatively, less rainfall in some locations is creating concern for agricultural producers, where increased use of irrigation is required (Webb, Whetton, & Barlow, 2007; Webb, Whetton, Bhend, Darbyshire, Briggs, & Barlow, 2012). However, as

changes in temperature and rainfall are manifested, proactive firms may be stimulated to not only adapt (or mitigate), but to develop new products that address these physical changes as well as serve new market segments. Organic products, for example, not only reduce environmental impacts given their means of production, but also serve segments of the market where consumers desire more naturally-produced, environmentally-friendly products (Delmas & Lessem, 2017; McWilliams & Siegel, 2001; Wheeler & Crisp, 2009). In this sense, changes in temperature and rainfall may induce power over firms in that they not only respond through adaptive or mitigative actions, but by engaging in alternative product strategies in order to exploit new consumer market segments.

With respect to legitimacy, in May 2013, the daily mean concentration of carbon dioxide in the atmosphere exceeded 400 parts per million for the first time in recorded history—a demonstration of human activities' impact on climate change according to Carrington (2013). Linked to emissions are temperature and rainfall records. For example, based on scientific inquiry, the earth is warming, specifically as relative to temperatures 100 years ago (IPCC, 2007). Since the mid-1970s, the global land surface temperature has warmed at a rate about twice the ocean surface temperature and, measured over the last 50 years, the world has warmed at nearly twice the rate of that of the past 100 years (IPCC, 2007). Further, changes to rainfall patterns in the last 100 years have varied (IPCC, 2007). For example, increases in rainfall have been documented in North and South America, northern Europe, and northern and central Asia (IPCC, 2007). Alternatively, in the Mediterranean, southern Africa, and parts of southern Asia, the documented scientific evidence demonstrates less rainfall (IPCC, 2007). Over the last 50 years, the scientific evidence suggests that the frequency of heavy rainfall events have increased over most areas (IPCC, 2007). Climate change is therefore rooted in scientific discovery and although there are detractors and skeptics, the major scientific bodies generally support the scenario of a human-induced warming of the planet (Australian Academy of

Science, 2010; IPCC, 2007; National Academy of Sciences, 2008; The Royal Society, 2010). Hence, climate change is argued to have legitimacy.

When a stakeholder has legitimacy, firms are expected to take action. According to Mitchell et al. (1997, p. 878), stakeholders who have legitimacy give managers a "…clear and immediate mandate to attend to and give priority to that [stakeholder]". Following Haigh and Griffiths (2009), the natural environment is a primary stakeholder because of climate change, and therefore not responding or actively engaging in ways that demonstrate actions towards climatic changes could lead to the loss of social legitimacy (Kramer & Porter, 2011). While response and actions could be related to adaptive measures (Bergmann et al., 2016), some firms may see changes in climate as a signal to develop new products that can expand their scope to new markets and serving new customer segments.

Lastly, urgency reflects the degree to which an issue requires immediate attention (Mitchell et al., 1997). Although there is debate as to whether or not slowly unfolding, incremental facets of climatic changes are urgent (e.g., Driscoll & Starik, 2004; Galbreath, 2014), some recognize that events related to climate change, such as extreme weather and the implications of disrupting the thermohaline circulation, do require immediate attention (Arnell, 2006). Further, there is belief that climate change does have urgency because events associated with climate change (e.g., droughts, extreme heat, floods) are already affecting business operations (Fenner, 2009; Wahlquist, 2009), and are predicted to increase in the future (Hätel & Pearman, 2010). Given that firms are profit maximizers (Fama & Jensen, 1983), at least some firms would be expected to reply to signals in the external environment, appropriately adjusting their strategies and taking immediate action to respond to capitalize on consumer market opportunities. Thus, based on NSBT, factoring the power, legitimacy, and urgency of climate change:

Hypothesis 1: Changes in temperature are associated with organic products.

Hypothesis 2: Changes in rainfall are associated with organic products.

Contingent factors: Women in leadership

The extent to which firms market organic products in response to climatic changes may depend on the strength of leadership within those firms. As firm leadership more clearly recognizes the impacts of climatic changes, and seeks to take a proactive stance, firms may feel even greater need to respond through initiatives such as organic products. In particular, women in leadership would be expected to strongly influence actions related to climatic changes. For example, women tend to be more sensitive to environmental issues than men (Diamantopoulos et al., 2003), express higher levels of concern than men about environmental risks (Davidson & Freudenburg 1996), and have been found to express significantly greater awareness of, and sense of perceived impacts from, climate change than men (Davidson & Haan 2012).

Women also have more of a relational orientation than men (Eagly, Johannesen-Schmidt, & van Engen, 2003; Wood and Eagly 2009). Hence, women in leadership roles may be more willing to build relationships with a broader set of firm stakeholders, or at least to expend the effort required to better understand these stakeholders' interests (Rosener, 1995). Ultimately, due to their broader stakeholder focus, and empathy and concern about the well-being of others (Learned, 2011; Wood & Eagly, 2009), this could lead women in leadership to more carefully take into account the natural environmental and actions that respond to it, as the natural environment is considered a primary stakeholder (Haigh & Griffiths, 2009; Starik, 1995; Starik & Starik, 2004).

As women in leadership have power and authority to influence and shape firm decisions (Hambrick & Mason, 1984), given that they appear to be more attuned to the natural environment than men, they would be expected to more readily advocate to take actions that respond to the impacts of climatic changes, including the impact of changes in temperature and rainfall. Therefore:

Hypothesis 3: Women in leadership moderate the relationship between changes in temperature and organic products.

Hypothesis 4: Women in leadership moderate the relationship between changes in rainfall and organic products.

Methods

Sample and data collection

This study is part of an on-going research program on climate change and the wine industry conducted over many years by the author. The wine industry is well-suited for this particular study as climate change is already thought to be affecting business operations (Fenner, 2009; Fleming, Richards, & Dowd, 2015; Galbreath, 2011, 2014; Wahlquist, 2009; Webb et al., 2007; Webb et al., 2012). Data were collected in two parts. First, data on temperature and rainfall was collected during the years 2012 and 2013. Second, with data on climatic changes completed, data on dependent, moderating, and control variables were then collected in 2014 and merged with the temperature and rainfall data. Temperature and rainfall data were collected from the Australian Bureau of Meteorology (http://www.bom.gov.au). Data on organic products, women in leadership, and the control variables were collected from the Winetitles annual Australia and New Zealand Wine Industry Directory database, Australia's most extensive and comprehensive source for information related to the wine industry.

The initial sample consisted of 2,574 wineries operating across Australia. Two hundred and twenty six firms were eliminated because they were in locations which lacked data availability on temperature and rainfall. Thus, the final sample consisted of 2,348 wine firms. To test for sampling bias, the eliminated firms were compared to those in the sample on the key variables of firm size, firm age, export percentage, and women in leadership, and no differences were found. Hence, sampling bias is not likely to be present.

Dependent variable

Organic products are products that meet a specific niche in the market; namely, green consumer markets (Galbreath & Benjamin, 2010; Geier, 2006; Wheeler & Crisp, 2009). To measure whether or not firms offer organic products, the Winetitles database was used. Winetitles captures each firm's product offerings with respect to organic wine, where a firm with such an offering is designated as true, false otherwise. For the empirical study, if a firm offered organic product, they were coded 1, 0 otherwise. Data for this variable was collected for the final year the change in climate was taken, 2012, and for the years 2013 and 2014, to account for any lagged effects ($t + 2$). The average of the three years was then calculated for inclusion in the regression models.

Independent and moderating variables

Temperature (in Celsius) and rainfall (in millimetres) data were collected for firms based on location. More specifically, wine firms within Australia are classified by geographic indication (GI) zones. A GI zone is a geographic location of origin. To achieve the most appropriate spatial relevance and to capture the climatic effects, firms were classified according to their GI zone. After accounting for firms eliminated from the sample due to lack of weather data, in all, there were 29 GI zones.

To determine changes in temperature and rainfall, the minimum baseline timeframe for examining climatic changes has been recommended as 30 years by the World Meteorological Organisation.[1] Hence, temperature and rainfall data were collected from the Australian Bureau of Meteorology website, based on the weather station in each of the 29 GI zones which contained complete information for the years studied. To calculate the change (Δ) in temperature and rainfall, the annual mean for 1982 was subtracted from the annual mean for

[1] See http://www.wmo.int/pages/prog/wcp/ccl/faq/faq_doc_en.html.

2012 (30 years). Each firm in each relevant GI zone was assigned its respective change in both temperature and rainfall.

As a proxy for women in leadership, women who lead a firm's marketing efforts were examined. Those who lead a firm's marketing efforts are critical because they detect and absorb trends and external signals, provide input into new product development, market and promote products, and help generate the revenue streams that sustain the business (Germann, Ebbes, & Grewal, 2015). Hence, women who head a firm's marketing efforts can be considered leaders. For measurement, the Winetitles database was used. If a firm had a woman listed as head of marketing, they were coded 1, 0 otherwise.

Control variables

The size of the firm could determine whether or not firms develop organic products as larger firms tend to have more resources to invest in new products and innovation (Delmas & Lessem, 2017). Size of the firm was determined by examining the number of cases of wine produced, where 1 = up to 2,499 cases produced, 2 = 2,500 to 19,999 cases produced, 3 = 20,000 to 99,999 cases produced, 4 = 100,000 to 1,499,000 cases produced, and 5 = 1,500,000 cases or more produced. Second, not all firms produce all of their own grapes, which could impact on the extent of their engagement in producing organic products. Grape tonnage harvested was measured where 1 = 99 tonnes or less, 2 = 100 to 999 tonnes, 3 = 1,000 to 4,999 tonnes, 4 = 5,000 to 19,999 tonnes, and 5 = 20,000 tonnes or more, assessed by examining the Winetitles databased for each firm. Third, older firms may have temporal orientations that affect response to climate change (Slawinski & Bansal, 2015). Firm age was controlled for by examining company websites to determine the year the winery was founded, and then calculating the age.

Other control variables include export intensity and organic vineyards. For example, firms that export more may face greater pressures to introduce products that address environmental issues such as climate change (Galbreath, 2017). Hence, fourth, for export

intensity, firms were coded on the basis of their annual percentage of export sales, where 1 = do not export, 2 = 1 to 25 percent, 3 = 26 to 50 percent, 4 = 51 to 75 percent, and 5 = 76 to 100 percent. Export orientation was sourced from the Winetitles database. Fifth, organic wine is produced from grapes grown in organic vineyards. Whether or not firms had their vineyards certified organic was captured, where an external organization assesses and certifies that organic growing processes have met certain standards (Delmas & Lessem, 2017). Firms were coded 1 for certified organic vineyards, 0 otherwise. Certification was determined by relying on the Winetitles database, which captures this data point. Lastly, changes in climate may be location specific (IPCC, 2007). Therefore, 29 GI zone dummy variables were created to account for any location effects.

Results

Means, standard deviations, and correlations are presented in Table 1. Although there are some correlations between the independent variables, none are above .80, indicating that multicollinearity is not likely present (Licht, 1995). However, as a check, variance inflation factors (VIF) and tolerance values were calculated. The highest VIF was 5.42 and the lowest tolerance value was .31. These values suggest that multicollinearity was not likely present (O'Brien, 2007).

Insert Table 1 about here

To test the hypotheses, moderated regression analysis was employed (Table 2). Moderated hierarchical regression analysis is used to determine R^2 changes, which aids in interpreting the impact of model fit and significance for both the independent and moderating variables (Baron & Kenny, 1986). In Step 1, the control variables were entered; in Step 2, the independent variables were added; and in Step 3, the interaction variables were added. Significant interaction indicates a moderating effect (Baron & Kenny, 1986). Hypothesis 1

posits that changes in temperature are associated with organic products. As shown in Model 2, there is support for this hypothesis, as changes in temperature is significantly associated with organic products ($\beta = 0.54$; $p < 0.001$).

Insert Table 1 about here

Hypothesis 2 posits that changes in rainfall are associated with organic products. Model 2 suggests that there is support for this hypothesis, as the relationship between changes in rainfall and organic products is significant ($\beta = 0.47$; $p < 0.001$). As for the moderation effects, Hypotheses 3 and 4 state that women in leadership will moderate the relationship between changes in temperature and rainfall and organic products. As demonstrated in Model 3, the interaction between changes in temperature and women in leadership is positive and significant ($\beta = 0.23$; $p < 0.01$), indicating moderation. Similarly, the interaction between changes in rainfall and women in leadership is also significant ($\beta = 0.20$; $p < 0.05$), demonstrating a moderating effect. Hence, the results suggest support for both Hypothesis 3 and 4. To help interpret these findings, the interaction terms are plotted in Figures 2 and 3.

Insert Figure 2 about here

Insert Figure 3 about here

Robustness checks

The robustness of the results was assessed. There is the possibility that firms who previously demonstrate the sales of organic products could influence results in the current time period. Hence, for this test, whether or not firms in the previous year demonstrated the sale of organic products was sourced from the Winetitles database. After accounting for the previous year effects of organic products ($t - 1$), the results remain substantively unchanged. Both

temperature (β = 0.51; $p < 0.001$) and rainfall (β = 0.45; $p < 0.001$) changes still have a significant effect, while the interaction terms (β = 0.20; $p < 0.01$ and β = 0.17; $p < 0.05$, respectively) are also significant.

Second, women in leadership, apart from the marketing role, could also influence the results. For example, winemakers are involved in all aspects of the technical side of making wine including crushing and pressing grapes, fermentation, filtering, quality control, and new product development such as new blends (Unwin, 1991). Hence, winemakers could have influence over the development (and sales) of organic products. The gender of winemakers was determined by relying on the Winetitles database, and recoded for each firm were 1 = woman winemaker, 0 otherwise. The results are somewhat similar. Temperature change (β = 0.52; $p < 0.001$) and rainfall change (β = 0.44; $p < 0.01$) are significant, while the interaction terms are also significant. For temperature, the interaction term demonstrates strength in significance (β = 0.19; $p < 0.05$), while for rainfall there is modest significance (β = 0.15; $p < 0.10$). Hence, even with alternative models, the results essentially corroborate the main findings.

Discussion

The focus of this article was to explore under if the physical effects of climate change impact on firm actions. The results suggest that changes in both temperature and rainfall, measured over several decades, do appear to impact on firm actions; namely, on the extent to which firms offer organic products. Following calls to further research on climatic changes in management science (Bergmann et al., 2016; Galbreath, 2014; Pinske & Gasbarro, 2016; Tashman & Rivera, 2016), this study makes a few key contributions to the literature.

First, the study contributes to theory. Previous studies have largely relied on theoretical frameworks that examine external influences, such as resource dependence, and internal factors, such as attention-directing structures, to explain how climate change might affect firm actions and decisions. For example, because firms are believed to be dependent upon natural

resources and ecosystem services provided by nature, if they perceive uncertainty with respect to the natural environment, they could act to adapt to changing conditions (Tashman & Rivera, 2016). Alternatively, as decision makers have structures in place that focus their attention on stimuli from the environment, and particularly climate change, they are more apt to take action (Pinske & Gasbarro, 2016). Following Haigh and Griffiths (2009), the present study posits that climate change is a primary stakeholder. In this sense, direct, physical climatic changes, such as those manifested in temperature and rainfall, effect the firm in that they are expected to have power, legitimacy, and urgency. Here, firms respond to the effects of power, legitimacy, and urgency (Mitchell et al., 1997). The findings do suggest that climatic changes (temperature, rainfall) are associated with firm action, in the form of organic products, and thus provides one of the first empirical tests of natural stakeholder-based theory (NSBT).

Second, previous studies in the literature have attempted to investigate contingencies in the relationship between climate and firm behavior. For example, in their study, Tashman and Rivera (2016) examine the moderating role of *external*, institutional pressures (DiMaggio & Powell, 1983). They find that external, institutional pressures do have a moderating effect on the relationship between ecological uncertainty (as measured by variation in winter snowpack depth) and ecological adaptation and mitigation. This study extends their findings by considering *internal*, human agency. More specifically, there is a view that the will of human agents account for, at least in part, firm decisions beyond the passive acceptance of external, institutional pressures (e.g., Galbreath, 2017). In the case here, due to their traits, characteristics, cognitive frames, and sensitivities towards the natural environment, women leaders would be expected to more readily recognize climate change, leading to a strengthening of the impact of climatic changes on the adoption of organic products. The findings of this study suggest support for such a postulate, thereby contributing to new knowledge with respect

to the role that contingent factors may play on the relationship between climatic changes and firm outcomes.

Lastly, there are practical contributions. Climate change remains an often discussed—if not contested—issue among governments, citizens, and businesses. According to NSBT (Haigh & Griffiths, 2009), and the predecessor, stakeholder theory (Freeman, 1984; Mitchell et al., 1997), not taking action on climate change could result in a loss of reputation, resources, and sustainability. As discovered here, over the time period studied, there have been physical changes in both temperature and rainfall. Responding through both mitigative and adaptive actions is a possibility; however, so are actions that serve new or growing consumer segments, such as the segment for organic products. Because organic products both demonstrate sensitivity to the natural environment through modified productions techniques, but also serve a real market need, firms should consider climatic changes in their local contexts, and how they can better serve customer target segments as a means to respond to changes in the natural environment.

Limitations and future research

This study is not without limitations. The main effects test is limited in that changes in temperature, rainfall, or organic products are not captured through time series, panel data. However, capturing or detecting changes in climate for anything less than 30 years could be problematic, as noted, the minimum baseline timeframe for examining climatic changes has been recommended as 30 years by the World Meteorological Organisation. Because of limited access to data, particularly with respect to organic products, the study instead relied on changes in temperature and rainfall by considering a cross-sectional, 30-year period (Δ from 1982 to 2012). Future studies could explore long time series (panel) data and others types of firm outcomes. Second, only the wine industry is studied, an industry particularly susceptible to weather (Fleming et al., 2015; Webb et al., 2007; Webb et al., 2012). Future studies could

explore other industries, for example, consulting or education, where the physical impacts of climate change could be less severe. In this way, a better understanding of how climatic changes impact firm behavior could be expanded. Lastly, this study examines only women in leadership as a contingent variable. Future studies could explore further internal and external contingencies to determine what factors might strengthen—or weaken—the relationship between climatic changes and firm behavior and outcomes.

Conclusion

In conclusion, limited research has studied the impact of physical changes in climate on firm behavior (Tashman & Rivera, 2016)—the so-called outside-in approach (Bergmann et al., 2016). This study examines the impact of changes in both temperature and rainfall on the adoption of organic products. The findings suggest that changes in temperature are associated with organic products. Similarly, changes in rainfall are also associated with organic products. Further, accounting for human agency, women in leadership positively moderate the relationship between changes in temperature and rainfall and organic products. The findings advance the study of climate change and NSBT, and provide a pathway for future research in the field.

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TABLES

Table 1. Descriptive and correlations

Variable	Mean	*SD*	1	2	3	4	5	6	7	8	
1. Organic product	.06	.23	1.00								
2. Case production range	1.65	.79	.02	1.00							
3. Tonnage range	1.37	.70	.05*	.14**	1.00						
4. Export intensity	2.16	1.07	.04	.49**	.41**	1.00					
5. Firm age	22.32	23.96	.00	.19**	.20**	.05*	1.00				
6. Organic vineyard certification	.03	.17	.44**	.00	-.03	-.01	.01	1.00			
7. Temperature change 2012 -1982 (Celsius)	.50	.64	-.02	.01	-.03	.03	-.01	-.04*	1.00		
8. Rainfall change 2012 -1982 (mm)	104.30	176.44	.01	.04	.06**	.11**	-.09**	.03	-.63**	1.00	
9. Women in leadership	.54	.50	.04	-.16**	-.15**	-.12**	-.01	.02	-.00	-.02	1.00

* $p < 0.05$; ** $p < 0.01$

Table 1. Regression analysis

Variables	Model 1 Control variables	Model 2 Direct effects	Model 3 Interaction effects
	β	β	β
Case production range	0.04	0.08	0.08
Tonnage range	0.17†	0.15†	0.15†
Firm age	-0.03	-0.11	-0.11
Export intensity	-0.01	-0.05	-0.05
Organic vineyard certification	0.81***	0.79***	0.79***
Location dummies	Yes	Yes	Yes
Temperature change		0.54**	0.55***
Rainfall change		0.47**	0.49**
Women in leadership		0.04	0.05
Women in leadership x temperature change			0.23**
Women in leadership x rainfall change			0.20*
R	0.807	0.840	0.856
R^2	0.651	0.706	0.733
F	21.72***	17.86***	16.23***
ΔR^2		0.055**	0.027*

n = 2,348 firms

† $p < 0.10$

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

FIGURES

Figure 1. Conceptual model

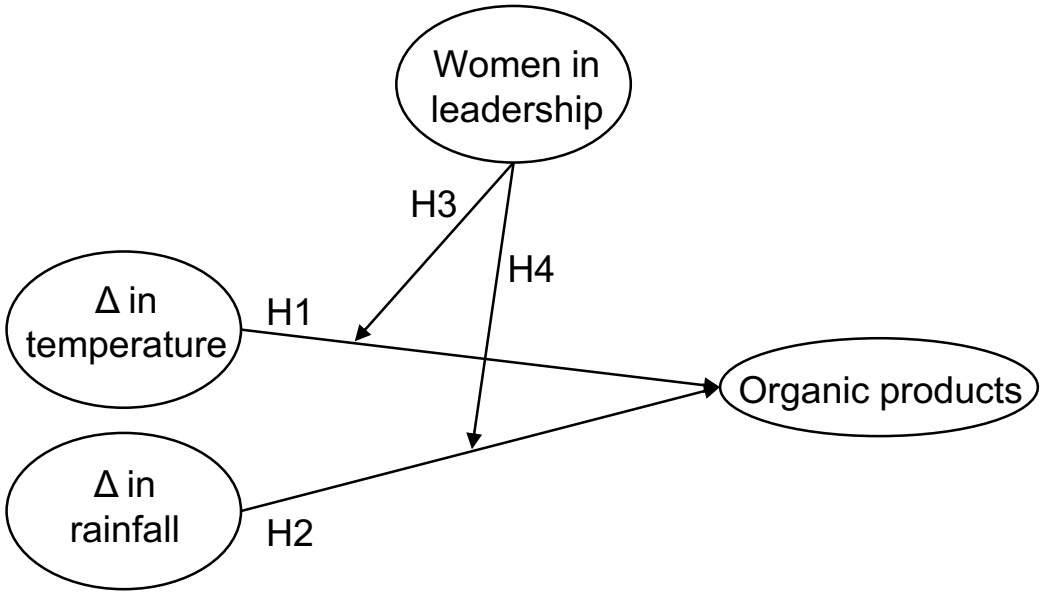

Figure 2. Plot analysis: Temperature change x women in leadership

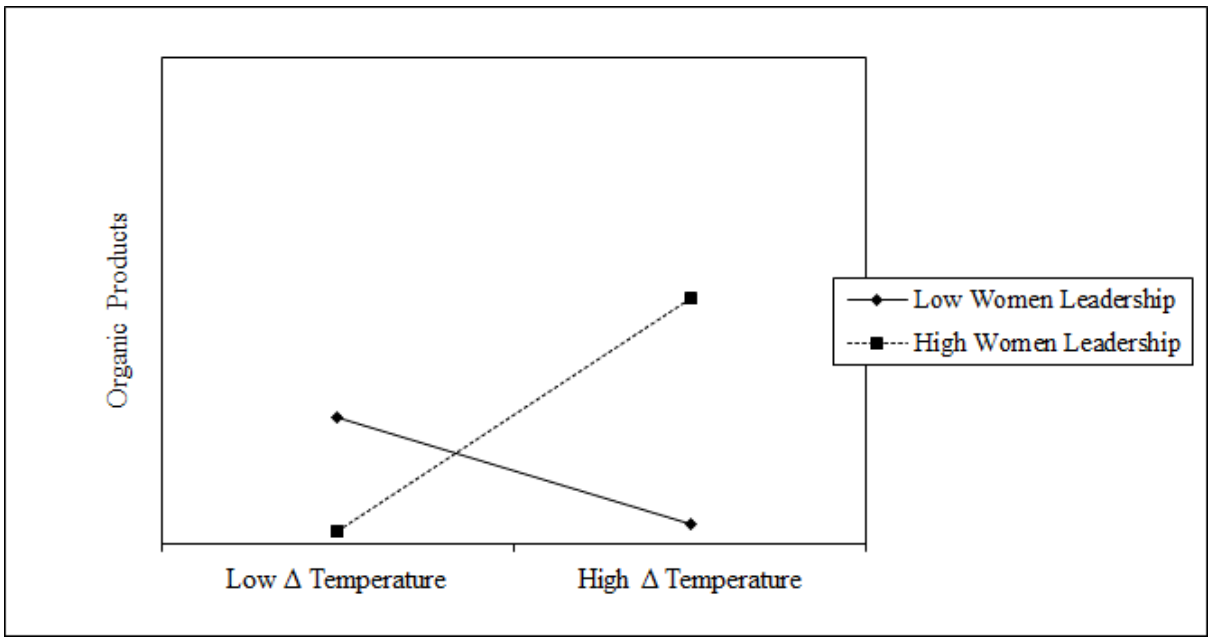

Figure 3. Plot analysis: Rainfall change x women in leadership