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Costa, L., Teixeira, A. & Brochado, A. (2021). Determinants of consumers' frugal innovation acceptance in a developed country. *Young Consumers*. 22 (2), 185-201

Determinants of Consumers' Frugal Innovation Acceptance in Developed Countries: a Partial Least Squares Structural Equation Model

Abstract

Purpose: This study sought to understand why young people are interested in buying frugal innovations.

Design/methodology/approach: Data were collected with a survey administered to 534 university students enrolled in various fields of study (e.g., sciences, technology, economics, and fine arts). Using the Tata Nano car as an example of frugal innovation, a model based on the unified theory of acceptance and use of technology was developed using partial least squares structural equation modeling.

Findings: The model's results reveal that effort expectancy, performance expectancy, and facilitating conditions are critical factors that explain university students' intention to buy the Tata Nano.

Originality: Although frugal innovations are often introduced first in developing countries, frugal innovations could be highly relevant to users in developed nations since these innovations can provide market opportunities in terms of cost-conscious, relatively low-income, and sustainability-conscious consumers.

Keywords: frugal innovation, unified theory of acceptance and use of technology, partial least squares structural equation modeling, developed countries.

Article classification: Research paper

Introduction

The world's population is growing exponentially, which means the planet is running out of resources (Prahalad *et al.*, 2016; Sobottka *et al.*, 2020) as they are being consumed at a much higher rate. This trend means the Earth could become unsustainable for future generations. The pursuit of more sustainable forms of growth explains in part the emergence of frugal innovations (Kroll and Gabriel, 2020).

Frugal innovations were first introduced in developing and emerging countries, but these advances can also be highly relevant to users in developed countries (Winkler *et al.*, 2020). According to Knorrinda *et al.* (2016), cutting costs while safeguarding user value could create opportunities for new business models and potentially disrupt traditional innovation processes throughout entire economies. Frugal products and services could specifically provide market opportunities in terms of low-budget and sustainability-conscious consumers in developed countries (Immelt *et al.*, 2009; Kroll and Gabriel, 2020; Winkler *et al.*, 2020).

Studies of frugal innovation are not abundant, but this field is rapidly expanding (Hossain, 2018; Angelo and Magnusson, 2020; Santos *et al.*, 2020). The bulk of the literature deals with theoretical concepts and definitions of frugal innovation, with only a few researchers focusing on applications of frugal innovation in specific areas. The most widely adopted perspective has been a focus on developing countries, but more recent studies (e.g., Agarwal *et al.*, 2017; Kroll and Gabriel, 2020) have called for further research on users' viewpoints in developed countries. Hossain (2020), for example, asserts that frugal innovation diffusion in developed nations is an underresearched area.

Various frugal innovations have been transferred from developing to developed countries and turned into reverse innovations (Hossain, 2018). More economical innovations that come to developed countries and achieve commercial success are being considered by many companies operating in developing countries, such as General Electric, Siemens, and Procter and Gamble (Hossain, 2013). Thus, quality products for low-income consumers are likely to become widely “available not only in developing countries but also in developed countries” (Hossain, 2013, p.2). If these companies’ concomitant business strategies and models are to be successful, researchers need to ascertain whether final users and/or customers are prone to adopting these firms’ frugal products and services.

A review of the literature conducted for the present study produced no evidence of empirical research on users’ propensity in developed countries to adopt frugal and/or reverse innovations. Thus, this research sought to assess these users’ propensity to accept and/or adopt this type of innovation in developed nations, as well as this tendency’s main determinants. To answer the calls for further research (Agarwal *et al.*, 2017; Molina-Maturano *et al.*, 2020), the current study applied a technology acceptance model (TAM) to a frugal innovation based on the theoretical framework of the unified theory of acceptance and use of technology (UTAUT) (Venkatesh *et al.*, 2003). According to Williams *et al.* (2015), this theory posits that:

[P]erformance expectancy, effort expectancy, social influence and facilitating conditions ... are direct determinants of behavioural intention and ultimately behaviour... [, which facilitates] assess[ments of each] ... individual’s intention to use a specific system, thus allowing for the identification of the key influences on acceptance in any given context. (p.444)

The present study specifically focused on two research questions:

1. Are young consumers in developed countries likely to buy frugal innovations previously created for bottom of the pyramid (BOP) markets?
2. What are the main determinants of frugal innovation adoption by young consumers in developed nations?

To address these objectives more closely, this paper is organized as follows. Section two reviews the relevant literature on frugal and reverse innovation and presents the analyses' theoretical framework. Section three details the methodology used to conduct the analyses. Section four describes and discusses the empirical research's results. In the final section, the main contributions are presented along with their policy implications, the study's limitations, and paths for future research.

Review of literature on frugal innovation and related determinants of acceptance

Discussion of frugal innovation

Frugal innovation is based on a user-centric approach (i.e., applied to specific market segments) that creates more value at a lower cost to reach a greater number of people (Agarwal *et al.*, 2017). This type of innovation offers varied benefits, such as simplicity, affordability, and environmental sustainability (Simula *et al.*, 2015). Frugality strategies are needed in innovation because reducing prices means companies can reach a larger volume of users and thus obtain higher profits (Prahalad *et al.*, 2016). Prahalad *et al.* (2016) contend that frugal innovation has become the main driver of emerging markets' economic growth.

Since 2012, this form of innovation has received significant attention from academic researchers because of its high economic potential and increased application by businesses (Nakata and Weidner, 2011; Zeschky *et al.*, 2011; George *et al.*, 2012). According to Weyrauch and Herstatt (2017), the criteria for classifying an innovation as frugal needs to be universal. After examining a wide range of definitions, the cited authors carried out a study

based on pattern coding to identify the most universal criteria (see Table I for some of these definitions of frugal innovation).

Insert Table I near here

Weyrauch and Herstatt (2017) propose that three main criteria be used to classify innovations as frugal: substantial cost reduction, optimal performance level, and focus on core functionalities. Von Janda *et al.* (2020) subsequently developed an index of product frugality with four dimensions: consumption costs, sustainability, simplicity, and basic quality. Frugal innovation thus reflects new or significantly improved products, services, or systems created in resource-constrained contexts. Due to this scarcity of resources, frugal innovation focuses on cost reduction and core functionalities (e.g., sustainability) but seeks to avoid compromising quality (e.g., an optimal performance level).

Constraint-based innovation has generated a range of related concepts. Besides frugal innovation, other relevant forms of innovation include, among others, jugaad innovation, Gandhian innovation, catalytic innovation, grassroots innovation, indigenous innovation, and reverse innovation. These concepts share some characteristics with frugal innovation that revolve around affordable solutions (see Table I above). Frugal innovation initially started mainly as a way to serve consumers with affordability constraints, that is, BOP individuals (see Hossain [2020] for an overview of frugal innovation cases).

Frugal innovation trend: from developing to developed markets

Emerging markets are becoming more economically dynamic, and part of this growing vitality is due to frugal innovation (Prahalad, 2006). Berger (2013) predicted that frugal products and services were going to double their global market share by 2018. The cited author also suggests that developed countries have a quite competitive position in high-end markets but a weak or almost non-existent position in low-end markets. In addition, Berger

(2013) expects the latter markets to grow in the future due to environmental, demographic, economic, and social changes.

Frugal innovations' potential benefits for developed countries have translated into market realities labeled "Frugal 3.0" by Tiwari *et al.* (2016). Frugal products and services developed for emerging economies can also provide opportunities in terms of cost-conscious or relatively low-income consumers in developed countries (Immelt *et al.*, 2009). Various authors (e.g., Cunha *et al.*, 2014) contend that developed markets need to follow this growing trend in order to respond to emerging consumer demands, namely, learning how to do more with less.

The frugal innovation paradigm is thus essential to meet future sustainability challenges and create appropriate value chains. These chains are generated when business contexts shift (Rosca *et al.*, 2017) due to environmental, demographic, economic, and social changes. Regarding environmental aspects, the most important issue is global warming, so the amount of materials used must be reduced to decrease emissions and water and energy consumption (Rosca *et al.*, 2017). To meet the climate targets set by the Paris Agreement, developed countries need to modify their production and consumption patterns (Winkler *et al.*, 2020).

Relevant demographic changes include that populations are aging faster, which means consumers tend to be less interested in more expensive products or services with multiple functionalities that seniors are not going to use. Instead, they are more likely to prefer simple, easy to use, and cheaper products (Rosca *et al.*, 2017). At an economic level, the most recent financial crisis decreased people's purchasing power, so businesses should follow circular and sharing economy principles (Rosca *et al.*, 2017). Finally, social changes include growing concerns about improving standards of living (Rosca *et al.*, 2017).

Frugal innovations could diffuse from developing to developed markets (Hossain, 2020). Although a potential market for these innovations exists in developed countries, it might not yet translate into market demand (Kroll *et al.*, 2015). Winkler *et al.* (2020) argue that, for frugal innovations to succeed as products in developed nations, these innovations need to meet Weyrauch and Herstatt's (2017) optimal performance criterion by adapting to match user-specific characteristics (e.g., personal, market, or legal requirements).

Theoretical framework: UTAUT

To analyze consumers' acceptance of and/or intention to buy frugal innovations in developed countries, the present study adapted the selected TAM to assess frugal innovation acceptance. How technologies are perceived influences individuals' intention toward and actual use of these products (Holden and Karsh, 2010). TAMs have only recently become an important theoretical tool (Holden and Karsh, 2010), but this type of model was originally proposed in the 1980s to explain why workers were not using the available information technologies (Davis, 1989). The first TAM has evolved into an updated model—TAM2 (Venkatesh and Davis, 2000)—and subsequently a new model—the UTAUT (see Figure 1). As the latter unifies all previous TAMs, it served as the current research's framework.

Insert Figure 1 near here

The UTAUT model explains behavioral intentions to use specific information systems, namely, each "individual's motivation or willingness to exert effort to perform the target behavior" (Holden and Karsh, 2010, p.160). This intention is a proxy for the actual use of a given technology, which is "the action, specific or general, whose prediction is of interest" (Holden and Karsh, 2010, p.160). Intention to use is based on four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions.

Performance expectancy is the "degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh *et al.*, 2003,

p.447). Technologies must be perceived as useful (Gupta *et al.*, 2008) to generate individuals' intention to buy and use these products (Tsai *et al.*, 2007). Technologies also have to meet individuals' needs while performing tasks (Brandon-Jones and Kauppi, 2017), thereby enhancing their job performance (i.e., job fit) (Thompson *et al.*, 1991). In addition, innovative technologies need to have a relative advantage when compared to those that already exist in the market (Moore and Benbasat, 1991).

Some empirical studies have found proof of a positive relationship between performance expectancy and user intention. Chiou and Fang (2005) concluded that, when websites are updated with useful information, users are more willing to use those websites. Verma and Sinha (2018) also confirmed that individuals' performance expectancy of mobile agricultural extension services is positively related with these users' intention to use. Thus, this relationship was incorporated as the present study's first hypothesis:

H1: Performance expectancy is positively related to frugal innovation adoption (i.e., intention to use and/or buy) in developed countries.

Effort expectancy is the "degree of ease associated with the use of the system" (Venkatesh *et al.*, 2003, p.450). Technologies must be easy to use (Pahnila *et al.*, 2011), which occurs when technologies are effortless, clear, understandable, and flexible (Holden and Karsh, 2010). Complexity should, therefore, be minimized so that it does not compromise ease of use.

Empirical research has provided evidence that usability is a key predictor of intention to adopt. Choi *et al.* (2014) found proof of this in studies of intent to recommend mobile devices. Chen *et al.* (2008) also confirmed effort expectancy's importance in public electronic services. However, this variable was not a statistically significant factor in users' adoption of knowledge repository systems (Tsai *et al.*, 2010) or an e-pharmacy application in Turkey

(Alasehir *et al.*, 2013). Despite these somewhat conflicting results, the current research included the following hypothesis:

H2: Effort expectancy is positively related to frugal innovation adoption (i.e., intention to use and/or buy) in developed countries.

Social influence is the “degree to which an individual perceives that important others believe he or she should use the new system” (Venkatesh *et al.*, 2003, p.451). Various researchers have suggested that, for users to adopt technologies, others’ opinion about these products’ use is extremely important (Pahnila *et al.*, 2011). People tend to be influenced by normative expectations among individuals in their reference group (Verma and Sinha, 2018). According to classic comparison theory, people normally compare themselves to their reference group, which is composed by those who are similar and familiar, such as friends, family, neighbors, and coworkers (Verma and Sinha, 2018). In some cases, consumers are influenced by what other people outside their reference group do and think consumers should do. Social influence is thus quite important during the early stages of specific technologies’ adoption (Swinerd and McNaught, 2015).

Lin and Lu (2015) confirmed that social influence has an impact on users’ intention to use mobile social networking sites. However, other studies have found that social influence is not a significant factor in terms of predicting consumers’ intention to use, as was true, for example, in the case of mobile phones connected to farmers’ agricultural activities in Uganda (Lwasa *et al.*, 2013). The present study, nevertheless, tested the following hypothesis:

H3: Social influence is positively related to frugal innovation adoption (i.e., intention to use and/or buy) in developed countries.

Facilitating conditions are defined as the “degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (Venkatesh *et al.*, 2003, p.453). Consumers must have access to the knowledge and resources needed to

use technologies. This factor comprises the perceived importance of infrastructure that supports systems' utilization (Dwivedi *et al.*, 2017). This relationship was encapsulated by the current research's last hypothesis:

H4: Facilitating conditions are positively related to frugal innovation adoption (i.e., intention to use and/or buy) in developed countries.

To summarize, individuals' willingness to adopt frugal innovations depends on affordability and how well the products or services can fulfill users' needs and maintain an optimal level of performance (i.e., performance expectancy). Frugal innovations focus on core functionalities (i.e., the essentials), so these products must be simple and easy to understand and use (i.e., effort expectancy). In emerging countries, social influence is most likely less fundamental to individuals' intention to use frugal innovations given that these are made to address unmet needs in low-end markets. That is, innovations have to be frugal so that consumers can afford them. However, in developed countries, social influence might have a stronger impact on individuals' intention to use. Consumers also only develop intentions to use and/or buy if these individuals feel they have the required knowledge and resources to use these products (i.e., facilitating conditions).

Methodology

Partial least squares structural equation modeling (PLS-SEM) (Hair *et al.*, 2017) was selected as the data analysis methodology for its compatibility with the theoretical framework. This technique has been widely used in studies of consumers' intention to purchase specific goods and service (e.g., Amaro and Duarte, 2015; Thananusak *et al.*, 2017; Hew *et al.*, 2018), but PLS-SEM has never been applied to users' intention to buy frugal innovations.

The present study's target population was university students enrolled in various degree programs at the University of Porto (UP). This segment (number = 10,144) was

deemed suitable because students are usually not financially independent since most depend on their parents—at least at the undergraduate level. Nonetheless, students are seen as trend setters and early adopters (Gill, 2012) who generally tend to be sensitive to environmental issues and increased resource constraints (Immelt *et al.*, 2009), which makes these individuals more cautious in their purchases. University students also have low earned incomes (Martins *et al.*, 2018), are sensitive to sustainability issues (Rosentrater and Burke, 2018), and have—or are close to Portugal’s minimum age to get—a driver license. These characteristics mean they are potential users of the frugal innovation in question: the Tata Nano car.

The questionnaire was developed by adapting scale items validated by previous research on the UTAUT framework (see Table II). Each important reflective construct (i.e., performance expectancy [*PE*], effort expectancy [*EE*], social influence [*SI*], and facilitating conditions [*FC*]) was assessed using 4 to 5 positive and negative statements. For each item, the respondents were asked to indicate their level of agreement on a Likert-type scale (1 = “Strongly disagree”; 5 = “Strongly agree”). The list of statements by construct shown in Table II was used to create the items listed in the survey questionnaire.

Insert Table II near here

A scenario with two purchase options was also created: 1) a well-known example of frugal innovation—the Tata Nano—a 2,000 United States dollars urban car developed by an Indian company and 2) its closest urban car competitors, the Toyota Aygo and Fiat 500. In the questionnaire, the respondents could pull up an image and small set of characteristics for each car, namely, price, fuel consumption, maximum power, and options offered in air conditioning and light-emitting diode lights.

In addition to the statements assessing the reflective constructs, a set of questions about the respondents’ traits was added to the questionnaire. These items included age, gender, permanent residence, monthly family income, and number of household members.

The questionnaire was created and implemented using Google Forms. The survey was sent to all students enrolled at the UP's faculties using the institution's internal e-mail system. Because the initial response rate was quite low, the e-mail was sent three times so that the study could gather as many completed questionnaires as possible. The survey remained open for two weeks from April 15th to 30th, 2018, at the end of which the questionnaire had been filled out by a total of 534 students (i.e., a 2% response rate).

Findings and discussion

Descriptive analysis

A sample of 534 students completed the questionnaire, of whom about 60% were under 23 years old. A similar percentage (59%) of the respondents were female. The vast majority lived (i.e., permanent residence) in the district of Porto (72%). Three districts (i.e., Porto, Braga, and Aveiro) accounted for 88% of the sample, which is to be expected as the UP attracts students mainly from geographically closer areas in Portugal's North region.

Almost 40% of the respondents reported that their family's monthly gross income was between 1,000 and 1,999 euros (€), with about a quarter of the sample selecting the next income group of €2,000–€2,999. About 70% of the students came from a family with 3 (27%) or 4 (40%) members. Only 9% of the respondents had large families with 5 or more members. A large percentage of the sample (43%) were in engineering-related degree programs in the Faculty of Engineering, followed by programs in the Faculty of Sciences and Faculty of Economics, with 14% and 9%, respectively.

The questionnaire included four statements that assessed the students' likelihood of buying the Tata Nano (see Table III). Over half (56%) of the respondents felt that, if they did not have enough money (i.e., €15,000, which would allow them to buy alternative, non-frugal urban cars such as the Toyota Aygo or Fiat 500), they would buy the Tata Nano. Only 16% of

the respondents would prefer the Tata Nano over the Toyota Aygo or Fiat 500 regardless of the funds available. This result was further corroborated by responses to the statement, “even if I had €15,000, I would prefer to buy the Tata Nano instead of the Toyota Aygo or Fiat 500,” since only 12% of the students agreed and totally agreed with this item.

Insert Table III near here

Notably, students from arts and architecture programs (i.e., students enrolled in the UP’s Faculties of Architecture and of Fine Arts) proved to be the most prone to buying frugal innovations. A full 23% of these respondents stated that they would prefer to buy the Tata Nano rather than the Toyota Aygo or Fiat 500, and 19% chose this option even if they had €15,000 available. This tendency contrasted with that of social sciences students, of whom only 14% agreed or totally agreed that they would prefer to buy the Tata Nano (i.e., the frugal innovation) rather than the Toyota Aygo or Fiat 500.

The results indicate a relationship may exist between intention to buy frugal innovations (i.e., the Tata Nano) and income constraints. Students who reported that their family gross income was under €1,000 showed a higher propensity to buy the Tata Nano—almost 10 percentage points higher than their counterparts from wealthier households (see Table III above). Respondents who came from higher income families (i.e., gross income above €5,000) reported consistently lower intentions to buy a Tata Nano. One-third of these students affirmed that, if they did not have €15,000, they would rather take out a loan to buy the Toyota Aygo or Fiat 500 instead of buying the Tata Nano.

The respondents’ responses do not vary significantly by age and gender in terms of intention to buy the frugal innovation (see Table III above). The only exception is the item, “if I did not have €15,000, I would prefer to buy the Tata Nano,” to which 63% of the students aged 21–23 years old agreed or totally agreed—a higher percentage than that recorded for the remaining younger and older age groups.

A simple bivariate analysis revealed that intentions to buy the Tata Nano (i.e., the frugal innovation) are positively and strongly associated with some dimensions of performance expectancy. The items in question included, among others, *PE1* (“The Tata Nano fulfills my needs”), *EE4* (“I would easily adapt to a Tata Nano”), and, most notably, *FC3* (“The Tata Nano is compatible with my lifestyle”).

Determinants of intention to buy

The proposed model incorporated performance expectancy, effort expectancy, social influence, and facilitating conditions as reflective constructs. This model was estimated using PLS-SEM (Hair *et al.*, 2017; Sarstedt *et al.*, 2017), which has been widely used in previous studies of intentions to purchase products such as electric vehicles (Thananusak *et al.*, 2017), smartphones (Toufani *et al.*, 2017), clothing (Valaei and Nikhashemi, 2017), online travel (Amaro and Duarte, 2015), mobile social tourism (Hew *et al.*, 2018), or digital goods (Hsieh and Tseng, 2018). The present research’s analyses included two steps (Hair *et al.*, 2017). The measurement model was first estimated and evaluated, after which the same was done with the structural model (i.e., structural relationship among the constructs). Thus, two types of relationships were analyzed: links between the items and constructs (i.e., measurement model) and between the constructs (i.e., structural model).

Measurement model

The evaluation of the measurement model’s results implied assessing the indicators’ reliability: internal consistency or composite reliability (Cronbach’s alpha and rho_A), convergent validity (average variance extracted [AVE]), and discriminant validity (square roots of AVEs). The outer model’s specification is presented in Table IV. As the model only included reflective constructs, the analysis focused on their loadings. The bootstrapping method was applied to estimate the measurement model’s *t*-statistic.

The items that presented low value loadings (< 0.40) and that were not statistically significant at 5% were excluded from further analyses. When items' loadings are higher or equal to 0.70, more shared variance than error variance exists between the construct in question and its measures. Thus, the items with loadings between 0.40 and 0.70 whose removal did not increase the model's composite reliability were retained.

Regarding internal consistency reliability, the constructs produced satisfactory values for the Cronbach's alpha and rho_A indicators (i.e., reaching the threshold of 0.70), which confirmed the model's consistent reliability (Hair *et al.*, 2011). The Cronbach's alpha values vary between 0.70 (social influence) and 0.79 (intention to buy), while the rho_A ranges between 0.70 (social influence) and 0.82 (intention to buy).

The outer loadings for the reflective constructs are higher than 0.70, and the AVE is higher than 0.50, providing adequate evidence of convergent validity. An AVE value higher than 0.50 shows that the construct in question explains more than half of its indicators on average. To test for discriminant validity, the Fornell-Larcker criterion was applied. The results indicate that each construct's square root of AVE (i.e., see Table IV) is higher than the strongest correlation between that construct and any other construct.

Insert Table IV near here

The evaluation of the measurement model confirmed that all the constructs exhibit internal consistency, convergent validity, discriminant validity, and, thus, item reliability. As the data on all the variables were gathered from a cross-sectional survey, the next step in the analysis was to run Harman's single-factor test. The first factor accounted for 26.3% of the overall variance, suggesting that common-method variance did not affect the results (Podsakoff *et al.*, 2003).

Structural model

PLS-PM was then used to test the hypotheses regarding the relationships between the constructs in the proposed model. The assessment of the structural model comprised an evaluation of the significance and relevance of the model's relationships and the R^2 values (Hair *et al.*, 2017). Next, the structural model's path coefficients were examined. Whether a coefficient is significant depends on the standard error obtained via bootstrapping (5,000 runs), which is used to calculate the t - and p -values.

The first hypothesis predicted that performance expectancy is a significant factor (i.e., positively correlated) that explains frugal innovation adoption in developed countries ($\hat{\beta} = 0.251$) (see Table V). An analysis of the correlations between intention to buy the Tata Nano (i.e., frugal innovation) and the items used to measure performance expectancy provided clear evidence that *PE1* ("The Tata Nano fulfills my needs") is the most strongly correlated (0.643) with frugal innovation adoption. Performance expectancy's importance is also supported by perceived usefulness (Gupta *et al.*, 2008) and relative advantage when respondents compared the Tata Nano with the Fiat 500 or Toyota Aygo (correlations of 0.334 and 0.352, respectively). Otherwise, UP students are not interested in using and/or buying this frugal invention. The first hypothesis was thus verified.

Insert Table V near here

The second hypothesis posited that effort expectancy is a determinant of purchase decisions involving frugal innovation products. The correlation between *EE3* ("I am willing to pay more for a Fiat 500 or Toyota Aygo because they offer more functionalities") and the item *IB1* is significantly negative (-0.513), which means that UP students are not sensitive to higher prices if this means the product will be less complex to use. They prefer technology that is easy to use (Holden and Karsh, 2010) and to which they can easily adapt, as shown by correlations between *EE4* and *EE5* and *IB1* of 0.553 and 0.389, respectively. These results

were expected since one of the three defining criteria of frugal innovation is “focus on core functionalities.” The results, therefore, reveal that effort expectancy has the greatest positive and significant effect on intention to buy (*IBI*) ($\hat{\beta} = 0.453$) in the proposed structural model.

The third hypothesis (i.e., “Social influence is positively related to frugal innovation adoption [intention to use and/or buy] in developed countries”) was not supported by the data gathered on potential consumers of a frugal innovation. Most UP students are not influenced by their reference group nor by what other people do or think these students should do. All the correlations between social influence and intention to buy are lower than 0.16—regardless of positive or negative direction. In the structural model, social influence’s coefficient in terms of determining users’ adoption is below 0.05 ($\hat{\beta} = 0.048$). Thus, this construct’s impact is insignificant.

Finally, the fourth hypothesis proposed that facilitating conditions are positively related to frugal innovation adoption in developed countries. Regarding this predictor, *FC3* (“The Tata Nano is compatible with my lifestyle”) has by far the strongest correlation with intention to buy (0.54), which means that UP students are more likely to use and/or buy this specific frugal innovation (i.e., the Tata Nano) if it fits and is compatible with their lifestyle. However, although the last hypothesis is supported, this construct’s coefficient is the lowest among all the determinants in the inner model (i.e., 0.16).

This weak relationship was also confirmed by the coefficient of determination (i.e., the R^2 value), which is a measure of the model’s predictive accuracy. An R^2 of 0.672 ($F = 201.9$; $p = 0.00$) can be considered a good result. Effort expectancy contributes to 54.487% of intention to buy’s R^2 , while performance expectancy, facilitating conditions, and social influence contribute 27.589%, 15.840%, and 2.093%, respectively. The first two constructs (i.e., effort expectancy and performance expectancy) together explain more than 80% of individual UP students’ intention to purchase the frugal innovation in question.

Discussion

Given that no empirical research has been conducted on intentions to use frugal innovations in developed countries, the present study sought to fill this gap in the literature by assessing the determinants of consumers' acceptance of frugal innovation in developed nations. The target population was a sample of potential users—university students. These individuals must usually deal with significant financial constraints because, at least at the undergraduate level, a large percentage are financially dependent on their parents and/or relatives. In addition, these students tend to be, in general, sensitive to environmental issues and increased resource constraints (Immelt *et al.*, 2009; Rosentrater and Burke, 2018).

PLS-SEM was applied to assess the validity of the pre-defined hypotheses (i.e., the UTAUT model), of which three out of four were confirmed. Swinerd and McNaught (2015) assert that social influence is important in the early stages of consumers' adoption of specific technologies. However, the present study's data did not support the third hypothesis (i.e., "Social influence is positively related to frugal innovation adoption [intention to use and/or buy] in developed countries"). The majority of UP students are not socially influenced by their reference group in terms of intention to buy a frugal innovation, which contradicts Verma and Sinha's (2018) findings. The current result is thus unexpected given previous applications of the UTAUT model. Williams *et al.*'s (2015) review, for example, found that social influence is the second most important determinant of purchase intentions in existing studies.

As in previous research, the present study confirmed that effort expectancy has a significant positive effect on intention to buy, although the relative importance of this determinant appears to vary compared to some previous empirical research results. Chen *et al.* (2008) and Choi *et al.* (2014) concluded that effort expectancy has the most significant

positive effect on intention to buy. In contrast, effort expectation was shown to be the least important determinant of intention to buy in Williams *et al.*'s (2015) systematic review of the literature on the UTAUT, as well as in the first results obtained for the UTAUT model (Venkatesh *et al.*, 2003).

In line with Chen *et al.* (2008) and Choi *et al.*'s (2014) studies, the current research found that effort expectancy has the most significant positive effect on intention to buy a frugal innovation. This result can be explained by the core characteristics of frugal innovations and frugal products, such as simplicity (Von Janda *et al.*, 2020) and concentration on core functionalities (Weyrauch and Herstatt, 2017). In addition, similar to Venkatesh *et al.*'s (2003) respondents, UP students think that the Tata Nano has all the support infrastructure they need, so facilitating conditions are positively related to their adoption of this frugal innovation.

Conclusion

This study focused on answering two research questions. The first question was whether young consumers in developed countries are likely to buy frugal innovations previously created for BOP markets. The results provide new evidence of intentions to use and/or buy a frugal innovation (i.e., the Tata Nano car) among a resource-constrained and environmentally aware market segment (i.e., university students) in developed nations.

The second research question was about the main determinants of frugal innovation adoption by young consumers in developed countries. The findings confirmed that, with the exception of social influence, the three remaining determinants—effort expectancy, performance expectancy, and facilitating conditions—are critical factors in intention to buy a frugal innovation (i.e., the Tata Nano car) among university students. Of these three factors,

effort expectancy is the most important determinant of intention to purchase frugal innovations.

Theoretical contributions

The present results contribute to the literature on three main levels. First, although various studies have already used a UTAUT-based model to assess the main determinants of innovation adoption (Williams *et al.*, 2015), the current research appears to be the first attempt to apply this holistic framework to frugal innovations.

Second, this study analyzed university students' intentions to use a frugal innovation in a developed country. Most existing research on frugal innovations have been theoretical (e.g., Pison *et al.*, 2018; Bhatti, 2012; George *et al.*, 2012). The few empirical studies conducted (e.g., Tiwari and Herstatt, 2012; Abrol and Gupta, 2014), in general, focused on developing countries or frugal innovation's characteristics (Von Janda *et al.*, 2020) in the context of small and medium-sized enterprises (Shibin *et al.*, 2018). Last, the present UTAUT model's results reveal that the most important determinants of purchase intentions regarding a specific frugal innovation in a developed nation could differ from key determinants in other UTAUT research contexts (Williams *et al.*, 2015).

Managerial implications

From a policymaker and managerial perspective, this study confirmed that a significant number of individuals are willing to buy frugal innovations in developed countries. The respondents were mostly university students from lower income households, who believe that this kind of innovation would be easy to use and useful in their daily lives and/or jobs and that adequate infrastructure would be available to support the innovation's use. When these findings are aligned with frugal innovation's high economic potential and applicability in the business world (George *et al.*, 2012; Nakata and Weidner, 2012), the present results turn the

spotlight on a potentially interesting commercial opportunity to stimulate developed nations' economies.

Given the openness of young consumers in developed countries to frugal innovative products, the relevant industries could change their business model to become more competitive in this market (Radjou and Prabhu, 2013). The demand for frugal products is expected to continue growing, so companies need to rethink their strategies in order to satisfy this market segment's needs and wants (Brem, 2017). The current study's findings thus have managerial implications for firms that intend to market frugal innovations in developed countries.

In terms of strategic marketing, university students from low-income households might be a potential market segment for frugal innovations such as the Tata Nano. Regarding operational marketing, the communication mix needs to consider the UTAUT model's results in this research. Social influence is not a statistically significant determinant of intention to buy, so young people apparently do not perceive as important what others believe about frugal innovation adoption. A communication approach targeting influencers or opinion leaders is, therefore, likely to be an inefficient strategy for this type of product. As effort expectancy was shown to have the strongest influence on intention to buy, communication messages have to increase frugal innovations' perceived ease of use by highlighting their simplicity and core functionalities.

In addition, the results confirm that stronger intentions to buy are associated with higher levels of performance expectancy. This finding suggests that companies seeking to offer frugal innovations in developed nations need to optimize consumers' perceived expectation, which can be done by conducting market research to identify to which consumers frugal innovations should be introduced. Finally, facilitating conditions are also a significant determinant of intentions to buy these products, so companies should ensure the necessary

resources to use frugal innovation are available, as well as assistance in case of problems (e.g., affordable maintenance services).

Limitations and avenues for future research

While this study offers novel contributions, it also has limitations that need to be noted. First, this pioneering research on frugal innovation acceptance in developed countries only explored the UTAUT's four dimensions (i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions). Thus, intentions to buy these products could be further explored by including other variables in structural equation models, such as durability (i.e., innovations' life cycle) and design aspects, or/and analyzing moderator variables—most notably age and income.

Second, even though university students are a relevant sample in this research context, the respondents were only UP students who are mainly from Portugal's North region. All due caution thus needs to be taken to avoid improper generalization of the results. An interesting path for further research would be to replicate this research with university students from other locations and/or other segments of the population (e.g., lower vs. higher income consumers).

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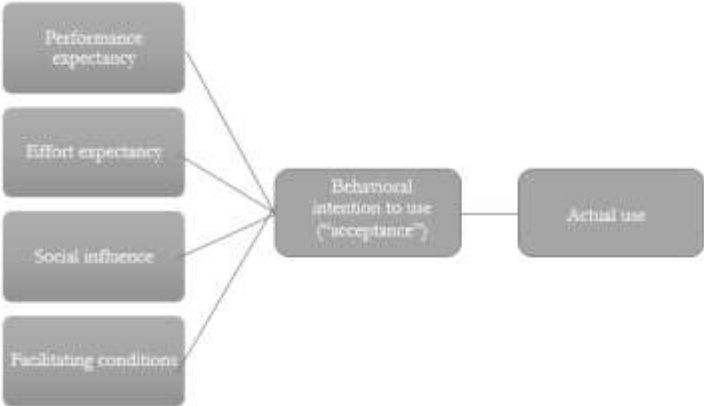


Figure 1: UTAUT model

Table I: Concept matrix augmented by units of analysis

	Frugal innovation: three main criteria			Scalability		
	Substantial cost-reduction	Optimal performance level	Focus on core functionalities	Local context	Small diffusion	Diffusion
Grassroots innovation	x			x		
Jugaad innovation	x		x		x	
Gandhian innovation	x	x		x		
Indigenous innovation	x	x			x	
Catalytic innovation	x		x			x
Frugal innovation	x	x	x			x
Reverse innovation	x	x	x			x

Source: Authors

Table II: Correspondence between conceptual framework and previous studies'

questionnaire items

Constructs	Statements	Authors
	– The ETMall/Momo’s performance is highly recommended.	Chang <i>et al.</i> (2016)
	– Using the ETMall/Momo enhances my effectiveness when searching for and purchasing smartphones.	
	– Using the ETMall/Momo enables me to search for and purchase smartphones more quickly.	
	– Using the ETMall/Momo makes it easier to search for and purchase smartphones.	
Performance expectancy	– Considering all the tasks involved, I appreciate the extent to which using the ETMall/Momo could assist me in searching for and purchasing smartphones.	Howard <i>et al.</i> (2017)
	– I would find BIM (building information modelling) useful in my job.	
	– Working with BIM enables me to accomplish tasks more quickly.	
	– Working with BIM increases my productivity.	
	– If I work with BIM, I will increase my chances of getting a raise.	Agag and El-Masry (2016)
	– Using this online community helps me to resolve any doubts when I plan a trip.	
	– Using this online community helps me to organize trips in a more efficient way.	
	– In general, this online community is useful to plan trips.	
	– It is easy for me to become skillful at using the ETMall/Momo to search for smartphones.	Chang <i>et al.</i> (2016)
	– My interactions with the ETMall/Momo when searching for smartphones are clear and understandable.	
	– I find it easy to search smartphones with the ETMall/Momo.	
	– Learning to search for smartphones with ETMall/Momo would be easy for me.	
Effort expectancy	– This online travel community is simple to use, even when using it for the first time.	Agag and El-Masry (2016)
	– In this online travel community, everything is easy to find.	
	– It is easy to move around within this online travel community.	
	– My interactions with BIM would probably be clear and understandable.	
	– It would be easy for me to become skilled at working with BIM.	Howard <i>et al.</i> (2017)
	– I would find BIM easy to use.	
	– Learning to operate BIM would be easy for me.	
Social influence	– Almost all my friends and family members use smartphones.	Suki (2013)
	– My friends and family members think that we should all use smartphones.	
	– My friends and family members influenced my decision to buy a smartphone.	
	– People around me have encouraged me to use a smartphone.	Graf-Vlachy <i>et al.</i> (2018)
	– People who are important to me/people who influence me/people whose opinion I value/... think that I should use this system.	
	– My supervisor/my colleagues/my friends/my family/my relatives/... think that I should use this system.	
	– People who influence my behavior think I should use BIM.	Howard <i>et al.</i> (2017)
	– People who are important to me think that I should use BIM.	

	<ul style="list-style-type: none"> - The LBS (location-based services) platform is available for most of my queries. - The LBS connection is reasonably reliable. - The LBS application has a reasonable response time. - Guidance is available to me when I need assistance with problems. 	Hossain <i>et al.</i> (2017)
Facilitating conditions	<ul style="list-style-type: none"> - When I need help to use the computer, the necessary guidance is available to me. - When I need help to use the computer, specialized instruction is available to help me. - When I need help to use the computer, a specific person is available to provide assistance. 	Teo (2009)
	<ul style="list-style-type: none"> - I have the necessary resources to work with BIM. - I have the necessary knowledge to work with BIM. - BIM is incompatible with the work tools I use. - A specific person (or group) is available to provide assistance with BIM-related difficulties. 	Howard <i>et al.</i> (2017)

Table III: Intention to buy a frugal innovation (the Tata Nano) by field of study, family income, age group, and gender (% of respondents who agreed and totally agreed with statements)

Variable	Category	“I would prefer to buy the Tata Nano rather than the Toyota Aygo or Fiat 500.” (IB1)	“If I did not have €15,000, I would prefer to buy the Tata Nano.” (IB2)	“If I did not have €15,000, I would prefer to take out a loan and buy the Toyota Aygo or Fiat 500.” (IB3)	“Even if I had €15,000, I would prefer to buy the Tata Nano instead of the Toyota Aygo or Fiat 500.” (IB4)
Gender	Female (n ^a = 316)	15.4%	57.5%	12.5%	11.8%
	Male (n = 218)	16.6%	54.8%	10.1%	13.4%
Age group	< 20 years old (n = 113)	18.8%	52.2%	7.1%	10.6%
	21–23 (n = 204)	15.8%	63.1%	9.4%	13.8%
	24–27 (n = 99)	13.1%	53.5%	12.1%	13.1%
	> 27 (n = 118)	15.3%	51.7%	19.5%	11.0%
Household income (€)*	< 1,000 (n = 67)	25.4%	64.2%	10.4%	9.0%
	1,000–1,999 (n = 170)	16.0%	55.6%	10.7%	12.4%
	2,000–2,999 (n = 105)	10.6%	55.2%	5.7%	13.3%
	= > 3,000–3,999 (n = 102)	13.9%	51.1%	27.7%	6.4%
Academic field of study**	Sciences and technology (n = 302)	15.0%	54.8%	10.6%	12.0%
	Social sciences (n = 140)	14.4%	59.3%	17.9%	11.4%
	Other: arts and architecture or health and life sciences (n = 94)	22.4%	54.4%	5.9%	16.2%
Overall (n = 534)		15.8%	56.5%	11.6%	12.4%

Note: ^a n = number; missing values: *n = 90, **n = 24.

Table IV: Specification of outer model

Construct^a	Item	Loading	Cronbach's alpha, rho_A, AVE
<i>PE</i>	<i>PE1</i> : "The Tata Nano fulfills my needs."	0.873*	0.74, 0.77, 0.56
	<i>PE2</i> : "The Tata Nano is useful when driving in cities."	0.665*	
	<i>PE4</i> : "I always buy the cheapest product."	0.596*	
	<i>PE5</i> : "Fuel consumption is an important factor in my buying decisions."	0.515*	
	<i>EE3</i> : "I am willing to pay more for a Fiat 500 or Toyota Aygo since they offer more functionalities."	0.757*	
<i>EE</i>	<i>EE4</i> : "I would easily adapt to a Tata Nano."	0.839*	0.75, 0.78, 0.54
	<i>EE5</i> : "I would adapt more easily to a Tata Nano than to a Fiat 500 or Toyota Aygo."	0.596*	
	<i>SI1</i> : "If a lot of people had a Tata Nano, my propensity to buy it would be stronger."	0.690*	
<i>SI</i>	<i>SI2</i> : "My friends would prefer a Fiat 500 or Toyota Aygo over a Tata Nano."	0.497*	0.70, 0.70, 0.51
	<i>SI3</i> : "My friends' opinion is important when I buy a car."	0.522*	
	<i>FC1</i> : "Maintenance costs are a significant factor in my buying decisions."	0.535*	
<i>FC</i>	<i>FC3</i> : "The Tata Nano is compatible with my lifestyle."	0.944*	0.73, 0.76, 0.59
	<i>IB1</i> : "I would prefer to buy the Tata Nano rather than the Toyota Aygo or Fiat 500."	0.872*	
<i>IB</i>	<i>IB2</i> : "If I did not have €15,000, I would prefer to buy the Tata Nano."	0.692*	0.79, 0.82, 0.54
	<i>IB3</i> : "If I did not have €15,000, I would prefer to take out a loan and buy the Toyota Aygo or Fiat 500."	0.487*	
	<i>IB4</i> : "Even if I had €15,000, I would prefer to buy the Tata Nano instead of the Toyota Aygo or Fiat 500."	0.843*	

Note: ^a *PE* = performance expectancy; *EE* = effort expectancy; *SI* = social influence; *FC* = facilitating conditions; *IB* = intention to buy; AVE = average variance extracted; * statistically significant at the 0.01 level.

Table V: Structural model's results

Path^a	Coefficient (β)	Standard error	<i>t</i>-value	<i>p</i>-value
<i>PE -> IB</i>	0.251	0.040	6.203	0.000
<i>EE -> IB</i>	0.454	0.039	11.702	0.000
<i>SI -> IB</i>	0.048	0.029	1.692	0.091
<i>FC -> IB</i>	0.160	0.037	4.283	0.000

Note: ^a *PE* = performance expectancy; *IB* = intention to buy; *EE* = effort expectancy; *SI* = social influence; *FC* =

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