UNDERSTANDING FACEBOOK COMMERCE (F-COMMERCE) ACTUAL PURCHASE FROM AN ARTIFICIAL NEURAL NETWORK PERSPECTIVE

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ABSTRACT

Despite the abundance of studies in electronic commerce, few studies have validated the antecedents of actual purchase from the perspective of Facebook commerce or f-commerce. Most of the existing e-commerce studies have focused on purchase intention and little attention has been paid on consumers' actual purchase especially from the f-commerce context. This study intends to examine the effects of demographic variables, Web Usage Theory, Trust Transference Theory and F-commerce usage behaviors in predicting f-commerce actual purchase. The instrument was rigorously developed and validated using expert panel, Q-sort procedure, pretest and pilot test. Several issues of validity in previous studies were addressed. Unlike existing studies which engaged compensatory linear models such as SEM, PLS, MLR and etc., in this study 808 f-commerce users were selected and the data is analyzed using the non-compensatory and non-linear artificial neural network (ANN) model. ANN can overcome challenges encountered by conventional statistical analysis that relies on p-value caused by false correlations. The findings reveal that consumers' experience is the strongest predictor followed by Facebook usage, hedonic motivation, browsing, age, trust motivation, participation, utilitarian motivation, number of children, monthly income and educational level. Theoretical and managerial contributions were provided for scholars and practitioners of f-commerce.

Keywords: Facebook commerce (f-commerce); Actual purchase; Web usage theory; Trust transference theory; Artificial neural network

1. Introduction

The advent of Facebook and Web 2.0 has led to the birth of a new form of online business known as Facebook commerce or f-commerce [Jambulingamis et al. 2015; Kang & Johnson 2015; Liébana-Cabanillas & Alonso-Dos-Santos 2017]. F-commerce can be classified as two classes. The first class consists of companies (e.g. *Levis*, *Amazon*, *TripAdvisor* etc.) that connect to Facebook pages, which divert potential buyers to their online stores while the second class are companies (e.g. *Groupon*, *Hallmark*, *Watson* etc.) that connect to Facebook through fan pages and allows prospective buyers to buy directly from their Facebook stores. E-marketers have started to adopt f-commerce to improve buying experiences by assisting consumer loyalty, advocacy and acquisition [Kang & Johnson 2015]. For

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example, Gamboa and Goncalves [2014] found that 97% of Fortune-100 companies have used social media and 54% possess Facebook fan pages. Furthermore, Barnes et al. [2013] found that 96% of the Fortune-500 specialty retailers also utilized Facebook. In fact, retailer Facebook pages have enabled nearly 68% users to trade products and services to other users particularly in Asian countries [Duggan & Brenner 2013]. In addition, renowned retailers (e.g. *Macy's*, *Express*, *Delta and Hallmark*) have started to trade products via Facebook pages [Kang & Johnson 2015]. The Facebook pages allow consumers to interact with each other and share product information as well as to buy product within the Facebook page and news feed. Moreover, a Facebook shopping service known as *Soldsie* has enabled sellers to upload product photos, prices, quantities and images on Facebook [Cohen 2014]. On top of that, a Facebook store app known as *Shopify* also enables sellers to trade products via Facebook. Tsukayama [2015] asserted that another Facebook app known as *Messenger* enables buyers to request for more product info and obtain prompt responses as well as placing additional orders and finally confirm the orders through the *Messenger* account. Besides, the *TheFind* app as a search engine which extracts consumers' shopping habits and social profiles may provide consumers with a custom-made buying experience [Kang & Johnson 2015]. With Facebook's '*buy'* button, retailers may post product information and consumers can buy it by just clicking this button and then the transaction can be done via credit card.

In terms of social media platform(s) used by marketers, Statista [2016] reported that 93% marketers used Facebook followed by Twitter (i.e. 78%), LinkedIn (i.e. 67%), YouTube (i.e. 53%), Google+ (i.e. 49%), Instagram (i.e. 44%), Pinterest (i.e. 40%), and Forums (i.e. 12%). Facebook may serve as a marketing tool for businesses especially small and medium enterprises and as a channel for interaction with consumers [Chen et al. 2014]. Lin and Lu [2015] opined that mobile- and e-commerce have been enhanced by SNSs (e.g. Facebook, Twitter and etc.) by enabling businesses to interact with lots of consumers simultaneously [Hew J.J. et al. 2016a] and businesses at the same time need not spend a lot of investment for adopting social media [Gamboa & Goncalves 2014]. Labrecque [2014] and Laroche et al. [2013] asserted that companies can directly interact with customers and trade services and products with lesser charges to enhance brand loyalty. Furthermore, brick-and-mortar companies have also augmented their social media adoption in customer relationship management, product campaign and brand communication [Zhang et al. 2014]. Turban et al. [2010] opined that large companies such as *Starbucks* and *Dell* have also appreciated social media as a stimulant for sales. For example, Starbucks has engaged several social media platforms like Facebook, Twitter, Foursquare, etc. by hosting a discussion forum known as *MyStarbucksIdea* to enable consumers to discuss relevant issues. Facebook commerce or f-commerce is a category of s-commerce which is associated to retailing and purchasing of goods and services via Facebook [Marsden 2011]. F-commerce stores may give marketers a supplementary channel to facilitate sales and promotion opportunities besides offering a synergetic bridge between retailers and consumers [Kang & Johnson 2015]. E-marketers which have adopted f-commerce have boosted customers' shopping experience by facilitating their loyalty, advocacy and acquisition [Marsden 2011].

E-commerce is significantly different from f-commerce as the former concentrates on optimizing shopping efficiency through provision of product catalogues, recommendations and one-click purchase whereas the latter main focus is on direct social activities like collaborating, networking and sharing with lesser focus on online buying [Huang & Benyoucef 2013]. Furthermore, in e-commerce, buyers normally interact individually with the e-commerce platforms independent from the other buyers and possess limited or no control since messages and exchanges are handled by the companies whereas in f-commerce, buyers are delegated with control thus shortening the distance between buyers and the companies [Constantinides & Fountain 2008]. Due to these differences, we argue that the findings from existing e-commerce studies may not be relevant and applicable in the f-commerce context. Hence a study on the specific f-commerce context is indeed a necessity.

Generally, self-reported purchase intentions are common proxy measures of buying in sales predictions [Verhoef & Franses 2003; Wittink & Bergestuen 2001] and tests on new product [Jamieson & Bass 1989; Urban & Katz 1983] due to their flexibility, inexpensiveness and ease-of-use. Nevertheless, the widespread use of purchase intentions strongly depends on the assumption that purchase intentions are effective pointers of individual's buying behavior [Sun & Morwitz 2005]. However, previous studies have indicated that prediction validity of stated intention to purchase remains arguable [Belk 1985; Clawson 1971] and purchase behavior at individual level varies from the stated intentions to purchase and these variations do not cancel in aggregate [Sun & Morwitz 2005]. Prior studies in psychology and marketing have identified 3 main justifications for these variations namely (a) the systematic biases in reporting the stated intentions [Hsiao & Sun 1999; Kalwani & Silk 1982), (b) variations in real intentions over time e.g. price increase between the moment of purchasing and the moment of the survey [Manski 1990] and (c) imperfect correlations between purchasing and true purchase intentions i.e. the psychological variation among behavior and intentions [Bagozzi & Dholakia 1999]. Hence, similar to Rimal et al. [1999], we argue that consumers' purchase intention need not necessary lead to the actual purchase in f-commerce and therefore it would be a motivation for

scholars to examine the drivers that can predict consumers' actual purchase in f-commerce as this can further close the existing research gap and advance the extant literature on f-commerce.

Nevertheless, we found that there are some issues of validity as most of the existing studies on purchase intention, decision or behavior in social commerce (Appendix A) have not examined the assumptions of linearity, normality, multi-collinearity and homoscedasticity for multivariate statistical analysis such as SEM, PLS, MRA or MLR. Besides that, very few of these studies have rigorously developed and validated the survey instrument by engaging expert panel in assessing the face validity, content validity as well as construct validity. In addition to that, no content validity index (CVI) and Q-sort procedure were engaged in these studies. Except for Kim and Ko [2012] and also Pöyry et al. [2013] who have conducted only pre-test as well as Wang and Chang [2013] who have conducted only pilot test, none of the existing studies have conducted both pre-test as well as pilot test to safeguard the validity of the measurement instruments. In addition to this, some of these studies also did not examine common method bias (CMB) even though both dependent as well as independent variables have been gathered using a single instrument. Majority of the current studies also did not check for non-response bias. We argue that there are issues of validity and biases in the findings of these studies and hence, new studies especially from the context of f-commerce are definitely needed to properly address these issues. Thus, this has been the second motivation for conduct the current study.

Besides the issues of validity, the third motivation we found is the existing studies have engaged individual theory such as social capital theory, socialization theory, customer value theory, information processing theory, trust transference theory, social network theory, modified Technology Acceptance Model (TAM), social media marketing (SMM) activities, Hofstede's cultural dimensions, hedonic and utilitarian motivations. However, these studies did not include demographic variables even though psychology literature has claimed that these variables are capable of predicting individuals' behaviors as shown in various studies in different contexts of study [Chong et al. 2012; Chong 2013; Chong et al. 2015; Lee et al. 2007; Leong et al. 2011; Lightner 2003; Teo 2001; Yang 2005]. Furthermore, since majority of these studies have engaged single theory, therefore, we expect that an integrated model consisting of demographic variables, Trust Transference Theory, Web Usage Theory and F-commerce usage behaviors (i.e. participation and browsing) will be able to provide a better prediction on f-commerce consumer behavior.

Last but not the least; it is obvious that there is a dearth in study that examines non-compensatory and non-linear relationships from the context of f-commerce. This can be seen from Appendix A which shows that majority of the existing social commerce studies have engaged the SEM, PLS-SEM, MLR, etc. and all of the statistical methods required for testing of linear relationships among the independent and dependent variables. However, none of these studies have assessed the linearity assumption. Majority of the Information Systems (IS) studies have engaged the above mentioned statistical methods by assuming users' decisions as linear and compensatory [Chiang et al. 2006]. A compensatory assumption means that the shortfall in a factor (e.g. hedonic motivation) may be compensated by improving other factor (e.g. utilitarian motivation). However, when consumers make their decisions, the process of evaluation may not be compensatory. For example, a consumer of m-commerce may choose not to engage m-commerce because of the concerns of cost and this cannot be compensated through improvement in ease of use of mobile commerce [Chong 2013a]. Since linear statistical methods are incapable of capturing the non-compensatory decisions therefore they are deemed unreliable [Chiang et al. 2006]. Furthermore, linear models have the tendency to oversimplify the complications in users' decision making processes [Venkatesh & Goyal 2010]. Therefore, we used artificial neural network (ANN) with multi layer perceptron (MLP) as it can help researchers in developing new theories while overcoming the weakness of using p-value in traditional statistical analysis due to false correlations [George et al. 2014]. Hence, it is a motivation to carry out a study that can investigate not only the linear and compensatory relationships that were commonly found in the existing studies but also to investigate the non-linear and non-compensatory relationships in decision making among consumers of f-commerce using ANN model.

The paper is structured as follows. We start with an introduction about f-commerce that is followed by a literature review. Next, we explain the theoretical underpinnings, theoretical framework and hypothesis development. Research methodology, instrument development and validation and scale operationalization are presented subsequently. Data gathering and analysis are included next and then followed by discussions on the results and findings of the neural network analysis. Lastly, we explain some theoretical and managerial contributions and then ending the paper with limitations, impending research direction and conclusion.

2. Literature review

Being a subset of s-commerce and its huge market potential, we believe that f-commerce is worth studying. However, until now the number of study that focuses specifically on f-commerce remain scarce. Hence, we will use social commerce as a base for f-commerce. Zhang and Benyoucef [2016] have conducted a literature review on consumers' behavior in s-commerce. Based on Zhang and Benyoucef's [2016] review, we found that the main focus of s-commerce studies has been on purchase intention [e.g. Kang & Johnson 2015], intention to use [e.g. Kumar et al.

2015], continuance intention [e.g. Pentina et al. 2013], user and marketer generated content [e.g. Goh et al. 2013], purchase decision [e.g. Goodrich & Mooij, 2014], brand engagement [e.g. Hollebeek et al., 2014], intention to engage [e.g. De Vries & Carlson 2014], intention to social shop online [e.g. Kang et al. 2014], consumer attitude [e.g. Li 2014], brand evaluation [e.g. Li & Li 2014], purchasing behavior [e.g. Napompech 2014], customer loyalty [e.g. Rapp et al. 2013] and info disclosure [e.g. Sharma & Crossler 2014]. Therefore, it is obvious that most of the existing social commerce studies have been focusing on purchase intention; decision or behavior; intention and continuance intention; user generated content and information disclosure; consumer attitude and loyalty; brand engagement and evaluation. Basically, these social commerce studies have most of the outcome measures in the research framework proposed by Liang and Turban [2011]. However, it is obvious that there has been hardly any study that examined the actual purchase especially from the more specific context of f-commerce.

The easiest definition of f-commerce is selling of products or services within Facebook [Valles & Petrova, 2012]. A more specific definition is that "F-commerce, derived from e-commerce, is the use of Facebook as a platform for facilitating and executing sales transactions - either on Facebook itself or externally via the Facebook Open Graph" [The f-commerce FAQ 2012, p. 1]. In other words, f-commerce represents the merging of social media platform i.e. Facebook and e-commerce.

The first f-commerce transaction occurred inside Facebook in 2009 through the store of 1-800-flowers.com [The f-commerce FAQ 2012]. As a result, several important software companies such as Payvment, Vendor Shop Social and etc. have started to offer Small and Medium Businesses e-commerce solutions for the Facebook market [Top 50 Facebook Stores 2011] and what was known as brand pages have been converted into digital malls [Solis 2012]. F-commerce is an innovative platform that has brought about not only attention as a phenomenon but also as investments for more than USD2 billion for the first quarter of 2011 [Chaney 2012].

Although studies on social commerce are gaining momentum however, not many of these studies have focused specifically on f-commerce as it is still a relatively new context of study. Nevertheless, we are able to find several studies which have examined intention to purchase in f-commerce. First of all, Wang and Chang [2013] conducted a study on the influence of product-related risks and online social ties towards purchase intentions using a Facebook experiment with 420 subjects. They developed the hypotheses about consumers' decision-making by applying Stimulus-Organism-Response (S-O-R) model and Information Processing Theory. Using a Facebook field experiment, they discovered that product recommendations and information from acquaintances whom the consumer has strong ties are considered as possessing high degree of diagnosticity which may increase the chances for consumers to purchase the product. Perceived diagnosticity refers to perceptions of information sources' ability in assessing product quality [Mudambi & Schuff 2010]. It was also found that product-related risks have significant moderating effect on the strength of influence on perceived diagnosticity only on high-risk products.

Besides that, Anderson et al. [2014] have investigated utilitarian and hedonic motivations' impacts on consumer's intention to purchase as well as retailer loyalty using Facebook retail pages with 250 participants from a national online consumer panel. The findings showed that experiential shopping affects loyalty but not intention to purchase. In addition, we found no significant effects of bargain perception on purchase intention and loyalty. However, information access was validated to have significant effect on loyalty and time savings while intention to purchase is directly affected by loyalty. Their study suggests that even though both hedonic and utilitarian shopping motivations can be essential for consumers' loyalty as well as purchasing however, only relationship between time saving (i.e. utilitarian) and intention to purchase and the associations between experiential shopping (i.e. hedonic) and information access (i.e. utilitarian) as well as loyalty were validated [Anderson et al. 2014].

On the other hand, Kang and Johnson [2015] have tested Mowen's Meta-Theoretic Model of Motivation and Personality or 3M model on online apparel social shopping. Based on 601 Facebook users chosen with purposive sampling from a consumer panel, they found that consumers who are social browsers and market mavens have high tendency to adopt online social shopping for intend to involve and socializing. Social browsers and value conscious consumers have high tendencies to adopt online social shopping especially for information searching as well as intend to get involved while homophily and tie strength moderate the relationship between social shopping intention and gratification. Kang and Johnson [2015] found that the associations between intention for online social shopping and gratifications were more influential in consumers who believed that contacts on Facebook's friends list are vital, close to them and thought like them.

Last but not the least, Harris and Dennis [2011] performed an exploratory study on interactions between consumer products/services and young consumers on social networks. Using a qualitative method with 4 focus groups that engaged undergraduates from 2 UK-based universities, their findings showed that a 'nudge' in terms of acquaintances' recommendations as well as experimental of suitable systems will bring about substantial variations in consumer behaviour towards its adoption. They also found that there is "a hierarchy of trust in recommenders or reviewers from 'real' friends at the top-down ordinals scales to reviews on retailers' websites at the bottom" [Harris & Dennis 2011,

p. 345]. They speculated that the scale can serve as a substitution for trust in friends' recommendations and significantly linked to purchase intention of the recommended products or services and thus recommended that in future quantitative studies are required.

3. Theory

Based on the above literature review on f-commerce, it is clear that researchers have applied Information Processing Theory, S-O-R framework, Mowen's 3M model, hedonic and utilitarian motivations in their studies. However, these studies did not examine the effects of demographic variables which have proven their abilities to predict consumer behaviors [Chong et al. 2012; Chong 2013; Chong et al. 2015; Lee et al. 2007; Leong et al. 2011; Lightner 2003; Teo 2001; Yang 2005]. Therefore, in this study, we have integrated the demographic (i.e. age, number of children, monthly income, educational level, Facebook usage and experience) as control variable with the Web Usage Theory and Trust Transference Theory. Web Usage Theory was chosen due to the fact that f-commerce transaction is performed using the Web 2.0 technology and since transactions over the cyberspace involve consumers' trust, therefore Trust Transference Theory is an appropriate theory to explain consumers' behavior in f-commerce. The succeeding section will elaborate the underpinning theories in this study.

3.1. Web Usage Theory

Web Usage Theory [Cotte et al. 2006] theorized that benefits gained through using Web may be generally classified into "(a) hedonic consumption benefits obtained when the Web is used for the enjoyment of the online experience itself, and (b) utilitarian consumption benefits resulting from consciously achieving a specific task via interaction with the Web" [Cotte et al. 2006, p. 47]. Moreover, hedonic consumption benefits are obtained when consumers look for fun, sensory stimulation and amusement in exchange for expending resources like money and time and consider consumptions in the forms of user experience rather than the object of consumption [Cotte et al. 2006; Holbrook & Hirschman 1982]. Hedonic benefits are more subjective, personal and depend on playfulness and fun while interacting with the Web [Cotte et al. 2006].

In contrary, Babin et al. [1994] opined that utilitarian benefits are assumed to be task-specific with eventual satisfaction derived from accomplishment instead of the nature of user experience. Utilitarian benefits focused on objective accomplishment where consumers are likely "to use the Web for what they perceive as objective reasons and would often have preconceived expectations of what they wish to accomplish when they go online." [Cotte et al. 2006, p. 47]. Cotte et al. [2006] asserted that their research conceptualized utilitarian and hedonic benefits as two distinct categories of benefits different from the opposed extremes of a continuum, hence, the two categories of benefits can be obtained in a particular circumstance, though in certain occasions, occurrence of a benefit may hinder the other [Babin et al. 1994; Griffin et al. 2000]. Hedonic and utilitarian benefits constructs of Cotte et al. [2006] are tailored for the application of the Web in general and can be applied on shopping, purchase and non-purchase situations (e.g. playing online games or reading online news).

3.2. Trust Transference Theory

An imperative component in online purchase intentions is trust [Kim et al. 2012] because consumers are not able to assess and access actual product online prior to buying it. Trust has been examined in various contexts such as mobile commerce [Vance et al. 2008], Internet-based inter-organizational systems [Lai et al. 2011] as well as product recommendation agents [Wang & Benbasat, 2005]. Ng [2013] asserted that trust is transferable from a source to others. Likewise, organization trust can be transferred to trust in its members and subsequently be extended to other members and trust can even be transferred between different contexts [Ng 2013]. According to Trust Transference Theory, trust transfer may happen when "the unknown target is being perceived as related to the source of the transferred trust" [Steward 2003, p. 6]. Campbell [1958] opined that the perception of relatedness happens according to the proximity, similarity and common fate of the entities to or from where trust is shifted. Campbell [1958] defined similarity as the entities (e.g. members of the social community) level of sameness while proximity as the level of closeness and common fate as the perception that the entities are propagating towards similar direction. From the perspective of group members, relatedness can be affected by the behavior of members [Wilder & Simon 1998] and the types of interactions (e.g. establishment of a business partnerships or a social network community) [Lickel et al. 2000].

4. Research model development

Demographic variables are incorporated into the research model as control variable since previous studies have demonstrated that they are able to predict consumer behaviors [Chong et al. 2012; Chong 2013; Chong et al. 2015; Lee et al. 2007; Leong et al. 2011; Lightner 2003; Teo 2001; Yang 2005]. We expect that consumers of older age have high spending power and therefore will be able to spend more money in f-commerce compared to the younger ones. Similarly, we anticipate that consumers with lesser number of children will have more flexibility in money

spending thus allowing them to buy more products or services in f-commerce storefronts due to the lesser commitment and burden. Likewise, consumers with high educational level are expected to earn more income thus enabling them to purchase more via the f-commerce platforms. Besides that, high rate of interactivity between members of virtual communities may lead to customer loyalty [Lu et al. 2010] and loyal users of Facebook communities will turn into a considerable pool of targeted consumers for e-vendors, hence intensity of Facebook usage will influence consumers' purchase intentions [Xu 2015]. From the perspective of Facebook usage, we foresee that consumers with high rate of Facebook usage will have high tendency to perform f-commerce purchase. Finally, consumers who have more experience in f-commerce are expected to become f-commerce consumers compared to the inexperienced ones as they have gained adequate experience, confidence and trust towards f-commerce. This is consistent with Hargittai [2007] who asserts that users with more experience with the Internet have higher tendency to become users of a social networking site.

Drawing from Web Usage Theory, in f-commerce, consumers need to go online to visit the f-commerce stores in order to purchase products or services. However, they may end up with pure browsing pleasure (i.e. hedonic benefit) or purchase of a product or service that they intended to buy (i.e. utilitarian benefit) or enjoy themselves while buying the product or service. Therefore, we expect that Web Usage Theory may predict consumers' f-commerce behaviors. Furthermore, in f-commerce stores, potential consumers make purchase decisions according to the advice from family and friends to whom they trusted [Raito 2007]. Drawing from the idea of relatedness in Trust Transference Theory, trust within a social network community can be transferred to other relevant sources such as trust in different companies within the particular community [Ng 2013]. Potential customers may perceive that online setting is well managed and safe and that everybody including sellers is trustworthy. Hence, we believe that Trust Transference Theory can predict f-commerce consumer behavior.

In terms of f-commerce usage behaviors, Ng [2013] has differentiated two forms of behavior, namely participation and browsing. Casaló et al. [2010] asserted that participating in community means producing content for the community and it signifies contributive and interactive community use behavior. Moreover, Wiertz and de Ruyter [2007] stressed that participation is a basis for establishing knowledge sharing among the company-hosted virtual communities. Similarly, adopters of Facebook community pages "participate in the community by producing content like posting comments on other users' posts or posting questions related to the host company's services or the community topic in general as well as posting product reviews and experiences" [Ng 2013, p. 4]. Active participation is assumed as a solid sign of members' commitment [Casaló et al. 2010] and brand loyalty which is assumed as a determinant of consumer purchase intention [Malthouse & Blattberg 2005]. In this study, f-commerce participation is defined as the extent to actively participate, contribute and generate content in the f-commerce, e.g. posting purchase information, comment on other users' posts, posting product reviews and experiences or questions regarding to the host company's services or f-commerce topic in general [Pöyry et al. 2013].

Browsing on the other hand has various definitions subject to the context and generally it is referred to as "a type of search behavior attributed by the user actively scanning an environment when moving through it" [Ng 2013, p. 4]. Chang and Rice [1993] stressed that browsing may be categorized as planned, unplanned, non-goal directed or goal directed. In this study, f-commerce browsing is defined as monitoring and scanning, most of the time via the 'newsfeed' view or directly on the real f-commerce page [Ng 2013]. In f-commerce context, the more the user surfs a page; the more probable the user is exposed to interesting and useful marketing messages and information which create positive predisposition and stimulate purchase intention. The purchase-related needs arise once browsing is repeated, and users will revisit the f-commerce page with more acute purchase-related needs which eventually trigger their intentions to purchase [Ng 2013]. Generally, when the propensity of Facebook usage increases, the tendency for users to engage in participation and browsing will also increases. Therefore, Facebook usage can act as a predictor for f-commerce purchase. Hence, according to these justifications, we suggest the research model (Figure 1) as follows.

5. Research Method

The study engaged quantitative research method with a cross sectional research design. The subsequent section will provide the research methodology details.
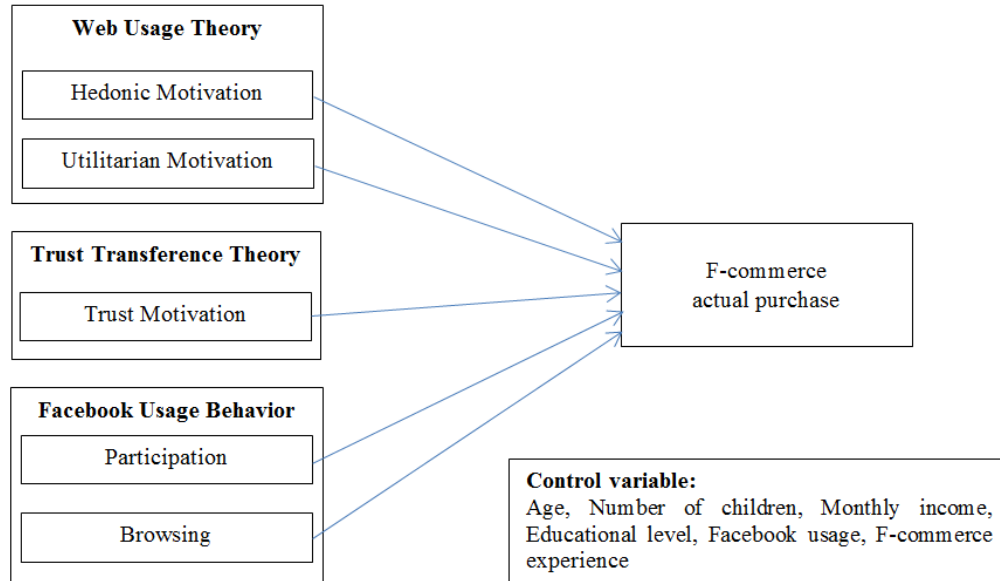
Figure 1: Research Model

5.1.   Instrument development and validation

The survey instrument has been rigorously validated for content and face validity, construct validity and reliability through pretest and pilot test. To ensure content validity, items from previously published studies were adapted as shown in Appendix B. In the pretest stage, a six member expert panel consists of three IS professors and three industrial practitioners who have social media or marketing background were consulted to seek their expert opinions on content and face validity. The industrial practitioners include a Vice President, an Executive Director and a General Manager. Minor amendments were performed according to their comments and suggestions. As suggested by Lynn [1986], a standard content validity index at item-level (I-CVI) of at least 0.83 and averaged scale-level CVI (S-CVI/Ave) of at least 0.90 for 6 experts were used to evaluate content validity. All items were found to have satisfied these criteria. To evaluate construct validity, two rounds of Q-sort procedure similar to Moore and Benbasat [1991] were engaged. In each round, two pairs of working professionals were involved as judges or rater to evaluate the relevancy of the scales with a four point scale (i.e. not, somewhat, relevant or very relevant) based on their definitions. The inter-rater agreements were measured using Kappa inter-rater reliability [Cohen 1960]. The first round yielded a Kappa of 66.05% while the second round produced 69.05% and both have exceeded the minimum threshold of 65% [Abhari et al. 2017; Cheung et al. 2011; Hew & Kadir 2016b; Lu & Ramamurthy 2011; Moore & Benbasat 1991]. The hit ratio (i.e. percentage of correct placements into the actual targeted constructs) for round 1 and 2 are 78% and 79% respectively. Therefore, we conclude that the instrument has good construct validity. In the pilot test stage, construct reliability was assessed by administering the draft instrument to 50 f-commerce users randomly chosen from Klang Valley, Malaysia. However, only 38 were returned (i.e. 76% response rate). The Cronbach's alpha for internal-consistency for all indicators were found to be above 0.70 and therefore we conclude that the instrument holds good reliability. Based on the feedbacks and comments from the respondents, minor amendments were done. The indicators in the finalized instrument are shown in Appendix B together with their sources.

5.2.   Operationalization of scales

Except for the demographic variables, all items of the constructs were measured through 7-point Likert scales starting from one (strongly disagree) until seven (strongly agree). Age, monthly income, educational level, Facebook usage, experience and average yearly purchase in f-commerce were measured using ordinal scales. The average yearly purchase is measured as follows:

My average yearly purchase using f-commerce is:
❑ *< $50*   ❑ *$50 – 100*   ❑ *$101 – 150*   ❑ *$151 – 200*   ❑ *$201 – 250*   ❑ *> $251*

5.3.   Sampling procedure

The population of f-commerce consumers is defined as Malaysian working adults with ages ranging from 15 to 64 years old [Department of Statistics 2016]. Due to the absence of sampling frame, the non-probability criterion sampling was engaged by selecting active f-commerce consumers who have made at least one transaction through f-

commerce platform in the past one year. Respondents were identified through mall intercept technique. Altogether, one thousand paper-and-pencil questionnaires have been administered to consumers in Klang Valley, Malaysia since this area has the highest Internet penetration rate per 100 household of 156.6 in Q2 for the year of 2015 [MCMC 2015]. Klang Valley or Greater Kuala Lumpur includes Malaysia's capital city and is a huge urban agglomeration with approximated population of 7.2 million in 2016 [World Population Review 2016]. Altogether, 808 questionnaires were successfully collected for further statistical analyses. On the reasons to participate in f-commerce, 9.7% are browsing for new products or services, 11.6% searching information for particular products or services, 14.7% evaluating products or services, 22.8% reviewing products and services, 32.8% purchasing products or services and 8.7% for entertainment/leisure/past times. The main obstacles in using f-commerce are 14.4% lack of guidance in how to use f-commerce, 14.8% lack of knowledge and skill in conducting f-commerce, 17.4% lack of time to browse through the many f-commerce pages, 24.6% lack of trust on the privacy of the information provided, 21.1% lack of confidence on the security of the f-commerce and 7.6% lack of budget to purchase items from f-commerce. The descriptive statistics of the survey respondents is shown in Appendix D. The sampling demographics are similar to urban populations in other countries; hence the finding of the study is generalizable.

5.4. Scale reliability and validity

The scales' reliability and validity were examined in the following sections.

5.4.1. Convergent validity and construct reliability

From Table 1, we found that all items possess Average Variance Extracted (AVE) more than the proposed threshold of 0.50 [Fang et al. 2016] and thus convergent validity is achieved. Meanwhile, composite reliability as well as Cronbach's alpha were engaged to assess construct reliability [Hew J.J. et al. 2016]. Table 1 further demonstrates that the Cronbach's alphas and composite reliability (CR) have superseded the standard threshold of 0.70. In addition, Table 2 also shows that CR is greater than the AVE indicating further support for construct reliability. Hence, it is concluded that the constructs are indeed reliable.

Table 1: Convergent Validity and Construct Reliability

Construct	AVE	Composite Reliability	Cronbach's Alpha
BR	0.8327	0.9372	0.9006
HM	0.8129	0.9453	0.9294
PTC	0.7797	0.9337	0.9127
TM	0.7371	0.9332	0.9189
UM	0.8085	0.9266	0.8915

Note: BR=F-commerce Browsing, HM=Hedonic Motivation, PTC=F-commerce Participation, TM=Trust Motivation, UM=Utilitarian Motivation; AVE=Average variance extracted.

5.4.2. Discriminant validity

Fornell-Larcker's [1981] criterion has been deployed to measure the discriminant validity and Table 2 also shows all square root of AVE is significantly bigger than the correlation coefficients indicating existence of discriminant validity [Zhu & Chang, 2015]. Besides that, the AVE is superior to the average shared variance (ASV) and maximum shared variance (MSV). The cross-loadings in Appendix C further strengthen the support for discriminant validity as the loadings load heavily to the relevant construct but poorly to other irrelevant constructs. On top of that we also used the heterotrait-monotrait (HTMT) criterion [Henseler et al. 2015] to assess discriminant validity. Appendix E and F show that all HTMT ratio correlations are less than the recommended threshold of 0.85 [Kline 2011] and all confidence intervals do not contain 1. Thus, discriminant validity is statistically verified.

Table 2: Correlations and Discriminant Validity

	BR	HM	PTC	TM	UM	CR	AVE	MSV	ASV
BR	**0.9125**					0.9372	0.8327	0.4844	0.2319
HM	0.2474**	**0.9016**				0.9453	0.8129	0.3593	0.1169
PTC	0.4611**	0.0862*	**0.8830**			0.9337	0.7797	0.3748	0.1746
TM	0.6960**	0.1997**	0.6122**	**0.8585**		0.9332	0.7371	0.4844	0.2630
UM	0.4117**	0.5994**	0.3221**	0.3912**	**0.8992**	0.9266	0.8085	0.3593	0.1964

Note: **$p<0.001$, *$p<0.05$; Diagonal element (bold) is the square root of the AVE; BR=F-commerce Browsing, HM=Hedonic Motivation, PTC=F-commerce Participation, TM=Trust Motivation, UM=Utilitarian Motivation, AVE=Average variance extracted, MSV=Maximum shared variance, ASV=Average shared variance, CR=Composite reliability; Marker=Urgency; n.a.=not applicable

5.4.3.   Overview of artificial neural networks (ANN)

ANN is a gigantic processor composing of large number of simple processing units identified as neurons and it resembles human brain in learning and storing knowledge through repetitive training processes and synaptic weights. ANN has been applied in various contexts of study including m-commerce (Chong 2013a), m-entertainment (Hew T.S. et al. 2016), aviation [Leong et al. 2015], m-music [Sim et al. 2014] and NFC-enabled mobile credit card [Leong et al. 2013].   It has even outperformed other traditional compensatory techniques like multiple, logistic and discriminant regression analyses [Chong 2013a].   In the current study, multi-layer perceptrons (MLP) with input, hidden and output layers are engaged using the feed-forward-back-propagation (FFBP) neural networks as it is the most widely used networks in the field of e-commerce [Chiang et al. 2006].   Input data is fed forward to the output layer via the hidden layer by using activation function.   At the learning process stage, synaptic weights are repetitively adjusted by applying the *Delta* rule within the range of 0 to 1 and the error (i.e. difference between actual and desired output) is computed by the output layer which is then repetitively transmitted backward to the input layer until a minimum error is obtained.

A ten-fold cross-validation procedure has been applied with ninety percent of the data deployed for training with the remaining for testing to avoid over-fitting [Chong 2013a].   We applied sigmoid activation functions for the output and hidden layers and allowed the amount of hidden neurons to be automatically calculated based on the Bayesian Information Criterion (*BIC*).   Root Mean Square of Errors or RMSE was engaged to measure model fit and normalized importance was calculated with sensitivity analysis.   Normalized importance refers to the ratio of individual relative importance over the maximum relative importance express as percentage.   According to the normalized importance, the predictive power of each predictor in the ANN model (Figure 2) can be compared.
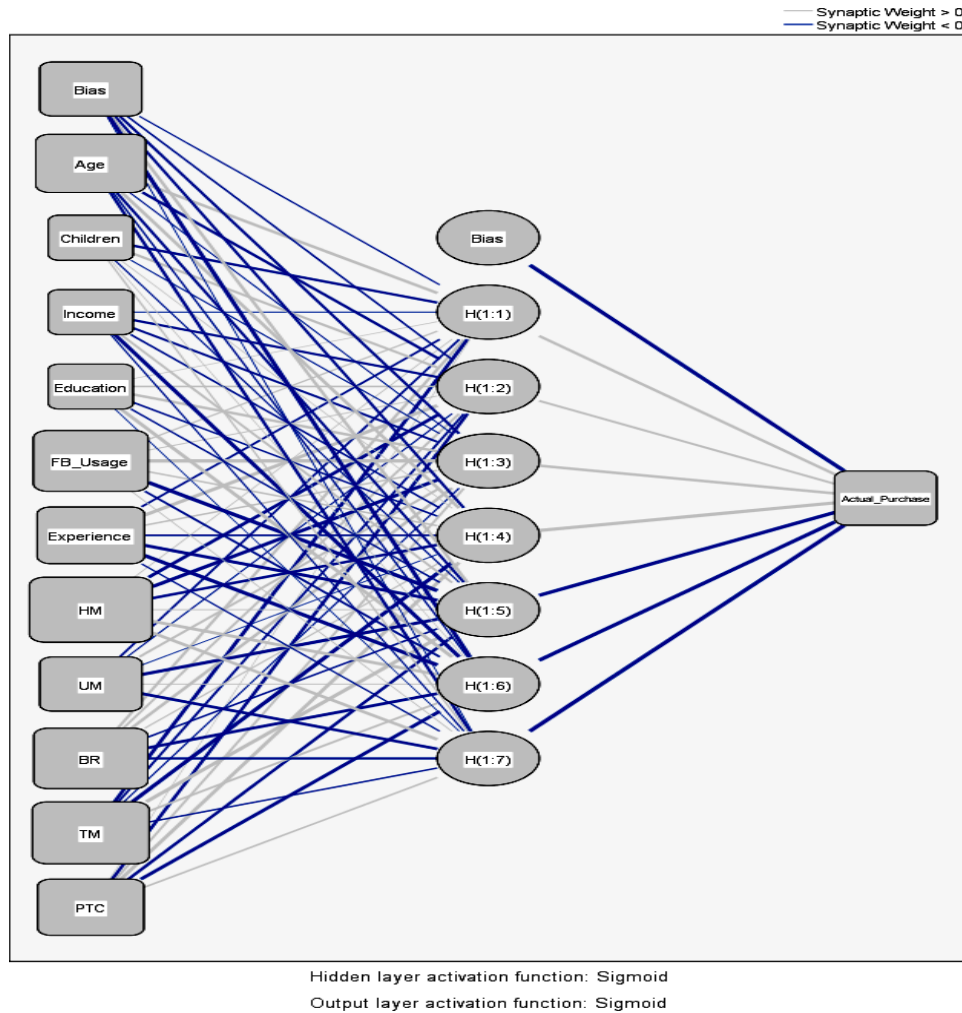

Figure 2: The f-Commerce ANN Model

6. Data analysis

6.1. Assessment of multivariate assumptions

Prior to multivariate statistical analysis, several assumptions need to be satisfied. The following sections will provide the details of these assumptions.

6.1.1. Normality of distribution

The normality assumption has been examined through one-sample Kolmogorov-Smirnov test and the p-value shows that the constructs are not distributed normally.

6.1.2. Linearity of relationships

Linearity of relationship was examined using ANOVA test and a p-value greater than 0.05 on deviation from linearity indicates linear relationship between the two variables and vice versa. Table 3 shows that there are non-linear relationships between average purchases in f-commerce with age, number of children, monthly income, educational level and Facebook usage. However, there are also linear relationships between average purchases in f-commerce with experience in f-commerce, hedonic, utilitarian and trust motivation, browsing and participation.

Table 3: ANOVA Test of Linearity

		Sum of Squares	df	Mean Square	F	Sig.	Linearity
FCAP * Age	Deviation from Linearity	14.608	4	3.652	3.051	0.016	No
FCAP * Number of children	Deviation from Linearity	18.779	4	4.695	3.838	0.004	No
FCAP * Monthly Income	Deviation from Linearity	49.042	5	9.808	8.448	0.000	No
FCAP * Education	Deviation from Linearity	28.037	4	7.009	5.793	0.000	No
FCAP * Facebook usage	Deviation from Linearity	39.362	4	9.840	8.697	0.000	No
FCAP * Experience	Deviation from Linearity	1.636	3	0.545	0.484	0.694	Yes
FCAP * HM	Deviation from Linearity	21.667	21	1.032	0.833	0.680	Yes
FCAP * UM	Deviation from Linearity	24.595	16	1.537	1.236	0.234	Yes
FCAP * BR	Deviation from Linearity	13.713	17	0.807	0.660	0.844	Yes
FCAP * TM	Deviation from Linearity	43.607	29	1.504	1.215	0.203	Yes
FCAP * PTC	Deviation from Linearity	32.088	21	1.528	1.249	0.202	Yes

Note: FCAP= F-commerce actual purchase, BR=F-commerce Browsing, HM=Hedonic Motivation, PTC=F-commerce Participation, TM=Trust Motivation, UM=Utilitarian Motivation; df=degree-of-freedom

6.1.3. Multicollinearity

In any multivariate regression analysis, the existence of multicollinearity problem may render the statistical results invalid. The existence of multicollinearity is examined through variance inflation factor [Liang et al. 2012] and tolerance [Hew & Kadir 2016a]. We found that the VIF is below 10 while tolerance is above 0.10 hence suggesting that there is no issue of multicollinearity [Hair et al. 2016]. This is further validated based on the correlation coefficients less than 0.80 (Table 2).

6.1.4. Homoscedasticity

Homoscedasticity of distribution was validated based on the scatter plot of standardized residual of the dependent variable. The scatter plot shows that the residuals scatter uniformly along the diagonal straight line supporting the existence of homoscedasticity.

6.2. Common method bias (CMB)

The issue of CMB was addressed using both procedural and statistical approaches [Chiu et al. 2017; Choi et al. 2017; Wirtz et al. 2017]. Procedurally, the anonymity of respondents' identities and the non-existence of right or wrong answers were conveyed to all respondents and these respondents were required to attempt all questions candidly [Podsakoff et al. 2003]. Statistically, we evaluated Harman's single factor [Hew & Kadir 2016b, 2016c] and found that a sole factor can explain just 23.3% of the total variance. Thus, we conclude that there is no CMB problem. Similar to Chang et al. [2015, p. 6], we applied the correlational marker variable (MV) method [Lindell & Whitney 2001] by using a twelve-item 7-point Likert scale of urgency as the marker variable as it is theoretically unrelated to at least one variable and offered as a proxy for CMB. Lindell and Whitney [2001] asserted that the least observed correlation between the MV and any other key variable that is theoretically unrelated is assumed to be caused by CMB. The correlation between the MV and income has the smallest positive correlation of 0.007 and therefore was used in the partial correlation adjustment procedure. Following Wuyts et al. [2015, p. 45], we calculated the adjusted

correlation (Equation 1) and the respective t-statistics (Equation 2) as recommended by Malhotra et al. [2006, p. 1868] and Lindell and Whitney [2001].

$$r_A = \frac{r_U - r_M}{1 - r_M} \qquad \text{(Equation 1)}$$

$$t_{\alpha/2,n-3} = \frac{r_A}{\sqrt{\left(1 - r_A^2\right)/(n-3)}} \qquad \text{(Equation 2)}$$

where r_A is the adjusted correlation coefficient, r_M is the MV correlation coefficient and r_U is the uncorrected (observed) correlation coefficient.

The adjusted correlation coefficients are slightly lower than the uncorrected correlation coefficients and all of the correlation coefficients remained significant even after the partial correlation adjustment indicating CMB is not an issue [Lee et al. 2015]. In addition, Table 2 shows that the correlation coefficients are less than 0.90 indicating no CMB problem [Pavlou et al. 2006].

6.3. Non-response bias

Similar to Teo et al. [2009], we conducted chi-square test on the demographic variables between late and early respondents. The test indicated no substantial differences in age ($\chi^2_{5,N=808} = 5.287, p = 0.382$), number of children ($\chi^2_{4,N=808} = 8.437, p = 0.077$), monthly income ($\chi^2_{6,N=808} = 6.590, p = 0.360$) and educational level ($\chi^2_{5,N=808} = 6.511, p = 0.260$) between the late and early respondents. Thus, we conclude non-response bias is a non-issue.

6.4. Artificial neural networks and structural equation modeling

Basically there are three approaches to be used in multivariate statistical analysis namely the covariance-based SEM such as AMOS, LISREL, EQS, etc., variance-based SEM like SmartPLS 3 [Ringle et al. 2015], Visual PLS, PLS Graph, etc. and artificial neural network such as SPSS Neural Network module, Tiberius, WinNN, etc. The choice depends on the following criteria:

1. Multivariate assumptions: Covariance-based SEM demands that all multivariate assumptions (i.e. normality, linearity, homoscedasticity, multicollinearity) are fulfilled with absence of outliers and presence of large sample size. However, variance-based SEM is robust against non-normality, outliers and small sample size but requires satisfaction of linearity, multicollinearity and homoscedasticity. Artificial neural network however is robust to all multivariate assumptions, outliers and is also able to identify both linear and non-linear associations.

2. Nature of study: Covariance-based SEM is mainly apposite for theory testing and confirmation with strong underlying hypotheses and is model driven based on goodness-of-fit indices while variance-based SEM is appropriate for theory building and it is data driven based on maximum variance explained [Jöreskog 1982]. However, artificial neural network has the highest predictive power and can be used when there is lack of underlying hypotheses [Henseler et al. 2009].

Since the assumptions of normality and linearity were violated and there is lack of underlying hypotheses that predict actual purchase in f-commerce, we therefore have decided to choose artificial neural network approach for this study.

6.5. Predictive relevance, neural network validation and variance explained

Predictive relevance of the ANN model was validated as there is more than one non-zero synaptic weights linked to the hidden layers. Predictive accuracy is measured by using RMSE and Table 4 depicts that the mean RMSE values for the ten neural networks in the training and testing process are 0.1395 and 0.1379 respectively indicating very high degree of predictive accuracy. Similar to Philips et al. [2015], we computed the percentage of variance explained (R^2) based on the average RMSE and variance of preferred output (s_y^2) of testing where

$$R^2 = 1 - \frac{RMSE}{s_y^2}$$

The result shows that the ANN model can explicate 91.3% of the total variance in actual purchase.

6.6. Sensitivity analysis

Sensitivity analysis is used to compare the relative importance and normalized importance of the predictors [Lee et al. 2016]. Table 5 illustrates that the normalized importance (NI) ranging from 7.8% to 100% with experience in f-commerce as the strong predictor for actual purchase (NI=100%) followed by Facebook usage (NI=80.2%), hedonic motivation (NI=72.1%), browsing (NI=67.5%), age (NI=49.4%), trust motivation (NI=49.3%), participation (NI=37.9%), utilitarian motivation (NI=37.5%), number of children (NI=21.4%), monthly income (NI=19.0%) and finally educational level (NI=7.8%). Similar to Sexton et al. [2002], we also analyzed the data using correlations to examine the direction of causality of all independent predictors on actual purchase in f-commerce. Table 6 shows that except for hedonic motivation which has negative effect, other predictors have positive effects on actual purchase in f-commerce.

Table 4: RMSE Values for Training and Testing Processes

Network	Training			Testing		
	N	SSE	RMSE	N	SSE	RMSE
1	722	13.626	0.1374	86	1.472	0.1308
2	724	13.749	0.1378	84	1.901	0.1504
3	725	13.941	0.1387	83	1.841	0.1489
4	724	14.380	0.1409	84	1.203	0.1197
5	725	14.404	0.1410	83	1.134	0.1169
6	731	13.811	0.1375	77	1.971	0.1600
7	720	13.991	0.1394	88	2.132	0.1557
8	732	15.709	0.1465	76	1.231	0.1273
9	731	13.580	0.1363	77	1.381	0.1339
10	721	14.108	0.1399	87	1.589	0.1351
	mean	14.130	0.1395	**mean**	1.586	0.1379
		sd	0.0029		**sd**	0.0151

Note: N=number of data; sd = standard deviation; SSE=Sum square of error; RMSE=Root mean square of error

Table 5: Sensitivity Analysis

Network	Relative importance										
	Age	Children	Income	Edu	FBU	Exp	HM	UM	BR	TM	PTC
1	0.126	0.032	0.030	0.022	0.126	0.161	0.155	0.078	0.118	0.091	0.063
2	0.071	0.017	0.021	0.008	0.156	0.173	0.155	0.092	0.115	0.117	0.074
3	0.075	0.038	0.047	0.005	0.173	0.232	0.135	0.077	0.101	0.054	0.064
4	0.073	0.023	0.009	0.006	0.140	0.150	0.167	0.104	0.149	0.130	0.050
5	0.082	0.016	0.025	0.010	0.153	0.171	0.147	0.069	0.164	0.113	0.050
6	0.105	0.038	0.018	0.007	0.183	0.216	0.140	0.052	0.110	0.072	0.061
7	0.092	0.054	0.078	0.030	0.185	0.213	0.094	0.057	0.126	0.021	0.051
8	0.134	0.055	0.072	0.022	0.064	0.185	0.059	0.062	0.097	0.098	0.150
9	0.088	0.052	0.024	0.026	0.137	0.163	0.122	0.028	0.139	0.142	0.078
10	0.066	0.070	0.027	0.007	0.163	0.181	0.157	0.073	0.126	0.072	0.058
Mean	0.091	0.040	0.035	0.014	0.148	0.185	0.133	0.069	0.125	0.091	0.070
Normalized	**49.4**	**21.4**	**19.0**	**7.8**	**80.2**	**100.0**	**72.1**	**37.5**	**67.5**	**49.3**	**37.9**

Note: Edu=Education, FBU=Facebook Usage, Exp=Experience, HM=Hedonic Motivation, UM=Utilitarian Motivation, BR=F-commerce Browsing, TM=Trust Motivation, PTC=F-commerce Participation

Table 6: Correlations: Direction of Effect on Actual Purchase

	Age	Children	Income	Edu	FBU	Exp	HM	UM	BR	TM	PTC
FCAP	0.181	0.089	0.169	0.096	0.246	0.317	-0.128	0.023	0.175	0.059	0.140

Note: FCAP=F-commerce Actual Purchase in f-commerce, Edu=Education, FBU=Facebook Usage, Exp=Experience, HM=Hedonic Motivation, UM=Utilitarian Motivation, BR=F-commerce Browsing, TM=Trust Motivation, PTC=F-commerce Participation

Following Phillips et al. [2015], we calculated the contribution of the predictor in the hidden layer based on their sum of absolute values. Table 7 indicates that experience is the strongest contributory predictor followed by utilitarian motivation, age, hedonic motivation, browsing, FB usage, trust motivation, education, participation, number of children and finally monthly income. The result also reveals that the hidden neuron H(1:3) has the strongest contributory influence on actual purchase followed by H(1:4) H(1:2) and H(1:7). Surprisingly, H(1,5) was found to have the strongest inhibitory influence on actual purchase followed by H(1,6) and H(1,1).

Table 7: Contribution of Hidden Layer Based on Synaptic Weight

| | | Predicted | | | | | | | Output Layer | |
| | | Hidden Layer 1 | | | | | | | F-commerce Actual Purchase | Total contribution |
Predictor		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)		
Input Layer	(Bias)	-0.167	0.163	-0.429	0.245	0.357	-0.176	-0.330		
	Age	0.090	-0.378	-0.085	0.503	-0.518	-0.543	-0.504		2.621
	Children	-0.368	0.377	0.065	0.206	0.128	-0.033	-0.377		1.553
	Income	0.021	-0.334	-0.074	0.058	0.142	-0.663	-0.172		1.465
	Edu	0.194	0.372	0.305	0.158	-0.054	0.337	0.286		1.705
	FBU	0.012	0.278	0.597	0.272	-0.888	0.048	-0.149		2.244
	Exp	-0.220	0.527	0.205	-0.112	-0.766	-1.013	-0.375		3.218
	HM	0.283	-0.741	-0.487	-0.306	0.036	0.183	0.416		2.452
	UM	-0.373	-0.304	0.395	-0.426	-0.413	0.547	-0.388		2.845
	BR	0.275	0.169	0.717	0.191	0.219	-0.418	-0.461		2.451
	TM	-0.206	0.024	0.373	-0.364	0.236	-0.104	-0.448		1.755
	PTC	-0.214	-0.398	-0.084	0.632	-0.066	-0.253	-0.005		1.653
Hidden Layer 1	(Bias)								-0.766	
	H(1:1)								-0.156	
	H(1:2)								0.202	
	H(1:3)								0.765	
	H(1:4)								0.397	
	H(1:5)								-0.961	
	H(1:6)								-0.812	
	H(1:7)								0.055	

Note: Edu=Education, FBU=Facebook Usage, Exp=Experience, HM=Hedonic Motivation, UM=Utilitarian Motivation, BR=F-commerce Browsing, TM=Trust Motivation, PTC=F-commerce Participation

7. Discussions

It is quite surprising and interesting to discover that experience has emerged as the strongest predictor for actual purchase in comparison to constructs from Web Usage Theory, Trust Transference Theory, Facebook usage behavior and other demographic variables. It shows that the more experienced the consumers, the more he or she will actually purchase in f-commerce. This may be attributed to the previous post-purchase experiences which drive consumers to establish higher degree of trust and confidence towards f-commerce. Equally astonishing is Facebook usage which emerged as the second strongest predictor and demonstrated a non-linear relationship towards actual purchase. This has provided sufficient support that the more the consumers use Facebook, the volume of actual purchase will also increases.

From the perspective of Web Usage Theory, hedonic motivation has outperformed utilitarian motivation as it can provide 72.1% normalized importance compared to 37.5%. This influence is twice as strong as the effect from utilitarian motivation. Surprisingly, the finding shows that when consumers possess high degree of hedonic sensation, it will reduce their actual purchase behavior based on the negative direction (Table 6). It shows that high degree of

enjoyment and pleasure may overshadow consumers' tendency to actual purchase. The sensation of enjoyment may have distracted consumers' actual purchase. This is contradicting to the finding by Chiu et al. [2014]. However, the finding also shows that if consumers perceive that f-commerce can fulfill their task-related needs, they are more likely to conduct more actual purchase. The effect of utilitarian motivation is similar to Chiu et al. [2014]. However, from the perspective of Trust Transference Theory, trust motivation (NI=49.3%) has a stronger effect than utilitarian motivation. Again, there is evidence to support that when consumers have higher degree of trust in f-commerce, their tendency to perform actual purchase will also be higher. This is similar to the finding of Corbitt et al. [2003].

In terms of F-commerce usage behaviors, f-commerce browsing (NI=67.5%) is twice as strong as participation (NI=37.9%). The double size effect is attributed by the fact that f-commerce consumers have more interest in browsing than participating in f-commerce. Generally, the evidence shows that the more the consumers browse the f-commerce stores or the more active they involve themselves in f-commerce, the magnitude of the actual purchase will be also greater.

Except for Facebook usage (NI=80.2%), which emerged as the overall second strongest predictor, among the demographic variables, age (NI=49.4%) is the strongest followed by number of children (NI=21.4%), monthly income (NI=19.0%) and finally educational level (7.8%). However, all of these effects of are non-linear and the effect of age is almost double as strong as number of children and monthly income. Interestingly, the finding shows that the more the numbers of children, the more the consumers actually buy. This shows that consumers who can be also parents may purchase items or services in f-commerce not only for themselves but for their children as well. However, the effect of educational level is marginally significant as the NI is less than 10%. Based on the positive directions (Table 6), it is obvious that consumers of older age, higher monthly income and educational level are having more spending power and thus are able to spend more on actual purchase.

7.1.   Theoretical contributions

The principal theoretical contribution is the application of the integrated research model using Web Usage Theory, Trust Transference Theory, f-commerce usage behaviors and demographic variables. The effects of demographic variables were perhaps examined for the first time in f-commerce contexts and the non-linear relationships of these demographic variables may provide new insight and understanding to scholars and can further enriched the f-commerce literature. Furthermore, the negative effect of hedonic motivation on actual purchase is a new finding and may open the eyes of researchers as previous studies only reveal positive effects. This study may be also among the first studies to validate the influences of f-commerce usage behaviors on f-commerce actual purchase.

The second contribution is the use of actual purchase as the outcome measure in comparison to other commonly used dependent variables in previous studies such as purchase intention, usage intention, customer loyalty, satisfaction, etc. This is perhaps the first time that the determinants or antecedents of actual purchase in f-commerce were empirically validated. These findings have provided the necessary theoretical foundation for future studies and may create a new paradigm shift from studying purchase intention to actual purchase in s-commerce generally.

Third, the use of ANN approach has contributed to the advancement in research methods. Previous studies have used linear and compensatory models such as SEM, PLS, MLR, etc. This is perhaps the first time ever that a non-compensatory and non-linear ANN model is used to study actual purchase in f-commerce. As ANN can identify linear and non-linear relationships, the study has provided a new approach in studying consumer behaviors in f-commerce. Finally, the theoretical contributions perhaps have further enhanced the research framework proposed by Liang and Turban [2011] in terms of new theories, context of study, research method and outcome measure.

7.2.   Managerial contributions

There are some important managerial contributions of this study. Firstly, since experience is the strongest predictor of actual purchase, f-commerce sellers, marketers and advertisers may consider promoting f-commerce shopping experience to potential and new customers by offering first time buyers to get the experience of actually buying some products or services with great discounted price; free e-vouchers; or free product trial. Regular offering of small tokens or gifts may eventually turn the new buyers to become long term customers if they perceive these small gestures as something valuable to them and they may reciprocate by returning to buy more products. Their pleasant experiences gained through these transactions may become a factor leading to more similar f-commerce transactions in future.

Secondly, to raise the Facebook usage intensity, f-commerce sellers may host contests in which their active followers with the most shares and social media engagements can be duly rewarded with complementary products or additional discounts for products or services purchased. It is also essential for the f-commerce sellers to regularly post quality and worth sharing contents and also useful information with regards to their businesses in their official Facebook pages. By doing so, it may encourage their followers to regularly check for more updates and hopefully become a habit to visit the Facebook pages regularly and may end up making purchase when they come across something useful to them.

Thirdly, since hedonic may have distraction effect of actual purchase, f-commerce players and stakeholders may consider focusing in other areas such as increasing browsing, participation, utilitarian motivation and trust towards their f-commerce pages. As such, more attention should be given in formulating more effective advertising strategies that may attract targeted audience to often browse their Facebook pages. These may include video ads, pop-up discount banners and posts that can communicate contents to the audience in a chatty style or informal tone so that audience feels connected to the f-commerce sellers. In addition, creative or humorous videos may gain more shares and attention and thus can increase the browsing rate.

Fourthly, to increase Facebook participation from users, they are encouraged to check-in at business places and in return, they can be rewarded with some kind of incentives such as free drinks or vouchers redeemable on the spot. Check-in feature can act as a promotion tool, particularly to local audience as it provides free visibility in the news feed for other Facebook users to know more about a particular business. The perception that a business is popular; offers good quality or variety of products; or good customer service can be generated when more Facebook users check-in to certain business places and indirectly can bring more income to the f-commerce sellers. Besides that, f-commerce sellers can drive more audience and increase participations at their Facebook stores by being attentive and create topics that their followers or fans are hotly talking about.

Fifth, to enhance utilitarian motivation among consumers, the f-commerce stores' owners must be smart in ensuring the content types can echo with their followers or targeted audience. It can be very encouraging for their followers having to see their pictures, posts, or other user generated contents being highlighted at the f-commerce stores. Hence, they will develop a "task" in their mindset and be motivated to post more quality contents. Besides that, it is important to ensure the f-commerce stores is being included with complete task-related features such as "search", "buy" or "add-to-cart", "pay", "recommend", "book", "availability", "watch", "comment", "feedback", "wishlist", "money converter", "redeem points", "tag", etc.

From the perspective of psychology, f-commerce sellers can build consumers' trust by developing partnerships with people or brands that their target audience or fans trust as a way to build brand credibility. This tactic is effective because consumers tend to response better to those they trust and will not hesitate to make purchase from these f-commerce stores. In addition, f-commerce sellers can organize social events such as tea breaks; children coloring competitions; or fun-runs and share these events with their fans through their Facebook pages. Through these events, f-commerce sellers would have better opportunities to be closer to their fans, which are essential steps in building customer trust and loyalty that eventually can turn into actual sales. F-commerce sellers may also provide money back guarantee for unsatisfactory services or replacement for faulty items to boost the trust level in their customers. Testimonies from existing customers can also be displayed on their Facebook pages to convince the potential new customers or target audience. Nevertheless, to build consumers' trust and loyalty, it would be the best if these f-commerce sellers themselves can become influencers in their market rather than just followers of the trend.

Finally, f-commerce marketers should also pay attention in catering to the differences in terms of age, number of children, monthly income and educational level among the f-commerce consumers. A 'one size for all' marketing strategy cannot be applied across all consumer segments. Therefore, the f-commerce stores may utilize customer sensitive pop-up by tracking on the customer's buying preferences so that individual attention can be given to each customer. Alternatively, customers can be referred to different pages based on their purchasing styles. In terms of Facebook ad, f-commerce sellers can be more precise in reaching out to their audience by selecting the demographics such as location, age range, education, gender, interest, income level or behaviors of audience they wish to target. This will further increase the chances of these target audience to perform actual purchase in f-commerce.

8. Limitation and future research

The study is constrained in terms of geographical region; hence future studies may use larger geographical setting or focus on cultural and cross-country comparative studies. Since the study engaged cross-sectional design, future studies may use longitudinal design to examine the temporal effects. In addition, in terms of sampling limitation, since the study engaged criterion sampling, the outcomes of the study maybe limited therefore we suggest that future studies may use random sampling. As for data limitation, the sample size of the study is limited to 808 f-commerce consumers; therefore we recommend that future studies may use larger sample size in order to increase its external validity. Finally, since this study has provided the necessary theoretical foundation on actual purchase in f-commerce, future studies may develop hypotheses that predict actual purchase and use parametric hypothesis testing instead of the non-parametric ANN model.

9. Conclusions

This study has successfully identified the normalized importance of the predictors of actual f-commerce purchase and thus provided the necessary theoretical foundation for future studies. Except for educational level, other demographic variables, web usage theory, trust transference theory and f-commerce usage behaviors have demonstrated adequate predictive powers towards actual purchase. The ANN approach has provided a new research method in detecting both linear as well as non-linear relationships. In a nutshell, the research findings have further advanced the f-commerce literature in terms of theories, outcome measure, research method and context of study.

Acknowledgments

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Appendix A. Summary of existing studies on purchase intention, decision or behavior in social commerce

Study	Anderson et al. (2014)	Goodrich & Mooij (2014)	Hajli (2014)	Harris & Dennis (2011)*	Kang & Johnson (2015)	Kim & Ko (2010)	Kim & Ko (2012)	Kim et al. (2014)	Kim et al. (2011)	Mikalef et al. (2013)	Nampech (2014)	Ng (2013)	Park et al. (2014)	Pöyry et al. (2013)	Wang & Chang (2013)	Wang et al. (2012)
Research theme	Purchase intention in Retailer Facebook Pages	Purchase decision in social media	Purchase intention in SNSs	Purchase intention in Facebook	Intention in online social shopping	Purchase intention in SNSs	Purchase intention in luxury fashion brand	Purchase intention for virtual products in multi-channel shopping	Purchase intention in digital items	Purchase intention in SNSs	Purchase behavior in social media	Purchase intention in clothes	Purchase intention of social deals	Purchase intention in a travel agency's Facebook page	Purchase intention in online social ties & product-related risk	Purchase intention in social media peer communications
Sampling method	250 Facebook users selected using online consumer panel	27,000 Internet users selected using Nielson Global Online consumer survey	500 online and 300 paper survey were selected using criterion sampling	Convenience sample of 26 undergraduates	Purposive sampling of 601 users chosen from consumer panel	Convenience sampling of 304 college students	Convenience sample of 362 consumers	Convenience sample of 212 consumers	225 Cyber world members selected using random online sampling	Convenience sample of 165 undergraduates	Convenience sample of 412 online consumers	284 Facebook users selected by snowball sampling	Judgment sampling of 211 SNS users	Web survey of 1162 Facebook users by public web link.	2 x 2 between subjects design using 216 random samples	Criterion sampling of 292 online consumers
Model/Theory	Utilitarian & Hedonic values	Hofstede dimensions	Modified TAM	None	Mowen's 3M model		Perceived SMM activities	Social capital theory	Customer value theory	Hedonic & Utilitarian motivations	None	Trust transference theory	Social network theory	Hedonic & Utilitarian motivations	Information processing theory	Socialization theory

Scale	4-point Likert	Miscellaneous	5-point Likert	N.A.	5-point Likert		5-point Likert	5-point Likert	7-point Likert	7-point Likert	5-point Likert	7-point Likert	7-point Likert	7-point Likert	7-point Likert	7-point Likert
Expert panel (Face validity)	No	No	Yes	N.A.	No		No	No	Yes	No	No	No	No	No	No	No
Content validity index (CVI)	No	No	No	N.A.	No		No	No	No	No	No	No	No	No	No	No
Q-sort (kappa & hit ratio)	No	No	No	N.A.	No		No	No	No	No	No	No	No	No	No	No
Pre-test/ Pilot test	No	No	No	N.A.	No		Only pre-test	No	No	No	No	No	No	Only pre-test	Only pilot test	No
CMB tested	No	No	No	N.A.	No		No	No	No	No	No	Yes	No	No	No	No
Non-response bias tested	No	No	No	N.A.	No		No	No	Yes	No	No	No	No	Yes	No	No
Normality test	No	No	No	N.A.	No		No	No	No	No	No	No	No	No	No	No
Linearity test	No	No	No	N.A.	No		No	No	No	No	No	No	No	No	No	No
Homoscedastici-ty test	No	No	No	N.A.	No		No	No	No	No	No	No	No	No	No	No
Multi-collinearity test	No	No	No	N.A.	No		No	No	No	No	No	No	No	No		No
Statistical test	SEM	Stepwise MLR	PLS-SEM	FGD	SEM, MGA		SEM	SEM	SEM	PLS-SEM	Factor analysis	SEM, MGA	SEM	SEM	ANOVA	SEM

Note: * qualitative study; FGD=Focus group discussion, SEM=Structural equation modeling; PLS= Partial least squares; MGA=Multiple Group Analysis; N.A.=Not applicable; TAM=Technology acceptance model; SMM=Social media marketing; SNSs=Social networking sites.

Appendix B. Items and their sources

Construct and indicators	Source(s)
Hedonic Motivation (HM) HM1: Using the Facebook Pages is truly a joy.[1] Compared to the other things I could have done, being in the Facebook Pages is truly enjoyable.[1] I enjoy using the Facebook Pages for its own sake, not just for the information I find.[1] HM4: I enjoy passing the time in the Facebook Pages.[2]	1. Babin et al. (1994) 2. Hartman et al. (2006)
Utilitarian Motivation (UM) Success in the Facebook Pages is finding what I'm looking for. The Facebook Pages help me with purchase planning. I like to get in and out the Facebook Pages with no time wasted.	Hartman et al. (2006)
Trust Motivation (TM) I feel fine interacting with the social network community (e.g., friends, and relatives) because it fulfills my needs of interaction efficiently. I always feel confident that I can rely on the social network community's (e.g., friends, and relatives) responses and feedback when I interact with them. I assume my Facebook friends would always look out for my interests. I assume my Facebook friends would make sure that I was not harmed or in danger. TM5: I feel like my Facebook friends care what happens to me.	Ng (2013)
F-commerce Participation (PTC) : I participate actively in the Facebook Pages activities (for example by posting to the page or commenting other's posts). PTC2: I use to contribute to the Facebook Pages. : I usually provide useful purchase information to other Facebook Pages members. : I post messages and responses in the Facebook Pages with great excitement and frequency.	Casaló et al., (2010)
F-commerce Browsing (BR) The percent of my time I spent just looking around on the browsing trip was fairly high. I would say that I was primary ''just looking around'' on this browsing trip. I devoted most of my attention to the items I planned to buy in this browsing trip.	Beatty & Farrell (1998)

Appendix C. Cross loadings

	BR	HM	PTC	TM	UM
BR1	**0.873**	0.248	0.417	0.562	0.370
BR2	**0.932**	0.256	0.430	0.651	0.377
BR3	**0.932**	0.189	0.419	0.681	0.380
HM1	0.152	**0.938**	0.009	0.130	0.464
HM2	0.235	**0.962**	0.073	0.169	0.538
HM3	0.298	**0.903**	0.142	0.246	0.641
HM4	0.331	**0.795**	0.216	0.292	0.733
PTC1	0.463	0.165	**0.769**	0.652	0.313
PTC2	0.417	0.117	**0.893**	0.581	0.298
PTC3	0.409	0.072	**0.937**	0.543	0.285
PTC4	0.411	0.036	**0.924**	0.520	0.286
TM1	0.728	0.201	0.492	**0.892**	0.365
TM2	0.610	0.149	0.521	**0.924**	0.344
TM3	0.536	0.159	0.550	**0.878**	0.333
TM4	0.502	0.181	0.569	**0.828**	0.322
TM5	0.480	0.170	0.644	**0.762**	0.307
UM1	0.350	0.646	0.253	0.298	**0.827**
UM2	0.364	0.570	0.276	0.342	**0.931**
UM3	0.398	0.499	0.325	0.393	**0.935**

Note: HM=Hedonic Motivation, UM=Utilitarian Motivation, BR=F-commerce Browsing, TM=Trust Motivation, PTC=F-commerce Participation

Appendix D. Descriptive statistics of survey respondents

		Frequency	Percent
Gender	Female	447	55.3
	Male	361	44.7
Age	15 to 24 years	250	30.9
	25 to 34 years	395	48.9
	35 to 44 years	125	15.5
	45 to 54 years	28	3.5
	55 to 64 years	8	1.0
	65 years or more	2	0.2
Number of children	None	644	79.7
	1	95	11.8
	2	43	5.3
	3	17	2.1
	4	8	1.0
	5	1	0.1
Monthly income	$1000 or less	166	20.5
	$1001 - $2000	83	10.3
	$2001 - $3000	332	41.1
	$3001 - $4000	91	11.3
	$4001 - $5000	89	11.0
	$5001 - $10000	44	5.4
	More than $10000	3	0.4
Educational level	O-Level	240	29.7
	A-Level	58	7.2
	Diploma	257	31.8
	Bachelor	212	26.2
	Master	32	4.0
	Ph. D.	9	1.1
Weekly hours spent surfing the Internet	Lee than 7 hours	450	55.7
	7 to 14 hours	192	23.8
	15 to 21 hours	140	17.3
	More than 21 hours	26	3.2
Years of f-commerce experience	Less than 1 year	147	18.2
	1 to 2 years	433	53.6
	3 to 4 years	211	26.1
	5 to 6 years	13	1.6
	More than 6 years	4	0.5
Number of f-commerce transactions in the last 12 months	1 to 5 times	500	61.9
	6 to 10 times	250	30.9
	11 to 15 times	50	6.2
	More than 15 times	8	1.0
Average purchase using f-commerce	Less than $50	168	20.8
	$50-100	366	45.3
	$101-150	162	20.0
	$151-200	71	8.8
	$201-250	24	3.0
	More than $250	17	2.1

Appendix E. HTMT ratio correlations

	Age	BR	Child	Edu	Exp	FBU	FCAP	HM	Income	PTC	TM	UM
Age												
BR	0.072											
Child	0.557	0.064										
Edu	0.384	0.037	0.133									
Exp	0.041	0.114	0.017	0.122								
FBU	0.059	0.030	0.105	0.051	0.242							
FCAP	0.181	0.179	0.089	0.096	0.317	0.246						
HM	0.126	0.311	0.115	0.049	0.010	0.071	0.117					
Income	0.591	0.069	0.290	0.531	0.081	0.019	0.169	0.104				
PTC	0.087	0.528	0.072	0.017	0.075	0.066	0.128	0.163	0.113			
TM	0.063	0.719	0.043	0.021	0.061	0.051	0.052	0.246	0.059	0.738		
UM	0.044	0.456	0.038	0.081	0.009	0.013	0.022	0.756	0.038	0.360	0.413	

Note: BR = F-commerce browsing, Child = Number of children, Edu = Educational level, Exp = F-commerce experience, FBU = Facebook usage, FCAP = F-commerce actual purchase, HM = Hedonic motivation, Income = Month income, PTC = F-commerce participation, TM = Trust motivation, UM = Utilitarian motivation.

Appendix F. HTMT confidence intervals

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
BR → Age	0.072	0.075	0.017	0.146
Children → Age	0.557	0.557	0.498	0.613
Children → BR	0.064	0.069	0.018	0.138
Edu → Age	0.384	0.384	0.311	0.454
Edu → BR	0.037	0.046	0.010	0.109
Edu → Children	0.133	0.132	0.063	0.199
Exp → Age	0.041	0.046	0.002	0.116
Exp → BR	0.114	0.114	0.045	0.184
Exp → Children	0.017	0.035	0.001	0.095
Exp → Edu	0.122	0.121	0.050	0.189
FBU→ Age	0.059	0.061	0.003	0.133
FBU → BR	0.030	0.041	0.008	0.101
FBU → Children	0.105	0.106	0.034	0.180
FBU → Edu	0.051	0.053	0.003	0.115
FBU → Exp	0.242	0.242	0.167	0.314
FCAP→ Age	0.181	0.181	0.101	0.258
FCAP → BR	0.179	0.179	0.113	0.245
FCAP → Children	0.089	0.090	0.013	0.175
FCAP → Edu	0.096	0.096	0.025	0.166
FCAP → Exp	0.317	0.317	0.246	0.389
FCAP → FBU	0.246	0.245	0.182	0.308
HM → Age	0.126	0.125	0.064	0.189
HM → BR	0.311	0.311	0.237	0.386
HM → Children	0.115	0.115	0.048	0.185
HM → Edu	0.049	0.053	0.011	0.117
HM → Exp	0.010	0.034	0.008	0.084
HM → FBU	0.071	0.075	0.022	0.144
HM → FCAP	0.117	0.118	0.061	0.182
Income → Age	0.591	0.592	0.533	0.645
Income → BR	0.069	0.072	0.017	0.141
Income → Children	0.290	0.290	0.221	0.353
Income → Edu	0.531	0.531	0.469	0.589
Income → Exp	0.081	0.082	0.012	0.153
Income → FBU	0.019	0.035	0.002	0.098
Income → FCAP	0.169	0.169	0.091	0.245
Income → HM	0.104	0.104	0.038	0.174
PTC → Age	0.087	0.088	0.030	0.154
PTC → BR	0.528	0.528	0.456	0.595
PTC → Children	0.072	0.075	0.026	0.136
PTC → Edu	0.017	0.036	0.012	0.087

Appendix F. HTMT confidence intervals (continued)

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
PTC → Exp	0.075	0.076	0.017	0.144
PTC → FBU	0.066	0.067	0.014	0.133
PTC → FCAP	0.128	0.129	0.070	0.191
PTC → HM	0.163	0.167	0.107	0.238
PTC → Income	0.113	0.113	0.046	0.181
TM → Age	0.063	0.069	0.025	0.130
TM → BR	0.719	0.719	0.670	0.765
TM → Children	0.043	0.054	0.016	0.117
TM → Edu	0.021	0.038	0.013	0.084
TM → Exp	0.061	0.066	0.020	0.129
TM → FBU	0.051	0.054	0.013	0.118
TM → FCAP	0.052	0.059	0.017	0.124
TM → HM	0.246	0.246	0.169	0.326
TM → Income	0.059	0.067	0.024	0.127
TM → PTC	0.738	0.738	0.693	0.780
UM → Age	0.044	0.051	0.019	0.094
UM → BR	0.456	0.456	0.386	0.522
UM → Children	0.038	0.054	0.018	0.109
UM → Edu	0.081	0.082	0.023	0.156
UM → Exp	0.009	0.035	0.008	0.083
UM → FBU	0.013	0.037	0.009	0.089
UM → FCAP	0.022	0.037	0.008	0.090
UM → HM	0.756	0.756	0.717	0.793
UM → Income	0.038	0.048	0.018	0.099
UM → PTC	0.360	0.360	0.278	0.438
UM → TM	0.413	0.412	0.335	0.486

Note: BR = F-commerce browsing, Child = Number of children, Edu = Educational level, Exp = F-commerce experience, FBU = Facebook usage, FCAP = F-commerce actual purchase, HM = Hedonic motivation, Income = Month income, PTC = F-commerce participation, TM = Trust motivation, UM = Utilitarian motivation.