ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

THE EFFECT OF CONTROL VARIABLES WHEN USING TECHNOLOGY ACCEPTANCE MODEL TO PREDICT CONSUMERS' INTENTIONS TO BUY ONLINE

Iconaru Claudia
The Bucharest University of Economic Studies
ROMANIA.
claudiaiconaru@ase.ro

ABSTRACT

The Technology Acceptance Model (TAM) was employed in order to predict consumers' intentions to buy online. Initial TAM latent variables were used and indicators were adapted for the purpose of the study. Measurements' reliability and validity are tested in the study. What differentiates this study from other TAM-based studies is the control for the effects of socio-demographic variables: gender, education and income. TAM initial associations were tested for statistical significance, when the effects of gender, education and income were controlled for. The results of the PLS-based structural equation modeling indicate that TAM original associations among variables are significant, regardless of the socio-demographic variables employed in the model. This study once more confirms the predictive power of TAM in explaining and predicting online buying behavior.

Keywords: technology acceptance model, online buying, structural equation modeling, control variables

INTRODUCTION

Online consumer behavior has gathered considerable attention over the last decade (Li and Huang, 2009), when individuals began adopting the Internet to buy goods and services for private use. Several taxonomies of online consumer behavior models (e.g. Cao and Mokhtarian) have analyzed various theoretical frameworks as starting points for modeling either behavioral intention to buy online or actual behavior.

One of the most widely spread theoretical framework used in modeling online consumer behavior is Technology Acceptance Model (e.g. Chen et al, 2002; Liu and Wei, 2003; O'Cass and Fenech, 2003; Shang et al, 2005; Crespo and Bosque, 2008; Shin, 2008; Yoon, 2009; Said, 2011). The Technology Acceptance Model has contributed to a better understanding of individuals' behavior when engaging in buying goods and services for private use via the Internet.

Technology Acceptance Model (TAM) was first developed by Davis in 1986 (Davis et al, 1989) in order to predict users' adoption and use of information systems. Since being first published, TAM began to be tested and validated in various contexts, even augmented with different variables in order to increase its predictive power (Venkatesh et al, 2003; King and He, 2006). Authors of various TAM-based models' taxonomies have concluded the reliability and validity of TAM measurements and relationships among its latent variables (King and He, 2006; Schepers and Wetzels, 2007).

The fact that TAM is a generally accepted robust model (Venkatesh et al, 2003) bears no doubt and its revalidation in the context of online buying is a secondary aim of this paper. Since most of the empirical TAM-based researches focuses on validating TAM relationships, this paper is taking a different approach to TAM's associations. Thus, the primary aim of this paper is to test whether TAM's associations stand for basic control variables chosen for the specificity of the study: consumers' gender, income and their level of education.

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

TECHNOLOGY ACCEPTANCE MODEL

Technology Acceptance Model focuses on two perceptions of individuals in order to predict system use: perceived usefulness of the information system, defined as users' belief that the use of the system is beneficial to them and perceived ease of use of the information system, defined as the extent to which an information system is perceived to require a low degree of effort for use (Davis, 1989, p. 320).

TAM also postulates a causal relationship between these salient beliefs: perceived ease of use will have a direct and positive effect on users' perceived usefulness of the information system. The rationale of this relationship is that although users may perceive the benefits of an information system, these benefits may be outweighed by the amount of effort necessary to use the information system (Davis, 1989, p. 320).

Drawing back from the Theory of Reasoned Actions, TAM postulates that these two salient beliefs will determine individuals' attitude toward the information system (Davis et al, 1989, p. 983).

Similar to Theory of Reasoned Actions, actual behavior, namely information system's usage is determined by the individuals' intention to use the information system but what differentiate TAM from TRA is the assumption that behavioral intention is determined not only the individuals' attitude toward the information system but also by the individual's perceived usefulness of the information system (Davis et al, 1989, p. 985).

CONCEPTUAL MODEL AND RESEARCH HYPOTHESES

This study's hypotheses are based on TAM initial framework:

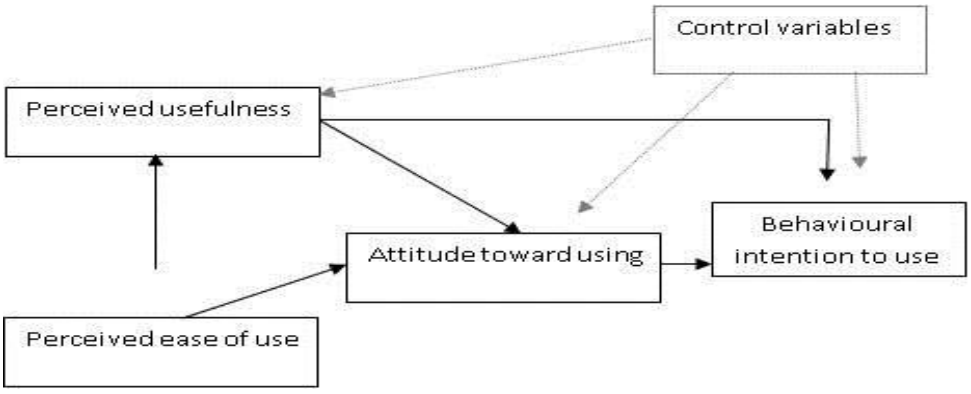

Figure 1: Initial Technology Acceptance Model (Davis et al, 1989, p. 987) augmented with control variables

Hypothesis 1: There is a direct and positive relationship between consumers' perceived usefulness of using the Internet for buying goods and services and their attitudes towards online buying, regardless of consumers' gender, income or education.

Hypothesis 2: There is a direct and positive relationship between consumers' perceived usefulness of using the Internet for buying goods and services and their intention to buy online, regardless of consumers' gender, income or education.

Hypothesis 3: There is a direct and positive relationship between consumers' perceived ease of using the Internet for buying goods and services and their attitudes towards online buying, regardless of consumers' gender, income or education.

Hypothesis 4: There is a direct and positive relationship between consumers' perceived ease of using the Internet for buying goods and services and consumers' perceived usefulness, regardless of consumers' gender, income or education.

Hypothesis 5: There is a direct and positive relationship between consumers' attitudes towards online buying and their intention to buy online, regardless of consumers' gender, income or education.

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

RESEARCH METHODOLOGY

Measurements

Each latent variable of the study was measured on multiple indicators, in order to provide reliability and validity test of the measures. Indicators for perceived usefulness, perceived ease of use, attitude were adapted from previous literature on TAM (Davis, 1989; Davis et al, 1989).

However, distinct from initial TAM measures is the conceptualization of perceived usefulness (PU) as a formative latent variable. PU's indicators are considered to form the latent variable (Bollen et al, 1991) and they are not expected to highly correlate within the construct (Subhadip et al, 2012). For example, some consumers may perceive buying online as enabling money saving (especially those buying from group discount web sites) but some may perceive higher prices when buying online because the cost of the delivery is added to the total cost. However, all consumers may perceive that online buying is convenient since it does not require dressing up, driving to the store, finding a parking lot, staying in line at check-up etc.

When, measuring consumers' intention to buy online, I followed Soderlund and Ohman approach of intentions as expectations, intentions as plans and intentions as wants (Soderlund si Ohman, 2006, p. 411), but not as separate latent variables, but as a single formative construct.

Data collection

Primary data collected for the purpose of this study is part of a larger online consumer survey, hosted on consumatorulonline.ro platform and targeting Romanian consumers that have made at least a single purchase via the Internet in the last six months.

Latent variables' indicators were translated from English to Romanian by a certified translator.

When data was first gathered, 98 valid and complete responses were exported into the excel database for the purpose of this study.

DATA ANALYSIS AND RESULTS

Data analysis consists of reliability and validity test of the measurements, the SEM analysis without the control variables and SEM analysis with each control variable introduced in the model. WarpPLS 3.0 software was used in data analysis.

Measurements' Reliability and Validity

Tests of measurements' reliability and validity were conducted before the actual structural equation modeling analysis in order to assure the effective use of such measures before using them to test the study's hypotheses (Kline, 1998).

Measurements' reliability was assessed following Bagozzi and Yi approach of interpreting Cronbach alpha coefficients, composite reliability and average extracted variance (AVE) (Bagozzi and Yi, 1988).

Table 1: Measures Reliability (Internal Consistency)

Construct	Composite reliability (CR)	Cronbach Alpha Coefficients	Avergender extracted variance (AVE)
PU	0.803	0.672	0.505
PEOU	0.889	0.834	0.667
A	0.918	0.880	0.736
I	0.924	0.891	0.753

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

All Cronbach Alpha coefficients are above the critical value of 0.5 (Hair et al, 1998) and all composite reliability coefficients are above the critical value of 0.5 (Nunally, 1978) which gives measurements acceptable reliability.

Measurements' convergent validity was conducted on the basis of combined loadings and cross-loadings among indicators to test whether indicators load more inside their construct that they do with other constructs (Jewell, 2011).

Table 2: Combined loadings and cross-loadings

	PU	PEOU	A	I	SE	P value
PU1	0.671	0.169	-0.301	0.277	0.121	<0.001
PU2	0.678	-0.021	0.295	-0.417	0.115	<0.001
PU3	0.749	-0.08	-0.285	0.324	0.108	<0.001
PU4	0.740	-0.053	0.291	-0.197	0.107	<0.001
PEOU1	-0.143	0.807	-0.242	0.314	0.084	<0.001
PEOU2	0.065	0.794	-0.034	-0.032	0.098	<0.001
PEOU3	-0.019	0.831	0.047	-0.067	0.068	<0.001
PEOU4	0.095	0.835	0.22	-0.206	0.065	<0.001
A1	0.074	0.098	0.812	0.295	0.077	<0.001
A2	-0.126	-0.119	0.886	0.037	0.066	<0.001
A3	0.083	-0.014	0.884	-0.056	0.067	<0.001
A4	-0.026	0.045	0.846	-0.263	0.077	<0.001
I1	-0.069	0.075	-0.042	0.882	0.071	<0.001
I2	0.014	-0.048	-0.057	0.898	0.07	<0.001
I3	-0.02	-0.088	0.116	0.837	0.082	<0.001
I4	0.076	0.06	-0.01	0.853	0.069	<0.001

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

As Table 2 indicates, indicators load very well on their construct, having similar loadings and we can assume that measurements have convergent validity (Jewell, 2011).

Table 3 shows Pearson's correlation coefficients for each latent variable employed in the model. Moreover, on Table 3 diagonal axis, the square roots of average variance extracted (AVE) for each latent variable are shown.

In order to confirm divergent validity, the square root of AVE for each latent variable should be higher than any of the bivariate correlations involving the latent variables in questions (Fornell and Larcker, 1981).

Table 3: Latent Variables correlations and square root of AVE

	PU	PEOU	A	I
PU	0.710	0.412	0.595	0.64
PEOU	0.412	0.817	0.434	0.407
A	0.595	0.434	0.858	0.742
I	0.64	0.407	0.742	0.868

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

PLS-based Structural Equation Modeling was performed using WarpPLS software, version 3.0. The path coefficients and their associated p values are shown in Table 4 and Figure 2:

Table 4: Path coefficients and associated p value

	PU	PEOU	A	I
PU		0.434 (p<0.01)		
PEOU				
A	0.512 (p<0.01)	0.237 (p<0.01)		
I	0.307 (p<0.01)		0.563 (p<0.01)	

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

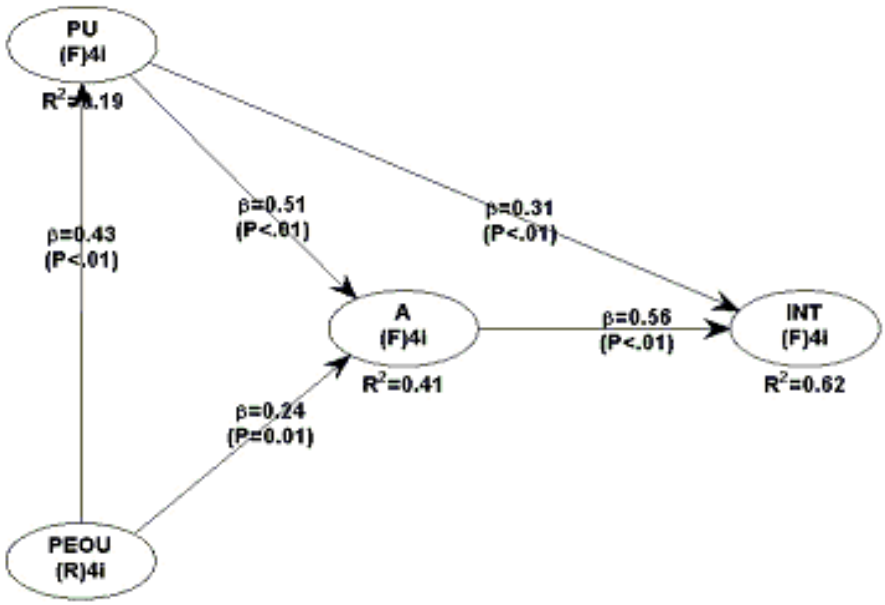

Figure 2: PLS-based SEM analysis

PLS-based SEM analysis confirms once more the validity of TAM when explaining and predicting online buying adoption among consumers.

TAM associations are valid in the context of online buying:

- Consumers' intention to buy online is determined by consumers' attitude toward online buying, with a path coefficient β=0.56 and consumers' perceived usefulness of online buying, with a path coefficient β=0.31.
- Attitude towards online buying remains the strongest predictor of consumers' intention to buy online and consumers' beliefs about the benefits of online buying has a both direct effect on consumers' intention to buy online, but also an indirect effect, through attitude.
- Consumers' attitude towards online buying is determined by two main consumers' beliefs: their perceived usefulness of online buying with a path coefficient β=0.51 and perceived ease of buying online, with a path coefficient β=0.24.
- The best predictor of attitude towards buying is perceived usefulness, as first postulated in initial TAM
- The causal relationship between perceived ease of use and perceived usefulness is validated, perceived ease of buying online being a strong predictor of consumers' perceived usefulness of online buying.

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

Model Fit

WarpPLS also computes several model fit indices: average path coefficients (APC), average R squared (ARS) and average variance inflation factors (AVIF). A model is robust when p<0.05 for APC and ARS and when AVIF <5 (Kock, 2011).

Table 5: Model fit

APC= 0.411, P<0.001	Good if p< 0.05
ARS= 0.404, P=0.001	Good if p< 0.05
AVIF=1.381	Good if AVIF < 5

Since all TAM relationships are validated, in the next phase of the analysis the control variables are included in the model to test whether TAM associations are valid when controlled for consumers' gender, income and level of education.

TAM Associations Controlled For "Gender"

The binary variable "gender" was introduced in the model as "1" for male and "2" for female. Causal links from gender to each endogenous variable in the model were drawn. Table 6 shows the new path coefficients and their associated p values.

Thus, TAM associations are validated in the context of online buying, when controlled for consumers' gender.

Table 6: Path coefficients and associated p value when controlled for "gender"

	PU	PEOU	A	I	Gender
PU		0.433 (p<0.01)			0.038 (p<0.34)
PEOU					
A	0.508 (p<0.01)	0.24 (p<0.015)			0.04 (p<0.29)
I	0.302 (p<0.01)		0.564(p<0.01)		0.063 (p<0.16)
gender					

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

TAM Associations Controlled For "Income"

The variable "income" was introduced in the model as "1" low income level, "2" for agerage income level and "3" for high income level. Causal links from "income" to each endogenous variable in the model were drawn. Table 7 shows the new path coefficients and their associated p values.

Thus, TAM associations are validated in the context of online buying, when controlled for consumers' income.

Table 7: Path coefficients and associated p value when controlled for "income"

	PU	PEOU	A	I	Income
PU		0.437 (p<0.01)			0.165
PEOU					
A	0.511(p<0.01)	0.238 (p<0.015)			0.451
I	0.306 (p<0.01)		0.563 (p<0.01)		0.424
income					

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

ISSN-L: 2223-9553, ISSN: 2223-9944
Vol. 3, No. 1, July 2012

TAM associations controlled for "education"

The variable education was introduced in the model as "1" individuals with university degree or above, "2" individuals without university degree. Causal links from "education" to each endogenous variable in the model were drawn. Table 8 shows the new path coefficients and their associated p values.

Thus, TAM associations are validated in the context of online buying, when controlled for consumers' education.

Table 8: Path coefficients and associated p value when controlled for "education"

	PU	PEOU	A	I	education
PU		0.434 (p<0.01)			-0.003 (p<0.493)
PEOU					
A	0.512 (p<0.01)	0.238 (p<0.015)			0.02 (p<0.38)
I	0.308 (p<0.01)		0.565 (p<0.01)		0.101 (p<0.008)
education					

*** PU = perceived usefulness of online buying, PEOU = perceived ease of buying online , A = attitude towards buying online, I = intention to buy online

CONCLUSIONS AND IMPLICATIONS

By employing a PLS-based structural equation modeling analysis, initial TAM associations were once more validated in the context of online buying. Consumers' intention to buy online is a function of consumers' attitude towards online buying and consumers' perceptions about the perceived benefits of online buying.

Consumers' perceptions about the benefits of online buying are conceptualized under TAM initial salient belief "perceived usefulness". When consumers believe that online buying is useful in terms of saving time, saving money, having access to wide range of products and online vendors, they report a more favorable attitude toward online buying and their intention to buy online increases as compared to those that do not perceive the usefulness of online buying.

Consumers' attitude is also determined by another salient belief: perceived ease of buying online. When consumers believe that buying online is easy, free of physical and mental effort, they report a more favorable attitude and increased perceived usefulness as compared to those consumers that perceive online buying as a complicated and time consuming process.

In the second part of the analysis, control variables were introduced in the model. The PLS-based structural equation modeling analysis was run once more with each control variable included in the model: consumers' gender, income and level of education.

The results of the analyses show that initial TAM associations are valid when controlled for socio-demographic variables. This means that whether consumers are males or females, whether they have low, average or high income or whether they hold a university degree or not, their intentions to buy online are predicted by attitude towards online buying and perceived usefulness of online buying. Moreover, despite socio-demographic background, consumers' attitude towards online buying can be explained by consumers' salient beliefs: perceived usefulness and perceived ease of online buying. Also, the causal relationship between consumers' salient beliefs, perceived ease of online buying and perceived usefulness is validated when controlled for the above mentioned socio-demographic variables.

Validating TAM's initial associations when controlled for socio-demographic variables shows once more that TAM is a reliable research framework when trying to explain and predict consumers' intention to buy online.

ACKNOWLEDGEMENTS

This article is a result of the project POSDRU/88/1.5./S/55287 „Doctoral Programme in Economics at European Knowledge Standards (DOESEC)" . This project is co-funded by the European Social Fund through The Sectoral Operational Programme for Human Resources Development 2007-2013, coordinated by The Bucharest University of Economic Studies in partnership with West University of Timisoara.

REFERENCES

Bollen, K., and Lennox, R. (1991). "Conventional Wisdom on Measurement - a Structural Equation Perspective," *Psychological Bulletin*, 110 (2), 305-314.

Bagozzi R.P., Yi Y. (1988). "On the evaluation of structural equation models" *Journal of the Academy of Marketing Science*, 16(1), 74–94

Cao, X., Mokhtarian, P. L. (2005). "The Intended and Actual Adoption of Online Purchasing: A Brief Review of Recent Literature" Research Report UCD-ITS-RR-05-07, Institute of Transportation Studies, University of California, Davis.

Chen L., M.L. Gillenson, D. L. Sherrell, (2002). "Enticing online consumers: an extended technology acceptance perspective", *Information & Management*, 39(8), 705-719

Crespo A. H., Rodriguez Del Bosque I. A., (2008). "Explaining B2C e-commerce acceptance: An integrative model based on the framework by Gatignon and Robertson", *Interacting with Computers*, 20(2), 212-224

Davis F.D. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, 13(3), 319–340

Davis F., Bagozzi R.P, Warshaw P.R. (1989). "User acceptance of computer technology: A comparison of two theoretical models" *Management Science*, 35(8), 982–1003

Fornell, C., Larcker, D. F. (1981). " Evaluating structural equation models with unobservable variables and measurement error" *Journal of Marketing Research*, 48, 39–50

Hair J.F., Anderson R.E., Tatham R.L., Black W.C. (1998). *Multivariate Data Analysis*, 5th edition. New Jersey: Prentice Hall.

Jewell D.V. (2011). *Guide to evidence-based physical therapist practice* (2nd edition). Ontario: Jones & Bartlett Learning.

King W. R., He J. (2006). "*A meta-analysis of the technology acceptance model"*, Available online at http://katzis.org/wiki/images/2/24/King_2006_Meta_TAM.pdf

Kline R.B. (1998). Principles and Practice of Structural Equation Modelling. New York: The Guilford Press.

Kock N., (2011). "Using WarpPLS in e-Collaboration Studies: Mediating effects, control and second order variables and algorithm choices" *International Journal of e-Collaboration*, 7(3), 1-13

Li Y-H, J. W. Huang, (2009). "Applying Theory of Perceived Risk and Technology Acceptance Model in the Online Shopping Channel," *World of Academy Science, Engineering and Technology*, 53, 919-925

Liu X, Wei K. K. (2003). "An empirical study of product differences in consumers' e-commerce adoption behavior", *Electronic Commerce Research and Applications*, 2, 229-239

Nunally J.C. (1978). *Psychometric Theory*, 2nd edition. New York: McGraw Hill.

O'Cass A., Fenech T. (2003). "Web retailing adoption: exploring the nature of internet users Web retailing behavior", *Journal of Retailing and Consumer Services*, vol. 10, 81-94

Rencher A.C. (1998). Multivariate Statistical Inference and Applications. New York: John Wiley & Sons.

Said S. A.G. (2011). "Modeling the electronic transactions acceptance using an extended technology acceptance model", *Applied Computing and Informatics*, 9, 47-77

Schepers, J., Wetzels M. (2007). *A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects*, *Information & Management*, 44, 90-103

Shang, R.A., Chen, Y.C. (2005). "Extrinsic versus intrisic motivations for consumers to shop on-line", *Information & Management*, 42(3), 401-413

Shin, D.H. (2008). "Understanding purchasing behaviors in a virtual economy: Consumer behavior involving virtual currency in Web 2.0 communities" *Interacting with computers*, 20, 433-446

Soderlund, M., Ohman, N. (2006). „Intentions are plural: Towards a multidimensional view of intentions in consumer research", *European Advances in Consumer Research*, 7, 410-416

Subhadip, R., Tarafdar, M., Ragu-Nathan T.S., Marsillac, E. (2012). „The effects of misspecification of reflective and formative constructs in operations and manufacturing management research" *The Electronic Journal of Business Research Methods*, 10(1), 34-52

Yoon, C. (2009). "The effects of national culture values on consumer acceptance of e-commerce: Online shoppers in China", *Information & Management*, 46, 294-301