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Factors Influencing B2c eCommerce Diffusion

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***Abstract*—**Despite the fact that B2c eCommerce has become important in numerous economies, its adoption varies from country to country. This paper aims to identify the factors affecting (enabling or inhibiting) B2c eCommerce and to determine their quantitative impact on the diffusion of online sales across countries. A dynamic panel model analyzing the relationship between 13 factors (Macroeconomic, Demographic, Socio-Cultural, Infrastructural and Offer related) stemming from a complete literature analysis and the B2c eCommerce value in 45 countries over 9 years has been developed. Having a positive correlation coefficient, *GDP, mobile penetration, Internet user penetration and credit card penetration* resulted as enabling drivers of the B2c eCommerce value across countries, whereas, having a negative correlation coefficient, *equal distribution of income and the development of traditional retailing network* act as inhibiting factors.

***Keywords*—**B2c eCommerce diffusion, influencing factors, dynamic panel model

I. Introduction

IN spite of the 2000 dot com bubble burst, in the last 10 years the B2c eCommerce has been developing in all the main markets in the world [47]. However, the level of B2c eCommerce adoption is significantly different from country to country [2]. Euromonitor International data show important differences between countries relating to both the B2c eCommerce value and its growth rates (cf. Fig. 1). In particular, the online expenditure in 2010 ranged from 0,7 € per capita (in the developing countries) to up to 660 € (in the developed ones), whereas the CAGR went from 6 (in the mature markets) to 70% (in the emerging countries).

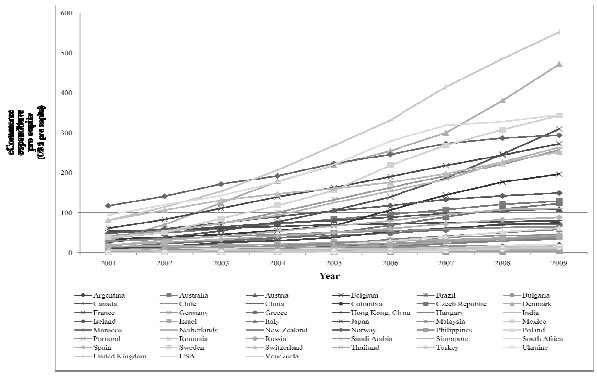

Fig. 1 eCommerce expenditure across countries (2001-2009)

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It is important to understand the B2c eCommerce diffusion among different countries considering the key global factors acting as enabling drivers or as barriers [3]. Drivers propel and facilitate the B2c eCommerce growth whereas barriers limit eCommerce growth.

In literature, the determinants of the B2c eCommerce diffusion were studied in numerous contributions, of which a great number is qualitative (i.e. do not use a statistical model to quantify the impact of the factors on the phenomena). The qualitative studies, on the one hand, do not assess the real impact of the different factors on the B2c eCommerce diffusion. The quantitative papers, on the other hand, do not usually take into account enough factors and/or enough countries to give the results a general validity.

In order to fill these gaps a statistical model including all the most important drivers and taking into account numerous countries has been developed. In particular, the study is aimed to identify the factors having the greatest influence on B2c eCommerce value across countries and to determine the quantitative impact of these drivers on the B2c eCommerce diffusion. A literature review on the topic is presented in Section II. Section III explains the research questions and the objectives. Then Section IV illustrates the methodology adopted. Section V presents the model developed. Section VI illustrates the results of the analysis. Finally, section VII reports the conclusion and the further developments of the research.

II. Literature Review

This paragraph aims to provide a general overview of the main contributions whose objective is the identification of the factors influencing the B2c eCommerce diffusion in a country.

All the most important papers have been examined according to three dimensions:

- Drivers considered to explain the B2c eCommerce diffusion in a country;
- Methodology adopted, i.e. qualitative models, statistical models such as correlation matrices, factor analysis, multi-linear regression;
- Countries taken into account in the analysis.

A. Drivers

The adoption of B2c eCommerce in a country is an evolutionary, path-dependent diffusion process affected by a wide range of socioeconomic and environmental factors[44]-[45]-[46], that can be considered as common influencers across different countries. Some of these factors are likely to facilitate the diffusion process, whereas others will act as impediments [5]. All the main drivers stemming from the

literature review and the papers that take them into account are presented in this paragraph and reported in Table I.

GDP per capita is a key determinant of eCommerce diffusion rates across countries [3]. It is generally the case that new technologies are adopted first and most intensively by richer countries, which have the financial resources to invest in these technologies, the human resources and infrastructure to support their use, and higher wage rates that make it worthwhile to introduce laborsaving technologies [34].

No equal distribution of income could delay the development of eCommerce in a country. The gap in average family annual incomes between the highest income families and the lowest income families among consumers is shaping both patterns and pace of B2c eCommerce diffusion [5].

Deregulation of the telecommunications market and increased competition among providers will be an important factor in reducing the cost of Internet access for both consumers and businesses [12]. High costs of Internet access limit the amount of time consumers use the Web to gather information or to do the shopping online [3].

*Country demographics (*most of all *population density* and *the level of urbanization)* are likely to act as enablers or inhibitors for eCommerce development, as they relate to market size and concentration, consumer needs and ease of access to technology. Densely populated nations, such as Singapore and Germany, enjoy strong IT infrastructures, whereas large countries with low population density, such as China and Brazil, suffer from underdeveloped infrastructures, plus distribution and delivery problems. Urban density may enable wired cities; however, high density may also lead to strong traditional retail networks that compete with on-line purchasing, as in the case of France and Taiwan [3]. Calem and Carlino have shown that urban areas typically have greater infrastructure and economies of scale [13]. As a result, the penetration potential for various kinds of technologies will be higher in countries with higher levels of urbanization [15].

The average level of education [16] within a country may also be influential. The technological knowledge, necessary for the creation and effective usage of eCommerce related activities, may not be available in countries with poorly educated populations [17]. High levels of educational attainment are proven to be critical in the extent of computer technology adoption in a country [34].

English was initially the *lingua franca* of the Internet, and the overwhelming majority of Internet communication continues to take place in English. For this reason, basic education skills and English language capabilities could play important roles in enabling eCommerce [6].

Concerns about security of payment mechanisms and trustworthiness of web vendors are, like privacy, often named by consumers as reasons to not engage in online transactions. Security generally consists of the security of the payment information as it is transmitted through the Internet to the retailer [12]. According to Koening, Wigand and Beck, concerns about privacy of data or even security issues are no longer an important obstacle, (e.g. in Germany). This might be a good indicator for the maturity level of the services and security applications offered online, but also indicates that Germans have had good experiences with the Internet and are losing more of their resistance to use it [20]. In their study, Hoffman, Novak and Peralta found that consumers, on the Web, may fear providing credit card information to any commercial Web provider and that consumers simply do not trust most Web providers enough to engage in exchange relationships involving money [40]. In addition, time asymmetries in delivery introduce a risk (perceived or real) into the transaction process for the parties who must invest resources before receiving a return [24].

The availability of online payment infrastructure capabilities, such as credit cards and other online shopping payment support, is likely to accelerate online transaction-making in B2c eCommerce [15].

The right balance between the price and value of the products and services online seems to be an enabling factor of B2c eCommerce development. In their study, Thaw, Mahomood and Dhanapal Durai Dominic showed that consumers are more inclined to purchase online if the products/services are of a higher quality or the prices are considerably lower [21].

The *presence of skilled B2c eCommerce service providers* plays a key role in offering key infrastructures such as information technology, telecommunications and commercial organization. This constellation of infrastructure is necessary to support eCommerce growth and further benefit from the strategic value that has made a profound impact globally [1].

The *existence of strong traditional retail networks*, such as in France, Japan, and Taiwan may act as an inhibitor to eCommerce. While such outlets compete with online commerce, they might also encourage B2c eCommerce because such retail networks are located in urban areas with concentrated economic activity and high Internet usage and they might adopt “click and mortar” strategies of integrating their physical and virtual infrastructures for competitive advantage [3].

Investment in telecommunications infrastructure has been shown to lessen the gap between computer and Internet usage [31]. In addition, there is evidence that the availability of information and telecommunication technologies is an enabler for eCommerce adoption and diffusion [30]-[32]-[41]. eCommerce development is only possible in the presence of a well-developed information and telecommunications infrastructure. Without the basic telecommunications infrastructure and accessibility of the Internet, the B2c eCommerce will not easily develop and grow. Thus, information and telecommunications investments have a great potential impact on the growth of eCommerce [15].

The availability of personal computers and greater *affordability of telephone service* drive the e-business activity. [13]. For example, the cost of PC equipment is a significant inhibitor in Brazil and Mexico, where a large portion of the population cannot afford computers [4].

Internet users are a critical resource in B2c eCommerce according to Ho, Kauffman and Liang. Internet users create value, such as positive network externalities, for the growth in scale size of eCommerce. Although not all of the Internet users in a country may shop online, they are still potential shoppers, a likely demand-side driver for a country’s eCommerce development [15].

The *delivery infrastructure* needs to be reliable, efficient and supportive of the same changes that eCommerce imposes

on transportation. Since eCommerce can open up the global marketplace to customers and bring even the most remote customer to this marketplace, crucial then is the capability of the delivery infrastructure to support significant fluctuations in geographical delivery patterns [12].

The *availability of venture capital* within a country is supposed to be a driver of its eCommerce revenue growth. In fact venture capital infusion into the technology sector paved the way for the growth of eCommerce, via the creation of innovative business models and technologies [15].

The launching of specific *policies* and *programs* by *national governments* involves the development and promotion of eCommerce industry and diffusion in the regulation. These programs include use of direct subsidies and other fiscal incentives to promote eBusiness adoption and the development of an eBusiness services industry, changes in regulations and policy framework to facilitate the diffusion of eCommerce activities, public educational programs, the proactive adoption of eCommerce within the public sector itself and liberalization of the telecommunications infrastructure industry [5].

The importance of the *rule of law* is magnified by the special risks associated with online transactions [2]. When the rule of law is strong, buyers and sellers know they have some legal recourse in the case of online fraud, effective punishment lowers the cost of reputation building for honest businesses, and people have a higher degree of trust in remote market transactions [8].

TABLE I
DRIVERS AND RELATED LITERATURE

Driver	Related literature
Macroeconomic factors	
a) GDP	[1]-[2]-[3]-[4]-[5]-[6]-[7]-[8]-[9]-[10]-[11]
b) No equal distribution of income	[3]-[5]-[7]-[10]
c) Deregulation and liberalization of the telecommunications market	[3]-[5]-[10]-[11]-[12]
Demographic factors	
d) Urbanization	[5]-[9]-[13]-[14]-[15]
Socio-cultural factors	
e) Educational level	[4]-[5]-[6]-[9]-[11]-[15]-[16]-[17]-[29]
f) English language capabilities	[3]-[4]-[6]
g) Privacy and payment security concerns	[5]-[7]-[12]-[19]-[20]-[21]-[40]
h) Trustworthiness of web vendors	[12]-[21]-[22]-[23]-[24]
i) Credit card penetration	[2]-[3]-[5]-[6]-[7]-[8]-[10]-[15]-[21]-[25]-[26]-[27]-[28]
Online offer factors	
j) Prices and quality of online offer	[12]-[21]
k) Number of eCommerce service providers	[4]-[29]
Offline offer factors	
l) Development of traditional retailing network	[3]-[9]-[10]-[11]
ICT infrastructure factors	
m) Amount of IT investments	[2]-[5]-[9]-[15]-[30]-[31]-[32]-[41]
n) PC penetration	[3]-[4]-[5]-[6]-[8]-[10]-[11]-[12]-[29]-[33]-[34]
o) Internet user penetration	[2]-[3]-[4]-[5]-[7]-[8]-[9]-[10]-[11]-[12]-[15]-[29]-[33]
Logistic infrastructure factors	
p) Availability of logistics and transportation services	[4]-[6]-[10]-[11]-[35]-[36]-[37]
Financial factors	
q) Venture capital availability	[3]-[11]-[15]-[56]
r) eCommerce incentives programs	[11]-[21]-[57]
Legislative factors	
s) Rule of law	[2]-[3]-[4]-[5]-[6]-[7]-[8]-[21]-[29]-[42]-[43]

B. Methodology

The different contributions studying the determinants of the B2c eCommerce diffusion can be clustered - according to the type of approach used by the authors - into qualitative (e.g. [3]-[4]-[10]) and quantitative models (e.g. [6]-[21]).

The first approach is grounded in case studies [3] or surveys [7] to identify those factors playing a role at B2c eCommerce development in each country. The major drawback of qualitative models is the fact that many evidences are not demonstrated by numbers and the results usually fail to extend to other contexts.

The quantitative model - portraying the hypothesized relationships between the dependent variable and the explanatory variables [6] - are able to provide a statistic evaluation of the factors enabling the B2c eCommerce diffusion in a country and to quantify the contribution of a single factor in affecting the B2c eCommerce B2c value. Their main drawback lies in the numerous assumptions required to reduce the complexity of the model and to solve problems linked to a specific dataset.

C. Countries

Research papers that explored the factors influencing the B2c eCommerce development can be divided into two different clusters according to the countries taken into account. In order to better understand the differences in the B2c eCommerce diffusion across countries, some papers analyze data - on both eCommerce volumes and various factors that may encourage or inhibit eCommerce - for numerous countries [2]-[3]-[6]-[15], whereas other papers focus on a single country - or on a limited set of countries - to get a precise evaluation of the drivers influencing eCommerce in a specific area [10]-[11]-[12]-[21]. On the one hand, country-specific papers, even if they are able to describe B2c eCommerce development through precise and deep understanding of the influencing factors, usually fail to extend the results to other countries. On the other hand those papers considering numerous countries, despite some limitations about homogeneity of dataset, provide results characterized by general validity.

D. Results of the Literature Review

The literature review highlighted 61 papers, of which 43 qualitative and 18 quantitative.

Among the quantitative papers, the majority of the contributions (13 out of 18) are focused on one or two countries. These papers can consider up to 13 different drivers

each, whereas the 5 papers taking into account more than two countries have considered 5 different drivers each as a maximum (cf. Fig. 2).

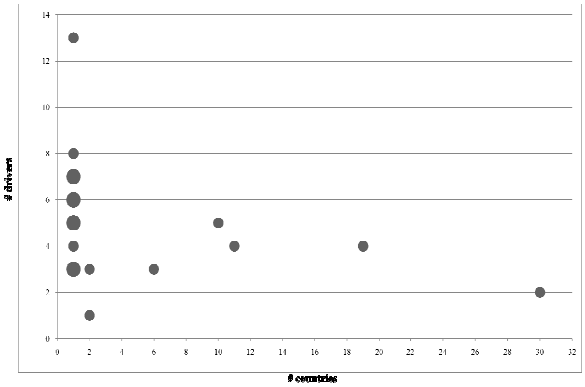

Fig. 2 Map of the quantitative papers

Table II reports the most important papers selected on the basis of the significance of the results achieved by the different studies. It should be noted that the majority of them take into account Macroeconomic, Demographic and Socio-cultural drivers, whereas the other classes of factors have been seldom considered.

TABLE II
SUMMARY OF THE MOST IMPORTANT PAPERS

Paper	Driver	Methodology	Countries
[2]	Macroeconomic: a Socio-cultural: i ICT infrastructure: m, o Legislative: s	Multilinear regression	30 countries
[3]	Macroeconomic: a, b, c Socio-cultural: f, i Offline offer: l ICT infrastructure: n, o Financial: q Legislative: s	Qualitative	10 countries
[4]	Macroeconomic: a Socio-cultural: e, f Online offer: k ICT infrastructure: n, o Logistic infrastructure: p Legislative: s	Qualitative	10 countries
[5]	Macroeconomic: a, b, c Demographic: d Socio-cultural: e, g, i ICT infrastructure: m, n, o Legislative: s	Qualitative	1 country
[6]	Macroeconomic: a Socio-cultural: e, f, i ICT infrastructure: n Logistic infrastructure: p Legislative: s	Correlation matrix and multilinear regression	78 countries
[7]	Macroeconomic: a, b Socio-cultural: g, i ICT infrastructure: o Legislative: s	Qualitative	1 country
[8]	Macroeconomic: a Socio-cultural: i ICT infrastructure: n, o Legislative: s	Correlation matrix and multilinear regression	30 countries
[9]	Macroeconomic: a Demographic: d Socio-cultural: e Offline offer: l ICT infrastructure: m, o	Qualitative	5 continents
[10]	Macroeconomic: a, b, c Socio-cultural: i Offline offer: l ICT infrastructure: n, o Logistic infrastructure: p	Qualitative	1 country
[11]	Macroeconomic: a, c Socio-cultural: e Offline offer: l ICT infrastructure: n, o Logistic infrastructure: p Financial: q, r	Qualitative	1 country
[12]	Macroeconomic: c Socio-cultural: g, h Online offer: j ICT infrastructure: n, o	Qualitative	1 country
[15]	Demographic: d Socio-cultural: e, i ICT infrastructure: m, o Financial: q	Multilinear regression	17 European countries
[21]	Demographic: d Socio-cultural: g, h, i Online offer infrastructure: j Financial: r Legislative: s	Factor analysis	1 country
[29]	Socio-cultural: e Online offer: k ICT infrastructure: n, o Legislative: s	Qualitative	5 continents

The literature review highlighted then a lack of quantitative contributions taking into account a wide set of factors in a significant number of counties, able to offer a precise and complete assessment of general validity.

III. RESEARCH QUESTIONS AND OBJECTIVES

On the one hand, despite the broad variety of the drivers considered, the qualitative studies do not assess the real impact of the different factors on the B2c eCommerce diffusion. On the other hand, the quantitative papers, despite being precise in the determination of the driver impact on the eCommerce diffusion, do not take into account enough factors and/or enough drivers to give the results a general validity.

In order to fill these gaps a statistical model including all the most important drivers and taking into account numerous countries has been developed. In particular, the study is aimed to address the following research questions:

RQ1. What are the factors having an influence on B2c eCommerce value across countries?

RQ2. Do they influence the B2c eCommerce development across countries positively or negatively?

RQ3. What is the weight/importance of the factors identified in affecting the B2c eCommerce diffusion?

IV. METHODOLOGY

The study has been divided into six phases:

1. Identification of the factors influencing B2c eCommerce value;
2. Selection of the drivers influencing B2c eCommerce value;
3. Data collection;
4. Data cleaning;
5. Statistical model identification;

6. Statistical model implementation.

The first phase has been devoted to the identification of the explanatory variables of the B2c eCommerce diffusion across countries through a complete literature review. The output of this activity was a list of 20 factors reported in Table III. According to the different contributions studied, these factors can be grouped in nine main categories (Macroeconomic, Demographic, Socio-cultural, Online offer, Offline offer, ICT infrastructure, Logistic infrastructures, Financial, Legal).

In the second phase, the selection of the factors has been carried out taking into account their measurability. Measurability was assessed using a value from 1 to 3 where 1 indicates a not measurable factor and 3 an easily measurable one. Factors with measurability equal to 3 have been taken into account. The 10 factors satisfying this condition were considered as possible explanatory variables of B2c eCommerce diffusion across countries.

TABLE III
MEASURABILITY OF DRIVERS

Driver	Measurability	Selected
Macroeconomic factors		
a) GDP	3	Yes
b) No equal distribution of income	3	Yes
c) Deregulation and liberalization of the telecommunications market	1	No
Demographic factors		
d) Urbanization	3	Yes
Socio-cultural factors		
e) Educational level	3	Yes
f) English language capabilities	2	No
g) Privacy and payment security concerns	1	No
h) Trustworthiness of web vendors	1	No
i) Credit card penetration	3	Yes
Online offer factors		
j) Prices and quality of online offer	1	No
k) Number of eCommerce service providers	3	Yes
Offline offer factors		
l) Development of traditional retailing network	3	Yes
ICT infrastructure factors		
m) Amount of IT investments	3	Yes
n) PC penetration	3	Yes
o) Internet user penetration	3	Yes
Logistic infrastructure factors		
p) Availability of logistics and transportation services	2	No
Financial factors		
q) Venture capital availability	2	No
r) eCommerce incentives programs	2	No
Legislative factors		
s) Rule of law	2	No

From the drivers selected, the number of eCommerce service providers was removed due to the lack of values in the sources of data used. 4 other drivers have been added due to their potential relationship with the B2c eCommerce diffusion and their availability in the database considered. More in particular they are *broadband penetration*, *mobile penetration*, *the presence of secure servers* and *road density*. Finally 13 independent variables have been considered and defined (cf. Table IV).

TABLE IV
INDEPENDENT VARIABLES OF THE MODEL

Driver	Unit of measurement	Description
Macroeconomic factors		
GDP	US $ per capita	GDP per capita under the assumption of purchasing power parity
No equal distribution of income	%	Gini index, defined as measure of the inequality among values of a frequency distribution[a]
Demographic factors		
Urbanization	%	Urbanization rate, defined as the percentage of population living in urban areas
Socio-cultural factors		
Educational level	%	Educational rate, defined as the percentage of population with qualification
Credit card penetration	Units per capita	Number of credit cards per capita
Offline offer factors		
Development of traditional retailing network	Units for 1.000 inhabitants	Number of traditional points of sales per 1.000 inhabitants
ICT infrastructure factors		
Amount of IT investments	US $ per capita	Total amount of IT investments per capita
PC penetration	Units per 100 inhabitants	Number of PCs per 100 inhabitants
Internet user penetration	%	Percentage of population using Internet
Broadband penetration	Units per 100 inhabitants	Number of broadband subscriptions per 100 inhabitants
Mobile penetration	Units per 100 inhabitants	Number of mobile subscriptions per 100 inhabitants
Presence of secure servers[b]	Units per 1 million inhabitants	Number of secure servers per 1 million of inhabitants
Logistics infrastructure factors		
Road density	Km/Km^2 of land area	Ratio of the length of the country's total road network to the country's land area

[a] A Gini coefficient of zero expresses perfect equality where all values are the same. A Gini coefficient of one expresses maximal inequality among values.

[b] Defined as web servers using a cryptographic system to create a secure connection between a client and a server.

In the third phase both the independent (i.e. the B2c eCommerce values) and the dependent (i.e. the values of the factors) variables have been collected.

The dependent variable, i.e. the B2c eCommerce B2c value across countries, measured as the online annual expenditure per capita, has been defined as the value of the online sales of products (including downloading music and movies). Services

(e.g. Tourism and Ticketing for events) have not been included because of lack of values in the sources considered.

In order to give the results a general validity it was necessary to obtain the values of the variables for a significant number of countries and years. Moreover, in order to guarantee homogeneity of the dataset, the values of the same factor have to belong to a unique reliable and consistent database. Data used by the model are from the World Bank and Euromonitor International. Data have been collected for:

- 45 countries, i.e. Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Czech Republic, Denmark, France, Germany, Greece, Hong Kong, Hungary, India, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, USA, Venezuela;
- 9 years, i.e. from 2001 to 2009.

In the fourth phase, for each country, several time series have been analysed in order to identify and remove outliers and/or anomalies.

In the fifth and sixth phases the panel model, presented in the next section, have been developed and implemented.

V. Model

This section aims to describe the model developed [38]-[39] to study the relationship between B2c eCommerce value across countries and the explanatory variables.

The natural starting point for determining how to estimate the value of the dependent variable is to consider the functional form, that in the panel model is:

$$y_{it} = \alpha_{it} + \beta_{it} x_{it} + \varepsilon_{it} \quad (1)$$

where:

- i=1, .., N cross-sectional units (in this case 45 countries);
- t=1, …, T periods (in this case 9 periods);
- $\beta_{it} = \beta$ = constant;
- α could change according to three different hypotheses:
  1. two-way model (the intercepts vary with the country and the year)
     $$\alpha_{it} = \alpha + \mu_i + \tau_t \quad (2)$$
     where μ_i and τ_t could be stochastic (random effects) or deterministic (fixed effects).
  2. one-way model (the intercepts vary with the country)
     $$\alpha_{it} = \alpha_i = \alpha + \mu_i \quad (3)$$
     where μ_i could be stochastic (random effects) or deterministic (fixed effects).
  3. pooled OLS (intercepts are constant)
     $$\alpha_{it} = \alpha \quad (4)$$

The significance of the period effects has been checked using the Wald test and the null hypothesis of temporal dummies cancellation was accepted (Chi-squared of Wald (7) = 2.24984 with p-value = 0.944729). The country effect significance has been checked using the F-test under the null hypothesis (that implies single *y*-intercepts for each country). This test rejected the null hypothesis and, as a consequence, the country effects are significant (F (43.294) = 18.5506 with p-value P(F(43.294)> 18.5506)=3.04811e^{-061}). The nature of μ has been determined through the Hausman test. Revealing the inconsistency of the GLS estimator, this test showed that μ was deterministic (Chi-squared (13) = 10.5521 with p-value = 0.648284). In conclusion, the statistical model that better explains the impact of the factors on the B2c eCommerce diffusion across countries is one-way fixed effects.

In order to assess the residuals autocorrelation the Durbin-Watson test has been used. With a value equal to 0.352691 the Durbin-Watson test revealed a strong positive autocorrelation. The Durbin-Watson statistic ranges from 0 to 4. A value close to 2 indicates non-autocorrelation, a value toward 0 indicates a positive autocorrelation, whereas a value toward 4 indicates a negative autocorrelation. Moreover, ρ coefficient suggested that ε_{it} was related to ε_{it+1} in 95% of cases, underlying a strong positive autocorrelation. In order to solve the residuals autocorrelation, the dynamic model for panel data has been considered.

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_k x_{k,it} + \rho y_{,it-1} + \varepsilon_{it} \quad (5)$$

where:

- i=1, .., N the cross-sectional units (in this case 45 countries);
- t=1, …, T periods (in this case 8 in place of 9 periods because of the introduction of delayed explanatory variable $y_{i,t-1}$).

Introducing $y_{i,t-1}$, Durbin-Watson value and ρ coefficient improved (Durbin-Watson value = 1.019548 and ρ = 43.13%).

The existence of heteroscedasticity (cf. Fig. 3) is a major concern in the application of models for panel data when there is a large difference between the sizes of the observations.

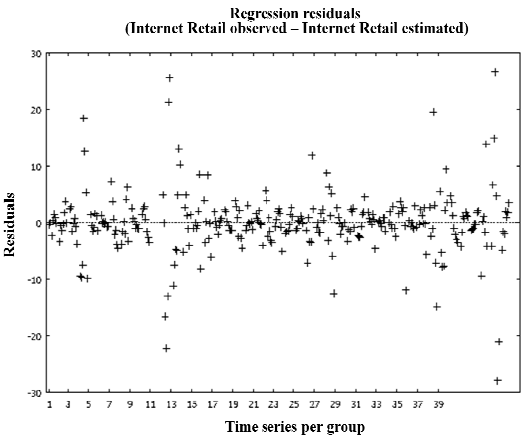

Fig. 3 Heteroscedasticity observed

The dependent variable has therefore been converted into a logarithmic scale to eliminate heteroscedasticity.
The new functional form is then:

$$\ln(y_{it}) = \alpha_i + \sum_{k=1}^{K} \beta_k x_{k,it} + \rho \ln(y_{,it-1}) + \varepsilon_{it} \quad (6)$$

Logarithmic transformation was also applied to explanatory variables (not for those expressed as a percentage), in order to obtain the *elasticity function*, defined as the ratio of the percentage change in the dependent variable to the percentage causative change in the independent variable.

In order to reduce the endogeneity problem between the explanatory variables and the error term that is frequent in the dynamic panel, the GMM-SYS estimator (one-step variant) has been introduced. The AR(1) and AR(2) tests showed that statistical model is well specified from a dynamic point of view (Test for AR(1): z=0.793004 [0.4278] and Test for AR(2): z=-1.57378 [0.1155]. The Sargan test, accepting the null hypothesis, showed that estimator of regressor coefficients is robust and, as a consequence, the country effects were significant (Sargan Test of overid. Restrictions: Chi-squared (33)=25.4074 [0.8248]).

The output of the dynamic model with the GMM-SYS estimator is represented in Fig. 4.

Dynamic panel one-step, using 301 observations
44 cross-sections units
Lenght of time series: min 4, max 6
Including equations in levels
H-matrix as per Ox/DPD
Dependent variable: l_Internet retailing

	Coefficient	*Std error*	*z*	*p-value*	
l_Internet retailing (-1)	0.506379	0.142818	3.5267	0.00042	***
const	-2.27055	1.56635	-1.4496	0.14717	
l_GDP	0.30629	0.146534	2.0902	0.03666	**
Equal distribution of income	-0.0127455	0.00530746	-2.4014	0.01633	**
Urbanization	0.000976952	0.00239428	0.408	0.68325	
Educational level	-0.00238419	0.00675288	-0.3531	0.72404	
l_Broadband penetration	0.0925107	0.0850135	1.0552	0.73986	
l_Mobile penetration	0.333221	0.15823	2.1059	0.03521	**
l_Presence of secure servers	0.0663885	0.0510456	1.3006	0.19341	
Internet users penetration	0.00931516	0.00433341	2.1596	0.01159	***
l_PCs penetration	0.0638701	0.10922	0.5848	0.55869	
l_Amount of IT investiments	-0.0277429	0.0395504	-0.7015	0.48302	
l_Road density	0.0171348	0.0352089	0.4867	0.6265	
l_Development of traditional retailing network	-0.216953	0.0791337	-2.7416	0.00611	***
l_Credit cards penetration	0.143864	0.0832194	2.7287	0.00838	***

Sum of squares of the residual 18.30764 — Standard error of the regression 0.253007
Number of instruments = 48
Test for AR(1): z=0.793004 [0.4278]
Test for AR(2): z=-1.57378 [0.1155]
Sargan Test of overid. Restrictions: Chi-squared (33)=25.4074 [0.8248]
Wald Test (combined)= Chi-squared (14) = 3808. [0.0000]

*** highly significant driver (p-value<0.01)
** medium-highly significant driver (p-value<0.05)
* medium significant driver (p-value<0.1)

Fig. 4 Dynamic panel model results

VI. Results

On the basis of the results reported in Fig. 4, the three research questions have been answered.

A. What are the factors having the greatest influence on B2c eCommerce value across countries?(RQ1)

The statistical model identified the factors that encourage or inhibit B2c eCommerce diffusion. The drivers resulting statistically significant (p-value < 0.05) are:

- *GDP*, defined as GDP per capita under the assumption of purchasing power parity;
- *No-equal distribution of income*, calculated through the Gini index defined as measure of the inequality among values of a frequency distribution. A Gini coefficient of zero expresses perfect equality where all values are the same. A Gini coefficient of one expresses maximal inequality among values;
- *Mobile penetration*, defined as mobile subscriptions per 100 inhabitants;
- *Internet user penetration*, defined as the percentage of total population using Internet;
- *Development of traditional retailing network*, defined as the number of traditional point of sales;
- *Credit card penetration*, calculated as the number of credit cards per capita;

These drivers act as the greatest influencing factors on B2c eCommerce development across countries.

B. Do they positively or negatively influence the B2c eCommerce development across countries (RQ2)?

The factors that result as determinants of B2c eCommerce diffusion can be grouped into two clusters, according to the type of correlation. On the one hand, some explanatory variables cause a positive effect on eCommerce value since an increase in these values generates a growth of the B2c eCommerce value. On the other hand, some drivers have a negative impact on the B2c eCommerce value.

Having a positive correlation coefficient, *GDP*, *mobile penetration*, *Internet user penetration* and *credit card penetration* are considered enabling drivers of eCommerce value across countries. Having a negative correlation coefficient, *equal distribution of income* and *development of traditional retailing network* act as inhibiting factors of eCommerce diffusion across countries.

C. What is the weight/importance of the factors identified in affecting the B2c eCommerce diffusion (RQ3)?

Among those factors affecting positively the B2c eCommerce diffusion, the Gini index, that measures *no equal distribution of income*, is the factor affecting the most the increase of the B2c eCommerce expenditure per capita. It is followed by the *Internet user penetration*, the *mobile penetration* and by the GDP.

Among those factors affecting negatively the B2c eCommerce diffusion, the *number of traditional points of sales* in a country (that describes *the presence/diffusion of traditional retailing network)*, is the factor reducing the most the B2c eCommerce expenditure per capita, followed by the *credit card penetration*.

VII. Conclusion

The main objective of this research was to identify the factors affecting (enabling or inhibiting) B2c eCommerce and to determine their quantitative impact on the diffusion of online sales across countries.

Consistently with evidences stemming from the literature review, 13 drivers (*amount of IT investment, broadband penetration, credit card penetration, development of traditional retailing network, educational level, equal distribution of income, GDP, Internet user penetration, mobile penetration, PC penetration, presence of secure servers, road density, urbanization*) have been identified in order to explain eCommerce diffusion.

A dynamic one-step panel model, including the previous drivers and taking into account 45 countries, has been proposed. The estimation of the dynamic model exhibited good statistical fit. Six independent variables have been considered as drivers influencing the B2c eCommerce

diffusion in a country because of statistically significant (p-value < 0.05). Based on model output, *GDP*, *mobile penetration*, *Internet user penetration* and *credit card penetration* are considered enabling factors of eCommerce value across countries, since they have a positive correlation coefficient, whereas *no equal distribution of income* and *development of traditional retailing network* act as inhibiting factors. The quantitative impact of these drivers on the B2c eCommerce diffusion has been identified.

In conclusion, some model limitations have to be pointed out. At this stage of research, the dependent variable was defined as total online purchases of products, excluding services due to lack of data. Tourism and Ticketing for events should be considered in the future to better understand the eCommerce development across countries. A further limitation is the lack of qualitative variables, most of all privacy/payment security concerns and web vendor trustworthiness , which should be quantitatively measured and then taken into account for future development of the model.

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