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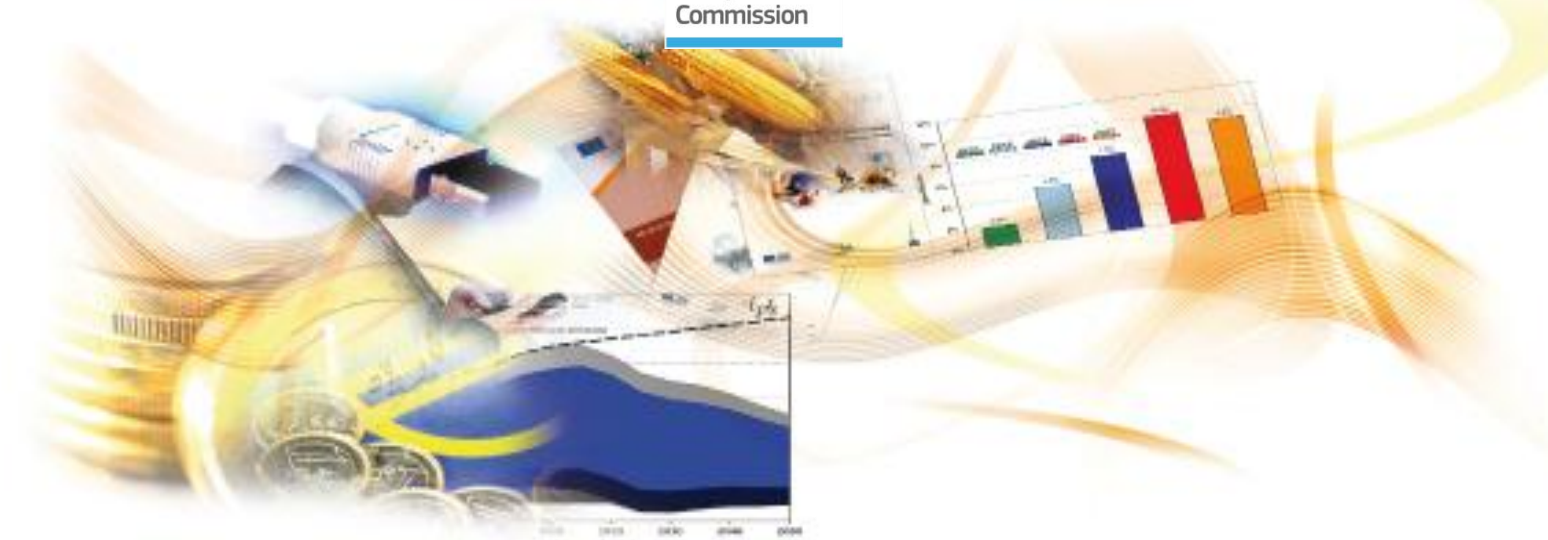

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The Value of the Internet for Consumers

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Abstract[1]

Several studies have examined the market value of paid-for internet services and internet access. This paper estimates the value of leisure time spent online for which the consumer pays no monetary price and which has become increasingly important as a leisure activity. We apply a methodology developed by Goolsbee and Klenow (2006), which relies on differences in time spent online and opportunity cost of time, to an internet users' clickstream dataset for the five largest economies in the European Union (Germany, United Kingdom, France, Italy and Spain). We find that, according to our most conservative measure, leisure time spent on the internet generated a consumer surplus of between 0.6 and 1% of full income in 2011 in the countries studied. The total consumer surplus for each country amounted to between 18 billion euros (Italy) and 44 billion euros (Germany).

JEL codes: *D12, D6, L86*

Keywords: *Internet Services, Consumer Surplus, Leisure.*

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1. Introduction

Several studies have estimated the value of the internet and its contribution to GDP (OECD 2012, 2013; Kalapesi *et al.* 2010). All these studies use the market value of goods and services sold online, or of telecom hardware and services that give access to the internet. That says something about the value of consumer expenditure on the internet and related products and services, but not necessarily how much consumers value the internet service. This is especially problematic since, once a consumer has paid for access to internet, most services provided on the internet are freely accessible. Almost 75% of total time spent online by internet users in Germany, Spain, France, Italy and United Kingdom is spent on leisure activities, such as social networks, videos and movies, online games and other entertainment activities (Pantea and Martens, 2013).[2] Consuming this type of online content generates consumer surplus, over and above consumer spending on marketed products and services. Failing to take into account the value of these free services to the consumer may result in serious underestimation of the economic value of the internet.

In this paper, we apply a method originally proposed by Goolsbee and Klenow (2006) that uses a revealed preference approach whereby time spent online and the opportunity cost of time (measured as wages) are used to calculate a measure of the value of internet to consumers. Several studies (Goolsbee and Klenow, 2006; Bayrak, 2011; Brynjolfsson and Oh, 2012) have used this or similar approaches to estimate the value of internet for consumers in the US.

To the best of our knowledge, the only estimate of consumer surplus from internet use that covers the European Union is the McKinsey study by Bughin (2011). Bughin (2011) uses an entirely different methodology, based on a survey and conjoint analysis to estimate consumers' willingness to pay for free internet services. Here, we follow the Goolsbee and Klenow (2006) methodology to estimate how much consumers benefit from spending time online in the five largest countries in the European Union: Germany, Spain, France, Italy and the United Kingdom. We use Nielsen Clickstream data, which provides objective and detailed data on 25,000 internet users' online activities and demographic characteristics.

2 Brynjolfsson and Oh (2012) estimate that as much as two thirds of internet time is spent on free online activities.

We find that, according to our most conservative measure, leisure time spent on the internet generated a consumer surplus of between 0.6 and 1% of full income in 2011 in the countries studied. The total consumer surplus for each country amounted to between 18 billion euros (Italy) and 44 billion euros (Germany). As a percentage of GDP, it represented between 1.1% in Italy and 2.2% in UK. The total consumer surplus for all five countries was 141 billion euros, considerably larger than the 100 billion consumer surplus estimated by McKinsey.

The paper is structured as follows. Section 2 reviews related studies. Section 3 describes the estimation strategy, Section 4 explains the data, Section 5 presents and discusses the estimates of elasticity of substitution and consumer surpluses and Section 6 offers conclusions concludes.

2. Related Literature

In this section, we will briefly review studies that attempted to estimate consumer surplus from internet or related goods and discuss the advantages and disadvantages of different methods used.

Estimating the price elasticity of demand for internet services is difficult for several reasons. First, the monetary cost of internet use is usually a fixed monthly subscription fee independent of the volume of use. Second, there is little variation in the monetary price paid by consumers. Finally, for time-intensive services like internet, the access price may be small compared to the opportunity cost of the time spent on the internet by the consumer.

A standard method to overcome these problems is to estimate the difference between how much a consumer would be willing to pay for a service and the market price he actually pays. For instance, Bughin (2011) used a consumer survey to estimate the net consumer value of internet services in the US and selected European countries at 100 billion euros, after deducting the cost of internet access and some payable online services as well as the 'nuisance' cost of online ads. The main limitation of this method is that it is based on survey data that reflects stated preferences, which may differ from actual choices of consumers.

There are several studies that use a revealed preferences approach to estimate the consumer surplus from goods related to internet using data on prices and money expenditure on these goods: personal computers (Greenwood and Kopecky, 2007), broadband (Greenstein and McDevitt, 2011, 2012) and from improvements in ICT infrastructure (Cooper, 2012). Greenwood and Kopecky (2007) propose a model to estimate the consumer surplus from using personal computers that relies on changes over time in the price and expenditure on personal computers. They estimate a consumer surplus from using personal computers of 2.4% when using a measure derived from their model and 0.16% when using the more conservative measure of consumer surplus proposed by Hausman (1999). Greenstein and McDevitt (2011) estimate the additional consumer surplus from switching from dial-up access to internet to broadband access using a survey of dial-up and broadband users in US between 1999 and 2006. They find that this switch generates a consumer surplus equivalent to a decline in the price of internet access of between 1.6% and 2.2% per year. Greenstein and McDevitt (2012) extend these estimations to thirty OECD nations between 2006 and 2010 using changes in prices and quality of internet access. The results indicate large differences across countries in consumer surplus generated by this switch. Cooper (2012) estimates improvements in consumer welfare due to government investment in ICT infrastructure in thirty OECD countries using data on these investments. His results indicate that the effects on consumer welfare differ considerably across countries. The main limitation of the empirical approaches used in these studies is that they consider only the money expenditure on internet access or personal computers and not the time expenditure. For time intensive goods, such as internet, time expenditure is likely to represent a large part of the consumers' total expenditure.

A revealed preference approach that takes into consideration both money and time expenditure of consumers on internet was proposed by Goolsbee and Klenow (2006). Their method uses differences in time spent online and in the opportunity cost of spending time online, in order to obtain a measure of consumer surplus. They apply this model to measure consumer surplus from using internet for a cross section of internet users in US in 2005. According to their preferred measure, the consumer surplus from using internet in the US in 2005 was 2.3% of full income. The Goolsbee and Klenow (2006) method of estimating of the value of time intensive goods was used by Bayrak (2012) to study consumer surplus from internet use in the US and by Loomis (2011) to study consumer surplus from urban recreation in Wyoming, US. Brynjolfsson and Oh (2012) also used a variant of this method to measure the value of internet for the consumer and found a consumer surplus of 3.3% of full income in the US in 2007.

Overall, the existing literature on estimating consumer surplus from internet or related goods is very heterogeneous in terms of the methods used and estimates obtained. We follow Goolsbee and Klenow (2006), which relies on consumers' revealed preferences and takes into consideration both money and time expenditure by consumers using internet. In addition, this approach is very suitable for our study because it has a similar purpose (estimating consumer surplus from leisure online) and uses similar types of data (time use data and the demographic information on internet users).

3. Estimation Strategy

In this section, we explain the Goolsbee and Klenow (2006) model and how we apply it to estimate consumer surplus from leisure online. In this model, consumers obtain utility from consuming two goods: an internet good and a composite good. The internet good represents online leisure activities. The composite good represents all other goods and services consumed, including offline leisure activities. Consuming these two goods requires both time and money. The amount of time that can be spent on the two goods is limited by the fixed time in a day. The amount of money that can be spent on the two goods is limited by the total money available, which is determined by hourly wages and number of hours worked. Consumers choose the time and money to spend on the two goods subject to combined time and money budget constraints. Goolsbee and Klenow (2006) assume that the utility function takes the following form:

$$U(L_I, L_O, C_I, C_O) = \theta(C_I^{\alpha_I} L_I^{1-\alpha_I})^{1-1/\sigma} + (1-\theta)(C_O^{\alpha_O} L_O^{1-\alpha_O})^{1-1/\sigma} \quad (1)$$

The budget constraint is:

$$P_I C_I + F_I + P_O C_O = W(1 - L_I - L_O) \quad (2)$$

U represents utility for a consumer. θ is the contribution of an internet good to utility and takes values between 0 and 1. L_I is the fraction of non-sleeping time spent on internet per week. L_O is the fraction of non-sleeping time spent on the composite good per week. P_O and C_O are the price and quantity of the composite good. P_I and C_I are the price and quantity of the internet good. F_I is the fixed fee for subscribing to internet. $1 - L_I - L_O$ is the fraction of non-sleeping time spent working per week. W is the wage consumers earn in labour markets. α_I and α_O are the money intensities of the internet and they are defined as time and money expenditure shares of total (time + money) expenditure spent on the internet and composite goods:

$$\alpha_I = \frac{P_I C_I}{P_I C_I + WL_I} \quad \text{and} \quad \alpha_O = \frac{P_O C_O}{P_O C_O + WL_O} \tag{3}$$

Following most of the time allocation studies since Becker (1965), Goolsbee and Klenow (2006) assume that the opportunity cost of time is given by the wage. The time intensities of the internet and composite goods are $(1-\alpha_I)$ and $(1-\alpha_O)$, respectively. The internet and composite goods differ with regard to their money and time intensities. The Internet good is time intensive: time expenditure represents a large part of total expenditure, while the share of money expenditure is small. The composite good is relatively less time intensive and more money intensive.[3] σ is the elasticity of substitution between the internet and the composite good. By solving the utility maximisation problem subject to the budget constraint, Goolsbee and Klenow (2006) obtain the optimal consumption bundle of the internet and composite goods.

Their measure of consumer surplus is the equivalent variation (*EV*). It indicates how much the income of a consumer without access to internet would need to increase in order to obtain the same utility as the consumer obtains when consuming the internet good. Using the optimal quantities of the two goods and the utility function for the consumer, Goolsbee and Klenow (2006) derive the following expression for the *EV* (hereafter referred to as the GK measure):

$$EV/W = \left(1 - \frac{L_I}{1 - F_I/W}\right)^{\frac{-1}{\sigma-1}} \left(1 - F_I/W\right) - 1 \tag{4}$$

This measure may overestimate the consumer surplus from leisure online because the utility function from which it is derived predicts that when the consumption of the internet good is close to zero, the additional utility obtained from consuming an infinitesimal quantity of internet good approaches infinity. Goolsbee and Klenow (2006) acknowledge

[3] It is important to notice that the composite good may also include time intensive offline leisure activities. However, overall, the composite good is relatively less time intensive and more money intensive than internet good, which includes only online leisure activities.

this problem and suggest that the following adaptation of the measure proposed by Hausman (1999) provides a better measure of consumer surplus:

$$EV/W = \frac{0.5L_I}{\sigma(1-L_I(1-F_I/W)} \tag{5}$$

This measure is based on a linear utility function and is not affected by the problem that affects the GK measure of consumer surplus. However, it is likely to underestimate the welfare gain when consumption of the good represents only a very small share of the expenditure (Hausman, 1999), which is likely to be the case of leisure time spent online. This measure is best interpreted as the lower bound of welfare gain.

Both measures depend on *σ* (the elasticity of substitution between internet and composite goods), which has to be estimated. We follow the Goolsbee and Klenow (2006) strategy for estimating *σ*. They derive from the equations of the optimal consumption quantities of internet and composite goods the following expression:

$$\ln\left(\frac{1-L_I}{L_I}\right) \approx \ln(A) + (\alpha_O - \alpha_I)(\sigma - 1)\ln W + \sigma \ln\left(\frac{1-\theta}{\theta}\right) \tag{6}$$

The left hand side variable is the logarithm of the ratio of the share of non-sleeping time spent offline to the share of non-sleeping time spent online. The right hand variables are a constant term,[4] the opportunity cost of time, and a term that represents individual differences in the preference for the internet good relative to the composite good. We assume that they depend on the demographic characteristics (*x)*:

$$\sigma \ln\left(\frac{1-\theta}{\theta}\right) = \sigma\gamma_x x$$

Then, to obtain the parameters of interest, we estimate:

$$\ln\left(\frac{1-L_I}{L_I}\right)_i = \beta_a + \beta_1 \ln W_i + \beta_x' x_i + u_i \tag{7}$$

i represents an internet user. From the estimated coefficients we can recover the parameters of interest using:

$$\sigma = \frac{\beta_I}{\alpha_O - \alpha_I} + 1 \qquad \gamma_x = \frac{\beta_x}{\sigma} \tag{8}$$

[4] In Goolsbee and Klenow (2006), *A* is a function of the price of internet good and time intensity of internet good to the price and time intensity of the composite good. This ratio is constant across individuals because it is assumed that all internet users are price takers and face the same prices.

We will estimate equation (7) using OLS and heteroskedasticity robust standard errors. One concern regarding the estimation of σ is that if the high income and low income consumers systematically differ in their preferences for the internet good, then the estimated σ will be biased. There is some empirical evidence that this might be the case (Goldfarb and Prince, 2008; Pantea and Martens, 2013). We address this potential problem by allowing the preferences of internet users for the internet good relative to the composite good to depend on internet users' occupation and education level. Internet users with different income levels might also systematically differ in the quality and speed of their access to internet. We will include regional dummies to control for differences in the quality of internet access in different regions.

4. Data Sources and Variable Measurement

➢ Sample

The main dataset used in this paper has been collected by Nielsen NetRatings. It contains information on all online activity on the home computers of 25,000 internet users in France, Germany, Italy, Spain and the United Kingdom, during the entire year 2011. This dataset was described in more detail in Pantea and Martens (2013). According to Nielsen, the sample of internet users is representative of the online population in these countries in terms of gender and age. The dataset contains information on all websites visited and on the time spent on them. This data is collected through a piece of software that internet users in the online panel voluntarily install on their PC. This software corrects for errors in measurement of the time spent on websites due to periods of inactivity or tabbed browsing. For each user, the dataset also contains information on basic social and economic characteristics. This data was collected when the person installed the software on their computer and, thus, before the recording of their clickstream.

In the empirical analysis, we use only the clickstream of employed internet users, who were between 16 and 74 years old and provided complete information on the relevant demographic characteristics and were not in the highest or the lowest 1% of the distribution of weekly time spent online. We focus on *employed* internet users because in our model the opportunity cost of spending time online is given by the wage that the internet user could earn on the labour market. We exclude internet users in the highest and the lowest 1% of the distribution of weekly time spent online, as their records might be affected by recording problems or by problems related to internet addiction, which are outside the scope of this empirical analysis. There are 12,311 individuals in the remaining sample. The number of observations in each country is reported in Table 1.

- **Time allocation variables**

All our time allocation variables are time shares out of total non-sleeping hours. In the absence of any data on sleeping hours, we follow Goolsbee and Klenow (2006) in assuming that all internet users spend 8 hours sleeping and the total non-sleeping time per week is 112 hours.[5]

Leisure time online is defined as the average number of hours spent online on websites related to leisure activities per week. Leisure websites were defined as those classified by Nielsen in the categories: entertainment, family and lifestyle, news and information, member communities (social networks) and internet services, which include popular services such as email and movie/music downloading websites.[6] The average number of hours spent online on these websites is calculated from the Nielsen Clickstream dataset. We consider leisure websites to be of the following types (based on the Nielsen classification): entertainment (adult, digital arts and graphics, books and magazines, broadcast media, events, gambling and sweepstakes, humour, comics and novelties, multicategory entertainment, music, online games, sports and videos and movies), family and lifestyle (family resources, genealogy, kids, games and toys, multi-category family lifestyle, personals, pets and animal care, religion and spirituality), news and information, social networks (member communities and targeted member communities) and telecom and internet services (email, instant messaging, long distance and local telephone carriers and internet tools, which include popular illegal downloading websites).

We do not have information on working hours for individual internet users and assume that they all work the same average number of full-time working hours for employees in their

[5] Goolsbee and Klenow (2006) do not discuss the other possible non-discretionary time use activities. Given the lack of data on such activities we will assume that these 8 hours include all the other non-discretionary activities.

[6] Goolsbee and Klenow (2006) and other studies related to measuring the welfare effects of time spent online assume that all time spent online is leisure. However, activities, such as ecommerce or online banking are not considered leisure by most people. Time spent on these activities contributes to the utility as an input in the production of the composite good.

countries. Data on this indicator comes from the Eurostat Labour Force Survey indicators. The time spent on the composite good is defined as non-sleeping time that is not spent on online leisure or working.

The descriptive statistics on these variables are in Table 1. For comparison, this table reports the corresponding statistics for US internet users in 2005, from Goolsbee and Klenow (2006). Time spent on leisure online varies from 2.3 hours per week in France to 3.8 hours in Germany. In all countries, the time spent on leisure online is lower than the 7.7 hours per week reported by Goolsbee and Klenow (2006) for the US. This happens for two reasons. First, internet users in the countries studied spent less time online (on all websites) than users in the US. Second, we focus on the time spent on leisure websites. Time spent online accounts for between 2% and 3% of the non-sleeping time in the countries studied. Average time spent working varies between 40.4 hours in Italy and 42.8 hours in United Kingdom. Time spent on composite good ranges between 65 and 68 hours, which represents between 59% and 61% of non-sleeping time in the countries studied.

- **Time and Money intensities: α_I and α_O**

Following Goolsbee and Klenow (2006), we assume that the marginal monetary cost of using internet is 0, which means P_I =0.[7] By substituting this in (3), if follows that α_I =0 and that α_O is:

$$\alpha_O = \frac{P_O C_O}{P_O C_O + WL_O} = \frac{P_O C_O / WL_W}{P_O C_O / WL_W + L_O / L_w} = \frac{(1 - P_I C_I)/WL_W}{(1 - P_I C_I)/WL_W + L_O / L_W} = \frac{1/WL_W}{1/WL_W + L_O / L_W}$$

L_W is the share of non-sleeping time spent working and its calculation is explained in the section on time allocation variables. WL_W is the total money consumption expenditure. As there are only two goods in this model, the share of consumption expenditure on the composite good is equal to one minus the share of consumption expenditure on the internet good, which is zero. The values of α_O obtained for the five countries are reported in

7 This assumption is not unreasonable. Van Dijk (2012) found that more 80% of the internet access offers were unmetered offers.

Table 1. These values are between 0.37 and 0.39 and are very similar to 0.38 obtained by Goolsbee and Klenow (2006) for the US.[8]

- **Income**

The dataset does not provide information on individual income, only on the household income range. We calculate income as the average of the lowest and highest income in the income range and we control for household size. Admittedly, this is a rough proxy for wage because we do not have precise information on income, nor on the number of employed persons in the household or whether the household has other sources of income. However, these types of approximations are frequently made in the literature on opportunity cost of time.

The descriptive statistics in Table 1 show that the average income in the sample is between 32,439.81 euros per year in Spain and 40,282.53 euros per year in France. The higher average income in France is due to the larger share of internet users that have managerial/executive occupations in the sample for this country.

- **Demographic Characteristics**

We assume that preferences for the internet good relative to the composite good depend on the following demographic characteristics: education level, gender, age, being single or married/cohabitating, household size, occupation and region of residence. Previous empirical studies on the use of internet found that people who differ with regard to these characteristics differ in their use of internet or the use of internet for leisure purposes.

Table 1 shows descriptive statistics for these demographic characteristics. They show that the sample used in the empirical analysis includes a large variety of internet users in terms of gender, age, education, occupation, family composition. We have examined the correlation between different demographic characteristics of the internet users and their income.

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[8] We considered several alternative measures of α_0. We considered that the share of consumption expenditure with internet is equal to share of consumption expenditure with all telecommunication services. We also used different measures of average working hours. Overall, the estimates were very similar to the baseline estimates.

Table 1 Summary statistics

Variable	DE	ES	FR	IT	UK	US**
Time allocation variables						
Non sleeping time	112.00	112.00	112.00	112.00	112.00	112.00
Time spent on online leisure	3.81	3.43	2.34	3.25	3.60	7.70
Time spent working	41.90	41.60	41.20	40.40	42.80	40.00
Time spent on composite good	66.29	66.97	68.46	68.35	65.60	64.30
L_i	0.03	0.03	0.02	0.03	0.03	0.07
Lw*	0.37	0.37	0.37	0.36	0.38	0.36
L_o	0.59	0.60	0.61	0.61	0.59	0.57
Money intensity of internet and composite goods						
α_I	0.00	0.00	0.00	0.00	0.00	0.00
α_O	0.39	0.38	0.38	0.37	0.39	0.38
Income						
Income	35934.69	32439.81	40282.53	32595.57	36338.69	
Demographic characteristics						
Gender	0.46	0.47	0.49	0.44	0.56	
Age < 30	0.17	0.15	0.07	0.12	0.20	
Age 30-40	0.25	0.42	0.34	0.32	0.25	
Age 40- 50	0.33	0.29	0.33	0.33	0.27	
Age >50	0.25	0.15	0.27	0.24	0.28	
Single	0.33	0.19	0.35	0.20	0.29	
Household size 1-2	0.62	0.46	0.55	0.42	0.58	
Household size 3-4	0.32	0.48	0.36	0.51	0.36	
Household size >5	0.05	0.06	0.10	0.07	0.07	
Below secondary education	0.61	0.14	0.16	0.11	0.04	
Secondary education	0.16	0.25	0.13	0.50	0.24	
Tertiary education	0.23	0.61	0.71	0.39	0.72	
Clerical/administrative	0.23	0.24	0.22	0.39	0.20	
Craftsman/craftswoman	0.07	0.01	0.01	0.01	0.00	
Education	0.06	0.07	0.09	0.08	0.00	
Executive/managerial	0.06	0.07	0.33	0.05	0.20	
Military	0.01	0.01	0.01	0.03	0.00	
Operator/labourer	0.11	0.08	0.07	0.13	0.12	
Other	0.14	0.15	0.05	0.06	0.05	
Professional	0.05	0.03	0.03	0.06	0.16	
Sales	0.05	0.07	0.05	0.03	0.11	
Services	0.16	0.12	0.04	0.10	0.10	
Technical	0.05	0.16	0.12	0.06	0.07	
Obs.	2669	2491	2787	2260	2104	

Data sources: Nielsen Clickstream, * Labour Force Survey Indicators (Eurostat), ** Goolsbee and Klenow (2006).

The correlation matrixes show that household income, having tertiary education and certain occupation dummies, especially executive/managerial occupation, are positively and significantly correlated. However, the magnitude of these correlations is between 0.20 and 0.41. We conclude that multi-collinearity is not likely to be an important concern.

5. Estimation Results

The results of the estimation of equation (7) and the implied parameters computed using equations (8) are reported in Table 2. In all regressions, the coefficient of income is positive and significant. Its values vary between 0.24 in Spain to 0.47 in the United Kingdom. These results indicate that internet users with higher incomes spend less time online. These results are in line with previous results (Goolsbee and Klenow, 2006; Goldfarb and Prince, 2008; Pantea and Martens, 2013). The estimated coefficients of income imply an elasticity of substitution between 1.64 in Spain and 2.18 in United Kingdom. The estimated elasticity for Spain is very similar to the elasticity of substitution obtained by Goolsbee and Klenow (2006) for the US in 2005 (1.62). For all the other countries, the elasticities are higher, close to or above 2.

The relationship between preferences for an internet good relative to the composite good and demographic characteristics is given by equation (8), which can be rewritten as:

$$\theta = \frac{1}{1 + \exp(\gamma_x x + u_i)}$$

Thus, a positive and significant γ_x implies that internet contributes less to utility for internet users with the characteristic x, and a negative coefficient implies that internet contributes more to utility for internet users with the characteristic x.

The results reported in Table 2 suggest several interesting patterns. First, the effect of education is mixed and in most countries, tertiary education does not have any effect on the relative preference for leisure online. In almost all countries, leisure online contributes less to utility for women than men. Internet goods contribute less to utility for older consumers (over 50) than younger consumers (in Spain, the same is true for consumers who are over 30). Internet contributes most to utility for single people, and it contributes less to utility for internet users who are married/cohabitating or living in large households. Generally, the results for the demographic characteristics are plausible and in line with previous findings related to use of internet by different demographic groups.

Table 2 Estimation equation

	Regression Coefficients β_I and β_x					Implied parameters σ and γ_x				
	DE	**ES**	**FR**	**IT**	**UK**	**DE**	**ES**	**FR**	**IT**	**UK**
Income	0.43	0.24	0.38	0.36	0.47	2.12	1.64	2.01	1.96	2.18
	[0.05]***	[0.05]***	[0.06]***	[0.06]***	[0.06]***	[0.14]	[0.13]	[0.16]	[0.15]	[0.15]
Secondary education	0.06	-0.28	0.00	-0.20	0.13	0.03	-0.17	0.00	-0.10	0.06
	[0.09]	[0.10]***	[0.11]	[0.11]*	[0.19]	[0.04]	[0.06]***	[0.06]	[0.06]*	[0.09]
Tertiary education	0.31	-0.14	-0.05	-0.16	0.05	0.15	-0.08	-0.02	-0.08	0.02
	[0.09]***	[0.10]	[0.10]	[0.13]	[0.18]	[0.04]***	[0.06]	[0.05]	[0.06]	[0.08]
Gender	0.01	0.17	0.10	0.11	0.18	0.00	0.10	0.05	0.05	0.08
	[0.07]	[0.06]***	[0.06]*	[0.07]	[0.07]**	[0.03]	[0.04]***	[0.03]*	[0.04]	[0.03]**
Age 30-39	0.05	0.25	-0.07	-0.03	-0.07	0.01	0.15	-0.04	-0.02	-0.03
	[0.09]	[0.08]***	[0.12]	[0.10]	[0.10]	[0.06]	[0.05]***	[0.06]	[0.05]	[0.05]
Age 40-49	0.15	0.41	-0.04	0.16	-0.05	0.01	0.25	-0.02	0.08	-0.02
	[0.10]	[0.09]***	[0.12]	[0.10]	[0.10]	[0.05]	[0.06]***	[0.06]	[0.05]	[0.05]
Age >50	0.37	0.44	0.17	0.31	0.31	0.00	0.27	0.08	0.16	0.14
	[0.10]***	[0.11]***	[0.13]	[0.11]***	[0.10]***	[0.03]***	[0.07]***	[0.06]	[0.06]***	[0.05]***
Single	-0.51	-0.29	-0.50	-0.42	-0.48	-0.26	-0.18	-0.25	-0.21	-0.22
	[0.08]***	[0.08]***	[0.08]***	[0.09]***	[0.08]***	[0.06]***	[0.05]***	[0.05]***	[0.05]***	[0.04]***
Household size 2-4	0.18	0.28	0.30	0.15	0.16	0.09	0.17	0.15	0.08	0.07
	[0.08]**	[0.07]***	[0.08]***	[0.08]*	[0.09]*	[0.04]**	[0.05]***	[0.04]***	[0.04]*	[0.04]*
Household size >5	0.21	0.33	0.28	0.09	-0.01	0.11	0.20	0.14	0.05	-0.01
	[0.15]	[0.13]**	[0.12]**	[0.14]	[0.16]	[0.08]	[0.08]**	[0.06]**	[0.07]	[0.07]
Obs.	2669	2491	2787	2260	2104					
R^2	0.12	0.09	0.11	0.10	0.11					

Notes: Dependent variable is $\ln((1-L_i)/L_i)$. All equations include occupation and region fixed effects. Heteroskedasticity robust standard errors are in brackets. *, ** and *** indicate significance at 10%, 5% and 1%, respectively.

Next, we compute consumer surplus from leisure online as a percentage of full income, as defined by Becker (1965): the income that could be achieved if a person dedicated all his non-sleeping time to earning income. The results of these estimations are reported in Table 3.

Table 3 Estimated consumer surplus from time spent online

	DE	ES	FR	IT	UK	US
GK consumer surplus (% of Full Income)	3.35	5.33	2.20	3.27	2.95	12.50
Hausman consumer surplus (% of Full Income)	0.89	1.01	0.55	0.80	0.81	2.30
GK consumer surplus (Euros/Pounds)	2627.70	4125.88	2081.99	2538.62	2387.46	
Hausman consumer surplus (Euros/Pounds)	696.32	785.09	524.22	620.50	651.30	

Notes: Authors calculations based on estimated parameters.

The Goolsbee and Klenow measure suggests a consumer surplus of between 2.2% in France and 5.3% in Spain. The Hausman measure indicates a consumer surplus of between 0.6% in France to just above 1% in Spain. In monetary terms, they suggest that a consumer would need to receive between 2,082 euros in France and 4,125 euros in Spain to achieve the same utility that they achieve when being able to spend time online, according to the GK measure of consumer surplus, or between 584 euros and 785 euros according to the Hausman measure. As expected, given the assumptions of the two methods explained in Section 3, the estimates using the Goolsbee and Klenow and Hausman methods differ considerably. They can be interpreted as the lower and upper bounds of consumer surplus.

How do these estimates compare with previous related estimates? They are lower than those obtained by Goolsbee and Klenow (2006) who estimated consumer surplus in the US at 12.6 % when using their measure and at 2.3% when using the Hausman measure. They conceded that 2.3% was a more realistic estimate. Our estimates are lower because the European internet users in our sample spent less time on online leisure and because we found a higher elasticity of substitution between online leisure and the composite good. Brynjolfsson and Oh (2012) use a model similar to Goolsbee and Klenow (2006) and report a consumer surplus of 3.3%. Overall, the estimates of consumer surplus are quite heterogeneous.

To gain better insight into the welfare gain from time spent online we compare our estimates of consumer surplus with related economic indicators. These comparisons are reported in Table 4.

Table 4 How large is consumer surplus?

	DE	ES	FR	IT	UK
Opportunity cost comparison					
GK consumer surplus per hour online (Euros/Pounds)	15.21	24.47	18.90	16.61	14.19
Hausman consumer surplus per hour online (Euros/Pounds)	4.02	4.72	4.76	4.06	3.85
Average hourly earnings (Euros/Pounds)	16.95	11.50	16.27	14.48	16.68
GDP comparison					
Total GK consumer surplus (billion Euros/Pounds)	165.41	112.35	98.78	73.88	120.89
Total Hausman consumer surplus (billion Euros/Pounds)	43.83	21.38	24.87	18.06	32.98
Total GK consumer surplus (% of GDP)	6.34	10.74	4.94	4.68	7.87
Total Hausman consumer surplus (% of GDP)	1.68	2.04	1.24	1.14	2.15

Notes: Authors calculations based on estimated parameters and Labour Force Survey Indicators (Eurostat), Population and Information Society Indicators (Eurostat) and National Accounts (Eurostat). Total consumer surplus represents the consumer surplus for all internet users in the country.

First, we compare the consumer surplus from an hour spent online with the average hourly wages, which can be interpreted as an average opportunity cost of spending time online. Estimates based on GK measure are very large, close to or higher than the average hourly earnings in most countries. In Spain, they are almost double the average hourly earnings. The Hausman estimates are smaller (around 4 Euro per hour) and amount to between 23% and 40% of average hourly earnings. These estimates suggest that leisure online is a low value activity for consumers. This is in line with findings of the previous studies (Goldfarb and Prince, 2008; Pantea and Martens, 2013).

Second, we compare consumer surplus with GDP. Using data on population and access to internet from Eurostat, we compute the total consumer surplus for all internet users in each country. The GK measure suggests that consumer surpluses are between 74 billion in Italy and 165 billion in Germany. The Hausman measure suggests more conservative but still large estimates between 18 billion in Italy and 44 billion in Germany. The consumer surplus is large despite the low value of an hour spent online because internet is consumed in large quantities and its price is essentially zero (for internet subscribers). As a percentage of GDP, consumer surplus is between 4.7% in Italy and 10.7% in Spain when we use the GK measure. According to the Hausman measure, it amounts to between 1.1% in Italy and 2.2% in UK. The latter estimates are in line with the 2% estimated by

Brynjolfsson and Oh (2012) for the US for 2010. Overall, the comparison with previous studies, with opportunity cost of time and GDP suggest that the Hausman measure provides more plausible estimates of consumer surplus.

Goolsbee and Klenow (2006) suggest that several caveats apply to the measures of consumer surplus derived from their model. First, in this model the opportunity cost of spending time online is the wage. It is possible that people value their leisure time less than their wage and in this case the consumer surplus is overestimated. However, if people value their leisure time at a constant fraction of their wage,[9] the estimates of elasticity of substitution and consumer surplus would not be affected.

Secondly, in this model there is only one possible substitute for leisure online: a composite good. In reality, there might be closer substitutes to spending time online, such as other types of leisure, and in this case the estimates of consumer surplus are biased. A model in which the consumer chooses between leisure online and other types of leisure activities and a composite good would address this potential problem. Due to lack of data on internet users' time allocation on other leisure activities, we are not able to examine this further.

Finally, we assume that internet users benefit from all the time spent online and that the principle of revealed preferences applies. However, the evidence on this topic is mixed. There are studies, such as Penard *et al.* (2011), which found that using internet has a positive effect on well-being. However, Nie and Hillygus (2002), Ward (2012) and Wallsten (2013) found that spending time online may negatively affect activities such as socialisation, other leisure activities, and studying, which are generally associated with higher wellbeing. We partially address this problem by focusing on economically active internet users and by excluding those who spend extremely high amounts of time online (in the highest 1% of the time spent online distribution), who are most likely to be affected by a possible negative effect from spending too much time online.

[9] Loomis (2011) suggests that a suitable estimate of price of leisure is one-third of the wage.

6. Conclusions

Spending time online has become an increasingly important leisure activity. It is difficult to measure the consumer surplus generated by leisure online because money expenditure represents only a small part of the total expenditure on it and variation in price of access to internet is limited.

In this paper, we quantify the consumer surplus from online leisure in the five largest countries in the European Union (Germany, United Kingdom, France, Italy and Spain) using an innovative method proposed by Goolsbee and Klenow (2006) and a unique dataset that covers the clickstream of a large number or internet users in these countries. The method proposed by Goolsbee and Klenow (2006) uses differences in time spent online and differences in the opportunity cost of spending time online to obtain a measure of consumer surplus. We use a dataset collected by Nielsen Clickstream that contains the entire clickstream of 25,000 internet users in Germany, United Kingdom, France, Italy and Spain during 2011 and demographic information on these internet users.

We find that internet leisure time generated a consumer surplus of between 0.6 and 1% of full income. This is equivalent to between 3.8 to 4.8 euros per hour spent online. The total consumer surplus for each country amounted to between 18 billion euros (Italy) and 44 billion euros (Germany). As a percentage of GDP it represented between 1.1% in Italy and 2.2% in UK.

These consumer surpluses could be somewhat overestimated due to assumptions made regarding the opportunity cost of time, possible substitutes of leisure online and the assumption that time spent online always increases utility for internet users. However, the estimates are in line with estimates of previous studies on this topic and compare in a plausible way with a variety of related economic indicators. Most importantly, they constitute, to the best of our knowledge, the first such estimates for European Union countries.

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Title: The Value of the Internet for Consumers

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Abstract
Several studies have examined the market value of paid-for internet services and internet access. This paper estimates the value of leisure time spent online for which the consumer pays no monetary price and which has become increasingly important as a leisure activity. We apply a methodology developed be Goolsbee and Klenow (2006), which relies on differences in time spent online and opportunity cost of time, to an internet users' clickstream dataset for the five largest economies in the European Union (Germany, United Kingdom, France, Italy and Spain). We find that, according to our most conservative measure, leisure time spent on the internet generated a consumer surplus of between 0.6 and 1% of full income in 2011 in the countries studied. The total consumer surplus for each country amounted to between 18 billion euros (Italy) and 44 billion euros (Germany).
JEL codes: D12, D6, L86
Keywords: Internet Services, Consumer Surplus, Leisure.

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