

Giving up your privacy for free after Snowden

Preliminary version, please do not quote

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The massive collection of personal data revealed by Snowden in June 2013 has focused the attention of individuals on possible misuses of personal data. The event represents a natural experiment to study individuals' privacy behaviors. We exploit this to investigate whether after these revelations, individuals feel more or less comfortable with the fact that some Internet companies provide access to free services in exchange for personal data. We analyze individual data collected in Europe before and after Snowden's revelations, and we estimate acceptance using pooled cross section. To measure the effect of being informed about the collection of personal data, we use propensity score matching. We find that the revelations of collection of personal data has reduced the probability that individuals mind providing personal data for free services.

Key words: privacy, information asymmetry, Snowden's revelations

1. Introduction

In 2013, the ex-NSA employee and ex-CIA agent Edward Snowden leaked about the NSA's and other international governmental agencies' use of widespread programs of global surveillance of individuals.¹ Snowden's revelations grabbed the attention of public opinion because these surveillance programs relied on the consent and assistance of most of the major Internet companies including Google, Amazon, Facebook, Apple, etc. Snowden's allegations were backed up by strong

Acknowledgements: We are grateful to Alessandro Acquisti, Anja Lambrecht, and Catherine Tucker for their valuable comments. We also thank the participants of the 9th IDEI Postal Economics Conference 2016, and OECD NAEC Seminar 2017. All errors are our own.

¹ The National Security Agency (NSA) is a U.S. government agency that monitors, collects, and processes strategic information and data. The revelations in relation to the NSA and Verizon were published on June 6, 2013 in The Guardian newspaper. This was followed by many other press reports and publication of documents provided by Edward Snowden who was in contact with journalists from The Guardian and The Washington Post. See "NSA collecting phone records of millions of Verizon customers daily" by Greenwald G. for the initial The Guardian article. PRISM and XKeyscore are two examples of such programs. PRISM is a massive data-collection program launched in 2007 and initiated by the NSA.

evidence, and were well publicized and commented on media across the world. The business models of Internet firms that are based on individuals' trust in Web companies were likely to be challenged since individuals often have to disclose their personal data in order to access "free" services on the Internet. In this context, individuals' privacy concerns are a keystone of this model, and Snowden's revelations may have highlighted the questions related to the massive collection of personal data by private companies. As personal data are at the heart of the Internet model, it becomes imperative for firms to assess how individuals' privacy concerns are evolving, and more particularly the impact of Snowden's revelations.

To address the question of a potential "chilling effect" for individuals regarding privacy issues after Snowden's revelations, we present evidence from a natural field experiment by exploiting European data that were collected before and after the event. In particular, a specific question in the 2015 survey helps us to distinguish informed individuals from uninformed individuals. The literature on privacy focuses on the effects of the presence of incomplete information, and more particularly of information asymmetry between firms and individuals (Acquisti and Grossklags, 2007). It aims to explain why individuals make privacy choices that seem to be misfits with this inequity. Indeed, while they are the initial owners of their data, individuals are notably excluded from the "market" for personal data. From individuals' perspective, on the one hand, individuals are not fully informed about the potential risks associated with the disclosure of their personal data, and its misuse by firms, and on the other hand, they lack information about how to protect their personal data. It has been recognized that information asymmetry between firms and individuals can cause market failure (Acquisti et al., 2016). Therefore, governments and firms are interested in how to provide individuals with a better understanding of their privacy choices and the consequences of these choices. We argue that this relies on individuals feeling uncomfortable with the current model of the Internet which is based on free access to services in exchange for personal data. Our approach is based on the expectation that information related to massive unwanted collection of personal data – such as enabled by PRISM – will drive individual's awareness of potential secondary misuse of personal data.

In this article, we estimate the effect of a pervasive and unexpected event related to a misuse of personal data – here Snowden's revelations – on the acceptance of the Internet model by individuals. To address this question, we analyze two Eurobarometer surveys of large samples of 40,275 individuals, conducted in 2010 and 2015 in 27 European countries, that is before and after Snowden's revelations. The structure of the data allows us to implement a natural field experiment. We measure the evolution of individuals' acceptance of the current Internet model through the

responses to a question that asks explicitly whether respondents “don’t mind providing personal information in return for free services online”. Both surveys deal specifically with privacy matters, and contain numerous identical questions on respondents’ privacy habits. We use two empirical strategies to show evidence of a *Snowden effect*. First, we measure the change in individuals’ acceptance of the model following Snowden’s revelations, employing a pooled cross-section (2010 and 2015). Second, the 2015 survey allows us to distinguish two groups of individuals - those who have “heard about recent revelations about government agencies collecting personal data”, and a “control” sample of individuals who have not. We use propensity score matching to estimate the average treatment effect of being informed about this event on the probability to accept the exchange of personal data for getting access to free services.

We find that, overall, individuals are less likely to accept to provide personal data in return for free services. However, the results show that an increased level of information related to privacy issues decreases the probability for individuals to accept the model. In addition, we show that individuals experienced in use of the Internet feel comfortable with disclosing personal data in exchange for free services. The results of the propensity score matching estimation shows that individuals informed about Snowden’s revelations are less accepting of the model compared to non informed individuals.

Our article contributes to the literature on changes in consumers’ behaviors in response to government privacy policies and practices (and their implications for business outcomes), in particular in relation with Snowden’s leakages of the NSA’s mass surveillance program. Very few empirical and theoretical studies try to interpret the behavioral changes that occur when information asymmetry is reduced, and the implications for regulation in relation especially to mass collection of personal data which may affect individuals’ behaviors towards privacy issues. Notable exceptions are Marthews and Tucker (2015) and Preibusch (2015). Marthews and Tucker (2015) use Google Trend data to study whether search traffic for more privacy-sensitive search terms decreased after the details of the PRISM program were revealed. The authors collected data on a large sample of key word searches. They show that, in the U.S., search terms associated with “high government trouble” fell by about 10% after publication of Snowden revelations. In relation to search behavior outside the U.S., they show that the decrease in use of these search terms was related more to privacy issues. Moreover, statistical evidence from the 2015 Pew Research survey conducted in the U.S. shows that among individuals informed about Snowden’s revelations 25% changed their behaviors in response to learning about this surveillance program. In contrast, Preibusch (2015), on the basis of a limited number of search queries collected via Microsoft Bing,

found that Snowden’s revelations had a short impact on searching via keywords such as PRISM.

We also contribute to the literature on privacy economics by modeling the tradeoff for individuals between data protection and data disclosure for access to free services. We aim at explaining the determinants of the degree of acceptance of the current Internet model, and whether this degree of acceptance has changed following Snowden’s revelations. Theoretical models contribute to understand how users’ acceptance of the Internet model can influence firms’ behaviors. Varian (1997) shows in a seminal contribution that individuals might choose not to reveal private information if they consider the secondary usage of their personal data by firms. Taylor (2004) shows that firms can have different strategies according to consumers’ privacy expectations. Firms prefer a disclosure regime rather than a confidential regime if consumers are naive and the contrary if consumers anti risks and benefits of disclosing personal information (Acquisti et al., 2016). In particular, giving users more control over their data in order to reassure them can reduce risk aversion but also reduces the effectiveness of personalized advertising (Tucker, 2012). On the whole, a change in individuals’ privacy behaviors could challenge the business models of Internet companies.

Economics of privacy has investigated individuals’ ability in real situations to evaluate the risks and benefits of disclosing personal information (Acquisti et al., 2016). Individuals’ choices may stem from various biases such as information asymmetry between firms and individuals (Tucker, 2014), or individual risk-aversion. Empirical studies show that individuals are not sufficiently informed and thus, not sufficiently aware of potential secondary usage (possible misuse or the potential commercial exploitation) of their personal data (Acquisti and Grossklags, 2007). Chellappa and Sin (2005) show that improved customer trust in the vendor increases the probability that they will use personalized services. Schumann et al. (2014) use a crowdfunding platform to show that normative reciprocity is generally more effective than the common understanding that individuals’ receive immediate utility from disclosing their personal data. Other approaches analyze whether individuals attribute a value to their personal data by estimating their willingness to accept use of their personal data compared to willingness to pay to protect their data (Acquisti et al., 2013). In this respect, the role of regulation is crucial since fair information practices imply that users should be properly informed by companies which implies in turn provision of clear and understandable information of firms’ privacy practices.

The paper is organized as follows. Section 2 presents a review of the literature related to our main contribution. Section 3 provides the descriptive statistics and the two empirical strategies used. Section 4 concludes by presenting the results, and some robustness checks.

2. Data description

We analyze two Eurobarometer surveys of large samples of 40,275 individuals conducted in 2010 and 2015 in 27 European countries, that is before and after Snowden’s revelations. The data include detailed individual characteristics related to attitude to data protection and electronic identity in the European Union.

Our key variable of interest is the ordered variable *NotMindFree*. This is based on responses to the following question: “You don’t mind providing personal information in return for free services online (e.g. free email address).”. This is an ordinal variable, and the mutually exclusive responses are 1 if the individual totally disagrees; 2 if the individual tends to disagree; 3 if the individual tends to agree; and 4 if the individual totally agrees. Table 1 presents the breakdown statistics of this variable in the two periods 2010 and 2015.

Table 1 **Dependent variable NotMindFree in 2010 and in 2015**

NotMindFree	2010	2015
Totally disagree (1)	36.02	38.02
Tend to disagree (2)	30.61	27.24
Tend to agree (3)	24.98	25.64
Totally agree (4)	8.39	9.10
N	19,424	20,851

It is interesting that in relation to accepting the Internet model, a large share of individuals disagree, with an increase of about 2% for individuals who “totally disagree” in 2015, while the percentage of who “tend to disagree” decreases by around 2.5%. The individuals that totally agree represent around 9% of the population interviewed in 2015. The distributions of the answers are significantly different from each other over the two periods (Fisher test, p -value=0.000). This result suggests a change in individuals’ acceptance of the Internet model in Europe between 2010 and 2015.

Table 2 present the statistics of the variable NotMindFree and the Fisher tests for each country. Figures 1 and 2 depict the differences across countries in 2010 and 2015 respectively for individuals that declared agreeing to the tradeoff between disclosing personal data for access to free services. These maps and these statistics highlight some difference per country before and after Snowden’s revelations. In particular, the degree of acceptance of the tradeoff increased in Germany, the UK, and Spain, and fell in Poland, Czech Republic, and Sweden.

Table 2 Dependent variable NotMindFree by country (in %)

	(1)		(2)		(3)		(4)		<i>p</i> -value
	2010	2015	2010	2015	2010	2015	2010	2015	2010/2015
Austria	34.04	23.50	28.37	31.55	30.64	33.84	6.95	11.11	0.000
Belgium	36.08	38.65	34.79	32.49	23.47	23.79	5.66	5.07	0.644
Bulgaria	46.62	48.01	25.32	24.80	20.25	19.87	7.81	7.31	0.968
Cyprus	50.17	48.81	25.41	16.04	14.52	22.18	9.90	12.97	0.006
Czech Republic	29.78	35.19	42.28	33.91	23.28	23.81	4.66	7.08	0.001
Estonia	28.99	31.61	28.15	28.36	29.83	29.69	13.03	10.34	0.403
Denmark	34.47	34.92	27.85	24.25	23.17	24.36	14.50	16.47	0.315
Finland	39.95	38.54	30.70	28.09	23.43	22.04	5.92	11.34	0.002
France	49.88	47.64	25.44	24.84	18.33	17.96	6.36	9.55	0.133
Germany	42.05	33.91	28.01	27.58	23.51	30.88	6.44	7.63	0.000
Greece	47.40	50.07	31.79	20.89	17.20	24.62	3.61	4.43	0.000
Hungary	40.22	46.55	32.25	23.82	20.92	20.43	6.61	9.20	0.001
Italy	16.95	28.66	18.28	33.73	34.75	31.60	30.02	6.01	0.000
Ireland	42.03	33.54	25.49	22.68	27.47	32.32	5.01	11.46	0.000
Latvia	30.12	37.42	30.92	26.24	28.38	24.50	10.58	11.84	0.010
Lithuania	30.26	35.51	35.76	30.21	26.86	25.80	7.12	8.48	0.108
Luxembourg	41.69	40.79	26.70	27.89	23.43	26.32	8.17	5.00	0.305
Malta	29.60	27.71	36.82	22.89	26.35	37.05	7.22	12.35	0.000
Netherlands	34.88	41.92	35.31	25.75	22.94	22.97	6.87	9.36	0.000
Poland	26.03	31.95	33.28	35.29	31.72	26.47	8.97	6.28	0.014
Portugal	32.83	48.24	34.34	31.32	28.45	18.24	4.38	2.21	0.000
Romania	30.41	41.13	29.87	22.35	27.91	24.29	11.81	12.22	0.000
Slovakia	28.84	33.94	35.70	29.37	30.97	28.85	4.49	7.83	0.001
Slovenia	42.97	41.80	28.26	23.91	21.03	22.13	7.74	12.16	0.015
Spain	35.33	43.40	32.59	23.26	25.81	22.70	6.26	10.64	0.000
Sweden	40.72	48.00	27.45	26.16	21.80	18.74	10.03	7.10	0.007
UK	34.92	29.14	33.73	29.42	25.30	31.60	6.05	9.84	0.000
N	19,424	20,851	19,424	20,851	19,424	20,851	19,424	20,851	0.000

Notes. Columns (1), (2), (3) and (4) correspond resp. to Totally disagree, Tend to disagree, Tend to agree and Totally agree. The sums for one country over one year are 100%.

In Table 3, we present the variables that might have an influence on the level of acceptance of the current Internet model. We are here interested on the level of information related to privacy issues an individual might have been exposed to. To measure the existence of information asymmetry between firms and consumers, we use the dummy variable *Kn_authority* which indicates whether individuals are aware of the existence of the national data protection authority. This variable tests to what extent individuals are informed about privacy issues. The survey question refers to the national authority of the particular country by name, e.g. for France it refers to CNIL. In 2010, some 37.6% of individuals declared that they were aware of the national authority protecting personal data, a percentage fairly close to the 2015 level of 43.9%.

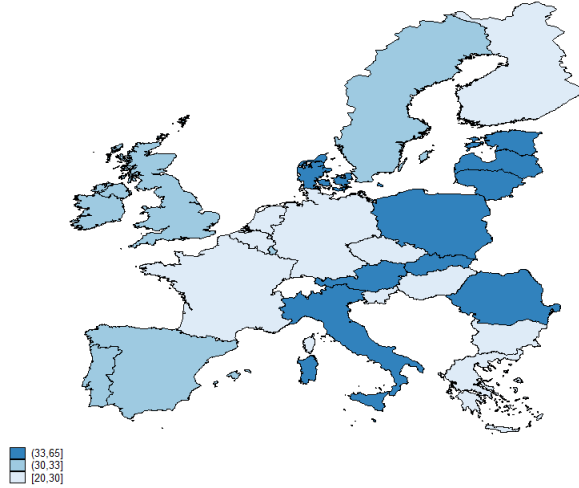


Figure 1 NotMindFree in percentage in 2010

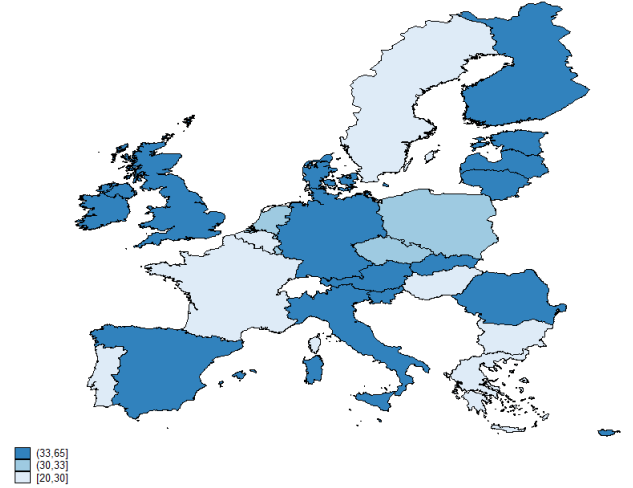


Figure 2 NotMindFree in percentage in 2015

Table 3 List of covariates

Variable name	Description
<i>NotMindFree</i>	Dependent variable
<i>Kn_authority</i>	Equals 1 if the individual knows the national authority protecting personal data; 0 otherwise.
<i>PublicSpace</i>	Equals 1 if the individual is concerned by data collection in public space; 0 otherwise.
<i>MissPolitical</i>	Equals 1 if individual does not declare political orientation; 0 otherwise.
<i>Age</i>	Age of the individual
<i>Male</i>	Equals 1 if the individual is a male; 0 otherwise.
<i>Middle</i>	Equals 1 if the individual lives in a small/middle sized town; 0 otherwise.
<i>Large</i>	Equals 1 if the individual lives in a big town; 0 otherwise.
<i>Married</i>	Equals 1 if the individual is married; 0 otherwise.
<i>Student</i>	Equals 1 if the individual is a student; 0 otherwise.
<i>Degree</i>	Equals 1 if the individual has a high degree; 0 otherwise.
<i>Self_emp</i>	Equals 1 if the individual is self employed; 0 otherwise.
<i>Employed</i>	Equals 1 if the individual is employed; 0 otherwise.
<i>Freqint</i>	Intensity of Internet usage
<i>Nodifficulties</i>	Equals 1 if the individual had no difficulty to pay his bills; 0 otherwise.

The disclosure of personal data in exchange for access to free services is the model proposed by a large number of websites, and apart from the Snowden revelation effect, there are other privacy related concerns which might affect its acceptability. Various empirical strategies can be used to test individual attitudes to privacy. Using the declared level of concern over privacy might result in a declarative bias.² Therefore, we use the dummy variable *Missing_Political* which takes the value 1 if the individual does not declare his/her political beliefs which might be a measure of the level of concern related to the disclosure of personal data, and 0 otherwise.

² This type of behavior can be associated with the privacy paradox.

The questionnaire also includes a set of questions related to data disclosure and confidence in institutions. The binary variable *PublicSpace* measures the extent to which the individual is concerned by the fact that many of our everyday activities in the public space are recorded through various means such as cameras, payment cards, websites, etc. This variable measures the risk aversion to invasions of privacy not necessarily related to the online setting. To take account of individual heterogeneity, all of the econometric specifications include a complete set of socio-demographic variables and country fixed effect dummies.

Table 4 presents detailed statistics of the pooled cross section data while Table 5 details the distribution of the variables respectively in 2010 and 2015.

Table 4 Summary statistics: Pooled cross section 2010 and 2015

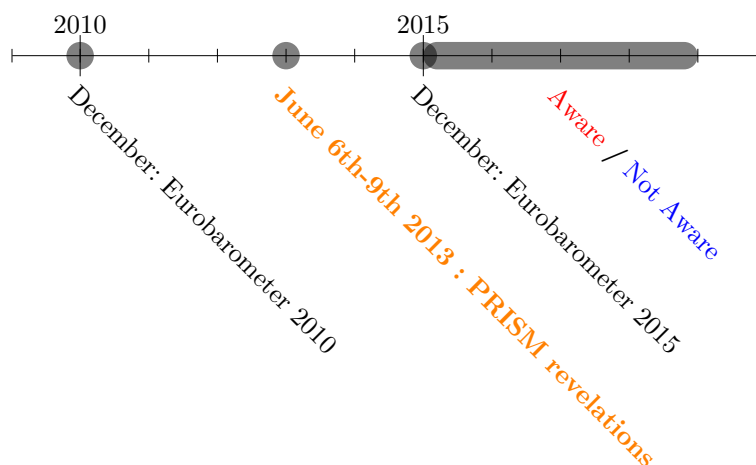
Variable	Mean	Std. Dev.	Min.	Max.
<i>NotMindFree</i>	2.058	0.985	1	4
<i>Kn_authority</i>	0.409	0.492	0	1
<i>PublicSpace</i>	0.325	0.469	0	1
<i>MissPolitical</i>	0.179	0.384	0	1
<i>Age</i>	45.867	17.135	15	85
<i>Male</i>	0.474	0.499	0	1
<i>Middle</i>	0.397	0.489	0	1
<i>Large</i>	0.291	0.454	0	1
<i>Married</i>	0.533	0.499	0	1
<i>Student</i>	0.088	0.284	0	1
<i>Degree</i>	0.703	0.457	0	1
<i>Self_emp</i>	0.080	0.271	0	1
<i>Employed</i>	0.463	0.499	0	1
<i>Freqint</i>	3.729	1.969	0	5
<i>Nodifficulties</i>	0.604	0.489	0	1

3. Research design

Our empirical estimation is based on the fact that Eurobarometer surveys have been conducted in 2010 and in 2015, that is, before and after Edward Snowden’s revelations. Random samples of the populations were selected to respond to the survey questionnaire, and data were collected according to the same stratification rules in the two periods. Figure 3 presents the graphical representation of the natural field experiment timeline where we conduct two different empirical strategies.

Table 5 Summary statistics per year 2010 & 2015

Variable	2010		2015	
	Mean	Nb Obs	Mean	N
<i>NotMindFree</i>	2.057	19424	2.058	20851
<i>Aware_gov</i>			0.499	20851
<i>Kn_authority</i>	0.376	18892	0.439	20580
<i>PublicSpace</i>	0.334	19039	0.318	20225
<i>MissPolitical</i>	0.196	19424	0.164	20851
<i>Age</i>	44.51	19424	47.131	20851
<i>Male</i>	0.477	19424	0.47	20851
<i>Middle</i>	0.372	19424	0.419	20851
<i>Large</i>	0.298	19424	0.286	20851
<i>Married</i>	0.521	19424	0.544	20851
<i>Student</i>	0.099	19424	0.079	20851
<i>Degree</i>	0.677	19424	0.727	20851
<i>Self_emp</i>	0.079	19424	0.08	20851
<i>Employed</i>	0.471	19424	0.457	20851
<i>Freqint</i>	3.415	19424	4.021	20851
<i>Nodifficulties</i>	0.588	19424	0.619	20851

**Figure 3** Before and after Snowden's revelations: a natural field experiment

3.1. Pooled cross section

The first part of the empirical analyses used a pooled cross section data which allows us to assess whether there was any evolution in individuals' acceptance of the Internet model over the two time periods. The advantage of a pooled cross section is that although the individual respondents may vary, we can measure the evolution of the dependent variable.³ We employ an ordered probit to model the probability of accepting to disclose personal information in exchange for free services. The specification of the model is written as follows:

³ The codebook accompanying the 2015 survey clearly indicates the questions that are common to both surveys which allows construction of the pooled cross section.

$$\begin{aligned} NotMindFree_i = & \beta_1 + \beta_2(X_i) + \beta_3(year2015_t) + \beta_4(year2015_t) * (X_i) \\ & + \beta_5(sociodemographic_i) + \alpha_c + \epsilon_i. \end{aligned}$$

where $NotMindFree_i$ measures the intensity of acceptance of the Internet model offering free services in exchange of personal data, X_i indicates two main covariates of interest $Knowledge_{Authority}$ and $Public_{space}$, $year2015_t$ measures both the effect of Snowden's revelations and the evolution over time, $year2015_t$ is a dummy variable, $sociodemographic_i$ provides detailed information on individual socio-demographic variables such as age, gender, type of the dwelling, and α_c measures the country fixed effect.

3.2. Propensity score matching

In the second part of the analysis, we distinguish between individuals who knew about the Snowden's revelations and those who did not. We exploited the responses to a question in the survey conducted in 2015 which asked whether the respondent had heard about a recent government agency program which was aimed at collecting personal data. The corresponding variable is $Aware_{gov}$. In order to disentangle the effect of being informed about the Snowden revelations, we estimate a propensity score matching to measure the effects of being informed on acceptance of the model proposed by Internet companies.

4. Estimation of the pooled cross section data in 2010 and 2015

The pooled cross section allows estimation of the probability to accept the model proposed by Internet companies (see results in Table 6). We estimate different specifications to test the robustness of our results. In each specification, we include several socio-demographic variables and the country fixed effects. Column (1) tests the specification with all variables. The Column (3) and (4) include the variable $Kn_{Authority}$. The coefficient of this variable suggests that being informed about privacy related issues is significantly associated with accepting the exchange of personal data against free services. The estimations (4) and (6) include the interaction terms between the dummy variable $Year2015$ and the key variables of interest, respectively $Kn_{Authority}$ and $Public_{space}$. The columns (5) and (6) investigate the effect of the variable $Public_{space}$. Being concerned about the recording of personal data in the Public space is negatively associated with the acceptance of the model, and this negative effect remains significant and negative when interacted with the $year$ dummy.

The coefficient associated with the dummy variable *year2015* is negative and significant in almost all specifications. This suggests that in 2015 the respondents were less comfortable with disclosing personal data in exchange for free services. Note that this variable captures both the time lapse between the surveys, and the incident of Snowden’s revelations. To disentangle these two effects, we need to examine in more depth the impact of being informed about these revelations on acceptance of the industry model. To do this, we use propensity score matching. We include in all specifications the variable *MissPolitical* which measures concern over privacy is also negatively associated with the probability of feeling confident which suggests that individuals who are concerned about their privacy will opt for a different service if they have the choice. Frequent users of the Internet *Freqint* are more accepting of the model which might suggest that they have become resigned to the disclosure of personal data in exchange for access to Internet services.

The interaction effects show that in 2015, in a context of less information asymmetry meaning that individuals are aware of the work of the national regulatory authority *Kn_Authority*, there is a higher level of acceptance of the model compared to a situation with higher levels of information asymmetry. While being concerned about the recording of personal data in the *Public_space* in 2015 is still negatively associated with acceptance of the model.

Table 13 and 14 present a series of robustness checks. Table 13 includes non-linear ages controls, and Table 14 considers the frequency of Internet usage by category. Our results still hold when we conduct this robustness check.

To measure the different level of information about the PRISM revelations, we estimate a set of regression presented in Table 7. These include Google Trend search related to Snowden in each European countries. For this purpose, we collect the number of time ”Snowden” search key words has been used from June to December 2013. We include in the regression the quartile coefficient of dispersion of this value *Snowden_q*. The coefficient is negative and statistical significant showing that the information related this surveillance program negatively affect the acceptance of the Internet model.

Table 6 Ordered logit Pooled cross section 2010 and 2015

	(1)	(2)	(3)	(4)	(5)	(6)
Year2015	-0.058** (0.028)	-0.060*** (0.019)	-0.067*** (0.019)	-0.104*** (0.025)	-0.058*** (0.019)	-0.015 (0.023)
missing_political	-0.155*** (0.027)	-0.156*** (0.026)	-0.150*** (0.026)	-0.150*** (0.026)	-0.161*** (0.026)	-0.160*** (0.026)
kn_authority	0.035 (0.028)		0.084*** (0.020)	0.035 (0.027)		
Kn_authority*year2015	0.081** (0.038)			0.092** (0.038)		
Public_space	-0.170*** (0.028)				-0.233*** (0.020)	-0.165*** (0.028)
Public_space* Year2015	-0.125*** (0.040)					-0.135*** (0.040)
freqint	0.121*** (0.006)	0.121*** (0.006)	0.118*** (0.006)	0.119*** (0.006)	0.122*** (0.006)	0.122*** (0.006)
age	-0.039*** (0.004)	-0.039*** (0.004)	-0.039*** (0.004)	-0.039*** (0.004)	-0.039*** (0.004)	-0.039*** (0.004)
agesq	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
male	0.118*** (0.019)	0.118*** (0.019)	0.116*** (0.019)	0.116*** (0.019)	0.120*** (0.019)	0.120*** (0.019)
nodifficulties	-0.016 (0.021)	0.006 (0.021)	0.003 (0.021)	0.003 (0.021)	-0.011 (0.021)	-0.011 (0.021)
Socio demog. variables	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES
cut1_cons	-0.928*** (0.108)	-0.852*** (0.104)	-0.857*** (0.105)	-0.874*** (0.106)	-0.929*** (0.106)	-0.901*** (0.106)
cut2_cons	0.342*** (0.108)	0.408*** (0.104)	0.404*** (0.105)	0.387*** (0.106)	0.340*** (0.106)	0.369*** (0.106)
cut3_cons	2.095*** (0.109)	2.148*** (0.105)	2.148*** (0.106)	2.131*** (0.107)	2.088*** (0.107)	2.117*** (0.107)
<i>N</i>	38503	40275	39472	39472	39264	39264
Pseudo <i>R</i> ²	0.029	0.027	0.027	0.027	0.029	0.029

Notes. Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7 Quartile coeff. Dispersion for Google Trend (Jun.-Dec. 2013)

	(1)	(2)	(3)	(4)	(5)	(6)
NotMindFree						
Years2015	-0.034 (0.028)	-0.036* (0.019)	-0.041** (0.019)	-0.073*** (0.025)	-0.031 (0.019)	0.001 (0.023)
Missing_Political	-0.107*** (0.026)	-0.102*** (0.025)	-0.100*** (0.026)	-0.100*** (0.026)	-0.109*** (0.026)	-0.108*** (0.026)
Kn_Authority	0.039 (0.027)		0.078*** (0.019)	0.038 (0.027)		
kn_Authority*Year2015	0.064* (0.038)			0.076** (0.038)		
PublicSpace	-0.167*** (0.028)				-0.211*** (0.020)	-0.161*** (0.028)
PublicSpace*Year2015	-0.091** (0.040)					-0.103*** (0.040)
freqint	0.105*** (0.006)	0.105*** (0.006)	0.104*** (0.006)	0.104*** (0.006)	0.105*** (0.006)	0.106*** (0.006)
nodifficulties	0.003 (0.020)	0.028 (0.020)	0.025 (0.020)	0.025 (0.020)	0.007 (0.020)	0.007 (0.020)
Snowden_6M	-0.012*** (0.002)	-0.012*** (0.001)	-0.012*** (0.001)	-0.012*** (0.001)	-0.012*** (0.001)	-0.012*** (0.001)
Socio demog. variables	YES	YES	YES	YES	YES	YES
cut1_cons	-1.754*** (0.106)	-1.678*** (0.103)	-1.674*** (0.104)	-1.688*** (0.104)	-1.759*** (0.105)	-1.739*** (0.105)
cut2_cons	-0.501*** (0.106)	-0.433*** (0.102)	-0.429*** (0.104)	-0.443*** (0.104)	-0.507*** (0.104)	-0.486*** (0.104)
cut3_cons	1.233*** (0.107)	1.289*** (0.103)	1.297*** (0.104)	1.282*** (0.104)	1.223*** (0.105)	1.244*** (0.105)
<i>N</i>	37671	39398	38609	38609	38418	38418
pseudo R^2	0.021	0.019	0.019	0.019	0.021	0.021

Notes. Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

5. Robustness check: Propensity score matching

In order to estimate the impact of Snowden's revelations on informed individuals, we use the method of the propensity score matching to estimate the impact of being informed into the acceptance of the model. We use propensity score matching to estimate the average treatment effect which allows measurement of the impact of being informed about government revelations on the acceptability of the model since we assume that the information leaked by Snowden increased individuals' concerns over privacy issues. In this empirical setting, the dummy variable *Aware_gov* take the value 1 if the individuals is informed about mass governmental surveillance program measured by and 0 otherwise. Figure 4 is a map showing the percentage of individuals who are aware of Snowden's revelations. Table 8 shows the detailed descriptive statistics of the percentage

of informed and uninformed individuals. The final sample includes 19,967 individuals.⁴

Figure 4 Distribution of individuals informed about the Snowden's revelations

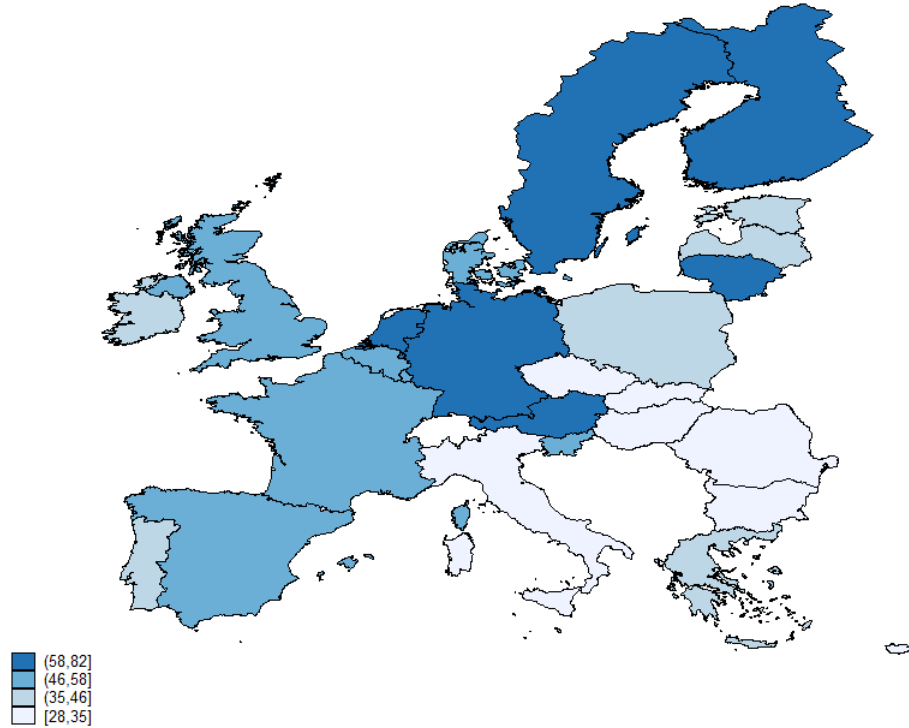


Table 8 Summary statistics by Aware.gov for the dataset collected in 2015

	Aware		Not Aware	
	Mean	Obs.	Mean	Obs.
NotMindFree	2.088	10,399	2.028	10,452
Kn_authority	0.574	10,264	0.306	10,316
PublicSpace	0.319	10,195	0.317	10,030
MissPolitical	0.130	10,399	0.198	10,452
Age	46.724	10,399	47.536	10,452
Male	0.527	10,399	0.414	10,452
Middle	0.416	10,399	0.422	10,452
Large	0.296	10,399	0.276	10,452
Married	0.539	10,399	0.549	10,452
Student	0.083	10,399	0.075	10,452
Degree	0.770	10,399	0.685	10,452
Self_emp	0.092	10,399	0.068	10,452
Employed	0.482	10,399	0.431	10,452
Freqint	4.367	10,399	3.677	10,452
Nodifficulties	0.676	10,399	0.562	10,452

⁴ There are different missing variables that reduce our sample.

To conduct propensity score matching estimation requires certain conditions to hold (see Caliendo and Kopeinig (2008) for details about these conditions), in particular conditional independent assumption (CIA), and common support. CIA implies that, conditional on observed characteristics (X), the matching strategy requires the outcome variable(s) to be independent of treatment conditional on the propensity score (Rosenbaum and Rubin, 1983). This assumption relies on the possibility to measure all relevant variables that can simultaneously affect both the treated and the untreated outcome variables (Caliendo and Kopeinig, 2008). Common support ensures that individuals with the same set of characteristics have a positive probability of being treated and non-treated (Caliendo and Kopeinig, 2008).

To estimate the propensity score matching, we use a detailed set of variables such as the demographics variables which include individual's age, education, type of job, type of dwelling, and country of residence. Table 9 reports the results of the two-samples t-tests. It shows that the two groups of informed and uninformed individuals are statistically different. Figure 4 shows the distribution of individual informed about Snowden revelations based on the variable *Aware_gov*. It shows that individuals in Germany, Netherlands, Sweden, and Finland on average are better informed compared to those from southern European countries such as Italy, Romania, and Bulgaria.

Table 9 Significance difference between informed and uninformed individuals: *Aware_gov* by variables

variable	t	$P > t $
NotMindFree	-4.336	0.000
kn_authority	-40.195	0.000
PublicSpace	-0.290	0.769
missing_political	13.349	0.000
age	3.430	0.000
male	16.33	0.000
Nodifficulties	13.35	0.000
middle	0.811	0.418
large	-3.160	0.001
married	1.392	0.164
student	-2.291	0.022
degree	-13.959	0.000
self_emp	-6.390	0.000
employed	-7.352	0.000
freqint	-28.516	0.000

We use different matching algorithms to assess the robustness of the results with respect to different matched samples (see Table 10). The results show that the Score are always negative

and significant. In particular, the Average treatment of treated (ATT) is equal to -0.007. This suggests that to be informed about government revelations decreases the probability of accepting the exchange of personal data against free service among treated individuals. This result has important policy and managerial implications. On the one hand, it suggests that after these revelations individuals have become more conscious and careful about the disclosure of personal data, and thus they might try to protect against it. On the other hand, it might suggest an increase demand for privacy and that the advent of privacy enhancing services would attract a certain type of consumer who is becoming cautious about the disclosure of personal data. Table 9 reports the results of the t-test of the covariates after matching is balanced. To evaluate the quality of propensity score matching, we compare the overall distributions of propensity scores, and we check the covariate balance for treated and untreated individuals. Figure 5 shows the distributions of the propensity score matching. Under the baseline matching process, 100% of individuals in our sample have appropriate matches, as shown in Table 11 where the results of common support are presented.

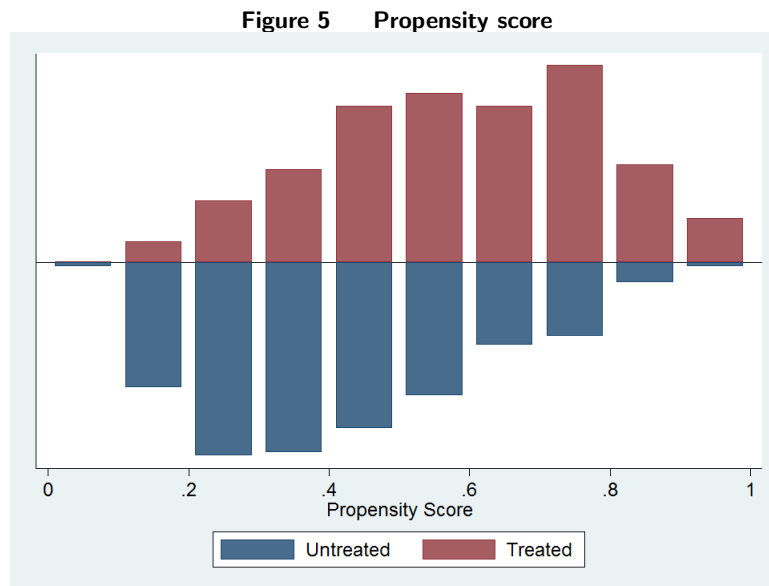


Table 10 Results of the propensity score matching with different methods

Method	Variable	Treated	Controls	Difference	S.E.	T-stat
Logit	Unmatched	2.090	2.037	0.053	0.014	3.79
	ATT	2.090	2.098	-0.007	0.023	-0.31
Matching with replacement	Unmatched	2.090	2.037	0.053	0.014	3.79
	ATT	2.090	2.114	-0.023	0.023	-1.00
Kernel	Unmatched	2.090	2.037	0.053	.014	3.79
	ATT	2.090	2.098	-0.008	0.017	-0.45
ATE	Unmatched	2.090	2.037	0.053	0.014	3.79
	ATT	2.090	2.098	-0.007	0.023	-0.31
	ATU	2.037	2.042	.005		
	ATE			-.001		

Table 11 Common support for the propensity score matching

psmatch2:		
psmatch2	Common support	
Treatment assignment	On support	Total
Untreated	9,903	9,903
Treated	10,064	10,064
Total	19,967	19,967

6. Conclusion

The present article draws upon two strands of literature. First, we rely on the literature on the impact of Snowden’s revelations, and the commercial impact of data breaches, to analyze how consumer behavior might change in response to government practices. Second, we follow on from the economics of privacy to enhance the understanding of compliance with disclosure of personal data in exchange for free services.

The economics of Internet platforms rely heavily on the use of personal data which are a key input of their business models. However, the link between business model that propose free services in exchange for personal data and demand for privacy is a topic that has not been well researched. This business model provides benefits to both firms and individuals. Individuals willing to disclose their personal data can get immediate access to the free services provided by Internet companies (Acquisti, 2010). The firms then are free to exploit these data in the form of personalized ads (Lambrecht and Tucker, 2013). Thus, the role of the individual can be crucial to the functioning of the business model; the individual owns these data and their disclosure depends on his/her understanding and acceptance of the Internet model. However, little is known about the extent to which individuals are aware of such business models, and more precisely, whether their behaviors might change with the provision of information on privacy.

We analyzed how the wide coverage in the media of the existence of PRISM might have increased individuals’ concerns over protection of personal data. PRISM which was launched in

Table 12 Propensity Score Matching Results

Variable	Treated	Mean		<i>t - test</i>		V(T)/ V(C)
		Control	%bias	t	<i>p > t</i>	
NotMindFree	2.0904	2.0977	-0.7	-0.52	0.606	1.03
kn.authority	.57492	.5782	-0.7	-0.47	0.638	1.00
Public_space	.31965	.32204	-0.5	-0.36	0.717	1.00
Age	46.546	47.079	-3.1	-2.24	0.025	0.93*
Male	.52921	.51918	2.0	1.43	0.154	1.00
Middle	.41673	.41107	1.1	0.82	0.415	1.00
Large	.2972	.3127	-3.4	-2.39	0.017	0.97
Married	.53855	.54034	-0.4	-0.25	0.799	1.00
Student	.08376	.08645	-1.0	-0.68	0.495	0.97
Degree	.77355	.77693	-0.8	-0.57	0.566	1.01
Self_emp	.09231	.08198	3.8	2.60	0.009	1.11*
Employed	.48549	.47824	1.5	1.03	0.303	1.00
Freqint	4.3976	4.4086	-0.6	-0.56	0.574	1.06*
Nodifficulties	.67846	.68402	-1.2	-0.85	0.397	1.01
2.country	.04283	.04134	0.8	0.53	0.598	1.03
3.country	.06628	.05872	3.7	2.21	0.027	1.12*
4.country	.08883	.08337	2.4	1.38	0.167	1.06*
5.country	.02832	.02653	0.9	0.78	0.437	1.07*
6.country	.02027	.02305	-2.1	-1.36	0.175	0.88*
7.country	.04829	.05097	-1.3	-0.88	0.381	0.95*
8.country	.03339	.03428	-0.5	-0.35	0.726	0.97
9.country	.05515	.05982	-2.1	-1.42	0.155	0.93*
11.country	.0311	.03011	0.5	0.41	0.682	1.03
12.country	.0319	.02971	1.2	0.90	0.369	1.07*
13.country	.02921	.02832	0.5	0.38	0.704	1.03
16.country	.04471	.04581	-0.6	-0.37	0.709	0.98
17.country	.05435	.05763	-1.6	-1.01	0.312	0.95*
18.country	.05882	.0626	-2.0	-1.12	0.262	0.94*
19.country	.00934	.01153	-1.8	-1.53	0.127	0.81*
20.country	.02693	.02752	-0.3	-0.26	0.795	0.98
21.country	.02931	.03001	-0.4	-0.29	0.771	0.98
22.country	.02295	.02574	-1.5	-1.28	0.200	0.89*
23.country	.03021	.0313	-0.6	-0.45	0.653	0.97
24.country	.0313	.03994	-5.4	-3.31	0.001	0.79*
25.country	.01322	.01302	0.2	0.12	0.901	1.02
26.country	.02981	.02852	0.7	0.54	0.586	1.04*
27.country	.02335	.02017	1.7	1.55	0.122	1.15*
28.country	.03865	.04094	-1.2	-0.83	0.407	0.95*
29.country	.01739	.01431	1.8	1.75	0.080	1.21*
30.country	.02126	.02156	-0.2	-0.15	0.884	0.99
32.country	.02832	.02395	2.2	1.94	0.052	1.18*

2007 and initiated by the American National Security Agency (NSA), is a program that allows mass data collection. The existence of the program was leaked by former CIA agent Edward Snowden.⁵ Our approach to investigating individuals' perceptions is relevant since it might help in the design of privacy regulation. If individuals are comfortable with disclosing their personal data in order to get access to free services, regulation is likely to be inefficient since individuals find this model acceptable.

To our knowledge, the present paper is the first attempt to explicitly measure the extent to which individuals feel comfortable with the fact that web companies use their personal information to personalize ads. We show that individuals experienced in Internet use feel comfortable about with disclosing personal data in exchange for free services. An increased level of information related to privacy issues decreases acceptance of the model. We tested the robustness of our results in the context of 2015, that is, after the news about PRISM, using a pooled cross-section of the two surveys (2010 and 2015). This allowed us to study how acceptance of the Internet model in Europe has evolved. In order to estimate the impact of Snowden's revelations about PRISM, we estimate the average treatment effect which allows an estimate of the impact of being informed about government revelations on acceptance of the Internet model since we assume that the event increased public concerns about privacy. We show that the probability of minding to exchange personal data for free services reduced after Snowden's revelations.

The lack of acceptance of the actual Internet model based on collection of personal data to tailor services or to resell them can spur alternative business models that use privacy as business differentiators. Lastly, we note the limitations of our approach. Our ana

declarative / real behavior Base survey not the same individuals pooled cross section

Unless the stratification of the sample in the two waves is the same, we do not observe the same individuals across time.

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⁵ News published in The Guardian and The Washington Post on June 6, 2013

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Appendix

Table 13 Robustness Checks: Ordered logit Pooled cross section 2010 and 2015 with Age variable in class

	(1)	(2)	(3)	(4)	(5)	(6)
years20102015	-0.067** (0.028)	-0.067*** (0.019)	-0.074*** (0.019)	-0.112*** (0.025)	-0.066*** (0.019)	-0.023 (0.023)
missing_political	-0.148*** (0.027)	-0.149*** (0.026)	-0.144*** (0.026)	-0.144*** (0.026)	-0.154*** (0.026)	-0.153*** (0.026)
kn_authority	0.030 (0.028)		0.080*** (0.020)	0.031 (0.027)		
kn_authority* Year2015	0.083** (0.038)			0.094** (0.038)		
Public_space	-0.172*** (0.028)				-0.234*** (0.020)	-0.167*** (0.028)
Public_space* Year2015	-0.123*** (0.040)					-0.134*** (0.040)
freqint	0.125*** (0.006)	0.125*** (0.006)	0.123*** (0.006)	0.123*** (0.006)	0.127*** (0.006)	0.127*** (0.006)
ageless30	0.676*** (0.041)	0.668*** (0.040)	0.674*** (0.040)	0.674*** (0.040)	0.671*** (0.041)	0.671*** (0.041)
age3146	0.393*** (0.036)	0.389*** (0.035)	0.390*** (0.035)	0.389*** (0.035)	0.393*** (0.035)	0.394*** (0.035)
age4762	0.146*** (0.034)	0.145*** (0.033)	0.147*** (0.033)	0.147*** (0.033)	0.144*** (0.033)	0.145*** (0.033)
male	0.121*** (0.019)	0.121*** (0.019)	0.119*** (0.019)	0.119*** (0.019)	0.123*** (0.019)	0.123*** (0.019)
nodifficulties	-0.015 (0.021)	0.007 (0.021)	0.004 (0.021)	0.004 (0.021)	-0.011 (0.021)	-0.012 (0.021)
Socio demog. variables	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES
<hr/>						
cut1						
_cons	0.590*** (0.064)	0.653*** (0.061)	0.655*** (0.062)	0.638*** (0.062)	0.579*** (0.063)	0.606*** (0.063)
<hr/>						
cut2						
_cons	1.859*** (0.065)	1.912*** (0.062)	1.914*** (0.063)	1.897*** (0.063)	1.847*** (0.064)	1.874*** (0.064)
<hr/>						
cut3						
_cons	3.609*** (0.067)	3.650*** (0.065)	3.656*** (0.065)	3.639*** (0.066)	3.592*** (0.066)	3.620*** (0.067)
<i>N</i>	38503	40275	39472	39472	39264	39264
pseudo <i>R</i> ²	0.029	0.027	0.027	0.027	0.028	0.028

Standard errors in parentheses

* p_i.10, ** p_i.05, *** p_i.01

Table 14 Robustness Checks: Ordered logit Pooled cross section 2010 and 2015 with Frequent internet users

	by categories					
	(1)	(2)	(3)	(4)	(5)	(6)
Year2015	-0.061** (0.028)	-0.064*** (0.019)	-0.070*** (0.019)	-0.107*** (0.025)	-0.068*** (0.020)	-0.028 (0.023)
missing_political	-0.154*** (0.027)	-0.155*** (0.026)	-0.150*** (0.026)	-0.150*** (0.026)	-0.156*** (0.027)	-0.154*** (0.027)
kn_authority	0.033 (0.028)		0.081*** (0.020)	0.034 (0.027)	0.076*** (0.020)	0.075*** (0.020)
kn_authority* Year2015	0.079** (0.038)			0.090** (0.038)		
Public_space	-0.170*** (0.028)				-0.234*** (0.020)	-0.171*** (0.028)
public_spaceb* Year2015	-0.124*** (0.040)					-0.124*** (0.040)
freqlin2	0.109 (0.073)	0.086 (0.070)	0.084 (0.072)	0.084 (0.072)	0.106 (0.073)	0.107 (0.073)
freqlin3	0.053 (0.088)	0.054 (0.085)	0.036 (0.086)	0.036 (0.086)	0.050 (0.088)	0.053 (0.088)
freqlin4	0.235*** (0.051)	0.209*** (0.050)	0.210*** (0.050)	0.212*** (0.050)	0.231*** (0.051)	0.232*** (0.051)
freqlin5	0.397*** (0.037)	0.395*** (0.036)	0.386*** (0.037)	0.387*** (0.037)	0.394*** (0.037)	0.396*** (0.037)
freqlin6	0.595*** (0.032)	0.595*** (0.031)	0.583*** (0.031)	0.584*** (0.031)	0.592*** (0.032)	0.595*** (0.032)
age	-0.038*** (0.004)	-0.038*** (0.004)	-0.038*** (0.004)	-0.038*** (0.004)	-0.038*** (0.004)	-0.038*** (0.004)
agesq	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
male	0.116*** (0.019)	0.116*** (0.019)	0.114*** (0.019)	0.114*** (0.019)	0.116*** (0.019)	0.116*** (0.019)
nodifficulties	-0.018 (0.021)	0.004 (0.021)	0.001 (0.021)	0.001 (0.021)	-0.017 (0.021)	-0.017 (0.021)
Socio demog. variables	YES	YES	YES	YES	YES	YES
Country Fixed Effects	YES	YES	YES	YES	YES	YES
cut1						
_cons	-0.926*** (0.108)	-0.850*** (0.104)	-0.855*** (0.105)	-0.872*** (0.106)	-0.938*** (0.107)	-0.912*** (0.107)
cut2						
_cons	0.344*** (0.108)	0.411*** (0.104)	0.406*** (0.106)	0.389*** (0.106)	0.333*** (0.107)	0.359*** (0.108)
cut3						
_cons	2.098*** (0.109)	2.151*** (0.105)	2.151*** (0.107)	2.134*** (0.107)	2.086*** (0.108)	2.112*** (0.109)
N	38503	40275	39472	39472	38503	38503
pseudo R ²	0.029	0.027	0.028	0.028	0.029	0.029

Standard errors in parentheses

* p<.10, ** p<.05, *** p<.01

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
NotMindFree	1													
Aware_gov	0.0295†	1												
Kn_authority	0.0323†	0.291†	1											
publicSpace	-0.0543†	0.0315†	0.0258†	1										
natAuthTrust	0.127†	0.0229†	0.0612†	-0.141†	1									
MissPolitical	-0.0102**	-0.113†	-0.0865†	-0.0157†	-0.0745†	1								
Age	-0.176†	-0.0903†	-0.0706†	-0.0951†	-0.0195†	-0.0775†	1							
Male	0.0379†	0.115†	0.0693†	-0.00585	-0.0213†	-0.0775†	-0.0215†	1						
Middle	0.0103**	-0.0000703	-0.000667	-0.0128†	0.0161†	-0.00369	0.0251†	-0.00817*	1					
Large	0.00279	0.0288†	0.0534†	0.0188†	-0.00986**	-0.0109**	-0.0590†	-0.00817*	-0.500†	1				
Married	-0.0487†	-0.00524	0.0349†	0.00258	-0.00336	-0.0511†	0.194†	0.0560†	-0.00253	-0.0678†	1			
Degree	0.0281†	0.131†	0.170†	0.0181†	0.0651†	-0.0923†	-0.189†	0.0228†	0.00432	0.0938†	0.0474†	1		
Frequent	0.155†	0.253†	0.196†	0.0347†	0.110†	-0.0968†	-0.482†	0.0626†	0.0369†	0.0752†	-0.0330†	0.338†	1	
Notdifficulties	0.00752	0.120†	0.0679†	-0.0894†	0.130†	-0.103†	0.143†	0.0455†	0.0379†	-0.0425†	0.0500†	0.0834†	0.133†	1

* $p < .10$, ** $p < .05$, † $p < .01$