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ECONOMIC PAPERS

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Assessing Inequalities in Preventive Care Use in Europe

RUHR UNIVERSITÄT BOCHUM RUB

#371

Imprint

Ruhr Economic Papers

Published by

Ruhr-Universität Bochum (RUB), Department of Economics
Universitätsstr. 150, 44801 Bochum, Germany

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Ruhr Economic Papers #371

Responsible Editor: Thomas K. Bauer

ISSN 1864-4872 (online) – ISBN 978-3-86788-426-6

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Bibliografische Informationen der Deutschen Nationalbibliothek

Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über: *http://dnb.d-nb.de* abrufbar.

http://dx.doi.org/10.4419/86788426
ISSN 1864-4872 (online)
ISBN 978-3-86788-426-6

Vincenzo Carrieri and Ansgar Wübker[1]

Assessing Inequalities in Preventive Care Use in Europe

Abstract

This paper presents the first cross-country estimation of needs-adjusted income and education-related inequalities in the use of a whole set of preventive care treatments. Analysis is based on the first three waves of the Survey of Health, Ageing and Retirement (SHARE) for individuals aged 50 and over living in 13 European countries. We employ alternative concentration indices based on the CI-corrections for binary outcomes to compute inequalities in the use of breast cancer screening, of colorectal cancer screening, of influenza vaccination, and of routine prevention tests (blood pressure, cholesterol, and blood sugar tests). After controlling for needs, we find that in many European countries strong pro-rich and educational inequalities exist with respect to breast and colon cancer screening, blood tests and flu-vaccination. Furthermore, poor and less educated people are more likely than the better off to use preventive care late, e.g. when health shocks occurred or health problems already display symptoms. Finally, results suggest that access to treatments within a specialist setting is generally less equal than access to treatments provided within a GP setting.

JEL Classification: I14, D63

Keywords: Preventive care; socio-economic related inequalities; concentration indices

September 2012

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1 Vincenzo Carrieri, Department of Economics and Statistics and CELPE, University of Salerno; Ansgar Wübker, Ruhr-Universität Bochum and Department of Economics, Witten/Herdecke University. *– We thank Elena Granaglia, Antonio Abatemarco, Patrick Bremer, Jens Harbecke, Jan Kleibrink and Dominic Trepel and all participants at May 2012 IEMS seminar in Lausanne for valuable comments. This paper uses data from SHARELIFE release 1, as of November 24th 2010 or SHARE release 2.3.1, as of July 29th 2010. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see www.share-project.org/t3/share/index.php for a full list of funding institutions).* *– All correspondence to Ansgar Wübker, Ruhr-Universität Bochum, Chair of Competition Theory and Policy, Universitätsstr. 150, 44801 Bochum, Germany, E-mail: ansgar.wuebker@rub.de.*

1. Introduction

Increasing prevention is one of the most important goals of public health policies across the world. Early detection of cancer is associated with a significant reduction in mortality whilst cancer is currently one of the leading causes of death in developed countries (Jemal *et al.*, 2011). Routine prevention measures, such as blood-pressure checks and blood tests (i.e. cholesterol checks and blood sugar tests), allow the detection of many forms of illness like cardiovascular diseases or diabetes (Steinberg and Gotto, 1999, Kearney *et al.*, 2005). Annual influenza vaccination can prevent premature death and has shown to be highly cost-effective, especially for the elderly and people with cardiovascular and respiratory diseases (Maciosek *et al.*, 2006). Needless to say that increasing prevention means to improve the survival and well-being of many people significantly. Moreover, as preventive care for some targeted groups is also more cost-effective than cure, increasing prevention for these groups is also a strategic tool to control health care spending growth (Cohen, Neumann and Weinstein, 2008).

Despite its importance, preventive care is used by significantly less than 100% of the population in need of it and it is strongly underused by low-income and low-education individuals. Underuse has been found in several countries and health care systems (see Kenkel 2000 Kenkel, 1994; Lairson *et al.*, 2005; Schmitz and Wübker, 2011, Carrieri and Bilger, 2013)). However, while we know that income and education increase preventive care use, we still do not know *the magnitude* of disparities in preventive care use and whether preventive care distribution across individuals is *unfair* from a normative point of view. Related literature focusing on health care delivery (see Bago d'Uva, Jones and van Doorslaer, 2009, Van Doorslaer, Koolman and Jones, 2004; Stirbu *et al.*, 2011, Crespo-Cebalda and Urbanos-Garrido, 2012) does not include preventive care treatments. On the other side, very few papers on determinants of preventive care take into account the distribution of needs among the population. As many treatments are recommended for specific age or at-risk group, normative assessment of inequalities is meaningful only if it is based on needs-adjusted measures of inequalities. To our knowledge, such assessment has been done only by McKinnon, Harper, and Moore (2011) with respect to cervical cancer screening in 67 countries and Lorant *et al.* (2002) with respect to inequalities in several preventive care treatments in Belgium.

This paper contributes to this literature along two directions. Firstly, we present the first estimation of both income and education related inequalities in the use of a wide range of preventive treatments (mammography, colonoscopy and fecal occult blood test, influenza vaccination, blood pressure test, cholesterol and blood sugar test) in 13 European countries. Such analysis is useful to detect differences among countries and among treatments and to get insights into the main characteristics of inequalities in preventive care use in Europe.

The second contribution of the paper is to consider different type of needs in the analysis of preventive care inequalities. Basically, we separate inequalities in "true" preventive care from inequalities in the use of preventive care for diagnostic reasons. Indeed, poor and less educated might have more problems in understanding the benefits of prevention than the better off and consider treatments as unnecessary in the absence of symptoms (see Filèe *et al.*, 1996). Thus, they might be more likely to use preventive care late, e.g. when health shocks

occurred (i.e. a mammogram if a woman had a personal history of breast cancer) or health problems already display symptoms (i.e. a colonoscopy in presence of bowel disorders). Distinction between preventive and "diagnostic" needs allows us to shed light on behavioral differences in preventive care use among socio-economic groups and provide insights on whether inequalities in preventive care only reflect health care inequalities or if they are a special case of inequalities in health care delivery.

In the paper, we do not share any normative view on the inequality we estimate. This pragmatic approach allows people with different views on health equity to interpret our results in different ways. Strictly speaking, normative analysis of inequalities can be based on two general approaches. A first approach is to consider all inequalities in use which are not explained by needs as unfair. This is coherent with Sen`s argument of generated "unfreedom" (see Sen, 2002), and with an equality-of-opportunities approach which considers the socio-economic status as part of circumstances and the needs as the only source of legitimate inequality (Fleurbaey and Schokkaert, 2012). A second approach is to consider all inequalities in prevention use which are not explained by needs and preferences as unfair. This is in line with the equality of access view (with the assumption that time and money constraints are effectively equal across individuals) ((Le Grand, 1982; Mooney, 1983, Culyer and Wagstaff, 1993)) and with an equality of opportunity approach ((Roemer, 1993; Roemer, 1998; Roemer, 2002)) (once one has taken into account correlation between needs and socio-economic status, see Fleurbay and Schokkaert, 2012). Our empirical approach considers a careful standardization of needs. Thus, it directly allows us to estimate the extent of inequality consistent with Sen's (2002) view. However, empirical evidence shows that pure individual preferences such as risk aversion and time preferences do not account for any of the education gradient in preventive care use (See Birò, 2012, Cutler and Lleras-Muney, 2010). Thus, if preferences do not play a significant role, our estimates provide insights also on the presence of equality of opportunity in preventive care use in Europe.

The paper is structured as follows. The next section describes the data. The analytical methods are discussed in section 3. In the fourth section we present estimates of inequalities with and without adjustment for needs and a decomposition of inequality indexes to assess contribution of demographic factors (i.e. being in target age groups) and health conditions. The last section presents a discussion of the implications of the findings and some final remarks.

2. Data

Preventive care use

We use data from the first three waves of the Survey of Health, Ageing and Retirement in Europe (SHARE) to analyse socio-economic related inequalities in preventive care use in 13

European countries.[1] SHARE is a large representative micro data set providing detailed information on health, healthcare use, as well as a variety of other socio-economic characteristics of more than 30,000 individuals above the age of 50 years starting in 2004. We calculate binary variables for whether (i) a women had a mammogram (to check for breast cancer) in the last two year, (ii) a respondent had a colonoscopy or a test for hidden blood in the stool (to check for colorectal cancer) in the last ten years and (iii) a respondent had a flu vaccination in the previous year. With respect to routine preventive treatments, we calculate binary variables for whether a respondent (a) regularly (i.e. at least every two years) checks his blood pressure and (b) regularly (i.e. at least every two years) checks his blood for measurements of cholesterol and blood sugar. Table 1 provides take-up rates by countries of the preventive measures included in the empirical analysis. As Table 1 indicates take up rates are far from 100 per cent. A little more than half of women got a mammography within the past two years and about 16 per cent of this population underwent a colonoscopy within the past ten years. About 21 per cent got a stool examination within the past ten years. 31 per cent have been immunised against the flu during the preceding year, while about 70 per cent have undergone a blood pressure check and a blood test within the past two years. Moreover there are substantial differences in the means for each preventive measure across the countries.

[Table 1 around here]

Socio-economic status and needs

We capture socio-economic status by two measures: education and equivalent gross household income. Education is measured by ISCED-97 classification. The ISCED-code has a range from 0 (pre-primary education) to 6 (second stage of tertiary education) meaning the higher the ISCED-value the higher the education-level.[2] The income variable is derived from the annual income of the whole household before deductions for income tax and social or national insurance contributions. It mainly comprises labour income; public pensions and income from assets (compare Christelis *et al.*, 2009). To get the annual "equivalent gross household income" we adjust for household size by dividing through the square root of the number of household members.

Need for cancer-screening and routine preventive measures (i.e. flu-immunisation, blood pressure and blood tests) was defined as the expected utilization according to well known risk factors and preventive guidelines (e.g. Karsa *et al*, 2008 for cancer, WHO 2003 for influenza, Steinberg and Gotto, 1999 for cholesterol and Kearney *et al.*, 2005 for high blood pressure). Need for cancer prevention (i.e. mammography, colonoscopy and stool examination) was related to age (for mammography women aged 50 to 69 years and for colonoscopy and stool examination men and women aged 50 to 74 years) as this is the main screening indication.

[1] We do not consider Israel and Ireland because most preventive measures (except flu vaccination for Ireland) are not available for both countries.

[2] Level 0 captures pre-primary education, level 1 mirrors primary education or first stage of basic education, level 2 contains lower secondary or second stage of basic education, level 3 captures (upper) secondary education, level 4 includes post-secondary non-tertiary education, level 5 captures first stage of tertiary education and level 6 second stage of tertiary education.

"Diagnostic" need was linked to following (risk) factors: a history of cancer (for mammography and colonoscopy or stool examination), self-stated gastrointestinal problems (for colonoscopy and stool examination), a history of intestinal ulcer. For influenza immunisation the following need factors were considered: age 60+, self-assessed health and chronic conditions classified as high risk or intermediate risk (Schmitz and Wübker, 2011). In the data set, these are heart attack, lung disease, asthma, stroke, diabetes, and arthritis. Finally, for blood pressure examinations and blood tests (i.e. cholesterol check) need was related to the most important risk factors for cardiovascular diseases: older age, diabetes, overweight (bmi $\geq$ 25), sex (being a male), heart attack and stroke.[3] Table 1 presents basic sample statistics for all variables included in our analysis.

3. Methods

The empirical analysis is divided into two steps. Firstly we point to the relevance of socio-economic related inequalities in Europe by regressing the dependent variables (i.e. different preventive measures) on the (a) ISCED-categories and (b) income quintiles with and without adjustment for need variables using the sample of all countries.[4] Doing this analysis we provide an easy interpretable quantification of the general association between education (and income respectively) and the preventive measures. In order to get insights in the relevance of need adjustment, we present the results with and without controlling for need variables.

Secondly we use the concentration index (CI) as a comprehensive measure of socio-economic-related inequalities in preventive care use (Wagstaff, van Doorslaer and Paci, 1991).[5] However, as pointed out by Kjellsson and Gerdtham (2011), for bounded variables (e.g. mammography screening yes or no) (a) the maximum and minimum value of the CI depends on the average preventive care use in the country (Wagstaff, 2005), (b) the value of the CI depends on the scale of the preventive care variable (Erreygers, 2009a) and (c) the CI may rank countries by inequalities in doing a screening or not differently (Clarke *et al.*, 2002). To account for these problems and to enable comparison of the results for different populations, Erreygers (2009a) and Wagstaff (2005) developed alternative corrections of the CI for bounded variables.[6] Since the value judgements behind these corrections differ and country rankings might differ in dependence of the adjustment used (compare Kjellsson and Gerdtham, (2011) and Fleurbaey and Schokkaert, (2012)), we calculate and present both adjustments for the CI to check robustness of results in dependence of the underlying value judgments. We estimate standard errors for concentration indices that are robust to heteroskedasticity and autocorrelation (O´Donnell *et al.*, 2008) and use sampling weights that are available in the SHARE-data.

[3] Note, we do not control for some major risk factors that are available in the data. These are tobacco use and alcohol use. We neglect these health behaviour variables since they could be strongly related with preferences.
[4] The seven education levels are recoded into three broader categories: low (ISCED-code 0 to 2), medium (ISCED-Code 4 to 5) and high (ISCED-Code 6 to 7).
[5] The concentration index has become the driving force for a large and rapidly growing empirical literature on socioeconomic inequalities in health care (compare Fleurbaey and Schokkaert, 2012).
[6] In an exchange in the Journal of Health Economics, Wagstaff (2009) and Erreygers (2009a; 2009b) debate the merits of these corrections. For a nice summary of this discussion and a systematic classification of the pros and cons of both approaches see Kjellsson and Gerdtham (2011).

In order to solve the standardization or need adjustment problem we finally apply decomposition methods. We decompose the CI (or W and E respectively) assuming that the relevant outcome y_i (i.e. preventive care utilization measure) can be written as a linear function of a set of characteristics k as follows:

(1) $y_i = \alpha + \sum_k \beta_k x_{ki} + \varepsilon_i$ [7]

Even though it is necessary to assume linearity of this equation for the decomposition, it is possible to extend it to allow for binary health care outcomes (Gravelle, 2003, McKinnon, Harper and Moore, 2011). The concentration index CI (y) can be decomposed as

(2) $CI(y) = \sum_k \eta_k CI(x)_k + 2 * \frac{\mathrm{cov}(\varepsilon_i, \mathrm{R_i})}{\mu(y)}$

Equation (2) reveals that the effect of any need-variables x on CI(y) depends both on its own concentration index CI(x) and on the elasticity η_k of y with respect to x (compare Fleurbaey and Schokkaert, 2012).[8] For example, if belonging to the recommended age-group increases the probability of getting a mammogram (positive elasticity η_k) and it is more concentrated among the rich [positive age related CI(x)], the recommended age-group will make a positive contribution to the overall CI. A negative contribution therefore indicates that either the determinant decreases the probability of getting a mammogram and the variable is concentrated among the better-off or there is a pro-poor inequality in the determinant (CI (x) is negative) and the determinant increases the probability of getting a mammogram (positive elasticity). We differentiate between two types of needs: specific age groups when referring to routine prevention (routine prevention) and both subjective and objective health conditions and specific health problems when we refer to diagnostic treatments (diagnostic treatment). Suppose that we can partition the vector x between "routine needs" variables x_{Ri} and diagnostic needs variables x_{Di}, so that we can rewrite (2) as

(3) $y_i = \alpha + \sum_R \beta_R x_{Ri} + \sum_D \beta_D x_{Di} + \varepsilon_i$

Using an indirect standardization method (e.g. Gravelle, 2003) we first calculate a routine-needs-corrected value for preventive care by putting the diagnostic-needs variables x_{Di} in (3) at a fixed value and then focus on the differences between actual preventive care levels and these corrected preventive care levels. In terms of the concentration index this yields:

(4) $CI^{IND}(y) = CI(y) - \sum_R \eta_R CI(y)_R$.

[7] Where the ßk are regression coefficients and ε_i is the error term.

[8] This decomposition approach has been applied to interpret differences in the concentration index between different countries (e.g. van Doorslaer, Koolman, and Jones, 2004 or Bago d'Uva, Jones and van Doorslaer, 2009) and changes over time but also to tackle the standardization problem as in our case (compare Fleurbaey and Schokkaert, 2012).

Secondly, we correct for both (routine needs and diagnostic needs) focusing on the differences between actual preventive care levels and routine needs and diagnostic needs adjusted preventive care levels. In terms of the concentration index this yields:

$$(5)\quad CI^{IND}(y) = CI(y) - \sum_{R} \eta_R CI(y)_R - \sum_{D} \eta_D CI(y)_D$$

4. Results

Preventive services and socio-economic status

For each preventive service, Table 2 provides the regression results of the five income quintiles (when ranking on income) with and without controlling for need factors. Regarding income quintiles (note that the highest income quintile is the reference income group) and mammography screening there is a significant, monotonic and strong increasing gradient of use if we do not control for need factors. The association between income and "StoolColo" (stool examination or colonoscopy) is much lower but still positive; i.e. higher income groups have significant higher uptake rates than the lowest income group. In contrast, no consistent association is found between income quintiles and blood tests or blood pressure checks and a slight negative correlation is found between higher income and flu-vaccination-uptake.

The picture is different when we control for need variables and two general results are striking. Firstly, almost all need variables are significantly related to take up rates in line with the expected direction. Regarding influenza vaccination a similar strong relation is found for persons over 60. Secondly, the association between income quintiles and preventive care uptake changes considerably for some preventive care measures when we control for need variables. After controlling for needs there remains a significant, monotonic and increasing gradient between income and mammography screening. However, the strengths of the effects decrease strongly. This result suggests that the recommended age group (women aged 50 to 69 years) is concentrated among the rich. In contrast, the association between higher income and stool examination or colonoscopy ("StoolColo") remains fairly stable. However, for blood tests and blood pressure checks higher income is associated with higher rates when controlling for needs. Moreover, for influenza vaccination the negative association found before vanishes when controlling for needs. Thus, need factors (heart attacks, stroke, etc.) that have a positive impact on the uptake of these preventive measures might be concentrated among the lower income groups and capture some of the correlation between income groups and the preventive measures. As shown in Table A1 the results are quite robust regarding the choice of socio-economic measure; i.e. if we take education groups as a measure of socio-economic status, the general direction of results does not change much.

[Table 2 around here]

Inequality

For cancer preventive care (i.e. mammography, colonoscopy or stool) the concentration indices are given in Table 3. Two indicators of socio-economic status are used: the rows in the upper half of the Table present the calculation for education-related inequalities and the rows in the lower half display the results with regard to income-related inequalities. The first column provides results for the only age-adjusted concentration index based on Erreygers (E) CI-correction. We standardize for age, because income and education level is generally lower for older age independently of needs. The second column shows the adjustment for recommended age groups or routine needs according to equation 5 and the third column presents additional adjustment for diagnostic needs, i.e. overall needs adjusted results according to equation 6. The fourth column provides results for the need adjusted CI-correction based on the method proposed by Wagstaff (2005) (W).

[Table 3 around here]

A negative value (E or W) points to a concentration favouring the poor (less educated), while a positive value implies a concentration in favour of the better off (better educated) individuals. In the following, we explain results for mammography uptake in detail to get a clue on the general interpretation of the results. Regarding mammography, all countries have for both education and income a positive index without controlling for need factors. This indicates that mammography take up is more prevalent amongst the better off (better educated) groups. The concentration among the rich is highest in Italy and lowest in Greece. A similar picture arises for education-related inequalities. The pattern changes considerably when we adjust for the recommended age group (i.e. women aged 50 to 69 years). For both education and income inequalities in mammogram utilization decrease sharply in all countries, however remain significantly in most countries (except Austria, Sweden, Netherlands, Spain, Switzerland and Czechia for education-related inequalities and Austria, Sweden, Denmark and Czechia for income-related inequalities). Belonging to the target group related to age (i.e. women aged 50 to 69 years) statistically explains between 91 per cent in Sweden (207 per cent in Sweden) and 8 per cent in Poland (36 per cent in Germany) of income-related (education-related) inequalities. According to equation 2 this result can be explained by the fact that this age group is concentrated among the better off (not shown here) and being in this age group is strongly positively associated with mammography uptake (compare Table 2). Still, Italy is one of the most unequal country but the index decreases from E = 0.259 to E= 0.227 for income-related inequalities and from E = 0.166 to E = 0.083 for education-related inequalities. Turning to the additional adjustment for “diagnostic needs”, i.e. adjusting for all need factors, inequality changes not much and inequalities in mammogram uptake still remain statistically significant in the same countries as before. Regarding mammogram the results are fairly robust considering the correction method applied to the concentration index; i.e. regarding the value judgment behind them.

Three major differences compared to mammography are evident when turning to colorectal cancer prevention (i.e. colonoscopy or stool examination): firstly, inequality is sensibly lower. Secondly, needs adjustment has a much smaller impact on inequalities compared to mammography. Thirdly, additional adjustment for “diagnostic needs”, i.e. adjusting for all

need factors, increases inequality in favour to the rich in most countries. The effect of a cancer history on income- and education-related inequalities in colonoscopy, as measured by the difference between the Erreygers index adjusted for recommended age-group and the overall adjusted Erreygers index accounts up to 0.028 index points and inequality becomes significant in some countries after adjusting for all needs (e.g. in Sweden and Denmark with regard to education-related inequalities). This means that colon-cancer specific risk factors and health problems are not only concentrated among the poor but also are positively related to higher use of preventive care. Thus, poor and less educated people are generally more likely than the better off to use preventive care late, e.g. when health problems already display symptoms and increase health risks.

Results for blood tests, blood pressure checks and influenza-vaccination are given in Table 4. Following general pattern emerges: Firstly, there is no systematic education and income-related inequality if we only standardize for age. Secondly, if we additionally adjust for risk factors and symptoms (diagnostic needs) the inequality shifts on average in favour to a pro-rich or pro better educated inequality. Again, this can be seen comparing recommended age-group adjusted to all-need-adjusted E-index. In example, the effect of blood-pressure risk factors (i.e. self-assessed-health, heart attack, etc.) on income-related inequalities in blood-pressure checks, as measured by the difference between the age adjusted Erreygers index and the overall adjusted Erreygers index, ranges from 0.057 index points (Denmark) to -0.005 (Austria) index points. The impact on education-related inequalities ranges from 0.045 (Sweden) to 0.005 index points (Austria). This means that risk factors and health problems are not only concentrated among the poor but also are positively related to higher use of preventive care. Moreover pro-rich inequality increases when we adjust our assumption from "Diagnostic needs do differ across income and education groups (only age-adjusted E)" to "Diagnostic needs do not differ across income and education groups" (overall need adjusted E). Under the assumption that diagnostic needs are equal the inequality would be even higher, but, in fact, needs are pro-poor and less educated distributed; thus inequality would be underestimated if we did not standardize for diagnostic needs.[9] Strikingly is that on average, after adjustment for all needs, a considerable higher inequality favouring the rich (6 out of 13 countries) and better educated (5 out of 13 countries) can be found for blood tests compared to blood-pressure (only 3 pro-rich respectively 2 pro better educated). After adjusting for all needs, the concentration among the rich and better educated is highest in Poland for blood pressure checks and blood tests and in Italy (income-related inequality) and Sweden (education-related inequality) for influenza vaccination.

[Table 4 around here]

[9] This result is confirmed for all treatments analysed for which poor and less educated are effectively more in need of diagnosis, as they suffer more from specific health problems (heart attack, stroke, diabetes, gastrointestinal problems, etc.). The only exception is breast cancer screening, where diagnostic needs as measured in our analysis (history of cancer) seem to be distributed effectively equal across socio-economic groups. This is likely due to the fact that breast health problems are difficult to be detected by individuals as they do not produce evident symptoms as other diseases. Thus, the only measure of symptoms we can use is unlikely informative.

5. Discussion

This paper presents the first cross-country estimation of needs-adjusted income and education-related inequalities in the use of a whole set of preventive care treatments. Our analysis detects at least three stylized facts in socio-economic related inequalities in preventive care across Europe.

Firstly, after adjusting for needs, strong pro-rich (better educated) inequalities in breast screening are detected in nearly all countries with very few exceptions. A similar pattern is observed for inequalities in colorectal cancer prevention, flu-vaccination and blood tests with many countries exhibiting pro-rich and educational inequalities in favour of the better educated. On the other side, we do not find considerable inequalities favouring the better off for income and education-related inequalities in blood-pressure checks.

With the only exception of influenza vaccination, we find that treatments provided by GP (blood pressure) are more equally distributed than treatments provided by specialists or labs (cancer screening, blood test). To this regard, comparison between inequalities in blood test and blood pressure check is particularly useful. Blood tests such as cholesterol and sugar tests are routine preventive measures very comparable to blood pressure test but provided in a non GP-setting such as labs or health care authorities. Our results show strong inequalities in the use of blood test and equality in the use of blood pressure. Similar results have been found also by Lorant *et al.* (2002) in Belgium and they mimic the pattern observed in doctor utilization in Europe. Indeed, evidence suggests pro-rich inequalities in specialist care and equality in the use of GP (see Van Doorslaer, Koolman and Jones, 2004; Stirbu *et al.*, 2011; Van der Heyden *et al*., 2003). Thus, it becomes important to understand why poor and less educated generally take preventive care provided by GP but not by the specialist or other authorities. Interestingly, we find a pro-rich pattern in specialist setting treatments even in countries with universal and comprehensive insurance coverage and little co-payment for specialist visits, such as Denmark. Thus, possible explanations may involve factors not directly related to monetary costs of treatments. One hypothesis is that there are differences in help-seeking processes among income and education groups as found by Vick and Scott (1998). Poor and less educated persons often do not possess abilities or medical insight to self-refer to a specialist preferring a consultation with a long term physician as a family GP. Alternatively, with respect to cancer screening use, it might be that psychological factors such as fear and anxiety –which are negatively related with screening (see Wu, 2003) – are more concentrated among poor and less educated. This hypothesis is corroborated by long-standing research (see Dohrenwend *et al.*, 1992 among others), but it has not been related yet to preventive care inequalities.

A second pattern observed is that poor and less educated people are generally more likely than the better off to use preventive care late, e.g. after health shocks occurred or health problems display already symptoms. The effect of the additional standardization for diagnostic needs is quite small for many countries and not significant in others.[10] However, the result is interesting from a normative point of view and it might have two possible explanations.

On one hand, worse-off may consider treatments as unnecessary in the absence of symptoms (see Filèe *et al.*, 1996) and only seek examinations when health problems display symptoms. To put it in terms of the Grossman Model (1972) it could be that poor and less educated people are more prone to consume than invest in health care (i.e. seeking an examinations only to confirm an expected diagnosis and therefore to cure an health problem). Effectively, some papers find that poor and less educated demand less information from the physician regarding their health problems (see Vick and Scott, 1998). If we adopt an equality of opportunity approach, this kind of inequality can be considered legitimate and it would not require a policy intervention.
On the other hand, this behavior could be based on few or wrong information on the relevance of prevention for health. O'Malley, Earp and Hawley (2001) find that poor and less educated patients effectively receive less screening recommendations by physicians. Thus, if bad preventive behavior is due to a lack of information of which poor and less educated individuals have no responsibility this would constitute an illegitimate inequality from an equality of opportunity stand-point. Note that the difference in interpretation does not affect Sen's view, given that also inequalities due to a complete information set would be considered illegitimate because they represent *an 'unfreedom' to conquer the bad habit of not doing prevention* (Sen, 2002, p. 660).

Lastly, we find a mild association between inequalities and the generosity of welfare state regimes. We find a more pronounced inequality pattern in health care systems with higher recourse to private out-of pocket payments (OOP). For instance, in Greece where recourse to OOP is massive (Wendt, 2009), significant pro-rich inequalities are observed for many treatments. A similar pattern is observed in Poland, where OOP payments in the health sector are emerging as a fundamental aspect of health care financing which creates serious access problems to various kinds of health care services (Busse *et al.*, 2006). On the other side, systems with public and generally universal coverage (such as Sweden, Denmark, Netherlands and Sweden, to less extent) manage quite well in fighting inequalities. But with the exception of these extreme versions, pro-rich inequalities patterns are quite similar in all welfare models. For instance, breast cancer screening is distributed pro-rich in all mixed private-public systems such as Germany, France and even in some countries with universal coverage such as Italy.

These findings have direct health policy implications. Firstly, they demonstrate that socio-economic related inequalities in preventive care are an European issue and not a single

[10] This can be seen by the difference between age-group adjusted and all-need-adjusted E-index in Tables 3 and 4 which is negligible for many countries and null for some others.

country phenomenon. A scarce use of preventive care by poor and less educated other to raise ethical concerns is likely to be not cost-effective. Indeed, social costs of late diagnosis are higher for low socio-economic status individuals because they are generally less able to convert cure into health (compared to high SES individuals).[11] Thus, it is possible that less preventive care today means much more health care spending tomorrow. Secondly, our results demonstrate that inequalities are present even in countries where cost-sharing is zero or very low and that very often preventive care is used late by poor and less educated individuals. These finding cast some doubt on the effectiveness of free preventive care policy alone to contrast inequalities. Our finding might suggest that to ensure the "equal treatment of equals" in preventive care use, it could be necessary also an equal agency relationship between specialists and patients and an equal access to information on the importance of prevention. This is perhaps as important (or even more) as (than) very low costs at point of consumption.

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Table 1: Descriptive Statistics

	All		AT		BE		CH		CZ		DK		ES		FR		GE		GR		IT		NL		PL		SE	
Variables	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**	**M[1]**	**SD[2]**
Endogenous																												
Mammogram (%)	51	50	55	49	63	48	39	49	53	50	21	41	51	50	68	47	40	48	34	48	53	50	77	42	34	47	69	46
Colonoscopy (%)	16	37	31	46	15	35	20	40	n/a	n/a	14	35	8.5	28	22	42	26	43	6.1	24	15	35	9.5	29	n/a	n/a	13	34
Stool (%)	21	41	72	45	8.7	28	24	43	n/a	n/a	6.7	25	5.1	22	23	42	66	48	3.9	19	13	34	4.3	20	n/a	n/a	14	35
FluVacc. (%)	31	46	28	45	43	50	31	46	16	37	24	42	42	49	35	48	36	48	18	38	36	48	43	50	11	32	29	45
Bloodpressure (%)	71	45	70	49	84	36	68	47	64	48	49	50	79	41	86	35	64	48	81	39	76	42	62	49	64	48	61	48
Bloodtest (%)	70	46	59	46	84	37	63	48	54	48	51	50	83	38	79	41	71	45	87	33	81	39	52	50	56	50	49	49
Exogenous																												
ISCED	2.6	1.5	2.8	1.3	2.9	1.5	2.9	1.2	2.5	1.1	3.4	1.4	1.4	1.3	2.5	1.8	3.5	1.1	2.2	1.5	1.8	1.2	2.9	1.4	2.3	1.3	2.8	1.5
HH.Inc. (1000 €)	20	22	19	21	20	20	37	29	6.4	5	30	29	14	22	25	26	23	22	16	24	15	12	22	18	4.9	8.5	22	16
Age50_74 (%)	74	44	84	35	83	37	81	38	86	34	85	35	78	41	82	38	88	32	85	35	85	35	87	33	85	34	84	36
Age50_69 (%)	72	45	72	44	71	46	70	46	73	44	74	44	61	49	71	46	77	42	73	44	72	45	76	43	75	43	73	45
Age60+ (%)	61	49	67	47	59	49	62	49	61	49	57	50	68	47	57	49	62	48	57	49	66	47	57	49	54	43	66	47
Age	67	9.5	68	8.9	67	9.7	68	10	66	9.1	66	9.9	69	10.3	67	9.9	67	8.7	67	9.8	68	8.9	66	9	65	9.4	68	9.3
SAH	3.0	1.1	2.9	1.0	2.9	1.0	2.6	1.0	3.3	1.0	2.5	1.1	3.4	0.9	3.1	1.0	3.2	0.9	2.8	1.0	3.2	1.0	2.8	1.0	3.8	1.0	2.5	1.1
Cancer (%)	4.1	20	2.3	15	4.4	21	4.1	20	4.7	21	6.3	24	2.4	15	4.5	21	4.5	20	2.0	14	3.3	17	4.4	20	2.4	15	6.2	24
Heart Attack (%)	11	32	10	30	12	32	5.7	23	15	36	9.2	29	10	30	13	33	11	31	11	31	10	31	8.4	28	21	40	14	35
Lung Disease (%)	4.8	21	4.2	20	4.3	20	3.4	18	4.1	20	5.6	23	5.4	23	4.6	21	5.1	22	3.4	18	7.3	26	5.8	23	5.2	22	2.5	16
Asthma (%)	4.6	20	3.9	20	2.6	16	4.0	20	4.7	21	6.9	25	3.9	20	4.4	21	3.6	18	3.2	18	4.9	22	4.4	21	7.6	26	7.4	26
Stroke (%)	3.2	17	3.2	18	3.3	18	2.3	15	3.9	19	4.1	20	2.2	15	3.1	17	3.3	18	1.8	13	2.5	16	3.7	19	5.2	22	2.6	16
Diabetes (%)	9.6	29	8.9	29	8.1	27	5.3	22	14	35	6.1	24	15	36	8.6	28	12	32	10	30	12	32	8.4	28	10	31	7.7	27
Arthritis (%)	13	34	12	33	22	41	11	32	15	35	26	44	30	46	28	45	13	34	16	37	35	48	10	30	34	48	9.3	29
Gastro. Probl.(%)	13	34	9.6	29	14	35	10	31	16	37	11	31	14	34	16	36	13	34	11	32	16	37	9.5	29	18	39	14	35
intest.ulc.(%)	5.1	22	5.3	22	6.3	24	1.9	14	7.1	26	5.1	22	4.4	21	3.4	18	3.3	18	7.3	26	5.7	23	2.8	17	10	30	3.6	19
Overweight (%)	62	49	64	47	61	49	50	50	73	44	54	50	75	43	56	50	63	48	68	47	64	48	58	49	68	47	56	49
Men (%)	46	50	43	49	47	50	45	50	44	50	48	50	44	50	46	50	47	50	45	50	45	50	48	50	44	50	52	50
Observations	30702		1226		4276		1627		1509		2433		2041		2679		2530		2594		3121		2496		1607		2151	

Table 2: Effect of income on prevention

	Mam1	Mam2	StoolColo1	StoolColo2	Flu1	Flu2	BT1	BT2	BP1	BP2
Quintile 1	-0.26***	-0.16***	-0.13***	-0.14***	0.06**	0.00	-0.01	-0.05***	0.02	-0.02
Quintile 2	-0.20***	-0.12***	-0.02	-0.05*	0.04*	-0.04*	-0.00	-0.04***	0.04***	-0.01
Quintile 3	-0.16***	-0.09***	-0.01	-0.02	-0.00	-0.06***	0.01	-0.02*	0.02*	-0.01
Quintile 4	-0.05**	-0.03	-0.02	-0.03	0.02	-0.00	0.00	-0.01	0.02	0.01
Age50_69		0.37***								
Cancer		0.25***		0.11***						
Age50_74				0.09***						
Gastrointestinal probl.				0.10***						
Intestinal ulcer				0.12***						
Age60more						0.28***				
SAH						0.01*				
Heart attack						0.10***		0.11***		0.10***
Lung disease						0.11***				
Asthma						0.06**				
Stroke						0.06		0.10***		0.08***
Diabetes						0.10***		0.16***		0.12***
Arthritis						0.01				
Age								0.00***		0.01***
Overweight								0.08***		0.10***
Male								-0.01		-0.02**
Germany	-0.17***	-0.18***	-0.08***	-0.08***	0.07***	0.06**	0.01	0.00	0.05*	0.04*
Sweden	0.22***	0.17***	-0.45***	-0.45***	-0.01	-0.00	-0.21***	-0.19***	0.00	0.03
Netherlands	0.18***	0.17***	-0.65***	-0.64***	0.19***	0.17***	-0.17***	-0.17***	0.03	0.04
Spain	-0.07**	-0.03	-0.66***	-0.67***	0.14***	0.11***	0.14***	0.12***	0.21***	0.18***
Italy	-0.10***	-0.08***	-0.53***	-0.54***	0.10***	0.07***	0.11***	0.10***	0.16***	0.15***
France	0.14***	0.12***	-0.35***	-0.36***	0.07**	0.07***	0.08***	0.09***	0.27***	0.29***
Denmark	-0.24***	-0.30***	-0.49***	-0.49***	-0.05*	-0.02	-0.17***	-0.14***	-0.10***	-0.07***
Greece	-0.25***	-0.25***	-0.68***	-0.68***	-0.09***	-0.12***	0.17***	0.17***	0.22***	0.21***
Switzerland	-0.15***	-0.15***	-0.36***	-0.36***	0.02	0.02	-0.06**	-0.04	0.09***	0.11***
Belgium	0.03	0.04*	-0.56***	-0.56***	0.18***	0.17***	0.14***	0.14***	0.25***	0.25***
Poland	-0.26***	-0.27***	0.00	0.00	-0.15***	-0.20***	-0.15***	-0.16***	0.04*	0.04
Czechia	0.12***	0.07**	0.00	0.00	-0.14***	-0.14***	-0.17***	-0.17***	0.03	0.04
Constant	0.69***	0.37***	0.79***	0.71***	0.26***	0.09***	0.70***	0.41***	0.57***	0.17***
Observations	16988	16988	7687	7687	12845	12845	30702	30702	30702	30702

*$p<0.10$, **$p<0.05$, ***$p<0.01$

Table 3: Education and income-related inequalities in cancer prevention

	Mammogram				Colonoscopy or Stool			
	E stand. for age	**E adj. for recom. age group**[2]	**E adj. for all needs**(Top 5 ranking in brackets)[3]	**W adj. for all needs**(Top 5 ranking in brackets)[3]	**E stand. for age**	**E adj. for recom. age group**[4]	**E adj. for all needs**(Top 5 ranking in brackets)[5]	**W adj for all needs**(Top 5 ranking in brackets)[5]
Education-related inequalities in cancer prevention								
Austria	.080*	.0341	.034	.062	-.075*	-.072*	-.071 *	-.089*
Germany	.117***	.075**	.075**	.069**	.074**	.078**	.085** (2.)	.090** (4.)
Sweden	.040	-.043	-.043	-.054	.040	.044	.071** (4.)	.099** (3.)
Netherlands	.026	-.000	-.004	-.023	.005	.006	.017	.003
Spain	.099***	.002	.002	.027	-.030	-.025	-.018	-.021
Italy	.166***	.083***	.079*** (5.)	.124*** (3.)	.044	.059*	.072** (3.)	.085*
France	.144***	.093***	.086*** (4.)	.102***	.112***	.120***	.120*** (1.)	.117*** (2.)
Denmark	.115***	.054**	.057**	.095*** (5.)	.045	.045	.065**	.066
Greece	.117***	.088***	.088*** (3.)	.122*** (4.)	.055**	.052**	.052** (5.)	.134** (1.)
Switzerland	.022	.013	.007	-.001	.042	.039	.067	.069
Belgium	.200***	.139***	.135*** (1.)	.143*** (2.)	.044*	.045*	.052**	.071** (5.)
Czechia	.092**	.060	.070*	.092**	n.a.	n.a.	n.a.	n.a.
Poland	.156***	.121***	.119*** (2.)	.148*** (1.)	n.a.	n.a.	n.a.	n.a.
Income-related inequalities in cancer prevention								
Austria	0.108**	0.045	.040	.048	-.045	.040	-.033	.044
Germany	.146***	.117***	.110*** (3.)	.125*** (3.)	.101***	.112***	.118*** (2.)	.133*** (2.)
Sweden	.143***	.013	.013	.022	-.002	.017	.037	.053
Netherlands	.097***	.078**	.077**	.094** (5.)	-.001	-.000	.001	.014
Spain	.146***	.081***	.078*** (4.)	.111*** (4.)	.-.54	-.049	-.055	-.091
Italy	.259***	.227***	.221*** (1.)	.236*** (1.)	.032	.038	.040 (5.)	.055
France	0.111***	.085***	.078** (5.)	.094**	.141***	.148***	.150*** (1.)	.158*** (1.)
Denmark	.075***	.011	.020	.035	-.052	-.045	-.021	.037
Greece	.071**	.060**	.060**	.082**	.026	.021	.026	.076 (5.)
Switzerland	.084**	.071*	.068	.078*	.083	.091*	.097*(3.)	.102* (4.)
Belgium	.127***	.064**	.064**	.077***	.049**	.051**	.07*** (4.)	.103*** (3.)
Czechia	.099**	.025	.020	.047	n.a.	n.a.	n.a.	n.a.
Poland	.155***	.143***	.138*** (2.)	.169*** (2.)	n.a.	n.a.	n.a.	n.a.

E = Erreygers Index; W = Wagstaff Index;[2] Age50_69; [3] Age50_69, cancer [4] Age50_74; [5] sah, Age50_74, gastroinstestinal problems, intestinal, ulcer cancer;
* p < 0.10, ** p < 0.05, *** p < 0.01

Table 4: Education and income-related inequalities in routine prevention

	Reg_Bloodtest				Reg_Bloodpressure				Influenza Vaccination			
	E stand. for age	**E adj. for recom. age group**[2]	**E adj. for all needs**(Top 5 ranking in brackets)[3]	**W adj. for all needs**(Top 5 ranking in brackets)[3]	**E stand. for age**	**E adj. for recom, age group** [4]	**E adj. for all needs**(Top 5 ranking in brackets)[5]	**W adj. for all needs**(Top 5 ranking in brackets) [5]	**E stand. for age**	**E adj. for recom. age group** [4]	**E adj. for all needs**(Top 5 ranking in brackets)[5]	**W adj. for all needs**(Top 5 ranking in brackets)[5]
Education-related inequalities in routine prevention												
Austria	.078**	.078**	.068* (2.)	.046 (4.)	.011	.011	.016 (5.)	.025 (5.)	.008	.017	-.011	.001
Germany	-.009	-.009	.017	.017	-.031	-.031	.014	-.004	.034	.049	.076** (3.)	.089** (2.)
Sweden	-.066***	-.066***	-.017	-.025	-.096***	-.096***	-.058**	-.073	.075***	.103***	.126*** (1.)	.122*** (1.)
Netherlands	-.091***	-.091***	-.041	-.035	-.082***	-.082***	-.037	-.050*	-.039	-.008	.054** (5.)	.006
Spain	.041*	.041*	.066*** (3.)	.126*** (1.)	-.022	-.022	.009	.012	-.120***	-.064**	-.0084	-.040
Italy	.014	.014	.036* (5.)	.039 (5.)	-.047	-.047	-.022	-.033	.022	.069**	.093*** (2.)	.085** (4.)
France	-.021	-.021	.012	.036	.020	.020	.036* (3.)	.068* (2.)	-.004	.037	.024	.015
Denmark	-.038	-.038	.006	-.004	-.033	-.033	.010	.012	.049*	.059*	.069** (4.)	.087** (3.)
Greece	.023	.023	.037** (4.)	.062* (3.)	-.028	-.028	.021 (4.)	.029 (4.)	-.066***	-.039*	-.002	-.004
Switzerland	-.007	-.007	-.006	.001	.019	.019	.041 (2.)	.050 (3.)	-.002	-.012	.028	.028
Belgium	-.020	-.020	-.012	-.016	-.056***	-.056***	-.036**	-.069**	-.007	-.001	.043*	.012
Czechia	-.044	-.044	-.030	-.041	-.019	-.019	.001	-.007	.036	.043	.050	.047
Poland	.061*	.061*	.092*** (1.)	.111*** (2.)	.036	.036	.076*** (1.)	.071** (1.)	.028	.027	.033	.051 (5.)
Income-related inequalities in routine prevention												
Austria	.062	.062	.055	.049	.025	.025	.020	.027	.011	.002	-.014	-.016
Germany	.013	.013	.048* (5.)	.057*	-.040	-.040	.01	.006	-.049	-.038	-.008	-.001
Sweden	.009	.009	.033	.026	.028	.028	.040 (5.)	.042	.005	.045	.095*** (2.)	.063* (5.)
Netherlands	-.026	-.026	.009	.005	-.061***	-.061***	-.032	-.038	-.049	-.028	.028	.005
Spain	.003	.003	.039*	.071* (5.)	-.011	-.011	.005	.001	-.039	-.017	.020	.001
Italy	.062**	.062**	.080*** (2.)	.132*** (3.)	.025	.025	.041 (4.)	.056 (5.)	.091**	.115***	.126*** (1.)	.124*** (2.)
France	.010	.010	.036	.055	.018	.018	.031	.064 (4.)	.060	.082*	.074* (4.)	.074* (3.)
Denmark	-.082***	-.082***	-.018	-.030	-.080***	-.080***	-.023	-.036	-.001	.004	.045	.041
Greece	.052**	.052**	.078*** (4.)	.173*** (1.)	.038	.038	.075** (3.)	.121*** (1.)	-.043	-.021	-.0024	-.001
Switzerland	.086**	.086**	.079** (3.)	.084** (4.)	.075**	.075**	.081** (2.)	.091** (3.)	.011	.018	.055* (5.)	.051
Belgium	-.023	-.023	-.00	-.00	-.011	-.011	.004	.006	-.002	.003	.039	.021
Czechia	-.049	-.049	-.015	-.016	.000	.000	.022	.022	.035	.011	.038	.068 (4.)
Poland	.147***	.147***	.157*** (1.)	.161*** (2.)	.097***	.097***	.109*** (1.)	.117*** (2.)	.076***	.074***	.079*** (3.)	.196*** (1.)

E = Erreygers Index; W = Wagstaff Index; [2]age; [3] age, heart attack, stroke, diabetes, overweight and male; [4] Age60more; [5] Age60more, sah, heart attack, lung disease, asthma, stroke, diabetes, arthritis

* p < 0.10, ** p < 0.05, *** p < 0.01

Table A 1: Effect of education on prevention

	Mam1	Mam2	StoolColo1	StoolColo2	Flu1	Flu2	BT1	BT2	BP1	BP2
ISCED0	-0.39***	-0.21***	-0.06	-0.10**	0.15***	-0.02	0.02	-0.07***	0.07***	-0.04*
ISCED1_2	-0.23***	-0.12***	-0.05**	-0.07***	0.05**	-0.04**	0.04***	-0.01	0.08***	0.01
ISCED3_4	-0.05**	-0.02	-0.02	-0.03	-0.04**	-0.05**	0.02	0.00	0.05***	0.03**
Age50_69		0.36***								
cancer		0.25***		0.12***						
Age55_79				0.09***						
Gastrointestinal problems				0.14***						
Intestinal ulcer				0.20						
Age60more						0.27***				
SAH						0.01*				
Heart attack						0.10***		0.11***		0.10***
Lung disease						0.11***				
Asthma						0.06*				
Stroke						0.05		0.10***		0.08***
Diabetes						0.10***		0.16***		0.12***
Arthritis						0.01				
Age								0.00***		0.01***
Overweight								0.08***		0.10***
Male								-0.01		-0.02**
Germany	-0.21***	-0.20***	-0.09***	-0.10***	0.08***	0.05**	0.02	0.01	0.06**	0.04*
Sweden	0.12***	0.11***	-0.53***	-0.54***	0.01	0.01	-0.22***	-0.21***	0.01	0.02
Netherlands	0.22***	0.20***	-0.63***	-0.62***	0.16***	0.16***	-0.17***	-0.16***	0.02	0.05*
Spain	0.08***	0.06**	-0.62***	-0.61***	0.07**	0.10***	0.14***	0.15***	0.19***	0.20***
Italy	0.02	-0.00	-0.49***	-0.50***	0.06**	0.07***	0.10***	0.12***	0.14***	0.16***
France	0.19***	0.15***	-0.36***	-0.36***	0.05*	0.07***	0.08***	0.10***	0.27***	0.30***
Denmark	-0.37***	-0.37***	-0.57***	-0.58***	-0.02	-0.02	-0.17***	-0.16***	-0.09***	-0.08***
Greece	-0.16***	-0.20***	-0.64***	-0.63***	-0.14***	-0.13***	0.17***	0.18***	0.21***	0.22***
Switzerland	-0.16***	-0.15***	-0.39***	-0.38***	0.03	0.04*	-0.07***	-0.05*	0.07***	0.10***
Belgium	0.07***	0.07***	-0.54***	-0.54***	0.16***	0.16***	0.14***	0.15***	0.25***	0.26***
Poland	-0.20***	-0.23***	0.00	0.00	-0.18***	-0.21***	-0.14***	-0.15***	0.04	0.04*
Czechia	0.02	0.01	0.00	0.00	-0.11***	-0.12***	-0.18***	-0.19***	0.04	0.03
Constant	0.66***	0.35***	0.78***	0.70***	0.29***	0.11***	0.67***	0.38***	0.54***	0.13***
Observations	17277	16753	7631	7628	12760	12752	30436	30290	30436	30290

* p < 0.10, ** p < 0.05, *** p < 0.01