UNIVERSITY OF WARSAW

Faculty of Economic Sciences

Working Papers
No. 23/2022 (399)

THE CAUSAL EFFECT OF CATASTROPHIC HEALTH EXPENDITURE ON POVERTY IN POLAND

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Warsaw 2022

WORKING PAPERS 23/2022 (399)

The causal effect of catastrophic health expenditure on poverty in Poland

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Abstract: Out-of-pocket medical expenses are a crucial source of health care financing in a number of countries, and thus a significant burden for many households. In particular, large health-related spending can lead to financial hardship and impoverishment. The aim of our study is to assess the direct impact of large out-of-pocket medical payments on household poverty, while properly accounting for endogeneity between these two variables. We use catastrophic health expenditure as a proxy for problematic health-related costs and estimate recursive bivariate probit models using Polish household-level panel data. We show that the causal relationship between catastrophic health expenditure and relative poverty is significant and positive across different methodological approaches. However, we find no empirical evidence that a one-time incidence of catastrophic health expenditure creates a poverty trap. We also show that using a poverty measure which treats out-of-pocket medical payments and food consumption as perfect substitutes can lead to an underestimation of poverty among the elderly.

Keywords: monetary poverty, catastrophic health expenditure, out-of-pocket medical expenses, recursive probit models

JEL codes: I32, I14, J14

Aknowledgements: The authors are thankful to Tomasz Kopczewski, Leszek Morawski and Lucas van der Velde for their helpful comments on earlier concepts of the paper. We would like to thank 38th EBES Conference and Warsaw International Economic Meeting Conference in 2022 participants for their useful comments. The project was financed by the Polish National Science Center research grant No. 2019/35/D/HS4/02043. The views expressed in this paper are solely those of the authors.

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1 Introduction

Out-of-pocket medical (OPM) expenses are an important source of health care financing in many countries (WHO, 2020). Therefore, their size and distribution can have a considerable impact on an individual's well-being and the economy as a whole. In particular, households with large OPM payments can suffer from financial hardship and impoverishment (OECD *Health at a Glance 2020*). With the ongoing aging of the worldwide population, health care costs are likely to continue increasing (Garrett and Martini, 2007; Mendelson and Schwartz, 1993). Moreover, the recent COVID-19 pandemic exposed the vulnerability of the health care systems in many countries. Overall, a proper understanding of the relationship between OPM spending and poverty is becoming increasingly important.

This question is also particularly relevant in Poland, where the speed of population aging is one of the fastest in Europe (*World Population Aging 2020* by United Nations). As in the majority of European countries, Poland has free and universal healthcare. Yet, according to the Polish *Country Health Profile 2019*, total health spending in Poland is low and receives a relatively small share of public financing compared to other European countries. While the Polish health system is predominantly focused on hospital care, outpatient medicines account for the highest proportion of OPM payments. Since the probability of having pharmaceutical costs increases with age (Sanwald and Theurl, 2017), elderly households in Poland are likely to be particularly affected by the burden of OPM payments.

Most studies that analyze OPM expenses in the context of poverty use catastrophic health expenditure (CHE) to identify households with an excessive financial burden due to health-related costs. Households experience CHE if their OPM spending is high in relation to their available resources. One line of research describes cross-country differences in CHE and investigates their sources (see, among others, Xu et al., 2007, 2003; Sirag and Nor, 2021; Van Doorslaer et al., 2007; Wagstaff et al., 2016; Baird, 2016 and WHO 2020, as well as a variety of country-specific WHO reports). These studies emphasize the importance of the design of the healthcare system, showing that higher OPM spending increases both the share of households affected by CHE and the overall poverty rate. Another common approaches are to examine the characteristics of households affected by CHE, and to study the determinants of CHE (Ahmed et al., 2018; Kronenberg and Barros, 2014; Brown et al., 2014; Dhak, 2015; Tambor and Pavlova, 2020; Aregbeshola and Khan, 2018a; Zhou et. al., 2021). This line of the literature allows the extent of financial hardship to be

quantified, typically finding that high OPM payments are particularly burdensome for the poor and elderly (Scheil-Adlung and Bonan, 2013).

Assessing the overall impact of OPM payments on poverty is usually done by calculating the impoverishment effect. This measure shows the difference between actual and hypothetical poverty. In the hypothetical scenario, there are no OPM payments, and the available resources can finance basic household consumption. There is extensive literature that calculates the impoverishment effect for low- and middle-income countries, and a smaller body of research exists for high-income economies (see, among others, Flores et al., 2008; Aregbeshola and Khan, 2018b; Bredenkamp et al., 2011; Arsenijevic et al., 2013; Mchenga et al., 2017; Özgen Narcı et. al., 2015). In general, these studies find this effect to be substantial. Fewer studies look at the impact of CHE on transitions into and out of poverty. One example is a recent work by Kim and Kwon (2021), who show that households experiencing CHE have lower chances of exiting from poverty to near-poverty.

In this paper we contribute to the literature by investigating the relationship between OPM payments and monetary poverty using a somewhat different approach. Our goal is to quantify the average causal effect of large OPM spending (approximated by CHE) on the risk of poverty. To this end, we estimate a recursive bivariate probit model using Polish Household Budget Survey data which cover most of the 2010s. The model controls for a wide range of factors and endogeneity between poverty and CHE. Our modeling framework is related to the recent literature that addresses interdependence between social indicators with the help of multi-equation models (Ayllón and Gábos, 2017; Hohberg et al., 2021). In particular, Maruotti (2009) estimates determinants of CHE and impoverishment due to health spending for Italian households using a correlated random effects model. Since poverty and CHE measures are sensitive to methodological choices (see, among others, Deaton, 1997; Yerramilli et al., 2018; Hsu et al., 2018), we consider different thresholds and alternative approaches to the CHE measurement. To our knowledge, we are the first to examine the causal relation between CHE and poverty while correcting for endogeneity between CHE and poverty.

We find that experiencing CHE significantly increases a household's risk of poverty, and this result is robust across various measures of CHE. The estimated probability of relative poverty is 2 to 4 times higher for a household with a "new" incidence of CHE (i.e. it had no CHE in the previous year) compared to a household without CHE either currently or in the previous year, and

the odds ratios are slightly less than 3 for the most common CHE thresholds. Moreover, both poverty and CHE exhibit a considerable degree of state dependence, although this is more marked in the case of the former.

Our paper also adds to the debate on the appropriate poverty measure where OPM expenses are present (see, among others, Meyer and Sullivan, 2012; Wagstaff et al., 2007; van Doorslaer et al., 2006). Currently, the official measure of relative poverty, used by many statistical offices, including the Polish Central Statistical Office, is based on a household's total consumption expenditure. We show that treating OPM payments and food consumption as perfect substitutes might result in the proportion of elderly households (aged 70 and older) in poverty being underestimated by up to 2.5 percentage points.

Finally, we present estimates of transition matrices for the incidence of CHE in Poland. To our knowledge, these are the first such estimates to have been calculated. We then compare the implied standard mobility indices of CHE and poverty dynamics. Together with the estimates from the recursive probit regressions, they indicate that CHE has lower persistence than relative poverty. The remainder of the paper is structured as follows. Key definitions and concepts, followed by a brief description of the data, are given in Sections 2 and 3 respectively. Section 4 reviews the development of relative poverty, OPM payments, and CHE over recent years in Poland. In particular, we show how poverty and the incidence of CHE vary with household age and how these two measures overlap. Section 5 compares the mobility of relative poverty with that of CHE Section 6 describes the econometric model and discusses the main findings of this paper, i.e. the estimated causal effect of CHE on poverty in Poland. This is followed by concluding remarks in Section 7. The additional sensitivity check and descriptive statistics can be found in the Appendix.

2 Definitions and Concepts

Relative poverty Poverty is a multidimensional concept and refers to a state in which some basic human needs are not satisfied (Deaton, 2006; Alcock, 1997). In this study, we look at the monetary dimension of poverty. Individuals and households are at risk of monetary poverty if their available resources are below a certain threshold. This threshold can be set by reference to the costs of meeting basic needs, or to the standard of living of the whole community. In the case of latter, we talk about relative poverty. In many countries, official statistics on relative poverty are based on household consumption expenditure. In particular, such an approach is used by the Polish Central

Statistical Office (CSO) to calculate poverty rates. According to this definition, a person is in relative poverty if the total consumption expenditure of his/her household are lower than 50% of the country average. Another common approach to assessing relative poverty is based on disposable income instead of consumption. In particular, this method is used in the official European statistics (EU-SILC), which define the poor as those whose disposable income is lower than some proportion of a country median.

It is well recognized that households necessarily incur certain critical costs, such as OPM and work-related expenses, and these costs vary with geographical factors and household composition (Meyer and Sullivan, 2012). Thus, instead of incorporating only the average of this spending in the poverty threshold, another option is to subtract it from the measure of household economic resources as, for example, is the practice of the US Census Bureau for the *Supplemental Poverty Measure* (Short, 2012).

The cost of living depends on household size and composition. Therefore, poverty estimates typically use equivalised measures. More specifically, a household's income or consumption is divided by the appropriate equivalence scale, i.e. a weighted sum of all household members. In particular, the Polish CSO uses the original OECD equivalence scale, for which the weighting assigned to a household head is 1, the weighting used for children younger than 14 is 0.5, and all household members aged at 14 and over, except for the household head, are assigned a weighting of 0.7.

Measuring relative poverty in the context of OPM expenses Let us now consider how the standard measures of relative poverty respond to OPM payments. When equivalised income is used to indicate monetary poverty, health-related spending has no impact on the poverty status of a household or individual. By contrast, estimates of relative poverty based on total consumption are affected by the size of OPM expenses, but not always in a desirable way. Let us think of a household that is forced to reduce some of its basic consumption to meet some medical needs. At the same time, its total consumption, including OPM spending, is higher than it would be without a health shock. The thus measured poverty indicator for such a household would decrease.

A poverty rate calculated net of OPM payments would not have the above drawbacks. However, in this approach, all health-related expenses are treated as inevitable and necessary expenses. In real life, the size of OPM expenditure is not independent of an individual's financial situation. In

particular, economic status is widely recognized as a risk factor for having unmet health care needs (OECD *Health at a Glance 2020*; Park et al., 2016).

Apart from the decision whether or not to subtract OPM expenses before calculating poverty status, one has to choose a proxy for household resources. The two most popular alternatives are consumption and income. In this context, it is worth noting that the possibility of experiencing idiosyncratic health shocks and resulting health-related spending have an effect on intertemporal household decisions (De Nardi et al., 2010). More precisely, households can accumulate assets that help them smooth their consumption against health shocks. Using income as a poverty indicator would not account for this fact. Thus, for assessing the effect of large OPM expenses on relative poverty, consumption seems to be the more appropriate measure of household resources.

The data that we use in this study do not allow us to distinguish between essential and supplementary health spending, nor does it include sufficient information to appropriately approximate deferred health expenditure. For this reason, the poverty indicator that we use to assess the impact of CHE is based on total household consumption less the value of all health-related expenses paid directly by households. We discuss the consequences of this approach in Section 7. In addition to OPM spending, there are other types of critical costs, such as work- and child-related payments, that might also be considered as necessary. These suffer from similar methodological and measurement issues as health-related expenses, which makes accounting for them a non-trivial task. As we want to keep our poverty indicator as close as possible to that used in official statistics, we have chosen not to subtract any more expenditures from the resource measure defined above.
We define the threshold that separates the poor from the not-poor as a proportion of average household consumption. Similar to the Polish CSO, the cutoff is set at 50%, and we use the original OECD equivalence scale. As a robustness check, we also perform the analysis for two different cutoffs: 45% and 65%.

All variables used in this study are at the household level, so a household is also the basic unit for our analysis. In official Polish CSO statistics, poverty is determined at the household level, but poverty rates are calculated per capita, i.e. they show the proportion of the population living in poverty. For this reason, the aggregate statistics presented in this paper and the corresponding official estimates might differ slightly.

Catastrophic health expenditure OPM payments include all spending on health-related goods and services borne directly by households. For households with different socio-economic status, problematic levels of such payments can be different. Hence, in the literature, it is common to focus on the individuals whose OPM expenses constitute a large fraction of their resources. If this fraction exceeds a certain threshold, an incidence of catastrophic health expenditure (CHE) occurs. There are two main ways to measure CHE. The first one is called the ”budget share” approach, and OPM payments are expressed as a share of total household consumption or income. Another method is to examine a household's capacity to pay for health-related goods and services. In this case, we look at OPM payments in relation to a household's remaining consumption, which is total consumption less spending on basic needs. The most common proxies for the costs of basic needs are actual household food consumption (actual food spending approach) and a standard amount of food spending (the normative food spending approach, see Yerramilli et al., 2018). In recent WHO reports, spending on housing and utilities is also included in the costs of basic needs. A detailed discussion on the advantages and drawbacks of using different CHE measures can be found in Box 2 in a most recent WHO report (2020) on financial protection. In general, in the *capacity to pay* approach, CHE is more concentrated among poor households compared to the *budget share* method (Cylus et al., 2018).

There is no consensus on a single threshold that can be applied to identify an incidence of CHE. The majority of studies that focus on European countries use thresholds between 10% and 25% in the case of the *budget share* approach, and thresholds of around 40% when using the *capacity to pay* method (Yerramilli et al., 2018).

To evaluate the sensitivity to different CHE measures and thresholds, the results presented in the paper will be based on two standard approaches for identifying an incidence of CHE, which are the *budget share* approach with thresholds set at 10%, 15% 20%, and 25%, and the *normative spending* approach with thresholds at 25%, 30%, 35%, and 40%. For the latter, we approximate the cost of basic needs with the minimum of the following two values: actual household spending on food, housing, and utilities, and an average of such spending calculated for households between the 25th and 35th quantiles in the consumption distribution. We also adopted two alternative measures of CHE: an *actual food spending* approach and a *normative food spending* approach. As the estimates obtained with these two approaches did not change any of the main findings of this paper, they are not presented here, but we can make them available on request.

3 Data

In this study, we use household-level data from the Polish Household Budget Survey (HBS). The HBS provides a rich database on the income, consumption, and a variety of socioeconomic characteristics of Polish households. In particular, it is the only database with such precise and detailed information on household spending on health-related goods and services. The HBS data are used for calculating various official estimates, including consumption-based poverty.

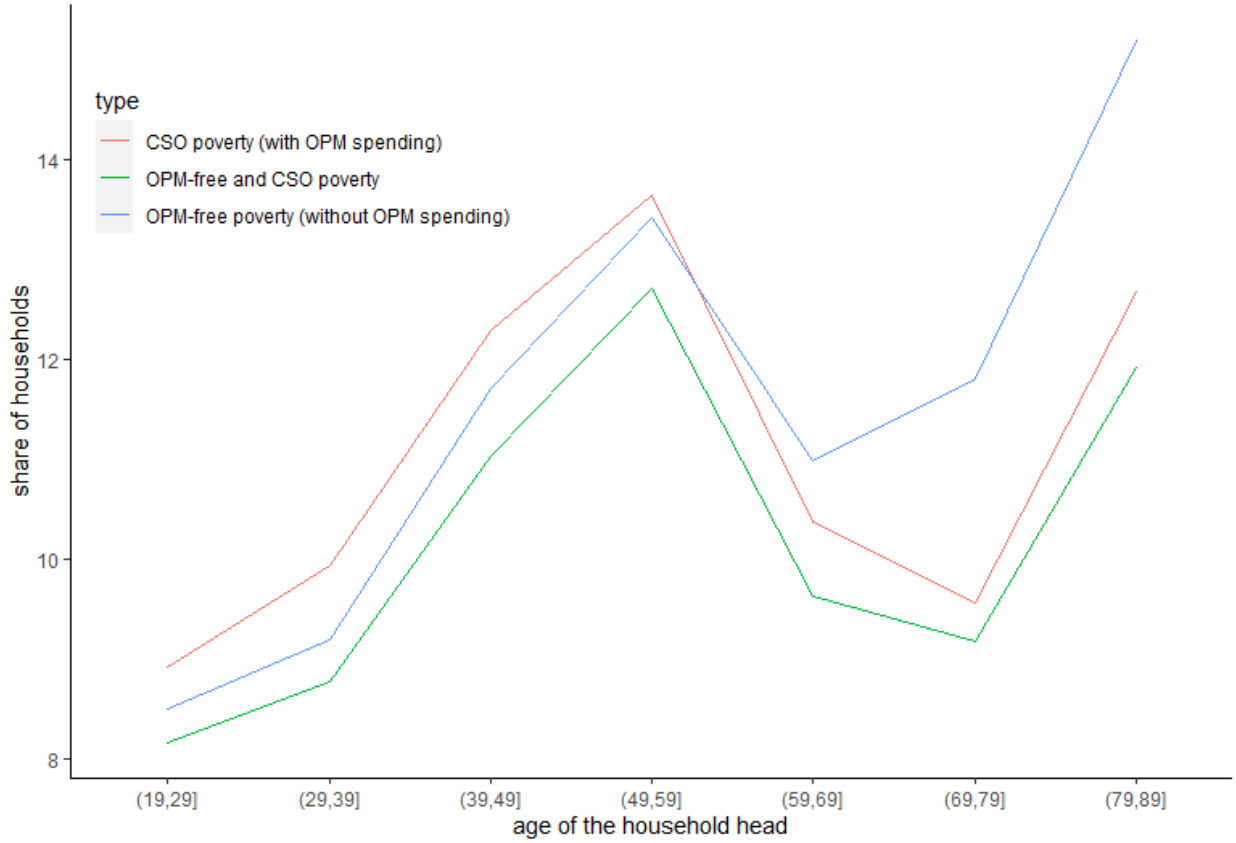
Every year, the survey is conducted on a sample of approximately 37 thousand Polish households. Each household is interviewed exactly twice in the two subsequent years. The detailed data on household expenditure and income are taken from one randomly selected month. In the next section, we show selected statistics based on data just from one year - 2018. In Sections 5 and 6 we present analysis based on data from the following five panels: 2010-2011, 2011-2012, 2012-2013, 2016-2017, 2017-2018. We excluded households in which the household head did not remain the same for both interviews. That gives us 74,186 observations in total. The number of observations for each panel is listed in the Appendix.

The Polish HBS database provides survey weights for cross-section data collected in a given year. When calculating the transition matrices, each household takes the weight assigned during its first interview. However, our results remain qualitatively unchanged if we use unweighted data.

4 Relative poverty, OPM payments, and CHE in Poland

Relative poverty Relative poverty in Poland is moderate in comparison to other OECD countries (OECD, 2019). The introduction of the universal child benefit *500 Plus* in 2016 was supposed to decrease it even further (see preliminary predictions by Goraus-Tańska and Inchauste, 2016, and Brzeziński and Najsztub, 2017). However, according to the Polish CSO, the share of the population at risk of relative poverty dropped only from 13.9% in 2016 to 13.0% in 2019, despite favorable economic conditions.

Figure 1. Relative poverty rates over age



Notes: Authors' estimates based on 2018 Polish HBS data; red line: relative poverty rate calculated on the basis of total consumption (CSO poverty rate); blue line: relative poverty rate calculated on the basis of total consumption minus OPM expenses (OPM-free poverty rate).

In Figure 1, we show how the relative poverty rates vary with the age of the household head. The estimates are based on the Polish Household Budget Survey (HBS) data from 2018. The red line represents consumption-based relative poverty rates calculated using the measurement approach adopted by the Polish CSO. We refer to poverty thus measured as CSO poverty. The blue line shows relative poverty rates based on household consumption without OPM expenses, which we refer to as OPM-free poverty. An examination of Figure 1 reveals that the share of households in relative poverty increases with household age up to the age of 50, and then declines. This trend is reversed again for households aged between 60 and 80. In general, the two relative poverty measures overlap, especially for younger households (Table 1). However, the estimates of the OPM-free poverty rate indicate a 2.4 percentage point higher share of poverty among elderly households. Overall, around 3% of households aged 70 or more are poor according to the OPM-

free indicator, but not poor based on the CSO indicator (Table 1). Moreover, the CSO poverty rate of elderly households (70 years old or more) is lower than that of the population as a whole, which is not the case for the OPM-free poverty rate (Table 2). Other studies confirm the elderly's vulnerability to poverty, and thus are more in line with the OPM-free poverty rate. In particular, Eurostat (based on EU-SILC data) reports that the risk of poverty or social exclusion for individuals aged 60 or more is 1 percentage point higher than for the entire population.

Table 1. Poverty rate by age groups and poverty indicators

Age of household head	Poor according to the CSO indicator, but not-poor according to the OPM-free indicator	Poor according to the OPM-free indicator, but not-poor according to the CSO indicator
under 70	1.00%	0.80%
70 or over	0.50%	2.90%

Notes: Authors' estimates based on 2018 Polish HBS data; CSO indicator: relative poverty calculated on the basis of total consumption; OPM-free indicator: relative poverty calculated on the basis of total consumption minus OPM expenses.

Table 2. Poverty rate by age groups and poverty indicators

age of household head	CSO poverty rate	OPM-free poverty rate
less than 70	11.30%	11.10%
70 and more	10.60%	13.00%

Notes: Authors' estimates based on 2018 Polish HBS data; CSO poverty: relative poverty calculated on the basis of total consumption; OPM-free poverty: relative poverty calculated on the basis of total consumption minus OPM expenses.

OPM payments According to the OECD *Country Health Profile 2019*, Poland has one of the lowest total healthcare spending levels (around 6.5% of GDP in 2017) and one of the highest out-of-pocket pharmaceutical expenditures among European countries. The share of OPM payments in total health expenditure in Poland has not changed much over the last ten years, accounting for approximately one-fifth of all health expenditure (the World Bank database). Pharmaceutics account for most OPM spending (around 3/5), followed by dental care (1/6) and outpatient medical care (1/7).

OPM expenses make up about 5% of total household consumption (2018 Polish HBS). Elderly households (with household heads aged 70 or over) spend slightly less than 1/10 of their consumption on health goods and services, more than twice as much as other households. Furthermore, Tambor and Pavlova (2020) report that in Poland senior citizens, the chronically ill, and the disabled have a higher probability of not being able to afford to purchase prescribed drugs than the rest of the population.

Catastrophic health expenditure Tambor and Pavlova (2020) look closely at the magnitude and distribution of CHE in Poland. According to their findings, the incidence of CHE in Poland does not stand out from other European countries. Between 2005 and 2014, it followed a moderate downward trend, with a more profound decrease for households in the middle three consumption quintiles. According to Tambor and Pavlova (2020), CHE is highly concentrated among the poorest. Łuczak and García-Gómez (2012) and Zawada et al. (2017) also confirm this finding for different threshold levels. Furthermore, Łuczak and García-Gómez (2012) point to a significant impoverishment effect of CHE in Poland. According to their estimates, the relative poverty rate in 2009 was 4.9 percentage points higher due to out-of-pocket pharmaceutical payments. In general, OPM payments have a larger impoverishment effect for seniors and the chronically ill.

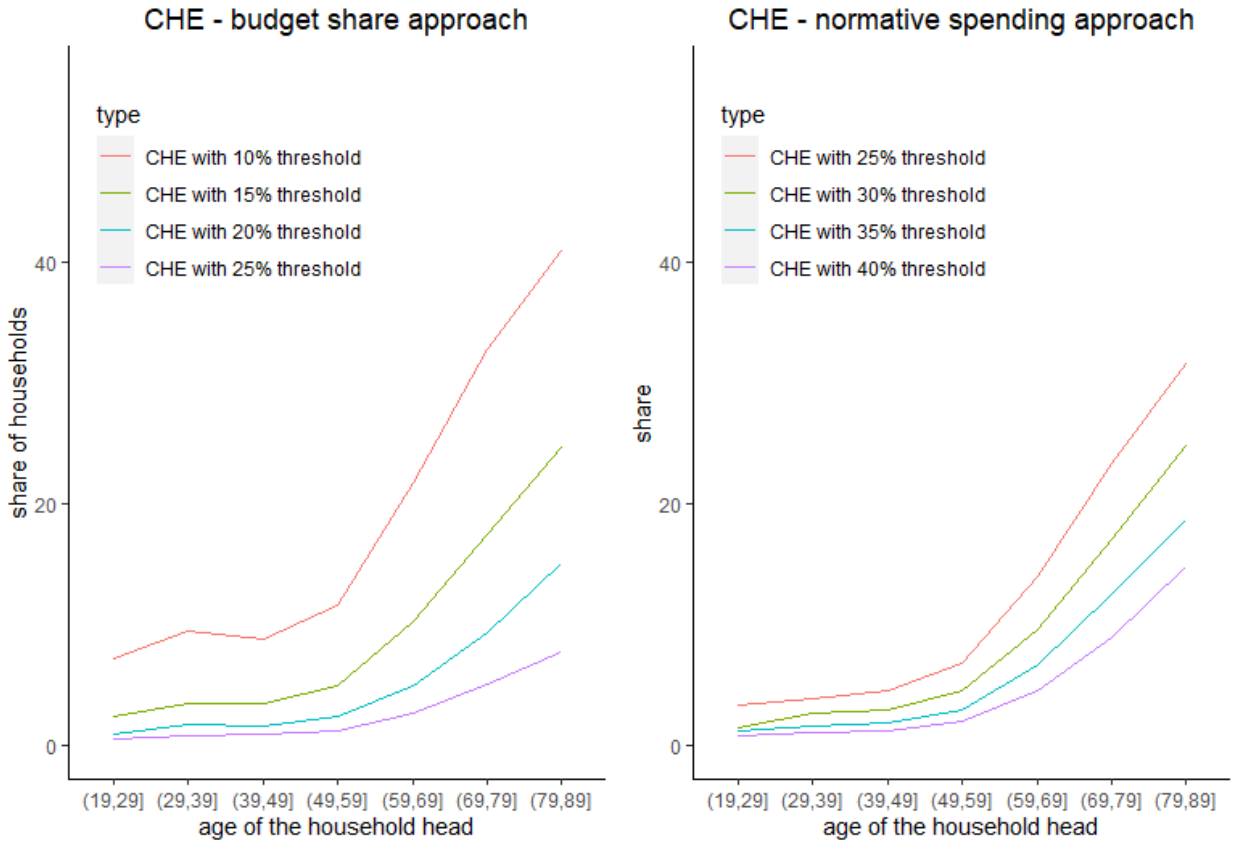
The share of households with CHE varies greatly with measurement and threshold choices. Indeed, according to our estimates calculated using the 2018 Polish HBS data, the incidence of CHE was between 2% and 17% for the budget share approach when thresholds were varied incrementally from 10% to 25%. For the normative spending approach and incremental thresholds on a scale from 25% to 40%, the share of households with CHE ranged between 4% and 10% (see Figure 2). However, regardless of methodological choices, the incidence of CHE grows considerably with the age of the household head from 60 years old and onwards. The share of households with CHE among households with household heads aged 65 or more is between 3 and 5 times higher than in the rest of the population.

Relative poverty and CHE Let us finally look at the interactions between relative poverty and CHE in relation to age, using the 2018 Polish HBS data. We focus on two CHE measures: the first one calculated with the budget share approach using a threshold of 15% (left panel of Figure 3), and the second one based on the normative spending approach for a threshold of 40% (left panel

of Figure 3). The grey line in Figure 3 shows the share of households that have CHE and are in OPM-free poverty, while the red line represents those experiencing CHE and CSO poverty.

First, Figure 3 indicates a higher share of households with CHE among those in OPM-free poverty compared to those in CSO poverty. In particular, around 13% of households in OPM-free poverty have CHE (calculated using the normative spending approach), but the incidence of CHE is only 8% for those in CSO poverty (Table 3). For the budget share approach, these numbers are 11% and 5% respectively. Regardless of the measure, the majority of poor households do not have CHE.

Figure 2. Shares of households with CHE according to age



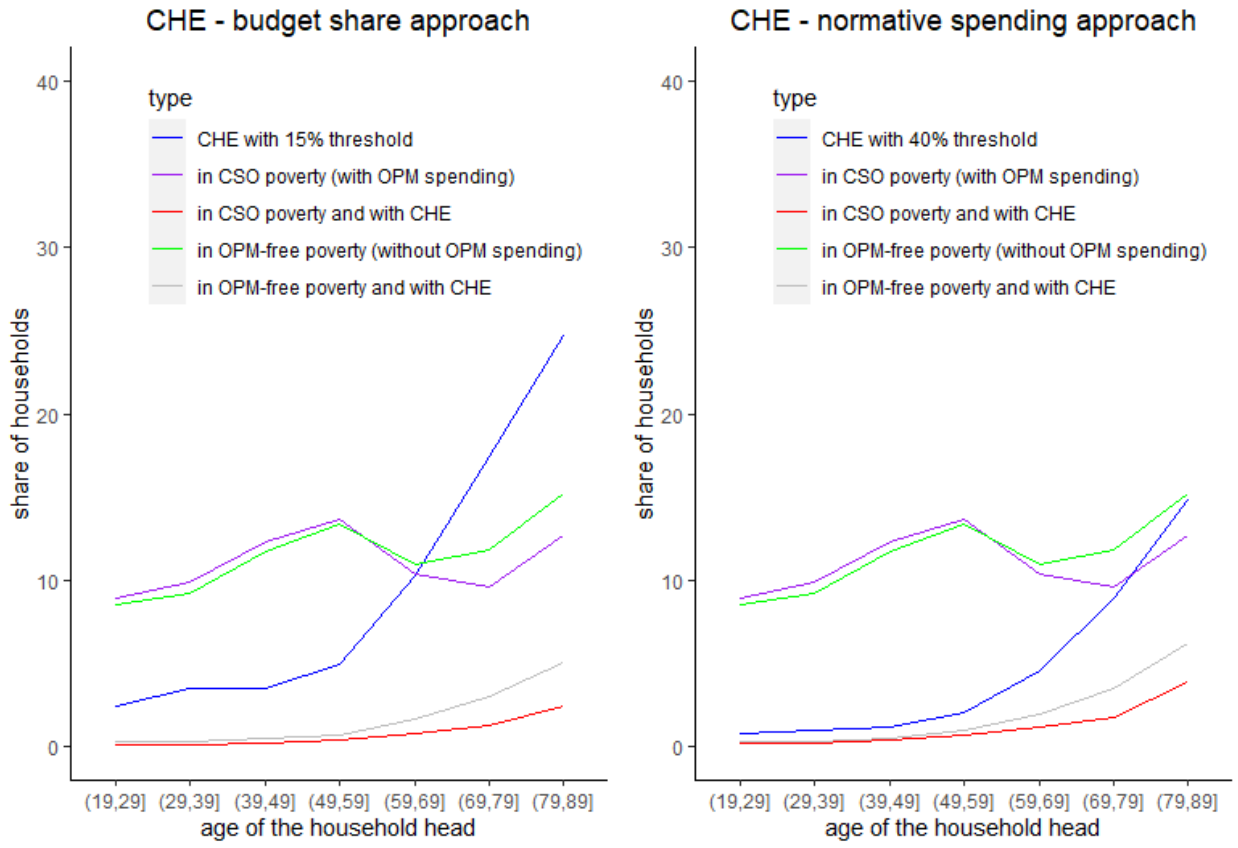
Notes: Authors' estimates based on 2018 Polish HBS data; CHE denotes *catastrophic health expenditure*.

Second, in line with the related literature, our estimates of CHE indicate that using the normative spending approach gives an incidence of CHE which is more concentrated among the poor. Indeed, 42% of households with CHE based on the normative spending approach are in OPM-free poverty,

and only 16% of those with CHE calculated using the budget share approach are identified as (OPM-free) poor.

Finally, as the risk of having CHE increases for elderly households, so do the shares of households that are both in poverty and have CHE.

Figure 3: Relative poverty and households with CHE according to age



Notes: Authors' estimates based on 2018 Polish HBS data; CHE denotes *catastrophic health expenditure* and OPM *out-of-pocket medical payments*.

5 Mobility indices

Having documented the correlation between relative poverty and CHE using cross-section data, we now focus on their dynamics. We evaluate the differences in poverty mobility and the mobility of the incidence of CHE. We also check whether having CHE might change the patterns of poverty persistence.

Table 3: The intersection of poverty and CHE

	Households in CSO poverty	Households in OPM-free poverty
Share of households with CHE (normative spending approach, threshold=40%)	13%	8%
Share of households with CHE (budget share approach, threshold=15%)	11%	5%
	Households with CHE (normative spending approach, threshold=40%)	Households with CHE (budget share approach, threshold=15%)
Share of households in OPM-free poverty	42%	16%

Notes: Authors' estimates based on 2018 Polish HBS data; CSO poverty: relative poverty calculated on the basis of total consumption; OPM-free poverty: relative poverty calculated on the basis of total consumption minus OPM expenses.

To this end, we use transition matrices, calculated for different groups and measurement approaches (Tables 4-6). A transition matrix shows the proportions of households that are poor/non-poor (or with/without CHE) in a particular year, broken down by their poverty (or CHE) status in a previous year. We summarize the degree of mobility in Table 7, using the following two one-dimensional statistics: the immobility ratio (the sum of diagonal elements of a transition matrix), and the Shorrocks (1978) mobility index (one minus the second greatest eigenvalue of a transition matrix). To establish the statistical significance of the results, we calculate 95% bootstrap confidence intervals.

Table 4 shows the poverty transition matrices calculated for the two indicators of relative poverty, OPM-free poverty and CSO poverty. For both poverty measures, we observe a similar degree of mobility. The share of households remaining in relative poverty for at least two years is between 52% and 53%, while the share of those that escape poverty every year slightly exceeds 6%.

Next, we look at poverty transitions of households with CHE (Table 5). We calculate CHE here using the two most common methodologies, i.e. the normative spending approach with a threshold of 40%, and the budget share approach with a threshold of 15%. Once again, our estimates confirm that CHE and poverty are positively correlated. If we take a household that has CHE at time t, its probability of staying in poverty at time t is 10-20 percentage points higher than

that of the entire population. There are significant differences between the results depending on the CHE measure used. In general, households which are determined to have CHE on the basis of the normative spending approach have higher probabilities of remaining in/falling into poverty than households determined to have CHE under the budget share approach.

Table 4: Poverty transition matrices

	CSO indicator			OPM-free indicator	
	poor (t)	not-poor (t)		poor (t)	not-poor (t)
poor $(t-1)$	53.3	46.7	poor $(t-1)$	52.4	47.6
not poor $(t-1)$	6.3	93.7	not poor $(t-1)$	6.4	93.6
shares at time t	12.1	87.9	shares at time t	12.3	87.7

Notes: Authors' estimates based on the Polish HBS data, number of observations is 74,186; CSO indicator: relative poverty calculated on the basis of total consumption; OPM-free indicator: relative poverty calculated on the basis of total consumption minus OPM expenses.

Table 5: OPM-free poverty transition matrices of households with CHE

Households with CHE at time t-1					
	budget share approach (threshold=15%)			normative spending approach (threshold=40%)	
	poor (t)	not-poor (t)		poor (t)	not-poor (t)
poor $(t-1)$	48.1	51.9	poor $(t-1)$	50.7	49.3
not poor $(t-1)$	6.1	93.9	not poor $(t-1)$	8.8	91.2
shares at time t	14.2	85.8	shares at time t	23.7	76.3
obs. no.: 6,390			obs. no.: 4,063		
Households with CHE at time t					
	budget share approach (threshold=15%)			normative spending approach (threshold=40%)	
	poor (t)	not-poor (t)		poor (t)	not-poor (t)
poor $(t-1)$	61.9	38.1	poor $(t-1)$	73.5	26.5
not poor $(t-1)$	11.1	88.9	not poor $(t-1)$	21.6	78.4
shares at time t	17.7	82.3	shares at time t	34.4	65.6
obs. no.: 6,168			obs. no: 3,935		

However, according to the transition matrices, there is no evidence that an incidence of CHE increases the risk of poverty in the next period (Table 5). On the contrary, the mobility indices suggest a slightly higher poverty mobility for households with CHE at time $t-1$ compared to the entire population (Table 7). This result might suggest that having CHE does not create a poverty trap. Indeed, after the initial shock of CHE, households might use their savings or other resources to finance medical needs, and thus be able to return to their previous consumption level.

Table 6. Transition matrices for the incidence of CHE

budget share approach					
threshold=10%			threshold=15%		
	with CHE (t)	without CHE (t)		with CHE (t)	without CHE (t)
with CHE (t-1)	43.1	56.9	With CHE (t-1)	32.9	67.1
Without CHE (t-1)	11.5	88.5	Without CHE (t-1)	6.0	94
shares at time t	17.2	82.8	shares at time t	8.3	91.7
threshold=20%			threshold=25%		
	with CHE (t)	without CHE (t)		with CHE (t)	without CHE (t)
With CHE (t-1)	25.3	74.7	With CHE (t-1)	18.6	81.4
Without CHE (t-1)	3.2	96.8	Without CHE (t-1)	1.8	98.2
shares at time t	4.2	95.8	shares at time t	2.2	97.8
normative spending approach					
threshold=25%			threshold=30%		
	with CHE (t)	without CHE (t)		with CHE (t)	without CHE (t)
with CHE (t-1)	40.7	59.3	with CHE (t-1)	37.3	62.7
without CHE (t-1)	8.9	91.1	without CHE (t-1)	6.6	93.4
shares at time t	13.3	86.7	shares at time t	9.6	90.4
threshold=35%			threshold=40%		
	with CHE (t)	without CHE (t)		with CHE (t)	without CHE (t)
with CHE (t-1)	33.8	66.2	with CHE (t-1)	30.0	70.0
without CHE (t-1)	4.8	95.2	without CHE (t-1)	3.6	96.4
shares at time t	6.9	93.1	shares at time t	4.9	95.1

Notes: Authors' estimates based on the Polish HBS data, number of observations 74,186.

Table 7. One-dimensional mobility measures

	CHE measure	Immobility ratio (Shorrocks,1978)	
CHE with threshold 25%	normative spending approach	0.65 [0.65,0.66]	0.69 [0.68,0.70]
CHE with threshold 30%	normative spending approach	0.65 [0.64,0.65]	0.70 [0.69,0.73]
CHE with threshold 35%	normative spending approach	0.64 [0.64,0.65]	0.71 [0.71,0.78]
CHE with threshold 40%	normative spending approach	0.63 [0.62,0.63]	0.74 [0.73,0.83]
CHE with threshold 10%	budget share approach	0.66 [0.66,0.66]	0.68 [0.67,0.69]
CHE with threshold 15%	budget share approach	0.63 [0.63,0.64]	0.73 [0.72,0.74]
CHE with threshold 20%	budget share approach	0.61 [0.60,0.62]	0.78 [0.77,0.79]
CHE with threshold 25%	budget share approach	0.58 [0.58,0.59]	0.83 [0.81,0.85]
OPM-free poverty (households with CHE at $t-1$)	normative spending approach (threshold=40%)	0.71 [0.69,0.72]	0.58 [0.56,0.62]
OPM-free poverty (households with CHE at t)	normative spending approach (threshold=40%)	0.75 [0.74,0.77]	0.49 [0.46,0.52]
OPM-free poverty (households with CHE at $t-1$)	budget share approach (threshold=15%)	0.71 [0.70,0.72]	0.58 [0.56,0.61]
OPM-free poverty (households with CHE at t)	budget share approach (threshold=15%)	0.75 [0.74,0.77]	0.49 [0.46,0.52]
OPM free poverty		0.73 [0.73,0.73]	0.54 [0.53,0.55]
CSO poverty		0.73 [0.73,0.74]	0.53 [0.52,0.54]

Notes: Authors' estimates based on the Polish HBS data; 95% bootstrap intervals in brackets; CSO poverty: relative poverty calculated on the basis of total consumption; OPM free poverty: relative poverty calculated on the basis of total consumption minus OPM expenses.

However, this might not be the whole picture. Consider individuals who do not have a sufficient financial buffer. They might be incapable of bearing high medical costs for an extended period, and, as a result, could end up with unmet health needs. Unfortunately, our data do not allow us to quantitatively verify these hypotheses.

The incidence of CHE has significantly lower persistence than relative poverty, for all considered thresholds and measurement approaches (Tables 6 and 7). Intuitively, the higher the threshold, the greater the mobility. For the two most common CHE measures, only less than one-third of households with CHE at time $t-1$ experience CHE at time t.

As a robustness check, we also calculated the mobility indices using single two-year panels. The results, available on request, confirm our findings described above.

6 The causal effect of CHE on poverty

6.1 Econometric model

We have shown so far that households experiencing CHE are more likely to fall into poverty and remain in it. However, this fact alone does not imply causality. Indeed, there might be factors, such as age or disability, that simultaneously influence both poverty and the incidence of CHE. If some of these factors are unobservable, endogeneity arises.

We address this problem by using joint bivariate regression models. Our modeling framework consists of two simultaneous probit equations: one for poverty and one for CHE. The error terms of these equations can be correlated. More specifically, we estimate the following model:

$$POV_s^* = \phi_1 POV_{s,-1} + \phi_2 CHE_s + \phi_3 CHE_{s,-1} + \beta X_s + \varepsilon_s \qquad (1)$$

$$CHE_s^* = \rho_1 POV_{s,-1} + \rho_2 CHE_{s,-1} + \Upsilon X_s + \tau_s, \qquad (2)$$

$$cov(\varepsilon_s, \tau_s) = \Theta, \qquad cov(\varepsilon_s, \varepsilon_{s-r}) = 0, \qquad cov(\tau_s, \tau_{s-r}) = 0, \qquad \text{for } r \neq 0$$

$$POV_s = \mathrm{I}(POV_s^* > 0), \qquad CHE_s = I(CHE_s^* > 0),$$

where POV_s and $POV_{s,-1}$ are binary variables indicating the current and previous poverty status of a household s, respectively. CHE_s equals one if a household s currently has CHE, while $CHE_{s,-1}$ refers to an incidence of CHE in the previous year. X is a vector of other explanatory (exogenous) variables, ϕ_1, ϕ_2, ϕ_3, ρ_1, ρ_2, β, γ are parameters and ϵ, τ are error terms. We refer to parameters ϕ_1 and ρ_2 as reflecting state dependence of poverty and of CHE, respectively.

We estimate the model using R package GJRM (Marra and Radice, 2019) and Gaussian copula. Apart from poverty and the incidence of CHE, the explanatory variables include: the number of children, working and non-working adults in a household, binary variables indicating the age, sex, education level, and relationship status of the household head (HH), the presence of disabled household members, the predominant source of income of household members, the type of area in which a household lives, and dummies for years. The definitions and descriptive statistics of all variables are presented the Appendix. As we discussed in Section 2, to properly capture the effect of CHE on poverty, OPM payments should not be included in household resources. Thus, from now on, our only poverty indicator is OPM-free poverty.

6.2 Results

With the gradient test (Marra et al., 2017), the hypothesis of no endogeneity was rejected at a significance level of 5% for all considered CHE thresholds in the case of the budget share approach and for the 25% threshold in the case of the normative spending approach. This confirms the need to use joint bivariate regression models in our analysis.

State dependence and feedback effects In Table 8 we present the average marginal effects (AME) of poverty and CHE based on the model described in the previous subsection. The table contains the estimates of state dependence, as well as the feedback effects from CHE to poverty and vice versa. The *poverty equation* refers to Equation 1, while the *CHE equation* refers to Equation 2. The AME of lagged poverty on current poverty captures poverty state dependence. Similarly, state dependence of CHE is approximated by the AME of an incidence of CHE in the previous year on a current incidence of CHE.

The estimates point to a high degree of state dependence of relative poverty. Poverty in the previous year increases its risk in the current year by more than 30 percentage points, and this result is robust

across all specifications. This finding indicates that Poland has a much higher level of poverty state dependence compared to the European average, but similar to countries such as Greece or Turkey (see Mussida and Sciulli, 2021; Yildirim et al., 2018; Giarda and Moroni, 2015). Our result is in line with Ayllón and Gábos (2017), who also find that poverty in Poland is strongly affected by state dependence. A high degree of poverty state dependence might suggest that the experience of poverty depreciates human capital and decreases motivation and incentives to change unfavorable conditions. Thus, this finding stresses the importance of public measures not only to alleviate already existing poverty, but also to prevent households from falling into poverty in the first place. The total effect of CHE on poverty is positive and significant for all specifications. A new incidence of CHE calculated with the normative spending approach increases the risk of poverty by 22-27 percentage points. In the case of the budget share approach, this increase can reach even 34 percentage points. However, for the two most common thresholds, i.e. 10% and 15%, having CHE increases the poverty risk by 14 and 17 percentage points, respectively.

We do not observe higher poverty risk for households with CHE in the previous year. This means that having an incidence of CHE does not negatively impact a household's future experience of poverty. On the contrary, an incidence of CHE slightly decreases the risk of poverty in the following year. While this effect is small in magnitude and insignificant for the normative spending approach with high threshold levels, it might be still worth discussing why a household with CHE in the two subsequent years would have a slightly lower risk of poverty than a similar household with CHE only in the current year. The economic explanation of this finding might be as follows. After the initial shock of a new incidence of CHE, households might finance their OPM expenditures by reducing their current consumption. But once they realize that they will need to bear health-related costs for longer, some of them might seek other sources of financing for OPM payments, such as additional income, the sale of some assets, or borrowing from family. As a result, their consumption might return to normal levels, or at least be at a higher level than in the previous year.

Our results confirm the existence of state dependence of the incidence of CHE. Having CHE in one year translates into a 6.6-19.5 percentage point higher risk of experiencing CHE also in the following year. The estimated effect varies with the approach and thresholds used, but poverty exhibits a much higher degree of state dependence than the incidence of CHE for all specifications.

The results for the impact of lagged poverty on a current incidence of CHE are mixed. For the normative spending approach, being poor in one year increases the risk of having CHE in the following year by around 1 percentage point. For the budget share approach, the effect of lagged poverty on CHE is insignificant for all but one of the thresholds.

Table 8. State dependence and feedback effects, poverty and CHE

	budget share approach							
th.	10%		15%		20%		25%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.325 ***	0.120	0.323 ***	0.117	0.319 ***	0.114	0.319 ***	0.113
CHE	0.142 ***	0.078	0.168 ***	0.083	0.277 ***	0.107	0.346 ***	0.116
CHE_{-1}	-0.035 ***	0.028	-0.029 ***	0.024	-0.034 ***	0.029	-0.034 ***	0.029
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	-0.022 ***	0.011	-0.006 *	0.004	0.000	0.000	0.002	0.002
CHE_{-1}	0.195 ***	0.055	0.150 ***	0.066	0.112 ***	0.064	0.080 ***	0.052
	normative spending approach							
th.	25%		30%		35%		40%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.303 ***	0.12	0.309 ***	0.118	0.311 ***	0.116	0.311 ***	0.115
CHE	0.211 ***	0.100	0.171 ***	0.087	0.164 ***	0.083	0.182 ***	0.087
CHE_{-1}	-0.02 ***	0.017	-0.015 **	0.012	-0.013 *	0.01	-0.013 *	0.011
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.030 ***	0.019	0.023 ***	0.017	0.025 ***	0.02	0.025 ***	0.022
CHE_{-1}	0.158 ***	0.068	0.155 ***	0.074	0.138 ***	0.077	0.117 ***	0.075

Notes: Authors' estimates based on the recursive bivariate probit models and the Polish HBS panel; AME expresses the average marginal effect of the change from 0 to 1; ***, **, *, and . denote parameter significance at the 0.1%, 1%, 5% and 10% levels, respectively.

Risk ratios and odds ratios In Table 9 we show the poverty risk ratios and odds ratios for a new incidence of CHE. For the normative spending approach and its most common threshold (i.e. 40%), the probability of relative poverty is 2.6 times higher for a household with a new incidence of CHE compared to a similar one without CHE. For this case, the odds ratio is 3.3. If we take the budget share approach with its most common threshold (15%), the estimated effects are of very similar

magnitude. In general, the risk ratios are between 2.3 and 3.8, and the odds ratios between 2.8 and 6.3 for all considered specifications.

Control variables In Table 10 we present the average marginal effects (AME) of the control variables from the poverty equation (Equation 1). The estimates are robust across different specifications and have intuitive signs. The poverty risk is highest for middle-aged and young households. Being in a relationship reduces the risk of poverty by around 3 percentage points. Each child increases the risk of poverty by 3.2-3.4 percentage points, and each non-working adult in the household by 3.7-3.8 percentage points. As expected, the risk of poverty is negatively associated with the number of working adults in a household, each reducing the risk of poverty by slightly less than 2 percentage points. Similar to previous studies, we also estimate a significant reduction in the risk of poverty (by more than 7 percentage points) for more educated households, i.e. those where households heads have an academic degree. These results confirm the well-known empirical finding that education and employment are correlated with a higher income status.

Living in a town reduces the risk of poverty by around 3.6 percentage points, while living in a village increases it by approximately the same magnitude. Being dependent on farming for income increases the risk of poverty by around 2 percentage points, while self-employment works in the opposite direction, lowering the risk of poverty by around 2 percentage points. Finally, the presence of a disabled person in a household and having a male household head turn out to be statistically insignificant.

Table 9. The causal impact of a new incidence of CHE on relative poverty

		budget share approach		
threshold	10%	15%	20%	25%
risk ratio	2.31 [1.82, 2.93]	2.45 [1.81, 3.16]	3.33 [2.61, 4.31]	3.84 [2.71, 4.98]
odds ratio	2.75 [2.10, 3.80]	3.02 [2.00, 4.41]	4.85 [3.14, 7.69]	6.34 [3.82, 10.34]
		normative spending approach		
threshold	25%	30%	35%	40%
risk ratio	3.03 [2.49, 3.62]	2.56 [2, 3.26]	2.45 [1.82, 3.04]	2.58 [1.88, 3.38]
odds ratio	3.96 [2.72, 5.37]	3.17 [2.47, 4.31]	3.00 [2.14, 4.25]	3.25 [2.28, 4.83]

Notes: Authors' estimates based on the recursive bivariate models and the Polish HBS panel; 95% confidence intervals are based on posterior simulations.

10. Poverty equation, AME of control variables

	budget share approach							
threshold	10%		15%		20%		25%	
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
HH age<35 and >24	0.025 *	0.018	0.025 *	0.018	0.026 *	0.019	0.026 *	0.019
HH age<45 and >34	0.022 .	0.016	0.023 *	0.016	0.023 *	0.017	0.024 *	0.017
HH age<55 and >44	0.028 *	0.020	0.029 *	0.021	0.029 **	0.021	0.03 **	0.021
HH age<65 and >54	0.019 .	0.014	0.021 .	0.015	0.022 *	0.017	0.023 *	0.017
HH age<75 and >64	0.000	0.000	0.004	0.003	0.007	0.005	0.009	0.007
HH age>74	0.016	0.012	0.021 .	0.015	0.022 .	0.016	0.003 *	0.021
HH is a male	0.000	0.000	-0.001	0.001	-0.001	0.001	-0.001	0.001
HH is in a relationship	-0.029 ***	0.022	-0.028 ***	0.021	-0.028 ***	0.021	-0.027 ***	0.020
HH has academic degree	-0.076 ***	0.065	-0.075 ***	0.065	-0.074 ***	0.066	-0.074 ***	0.065
Income from farming	0.02 ***	0.014	0.02 ***	0.015	0.02 ***	0.015	0.021 ***	0.015
Income from self-emp.	-0.019 ***	0.015	-0.02 ***	0.016	-0.02 ***	0.016	-0.02 ***	0.016
Lives in a town	-0.036 ***	0.030	-0.036 ***	0.030	-0.036 ***	0.031	-0.036 ***	0.030
Lives in a village	0.037 ***	0.027	0.036 ***	0.027	0.036 ***	0.027	0.036 ***	0.027
Disabled in household	0.002	0.002	0.003	0.002	0.003	0.002	0.004	0.003
Nb of working	-0.018 ***	0.121	-0.019 ***	0.124	-0.02 ***	0.126	-0.02 ***	0.127
Nb of not working	0.038 ***	0.156	0.038 ***	0.156	0.038 ***	0.157	0.038 ***	0.155
Nb of children	0.033 ***	0.151	0.033 ***	0.149	0.032 ***	0.148	0.032 ***	0.146
	normative spending approach							
threshold	25%		30%		35%		40%	
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
HH age<35 and >24	0.021 .	0.017	0.024 *	0.018	0.025 *	0.018	0.025 *	0.018
HH age<45 and >34	0.019 .	0.015	0.02 .	0.016	0.021 .	0.016	0.021 .	0.016
HH age<55 and >44	0.025 *	0.019	0.027 *	0.020	0.028 *	0.021	0.028 *	0.021
HH age<65 and >54	0.014	0.011	0.017	0.013	0.019 .	0.014	0.019 .	0.014
HH age<75 and >64	-0.010	0.008	-0.005	0.004	-0.001	0.001	0.001	0.001
HH age>74	-0.002	0.002	0.008	0.006	0.013	0.01	0.014	0.011
HH is a male	0.000	0.000	-0.001	0.001	-0.001	0.001	-0.002	0.001
HH is in a relationship	-0.028 ***	0.022	-0.03 ***	0.023	-0.029 ***	0.022	-0.029 ***	0.022
HH has academic degree	-0.071 ***	0.066	-0.072 ***	0.065	-0.072 ***	0.064	-0.072 ***	0.064
Income from farming	0.017 ***	0.013	0.018 ***	0.013	0.019 ***	0.014	0.018 ***	0.014
Income from self-emp.	-0.017 ***	0.015	-0.018 ***	0.015	-0.019 ***	0.015	-0.019 ***	0.016
Lives in a town	-0.034 ***	0.03	-0.035 ***	0.030	-0.035 ***	0.03	-0.035 ***	0.030
Lives in a village	0.034 ***	0.027	0.035 ***	0.027	0.035 ***	0.026	0.035 ***	0.026
Disabled in household	-0.001	0.001	0.000	0.000	0.001	0.001	0.002	0.001
No. of working	-0.016 ***	0.116	-0.017 ***	0.117	-0.017 ***	0.12	-0.018 ***	0.121
No. of not working	0.037 ***	0.16	0.037 ***	0.157	0.037 ***	0.156	0.038 ***	0.156
No. of children	0.033 ***	0.155	0.034 ***	0.153	0.033 ***	0.151	0.033 ***	0.150

Notes: Authors' estimates based on the recursive bivariate probit models and the Polish HBS panel; In the case of binary variables, AME expresses the average marginal effect of the change from 0 to 1, while, in the case of the remaining variables, it is a one-unit change, where a unit equals 1; ***, **, *, and . denote parameter significance at the 0.1%, 1%, 5% and 10% levels, respectively; Dummies for years and regions are included.

As a robustness check, we also estimate the models for different poverty cutoffs (i.e. 45% and 55% of mean consumption). The estimates obtained do not change our main findings (see the Appendix).

7 Concluding remarks

Using Polish micro-level data, we have shown that the causal effect of having CHE on the current risk of relative poverty is significant and positive across different methodological approaches. However, we have found no empirical evidence that a one-time incidence of CHE causes a poverty trap. Relative poverty exhibits a significantly higher degree of state dependence than CHE. Thus, it is much easier for a household to escape CHE than to escape poverty. Moreover, we show that the Polish official poverty statistics might not fully capture those impoverished due to CHE. As the elderly have the highest incidence of CHE, the share of households aged 70 and over in relative poverty might be underestimated by up to 2.5 percentage points by the Polish CSO.

The impact of large but still essential health-related expenditures on poverty can be even greater. This is because, in our analysis, we calculate CHE using actual household spending on health-related goods and services. However, such data do not contain information on whether a household simply decided on a relatively expensive choice or how urgent its medical need was. For instance, a person might not want to wait for a free appointment with a specialist, so she/he pays for a private visit. This option can be chosen only by those who can afford it. On the other hand, poorer households with limited resources might postpone health-related spending, even when urgent, resulting in unmet basic health care needs. Thus, household actual and basic health-related spending might not perfectly overlap, biasing the effect of CHE on poverty downwards.

Given our estimates and these additional arguments, OPM payments should probably receive more attention from policymakers than is suggested by the official statistics. Obviously, the key challenge is to correctly identify and appropriately support those who are most affected by CHE.

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Appendix

Table A1: Number of observations

panel	obs. no.
2010-2011	14,642
2011-2012	14,513
2012-2013	14,809
2016-2017	15,295
2017-2018	14,927

Table A2: Definitions of variables

Variable	Definition
POV	binary variable, takes one if a household is currently in OPM-free poverty
CHE	binary variable, takes one if a household currently has CHE
POV_{-1}	binary variable, takes one if a household was in OPM-free poverty in the previous year
CHE_{-1}	binary variable, takes one if a household had CHE in the previous year
HH age<35 and >24	binary variable, takes one if age of a household is between 25 and 34
HH age<45 and >34	binary variable, takes one if age of a household is between 35 and 44
HH age<55 and >44	binary variable, takes one if age of a household is between 45 and 54
HH age<65 and >54	binary variable, takes one if age of a household is between 55 and 64
HH age<75 and >64	binary variable, takes one if age of a household is between 65 and 74
HH age>74	binary variable, takes one if age of a household greater than 74
	baseline: age of a household is lower than 25
Disabled in household	binary variable, takes one if there is a disabled person in a household
No. of children	the number of children in a household
No. of working	the number of working adults in a household
No. of not working	the number of not working adults in a household
HH is a male	binary variable, takes one if a household head is a male
HH is in a relationship	binary variable, takes one if a household head is in a relationship
HH has an academic degree	binary variable, takes one if a household head has an academic degree
Income from farming	binary variable, takes one if a household's major source of income comes from farming
Income from self-emp.	binary variable, takes one if a household's major source of income comes from self-employment
Lives in a town	binary variable, takes one if a household lives in a town
Lives in a village	binary variable, takes one if a household lives in a village
Region1	binary variable, takes one if a household lives in the central region of Poland
Region2	binary variable, takes one if a household lives in the south region of Poland
Region3	binary variable, takes one if a household lives in the east region of Poland
Region4	binary variable, takes one if a household lives in the north-west region of Poland
Region5	binary variable, takes one if a household lives in the south-west region of Poland
	baseline: north region of Poland
Year11	binary variable, takes one if time t equals 2011
Year12	binary variable, takes one if time t equals 2012
Year13	binary variable, takes one if time t equals 2013
Year17	binary variable, takes one if time t equals 2017
	baseline: time t equals 2018

Table 3. Descriptive statistics of continuous/categorical variables

Variable	Mean	St. dev.
No. of children	1.12	0.99
No. of working	1.8	1.05
No. of not working	0.58	0.94

Table A4. Ratios for dummy variables

Variable	Ratio
HH age<35 and >24	0.12
HH age<45 and >34	0.18
HH age<55 and >44	0.2
HH age<65 and >54	0.23
HH age<75 and >64	0.15
HH age>74	0.1
HH is a male	0.62
HH is in a relationship	0.67
HH has an academic degree	0.2
Income from farming	0.05
Income from self-emp.	0.07
Lives in a town	0.11
Lives in a village	0.45
Disabled in household	0.21
Region1	0.22
Region2	0.2
Region3	0.18
Region4	0.15
Region5	0.1
Year11	0.2
Year12	0.2
Year13	0.2
Year17	0.21

Table A5. State dependence and feedback effects, poverty and CHE, poverty cutoff=0.45

	budget share approach							
threshold	10%		15%		20%		25%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.300 ***	0.127	0.296 ***	0.124	0.295 ***	0.121	0.295 ***	0.119
CHE	0.125 ***	0.079	0.173 ***	0.094	0.195 ***	0.098	0.237 ***	0.108
CHE_{-1}	-0.028***	0.027	-0.025 ***	0.025	-0.022 ***	0.022	-0.018 *	0.017
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	-0.02 ***	0.01	-0.005	0.004	0.001	0.001	0.001	0.001
CHE_{-1}	0.195 ***	0.055	0.150 ***	0.066	0.112 ***	0.064	0.081 ***	0.053
	normative spending approach							
threshold	25%		30%		35%		40%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.277 ***	0.125	0.282 ***	0.123	0.285 ***	0.12	0.286 ***	0.119
CHE	0.148 ***	0.089	0.12 ***	0.076	0.09 ***	0.061	0.082 **	0.056
CHE_{-1}	-0.011 **	0.011	-0.007	0.006	-0.001	0.001	0.004	0.003
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.033 ***	0.021	0.026 ***	0.018	0.028 ***	0.023	0.027 ***	0.024
CHE_{-1}	0.160 ***	0.069	0.156 ***	0.074	0.139 ***	0.077	0.119 ***	0.075

Notes: Authors' estimates based on the recursive bivariate probit models and the Polish HBS panel; AME expresses the average marginal effect of the change from 0 to 1; ***, **, *, and . denote parameter significance at the 0.1%, 1%, 5% and 10% levels, respectively.

Table 6. The causal impact of a new incidence of CHE on relative poverty, poverty cutoff=0.45

	budget share approach			
threshold	10%	15%	20%	25%
risk ratio	2.69 [2.00, 3.38]	3.2 [2.30, 4.08]	3.38 [2.08, 4.71]	3.82 [1.97, 5.77]
odds ratio	3.11 [2.18, 4.15]	3.94 [2.60, 5.48]	4.29 [2.31, 6.98]	5.15 [2.17, 10.19]
	normative spending approach			
threshold	25%	30%	35%	40%
risk ratio	3.08 [2.28, 3.88]	2.59 [1.85, 3.35]	2.14 [1.36, 3.01]	2.01 [1.16, 2.99]
odds ratio	3.67 [2.54, 4.93]	2.98 [2.00, 4.10]	2.37 [1.40, 3.59]	2.20 [1.18, 3.59]

Notes: Authors' estimates based on the recursive bivariate models and the Polish HBS panel; 95% confidence intervals are based on posterior simulations.

Table A7. State dependence and feedback effects, poverty and CHE, poverty cutoff=0.55

budget share approach								
threshold	10%		15%		20%		25%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.354 ***	0.109	0.354 ***	0.107	0.351 ***	0.105	0.350 ***	0.104
CHE	0.181 ***	0.08	0.197 ***	0.08	0.320 ***	0.101	0.433 ***	0.115
CHE_{-1}	-0.048 ***	0.033	-0.041 ***	0.029	-0.046 ***	0.034	-0.048 ***	0.035
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	-0.019 ***	0.009	-0.005	0.004	0.000	0.000	0.002	0.002
CHE_{-1}	0.195 ***	0.055	0.150 ***	0.066	0.112 ***	0.064	0.080 ***	0.052
normative spending approach								
threshold	25%		30%		35%		40%	
	poverty equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.334 ***	0.109	0.339 ***	0.108	0.344 ***	0.106	0.345 ***	0.105
CHE	0.281 ***	0.102	0.236 ***	0.091	0.213 ***	0.084	0.244 ***	0.089
CHE_{-1}	-0.034 ***	0.026	-0.024 ***	0.017	-0.021 **	0.015	-0.026 ***	0.018
	CHE equation							
	AME	s.e.	AME	s.e.	AME	s.e.	AME	s.e.
POV_{-1}	0.030 ***	0.019	0.023 ***	0.016	0.024 ***	0.02	0.022 ***	0.021
CHE_{-1}	0.154 ***	0.067	0.151 ***	0.073	0.135 ***	0.076	0.116 ***	0.074

Notes: Authors' estimates based on the recursive bivariate probit models and the Polish HBS panel; AME expresses the average marginal effect of the change from 0 to 1; ***, **, *, and . denote parameter significance at the 0.1%, 1%, 5% and 10% levels, respectively.

Table A8. The causal impact of a new incidence of CHE on relative poverty, poverty cutoff=0.55

budget share approach				
threshold	10%	15%	20%	25%
risk ratio	2.22 [1.81, 2.60]	2.24 [1.74, 2.69]	2.97 [2.35, 3.51]	3.62 [3.00, 4.08]
odds ratio	2.82 [2.13, 3.56]	2.93 [2.04, 3.92]	4.81 [3.19, 6.74]	7.53 [4.97, 10.54]
normative spending approach				
threshold	25%	30%	35%	40%
risk ratio	2.97 [2.48, 3.41]	2.58 [2.11, 2.99]	2.37 [1.86, 2.83]	2.55 [2.09, 2.94]
odds ratio	4.42 [3.32, 5.58]	3.57 [2.64, 4.55]	3.17 [2.22, 4.2]	3.58 [2.64, 4.59]

Notes: Authors' estimates based on the recursive bivariate models and the Polish HBS panel; 95% confidence intervals are based on posterior simulations.

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