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Diverging identification of the poor: A non-random process. Chile 1992–2017

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ABSTRACT

This paper investigates the degree of association in the identification of the poor between the standard monetary FGT poverty measure and the Alkire-Foster Multidimensional Poverty Index. For this purpose, we use a measure of redundancy in the identification of the poor between the two poverty measures (R^0). In Chile, over the past 25 years, R^0 has declined at a rate of 1.5% per year. The decline is unimportant during the 1990s, a decade of rapid economic growth, while it is notable thereafter, in a period characterized by modest economic growth and the progressive introduction and deepening of social policies. The conditional correlation between socio-economic and demographic characteristics with R^0 is examined at the province and household levels. After controlling for the household non-eligibility across some of the indicators of the multidimensional poverty index, we find that the divergence in the identification of the poor seems to be a real process which is not randomly distributed across the population. It is correlated with education improvements, increasing urbanization, and reduction in household size. On the basis of our results, we argue that this divergence may be a more general phenomenon that tends to occur in countries undergoing demographic transition, urbanization, and progress in education. If so, and given the fact that poverty alleviation strategies are adopted partly on the basis of poverty statistics, the diverging identification of the poor might have distributive consequences for the poor.

1. Introduction

The measurement of wellbeing and poverty have traditionally and prominently taken place in the utilitarian space.[1] In this space, poverty is defined as an insufficient level of consumption. Here, two types of poverty measurements have become widely available. On the one hand, the direct measurement of consumption levels, which is appealing as it is closely related to welfare or utility. It also has the advantage of being robust when changes in resources are transitory (see Hurd & Rohwedder, 2006; Mayer, 1993; Meyer & Sullivan, 2003; and Slesnick, 1993, 2001).[2] On the other hand, the lack of consumption data in many countries opened the space to income-based poverty measures, in which poverty is defined as the inability to dispose the income (resources) needed to reach a minimum level of consumption (Slesnick, 2001).[3]

Although the utilitarian view played and plays a key role in poverty measurement, it is subject to criticism. For instance, there is no convincing explanation of why all individuals need to have

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[1] Measures in the utilitarian space are a combination of welfarism, the principle of sum-ranking, and act consequentialism (Sen, 1979a). See Sen (2009) for an updated normative discussion on the space where poverty should be measured. See Baujard (2016) for a review of different utilitarian approaches to ethics and their influence in welfare economics.

[2] Hurd and Rohwedder (2006) find that households use wealth to smooth/sustain consumption when income decreases. Consequently, an income-based measure of wellbeing could yield misleading results for many households, especially those which consist only of elderly members. One of the main disadvantages of consumption-based measures is that they require substantial amounts of resources and survey time.

[3] There is evidence that different welfare distributions within the utilitarian space can produce significantly different patterns in the identification of the poor. For instance, in cross-sectional perspective, Meyer and Sullivan (2012) find a significant mismatch in the identification of the poor for the US when using two income-based poverty measures (the official poverty measure and the supplementary poverty measure). Noll and Weick (2007) find a similar mismatch in Germany.

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the same utility function. Moreover, fundamentally, what do we understand under 'utility' and what is the proper function of social welfare to use when assessing the social outcome (i.e. the average utility principle or the total utility principle; see Sen & Williams, 1982).[4] This question has also been posed by Sen (1993), under the capability framework, where he argues that: 'two persons with identical commodity holdings may have very unequal freedoms to lead the lives they value'.[5] Sen (1970), discussing the impossibility theorem put forward by Arrow (1951), also argues that it is impossible to give intrinsic value to utility, and, at the same time, to endorse certain liberal values. Nozick (1974) believes that humans are in fact hardly utilitarian as the mental state of happiness is not everything that is valued by people.[6] Moreover, considerations of agency, sympathy, and commitment imply that choices cannot be restricted exclusively to the value of commodity holdings (Ruggeri Laderchi, 1997).[7]

Although there is a wide recognition that poverty is a multidimensional phenomenon, unidimensional utilitarian measures can, in principle, account for the multidimensionality of poverty. In fact, income poverty represents a multidimensional concept in which the many dimension weights are based on relevant goods expenditures at the level of subsistence (Ravallion, 2011).

The mainstream income-poverty tradition turns out to be problematic, however, as resources are not a perfect proxy for inherently valuable states and activities (Sen, 1985, 1992, 1999). Markets often do not exist, or else they function imperfectly (Bourguignon & Chakravarty, 2003; Thorbecke, 2013). Additionally, there is the possibility that income is not broadly used in achieving a good quality of life (Atkinson, 1989; Townsend, 1979; Sen, 1983, 1984; Thorbecke, 2013; Hausman, 2011) or in expanding key capabilities (Ruggeri Laderchi, Saith, & Stewart, 2003; Sen, 1980). Consequently, the relationship between income and the ability to use it is crucial in developing countries, in which, at least for a portion of the population, having enough income does not guarantee the ability to purchase baskets of goods that are consistent with achieving a good quality of life (see Streeten, 1981).[8]

Given the aforementioned shortcomings of this approach, some alternative theoretical frameworks were developed emphasizing the plurality of values when assessing wellbeing (Baujard, 2016).[9] One of the most prominent alternative views is the capability approach, advocated by Sen (1985, 1992, 1999), which is based on the concepts of process freedom and opportunity freedom. This approach rejects the commodity space as the space in which freedom has to be judged (Sen, 1993).[10] Sen (1989) argues that the problem of assessing the quality of life consists in deciding which doings and beings (functionings) are valuable and also in evaluating the capability to function. Then, capability takes the form of a set of feasible n-tuples of functionings (Sen, 1985, 1992), and judgements about capability orderings take place in the multidimensional functioning space. In this context, poverty is ultimately a matter of capability deprivation (Drèze & Sen, 1999).[11]

Unlike the unidimensional approach to poverty measurement, multidimensional measures use joint deprivations across dimensions to determine the poverty status of the units. They do this by comparing deprivations across dimensions and seeking to respect the unit of measurement of each indicator. Venn diagrams, the dominance approach, statistical approaches, fuzzy sets, and the axiomatic approach are methods for measuring multidimensional poverty which are compatible with theoretical frameworks that consider a plurality of values when assessing wellbeing (see Alkire et al., 2015, for a detailed review of these multidimensional methods).

The most influential of the alternatives to the methods that adopt a social welfare function approach, focus on the counting of deprivations in the multiple dimensions of welfare. They have been particularly relevant to poverty alleviation policies and have been implemented in several contexts. Worth mentioning are UNICEF's Multiple Overlapping Deprivation Analysis for Children (MODA), based on child rights, and the Multidimensional Poverty Index (MPI).[12] Both methods build upon the capability approach and are estimated using the Alkire-Foster method (Alkire & Foster, 2011; De Neubourg, Chai, de Milliano, Plavgo, & Wei, 2012).

If different frameworks for poverty measurement (namely, the utilitarian and capability approaches and their associated measurement technologies) produce similar identification outcomes, then there would be no interest related to the empirical question on how to identify the poor. During the 1990s, researchers tended to overlook this issue, as influential literature claimed the existence of a close correlation between income achievements and non-income achievements (Anand & Ravallion, 1993; Pritchett & Summers, 1996; Anand & Bärninghausen, 2004). Such evidence motivated Devarajan, Miller, and Swanson (2002) to conclude that rising incomes would be enough to achieve the non-income Millennium Development Goals. The lack of an even closer correlation between income and non-income achievements drew attention to the provision of public services, income poverty and income inequality (Anand & Ravallion, 1993; Lipton & Ravallion, 1995; McGillivray, 2005).

Contrarily, and more recently, several studies have found that income poverty is in fact not strongly correlated with achieved functionings in key wellbeing indicators. For instance, Klasen (2000) found that, for the worst-off sections of society, there was only a weak correlation between expenditure poverty and a composite non-monetary deprivation index in South Africa. Whelan, Layte, and Maître (2004) showed that the level of poverty identification mismatch in Europe existed in both the cross-

[4] Moreover, the diversity of views regarding the concept of utility is important. One can favour the traditional view of utility (the 'hare's view'), with its emphasis on desires and their fulfilment, or the related choice-based understanding of utility by Harsanyi, or the interpretation by Mirrlees, who stated that utility directly describes wellbeing rather than a conception of it (Sen and Williams, 1982, p.64). On the other hand, there is the Benthamite utility conception, which relies on the concepts of pleasure and pain and is less acceptable now.

[5] In words of Sen (1993): 'A disabled person with the same commodity bundle may be just as rich as another, but still lack the capability to move about freely and to achieve other functionings that are affected by that disability.'

[6] Sen (1979b, 1980) claims that utilitarianism neglects any other values by reducing (social) wellbeing only to individual utility information (welfarism) representing a totally inadequate framework for analysing issues of distribution.

[7] Other critiques of utilitarianism were made by Yaari and Bar-Hillel (1984) showing that the assessment of income distributions is based on needs rather than tastes or beliefs, and more recently, Hausman (2011) claims that individuals may behave against their own interest, which is a contradiction under the utilitarian framework. In a review of the historical deployment of the utilitarian ideas, Baujard (2016) considers all versions of utilitarianism as fundamentally welfarist.

[8] For instance, the crowding out effect of non-basic-needs purchases on food, shelter, clothing, health, sanitation, clean water, education, transport, and cultural facilities.

[9] For instance, approaches based on the importance of primary goods (Rawls, 1971), basic needs (Hicks & Streeten, 1979; Streeten, Burki, Haq, Hicks, & Stewart, 1981; Stewart, 1985), social inclusion (Atkinson & Marlier, 2010), social protection (Barrientos, 2013), complex equality (Walzer, 1983), Ubuntu (Metz & Gaie, 2010), human rights (CONEVAL, 2010), livelihoods (Bowley & Burnett-Hurst, 1915), Buen Vivir (Hidalgo-Capitán, Guillén, & Deleg, 2014), and the Catholic social teaching (Curran, 2002).

[10] Following Drèze and Sen (2013, 43), the capability approach sees human progress, ultimately, as 'the progress of human freedom and capability to lead the kind of lives that people have reason to value'.

[11] The capability approach does not impose restrictions on the nature of utility functions and the functional form for their aggregation. It allows the existence of public goods and externalities and does not have any preconception about the transformation of resources into wellbeing.

[12] Since 2013, the MPI is the unique non-utilitarian poverty measure employed in Chile.

sectional and the longitudinal data structure. They suggested that (capability) deprivation was more affected by factors related to socioeconomic disadvantage, whereas income poverty was more influenced by the income stream but did not necessarily impact on living standards. Bourguignon et al. (2010) find no association between the alleviation of monetary poverty and a decrease in non-monetary deprivations, except for underweight (see Klasen, 2008). Wang, Feng, Xia, and Alkire (2016), using the 2011 China Health and Nutrition survey, show that about two out of three multidimensionally poor individuals are non-income poor. In a developed country setting, Suppa (2016) compares Germany's official income-based poverty measurement with a multidimensional poverty index and finds a significant poverty identification mismatch which is robust when stricter poverty lines are used. Alkire, Roche, and Vaz (2017) indirectly show at an aggregated level, that multidimensional and income poverty trends across sub-national regions and ethnic groups diverge for a group of 34 countries.

The current evidence on how the two different approaches identify the poor may have consequences for the design of poverty alleviation strategies as well as for their success. Addressing this issue, this paper makes three main contributions to the literature in this field. Firstly, it provides a 25-year analysis of the association between two mainstream poverty measures representing complementary views on poverty (the utilitarian and the capability views). The utilitarian approach bases its identification of the poor on the standard and officially recognized monetary poverty measure. The capability framework is usually applied using the Alkire-Foster method, and in this case, based on this method, we calculated a Historical Multidimensional Poverty Index (HMPI), to cover the 25 years between 1992 and 2017 in Chile. The Alkire-Foster MPI was selected to assess the poverty overlap due to its widespread use worldwide, as well as its advantages over other multidimensional poverty measures.[13] To the best of our knowledge, this paper presents the longest trend comparison of the identification outcomes reached by such alternative and relevant approaches. Our second contribution is to exploit this time variability to provide evidence about the nature of the identification mismatch between income poverty and multidimensional poverty, as well as its determinants, exploring the role of household composition and characteristics at different aggregation levels using panel data. Thirdly, following Dotter and Klasen (2014), the non-eligibility of certain parts of the population in a subset of indicators of the MPI can be an important empirical issue. To address this issue, we provide 25 years of novel evidence on the impact of the non-eligible populations on the identification discrepancy between the multidimensional and income-poverty measures.

The paper is organized as follows. The next section is devoted to presenting the data and analytical strategies for drawing up an HMPI for Chile for the period 1992–2017, and the poverty overlap measures. For the same period, Section 3 describes the trends in poverty, economic growth, social policy, poverty overlaps, and the shares of HMPI non-eligible populations. Section 4 outlines the results of our conditional analyses at the province and household levels. Finally, conclusions are presented in Section 5.

[13] The MPI produces a multidimensional single summary measure of poverty (as shown in the Stigliz Sen Fitoussi Commission Report – Stiglitz, Sen, & Fitoussi, 2009) and is based on the counting approach (as recommended by the Atkinson Commission Report, 2017, rec 19). In contrast to the multidimensional alternatives, this index identifies the poor and provides a single cardinal index to assess the degree of poverty in the population. The fuzzy sets and axiomatic methods are exceptions to this rule, but, to the best of our knowledge, there are no current poverty estimates for Chile calculated using these methods.

2. Data, analytical strategies for the income poverty, Historical Multidimensional Poverty Index (HMPI), and the poverty overlap measures

2.1. The data

This study employs data from all twelve waves of the Chilean household survey ('Encuesta Nacional de Caracterización Socio Económica' – CASEN) for the years 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009, 2011, 2013, 2015 and 2017. The twelve complex household surveys are representative at the country, regional and urban/rural levels of aggregation, covering the full population of the country, which was 13.5 million inhabitants in 1992 and 17.8 million inhabitants in 2017. All estimations in this study provide unbiased analytical standard errors that account for the complex survey design of CASEN household surveys.

2.2. Methodology to identify the monetarily poor

To determine severe income poverty and income poverty, CASEN household surveys reliy on a food poverty line and on a poverty line, respectively. Although the identification methodology underwent some changes in 1996 and 2013, for the empirical purposes of comparing the identification of the poor using the two approaches (income and multidimensional), we consider the official identification of the income-poor as given and as officially reported by the CASEN household surveys.[14]

2.3. Methodology to identify the multidimensionally poor

Following the Alkire-Foster method, a population of interest of n individuals $(i = \{1, \cdots, n\})$ is measured across d achievement indicators $(j = \{1, \cdots, d\})$. Each indicator j has a corresponding deprivation cutoff z_j. An individual is deprived in indicator j if his/her achievement in that indicator is below z_j (that is, $x_{ij} < z_j$). w_j is the weight of indicator j and the sum of the d indicators equal to one. The deprivation matrix $g^0 = [g^0_{ij}]$ defines each entry as equal to w_j if $x_{ij} < z_j$ and 0 otherwise. The method does not impose the restriction of equal weights across dimensions. Here, higher weights imply a greater relative value of dimensional deprivation. A deprivation score vector can be calculated for each person as $c_i = \sum_{j=1}^{d} g^0_{ij}$. This vector contains the sum of his/her weighted deprivations. The identification of the poor relies on a poverty cutoff denoted by k and on an identification function ρ_k. Then a multidimensionally poor individual has a deprivation score which is higher than k. That is, $\rho_k = 1$ if $c_i \geq k$ and $\rho_k = 0$ otherwise.

The MPI requires deprivations of those already identified as multidimensionally poor to be aggregated across dimensions, while neglecting the deprivations of those deemed non-poor (with $c_i < k$). The censored deprivation score vector $c_i(k)$ preserves the entries of c_i when $c_i > k$ and takes the values of zero for all individuals when $c_i < k$. The multiplication of each row in g^0 by the identification function ρ_k corresponds to the censored deprivation

[14] It is impossible to reverse the methodology changes in 1996 and 2013. Regarding the urban/rural definition, before 1996, all localities with more than 2000 inhabitants were considered urban. Thereafter, localities with 1000–2000 inhabitants were considered urban if at least 50% of the active population was employed in the secondary or tertiary economic sectors. Since 2013, the urban–rural divide has been disregarded when calculating the poverty line. From 1992 to 2011, the calorie intake threshold was set at 2176 Kcal in urban areas and 2236 Kcal in rural areas. Starting in 2013, the threshold was set at 2000 Kcal per person. Finally, the Orshanksy coefficient rose from 2 to 2.42, in 2013, the year in which the food basket was updated, economies of scale were introduced ($n^{0.7}$), and incomes were no longer adjusted to national accounts. Finally, there were more sources for imputing rental income (see CASEN, 2013).

matrix $g^0(k)$, in which all the entries of g^0 are made equal to zero for non-poor individuals. In the aggregation step, the MPI (or M_0) is obtained by the multiplication of the mean $g^0(k)$ and the number of deprivations d. Analytically, $M_0 = \mu(g^0(k))$ is the MPI, which is the mean of the censored deprivation matrix. Note that M_0 is also the multidimensional headcount ratio (H) adjusted by the deprivation intensity (A) suffered by the poor, or $M_0 = H \times A$ (see Alkire & Foster, 2011).

This counting methodology employs a dual cutoff approach to the identification of the poor. Firstly, it considers dimension-specific cutoffs (z), fulfilling the requirement of having deprivation cutoffs for each dimension of an individual's wellbeing (see Bourguignon & Chakravarty, 2003). Then, it aggregates to identify the poor on the basis of the count of weighted deprivations, given a poverty threshold (k). The aggregation step does not lose information on dimension-specific deficits. The dual cutoff approach is a general framework when identifying the poor, in which the intersection approach (deprivation in all dimensions, $k = d$) as well as the union approach (deprivation in any dimension $k = 1$) are special cases. One advantage of the MPI over the Multiple Overlapping Deprivation Analysis (MODA) is that it does not rely on the union approach and consequently it is more flexible when identifying the poor in a context of numerous dimensions. Moreover, and differently to MODA, MPI offers the possibility of breaking down the index by dimension (and by indicator within the dimensions). Additionally, the MPI allows subgroup's decomposition (using population shares as weights).[15] All these features allow the understanding of poverty patterns across population subgroups.[16]

Although the MPI has desirable features, it requires researchers to take the responsibility for their decisions regarding dimensions, weights and cutoffs (opening the door to misjudgements). Moreover, there are also some empirical issues related to its formulation. For instance, changes in the weighting scheme can produce significant changes in who is identified as poor (Cavapozzi, Han, & Miniaci, 2015). It also neglects inequality amongst the poor, while it unequally treats deprivations below the second threshold as substitutes, and above this threshold as complements (Rippin, 2012; Dotter & Klasen, 2014). The strict separation between identification and aggregation is less compelling than in the case of unidimensional poverty measurement as the deprivation counting of poor households can already be seen as a form of aggregation. In the same way, it is possible to see the identification process not as a dichotomy but as a question of degree (Rippin, 2012; Dotter & Klasen, 2014). While the dual cutoff approach does not rule out the possibility of potential trade-offs between deprivations (Ravallion, 2011, 2012), it has empirical advantages over the intersection and union approaches when the number of indicators is large. It can be fed with an unlimited number of indicators, thereby supporting a much broader definition of poverty, including culturally specific concepts of poverty, which also makes it less sensitive to misclassifications and mismeasurement (Dotter & Klasen, 2014).

[15] The subgroup's contribution to overall poverty can be calculated as the subgroup poverty level divided by the overall poverty level. Similarly, the percentage contribution of each dimension to total poverty corresponds to the weighted censored headcount ratio divided by the overall poverty level as the MPI is equal to the weighted average of the censored headcount ratios (the average of the mean of the columns of the censored deprivation matrix).

[16] For instance, Alkire and Seth (2011), in a cross-country comparison, show that while the Indian region of Madhya Pradesh and the Democratic Republic of the Congo share the same MPI (0.39), the dimensional contributions strongly differ between both populations. For instance, the contribution of nutrition to overall poverty in Madhya Pradesh reaches 21.6% while in the Democratic Republic of Congo it reaches only 7.2%.

2.4. A historical multidimensional poverty index for Chile 1992–2017

In the construction of an HMPI for 1992–2017, we adopt the same dimensions, dimension-specific cutoffs (z), weights (w), and poverty cutoff (k) that the Ministry of Social Planning (Ministerio de Desarrollo Social) used in its official estimation of the multidimensional poverty index in 2013. The advantage of this approach is that it makes achievements strictly comparable for the whole period 1992–2017 and thus, normative judgements about our Chilean HMPI can be avoided.[17] Contrarily, the disadvantage of doing this is that it reduces the amount of information necessary to create the achievement matrix X while reproducing the ineligibility problem across indicators (by directly assuming that a household outside the reference population in one indicator is non-deprived in that indicator).

The 2013 estimation of the Chilean MPI relies on the four dimensions of education, health, employment and social protection, and living standards. Each dimension consists of three indicators. The weights structure attaches equal importance to all dimensions, and within each dimension, it is assumed that each indicator is also equally important. Finally, the poverty cutoff was set at 0.25 implying that, if a household is deprived in 3 out of 12 indicators, their members are classified as multidimensionally poor.

Table 1 shows the structure of the index (including dimensions, definitions of deprivation by indicators, and weights as used here). It also includes the required definition departures of the indicator's definitions from the official 2013 MPI. This guarantees a time-consistent estimation of the HMPI for the period 1992–2017.

2.5. Measures of overlap between the income and multidimensional poverty approaches

To assess the matches and mismatches between the monetary and multidimensional approaches to the identification of the poor, we use a measure of association or redundancy dubbed overlap R^0 measure (see Alkire et al., 2015). The way this is calculated is illustrated in the two-way contingency table below (Table 2). Entries $\mathbb{P}^{jj'}_{00}$ and $\mathbb{P}^{jj'}_{11}$ show the percentages of people being classified simultaneously as non-poor and poor by both methods, respectively. $\mathbb{P}^{jj'}_{10}$ and $\mathbb{P}^{jj'}_{01}$ show the percentages of the population classified as monetarily poor but not multidimensionally poor and vice versa, respectively. The marginal distributions are $\mathbb{P}^{j}_{1+}$ for the monetarily poor, $\mathbb{P}^{j}_{0+}$ for the monetarily non-poor, $\mathbb{P}^{j'}_{+1}$ for the multidimensionally poor and $\mathbb{P}^{j'}_{+0}$ for the multidimensionally non-poor.

If poverty measures are not independent, and at least one of the headcount ratios is different from zero, this measure depicts the poverty identification matches as a proportion of the minimum of the marginal poverty rates.

$$R^0 = \frac{\mathbb{P}^{jj'}_{11}}{min[\mathbb{P}^{j'}_{+1}, \mathbb{P}^{j}_{1+}]} \tag{1}$$

R^0 takes values from zero to unity. For instance, if the monetary poverty headcount ratio is 10% and the multidimensional poverty headcount ratio is 22%, R^0 = 0.4 implies that 40% of the income poor population is simultaneously multidimensionally poor.[18]

[17] To assess the normative definitions is beyond the scope of this study, which is focused on the matches and mismatches in identifying the poor using two officially accepted and implemented estimation methodologies.

[18] An alternative interpretation of this overlap measure is that 60% of those who are income-poor are classified as non-multidimensionally poor.

Table 1
Historical Multidimensional Poverty Index (HMPI) for Chile 1992–2017: Dimensions, deprivation indicators, weights, and definition departures from the official 2013 MPI.

Dimensions	Deprivation indicators (People who live in households with the following characteristics)	Weights (%)
	Education	25
Children's school attendance	Households where there is at least one child or adolescent aged 4– 18 not attending school and who has not yet graduated (after completing 12 years of schooling). **Departure from the 2013 indicator definition:** The information regarding school absence for an extended period (permanent absence) for those aged 4–26, was excluded because of a lack of information in this variable across the 1992, 1994, 1996, 1998, 2000, 2003 CASEN waves.	25/3
Schooling gap	Households where there is at least one person aged 21 or below in primary/secondary education who is at least two years below his/her corresponding school level. **There is no departure from the original 2013 MPI definition.**	25/3
Adult schooling achievement	Households where there is at least one person whose level of education falls below the legal minimum for their cohort. These are as follows: those born between 1920 and 1929: 4 years of schooling; between 1930 and 1965: 6 years of schooling; and between 1966 and 2002: 8 years of schooling. From 2003 onwards, the legal minimum was 12 years of schooling. **There is no departure from the original 2013 MPI definition.**	25/3
	Health	25
Nutrition	Households where there is at least one child aged 0–5 who is undernourished, at risk of undernourishment or obese. **Departure from the 2013 indicator definition:** in 1992, 1994, 1996, 1998, 2000, 2003, and 2006, the key variable refers to children aged 0–5, while in the rest of the surveys, it refers to children aged 0–6. Thus, children aged 0–5 are the common denominator.	25/3
Insurance	Households where there is at least one person who does not have any health insurance, either public or private (including complementary insurance). **Departure from the 2013 indicator definition:** the information on complementary health insurance is excluded because in 1992, 1994, 1996, 1998, 2000, 2003, 2006, 2009, CASEN does not provide such information.	25/3
Access	Households where there is at least one woman aged 21 or above who has not completed a pap test during the past 3 years. **Departure from the 2013 indicator definition:** the original 2013 definition considers households to be deprived if there is at least one household member who suffered a health problem in the last 3 months and did not receive treatment, or if in the last 12 months he/she has been receiving health treatment but this has not been covered by the health system's warranty (AUGE-GES). This complex definition is impossible to reproduce, as the relevant programmes were created in 2005 and the recall time has changed continually since 2000. The solution was to select the pap test indicator for this dimension, as it can be consistently estimated from 1992 to 2017.	25/3
	Employment and social protection	**25**
Employment	Households with at least one member aged 18 or above being unemployed and not attending school. **There is no departure from the original 2013 MPI definition.**	25/3
Pension system contribution	Households with at least one working member aged 15 or above who is not contributing to the pension system and has not had any tertiary education. **There is no departure from the original 2013 MPI definition.**	25/3
Pension or retirement income	Households with at least one female member aged 60 or above, or a male member aged 65 or above, who is not receiving a pension or any retirement income. **There is no departure from the original 2013 MPI definition.**	25/3
	Living standards	**25**
Overcrowding	Households in which the average number of household members sharing a room is higher than 2.5. **There is no departure from the original 2013 MPI definition.**	25/3
Housing materials	A house whose floor, roof, or walls in bad shape, or the house is made of unsound materials. **There is no departure from the original 2013 MPI definition.**	25/3
Basic services: drinking water and sewage waste	A house without interior piped water supply (urban areas) or access to safe water supply (rural areas), or lacking a WC or septic tank (rural and urban areas). **There is no departure from the original 2013 MPI definition.**	25/3

Source: Ministry of Social Planning, Chile.

Table 2
Two-way contingency table for monetary and multidimensional poverty.

		Multidimensional poverty (j′)		
		Non-poor	Poor	Total
Monetary poverty (j)	Non-poor	$\mathbb{P}_{00}^{jj'}$	$\mathbb{P}_{01}^{jj'}$	$\mathbb{P}_{0+}^{j}$
	Poor	$\mathbb{P}_{10}^{jj'}$	$\mathbb{P}_{11}^{jj'}$	$\mathbb{P}_{1+}^{j}$
	Total	$\mathbb{P}_{+0}^{j'}$	$\mathbb{P}_{+1}^{j'}$	**1**

Source: Alkire et al. (2015).

Independently of which method provides a smaller poverty headcount, R^0 values close to the unity (zero) implies high degree of coincidence (discrepancy) in the identification of the poor.

3. Trends in poverty, economic growth and social policies. Poverty overlap trends, and HMPI household non-eligibility

3.1. Poverty trends

In Chile, poverty reduction took place in a favourable macroeconomic context. Fig. 1 depicts the headcount poverty trends in Chile over the period 1992–2017. The poverty trends calculated using our HMPI tally with the official MPI estimates for the period in which both multidimensional indices are available (2013–17).[19] The stagnation of the multidimensional poverty headcount between 2015 and 2017 drew public attention, owing to the fact that in the same period, income poverty showed an impressive reduction from 11.7% to 8.6%. Such strong divergence in terms of poverty headcounts influenced the public debate as it was not clear how to interpret such dynamics or what index should be considered for the purposes of social planning.[20] Contributing to the disorientation in how to interpret these numbers, both poverty measures are officially published by the government on the same day.

Fig. 2 shows how the shares of the population have fared according to their income and multidimensional poverty status. The share of population, which is unambiguously non-poor increased steadily after 1992 and even faster after 2011. By contrast, the share of population classified as unambiguously poor decreased steadily over the same period but at a declining rate.

[19] At the country level, multidimensional poverty declined between 2013 and 2015 and stagnated between 2015 and 2017.

[20] See 'The 'Politicization of the CASEN survey', by Ignacia Fernández, Executive Director of the Latin American Center for Rural Development (Rismip), https://www.elmostrador.cl/noticias/opinion/2018/08/23/la-politizacion-de-la-casen/.

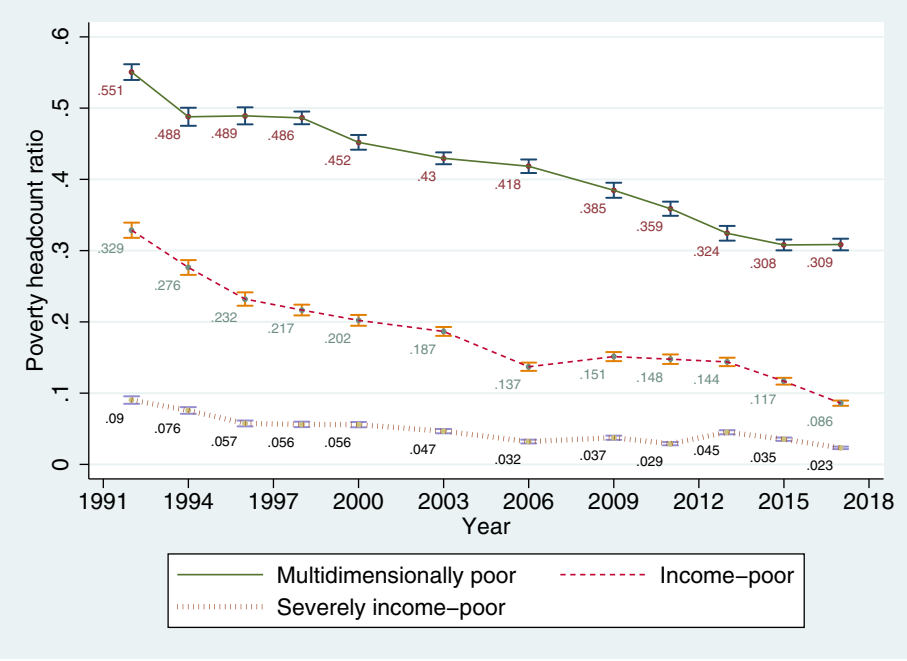

Fig. 1. Poverty Headcount Ratios, Chile, 1992–2017. Note: 95% confidence intervals. Source: Own elaboration based on CASEN household surveys.

Interestingly, the share of population whose poverty status is ambiguous seems to follow more stable trends, with a combined reduction of about ten percentage points over the whole 1992–2017 period.

3.2. Economic growth and social policies in Chile

Since the return of democracy in the early 1990s, the Chilean economy has experienced the longest period of economic growth ever. According to World Bank data, annual economic growth averaged 4.6% during the whole period 1992–2017. During the subperiods 1992–2000, 2000–09, and 2009–17, annual economic growth averaged 5.5%, 4.2%, and 3.0%, respectively (see Table 3 below). According to Ffrench-Davis (2018), the export-led period 1990–2007 was characterized by low inflation rates and the progressive liberalisation of capital and exchange markets. This macroeconomic set-up allowed the export of goods to grow at annual rates of 9.6%, 6.4% during the periods 1990–98 and 1999–2007, respectively. Differently, after the 2008 Global Economic Crisis, the export of goods grew at a modest annual rate of 0.5%. Ffrench-Davis (2018) argues that these dynamics were the consequence of changes in the macroeconomic environment (exchange terms and commodity prices) rather than of structural macroeconomic changes of the economy.

Along with 1992–2017 macroeconomic stability, social policies underwent significant transformations starting in the early 2000s. Based on the Esping-Andersen's (1990, 1999) welfare regime approach, the welfare regime shifted from 'conservative/informal' to 'liberal/informal' because its continued reliance on market provision (with weak job protection) together with the progressive introduction of social assistance (see Barrientos, 2009, 2011, 2014). In 2002, The *Chile Solidario*, a comprehensive anti-poverty program, was introduced. This program has three main components. (i) The Family Support component aimed to identify and overcome the adverse circumstances that retain households in poverty, (ii) the preferential access to social services and programs in health, education and housing conditions, and (iii) subsidies to increase household income, some of them being conditional to the fulfilment of children's education and health goals (see Larrañaga, Contreras, & Cabezas, 2015 for a detailed description of this program). In the same vein, an individualistic unemployment insurance program was introduced in 2002 which was successively reformed to incorporate solidaristic components (Ewig & Kay, 2011; Ramos & Acero, 2015). In the same year, a plan for universal access with explicit guarantees in health (AUGE) was introduced (see Ewig & Kay, 2011 for details about this program). These and other reforms introduced during the 2000s we accompanied by a progressive increase in public expenditure on education (Contreras & Ffrench-Davis, 2014).

Although the mentioned programs do not represent an exhaustive list of the changing social policy paradigm, they are enough to characterize the emergence of new forms of social assistance (conditional income transfer programmes, social pensions, public works, integrated anti-poverty programmes) that complemented the role of the labour market in providing welfare protection (Barrientos, 2009). The shift originated from the disappointing results of the Washington consensus policies (Cornia, 2014; Roberts, 2014). It is important to point out that the changes in social policy are not restricted to Chile, but a it is a more general trend, under all types of political regimes, particularly in many middle-income countries.

The mix of impressive but declining economic growth rates over the period 1992–2017 together with the deepening and broadening social policies started in the early 2000s can explain the strong poverty reduction over the same period as shown in Fig. 1. This piece of evidence is compatible with the common finding on the macroeconomic level that there is poverty reduction through growth and redistribution policies (Belke & Wernet, 2015). However, the rates of economic growth are heterogeneously associated to the poverty reduction following the different measures employed in this study. To investigate this issue, Table 3 shows the dissimilar rates of change in HMPI, income poverty and severe income poverty and their interactions with economic growth for the sub-periods 1992–2000, 2000–09, and 2009–17.

Over the whole period, the average growth elasticity of monetary poverty is about two times higher than the growth elasticity

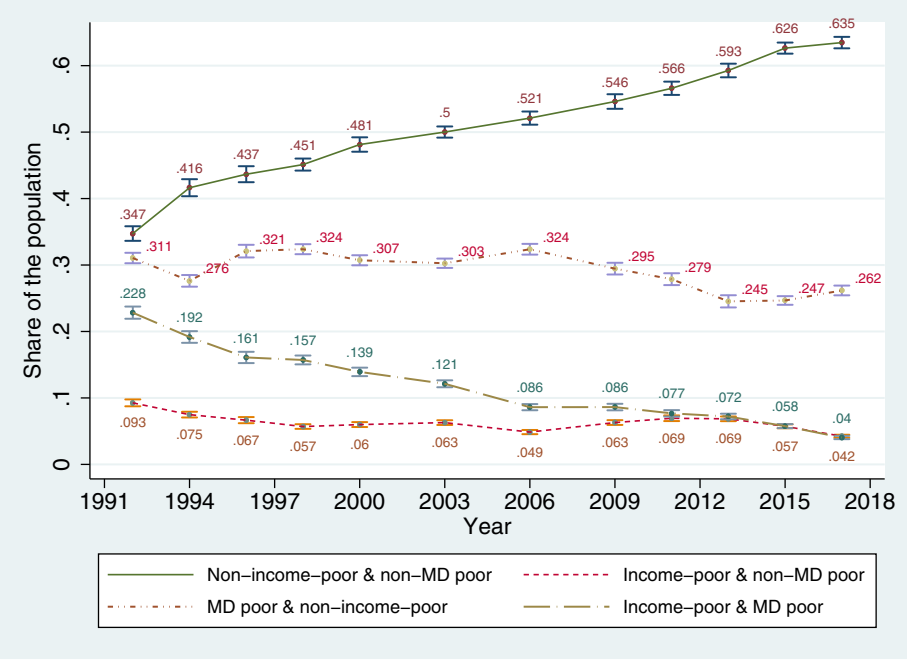

Fig. 2. Two-way poverty classification trends, Chile, 1992–2017. Note: 95% confidence intervals. MD = multidimensionally. Source: Own elaboration based on CASEN household surveys.

Table 3
Economic Growth and Poverty Changes by Subperiods, Chile, 1992–2017.

Economic Growth and Poverty Indices	Subperiods		
	1992–2000	2000–2009	2009–2017
Average GDP Growth	5.5	4.2	3.0
	Average Annual Relative Change in Poverty		
HMPI	−2.40	−1.96	−2.72
Income Poverty	−5.86	−3.06	−5.56
Severe Income Poverty	−5.70	−3.71	−3.37
	Average Annual Growth Elasticity to Poverty		
HMPI	−0.44	−0.47	−0.91
Income Poverty	−1.06	−0.73	−1.87
Severe Income Poverty	−1.04	−0.88	−1.13
	Average Annual Absolute Change in Poverty (in percentage points)		
HMPI	−1.23	−0.75	−0.95
Income Poverty	−1.58	−0.57	−0.82
Severe Income Poverty	−0.43	−0.22	−0.13
	Average Annual Absolute Change in Poverty for 1% in GDP Growth		
HMPI	−0.22	−0.18	−0.32
Income Poverty	−0.29	−0.13	−0.27
Severe Income Poverty	−0.08	−0.05	−0.04

Source: Own elaboration based on CASEN household surveys and World Bank data.

of multidimensional poverty. There are also significant differences between the subperiods. In absolute terms, the period 2000–2009 exhibits greater reduction in multidimensional poverty along with economic growth. This can be the result of economic growth rates above population growth rates together with the deepening and broadening of social policies, as mentioned earlier. These social policies will also likely affect the degree of overlap between monetary and multidimensional poverty. Prior to the enactment of these social policies, progress in multidimensional poverty is linked mostly to rising incomes, likely leading to a greater overlap between monetary and multidimensional poverty. After the introduction of these social policies, progress in multidimensional poverty is more related to these social policies, likely reducing the overlap. So, we expect the overlap to fall over time, which we now investigate in more detail.

3.3. Household characteristics and demographics and the two-way poverty status

Table 4 presents summary information on the household characteristics and demographics of those households classified as poor, both ambiguously (either monetarily or multidimensionally) and unambiguously. For the four cohorts presented in Table 4, a greater gap in mean characteristics and demographics is observed amongst the income-poor households, depending on their multidimensional poverty status. The socio-demographic gaps between the two groups of multidimensionally poor households (the income-poor and the non-income-poor) are less pronounced. In other words, amongst the same group of (ambiguously and unambiguously poor) households, there is a higher unconditional correlation between multidimensional poverty and disadvantaging household characteristics and demographics. Then, as expected, the multidimensional poverty approach seems to identify households with a priori more adverse non-income circumstances. This finding is highly relevant for the design of poverty alleviation policies, as it shows that targeting programmes solely at income-poor households can leave behind the worst-off families while inadvertently focusing on the less deprived ones.

3.4. Poverty overlap: multidimensional and income poverty

While informative, the dynamics in Fig. 2, do not say anything about whether those households identified as poor or non-poor by each method are the same ones or not. To investigate this, Fig. 3 shows the trends of the overlap R^0 measures (multidimensional poverty against income and severe income poverty).[21]

[21] Table 1.A presents also the values of the Carmer' V coefficient. Using this alternative measure, the poverty overlap trends remain very similar.

Table 4
Characteristics of households according to their poverty classification, Chile: 1992, 2000, 2009, and 2017.

Household characteristics and demographics	Multidimensionally poor								Income-poor and multidimensionally non-poor			
	Income-poor				Income non-poor							
	Mean	Lin. Std. Err.	[95% Conf. Interval]		Mean	Lin. Std. Err.	[95% Conf. Interval]		Mean	Lin. Std. Err.	[95% Conf. Interval]	
1992												
Household size	5.73	0.05	5.64	5.83	5.09	0.04	5.01	5.16	4.60	0.05	4.51	4.69
Adults' education (avg. years)	7.15	0.05	7.06	7.24	7.89	0.05	7.80	7.99	9.62	0.06	9.50	9.74
Years of education of the household head	6.15	0.06	6.03	6.26	6.65	0.07	6.52	6.78	9.23	0.09	9.06	9.40
HH head is single	0.20	0.01	0.19	0.22	0.23	0.01	0.22	0.24	0.18	0.01	0.16	0.20
HH head is female	0.18	0.01	0.17	0.20	0.19	0.01	0.18	0.20	0.16	0.01	0.14	0.17
HH head is elderly	0.17	0.01	0.16	0.18	0.31	0.01	0.30	0.33	0.08	0.01	0.07	0.09
2000												
Household size	5.86	0.05	5.76	5.97	5.09	0.03	5.02	5.16	4.69	0.05	4.59	4.78
Adults' education (avg. years)	7.65	0.05	7.56	7.74	8.45	0.04	8.36	8.54	9.79	0.07	9.66	9.93
Years of education of the household head	6.56	0.07	6.43	6.69	7.11	0.06	6.99	7.23	9.32	0.10	9.12	9.52
HH head is single	0.22	0.01	0.21	0.24	0.23	0.01	0.22	0.25	0.17	0.01	0.15	0.19
HH head is female	0.24	0.01	0.22	0.26	0.22	0.01	0.21	0.23	0.18	0.01	0.16	0.20
HH head is elderly	0.16	0.01	0.14	0.17	0.33	0.01	0.32	0.35	0.06	0.01	0.05	0.07
2009												
Household size	5.54	0.08	5.38	5.70	4.93	0.03	4.87	5.00	4.31	0.05	4.22	4.40
Adults' education (avg. years)	8.30	0.06	8.19	8.41	8.95	0.05	8.85	9.05	10.15	0.07	10.02	10.29
Years of education of the household head	7.01	0.09	6.84	7.19	7.70	0.08	7.55	7.86	9.69	0.09	9.51	9.86
HH head is single	0.34	0.01	0.31	0.36	0.28	0.01	0.27	0.29	0.39	0.01	0.36	0.41
HH head is female	0.39	0.01	0.36	0.41	0.31	0.01	0.30	0.32	0.40	0.01	0.38	0.43
HH head is elderly	0.25	0.01	0.23	0.27	0.38	0.01	0.36	0.39	0.15	0.01	0.14	0.17
2017												
Household size	4.61	0.06	4.49	4.73	4.56	0.03	4.50	4.63	3.84	0.04	3.77	3.91
Adults' education (avg. years)	8.67	0.07	8.53	8.81	9.58	0.04	9.50	9.66	10.74	0.07	10.61	10.88
Years of education of the household head	7.73	0.11	7.51	7.94	8.47	0.06	8.35	8.59	10.31	0.09	10.13	10.48
HH head is single	0.37	0.01	0.35	0.40	0.32	0.01	0.31	0.33	0.46	0.01	0.43	0.49
HH head is female	0.46	0.01	0.43	0.49	0.41	0.01	0.40	0.43	0.52	0.01	0.50	0.54
HH head is elderly	0.24	0.01	0.22	0.26	0.44	0.01	0.43	0.45	0.14	0.01	0.13	0.15

Note: HH = household. Source: Own elaboration based on CASEN household surveys.

The 1990s decade is characterized by high rates of market-driven economic growth and the implementation of deep liberal macroeconomic reforms.[22] In this decade, the level of association between the two poverty identification methods remained almost unchanged. From 2000 onwards, a period characterized by slower economic growth but accompanied by more comprehensive social policies, the overlap declined, as hypothesized, unambiguously and independently of the considered poverty measure.[23]

As the monetary poverty headcount ratio is strictly smaller than the multidimensional poverty headcount ratio over the whole period 1992–2017, the overlap R^0 measure represents the percentage of those monetarily poor people who are at the same time multidimensionally poor. From 1992 to 2000, the poverty overlap remains unchanged at the same level around 70%. It implies that about 30% of those deemed monetarily poor were not multidimensionally poor.[24]

The story dramatically changes during the 2000s as already in 2009, the same redundancy measures reached 58% (monetary and multidimensional poverty) and 61% (severe monetary and multidimensional poverty), respectively. The overlap reduction continued until 2017 year in which only about 49% of both, the income, and the severe income poor were simultaneously identified as multidimensionally poor.

To address the concern that the poverty overlap trends in Fig. 3 can be affected by compositional changes within the population identified as income-poor, we raise the income poverty line to match the monetary poverty headcount ratio to the multidimensional poverty headcount ratio. We do this in Table 5, dividing the whole period in three sub-periods, namely 1992–2000, 2000–09 and 2009–17.[25] While the overlap levels are somewhat different, the declining poverty overlap trend holds.

Table 6 shows the annualized relative rate of change of the overlap R^0 measure for a set of population subgroups based on household composition and its spatial distribution.[26] We find that the declining association of the poverty identification measures happens in all population subgroups for the whole period 1992–2017, being more pronounced from 2000 onwards. Although some heterogeneity is observed during the 1990s, the evidence supports the idea that the declining poverty overlap is a general dynamic, with speeds of reduction varying somewhat across population subgroups.

3.5. Multidimensional poverty and non-eligible households

A significant empirical concern relates to the fact that the poverty overlap can be affected by the presence of non-eligible households within some HMPI indicators (see Dotter & Klasen, 2014).

[22] Such a promising dynamic was interrupted by the 1997 Asian financial crisis (See Ffrench-Davis, 2018, Reinhart & Rogoff, 2009).

[23] See Ffrench-Davis (2018), Ramos and Acero (2015), AFC (2016), MINSAL (2003), and Arenas (2010) for analyses related to the reforms in the health and pension systems, labour markets and other economic reforms.

[24] The same dynamic is true for the overlap between multidimensional poverty and severe income poverty, at a level of about 80%.

[25] Such partition is arbitrary but consistent with the observed overlap trends as well as with the structural changes happened to the Chilean economy over the past 25 years (see Ffrench-Davis, 2018). Table 2.A show the same information for the overlap R^0 measure between severe income poverty and MD Poverty.

[26] Currently, the country is divided into 16 regions. However, to maintain the time comparability, we based the whole study on the 13 administrative regions that existed in 1992. The population subgroups under consideration are the zone (urban/rural), the 13 old administrative regions, whether the household head is elderly, the size of the household, and the education profile of the adult household members.

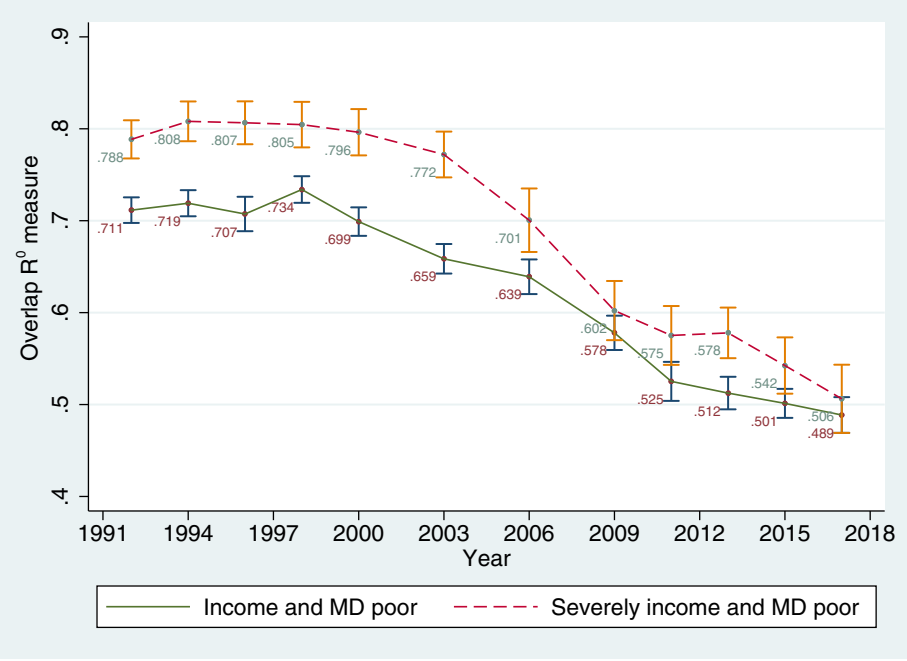

Fig. 3. Overlap R^0 trends, Chile, 1992–2017. Note: 95% confidence intervals. MD = multidimensionally. Source: Own elaboration based on CASEN household surveys.

Table 5
Poverty overlap trends and annualized rates of growth, Chile, 1992–2017.

	Overlap R^0 measure (standard errors in parenthesis)				Annualized rate of growth		
Year/Period	1992	2000	2009	2017	1992–2000	2000–09	2009–17
Overlap R^0, MD and income poverty	0.711 (0.0071)	0.699 (0.0079)	0.578 (0.0095)	0.489 (0.0099)	−0.213%	−2.328%***	−2.112%***
Overlap R^0, MD and severe income poverty	0.788 (0.0106)	0.796 (0.0129)	0.602 (0.0164)	0.506 (0.0189)	0.126%	−3.056%***	−2.148%***
Overlap R^0, MD and adjusted income poverty	0.673 (0.0060)	0.623 (0.0061)	0.518 (0.0067)	0.439 (0.0058)	−0.960%***	−2.030%***	−2.047%***

Note: *** Significance at 1% level; MD = multidimensionally. Source: Own calculations based on CASEN household surveys.

The official MPI is built upon 12 indicators and, in 8 of them, there are households which are by default treated as non-deprived because they have no eligible members. Table 7 shows that the household non-eligibility across HMPI indicators varies according to changes in the demographic structure of the population. For instance, the non-eligible population in the nutrition indicator, that is the proportion of households without children aged 0–5, increases from 49.8% in 1992 to 71.3% in 2017. Consequently, the likelihood of classifying a random household as deprived in this dimension has decreased sharply over the past 25 years. Thus, changes in the nutrition indicator not only convey information on improved nutrition but also on the increasing non-eligibility in this indicator.[27]

A second related issue is that the non-eligibility can happen in many indicators simultaneously. For example, households with no members aged 18 or below are by default classified as non-deprived in the school attendance, schooling gap and nutrition indicators. The eligibility problem gets even worse for households that additionally have no elderly members, as they are non-deprived in one-third of the indicators. In fact, the median household is ineligible in two out of twelve indicators, and the population share which is ineligible in three or more indicators has increased steadily since 2000. Surprisingly, only a modest 3% to 4% of the population is fully eligible. Consequently, our empirical analysis needs to control for the fact that the declining poverty overlap may reflect demographic changes rather than a genuine diverging poverty identification process.

To assess the degree to which this measurement constraint affects the overlapping trend between the poverty measures, we calculate the overlap R^0 measure for the same type of non-eligible household according to its demographic composition. Fig. 4 shows overlap R^0 measures between income and multidimensional poverty for households without children aged five or under (top left), households without children aged 6–18 (top right), households without women aged 21 or above (bottom left), and households without elderly people (bottom right).[28] 95% confidence intervals show that the declining overlap between multidimensional and income poverty follows almost the same pattern in households with different sources of non-eligibility. That is, the overlap measure remains stable during the 1990s and early 2000s, and then it decreases sharply.

[27] An inverse demographic shift affects the non-eligibility in the indicator of pension benefit. As the population gets older, a higher proportion of eligible households are expected. In the mid-1990s about 75% of the population lived in ineligible households for this indicator. The figure reached almost 65% in 2017.

[28] Figs. 1.A and 2.A show the overlap trends between severe income poverty and multidimensional poverty according to the source and depth of non-eligibility, respectively.

Table 6
Annualized relative rate of change in overlap R^0 measure between income-poor and multidimensionally poor households, Chile, 1992–2017.

Aggregation level	Whole period 1992–2017	Washington consensus period 1992–2000	Period of slowing growth and the introduction of social policies 2000–09	Period of slow growth and more comprehensive social policies 2009–17
Country level	−1.49	−0.21	−2.09	−2.07
			Geographic location	
Urban areas	−1.68	−0.22	−1.93	−2.84
Rural areas	−1.39	−0.02	−1.77	−2.32
Region I	0.27	3.38	−3.28	1.29
Region II	−1.36	−0.80	−0.17	−3.22
Region III	−0.42	−0.15	−0.63	−0.44
Region IV	−1.86	−1.01	−1.65	−2.95
Region V	−1.25	1.09	−1.78	−2.95
Region VI	−2.33	−0.36	−3.07	−3.44
Region VII	−2.18	−1.09	−4.06	−1.13
Region VIII	−2.53	−1.60	−2.17	−3.85
Region IX	−0.88	−0.15	−2.06	−0.28
Region X	−1.57	−0.65	−0.70	−3.45
Region XI	−0.69	−1.03	−2.04	1.21
Region XII	−1.17	0.50	0.22	−4.33
Region XIII (metropolitan)	−1.10	0.31	−2.05	−1.42
			Household type	
HH head is not elderly	−1.63	−0.25	−2.29	−2.24
HH head is elderly	−1.21	0.23	−2.41	−1.28
One-person HH	−1.69	0.89	−7.49	2.58
Two-person HH	−1.62	0.60	−5.22	0.32
HH consists of three or more people	−1.38	−0.25	−1.82	−2.00
			Average education amongst adult household members	
Less than 8 years	−0.78	−0.21	−1.14	−0.92
8 years or more	−1.13	0.57	−1.80	−2.05

Note: HH = household. Source: Own elaboration based on CASEN household surveys.

Table 7
Share of non-eligible population by indicator and accumulated indicator non-eligibility, Chile, 1992–2017 (%).

		Year											
	HMPI indicator	1992	1994	1996	1998	2000	2003	2006	2009	2011	2013	2015	2017
Share of population not eligible, by indicator	Children's school attendance	44.5	28.2	26.8	26.8	26.6	28.2	29.8	34.4	37.4	39.4	40.9	44.9
	Schooling gap	48.7	39.7	36.6	36.1	35.3	35.7	37.7	41.7	45.3	47.3	48.3	51.7
	Adult schooling achievement	2.33	0.06	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.02	0.02
	Nutrition	49.8	55.9	57.0	58.5	60.0	63.0	65.3	67.3	66.8	67.6	68.4	71.3
	Health insurance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Access to healthcare	17.5	3.3	2.6	2.8	2.8	2.9	3.0	3.5	3.6	3.9	4.0	4.5
	Employment	24.8	6.6	5.8	5.9	6.1	6.1	6.3	8.1	8.6	8.8	8.6	9.1
	Pension system contribution	27.3	8.6	7.6	9.5	9.8	9.1	8.2	10.8	10.6	10.7	10.7	11.4
	Pension or retirement income	42.6	75.4	75.4	75.9	75.2	75.0	71.3	69.2	68.6	68.4	67.2	65.4
	Overcrowding	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Housing materials	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Basic services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Share of population not eligible (N is the number of indicators)	N = 0	3.7	3.9	3.9	3.7	3.8	3.4	4.0	3.6	3.3	3.5	3.4	3.2
	N = 1	29.5	28.2	29.9	29.0	28.6	27.7	27.4	25.0	24.1	23.0	23.0	20.5
	N = 2	35.6	35.7	36.0	36.4	36.6	37.2	35.5	33.1	31.7	30.6	29.8	28.5
	N = 3	16.6	17.0	16.3	15.9	16.0	15.4	16.1	18.0	19.5	19.7	20.2	21.7
	N = 4	9.9	10.0	9.4	10.1	9.8	10.9	11.4	12.8	13.5	14.5	14.8	16.2
	N = 5+	4.7	5.2	4.5	5.0	5.2	5.4	5.6	7.4	7.9	8.7	8.9	9.9

Source: Own elaboration based on CASEN household surveys.

The second way of addressing this issue consists of depicting the poverty overlap trends according to the number of indicators in which households are non-eligible (depth of non-eligibility). Fig. 5 shows the poverty overlap trends for mutually exclusive households, from fully eligible households (top left) to those which are non-eligible in five or more indicators (bottom right).

A visual inspection shows the same pattern for the periods 1992–2000, and 2000 onwards. Fully eligible households follow the same pattern even though, due to their reduced population share, 95% confidence intervals are quite large. However, the difference in the overlap R^0 measure between 1992 and 2017 is statistically significant at the 2% level, and between 2009 and 2017 it is statistically significant at the 3% level.[29]

[29] P-values are based on two-sample one-sided t test with unequal variances.

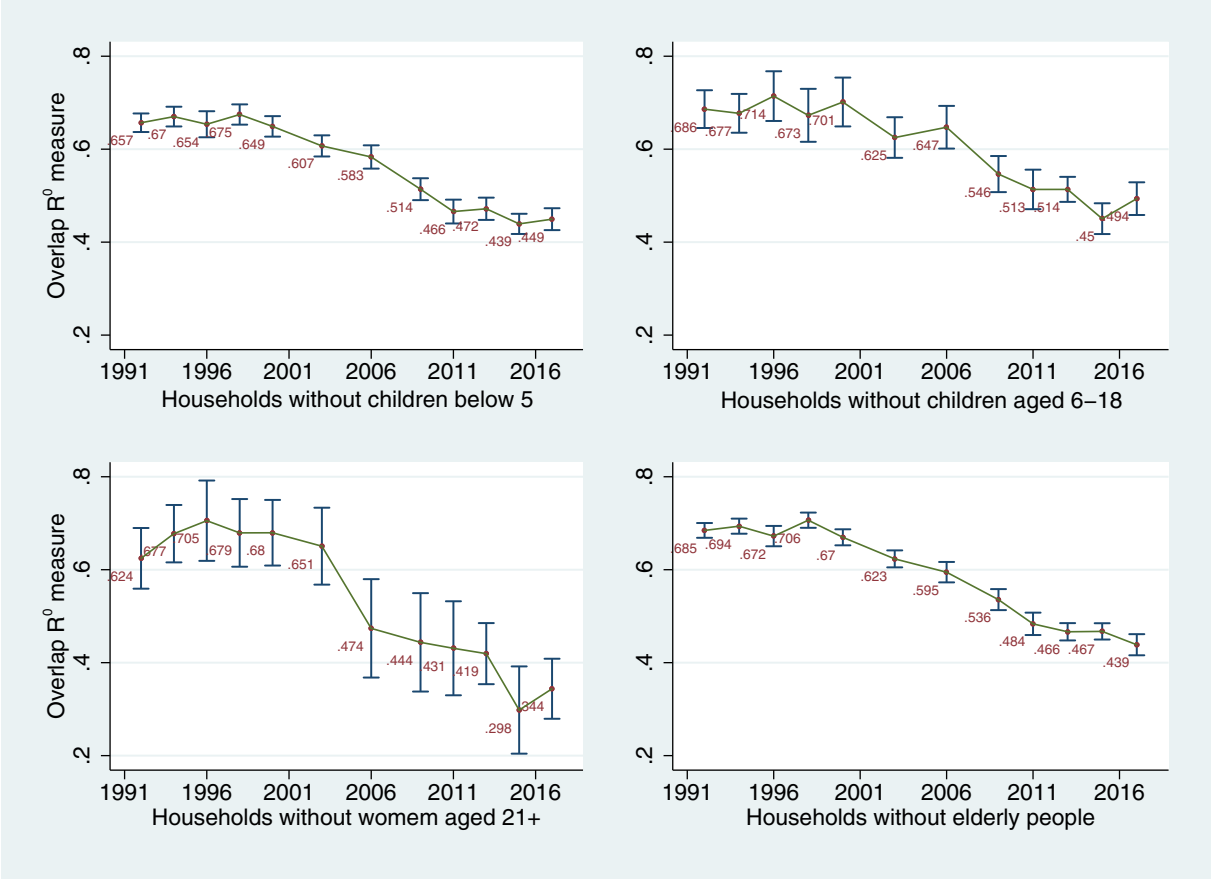

Fig. 4. Multidimensional and income-poverty overlap R^0 trends for groups of non-eligible households, Chile, 1992-2017. Note: 95% confidence intervals. Source: Own elaboration based on CASEN household surveys.

4. Determinants of the poverty overlap

4.1. Two-way fixed-effect regression of poverty overlap on education, demographic variables, and type and depth of the non-eligibility at the province level

In this section, we employ a two-way fixed-effect regression at the province level to detect the factors associated with the observed variability of the overlap R^0 measure.[30] As explanatory variables, we considered province proportions or province averages in household characteristics, household composition, rurality, and non-eligibility.[31] Household characteristics are represented by the years of education of the head of household. The demographic variables are the proportion of one-person households, the proportion of adults in the households, the proportion of female-headed households and the mean household size. Rurality is measured by the proportion of population living in rural households. The non-eligibility profile of the household is controlled by indicators capturing by the proportion of households with a demographic profile that makes them non-eligible in different indicators (quality of non-eligibility) and by the average number of indicators in which provincial households are non-eligible (depth of non-eligibility). We also include macroeconomic controls (unemployment rate, share of agricultural employment, and mean household income), and, in line with the fundamental export decline after the 2008 Global Financial Crisis, we include interactions of the post crisis periods with the explanatory variables of interest.[32]

The results in Table 8 show that all considered variables are correlated with the unconditional poverty overlap variation across provinces. However, conditional models (9) and (10) show that only the education of the household head, rurality and household size are significantly associated to the overlap level. The higher the education of the household head, the lower the poverty overlap. This is expected, as education should be positively correlated with other functionings, while the correlation with income seems

[30] We used the Durbin–Wu–Hausman test to investigate whether there is correlation between the unique errors and the regressors in the model. The result of this specification test show that there is correlation between the errors and the regressors resulting in biased coefficients (Prob>chi2 = 0.0326). Consequently, we reject the null hypothesis that the difference in coefficients is not systematic. This result supports our prior decision to estimate a fixed effect model which provides consistent estimates of the associations.

[31] The province-level variables correspond to population-weighted means.

[32] Using a Chow test, we tested for a structural break starting in 2009 due to the effects of the 2008 Global Financial Crisis (GFC). We first regressed the model with dummies pre and post 2008 GFC and all their (pre and post) interactions with the variables of our previously preferred model. Then, we test for equality of the coefficients of dummies and slopes jointly with previously tested hypotheses. The test yields an F-statistic F (13, 42) = 3.22; Prob > F = 0.0020. This evidence confirms that there is a structural break at 1% level of significance in 2009. Alternatively, we tested for a structural break without knowing the year of a potential structural break. We take advantage of the -contrast- Stata postestimation command to investigate this issue taking as reference the year of 1992. The procedure reveals a structural break in 2009. Finally, we apply a test for the joint significance of all post 2008 GFC interactions, and we find that they are jointly significant. The result is a F-statistic F (11, 42) = 3.55; Prob > F = 0.0014.

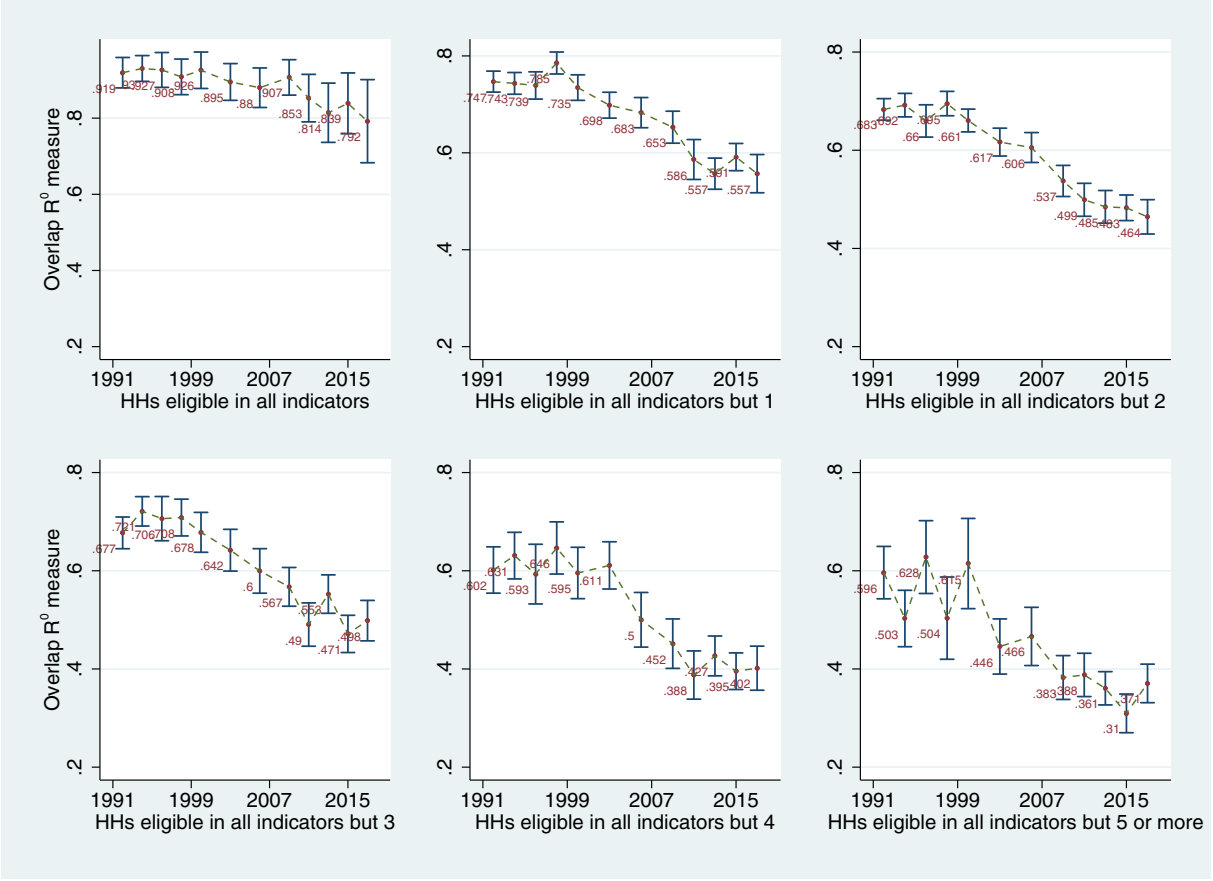

Fig. 5. Multidimensional and income-poverty overlap R^0 trends by depth of non-eligibility, Chile, 1992-2017. Note: 95% confidence intervals. Source: Own elaboration based on CASEN household surveys.

weaker. Moreover, it is directly included as an indicator in the MPI. By contrast, rurality seems to be more associated to the generation of lower incomes and to a reduced functionings achievement. This being a consequence of the relative incompleteness of markets and relative under provision of public goods in rural areas. Thus, income poverty and multidimensional poverty are more likely to go hand-in-hand there. Similar evidence is also found in Klasen (2000) for South Africa during the 1990s (see also Lipton, 1978; van de Walle & Nead, 1995).

We confirm the positive linkage between demographics and poverty (Lipton, 1983; Klasen, 2000; Merrick, 2002). The idea that larger families are on average poorer and less able to invest in education, as well as being less capable of functioning, is confirmed at this aggregation level. Following Libois and Somville (2018), the complex relationship between fertility and household size can explain the non-significant coefficient of the proportion of adults in the households, as higher birth rates are associated with larger household sizes.

None of the non-eligibility indicators appear to be significant. By contrasting the estimated coefficients with those in the robustness specification in the third column in Table 6.A in the appendix, we see, however, that to neglect the non-eligibility issue produces an upward bias in the coefficient of household size.

Interestingly, the mean provincial per capita household income is not correlated with the overlap after controlling for household education, rurality and household size. At this level of aggregation, the level of income seems to be uncorrelated with the proportion of income poor households that are simultaneously multidimensionally poor. Contrarily, and as expected, the unemployment rate is positively associated to the overlap level.[33]

Comparing the models estimated based on alternative poverty overlap definitions, we confirm that this redundancy measure depends on the level of poverty identified by both methods as they can capture different household mixtures. However, when using the severe poverty line, the condition of rurality is still associated to higher overlap levels.[34]

In Chile, the rise in the number of small households, the fall in the share of the rural population, and the increase in the level of education of heads, are the factors that can account for a large share of the decline in the overlap over time. The unsaturated model (i.e. the model with these three variables) has an adjusted R-squared of 0.66.[35] One might expect that the diverging identification of the poor is likely to occur in more countries for two reasons. First, due to the fact that in developing countries, the fall in fertility rates has reduced household sizes nearly everywhere (UN, 2017).

[33] The same is found when using overlap association measures defined over a narrow group of households. That is, between severe income poverty and multidimensional poverty (Table 3.A) and between the adjusted income poverty and the multidimensional poverty (Table 4.A). Table 5.A shows that neither unemployment nor household income are significantly associated to the poverty overlap between income poverty and the adjusted multidimensional poverty headcount (by decreasing the poverty cutoff k).

[34] This finding is also robust to the exclusion of time dummies and non-eligibility controls reported in robustness Appendix Table 6.A.

[35] See Figs. 3.A and 4.A in the appendix for the evolution of the population share living in rural areas and the shares of population living in households of different sizes.

Table 8
Two-way fixed-effect regression of poverty overlap on education and demographic variables at the province level.

Explanatory variable/model	Overlap R^0 measure: Income poverty and multidimensional poverty									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Education of head of household (years)	−0.102***								−0.0237*	−0.0302**
	(0.00537)								(0.0135)	(0.0147)
One-person household		−5.389***							0.968	0.931
		(0.518)							(0.579)	(0.582)
Proportion of adults in the household			−2.152***						−0.294	−0.332
			(0.125)						(0.573)	(0.568)
Household size				0.245***					0.0886**	0.0835**
				(0.0123)					(0.0400)	(0.0411)
Single-female-headed household					−1.716***				0.0768	0.0856
					(0.131)				(0.236)	(0.240)
Rural household						0.847***			0.199**	0.217**
						(0.0839)			(0.0957)	(0.105)
Depth of non-eligibility (%)							−1.215		−0.578	−0.758
							(0.845)		(0.877)	(0.923)
HH without children aged 5 or below (%)							0.196		0.108	0.156
							(0.130)		(0.198)	(0.196)
HH without children aged 6–18 (%)							1.105***		−0.0685	−0.130
							(0.307)		(0.453)	(0.456)
HH without elderly people (%)							0.419**		0.235	0.203
							(0.159)		(0.167)	(0.170)
HH without women aged 21+ (%)							−2.049**		−0.0279	−0.0985
							(0.762)		(0.766)	(0.766)
Share of employment in the agricultural sector								0.784**		−0.104
								(0.312)		(0.328)
Log of per capita household income								−0.158***		0.0371
								(0.0139)		(0.0333)
Unemployment rate								1.724**		1.107**
								(0.660)		(0.431)
Constant	1.510***	0.822***	2.113***	−0.472***	0.947***	0.435***	1.897**	2.370***	0.689	0.518
	(0.0468)	(0.0194)	(0.0864)	(0.0549)	(0.0249)	(0.0184)	(0.896)	(0.176)	(1.024)	(1.141)
Time dummies and Post GFC interactions	–	–	–	–	–	–	–	–	Yes	Yes
F-test (model)	21.15	9.335	18.94	20.86	13.55	5.580	19.35	17.38	21.85	22.20
DF	43	43	43	43	43	43	47	45	71	74
R-squared	0.609	0.401	0.602	0.617	0.504	0.268	0.622	0.604	0.718	0.721
SSM (model)	5.543	3.650	5.481	5.612	4.585	2.439	5.656	5.496	6.533	6.558
SSE (error/residual)	3.557	5.450	3.619	3.488	4.516	6.661	3.444	3.605	2.567	2.543
Root MSE (SEE)	0.0832	0.103	0.0839	0.0824	0.0937	0.114	0.0822	0.0839	0.0727	0.0726
Effect Test	8.104	4.193	5.168	6.476	3.740	2.911	4.510	4.413	3.668	3.091
Number of Observations	516	516	516	516	516	516	516	516	516	516

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. HH = household. GFC = 2008 Global Financial Crisis. Source: Own elaboration based on CASEN household surveys.

This, together with ongoing rural–urban migration processes (IOM, 2015) that can be reinforced by climate shocks (Nawrotski et al., 2017). Second, because in many middle-income countries the expansion of education, and the provision of public goods and social support policies in rural areas are likely to occur due to the argued shift in public policies.

4.2. Poverty overlap at the household level

Given the poverty headcounts in Chile over the past 25 years, the overlap R^0 measure corresponds to the proportion of income-poor households that are simultaneously multidimensionally poor. This definition allows us to investigate the probability that an income-poor household is simultaneously multidimensionally poor. We do this by means of a logit probability model for the 1992, 2000, 2009 and 2017 cohorts (see Table 7.A in the appendix). Besides household characteristics and composition, the logit model controls for province fixed effects, the type and depth of the household non-eligibility and the income level of the household. Table 9 shows the marginal effects at the mean characteristics.

We find that income-poor households are less likely to be multidimensionally poor if they have a higher stock of education, if they consist of a single person, and if they have higher income levels. However, the correlation between the level of household income and the poverty overlap is unimportant. For instance, doubling the income level of a household is associated with a reduction in the probability of its occupants being multidimensionally poor of 4.99%, 8.78%, 3.17%, and 4.25% in 1992, 2000, 2009, and 2017, respectively.[36] On the other hand, rural and larger households are more likely to also be multidimensionally poor. On average, an income-poor household located in a rural location is about 15 to 20% more likely to be multidimensionally poor than an income-poor household in an urban area with the same income level.[37]

Our results show a reduction in the rural bias since the early 2000s which is significant at the 1% level between 2000 and 2017. This positive trend can be explained by better-functioning and export-oriented agriculture, as well as the introduction of public policies devoted to improving the quality of life in areas that lag behind (see IFAD, 2016).[38] Finally, as expected, the non-eligibility of households across indicators does affect the probability of income-poor households of being simultaneously multidimensionally poor.

[36] As the income variable is expressed in natural logarithms, the probability changes at the mean characteristics were calculated by multiplying the reported marginal effect by 100 and dividing it by 171.8282.

[37] Access to markets, public services, and improved education can account for a large part of this gap. For instance, Jensen, Yang, and Muñoz (2012) show that a child living in a rural area in Chile is more likely to work than her urban counterparts (probably a manifestation of reduced job opportunities in rural areas).

[38] IFAD (2016) provides a comprehensive socioeconomic characterization of rural areas since the 1990s in Latin America.

Table 9
Marginal effects (at means) after complex survey logit estimation.

Variable|Year	Overlap at the Household Level $-\delta y/\delta x$							
	1992		2000		2009		2017	
Avg. years of education of adults in the HH	−0.0799***	−0.0855***	−0.0800***	−0.0807***	−0.0777***	−0.0741***	−0.0662***	−0.0588***
	(0.00440)	(0.00447)	(0.00570)	(0.00556)	(0.00441)	(0.00440)	(0.00413)	(0.00511)
One-person household	−0.276***	−0.337***	−0.212**	−0.236***	−0.208***	−0.211***	−0.0785*	−0.0665*
	(0.0772)	(0.0622)	(0.0866)	(0.0581)	(0.0477)	(0.0441)	(0.0457)	(0.0399)
HH head is elderly	0.0188	0.0314	−0.0419	−0.0297	−0.0264	−0.0189	−0.0697*	−0.0552
	(0.0430)	(0.0469)	(0.0456)	(0.0451)	(0.0426)	(0.0419)	(0.0396)	(0.0348)
HH head is female	0.0458**	0.0474**	0.111***	0.123***	0.0431**	0.0382*	−0.00144	−4.53e-05
	(0.0198)	(0.0220)	(0.0237)	(0.0259)	(0.0211)	(0.0212)	(0.0225)	(0.0201)
Household size	0.0779***	0.0809***	0.0879***	0.0874***	0.105***	0.101***	0.0835***	0.0691***
	(0.00762)	(0.00806)	(0.00869)	(0.00939)	(0.0101)	(0.0103)	(0.0100)	(0.0106)
Rural household	0.188***	0.190***	0.237***	0.228***	0.211***	0.192***	0.156***	0.146***
	(0.0195)	(0.0233)	(0.0162)	(0.0231)	(0.0227)	(0.0252)	(0.0245)	(0.0246)
Number of indicators in which the HH is non-eligible	0.0183	0.0101	0.00170	−0.0160	−0.0544***	−0.0606***	−0.0418***	−0.0430***
	(0.0117)	(0.0132)	(0.0140)	(0.0145)	(0.0121)	(0.0124)	(0.0138)	(0.0126)
HH without children aged 5 or below	0.137***	0.136***	0.0823***	0.0789***	0.0427*	0.0366	0.0773***	0.0655***
	(0.0169)	(0.0184)	(0.0226)	(0.0229)	(0.0233)	(0.0234)	(0.0250)	(0.0232)
HH without children aged 5–18	−0.0669	−0.0894*	−0.0935**	−0.130***	−0.237***	−0.245***	−0.206***	−0.199***
	(0.0412)	(0.0462)	(0.0410)	(0.0459)	(0.0406)	(0.0421)	(0.0387)	(0.0380)
HH without elderly people	0.0936**	0.103**	0.163***	0.182***	0.0803*	0.0786*	0.175***	0.158***
	(0.0379)	(0.0423)	(0.0405)	(0.0465)	(0.0438)	(0.0440)	(0.0432)	(0.0412)
HH without women aged 21+	−0.0348	−0.0558	−0.153***	−0.192***	−0.0904	−0.0854	0.0339	0.0256
	(0.0426)	(0.0456)	(0.0440)	(0.0575)	(0.0615)	(0.0641)	(0.0556)	(0.0486)
Log of the household income		−0.0859***		−0.151***		−0.0546***	–	−0.0731***
		(0.0224)		(0.0188)		(0.0163)	–	(0.0232)
Province Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations (Households)	35,939		64,925		70,748		70,666	
Population size	13,330,843		14,959,739		16,375,919		17,737,520	
Sub Population Observations	10,655		13,429		9,934		5,719	
Sub Population Size	4,258,759		2,993,033		2,474,368		1,472,235	
F	16.67	16.79	13.99	14.29	28.99	16.24	9.54	9.56
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Adjusted Wald Test (Model)	1.558	1.602	1.472	0.823	1.630	0.866	0.402	0.514
Goodness-of-fit test [a]	0.122	0.111	0.152	0.595	0.107	0.555	0.935	0.865

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. [a] We report the F-adjusted mean residual test following Archer and Lemeshow (2006) running the -svylogitgof- command after -svy:logit- in Stata 15.1. The goodness-of-fit tests indicate good fit in all specifications. HH = household. Source: Own elaboration based on CASEN household surveys.

5. Conclusion

In this paper, we have focused on the consequences of using different approaches to define and measure poverty. We have explored at different levels of aggregation the degree of association in the identification of the poor between the utilitarian approach and the capability approach (implemented using the standard monetary FGT measure and the Alkire-Foster method, respectively). We have empirically addressed the issue of non-eligibility of households across indicators of the MPI, aiming to understand the factors behind the poverty overlap divergence in Chile during the past 25 years. To the best of our knowledge, this is the longest trend comparison of identification outcomes brought about by such different and highly relevant approaches.

We find that the overlap between the identification of the poor following the multidimensional and monetary measures, ordinary and severe, have declined over the past 25 years at a rate of about 1.5% and 1.75% respectively per year. While the overlap decline was almost non-existent during the 1990s, a decade of rapid economic growth, it was remarkably pronounced during the period 2000–17, a period which was characterized by lower economic growth and the introduction and deepening of social policies. The decline in the level of association between the two poverty measures is robust in alternative overlap definitions, but it is still affected by the non-eligibility of households across some MPI indicators.

Two sets of estimates were produced to investigate the correlation between socioeconomic characteristics, household composition, and location, and the observed poverty association measure. The first set of estimates was based on a province-level panel fixed-effect model, and the second was obtained using different cross-sections to study the association of the poverty measures at the household level by means of a logit model. We have shown that in both estimates, the household non-eligibility across indicators of the HMPI is a relevant empirical issue, as it has the potential to bias the true underlying impacts on the poverty overlap figures.

The strong empirical result of this research is that the level of household education, the rural location of a household and the household size are correlated with the degree in which both poverty measures identify the same poor population.

Income poor household with higher education levels may have better access to public services and social programs, particularly since the 2000s, in health, education and housing, allowing them to achieve key functionings, and thus having a lower probability of being multidimensionally poor, despite insufficient levels of income.

Rurality is positively associated to the level of association between poverty measures. The lack of agglomeration in rural areas generates on the one hand a relative deficit in the provision of public services and less generous social programs, and, on the other hand, it constraints the access to markets. Consequently, income poor households are in a relative disadvantage in achieving key functionings and therefore, income and multidimensional poverty are more likely to go hand-in-hand there.

We find that the demographic component is also relevant in explaining the diverging identification of the poor since larger households find it relatively more difficult to improve their functionings.

The key conclusion of this study is that the poverty overlap decline is a real process, in which the misidentification of the poor is not randomly distributed across the population. Therefore, an understanding of this divergence is crucial, as poverty alleviation initiatives are partially based on poverty statistics. The fact that household education, household size, and a rural location are behind the observed divergence in Chile over the past 25 years, raises the question of how general this process is. On the basis of our results, we argue that this could be happening in more countries. In many developing countries, demographic transitions leading to the reduction of the household size and rural–urban migration are ongoing processes, while in many middle-income countries, the expansion of education, and the provision of public goods in rural areas are likely to occur due to the argued shift in public policies.

Declarations of interest

None.

CRediT authorship contribution statement

Stephan Klasen: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing - review & editing, Supervision. **Carlos Villalobos:** Conceptualization, Methodology, Software, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing, Visualization.

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Appendix

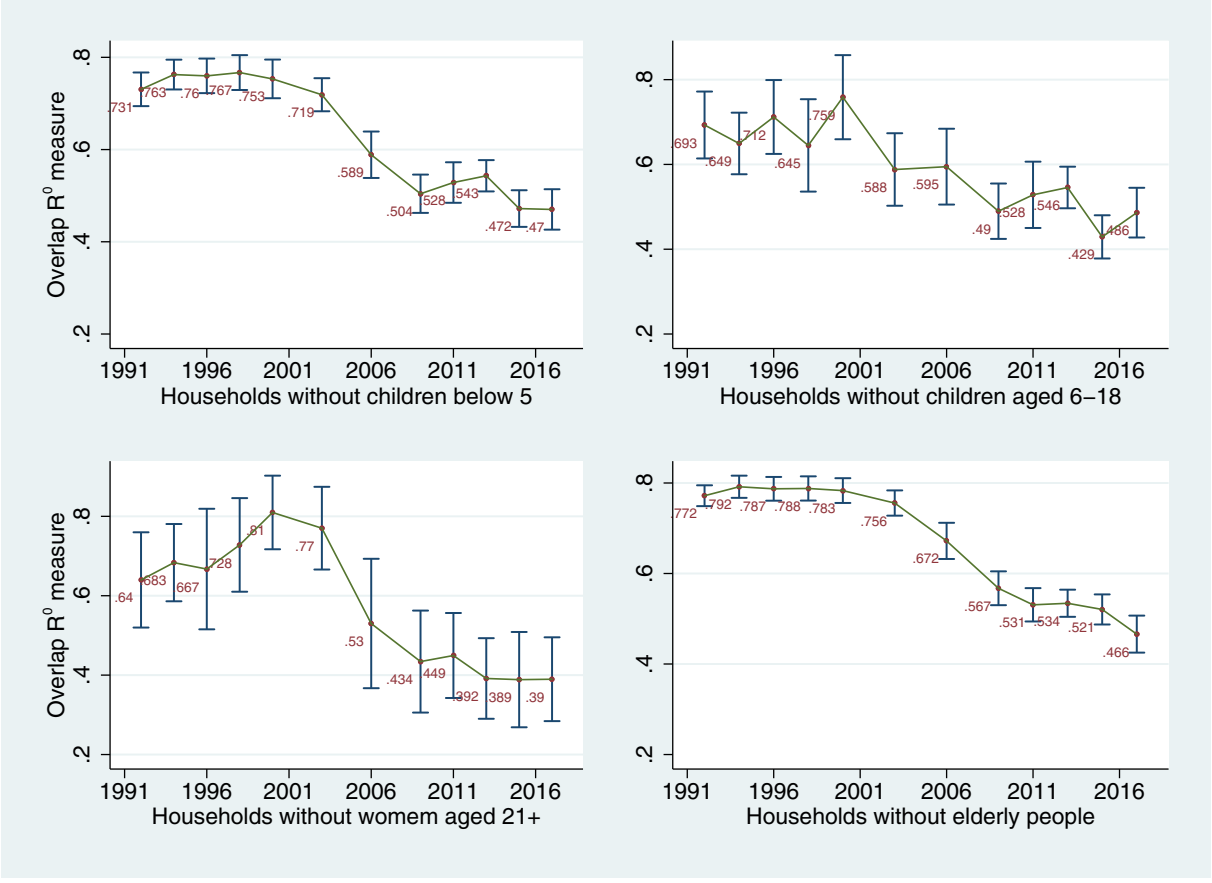

Fig. 1.A. Multidimensional and severe income-poverty overlap R^0 trends for groups of non-eligible households, Chile, 1992-2017. Note: 95% confidence intervals. Source: Own elaboration based on CASEN household surveys.

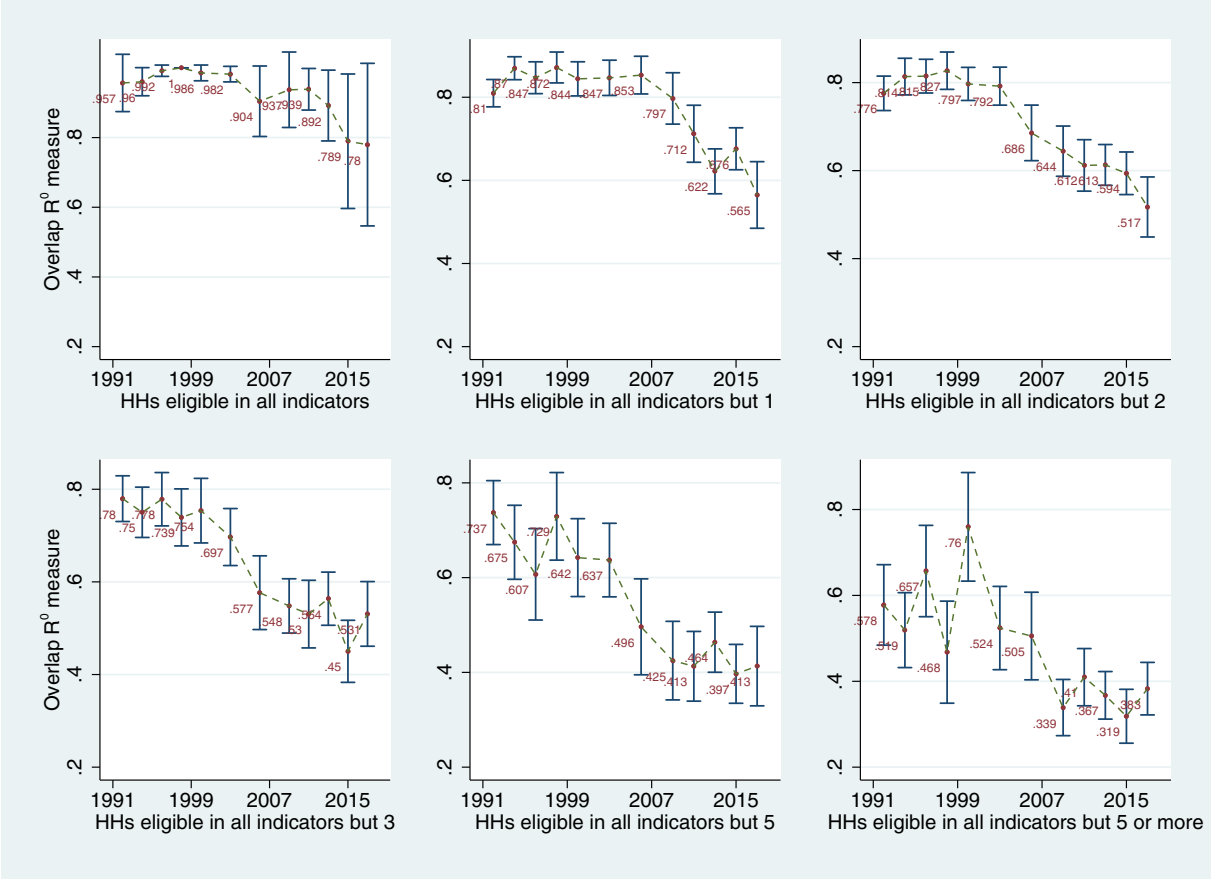

Fig. 2.A. Multidimensional and severe income-poverty overlap R^0 trends by depth of non-eligibility, Chile, 1992-2017. Note: 95% confidence intervals. Source: Own elaboration based on CASEN household surveys.

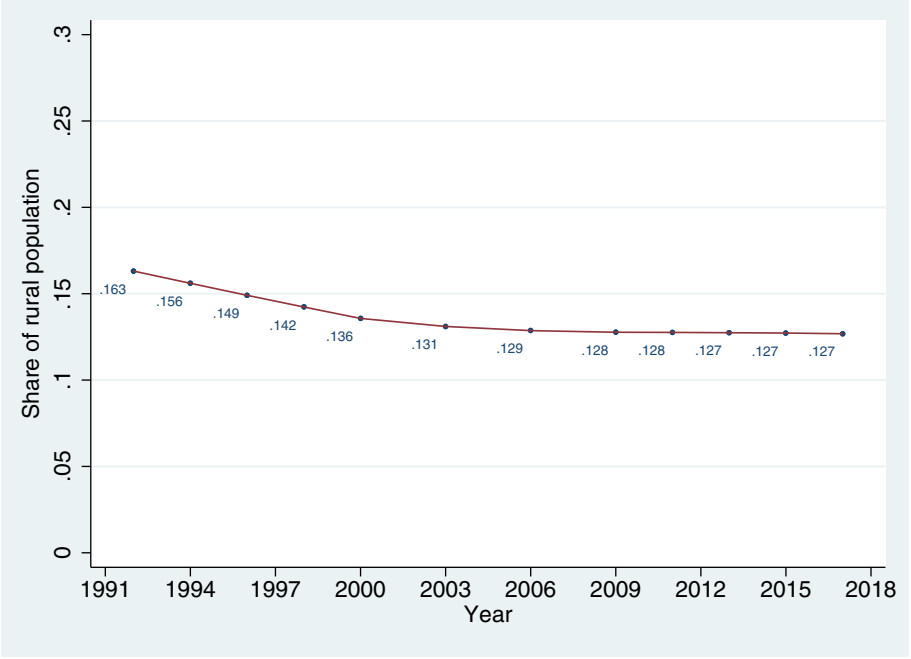

Fig. 3.A. Rural share of the population, Chile, 1992-2017. Source: Own elaboration based on CASEN household surveys.

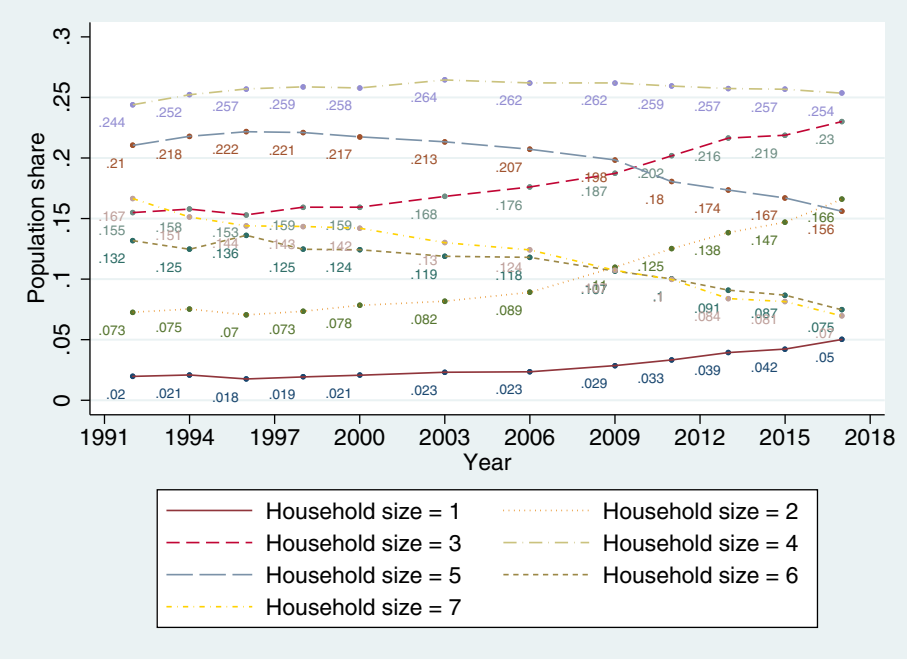

Fig. 4.A. Population shares by household size, Chile, 1992-2017. Source: Own elaboration based on CASEN household surveys.

Table 1A
The association level of the two different employed poverty identification methods, Chile, 1992–2017.

Year	Multidimensional and income poverty		Multidimensional and severe income poverty	
	Overlap R^0	Cramer's V	Overlap R^0	Cramer's V
1992	0.711	0.226	0.788	0.150
1994	0.719	0.287	0.808	0.184
1996	0.707	0.239	0.807	0.156
1998	0.734	0.260	0.805	0.156
2000	0.699	0.249	0.796	0.168
2003	0.659	0.222	0.772	0.153
2006	0.639	0.179	0.701	0.104
2009	0.578	0.167	0.602	0.088
2011	0.525	0.144	0.575	0.078
2013	0.512	0.165	0.578	0.117
2015	0.501	0.152	0.542	0.097
2017	0.489	0.118	0.506	0.065

Source: Own calculations based on CASEN household surveys.

Table 2A
Annualized relative rate of change in overlap R^0 measure between severe income poverty and multidimensional poverty.

Aggregation level	Whole period 1992–2017	Washington consensus period 1992–2000	Period of slowing growth and the introduction of social policies 2000–09	Period of slow growth and more comprehensive social policies 2009–17
Country level	−1.76	0.13	−3.06	−2.15
			Geographic location	
Urban areas	−2.09	0.09	−3.17	−3.01
Rural areas	−1.17	0.01	−1.92	−1.50
Region I	−0.26	4.41	−6.32	2.25
Region II	−0.76	−3.60	2.46	−1.42
Region III	−0.20	1.07	−3.53	2.40
Region IV	−1.13	0.18	−3.32	0.07
Region V	−1.36	1.92	−2.59	−3.19
Region VI	−2.24	−0.13	−5.27	−0.85
Region VII	−2.27	−0.30	−3.72	−2.60
Region VIII	−3.20	−0.55	−2.45	−6.58
Region IX	−0.70	0.52	−2.24	−0.17
Region X	−2.36	−0.35	−2.77	−3.86

(*continued on next page*)

Table 2A (*continued*)

Aggregation level	Whole period 1992–2017	Washington consensus period 1992–2000	Period of slowing growth and the introduction of social policies 2000–09	Period of slow growth and more comprehensive social policies 2009–17
Region XI	−3.04	−0.94	−10.03	3.23
Region XII	1.94	3.69	−8.18	12.75
Region XIII (metropolitan)	−1.37	0.30	−3.23	−0.90
			Household type	
HH head is not elderly	−1.90	0.16	−3.36	−2.28
HH head is elderly	−1.32	0.23	−2.70	−1.31
One-person HH	−1.33	3.45	−8.26	2.12
Two-person HH	−2.27	1.96	−7.14	−0.78
HH consists of 3 or more people	−1.53	0.08	−2.56	−1.96
			Average education amongst adult household members	
Less than 8 years	−0.81	0.03	−1.40	−0.98
8 years of more	−1.55	0.68	−3.30	−1.76

Note: HH = household. Source: Own elaboration based on CASEN household surveys.

Table 3A
Two-way fixed-effect regression of poverty overlap on education and demographic variables at the province level.

Explanatory variable/model	Overlap R^0 measure: Severe income poverty and multidimensional poverty									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Education of head of household (years)	−0.116***								0.00757	0.00728
	(0.00809)								(0.0379)	(0.0429)
One-person household		−6.332***							0.694	0.555
		(0.773)							(1.127)	(1.119)
Proportion of adults in the household			−2.600***						−0.542	−0.751
			(0.183)						(0.889)	(0.902)
Household size				0.287***					0.126	0.124
				(0.0183)					(0.0898)	(0.0930)
Single-female-headed household					−2.219***				−0.442	−0.431
					(0.161)				(0.369)	(0.378)
Rural household						0.951***			0.358*	0.343*
						(0.107)			(0.184)	(0.188)
Depth of non-eligibility (%)							−2.524**		−1.043	−1.133
							(1.175)		(1.412)	(1.408)
HH without children aged 5 or below (%)							0.0891		0.0578	0.123
							(0.210)		(0.309)	(0.312)
HH without children aged 6–18 (%)							1.094**		−0.0951	−0.225
							(0.500)		(0.584)	(0.605)
HH without elderly people (%)							0.313		0.396	0.370
							(0.307)		(0.370)	(0.370)
HH without women aged 21+ (%)							−3.481***		−1.788	−1.851
							(0.950)		(1.321)	(1.299)
Share of employment in the agricultural sector								1.286***		0.552
								(0.371)		(0.477)
Log of per capita household income								−0.184***		0.0554
								(0.0173)		(0.0640)
Unemployment rate								2.583***		1.973**
								(0.762)		(0.940)
Constant	1.688***	0.910***	2.477***	−0.607***	1.096***	0.465***	3.763***	2.667***	2.354	1.983
	(0.0706)	(0.0289)	(0.127)	(0.0816)	(0.0306)	(0.0235)	(0.953)	(0.213)	(1.476)	(1.510)
Time dummies and Post GFC interactions	–	–	–	–	–	–	–	–	Yes	Yes
F-test (model)	11.34	6.282	11.02	11.81	9.422	4.034	11.36	10.93	10.96	11.22
DF	43	43	43	43	43	43	47	45	74	77
R-squared	0.422	0.301	0.453	0.444	0.421	0.204	0.461	0.448	0.550	0.554
SSM (model)	7.920	5.647	8.508	8.333	7.895	3.839	8.646	8.403	10.33	10.41
SSE (error/residual)	10.86	13.13	10.27	10.44	10.88	14.94	10.13	10.37	8.450	8.369
Root MSE (SEE)	0.145	0.160	0.141	0.143	0.145	0.170	0.141	0.142	0.132	0.132
Effect Test	4.068	2.779	3.576	3.904	3.210	2.080	3.030	2.719	2.296	2.186
Number of Observations	516	516	516	516	516	516	516	516	516	516

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. HH = household. GFC = 2008 Global Financial Crisis. Source: Own elaboration based on CASEN household surveys.

Table 4A
Two-way fixed-effect regression of poverty overlap on education and demographic variables at the province level.

Explanatory variable/model	Overlap R^0 measure: Adjusted income poverty and multidimensional poverty									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Education of head of household (years)	0.00641								0.0460***	0.0452***
	(0.00524)								(0.0149)	(0.0146)
One-person household		0.123							−0.442	−0.412
		(0.406)							(1.052)	(1.046)
Proportion of adults in the household			0.0405						−0.259	−0.276
			(0.106)						(0.518)	(0.520)
Household size				−0.00634					0.0715	0.0579
				(0.0111)					(0.0438)	(0.0448)
Single-female-headed household					0.0504				−0.0153	−0.106
					(0.112)				(0.258)	(0.267)
Rural household						−0.00990			0.0423	0.0838
						(0.0746)			(0.115)	(0.114)
Depth of non-eligibility (%)							0.778		0.132	−0.135
							(1.042)		(1.383)	(1.378)
HH without children aged 5 or below (%)							0.0315		−0.530*	−0.496*
							(0.135)		(0.276)	(0.275)
HH without children aged 6–18 (%)							0.118		−0.198	−0.260
							(0.390)		(0.544)	(0.497)
HH without elderly people (%)							−0.0558		0.00222	0.0103
							(0.253)		(0.253)	(0.242)
HH without women aged 21+ (%)							0.333		−0.376	−0.405
							(0.816)		(0.976)	(0.956)
Share of employment in the agricultural sector								−0.914**		−0.615
								(0.385)		(0.431)
Log of per capita household income								−0.0157		−0.0358
								(0.0103)		(0.0492)
Unemployment rate								0.422		1.244*
								(0.640)		(0.678)
Constant	0.526***	0.577***	0.554***	0.610***	0.572***	0.584***	−0.0351	0.821***	0.794	1.428
	(0.0457)	(0.0152)	(0.0738)	(0.0497)	(0.0213)	(0.0163)	(1.067)	(0.134)	(1.507)	(1.639)
Time dummies and Post GFC interactions	–	–	–	–	–	–	–	–	Yes	Yes
F-test (model)	4.035	4.047	4.044	4.047	4.059	4.063	3.821	4.018	3.067	3.041
DF	43	43	43	43	43	43	47	45	71	74
R-squared	0.211	0.210	0.210	0.210	0.210	0.209	0.212	0.222	0.245	0.256
SSM (model)	1.886	1.870	1.870	1.872	1.872	1.869	1.889	1.981	2.191	2.282
SSE (error/residual)	7.040	7.056	7.055	7.054	7.054	7.057	7.037	6.945	6.735	6.644
Root MSE (SEE)	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.116	0.118	0.117
Effect Test	2.226	2.955	2.976	2.978	2.980	1.666	2.110	2.425	1.272	1.334
Number of Observations	516	516	516	516	516	516	516	516	516	516

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. HH = household. GFC = 2008 Global Financial Crisis. Source: Own elaboration based on CASEN household surveys.

Table 5A
Two-way fixed-effect regression of poverty overlap on education and demographic variables at the province level.

Explanatory variable/model	Overlap R^0 measure: Income poverty and adjusted multidimensional poverty headcount									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Education of head of household (years)	0.00221								0.0414*	0.0410*
	(0.00661)								(0.0207)	(0.0204)
One-person household		−0.186							−0.0945	−0.0710
		(0.465)							(1.005)	(1.025)
Proportion of adults in the household			−0.0871						0.102	0.0104
			(0.140)						(0.598)	(0.591)
Household size				0.00109					−0.0139	−0.0192
				(0.0144)					(0.0558)	(0.0575)
Single-female-headed household					−0.0805				0.107	0.0975
					(0.132)				(0.250)	(0.256)
Rural household						−0.0301			0.0441	0.0537
						(0.104)			(0.135)	(0.145)
Depth of non-eligibility (%)							1.075		0.937	0.774
							(1.040)		(1.261)	(1.265)
HH without children aged 5 or below (%)							−0.0866		−0.150	−0.133
							(0.127)		(0.219)	(0.213)
HH without children aged 6–18 (%)							0.340		0.454	0.387
							(0.405)		(0.552)	(0.561)
HH without elderly people (%)							−0.0797		0.129	0.135
							(0.326)		(0.422)	(0.422)

(*continued on next page*)

Table 5A (*continued*)

Explanatory variable/model	Overlap R^0 measure: Income poverty and adjusted multidimensional poverty headcount									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HH without women aged 21+ (%)							0.729		0.562	0.542
							(0.716)		(0.671)	(0.658)
Share of employment in the agricultural sector								−0.399		−0.140
								(0.345)		(0.428)
Log of per capita household income								−0.0158		−0.00396
								(0.0131)		(0.0585)
Unemployment rate								0.537		1.092
								(0.604)		(0.676)
Constant	0.329***	0.355***	0.408***	0.343***	0.363***	0.354***	−0.848	0.546***	−1.095	−0.869
	(0.0576)	(0.0174)	(0.0971)	(0.0643)	(0.0251)	(0.0228)	(1.080)	(0.162)	(1.281)	(1.368)
Time dummies and Post GFC interactions	–	–	–	–	–	–	–	–	Yes	Yes
F-test (model)	4.337	4.378	4.392	4.359	4.369	4.355	4.066	4.165	2.979	2.834
DF	43	43	43	43	43	43	47	45	66	69
R-squared	0.238	0.238	0.239	0.238	0.239	0.238	0.244	0.242	0.262	0.265
SSM (model)	2.286	2.287	2.291	2.284	2.291	2.286	2.340	2.323	2.513	2.546
SSE (error/residual)	7.306	7.305	7.301	7.308	7.301	7.306	7.253	7.269	7.079	7.046
Root MSE (SEE)	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.120	0.120
Effect Test	3.166	3.515	3.509	3.512	3.527	3.297	2.460	2.721	1.648	1.648
Number of Observations	516	516	516	516	516	516	516	516	516	516

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. HH = household. GFC = 2008 Global Financial Crisis. Source: Own elaboration based on CASEN household surveys.

Table 6A
Robustness checks. Alternative specifications for the different poverty overlap measures.

Explanatory variable/model	MD and Income Poverty			Overlap R^0 measures: MD and Severe Income Poverty			MD and Adjusted Income Poverty			Adjusted MD (headcount) and Income Poverty		
Education of head of household (years)	−0.0392***	−0.0304**	−0.0302**	−0.00270	0.00390	0.00728	−0.0147	−0.0136	−0.0188	−0.0217	−0.0174	−0.0233
	(0.0138)	(0.0143)	(0.0147)	(0.0371)	(0.0419)	(0.0429)	(0.0173)	(0.0182)	(0.0201)	(0.0181)	(0.0192)	(0.0214)
One-person household	1.076*	1.020*	0.931	1.052	1.090	0.555	0.908	0.897	0.934	−0.831	−0.391	−0.801
	(0.583)	(0.584)	(0.582)	(0.872)	(0.953)	(1.119)	(0.888)	(0.969)	(0.982)	(0.985)	(1.134)	(1.201)
Proportion of adults in the household	−0.556**	−0.333	−0.332	−0.713**	−0.557	−0.751	−0.205	−0.227	0.326	−0.311	−0.435	−0.479
	(0.224)	(0.261)	(0.568)	(0.334)	(0.475)	(0.902)	(0.351)	(0.357)	(0.698)	(0.399)	(0.454)	(0.791)
Household size	0.124***	0.125***	0.0835**	0.150**	0.164**	0.124	0.0298	0.0177	−0.00549	−0.0395	−0.0412	−0.0115
	(0.0320)	(0.0349)	(0.0411)	(0.0611)	(0.0655)	(0.0930)	(0.0387)	(0.0403)	(0.0605)	(0.0373)	(0.0383)	(0.0634)
Single-female-headed household	−0.0425	0.108	0.0856	−0.522	−0.409	−0.431	−0.286	−0.339	−0.232	−0.0399	0.00715	0.120
	(0.221)	(0.225)	(0.240)	(0.349)	(0.345)	(0.378)	(0.264)	(0.326)	(0.368)	(0.267)	(0.315)	(0.356)
Rural household	0.210**	0.217**	0.217**	0.360**	0.344*	0.343*	−0.401***	−0.379***	−0.349***	−0.326***	−0.268**	−0.220*
	(0.0954)	(0.102)	(0.105)	(0.163)	(0.176)	(0.188)	(0.0923)	(0.0969)	(0.106)	(0.115)	(0.122)	(0.130)
Share of employment in the agricultural sector	−0.103	−0.0918	−0.104	0.349	0.566	0.552	−0.539*	−0.673*	−0.721**	−0.119	−0.181	−0.236
	(0.312)	(0.321)	(0.328)	(0.383)	(0.462)	(0.477)	(0.316)	(0.334)	(0.345)	(0.355)	(0.382)	(0.382)
Log of per capita household income	0.0285	0.0399	0.0371	0.0287	0.0511	0.0554	0.0463	0.0210	0.0295	0.0317	−0.00902	0.00876
	(0.0209)	(0.0344)	(0.0333)	(0.0351)	(0.0590)	(0.0640)	(0.0284)	(0.0608)	(0.0641)	(0.0341)	(0.0680)	(0.0700)
Unemployment rate	1.123**	0.966**	1.107**	1.634**	1.753*	1.973**	−0.275	0.0128	0.0554	0.574	0.560	0.618
	(0.479)	(0.446)	(0.431)	(0.648)	(0.926)	(0.940)	(0.756)	(0.865)	(0.901)	(0.724)	(0.827)	(0.859)
Constant	−0.0392***	−0.0304**	−0.0302**	−0.00270	0.00390	0.00728	−0.0147	−0.0136	−0.0188	−0.0217	−0.0174	−0.0233
	(0.0138)	(0.0143)	(0.0147)	(0.0371)	(0.0419)	(0.0429)	(0.0173)	(0.0182)	(0.0201)	(0.0181)	(0.0192)	(0.0214)
Post GFC interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Non-eligibility controls	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Time dummies	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
F-test (model)	23.05	21.01	20.15	12.07	11.65	11.17	3.498	3.272	3.119	3.721	3.144	2.945
DF	51	62	67	51	62	67	51	62	67	51	62	67
R-squared	0.685	0.705	0.709	0.508	0.533	0.544	0.229	0.244	0.246	0.250	0.263	0.265
SSM (model)	6.230	6.413	6.454	9.539	10.01	10.22	2.047	2.175	2.195	2.402	2.518	2.543
SSE (error/residual)	2.870	2.688	2.647	9.236	8.768	8.557	6.878	6.750	6.730	7.190	7.074	7.049

Table 6A (*continued*)

Explanatory variable/model	MD and Income Poverty			Overlap R^0 measures								
				MD and Severe Income Poverty			MD and Adjusted Income Poverty			Adjusted MD (headcount) and Income Poverty		
Root MSE (SEE)	0.0753	0.0737	0.0735	0.135	0.133	0.132	0.117	0.117	0.117	0.119	0.120	0.120
Effect Test	3.851	3.192	3.038	2.710	2.366	2.224	1.697	1.678	1.470	2.412	2.206	1.710
Number of Observations	516	516	516	516	516	516	516	516	516	516	516	516

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. GFC = 2008 Global Financial Crisis. Source: Own elaboration based on CASEN household surveys.

Table 7A
Logit estimation for the poverty overlap at the household level.

Variable|Year	Poverty Overlap at the Household Level							
	1992		2000		2009		2017	
Education of adults in the HH (avg. years)	−0.353***	−0.351***	−0.333***	−0.332***	−0.312***	−0.305***	−0.276***	−0.277***
	(0.0174)	(0.0179)	(0.0223)	(0.0225)	(0.0181)	(0.0185)	(0.0186)	(0.0191)
One-person household	−1.135***	−1.449***	−0.861**	−1.154***	−0.910***	−1.003***	−0.340	−0.334
	(0.327)	(0.328)	(0.363)	(0.373)	(0.241)	(0.258)	(0.207)	(0.210)
HH head is elderly	0.0836	0.130	−0.173	−0.123	−0.106	−0.0781	−0.295*	−0.266
	(0.193)	(0.195)	(0.187)	(0.188)	(0.172)	(0.174)	(0.170)	(0.172)
HH head is female	0.207**	0.197**	0.480***	0.499***	0.173**	0.156*	−0.00602	−0.000214
	(0.0917)	(0.0930)	(0.106)	(0.105)	(0.0848)	(0.0862)	(0.0939)	(0.0948)
Household size	0.344***	0.332***	0.366***	0.359***	0.421***	0.414***	0.348***	0.326***
	(0.0343)	(0.0342)	(0.0363)	(0.0372)	(0.0404)	(0.0409)	(0.0414)	(0.0421)
Rural household	0.945***	0.842***	1.131***	0.930***	0.866***	0.780***	0.633***	0.641***
	(0.116)	(0.116)	(0.0934)	(0.0977)	(0.0993)	(0.103)	(0.0993)	(0.0992)
Number of indicators in which the HH is non-eligible	0.0806	0.0416	0.00710	−0.0658	−0.218***	−0.249***	−0.174***	−0.203***
	(0.0518)	(0.0543)	(0.0582)	(0.0596)	(0.0484)	(0.0513)	(0.0572)	(0.0575)
HH without children aged 5 or below	0.612***	0.563***	0.346***	0.323***	0.171*	0.150	0.319***	0.302***
	(0.0761)	(0.0776)	(0.0960)	(0.0933)	(0.0935)	(0.0955)	(0.103)	(0.103)
HH without children aged 5–18	−0.305	−0.376*	−0.401**	−0.527***	−0.968***	−1.004***	−0.854***	−0.912***
	(0.196)	(0.201)	(0.184)	(0.185)	(0.175)	(0.177)	(0.161)	(0.163)
HH without elderly people	0.430**	0.432**	0.714***	0.741***	0.322*	0.321*	0.723***	0.721***
	(0.182)	(0.184)	(0.192)	(0.190)	(0.176)	(0.179)	(0.179)	(0.182)
HH without women aged 21+	−0.157	−0.234	−0.705***	−0.777***	−0.363	−0.345	0.143	0.123
	(0.197)	(0.196)	(0.232)	(0.240)	(0.249)	(0.257)	(0.239)	(0.241)
Log of the household income	–	−0.352***	–	−0.621***	–	−0.225***	–	−0.345***
	–	(0.0876)	–	(0.0875)	–	(0.0702)	–	(0.130)
Constant	2.183***	5.890***	2.561***	9.100***	2.399***	4.855***	2.181***	6.304***
	(0.642)	(1.108)	(0.737)	(1.178)	(0.518)	(0.969)	(0.566)	(1.592)
Province Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations (Households)	35,939		64,925		70,748		70,666	
Population size	13,330,843		14,959,739		16,375,919		17,737,520	
Sub Population Observations	10,655		13,429		9,934		5,719	
Sub Population Size	4,258,759		2,993,033		2,474,368		1,472,235	
F	16.67	16.79	13.99	14.29	28.99	16.24	9.54	9.56
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Adjusted Wald Test (Model)	1.558	1.602	1.472	0.823	1.630	0.866	0.402	0.514
Goodness-of-fit test [a]	0.122	0.111	0.152	0.595	0.107	0.555	0.935	0.865

Note: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. [a]We report the F-adjusted mean residual test following Archer and Lemeshow (2006) running the -svylogitgof- command after -svy:logit- in Stata 15.1. The goodness-of-fit tests indicate good fit in all specifications. HH = household. Source: Own elaboration based on CASEN household surveys.

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