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Income-Related Inequity in the Use of GP Services: A Comparison of Ireland and Scotland

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Abstract: Equity of access to health care is a key component of national and international health policy. The Irish health-care system is unusual in requiring the majority of the population to pay the full cost of GP care at the point of use. In contrast, all Scottish residents are entitled to free GP care at the point of use. Using nationally representative micro-data on Irish and Scottish children, we find that the distribution of GP care in Ireland favours those on lower incomes (i.e., 'pro-poor'), but that there is no significant difference in the distribution of GP care across income groups in Scotland. Focusing just on children who pay for GP care in Ireland, we find some evidence for a significant 'pro-rich' distribution of GP visits.

Keywords: GP Services; Children; Concentration Index; Inequity; Ireland; Scotland

JEL Classifications: C20, D12, I10

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Income-Related Inequity in the Use of GP Services: A Comparison of Ireland and Scotland

Introduction

Equity of access to health care is a key component of national and international health policy. While there is considerable debate over the definition of equity in the context of health care (Culyer and Wagstaff, 1993; Smith and Normand, 2011), most countries subscribe to the principle that health care should be allocated on the basis of need, rather than on ability to pay or other criteria (e.g., location, ethnicity, *etc*.). Empirical analyses of the degree to which equal treatment for equal need is achieved typically use data on health-care utilisation to proxy treatment, and examine the way in which utilisation varies systematically by income. A large body of research has examined the degree to which various countries exhibit income-related inequity in health-care utilisation, i.e., differences in health-care utilisation across income groups that persist even after controlling for differential health-care needs across income groups (Propper and Upward, 1992; van Doorslaer *et al.*, 2000; Wagstaff and van Doorslaer, 2000; van Doorslaer *et al.*, 2002; Layte and Nolan, 2004; van Doorslaer *et al.*, 2004; van Doorslaer and Masseria, 2004; van Doorslaer *et al.*, 2006; Lu *et al.*, 2007; van Doorslaer *et al.*, 2008; Bago d'Uva *et al.*, 2009; Allin *et al.*, 2010; Cunningham *et al.*, 2011; Grasdal and Monstad, 2011; Yiengprugsawan *et al.*, 2011; van de Poel *et al.*, 2012).[1]

In this paper, we use data from nationally representative surveys of children in the Republic of Ireland and in Scotland to examine the degree of income-related inequity in the utilisation of GP services in both countries. We focus on the utilisation of GP services by children for a number of reasons. First, as the usual first point of contact with the health service, equity of access to GP services is a key component of an equitable and efficient health-care system. Internationally, access to free or heavily subsidised primary care is associated with more frequent GP visits (Chiappori and Geoffard, 1998; Jiminez-Martin *et al.*, 2001; van Doorslaer *et al.*, 2002); having a more regular source of care (Centers for Disease Control and Prevention, 1998); increased use of preventative services (Gadomski *et al.*, 1998; DeVoe *et al.*, 2003). In addition, countries with a well-defined primary health care system generally perform better in terms of health outcomes than those which do not (Macinko *et al.*, 2003). Second, the difference in health-care entitlements between Ireland and Scotland allows us to examine the impact of differences in financing structures on income-related equity in GP care.[2] As described in greater detail in Section 2, while only a minority of the Irish population is entitled to free GP care (the remainder must pay the full cost at point of use), all Scottish residents have access to free GP care under the UK National Health System (NHS). We add therefore to the existing body of cross-country comparative research that has focused on the degree to which differences in

[1] Most empirical analyses examine income-related inequity in health-care utilisation, but Stirbu et al. (2011) and Bago d'Uva et al. (2011) examine education-related inequity. A number of studies (Propper and Upward, 1992; Layte and Nolan, 2004; Cunningham et al., 2011) examine inequities in expenditure, rather than utilisation.

[2] We focus on Scotland (rather than the UK) due to data availability, i.e., data on GP utilisation among children are not collected in the UK-wide Millennium Cohort Study (see Section 3 for further details).

financing and delivery structures across health-care systems influence the extent of income-related inequity in health-care utilisation. Finally, most empirical analyses of income-related equity in health-care utilisation have focused on the adult population only.[3] In light of the finding that inequities in access to health care among children have significant effects on health status (Currie, 1995; Currie and Gruber, 1996; Currie *et al.*, 2008), and given the strong causal links that have been demonstrated between childhood health and later health, educational and labour market outcomes (Case *et al.*, 2005), it is particularly important to examine the implications of different financing structures for equity in child health-care utilisation.

Section 2 describes the Irish and Scottish health-care systems in greater detail, as well as reviewing the existing evidence on income-related inequity in the utilisation of GP services in both countries. Section 3 outlines our methods, Section 4 describes the data, while Section 5 presents empirical results. Section 6 discusses the results and concludes.

Context

While most European countries have universal cover for free or heavily subsidised GP care, the Irish system of eligibility for free GP services is unusual in this context (Ruane, 2010; Smith, 2010). Essentially, there are three broad categories of eligibility for free primary care services in Ireland: those on low incomes ('full medical card' patients) are entitled to free GP services and prescription medicines, those on low but not the lowest incomes ('GP visit card' patients) are entitled to free GP services but not prescription medicines, while the remainder ('private' patients) must pay the full cost of GP services and prescription medicines at the point of use. Eligibility for a full medical card/GP visit card is primarily assessed on the basis of an income means test, and the income thresholds for the GP visit card are 50 per cent higher than for the full medical card. In certain cases, individuals who are otherwise ineligible for a full medical card/GP visit card may be granted a card on a 'discretionary' basis, if they have particular health needs which would cause them undue hardship.

A further layer of complexity is added to the Irish system by the existence of private health insurance (PHI), which fulfils both a supplementary and complementary role in the Irish system (Thomson and Mossialos, 2009). Approximately 50 per cent of the population have PHI, which mainly provides cover for private acute hospital services (which may be delivered in public hospitals), but which increasingly offers full or partial reimbursement of certain primary care expenses. Full medical card and GP visit card holders may take out PHI if they wish, although the numbers with such 'dual cover'

[3] A number of studies focus on sub-sets of the adult population. Allin et al. (2010) focus on those aged 65+ years in the UK, while Cunningham et al. (2011) examines health spending in the year prior to death for a sample of British Columbian individuals aged 65+ years.

are small.[4] The current Programme for Government contains a commitment to introduce a system of universal health insurance (thus removing the two-tier nature of care in public hospitals) and to introduce free GP care for all by 2016 (Government of Ireland, 2011).

Given this structure of entitlements, in terms of access to primary care services, it is possible to identify five mutually exclusive groups in the Irish system:

- full medical card holders
- GP visit card holders
- PHI with full or partial cover for GP expenses
- PHI with no cover for GP expenses
- no medical card, GP visit card or PHI ('no cover')

As outlined in Table 1, these groups face varying GP fees (ranging from zero for full medical/GP visit card holders, to the full cost for the latter two groups). In general, GPs charge the same fee to adult and child private patients[5], with the average fee estimated to be €51 in 2010 (National Consumer Agency, 2010). Previous research on the adult population has found that this structure of entitlements for free GP care has a significant effect on GP visiting behaviour (Tussing, 1985; Nolan, 1991; 1993; Nolan, 2007a; O'Reilly *et al.*, 2007; Nolan, 2008b; a; Nolan and Nolan, 2008; Layte *et al.*, 2009; Nolan and Smith, 2012), with a more limited number of research studies on the utilisation of GP services by children finding similarly significant results (Tussing, 1985; Layte and Nolan, 2012).

GP services in Ireland are delivered by a network of self-employed GPs, who act as gatekeepers for secondary care. The majority of Irish GPs also enter into contract with the State for the provision of services to full medical/GP visit card holders (under the General Medical Services (GMS) Scheme). Full medical/GP visit card patients register with a GP of their choice from a list of GPs who participate in the GMS Scheme. Under the terms of the GMS contract, a GP cannot discriminate between public and private patients in terms of the quality and quantity of treatment (Nolan, 2007b). GPs receive a capitation payment for full medical card and GP visit card patients (and certain additional services are reimbursed by means of a separate fee-for-service (FFS) payment, e.g., vaccinations), and a FFS payment from private patients. While much of the focus of the empirical literature has been on the impact of user fees on GP visiting behaviour, it is important to note that GP visiting patterns may also in part reflect the incentives facing the GP (and how these interact with those facing the patient) (Barros *et al.*, 2008; Brick *et al.*, 2012).[6]

[4] In 2010, an estimated 41 per cent of the population held PHI only; 6 per cent held both a full medical/GP visit card and PHI ('dual cover'); 30 per cent held a full medical card or GP visit card only; and 23 per cent of the population had neither a full medical/GP visit card nor PHI (CSO, 2011).

[5] In the Irish health-care system, full medical and GP visit card holders are typically referred to as 'public patients' while those without a full medical card or GP visit card are typically referred to as 'private patients'.

[6] Previous research on supplier-induced demand among Irish GPs found evidence both for and against supplier-induced demand on the part of Irish GPs (Tussing, 1983; 1985; Madden et al., 2005).

In contrast to the complex system of entitlements to free primary care in the Irish health-care system, all Scottish residents have access to free GP care at the point of use under the UK NHS (see Table 1). Prescription charges were abolished in Scotland in April 2011. All residents must register with a GP. As in Ireland, GPs in Scotland act as gatekeepers for secondary care services. The vast majority of GPs in Scotland operate as self-employed practitioners under contract with the NHS. GP payments are administered by 14 local health boards, with remuneration primarily based on capitation payments (calculated using the 'global sum' formula). Scottish GPs may also receive additional payments tied to performance under the Quality and Outcomes Framework, and FFS payments for the provision of 'enhanced services' such as childhood immunizations and minor surgery) (Audit Scotland, 2006).[7] PHI plays a largely supplementary role in the UK system, providing cover for surgery as an inpatient or day case, hospital accommodation, nursing care and inpatient tests in the private sector. Complementary PHI covering the cost of user charges is not generally available in the UK. In 2008, it was estimated that approximately 12 per cent of the UK population had PHI (Boyle, 2011).[8]

[insert Table 1 here]

Both Ireland and the UK have featured in previous cross-country comparative analyses of income-related inequity in the utilisation of health-care services among the adult population (van Doorslaer *et al.*, 2000; van Doorslaer *et al.*, 2002; van Doorslaer *et al.*, 2004; van Doorslaer and Masseria, 2004; van Doorslaer *et al.*, 2006). Across all studies (using a variety of data sources covering different time periods), the distribution of GP visits has been found to be significantly 'pro-poor' in Ireland (i.e., even after controlling for the significant 'pro-poor' distribution of ill-health, lower-income individuals have a significantly higher number of GP visits). The most recent analysis of income-related inequity in the delivery of health-care services in Ireland (using data on adults aged 18+ years from 2000) found a significant 'pro-poor' distribution in expenditure on GP services in Ireland (and also for prescription medicines) (Layte and Nolan, 2004).[9] As noted by all authors, this result is not surprising given the particular structure of entitlements to free GP care in the Irish system. In contrast to the Irish evidence, the evidence for the UK is more mixed, with some studies finding evidence of a significant 'pro-poor' distribution of GP visits (van Doorslaer *et al.*, 2000; van Doorslaer *et al.*, 2004; van Doorslaer and Masseria, 2004) and others finding no significant difference across income groups (van Doorslaer *et al.*, 2002; van Doorslaer *et al.*, 2006; Allin *et al.*, 2010). In all of these studies, Scotland is included as part of the UK, but not separately analysed. Sutton (2002) found a weak, but insignificant, 'pro-rich' distribution of GP visits using Scottish data for 1995 and 1998, and they found that this estimate increased when vertical equity considerations were taken into account.[10]

[7] With the exception of the payments for enhanced services (where are supposed to reflect local health-care needs), Scottish GPs operate under the UK-wide GP contract agreed in 2004 (Oxtoby, 2012).

[8] Data for 2002 indicated that PHI cover was much lower in Scotland than in other parts of the UK (8 per cent in comparison with a rate of 18-20 per cent in London and South-East England) (Foubister et al., 2006).

[9] A later paper focused on equity in the utilisation of inpatient hospital services only (Layte, 2007).

[10] Some studies distinguish between the probability of a GP visit, and the conditional number of visits, and often find conflicting results for the two decisions (for instance, van Doorslaer et al. (2004) found an insignificant pro-rich

Methods

In common with other cross-country comparisons of income-related inequity in health-care utilisation, we use the concept of the concentration index (CI) to compare the observed distribution of GP services with the observed distribution of need, using income as our ranking variable. First, we compute the CI for actual, unadjusted, GP utilisation:

$$C_a = \frac{2}{\bar{y}} cov(y_i, R_i) \quad (1)$$

where y_i is GP utilisation of individual i, $\bar{y}$ is the mean level of y_i and R_i is the individual's fractional rank in the distribution of income. The CI is derived from the concentration curve, which plots the cumulative proportion of GP visits against the cumulative proportion of the population ranked by income. While the CI of GP utilisation measures the degree of inequality in GP utilisation, it does not indicate the degree of *inequity*. We must therefore control for legitimate differences in utilisation across income groups, i.e., those due to differences in need. We standardise for need using the indirect method (using the indicators described in Section 4). Following the approach of Wagstaff and van Doorslaer (2000), the degree of income-related inequity in GP utilisation may then be measured as the difference between the inequality in actual and need-adjusted use of GP services:

$$HI = C_a - C_n \quad (2)$$

where C_a and C_n represent the CIs for actual and need-adjusted utilisation of GP services respectively. C_n is computed using predicted values $\hat{y}_i$ which are estimated for each individual i (i.e., the amount of GP care he/she would have used had he/she used the average amount used by those with the same need characteristics). We also include a vector of non-need variables in these models, but neutralise their impact in the predictions by setting their values equal to their mean (van Doorslaer *et al.*, 2004; Bago d'Uva *et al.*, 2009). A positive (negative) value of HI indicates income-related inequity in GP utilisation that favours the better-off (worse-off).

As outlined in Wagstaff and van Doorslaer (2000), the CI may also be decomposed into the contributions of the various explanatory variables. Assuming that GP utilisation is a linear function of income x_i^s, need x_i^n, and non-need x_i^o, variables:

$$y_i = \alpha + \beta_s x_i^s + \sum_n \beta_n x_i^n + \sum_o \beta_o x_i^o + \varepsilon_i \quad (3)$$[11]

then the CI may be written as a weighted average of the CIs of each of the explanatory variables:

$$C_a = \left(\frac{\beta_s \bar{x}_s}{\bar{y}}\right) \hat{C}_s + \sum_n \left(\frac{\beta_n \bar{x}_n}{\bar{y}}\right) \hat{C}_n + \sum_o \left(\frac{\beta_o \bar{x}_o}{\bar{y}}\right) \hat{C}_o + \left(\frac{GC_e}{\bar{y}}\right) \quad (4)$$

where $\bar{x}_i^s$, $\bar{x}_i^n$, and $\bar{x}_i^o$ are the means of the explanatory variables, and $\hat{C}_s$, $\hat{C}_n$ and $\hat{C}_o$ are their CIs. GC_ε is the generalised CI of the errors. Therefore estimated inequality is a weighted sum of the inequality in each determinant, with the weights equal to the elasticities of GP utilisation with

distribution for the probability of visiting a GP in Ireland, but a significant pro-poor distribution for the conditional number of visits).

[11] As the models estimated are reduced-form cross-sectional models of GP utilisation, we cannot infer causality in any of the relationships. In any case, there may be concerns over the exogeneity of some variables (e.g., the use of current health status to predict past GP utilisation).

respect to each determinant. The contribution of each determinant to total income-related inequality may therefore be decomposed into two components: i) its impact on utilisation, as measured by its elasticity and ii) its degree of unequal distribution across income. This decomposition method allows us to separate out the contributions of the various explanatory variables, and also to identify the importance of each of these two components for each explanatory variable. In addition, as outlined in van Doorslaer *et al.* (2004), the decomposition has the additional advantage of greater transparency in the presentation of results, particularly if there is ambiguity over what constitutes 'legitimate' inequality in utilisation (e.g., is the residual variation a source of 'legitimate' or 'illegitimate' variation?). In common with others in the literature, we assume that all variation in utilisation that is not related to need is 'illegitimate'.[12]

Health-care utilisation is typically modelled using non-linear estimation techniques. However, the need-standardised CIs derived from non-linear models are contingent on the values used for the non-need variables, and therefore contains approximation errors. In addition, a direct approximation of the decomposition approach with non-linear models is impossible (van Doorslaer *et al.*, 2008). However, previous research has found that both the CI estimates, and the decomposition results, differ little when using OLS and alternative non-linear methods such as the negative binomial (Wagstaff and van Doorslaer, 2000; van Doorslaer *et al.*, 2004; van Doorslaer and Masseria, 2004; Lu *et al.*, 2007). We estimate negative binomial and two-part models (probit and truncated negative binomial models), and undertake the decomposition analysis using the OLS results (but test the robustness of the decomposition based on non-linear models). As outlined in van Doorslaer *et al.* (2000), van Doorslaer *et al.* (2002) and van Doorslaer and Masseria (2004), the various CIs may be calculated by way of 'convenient' regressions, which also allow for the calculation of standard errors, and this is the approach we adopt in this paper. All analyses are carried out in STATA 12.1, and sample weights are employed throughout.

Data

In this paper we use micro-data from two nationally-representative child cohort studies which are ongoing in the Republic of Ireland and Scotland.

Growing up in Ireland (GUI) surveys two cohorts of children (i.e., an Infant Cohort, and a Child Cohort). Currently, the micro-data from the first waves of each cohort are available for analysis. The Infant Cohort is made up of the families of 11,134 nine-month old children. The children were born between December 2007 and June 2008 and data collection took place between September 2008 and April 2009 (Quail *et al.*, 2011). The sampling frame for the Infant Cohort was the Child Benefit Register. The Child Cohort represents 8,568 children born between November 1997 and October

[12] Bago d'Uva et al. (2009) discuss this issue in greater detail. In the context of panel data, they argue that the 'conventional' HI may overstate the degree of inequity in health-care utilisation as the residual variation in utilisation may be picking up some of the variation in unobserved need for health care (see also van Doorslaer et al. (2004)).

1998. Data collection took place between August 2007 and May 2008, meaning that the children were aged nine years old on average. The sampling frame for the Child Cohort was the primary school system. The sample design was based on a two-stage selection process in which the school was the primary sampling unit and the children in the school were the secondary units (Murray *et al.*, 2011).

Growing up in Scotland (GUS) also surveys two cohorts of children (i.e., a Birth Cohort, and a Child Cohort). The Birth Cohort is made up of the families of 5,217 10-month old children. The children were born between June 2004 and May 2005. The Child Cohort is comprised of the families of 2,859 children aged on average 34 months, who were born between June 2002 and May 2003. Both samples were drawn from the Child Benefit Register. During the first phase of GUS families were visited by an interviewer every year until the child reached five years old (so data are available for five waves for the Birth Cohort, and four waves for the Child Cohort). In 2011/2012, a further 6,000 10-month old children who were born between March 2010 and February 2011 were recruited (although the micro-data from this cohort are not yet available to researchers).

As with any longitudinal data-set, attrition is a concern when using the later waves (e.g., for GUS, just under 75 per cent of Birth Cohort were re-interviewed in wave five). For the current paper, we therefore restrict the GUS analysis to the second wave (i.e., the first wave in which data on GP utilisation was collected).[13] After excluding non-singleton children and observations with missing data (largely due to missing data on household income) (see also Section 4), final samples of 9,719 (GUI 9-month olds), 7,585 (GUI 9-year olds), 4,137 (GUS 2-year olds) and 2,234 (GUS 4-year olds) are available for analysis.

The focus of this paper is income-related inequity in GP utilisation.[14] GP utilisation, which is self-reported, has the added advantage of being available in comparable form in the two surveys, although the reference period differs (see Table 2). Household income is adjusted for household size and composition using the modified OECD equivalence scale (Bradshaw *et al.*, 2010). As noted, for both surveys, the majority of the missing observations arise due to missing information on household income, with the problem more serious for GUS (approximately 7 per cent of GUI observations are missing information on income, while the corresponding figure for GUS is approximately 18 per cent). To ensure that our results are robust to the exclusion of these cases, we also run the analysis using imputed income values (further details are available in the Appendix).

Figure 1 illustrates the average number of GP visits by equivalised income quintile for each of the four samples of children. For both the GUI and GUS samples, the children from the younger cohorts have a higher overall average number of visits (2.7 vs. 1.0 for the GUI sample, and 1.6 vs. 1.3 for the

[13] In any case, there is some debate in the literature over whether panel data techniques (which control for unobserved time heterogeneity) are appropriate for analyses of children (Propper et al., 2007).

[14] Data on prescription medicine consumption are not available in either GUI or GUS.

GUS sample). In general, those in the lower quintiles have a higher average number of GP visits than those in higher income quintiles, although the discrepancy between the top and bottom quintiles is more marked for the GUI samples. There is also some evidence for a U-shaped relationship for the GUI 9-month olds, which may be suggestive of particular access issues among those in the middle income quintiles (who are most likely without a full medical card, GP visit card or PHI). To investigate this issue further, we also carry out our analysis on the samples of GUI private patients only (i.e., those without a full medical or GP visit card). Figure 2 illustrates the average number of GP visits by income quintile for the samples of private patients in both GUI cohorts. While the relationship is relatively flat for the GUI 9-year olds, the patterns for the GUI 9-month olds suggest that GP visiting rates (among those who must pay for GP care) are higher among children from higher-income families. Of course, the patterns presented in Figures 1 and 2 do not take account of the distribution of health need across income quintiles, nor do they allow us to investigate further the particular factors driving these relationships, issues that can be examined by calculating CIs and HIs, and decomposing the overall inequality into its various components.

[insert Figures 1 and 2 here]

To do this requires appropriate indicators of health need. Indicators for child age, sex, birth weight, gestation, parental assessments of the child's general health status and exposure to accidents, are included.[15] We also include a number of additional variables which have been shown in previous empirical research to affect health-care utilisation, namely, number of siblings, mother's highest level of education, mother's employment status, household composition (i.e., whether the child lives in a lone parent family) and mother's ethnicity. Wherever possible, variables are constructed in such a way as to minimise differences in definition across the various data sources. However, in a number of cases (e.g., mother's education, *etc*.), variable definitions differ, due to the difference in the underlying question and response categories. Table 2 presents variable definitions for all dependent and independent variables used in this analysis.

[insert Table 2 here]

[15] While an indicator of chronic illness incidence is available in both the GUI and GUS surveys, the underlying question differs considerably across the surveys. In the GUI Infant Cohort, the variable is constructed from responses to the question 'Has a medical professional ever told you that <baby> has any of the following conditions?, with 16 conditions specified (e.g., asthma, diabetes, epilepsy, etc.). In the GUI Child Cohort, the variable is constructed from the responses to the question 'Does the Study Child have any on-going chronic physical or mental health problem, illness or disability?'. In GUS, the question is 'Does ^childname have any longstanding illness or disability? By longstanding I mean anything that has troubled ^him over a period of time or that is likely to affect ^him over a period of time?'. Due to the differences in the underlying question, and the extent to which the GUI Infant Cohort indicator is an indicator of health need (rather than utilisation), we exclude the chronic illness indicator from our analyses. However, as detailed in the Appendix, we also check the robustness of the results to the inclusion of this variable (and other health need variables which are not available in comparable form across the four samples).

Empirical Results

The CIs for GP utilisation and the various indicators of health need are presented in Table 3. The CI ranges from -1 to 1, with a value of zero indicating no income inequality/inequity in the underlying variable. A negative value indicates a 'pro-poor' distribution of the variable, while a positive value reflects a 'pro-rich' distribution. van Doorslaer and Koolman (2004) have shown that multiplying the value of the concentration index by 75 gives the percentage of the underlying variable (in this case, GP visits) that would need to be (linearly) redistributed from the poorer half to the richer half of the population to arrive at a distribution with an index value of zero. Across the four samples, the (unadjusted) distribution of GP services is significantly 'pro-poor'. The CI is particularly large for the GUI Child Cohort. If health need were equally distributed across income groups, this would mean inequity favouring the lower income groups. However, the need for care is not distributed equally across income groups (as illustrated in columns (2) to (5) of Table 3). In particular, parental-assessed child health is significantly 'pro-poor' for all cohorts (the exception is the GUI 9-month olds, where it is insignificant), while birth weight is significantly 'pro-rich' for all cohorts. The results for accidents and gestation are more mixed, with accidents exhibiting a significant 'pro-poor' distribution for GUs 2-year olds only, and gestation significantly 'pro-poor' for both GUI cohorts only.

[insert Table 3 here]

In Table 4, we present the standardised CIs, with the results in column (2) standardised for health need only, those in column (3) standardising for other non-need variables (e.g., mother's education), and those in column (4) standardising for health-care entitlements (GUI analysis only). In general, the standardised CIs are less negative in the right hand side columns, i.e., the more extensive the specification used to predict utilisation, the smaller the extent of income-related inequity. The exception is the GUI Infant Cohort, where standardising for need results in little change in the magnitude of income-related inequity. This is largely driven by the insignificance of the CIs for one of the main health need indicators (parental assessment of child health) (see Table 3).

[insert Table 4 here]

Figure 3 presents the results of the decomposition analysis. We decompose inequality (C_a) in GP utilisation into four main components, namely, income, health need, non-need determinants and the residual term (an additional component, i.e., health-care entitlements, is available for the GUI analysis). The contribution of each determinant to total inequality may be further decomposed into two components: i) its impact on utilisation, as measured by its elasticity and ii) its degree of unequal distribution across income (although these results are not presented here). The results may be interpreted as follows: in a country with a perfectly equitable distribution of GP visits across income groups, the sum of the bars would be equal to the need bar. As soon as discrepancies emerge between the actual and need-adjusted distributions, the other bars appear.

The results indicate that for the GUI children, the main driver of the 'pro-poor' distribution of GP visits is health-care entitlements. An examination of the more detailed decomposition reveals that it is unequal distribution of the entitlements groups across income that is driving this result (medical card, GP visit card and 'no cover' groups are disproportionately concentrated in low income groups). Consistent with the patterns observed in Table 3, health need contributes little to overall inequality among the GUI 9-month olds but is an important driver of 'pro-poor' inequality among the 9-year olds. In both cohorts of GUI children, the overall contribution of the non-need variables is 'pro-rich', driven largely by the 'pro-rich' contributions for the variables indicating the number of siblings and mother's ethnicity.

For the GUS children, the contribution of health-care entitlements is zero (as all children have access to free GP care at the point of use). However, there are some interesting differences between the two cohorts. For the 2-year olds, the contribution of income is positive, i.e., it contributes to the 'pro-rich' distribution of GP visits observed in column (1) of Table 3. Income exerts little effect for the older (i.e., 4-year old) children however. For both cohorts, the contribution of health need is negative, reflecting the concentration of health need among lower income groups. In contrast to the GUI results, the non-need variables exhibit a 'pro-poor' distribution, particularly for the 2-year olds, and this is largely driven by the 'pro-poor' concentration of the mother's education variable.

[insert Figure 3 here]

It has been argued that two-step or hurdle approaches may be more appropriate in accounting for the nature of the decision-making process underlying the decision to visit a GP (Gerdtham *et al.*, 1992; Pohlmeier and Ulrich, 1995; Hurd and McGarry, 1997). The most common interpretation of the two-step model is in terms of a principal-agent framework whereby the patient initiates the visit to their GP, with the GP, sometimes in conjunction with the patient, deciding on the frequency of treatment. However, the hurdle model has been criticised for its reliance on the 'single illness spell' assumption (Santos-Silva and Windmeijer, 2001; Deb and Trivedi, 2002; Jiménez-Martín *et al.*, 2002). In previous analyses of income-related inequity in health-care utilisation, CIs were found to differ across the contract and frequency decisions (e.g., van Doorslaer *et al.* (2004) found an insignificant 'pro-rich' distribution for the probability of visiting a GP in Ireland, but a significant 'pro-poor' distribution for the conditional number of visits). While the results in Tables 3 and 4 are based on the negative binomial model, we also estimated probit and truncated negative binomial models, and calculated CIs and HIs for the two steps. However, the truncated negative binomial model would not converge for the GUI Child Cohort sample. The results are presented in Table 5.

They indicate that the probability of visiting a GP is significantly 'pro-rich' among the GUI 9-month olds, even after adjustment for health need and other determinants of utilisation. In contrast, the conditional number of visits exhibits a significant 'pro-poor' distribution, and this effect persists even after adjustment for health need and other determinants. This suggests that the overall 'pro-poor'

distribution of GP visits among the GUI 9-month olds is driven largely by the significant 'pro-poor' distribution of the conditional number of visits. For the GUS sample, there is evidence of a significant 'pro-rich' distribution for the probability of visiting a GP among the 2-year olds. In terms of the conditional number of visits, the initially significant 'pro-poor' distribution for both GUS cohorts becomes largely insignificant once utilisation is adjusted for health need and other determinants.[16]

[insert Table 5 here]

The results for the GUI analysis highlight the importance of health-care entitlements in explaining inequality in GP visiting across income groups. A particular policy concern in the Irish context is the extent to which those just above the income threshold for a full medical or GP visit card may be particularly disadvantaged in terms of access to GP care. Previous analyses of the adult population have found that the deterrent effect of the user charge for private patients persists throughout the income distribution of private patients. To examine whether GP visits are concentrated among higher income private patients, we calculated CIs and HIs for the samples of private patients only in GUI. The results are presented in Table 6. The (unadjusted) CIs indicate a significant 'pro-rich' distribution in GP visits for the GUI 9-month olds, and an insignificant 'pro-rich' distribution for the GUI 9-year olds. Standardising for health need and other determinants of utilisation does not remove the significant 'pro-rich' distribution of GP visits for the GUI 9-month olds, but the distribution of GP visits among the GUI 9-year olds remains insignificant. This suggests that the deterrent effect of user fees for GP care is a particular concern among low income children from the GUI 9-month old sample.

[insert Table 6 here]

Figure 4 decomposes the CIs into the contributions of the various determinants (income, health need, non-need and health-care entitlements). We can see that for the 9-month olds, both income and the non-need determinants contribute equivalent amounts to the observed 'pro-rich' inequality in GP visits, but in terms of individual components, income (and its 'pro-rich' distribution) is the single largest contributor to the 'pro-rich' distribution of GP visits among GUI 9-month olds. For the 9-year old cohort of GUI, the contribution of the health-care entitlement variables (i.e., PHI with GP cover, PHI without GP cover, and no cover) are now much larger and 'pro-rich', while the 'pro-poor' distribution of health need is an important contributor.

[insert Figure 4 here]

[16] Due to space constraints, the results of the decomposition analyses for the two-part models are not presented here, but are available on request from the authors.

While the two-part model would not converge for the GUI 9-year old sample, the results for the 9-month olds illustrate how the significant 'pro-rich' distribution of GP visiting among private patients is largely driven by the significant 'pro-rich' distribution for the probability of visiting.

The appendix contains further details on the various additional tests we carried out to ensure that the results presented in this section are robust.

Discussion and Conclusions

The issue of health-care entitlements is particularly pertinent for children given the strong causal links that have been demonstrated between health-care access and child health (Currie, 1995; Currie and Gruber, 1996; Currie *et al.*, 2008), and in turn, the causal impact of child health on later health, educational and labour market outcomes (Case *et al.*, 2005). The Irish system of entitlements to public health care is unusual in a European context, with the majority facing the full cost of GP care at the point of use, and contrasts strongly with the system in the UK where all residents are entitled to free GP care at the point of use. Previous cross-country comparisons of income-related inequity in the utilisation of GP care have highlighted the importance of different health-care financing structures in explaining differences across countries, but have largely concentrated on the adult population. The purpose of this paper was to investigate the impact of these differing health-care financing structures on the extent of income-related inequity in GP visiting among Irish and Scottish children. We find that while there is little or no income-related inequity in the distribution of GP care among Scottish children[17], the picture is more complex for Irish children, and indicative of the particular structure of health-care entitlements that exist in the current system.

In particular, there is significant 'pro-poor' inequity in GP utilisation among both groups of Irish children, i.e., the distribution of GP care in Ireland favours those on lower incomes. Most of the observed inequity in GP visits across income groups is driven by the concentration of full medical and GP visit card holders in lower income groups. Examining the contact and frequency decisions separately provided further insight; for the Irish 9-month olds, the probability of visiting a GP exhibits a significant 'pro-rich' distribution, but this is outweighed by the significant 'pro-poor' distribution of the conditional number of visits. For the Scottish 2-year olds, there is also some evidence for a significant 'pro-rich' distribution for the probability of a GP visit, but this is outweighed by the insignificant effect for the conditional number of visits.

Our analysis was also carried out on the subsample of Irish private patients only (i.e., those without a full medical or GP visit card). Previous research of the adult population in Ireland has found that the deterrent effect of GP user fees was not just confined to those just above the income threshold for a

[17] However, there is some evidence for a significant pro-rich distribution for the probability of a GP visit among GUS 2-year olds.

medical card (Nolan, 2008b). While we find that GP visits exhibit a 'pro-rich' distribution for both cohorts (i.e., 9 month olds and 9 year olds), the finding is significant only for the 9-month olds, and persists even when adjustment is made for need and other non-need determinants (including PHI cover). This suggests that the deterrent effect of user charges is a particular concern for low income families from the Irish 9 month cohort. In the absence of longitudinal data, it is impossible to say whether this reflects an age or a cohort effect, although it is possible that significant 'pro-rich' distribution of GP visits for the 9-month olds reflects the deteriorating economic conditions that characterised the data collection period for the Irish 9 month cohort (i.e., during 2008-2009, rather than a year earlier for the 9 year old cohort, when the recession has yet to begin).

With analyses of this type, there are inevitably data and methodological limitations. First, it is possible that certain indicators are subject to recall bias, particularly for the older children (e.g. child's birth weight). Second, information on some potentially important indicators is not available. For example, the data do not contain variables related to the supply side of the decision, such as GP or practice characteristics. Third, the use of a variety of data sources means that different indicators of health-care utilisation, income, need and non-need are used. However, we have constructed all indicators with careful regard for differences in definition, and wherever possible, have constructed variables so as to minimise such differences (e.g., by aggregating categories of maternal education). Fourth, there are methodological concerns, some of which have been addressed as part of our robustness checks (see Appendix). However, a broader concern with analyses of this kind is that inequality and inequity is assessed solely in terms of the quantity of care received; issues relating to the quality of care cannot be addressed with the data available. Finally, the use of cross-sectional data limits the extent of the standardisation procedure, as adjustment can only be made for need differences that are observed. This may mean that some of the variation in utilisation that is captured by the residual term could be 'legitimate' variation due to differences in unobserved health need.[18] A further limitation associated with the use of cross-sectional data is that the underlying utilisation equations are necessarily reduced-form; no causal inference is possible (Allin *et al.*, 2010).

The obvious question is whether the cross-country differences in income-related inequity in GP utilisation that we observe between Irish and Scottish children can be linked to the differing characteristics of the two health-care systems, principally in terms of financing structures. The decomposition analysis highlights the important role for the particular structure of health-care entitlements in the Irish system in driving income-related inequity in GP visiting among Irish children. Given the patterns we observe in the Irish system, a key question concerns the extent to which those with a full medical card/GP visit card/PHI with GP cover may be visiting their GP 'unnecessarily' and/or the extent to which those with PHI with no cover for GP expenses, and those

[18] Bago d'Uva et al. (2009) exploit the additional information available in longitudinal data to improve the measurement of income-related inequity in health-care utilisation by including the time-invariant part of unobserved heterogeneity in the need standardisation procedure. While they find (using the ECHP), that many of the cross-country comparisons are 'fairly robust' to the panel data test, the panel estimates lead to significantly higher estimates of income-related inequity for most countries. This confirms that better estimation and control for need often reveals more pro-rich inequity in health-care utilisation (also found by Grasdal and Monstad (2011), among others).

with no cover, may be deterring 'necessary' GP visits due to the cost. Unfortunately, we cannot answer this question without much more detailed information on GP consultations (reason, length, *etc*.), although there is plenty of international evidence that user fees deter both necessary as well as unnecessary health-care utilisation (Robinson, 2002). In terms of policy implications, the key concern is whether those who must pay for GP at the point of use services deter necessary visits, particularly preventive care visits, which may lead to poorer health and more expensive secondary care in the future. In the past, Irish policy with respect to GP services has targeted benefits on the less well-off, rather than extending benefits to the entire population.[19] However, a recent report proposed a new system of entitlements and user fees which would extend varying levels of subsidisation for GP services (ranging from 20 per cent to 100 per cent) to the entire population (Ruane, 2010), and the current Programme for Government contains a commitment to the phased introduction of free GP care for the entire population by 2016 (Government of Ireland, 2011). In this context, analyses such as this provide important evidence on the impact of different health-care entitlement structures on the degree of income-related inequity in GP visiting among children.

[19] An exception was the extension of full medical cards to all those over 70 years of age in July 2001; this entitlement was subsequently revoked from January 2009, and all over 70s must undergo an income means test to determine their eligibility for a full medical card or GP visit card (although the income thresholds are considerably higher than those for the under 70s).

Figures and Tables

Table 1: Health-Care Entitlements, and GP Reimbursement Methods, in the Irish and Scottish Health-Care Systems[a]

	GP User Fee[b]	Prescription User Fee[b]	GP Reimbursement
IRELAND			
Full medical card	Free	€1.50c per item up to a maximum of €19.50 per family per month[c]	Primarily capitation; fee-for-service for selected 'special items of service'
GP visit card	Free	Full cost up to €144 per family per month; free thereafter[d]	Primarily capitation; fee-for-service for selected 'special items of service'
PHI with GP cover	Full cost, with full or partial reimbursement by PHI company	Full cost up to €144 per family per month; free thereafter[d]	Fee-for-service
PHI without GP cover	Full cost	Full cost up to €144 per family per month; free thereafter[d]	Fee-for-service
No cover	Full cost	Full cost up to €144 per family per month; free thereafter[d]	Fee-for-service
SCOTLAND			
All residents	Free at point of use	Free[e]	Primarily capitation; pay-for-performance elements under the *Quality and Outcomes Framework*

Notes:

[a] current as of March 2013

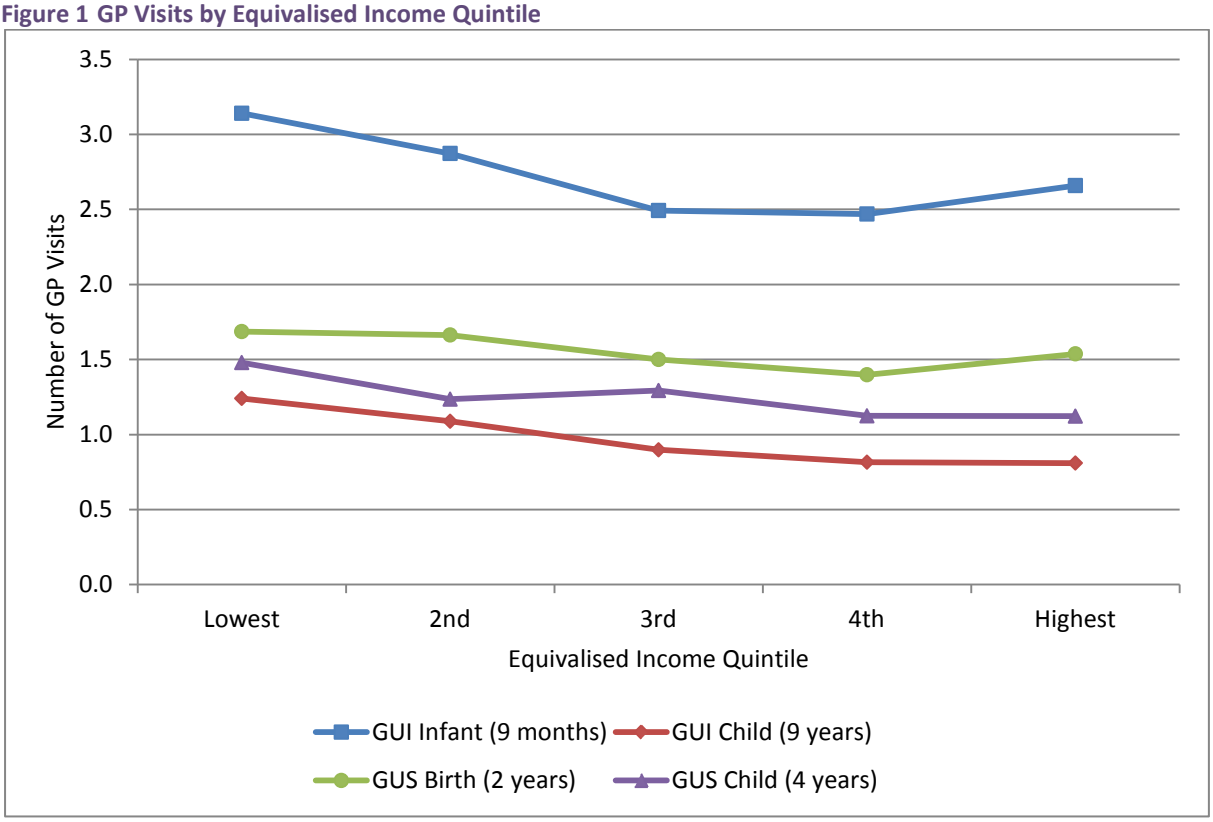
[b] In Ireland, tax relief at the standard rate (20 per cent) is available on certain medical expenses (including GP and prescription fees) that are not otherwise reimbursed by the State or PHI.

[c] In 2007-2009 (the period in which the Irish data used in this study were collected), there was no patient co-payment for prescription medicines for full medical card patients.

[d] In 2007-2009 (the period in which the Irish data used in this study were collected), the monthly deductible was €85 up to December 2007, €90 from January 2008 to December 2008 and €100 from January 2009 to December 2009 (Gorecki *et al.*, 2012). It further increased to €120 from January 2010, to €132 from January 2012, and to €144 from January 2013.

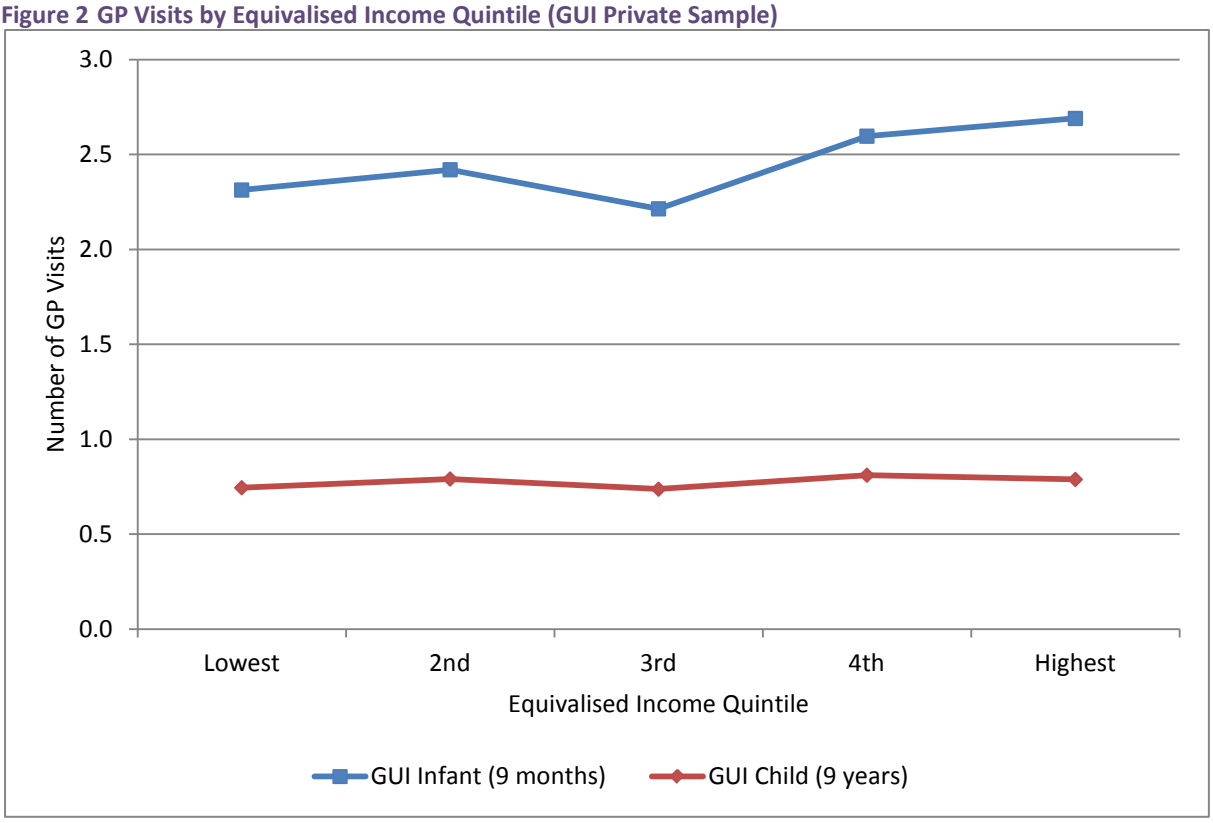
[e] During the period in which the Scottish data used in this paper were collected (2007-2008), a prescription charge of £6.85 per item applied in Scotland. However, prescriptions for children under the age of 16 years were exempt from the charge. From April 2007, the per-item charge was reduced gradually (£6.85 from April 2007 to £3.00 from April 2010), and abolished completely from 1 April 2011 (Information Services Division, 2011).

Figure 1 GP Visits by Equivalised Income Quintile



Note: Sample weights are employed.

Figure 2 GP Visits by Equivalised Income Quintile (GUI Private Sample)



Note: Sample weights are employed.

Table 2 Dependent and Independent Variable Definitions

	GUI Infant (Average age 9 months)	GUI Child (Average age 9 years)	GUS Birth (Average age 2 years)	GUS Child (Average age 4 years)
Dependent Variable				
GP visits[a]	Number of GP visits since birth	Number of GP visits in the previous year	Number of GP visits in the previous year	Number of GP visits in the previous year
Independent Variables				
Annual equivalised income[b]	Natural logarithm of annual equivalised net income	Natural logarithm of annual equivalised net income	Natural logarithm of annual equivalised net income	Natural logarithm of annual equivalised net income
Male	=1 if male	=1 if male	=1 if male	=1 if male
Female	=1 if female	=1 if female	=1 if female	=1 if female
Age	Age in years	Age in years	Age in years	Age in years
Number of siblings	Number of siblings	Number of siblings	Number of siblings	Number of siblings
Birth weight	Child birth weight in kgs	Child birth weight in kgs	Child birth weight in kgs	Child birth weight in kgs
Less than 37 weeks	=1 if early delivery (36 weeks or earlier)	=1 if early delivery (36 weeks or earlier)	=1 if early delivery (36 weeks or earlier)	=1 if early delivery (36 weeks or earlier)
37-41 weeks	=1 if on time delivery (37-41 weeks)	=1 if on time delivery (37-41 weeks)	=1 if on time delivery (37-41 weeks)	=1 if on time delivery (37-41 weeks)
42+ weeks	=1 if late birth (42+ weeks)	=1 if late birth (42+ weeks)	=1 if late birth (42+ weeks)	=1 if late birth (42+ weeks)
Very healthy[d]	=1 if very healthy, no problems	=1 if very healthy, no problems	=1 if very good	=1 if very good
Healthy[d]	=1 if healthy but a few minor problems	=1 if healthy but a few minor problems	=1 if good	=1 if good
Ill[d]	=1 if sometimes quite ill/almost always unwell	=1 if sometimes quite ill/almost always unwell	=1 if fair, bad or very bad	=1 if fair, bad or very bad

Notes: [a] The GUI Infant Cohort GP visiting question is: 'since <baby> was born, how many times have you seen, or talked on the telephone with any of the following about <baby's> physical health? (exclude at time of birth)', with the first of the five options being a GP or family physician. The GUI Child Cohort GP visiting question is: 'In the last 12 months, how many times have you seen, or talked on the telephone with any of the following about the Study Child's physical, emotional or mental health?' with the first of the three options being a GP. The GUS GP visiting question (identical for both cohorts) is: 'Which, if any, of the people on this card have seen ^childname in the last year, that is since ^month_of_interview, for any reason – not just about any problems or concerns you might have mentioned?', with the first of eight options being a local doctor or GP.

[b] The modified OECD equivalence scale used assigns a value of 0.67 to the first adult, 0.33 to all others aged 14 years and over, and 0.20 to all children aged 13 years and younger.

[d] While the wording of the question is identical in both cohorts of the GUI ('In general, how would you describe <baby's> current health?', the question refers to the baby's *current* health for the Infant Cohort, and to the child's health *over the past year* for the Child Cohort. In GUS, the question is: 'How is ^childname's health in general?'.

Table 2 continued

	GUI Infant (Average age 9 months)	GUI Child (Average age 9 years)	GUS Birth (Average age 2 years)	GUS Child (Average age 4 years)
Accident[e]	=1 if has ever had an accident	=1 if has ever had an accident	=1 if had accident in last year	=1 if had accident in last year
No accident[e]	=1 if has never had an accident	=1 if has never had an accident	=1 if did not have accident in last year	=1 if did not have accident in last year
Lone parent	=1 if lone parent family	=1 if lone parent family	=1 if lone parent family	=1 if lone parent family
Two parent	=1 if two-parent family	=1 if two-parent family	=1 if two-parent family	=1 if two-parent family
Non-degree or lower education	=1 if mother has no/primary/secondary/non-degree education	=1 if mother has no/primary/secondary/non-degree education	=1 if mother has no/primary/secondary/non-degree education	=1 if mother has no/primary/secondary/non-degree education
Degree or upper education	=1 if mother has degree/postgraduate education	=1 if mother has degree/postgraduate education	=1 if mother has degree/postgraduate education	=1 if mother has degree/postgraduate education
White	=1 if mother is of white ethnicity	=1 if mother is of white ethnicity	=1 if mother is of white ethnicity	=1 if mother is of white ethnicity
Non-White	=1 if mother is of mixed, black, Asian or other ethnicity	=1 if mother is of mixed, black, Asian or other ethnicity	=1 if mother is of mixed, black, Asian or other ethnicity	=1 if mother is of mixed, black, Asian or other ethnicity
Full medical card	=1 if full medical card with/without private health insurance (PHI)	=1 if full medical card with/without private health insurance (PHI)	n/a	n/a
GP visit card	=1 if GP visit card with/without PHI	=1 if GP visit card with/without PHI	n/a	n/a
PHI with GP cover	=1 if no medical card or GP visit card but has PHI with full or partial cover for GP expenses	=1 if no medical card or GP visit card but has PHI with full or partial cover for GP expenses	n/a	n/a
PHI without GP cover	=1 if no medical card or GP visit card but has PHI without full or partial cover for GP expenses	=1 if no medical card or GP visit card but has PHI without full or partial cover for GP expenses	n/a	n/a
No cover	=1 if no medical card, GP visit card or PHI	=1 if no medical card, GP visit card or PHI	n/a	n/a

Notes: [e] In the GUI Infant Cohort, the question is 'Many babies have accidents at some time. Has <baby> ever had an accident, injury, or swallowed something that required a visit to the doctor, health centre or hospital?', while in the GUI Child Cohort, the question is 'Most children have accidents at some time. Has the Study Child ever had an accident or injury that required hospital treatment or admission?'. In GUS, the question is: 'Most toddlers and small children have accidents at some time. Since we last saw you, has ^Childname had an accident or injury for which ^he has been taken to the doctor, dentist, health centre, or hospital?'.

Table 3 Actual Concentration Indices (C_a)

	(1) C_a GP visits	(2) C_a Birth weight	(3) C_a Gestation	(4) C_a Parental-assessed health	(5) C_a Accidents
GUI Infant (9 months)	-0.043 (0.009)***	0.007 (0.001)***	-0.107 (0.029)***	-0.038 (0.039)	0.030 (0.033)
GUI Child (9 years)	-0.101 (0.024)***	0.006 (0.001)***	-0.063 (0.024)**	-0.198 (0.072)***	-0.019 (0.012)
GUS Birth (2 years)	-0.028 (0.013)**	0.009 (0.002)***	0.001 (0.004)	-0.138 (0.035)***	-0.075 (0.017)***
GUS Child (4 years)	-0.054 (0.019)***	0.011 (0.002)***	0.000 (0.005)	-0.254 (0.048)***	-0.027 (0.026)

Table 4 Actual and Standardised Concentration Indices (C_a and HI)

	(1) C_a	(2) HI Adjusted for age, sex, health need[a] and income	(3) HI Adjusted for age, sex, health need[a], non-need[b] and income	(4) HI Adjusted for age, sex, health need[a], non-need[b], health-care entitlements[c] and income
GUI Infant (9 months)	-0.043 (0.009)***	-0.042 (0.009)***	-0.042 (0.009)***	-0.042 (0.008)***
GUI Child (9 years)	-0.101 (0.024)***	-0.051 (0.022)**	-0.052 (0.022)**	-0.053 (0.022)**
GUS Birth (2 years)	-0.028 (0.013)**	-0.001 (0.012)	-0.002 (0.012)	n/a
GUS Child (4 years)	-0.054 (0.019)***	0.004 (0.017)	0.002 (0.017)	n/a

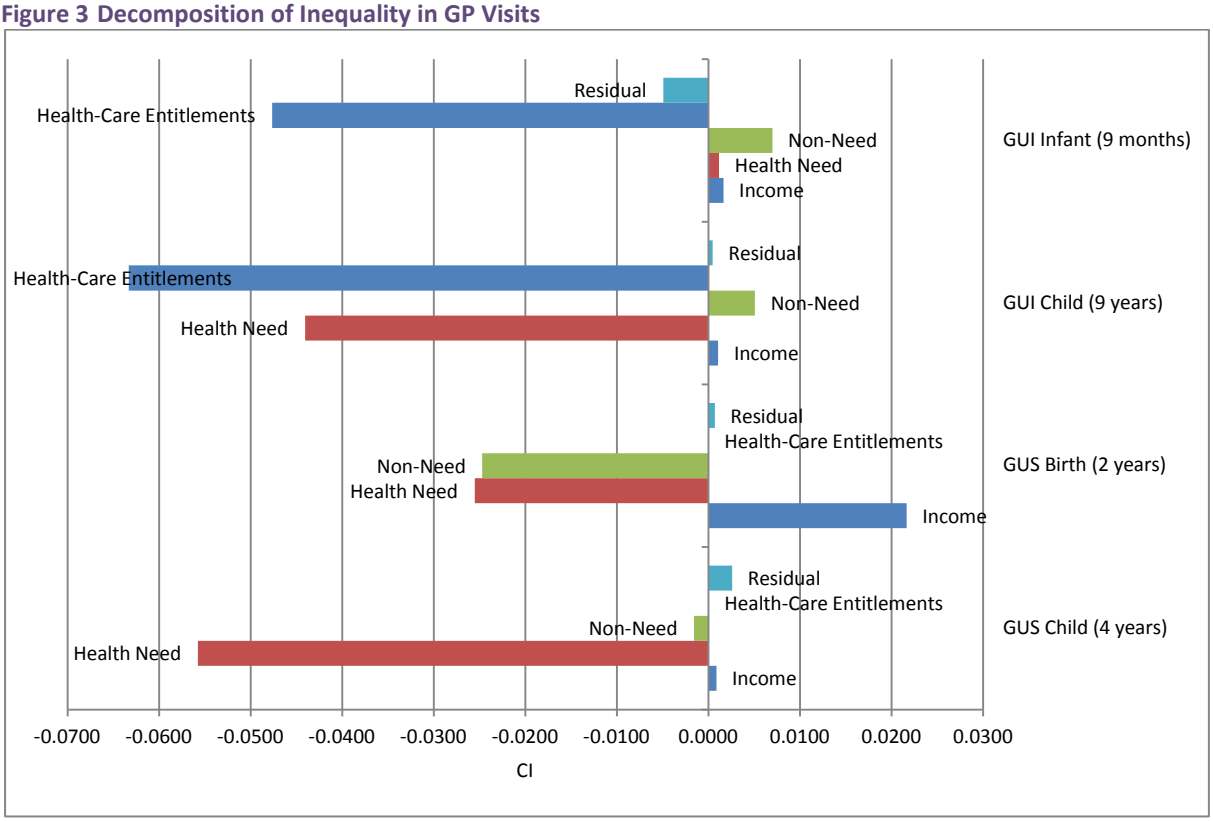
Notes:

[a] Health need variables are age, sex, birthweight, gestation, parental-assessed general health and accidents.

[b] Non-need variables are lone parent household, number of siblings, mother's education, mother's employment status and mother's ethnicity.

[c] The health-care entitlements variable is a five-category variable describing GUI health-care entitlements (i.e., full medical card; GP visit card; PHI with cover for GP expenses; PHI with no cover for GP expenses; no cover).

Figure 3 Decomposition of Inequality in GP Visits



Note: based on the OLS model of GP visits

Table 5 Actual and Standardised Concentration Indices (C_a and HI) - Contact and Frequency Decisions

	(1) C_a	(2) HI Adjusted for age, sex, health need[a] and income	(3) HI Adjusted for age, sex, health need[a], non-need[b] and income	(4) HI Adjusted for age, sex, health need[a], non-need[b], health-care entitlements[c] and income
PROBIT				
GUI Infant (9 months)	0.007 (0.003)**	0.007 (0.003)**	0.007 (0.003)**	0.007 (0.003)**
GUI Child (9 years)	-0.005 (0.010)	0.014 (0.010)	0.014 (0.010)	0.013 (0.010)
GUS Birth (2 years)	0.009 (0.006)	0.017 (0.006)***	0.017 (0.006)***	n/a
GUS Child (4 years)	-0.009 (0.010)	0.012 (0.009)	0.011 (0.010)	n/a
TRUNCATED NEGATIVE BINOMIAL				
GUI Infant (9 months)	-0.049 (0.008)***	-0.037 (0.006)***	-0.037 (0.006)***	-0.037 (0.006)***
GUI Child (9 years)	Does not converge			
GUS Birth (2 years)	-0.037 (0.012)***	-0.012 (0.008)	-0.013 (0.008)*	n/a
GUS Child (4 years)	-0.045 (0.015)***	-0.005 (0.010)	-0.005 (0.010)	n/a

Notes:

[a] Health need variables are age, sex, birthweight, gestation, parental-assessed general health and accidents.

[b] Non-need variables are lone parent household, number of siblings, mother's education, mother's employment status and mother's ethnicity.

[c] The health-care entitlements variable is a three-category variable describing GUI health-care entitlements (i.e., PHI with cover for GP expenses; PHI with no cover for GP expenses; no cover).

Table 6 Actual and Standardised Concentration Indices (C_a and HI) - GUI Private Sample

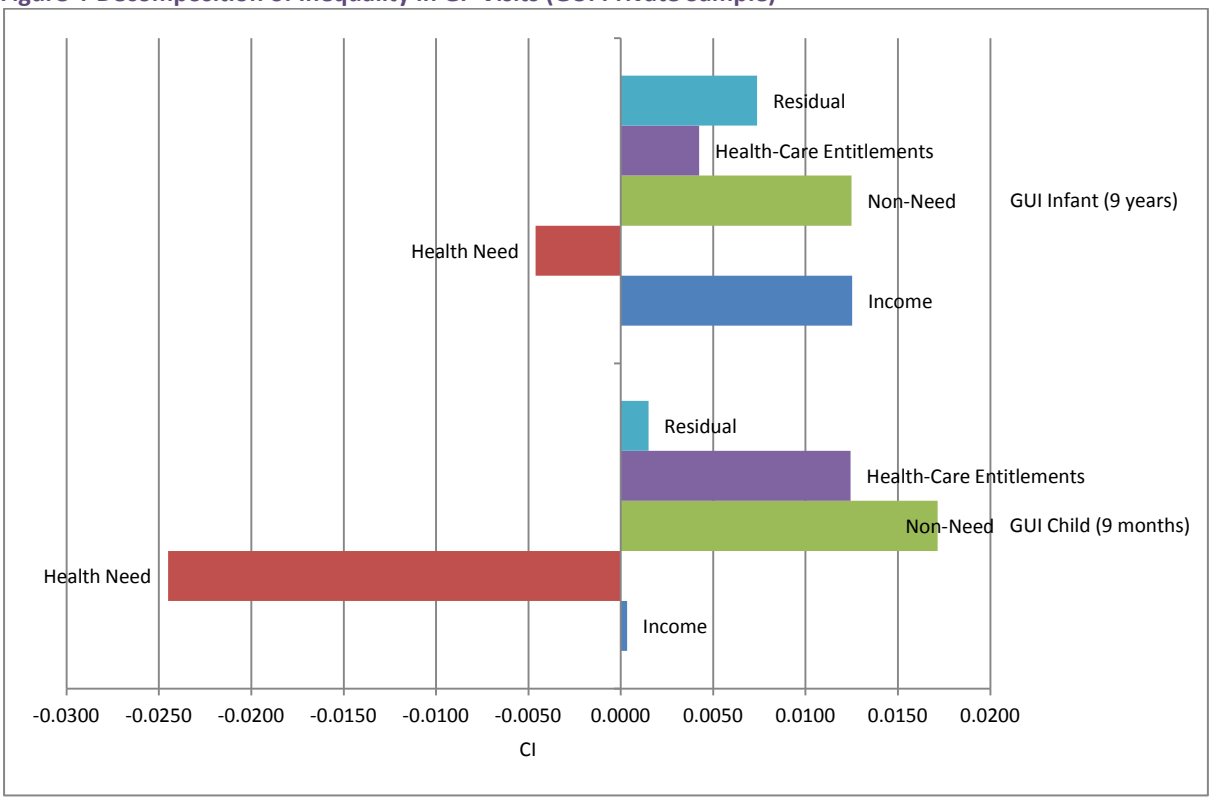
	(1) C_a	(2) HI Adjusted for age, sex, health need[a] and income	(3) HI Adjusted for age, sex, health need[a], non-need[b] and income	(4) HI Adjusted for age, sex, health need[a], non-need[b], health-care entitlements[c] and income
NEGATIVE BINOMIAL				
GUI Infant (9 months)	0.032 (0.009)***	0.034 (0.009)***	0.034 (0.009)***	0.034 (0.009)***
GUI Child (9 years)	0.007 (0.024)	0.030 (0.024)	0.029 (0.023)	0.029 (0.023)
PROBIT				
GUI Infant (9 months)	0.021 (0.004)***	0.021 (0.004)***	0.021 (0.004)***	0.021 (0.004)***
GUI Child (9 years)	0.044 (0.011)***	0.057 (0.011)***	0.057 (0.011)***	0.057 (0.011)***
TRUNCATED NEGATIVE BINOMIAL				
GUI Infant (9 months)	0.011 (0.008)	0.010 (0.006)*	0.010 (0.006)*	0.010 (0.006)*
GUI Child (9 years)	Does not converge			

[a] Health need variables are age, sex, birthweight, gestation, parental-assessed general health and accidents.

[b] Non-need variables are lone parent household, number of siblings, mother's education, mother's employment status and mother's ethnicity.

[c] The health-care entitlements variable is a three-category variable describing GUI health-care entitlements (i.e., PHI with cover for GP expenses; PHI with no cover for GP expenses; no cover).

Figure 4 Decomposition of Inequality in GP Visits (GUI Private Sample)



Note: based on the OLS model of GP visits.

Appendix

To ensure that our results are robust to the particular data and methods used for analysis, we undertake a number of robustness checks. First, as noted, for both surveys, the majority of the missing observations arise due to missing information on household income, with the problem more serious for GUS (approximately 7 per cent of GUI observations are missing information on income, while the corresponding figure for GUS is approximately 18 per cent). To ensure that our results are robust to the exclusion of these cases, we also run the analysis using imputed income values. Household income is imputed using the 'uvis' imputation command in STATA 12.1 (Royston, 2009), and we used indicators of maternal age, employment status, education, ethnicity and lone parent status to predict income values for missing cases. For all analyses presented in Tables 3-6, and Figures 3 and 4, the results are robust to the inclusion of additional observations with imputed income values.

Second, the crucial assumption of this approach to the measurement of income-related inequity in health-care utilisation is that the average relationship between utilisation and need is the implied norm for assessing equity in the health-care system (van Doorslaer *et al.*, 2004). A number of recent applications have questioned the validity of this approach (Sutton, 2002; Jones and López Nicolás, 2006; van de Poel *et al.*, 2012), particularly in developing countries where resource constraints may mean that the average relationship between need and utilisation is not an accurate reflection of the true relationship. In the Irish context, it is possible that the sharp dichotomy between those with access to free GP care and those without may imply that the observed average relationship between need and GP utilisation in the Irish system is not appropriate, i.e., for the large proportion of the population who must pay user fees for GP care, the amount of care received may not be an accurate reflection of need. Most analyses chose the group for which financial and other (e.g., geographic) barriers in accessing health care are least likely. To test whether utilisation responds differently to need, we follow the approach of van de Poel *et al.* (2012). We regress utilisation on health need in each of the five health-care entitlement groups in the GUI samples to test for the equality of the health need coefficients across the various health-care entitlement groups. All tests are not rejected, and so we assume that the average relationship between utilisation and need is appropriate.

Third, the need-standardised CIs derived from non-linear models (such as the negative binomial, probit and truncated negative binomial which are used in our analysis) are contingent on the values used for the non-need variables, and therefore contains approximation errors. We therefore ran the analysis using median rather than mean values for the non-need variables (Grasdal and Monstad, 2011), and found no differences in the estimated CIs and HIs.

Fourth, in the case of a non-linear model, the decomposition is an approximation only (and therefore the CI of the error term includes both an estimation error and an approximation error) (Vallejo-Torres and Morris, 2012, forthcoming). In common with others in the literature (e.g., van

Doorslaer *et al.* (2004)), we base the decomposition results presented in Figures 3 and 4 on those from the linear model. However, we also ran the decomposition using the results from the non-linear models, and while the residual component is higher (as expected), the broad patterns observed in Figures 3 and 4 holds across the various components, both within and across cohorts.

Finally, a particular feature of these types of analyses is that the more extensive the indicators of health need used in the need standardisation process, the smaller the extent of 'pro-poor' inequity (van Doorslaer *et al.*, 2008). This is because poor health tends to be concentrated among those on lower incomes. As noted, to ensure comparability between and within the GUI and GUS samples used in this analysis, we focused on a comparable group of health need indicators (i.e., birth weight, gestation, parental assessed health and accidents). However, we also tested a wider set of health need indicators (all of which are not available in all four samples)[20], and while the extent of 'pro-poor' inequity in the GUI samples falls as expected, the 'pro-poor' distribution of GP visits remains significant. The results for the GUS samples remain unchanged.

More detailed results of all these robustness checks are available on request from the authors.

[20] For all samples, we tested the inclusion of variables relating to chronic illness incidence, acute illness (GUI Infant Cohort only), child sleeping problems (GUI Infant and both GUS cohorts), breast feeding, mother's smoking and drinking during pregnancy, and current childcare arrangements.

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