A Cross National panel Data Analysis of Multidimensional Deprivation

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A Cross National Panel Data Analysis of Multidimensional Deprivation

A thesis submitted in partial fulfillment of the requirements for the award of the degree

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Statement of Originality

I, Melissa Ljubic, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Bachelor of Commerce (Honours) in Economics at the University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The work contained in this thesis has not been previously submitted for a degree or other qualification at any other higher education institution. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made.

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Date: 16/12/2013

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This thesis also uses unit record data from a set of Cross-National Equivalent Files (CNEF) that contain equivalently defined variables for the Household Income and Labour Dynamics in Australia (HILDA), the Panel Study of Income Dynamics (PSID), the Swiss Household Panel (SHP), and the German Socio-Economic Panel (SOEP). The CNEF is administered by Cornell University in close collaboration with the researchers from several institutions including: the Socio-Economic Panel Study at the German Institute for Economic Research (DIW Berlin), in Berlin, the Institute for Social and Economic Research (ISER) at the University of Essex, Statistics Canada in Ottawa, the Survey Research Center at the University of Michigan, the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute), the Swiss Foundation for Research in Social Sciences (FORS), the University of Lausanne, Demoscope and the Higher School of Economics in Moscow, Russia, the University of North Carolina at Chapel Hill, and the Korea Labor Institute.

The findings and views reported in this paper, however, are those of the author and should not be attributed to any of the institutions mentioned above.

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Abstract

The aim of this research is to examine the role of duration and persistence for measuring multidimensional deprivation firstly in a modern Australian context. Secondly, to extend this with a cross national comparison of Australia, the United States of America, Switzerland and Germany using a series of Cross National Equivalent Files (CNEF). Through the use of the Household Income and Labour Dynamics in Australia (HILDA) survey and the methodology outlined by Nicholas and Ray (2012), levels of multidimensional deprivation are calculated for men and women. The index is also disaggregated by age with reference to the 40 to 49 age group in Wave 1 of the survey in 2001. The properties of the deprivation index allow for decomposition by dimension, time period and population subgroups. These properties are important as they sensitize the index to movements in poverty levels.

The methodology outlined by Nicholas and Ray (2012) is a pioneering work within the literature on multidimensional deprivation. It blends theory and empirical application to the construction of a dynamic, multidimensional index of deprivation. A major intention of this thesis is to undertake an in depth exploration of the role of duration of deprivation for comparison between subgroups in the Australian population. The evaluation of dynamic factors in the analysis of multidimensional deprivation is expanded to incorporate the impact of the persistence of deprivation for the comparison between subgroups in the Australian population. It will also assess how accounting for the duration and persistence of deprivation on the augmented deprivation score ratios will impact the relationship between each group.

The results indicate there is a disparity between deprivation outcomes for women and men. Overall women are found to be deprived relative to men and it is the duration of deprivation rather than persistence that contributes the most to this outcome. The relationship between multidimensional deprivation and age is more complex. When the full set of eleven dimensions is considered, deprivation levels appear to be quite even between age groups. For a subset of material resource dimensions however there does appear to be a negative relationship between age and deprivation levels consistent with the findings of Siminski and Yerokhin (2012). The older cohorts are more likely to possess higher levels of wealth and home ownership and were found to have low levels of total deprivation which contributed to this result. The results of the cross national comparisons tended to reveal a similar pattern, whereby levels of relative deprivation between Australia and the other countries were exacerbated when the duration of deprivation was taken into account. A notable example was the comparison of Australia and Switzerland. Deprivation levels were considerably heightened when the duration of deprivation was taken into account. The inclusion of greater weight for persistent periods of deprivation tended only to marginally reinforce this outcome.

Chapter 1: Introduction

1.1 Motivation

The task of quantifying the extent of poverty is a challenge that has occupied social sciences including economics since the late 18th century (Ravallion 2011b). The emergence of this literature is in part due to the need to develop more targeted and effective social policy (Rodgers 2010). Secondly an increase in the prominence of the plight of the poor in developing countries has motivated institutions like the World Bank Group and the United Nations Development Programme to work towards large scale reductions in global poverty (Wade 2004). The premise being that poverty can be reduced or even eliminated with the right economic and social policies. Such marked a change in the philosophical view of poverty from a natural consequence of the economic system to a social issue that could be addressed for the benefit of society overall (Townsend 1979).

A high prevalence of poverty in society has consequences. One consequence of chronic poverty is social exclusion. Social exclusion is defined as a process whereby an individual finds it difficult to participate in society due to the disproportionate decline in resources relative to needs. Chronic poverty, particularly in childhood, is tied to other detrimental outcomes later in life including poor health and crime (Miranti et al 2010). Certain groups in society are known to be more likely to experience social exclusion as a result of relative income poverty including those who are unemployed, not in the labour force, those dependent on income support as well as single and lone parent households (McLaughlin et al 2013). The first World Development Report published by the International Bank for Reconstruction and Development in 1990 was emphatic in

its declaration of the importance of social policies to address poverty. The report stated that "no task should command a higher priority for the world's policymakers than that of reducing global poverty. In the last decade of the twentieth century it remains a problem of staggering dimensions" (World Bank 1990). Hence there is a need to identify and quantify the extent of poverty in a given context.

1.2 Evolution of Poverty Measurement

Traditionally, the measurement of poverty is a comparison of uni-dimensional measures such as income or expenditure relative to needs. A household can be considered poor using a relative income poverty standard, if the income of the household is less than a fixed proportion of the median household income where all incomes are adjusted for household needs using an equivalence scale (Wilkins 2013). The extent of chronic or persistent poverty is also an area of research interest. Chronic poverty is defined as an involuntary and persistent deficit of resources relative to needs whereas transitory poverty is the occasional shortage of resources relative to needs (Rodgers 2010). The importance of a dynamic poverty index stems from the notion that consecutive periods below the poverty line are said to be of greater detriment to wellbeing than the occasional poverty spell (Gradin et al 2012). The greater acceptance of the dynamic features of poverty necessitated a shift in the means of measuring poverty.

Another important step in the advancement of poverty measures was the shift in focus from a single dimension, such as income, to the notion of multidimensional deprivation (Alkire and Foster 2011a). The shift in focus was assisted by the pioneering work of economist Amartya Sen. Sen's 1985 work *Commodities and Capabilities* argues that to better understand poverty one must appreciate the

difference between a person's wellbeing and their level of advantage. The former refers to a person's achievement level or their ability to successfully attain a comfortable life and the latter refers to the real opportunities to achieve a state of wellbeing (Sen 1985). From this it is not enough simply to calculate an individual's wellbeing or discern whether or not they can be considered poor simply based on the quantity of goods they possess. Sen invented the term "functionings" which describes the achievement of a person, meaning what they are able to accomplish given their circumstances in life. Capabilities represent an individual's freedom to choose between alternatives, or the set of functionings. The choice of dimensions is often tied to the capabilities and functionings framework (Ele-Ojo Ataguba et al 2013). The essence of studies of multidimensional deprivation is to extend empirical measurements of poverty to incorporate the challenges of welfare measurement by taking into account the individual's capabilities.

1.3 Contributions

The methodology outlined in Nicholas and Ray (2012) is a pioneering work within the literature on multidimensional deprivation. It blends theory and empirical application to the construction of a dynamic, multidimensional index of deprivation. This thesis aims to contribute to the literature by adopting the methodology outlined in Nicholas and Ray (2012) and extending the analysis to a multinational comparison of Australia, Germany, the United States and Switzerland. Another major intention of this thesis is to undertake an in depth exploration of the role of duration of deprivation for comparison between subgroups in the Australian population. The evaluation of dynamic factors in the analysis of multidimensional deprivation is expanded to incorporate the impact of

the persistence of deprivation for the comparison between subgroups in the Australian population. It will also assess how accounting for the duration and persistence of deprivation on the augmented deprivation score ratios will impact the relationship between each group.

1.4 Overview

The thesis is organised as follows: chapter two presents an overview of uni-dimensional deprivation measures beginning with Sen (1976) and continuing with the Foster, Greer and Thorbecke class of decomposable poverty measures. Chapter three outlines in greater detail the theoretical underpinnings of an index of multidimensional deprivation including the capabilities and functionings framework. It also examines the development of a methodology to calculate a multidimensional deprivation index following Alkire and Foster (2011a) and Nicholas and Ray (2012, 2013). Chapter four is a review of previous empirical studies of multidimensional deprivation beginning with Townsend (1979). The review has two main components, an analysis of latent variable models favoured by European authors and the use of an index of multidimensional deprivation applied in many countries including in Australia, India and China. Chapter five is an overview of each data used in the empirical component of this thesis including the selection of each sample and dimensions utilised. Chapter six outlines the methodology developed by Nicholas and Ray (2012). Chapter seven presents the results of the empirical analysis and chapter eight concludes with a discussion of the implications of the choice of dimensions and avenues for further research.

Chapter 2 Overview of Uni-Dimensional Poverty Measurement

2.1 Introduction

This chapter outlines the measurement of uni-dimensional deprivation also often described as income or consumption poverty. Methods of calculating income poverty are very well established in the literature. Attempts to quantify poverty began as early as 1899 in York by Seebohm Rowntree who identified poverty as families with 'total earnings that are insufficient to obtain the minimum necessaries for the maintenance of merely physical efficiency' (Townsend 1979, 33). The examination of an index of poverty begins with an overview of an ordinal index of poverty developed by Sen (1976). It continues with the seminal work of Foster, Greer and Thorbecke (1984) who developed a class of decomposable poverty measures that satisfies properties such as additive decomposability, monotonicity and transfer sensitivity. These early measures are static however the importance of identifying chronic poverty necessitated a transition to a dynamic measure of poverty. The chapter concludes by detailing the construction of a dynamic index of uni-dimensional poverty.

2.2 Quantifying Income Poverty

Sen (1976) identifies two key issues for the study of income poverty. The first is to identify the poor among the total population, the second to aggregate this information into an index. The index combines two conceptually simple calculations, the headcount ratio or proportion of the poor with respect to the rest of the population and the poverty gap measure or the aggregate shortfall of the income of all poor from the poverty line. Each with their own limitations the headcount ratio is insensitive to the intensity of poverty and the poverty gap is insensitive to the number of people who are poor. In order to link the analysis of

income and welfare Sen (1976) constructs a poverty index based on the following set of axioms.

The Relative Equity Axiom states for any pair of individuals, i and j if $W_i\left(\underline{y}\right) < W_j(\underline{y})$ or the relative welfare of *i* given *y* level of income is less than the relative welfare of *j* then the weight given to the income shortfall should be higher for person *i* or $v_i(z,y) < v_j(z,y)$ where z is the relative income poverty line. The use of a general additive form of ordinal rankings gives rise to Axiom R (Ordinal Rank Weights) which means that the weight $v_i(z,y)$ on the income gap of person *i* equal the rank order of *i* in the interpersonal welfare ordering of the poor. Using the crude assumption that higher wealth also equals a higher level of welfare then the Monotonic Welfare Axiom can be formally expressed as follows for individuals i and j if $v_i > v_j$ then $W_i\left(\underline{y}\right) < W_j(\underline{y})$. Lastly Axiom N (Normalized Poverty Value) states that if all poor have the same income then a poverty index is simply the product of the headcount ratio and the poverty gap. The Gini Coefficient is utilised to identify the income distribution of the poor. A proposed poverty measure can be formalised in equation 2.1 where q represents the number of people classified as poor or living in poverty, H represents a poverty headcount ratio and I represents an income gap.

$$P = H\left[1 - (1 - I)\left(1 - G\left(\frac{q}{q+1}\right)\right)\right] \qquad 2.1$$

Both H and I are somewhat useful as they show the proportion and degree of income poverty within the population. There are two parts to the index, an absolute deprivation component represented by I and the relative deprivation component, with the rank order of the poor used as a weighting scheme. Such has

been augmented by the Gini coefficient (G) to show the distribution of income among the poor. The index can be extended from a measure of poverty to a measure of inequality by replacing the number of poor (q) with the total population and replacing the poverty line with the mean income of the population. The assumption behind the monotonic welfare axiom, that a richer person has a higher level of welfare, is problematic; hence the gap that the study of multidimensional deprivation attempts to fulfil.

2.2.1 Foster, Greer and Thorbecke Extension

Foster, Greer and Thorbecke (FGT) (1984) adapted Sen's index to reflect an alternative weighting scheme for relative deprivation. Instead of rank order of the poor the FGT class of decomposable measures adopt the magnitude of deprivation through the normalised gap that is the "extent of the difference between the desired situation and that of the person desiring it" (Foster, Greer and Thorbecke 2010, 495). The FGT class decomposable measures are developed as follows let $y = (y_1, y_2, \dots, y_n)$ be the vector of household incomes in increasing order. Let $z > 0$ be a predetermined poverty line such that $g_i = z - y_i$ becomes the income shortfall of the *i*th household. The total number of poor households is shown by $q = q(y; z)$ and $n = n(y)$ is the total number of households. The poverty measure P is then defined as

$$P(y\,; z) = \frac{1}{nz^2}\sum_{i=1}^{q} g_i^2 \qquad 2.2$$

Such is a normalised weighted sum of income shortfalls of the poor. It gives greater weight to those further from the relative poverty line. It also satisfies dominance conditions through the monotonicity and transfer axioms. The monotonicity axiom states, given other things, a reduction in the income of a poor

household must increase the poverty measure. The transfer axiom states, given other things, a transfer of income from a poor household to any other household that is richer must increase the poverty measure. The index described thus far fits with the index outlined by Sen (1976). The FGT class of decomposable poverty measures departs from this as follows.

The transfer sensitivity axiom emphasises transfers between the poorest households. The poverty measure defined in equation 2.2 does not satisfy the transfer sensitivity axiom. The transfer sensitivity axiom, states that if a transfer t > 0 of income takes place from a poor household with income y_i to a poor household with income $y_i + d$ (where $d > 0$) then the magnitude of the increase in poverty must be smaller for a larger y_i This necessitated a new class of decomposable poverty measures for $\alpha \geq 0$ where the poverty measure P_α is now given by

$$P_\alpha(y; z) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{g_i}{z}\right)^\alpha \qquad 2.3$$

For $\alpha = 0$ the index becomes a headcount ratio, for $\alpha = 1$ the index becomes the poverty gap and for $\alpha = 2$ greater weight is given to those furthest from the poverty line. As the size of alpha increases greater emphasis is given to the poorest households hence the parameter alpha becomes an indicator of poverty aversion. The monotonicity axiom holds for values of $\alpha > 0$ because the headcount ratio is insensitive to changes in personal poverty levels. The transfer axiom holds for values of $\alpha > 1$ and the transfer sensitivity axiom, holds for $\alpha > 2$. The FGT class of decomposable poverty measures have become

ubiquitous within the literature on poverty measurement (Foster, Greer, Thorbecke 2010).

The decomposability axiom allows the researcher to discern which groups in society are experiencing higher levels of disadvantage in order to develop targeted policy measures that can improve overall poverty levels. For instance, if the population is divided into m collections of j households where $j = 1, \dots, m$ and income is proportional to the size of households. For any income vector *y* broken down into subgroup income vectors $y^{(1)}, \dots, y^{(m)}$ the poverty index is additively decomposable with population share weights, meaning that an increase in poverty for a subgroup will increase total poverty. The subgroup monotonicity axiom requires that the larger the share of the population the greater its impact on the whole. The FGT class of decomposable poverty measures can be expressed formally as follows

$$P_\alpha(y; z) = \sum_{j=1}^{m} \frac{n_j}{n} P_\alpha(y^{(j)}; z) \qquad 2.4$$

2.2.2 Dynamic Extension

Foster (2009) extends the FGT class of decomposable poverty measures P_α to incorporate chronic poverty K_α. Assuming a set of {1,…, N} individuals in {1,…, T} periods let $y = (y_{it})$ be a matrix of non-negative observations, such that y_{it} is the income of individual *i* in period *t*. Each column vector y_i shows the individual i's income over time and each row vector y_t gives the distribution of income in period t. The analysis assumes the use of real household equivalized income so that a common poverty line *z* is established across periods. Let *g* be a matrix of normalized income gaps whereby $g_{it} = 0 \; if \; y_i \geq z$ and therefore the *i*th

individual is not considered poor and $g_i^t = (z - y_i^t)/z$ if otherwise. Let s be a matrix of the squared normalized income shortfalls such that $s_i^t = (g_i^t)^2$. It is therefore straightforward to transform g into a new matrix h of binary indicators that is if $g_{it} > 0$ then $h_{it} = 1$, and person i is considered poor and if $g_{it} \leq 0$ then $h_{it} = 0$ and person i is not poor. From this the duration (d) of individual *i's* poverty is the fraction of time spent below z which can be denoted $d_i = |h_i|/T$.

Chronic poverty is classified as a prolonged period under the poverty line, at least as long as an arbitrary period τ. If $d_i < \tau$ observations in the *i*th column of the matrix are replaced by zeros which isolates only those cases of chronic poverty. When $\tau = 0$ all instances of poverty are included analogous to the union method of identifying poverty and when $\tau = 1$ only a person considered poor in every period is identified as chronically poor analogous to the intersection method of identifying poverty. The next stage is to aggregate all individuals considered chronically poor by selecting a set Z from {1, …, N} such that $k(y\,;z)$ is the overall level of poverty. The aggregation method proposed is the dual cut-off method whereby the first cut-off is the poverty line $z > 0$, that determines whether or not an individual is considered poor in the given period. The second step specifies a value for τ, where τ is the proportion of time spent below the poverty line that qualifies an individual as chronically poor such that $0 \leq \tau \leq 1$. Formally the set of individuals experiencing chronic poverty is denoted by $Z = \{i: d_i \geq \tau\}$ and from this it follows that the poverty index is a function $K(y\,;z,\tau)$.

A description of the class of dynamic poverty measures K_α is given as follows. The headcount ratio is simply the proportion of a given population considered

chronically poor denoted $H = (y; z, \tau) = Q(y; z, \tau)/\, N$ where *N* is the population size of *y*. However, the headcount ratio violates the time monotonicity axiom, whereby if income in a given period falls for a chronically poor person, such that the duration of poverty increases, the level of chronic poverty should also increase. Therefore to account for the duration of poverty let $d_i(\tau) = |h_i(\tau)|/T$ show the duration of poverty of individual *i* and if $d_i(\tau) = d_i$ the individual *i* is considered chronically poor and if $d_i(\tau) = 0$ the individual is not chronically poor. The average duration of chronic poverty in society is shown by $D(\tau) = (d_1(\tau) + \cdots + d_N(\tau))/\, Q$. The duration adjusted headcount is a product of these two partial indices $K_0 = HD$. However K_0 violates the income monotonicity axiom because it is not sensitive to a change in the income of the poorest chronically poor person. A modification of K_0 is therefore required to account for the magnitude of the income gap.

The aforementioned matrix g enables the adaptation of K_0 to account for the magnitude of the income gap. Let $g(\tau)$ be a matrix of the normalised gaps of chronically poor individuals. The number of non-zero entries in $g(\tau)$ is $|h(\tau)|$ and the sum of non-zero entries in $g(\tau)$ is $|g(\tau)|$ hence the ratio $G = |g(\tau)|/|h(\tau)|$ gives the average size of normalized gaps across all periods in which the chronic poor are in poverty. The duration adjusted poverty gap index K_1 is therefore given by $K_1 \equiv K_0 G \equiv HDG$ that accounts for the prevalence, duration and depth of chronic poverty. Lastly K_2 is the duration adjusted FGT measure that gives greater weight to the impact of a decrease in income for an individual with a lower level of income. The premise being that the impact of a loss of income should be proportional to the distance between an individual's income and the poverty line. The matrix $s(\tau)$ shows the squared normalised gaps

of the chronically poor, therefore K_2 is derived from K_0 as shown by $K_2 \equiv K_0 S \equiv HDS$. The dynamic poverty indices K_α are analogous to their static counterparts P_α and thereby satisfy the same set of axioms.

2.3 Conclusion

Applying income poverty measures such as the ordinal poverty index outlined by Sen (1976) to the measurement of welfare can be problematic. In particular the assumption behind the monotonic welfare axiom, that states a richer person has a higher level of welfare. The shortfall weighting method was motivated by the challenge to make the index responsive to the level of poverty experienced by an individual, represented by the poverty aversion parameter alpha. For $\alpha = 2$ the poverty index P_α becomes the squared gap measure or the normalised weighted sum of income shortfalls of the poor. It gives greater weight to those further from the relative poverty line. The class of decomposable poverty measures developed by Foster, Greer and Thorbecke (1984) satisfy several key axioms. An example of such being subgroup decomposability whereby each sub population has their own level of poverty. The dynamic extension proposed by Foster (2009) enabled the index to account for chronic periods of poverty. Such was an important step in the development of a poverty index. The indices outlined in the class of decomposable poverty measures are broadly applicable to the study of poverty, inequality and wellbeing.

Chapter 3 Theoretical Justifications for the Multidimensional Measurement of Poverty

3.1 Introduction

This chapter outlines the theoretical context for an analysis of multidimensional deprivation. It begins by summarising the capabilities and functionings framework as a new perspective of the welfare economics paradigm. It discusses how the choice of dimensions is a link between the capabilities and functionings theory and the study of multidimensional deprivation. It then shows how Alkire and Foster (2011a) build on the previously established FGT class of decomposable poverty measures but extend them to allow for multiple dimensions. It goes on to describe how extensions to the multidimensional index have enabled a dynamic analysis of multidimensional deprivation. Properties of the index developed in Nicholas and Ray (2012) are subsequently examined. The chapter concludes with a consideration of an alternative means of measuring multidimensional deprivation through latent variable analysis.

3.2 Capabilities and Functionings Framework

The capability argument states that to better understand the impact of poverty one must appreciate the difference between a person's wellbeing and their level of advantage. The former refers to a person's achievement level or their ability to successfully attain a comfortable life while the latter refers to the real opportunities to achieve a state of wellbeing (Sen 1985). Therefore it is not enough simply to calculate an individual's wellbeing or discern whether or not they can be considered poor simply based on the quantity of goods they possess. Sen created the term "functionings" which describes the actual achievement of a person, what they are able to accomplish given their circumstances in life.

Capabilities represent an individual's freedom to choose between alternatives, or the set of functionings (Sen 1992, 83). The choice of dimensions of deprivation is often tied to the capabilities and functionings framework (Ele-Ojo Ataguba et al 2013). The aim of studies of multidimensional deprivation is to extend empirical measurements of poverty to incorporate the challenges of welfare measurement by taking into account the individual's capabilities. The choice of dimensions is a judgement that combines the capabilities and functionings theory and an understanding of the context under examination. While it can be difficult to find consensus on the most important dimensions, it can be argued that certain dimensions such as health or employment status are relatively more important than others (Anand, Krishnakumar, & Tran, 2011). The capabilities and functionings framework is important because it contributed to a novel understanding of welfare economics, the theory of poverty and related assessments.

A multidimensional index cannot fully characterise the nature of poverty. The aim is to measure poverty in a new way to incorporate aspects of wellbeing that an income only analysis may overlook. Commodities can be viewed in terms of their characteristics, for example, food can be understood in terms of its ability to satisfy hunger and provide nutrition. It also performs social functions and has a role in celebrations. However, these characteristics do not necessarily reveal what a person will do with these commodities. Even with the same set of commodities the innate diversity of human beings by age, gender and genetics will result in different capabilities. Individual differences must be taken into account as they impact the individual's ability to convert income or commodities into wellbeing.

Studies of multidimensional deprivation attempt to choose dimensions that reflect the capabilities of an individual given their unique set of functionings.

3.3 Development of an Index of Multidimensional Deprivation

Alkire and Foster (2011a) build on the FGT class of decomposable poverty measures and extend them to create a class of multidimensional poverty measures M_α. Each dimension has its own deprivation cut-off and each threshold is determined independently from the distribution of the dimension. Such means that improvement in one dimension may not compensate for increased deprivation in another (Bourguignon and Charkravarty 2003). Using a matrix to describe outcomes, each row contains a vector of an individual's achievement and each column contains the vectors of achievement levels in a given dimension. The dual cut-off method requires that a range of dimensional variables will be selected from the available data in the form of a $(n \times d)$ data matrix, *Y*, for *n* persons given $d \geq 2$ dimensions. Given a vector of deprivation cut-offs $z = (z_1, \dots, z_d)$ if a person's achievement in a given dimension, x_{ij} is less than the cut-off z_j the person is said to be deprived. The importance of certain dimensions may be given additional significance given a vector of weights $w = (w_1, \dots, w_d)$. If all dimensions are of equal weight the sum of *w* equals the number of dimensions, *d*. The column vector $c = (c_1, \dots, c_n)$ measures the cumulative sum of deprivations suffered by the *i*th individual. The poverty cut-off, k satisfying $0 \leq k \leq d$ determines whether an individual has sufficient deprivations to be considered poor. An example of the dual cut-off method is illustrated as follows: if $k = 2 \; and \; d = 4$ and the vector of deprivation cut-offs is given by z = [5,15,10,3] the achievement matrix Y is given by

$$Y = \begin{pmatrix} 2 & 11 & 3.1 & 5 \\ 6 & 7 & 12 & 2.5 \\ 7 & 19 & 15 & 8 \\ 8.1 & 14 & 11 & 4 \end{pmatrix}$$

From this, a deprivation matrix g is coded 'one' if the individual is considered deprived that is $x_{ij} < z_j$ and 'zero' if otherwise. The censored deprivation matrix g(k) shows only those cases where the sum of deprivation counts is greater than the poverty cut-off as shown by $c_i > k$. Three individuals are shown to be deprived in g. However, using the dual cut-off method only two individuals are considered deprived in a multidimensional sense.

$$g = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \qquad c = \begin{pmatrix} 4 \\ 2 \\ 0 \\ 1 \end{pmatrix}$$

$$g(k) = \begin{pmatrix} 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix} \qquad c(k) = \begin{pmatrix} 4 \\ 2 \\ 0 \\ 0 \end{pmatrix}$$

The value of k is an intermediate point between two contrasting methods of identifying the poor. Firstly, the union method whereby person *i* is considered poor if there is at least one dimension in which they are deprived. Such can be formally described as $\rho(y_i; z) = 1 \; if \; c_i \geq 1$. The problem being that if there are many dimensions it is likely that the analysis will be too broad as most of the population will be considered deprived. The second approach is the intersection method whereby person *i* is considered poor only if they are deprived in all dimensions that is $\rho(y_i; z) = 1 \; if \; c_i \geq d$. Whilst this approach will highlight those people experiencing a high level of multidimensional deprivation, it can miss those experiencing a deprivation across many but not all dimensions. The approach taken by Alkire and Foster (2011b) is to choose an intermediate point,

let ρ_k be the intermediate point such that $\rho_k(y_i; z) = 1\ whenever\ c_i \geq k\ and\ \rho_k(y_i; z) = 0\ when\ c_i < k$. This means that the function ρ_k will identify the *i*th person as poor when the number of dimensions in which they are deprived is at least k; otherwise they are not considered poor.

The dual cut-off method is poverty focused meaning an increase in the achievement level of a non-poor person does not affect the index. Similarly it is deprivation focused meaning that an improvement in a dimension where the individual is not deprived, that is $y_{ij} \geq z_j$ also does not prevent an individual from being identified as poor if they are deprived in the dimensions considered in the analysis. The notation for the class of multidimensional poverty measures are akin to those previously outlined with small modifications as follows. The identification measure ρ_k is associated with the set of poor given by $Z_k = \{i: \rho_k(y_i; z) = 1.$ Let $g^{\alpha}(k)$ be the matrix of achievement derived from g^{α} censored so that entries for individuals not considered deprived are coded with zeros and the matrix becomes a function of the identification variable expressed formally as $g_{ij}^{\alpha}(k) = g_{ij}^{\alpha}\rho_k(y_i; z)$. The adjusted headcount ratio now defines the extent of deprivation for those considered deprived in multiple dimensions multiplied by the number of people identified as poor through the dual cut-off identification method. Whilst the approach pioneered by Alkire and Foster (2011a) is appropriate for ordinal data that suits the dichotomous classification of deprived or not deprived this is not the only way to assign deprivation status. Belhadj and Limam (2012) introduced fuzzy sets theory on the assertion that the identification process should be more subtle than all those with an income below the threshold or those who are deprived in at least k dimensions are considered

poor and all those above the threshold not poor. Although this is an interesting direction for research it will not be considered here.

The headcount ratio is given by $H = H(y; z)$ where $H = q/n$ and q is the number of people considered poor identified through the function ρ_k and where $q = q(y; z) = \sum_{i=1}^{n} \rho_k(y_i, z)$. The average deprivation share is a censored vector of deprivation counts $c(k)$ by $c_i(k) = \rho_k(y_i; z)c_i$ for $i = 1, \dots, n$ times the average deprivation share of the poor given by $A = |c(k)|/(qd)$. The adjusted headcount ratio can be formally expressed as $M_0 = HA = \mu(g^0(k))$. The adjusted poverty gap is once again the product of the adjusted headcount ratio and the average poverty gap G. It is given by the sum of the normalised gaps of the poor divided by the maximum sum of normalised gaps shown formally as $M_1 = HAG = \mu(g^1(k))$. Such satisfies the monotonicity axiom because an increase in deprivation in any dimension is represented by an increase in the index. Lastly, the adjusted FGT measure gives greater prominence to more severe cases of deprivation by using the censored matrix of the squared normalized shortfalls $g^2(k)$. The average severity of deprivations is shown by $S = |g^2(k)|/|g^0(k)|$ hence the prevalence, depth and severity of deprivations is given by $M_2 = HAS = (g^2(k))$. While this class of multidimensional deprivation measures has come a long way since Sen's (1976) ordinal welfare ranking, it is static. The following describes the transition to dynamic measures of multidimensional deprivation.

3.4 A Dynamic Index of Multidimensional Deprivation

The importance of a dynamic index of deprivation stems from the notion that multiple periods below the poverty line are of greater detriment to wellbeing than

the occasional poverty spell (Gradin et al 2012). There are two methods of aggregating the incidence of poverty over time; the components approach and the spells approach. The components approach assumes the individual can transfer their income from periods of high income to periods of low income; therefore it is not necessary to identify the poor in each period. The components approach calculates an inter-temporal poverty index by aggregating across periods, then identifying moments where resources are insufficient to meet needs. The components approach has been utilised by Rodgers and Rodgers (1993) to compare permanent income to permanent needs, whereby permanent income is defined as the maximum sustainable annual consumption level the individual could achieve with his or her actual income stream over the period and the ability to borrow and save at prevailing interest rates. Therefore transitory poverty is defined as the difference between annual poverty in a given year and chronic poverty. The spells approach identifies whether an individual is poor in each period then aggregates the poverty index across individuals. Such is in line with the methodology utilised by Bossert et al (2012) and Nicholas and Ray (2012).

An index of multidimensional deprivation such as the one utilised by Nicholas and Ray (2012) has the following important properties that sensitise the index to changes in poverty over time. Firstly, subgroup decomposability identifies which groups in society are experiencing relatively higher levels of deprivation. Such is noteworthy as it enables more specific targeting of policy to alleviate this issue. Secondly, dimensional monotonicity requires that at any time and for any individual the index increases as the number of dimensions of deprivation increases. Similarly, durational monotonicity requires that the index increases as the number of periods in which individual is deprived increases. Such is achieved

by counting the individual's deprivations over time shown formally $\sum_j^K \sum_t^T d_{ijt}^0$ where d_{ijt}^0 is the *i*th individual's achievement in dimension *j* at time *t* with the set of dimensions given by $j \in 1, 2, \ldots K$ and the set of periods given by $t \in 1,2, \ldots T$. The order of summation can be adjusted to calculate deprivation spells for example $\left(\sum_j^K \left(\sum_t^T d_{ijt}^0 \times s\right)\right)$ where *s* is the length of the deprivation spell. Such enables the calculation of the duration and persistence of deprivation, longer deprivation spells are acknowledged to be more severe than sporadic periods below the poverty line (Rodgers 2010).

Another interesting avenue of research aims to overcome the limitations of the path independence which is a result of the counting approach. Path independence means that an individual's deprivation score is the sum of deprivation inputs regardless of the dimension or period in which they occur. Nicholas et al (2013) have extended the index in order to account for the depth of deprivation. The depth of deprivation measures the number of periods an individual is deprived in a given dimension. The breadth of deprivation measures the number of dimensions in which an individual is deprived in a given period. For example consider the following individual deprivation profiles given T= 3, K= 3 and α=0

$$D_A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} D_B = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} D_C = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

It can be argued that D_B and D_C are more deprived than D_A as D_B has experienced more persistent poverty concentrated in one dimension whereas D_C has experienced deprivation in multiple dimensions concentrated in the first period. Such a technique better exploits the existing characteristics of a panel data set.

3.5 Other Methods: Latent Variable Analysis

An alternative method of calculating multidimensional deprivation is through the use of latent variable models. It can be argued that latent variable models are better able to describe concepts such as poverty and social exclusion than a single index of deprivation. Social exclusion encompasses different forms of disadvantage and marginalisation that can occur as a result of poverty when poverty is defined as a lack of material resources. A significant segment of the literature utilised latent variable models as an alternate empirical approach to measuring multidimensional deprivation. Such is favoured by Whelan (2006), Whelan and Maitre (2005, 2007, 2008) as well as Ayala et al (2011), Navarro and Ayala (2008) and Pirani (2011). Latent class analysis assumes that the association between a set of indicators of an unobserved concept such as multidimensional deprivation can be accounted for by membership of a small number of latent classes. If the individual is part of one of N latent classes conditional independence relies on the idea that correlation between two variables may be a result of their common dependence on a third variable (Whelan and Maitre 2007). The explanatory variable is unobserved therefore must be identified statistically based on mutual dependence on the latent variable.

Factor analysis and latent trait are related types of latent variable models. Latent trait models show the probability of a randomly chosen individual suffering deprivation in an observed condition; x_i given his or her position in regard to the vector of latent variables, y, $P(x_i = 1 \mid y) = \pi_i(y)$. These conditional probabilities can be expressed as a linear function of latent variables. However, the logit and probit models are used to better describe the rate of change in the probability of being deprived. Latent trait models suit continuous dimensions

whereas latent class models are applied to discrete dimensions (Navarro and Ayala 2008). The conditional independence required for latent trait models relies on the independent nature of the latent variable. Such also assumes standard normal distribution and that the link function takes a logit or probit form. The latent class model imposes an explicit relationship on the probability of a positive response to the latent variable and can be considered a special case of the latent trait model which does not impose a functional form on probability. Latent variable models illuminate the relationship between the unobserved impact of poverty and the observed indicators of deprivation.

3.6 Conclusion

This chapter has outlined the theoretical context for an analysis of multidimensional deprivation. The capabilities and functionings framework developed by Sen (1985, 1992) was a new perspective of the welfare economics paradigm. Multidimensional indices go further than uni-dimensional studies to examine dimensions besides income that impact on an individual's level of wellbeing. The choice of dimensions links the capabilities and functionings theory to the study of multidimensional deprivation. Alkire and Foster (2011a) are widely acknowledged for helping to establish a multidimensional index of deprivation based on the FGT class of decomposable poverty measures. An index of multidimensional deprivation requires panel data in order to construct a matrix to describe the cohort's outcomes. The next extension was the combination of multidimensional and dynamic work to build a new index that incorporates both of these aspects. It was therefore necessary to examine the properties of this type of index. Such was not without its critics. A significant strand of the literature utilised latent variable analysis as a more effective means of examining

multidimensional deprivation. The next chapter will review empirical applications of this concept.

Chapter 4 Review of Previous Empirical Studies of Multidimensional Deprivation

4.1 Introduction

The literature examining empirical applications of multidimensional deprivation is growing (Alkire and Foster 2011a, Whelan and Maitre 2008, Mishra and Ray 2012, Kostenko et al 2009, Alkire and Santos 2010). A seminal work by Townsend (1979) expounding the need to go beyond income only measures was conducted in the late 1970s. Poverty was defined as relative deprivation when individuals, families or groups lack the resources to participate in the lifestyle considered normal for the society in which they live. Successive literature can be divided into two parts; an examination of multidimensional deprivation using latent variable models or a poverty index. Many European studies have utilised latent variable models to examine multidimensional deprivation. Poverty indices are popular for papers examining India, China and Australia among others. Cross national comparisons of multidimensional deprivation are less common outside of Europe. A key paper by Alkire and Santos (2010) is an exception whereby 104 developing countries were compared using a multidimensional poverty index. It highlights a new wave of poverty comparisons exemplified by the Human Development Index that embrace Sen's capabilities and functionings framework. The chapter concludes with some of the main critiques of a multidimensional poverty index.

Table 4.1 Summary of findings for selected set of key articles

Authors and Date	Key Terms and Concepts	Data	Methods	Conclusions
Townsend (1979)	Poverty as relative deprivation. Individuals, families or groups can be considered in poverty if they lack the resources to obtain the types of diet, participate in activities and have the living standards widely accepted as normal in the society to which they belong.	Household Survey of United Kingdom by the Dept. of Sociology at the University of Essex and the Dept. of Social Administration at the London School of Economics	Calculation of deprivation index by scoring the absence or lack of participation in an activity. Deprivation means calculated for various household types compared to the distribution of income.	Seminal work in the literature. Multidimensional poverty index mean score was higher for older adults over 50. Multidimensional index captures greater proportion of poverty as relative deprivation than analysis of income distribution alone.
Whelan and Maitre (2008)	Social exclusion as a symptom of economic vulnerability. Vulnerability entails increased exposure to risk and uncertainty that goes beyond the working class.	European Community Household Panel from 1994 to 1998	Latent class models were used to determine economic vulnerability which was defined as a heightened risk of multidimensional deprivation	The level of persistent economic vulnerability was found to vary by regime type with the lowest levels of persistent economic vulnerability in social democratic and liberal welfare regimes. Belonging to the professional or managerial class offered protection against economic vulnerability.

Authors and Date	Key Terms and Concepts	Data	Methods	Conclusions
Mishra and Ray (2012)	Measuring and comparing the development performance of China and India using a multidimensional deprivation framework and utilising household level data.	National Family and Health Survey in India conducted in 1992-1993, 1998-1999 and 2005-2006 and China Health Nation Nutrition Survey 1993, 2000 and 2006	Index of multidimensional deprivation that is additively decomposable by dimension and by region meaning the deprivation shares are proportional to the source and group experiencing the higher levels of deprivation.	China outperforms India in a number of indicators however; economic growth has delivered uneven levels of prosperity in both countries. Income poverty measures alone understate the level of deprivation in both countries.
Kostenko et al (2009)	Socioeconomic disadvantage is a multidimensional concept that requires more than income only analysis of poverty.	Household Income and Labour Dynamics in Australia Waves 1-7 (2001-2007)	Multidimensional index of deprivation and latent variable analysis to estimate impact of social exclusion based on deprivation levels.	In Australia 20-30 per cent of the adult population experience a marginal level of social exclusion. The elderly experience higher levels than the young, women are more likely than men to be persistently excluded.
Alkire and Santos (2010)	Development of a Multidimensional Poverty Index for 104 developing countries following the dimensions outlined in the Human Development Index	Demographic and Health Survey (DHS), the Multiple Indicators Cluster Survey (MICS) and the World Health Survey (WHS)	Dual cut-off method of determining multidimensional deprivation, advancing the class of decomposable measures first proposed by FGT (1984)	The Multidimensional Index is better able to identify poverty than income only measures in very poor countries.

4.2 Origins of empirical studies

Townsend (1979) defines relative income poverty in two categories; 50 per cent of mean income and 80 per cent of mean income. Mean income was chosen rather than median income as it was argued that this statistic was less sensitive to the distribution of the data. However, most modern examinations of income poverty use a proportion, normally 50 or 60 per cent of the median income (McLaughlin et al 2013). The analysis also incorporated a deprivation standard of poverty whereby 60 indicators of style of living were examined of which 12 dimensions representing dietary, household, familial and social life indicators were chosen to form a summary multidimensional deprivation index. Each dimension was constructed by scoring the absence or lack of participation in an activity and the index simply summed each incidence of deprivation. The sample mean score was 3.5, for children (3.4), adults (3.5), for people 15-44 (3.0) versus older adults 50-59 (3.5), 60-69 (4.1) and over 70 (5.1). Household income was negatively related to the multidimensional index score. Mean scores were adjusted by household type rather than using an equivalence scale. Much effort was taken to assess the needs of various household types such as single person households, working age as opposed to retired persons, small and large families. By these measures 10.6 per cent of households were considered income poor, that is household income was below 50 per cent of the mean, whereas 25.2 per cent were considered deprived in a multidimensional sense such that net disposable income was below an estimated social exclusion threshold. A total of 2,500 households were randomly selected within the United Kingdom however Northern Ireland was oversampled because of the high proportion of low income households. The data was only collected and analysed in a one-off survey thus it

can only capture a cross section of British society. The distinction between chronic and transitory poverty has been widely acknowledged. Such work is important because it marks the beginnings of a shift in empirical studies from solely income based measures to a broader view of poverty as multidimensional deprivation.

4.3 Latent Variable Models

4.3.1 European Studies

Other studies have attempted to describe the relationship between income and multidimensional deprivation. Ayala et al (2011) found only a weak relationship between income and an index of multidimensional deprivation using a logit model to determine the impact of household characteristics, educational attainment and labour market status on the probability of being considered income poor. Income poverty was defined as being below 60 per cent of the median equivalized income. Data was taken from the Spanish sample of the 2005 Survey on Income and Living Conditions (EU-SILC). Poverty levels are disaggregated by region. However the index is composed almost exclusively by dimensions in the material resources category. Employment was excluded from the index despite the fact that being employed is negatively related to poverty status.

Navarro and Ayala (2008) utilised observable housing characteristics such as hot running water, heating, leaking roof, damp walls or floors, rot and overcrowding as indicators to observe a specific type of multidimensional deprivation using latent class analysis. By targeting such a specific aspect of deprivations the aim of the paper was to overcome the limitations found in other types of methodologies such as choice of dimension weights and the relative arbitrariness of setting deprivation thresholds. Using the Spanish component of the European

Community Household Panel in 1998 the indicators were chosen based on significant correlation with household equivalized income. The indicators were also chosen because 85 to 90 per cent of Spanish households did not suffer the observed housing deficiencies therefore it was considered more strongly defensible that the presence of these problems indicates a level of deprivation. Narravo and Ayala (2008) found that there was a higher incidence of deprivation among renters which is consistent with the findings of Nicholas and Ray (2012). In addition single person households had a higher probability of deprivation than couples. The limitations of these studies are the static nature of the analysis which cannot examine these trends over time.

Whelan (2006), using a logistic regression strategy and the Irish component of the EU-SILC in 2004 showed that a broad deprivation index which attempts to quantify social exclusion is able to identify a distinct group within the population experiencing consistent poverty. Whelan and Maitre (2007) went on to compare a narrow set of 19 indicators available in the EU-wide version to the 46 indicators available in the 2004 Irish component of the EU-SILC. Health status was included to go beyond measures of material deprivation in order to better account for social exclusion. The authors validated the use of the narrow EU-SILC data set as robust enough to identify individuals experiencing multidimensional deprivation.

Whelan and Maitre (2005) also used multidimensional deprivation to examine the impact on social cohesion of an expansion in EU member states. They discovered that a decline in social cohesion can be considered a result of higher levels of inequality. The authors used data from the 2004 European Foundation for the

Improvement of Working and Living conditions that features 28 countries including the then current 15 EU member states, 10 acceding countries and three candidate countries. The study further stratified countries in terms of GDP per capital into high, intermediate and low and the candidate countries. The use of low income, lifestyle deprivation and financial hardship were identified as manifestations of social exclusion. Current lifestyle deprivation was described in three categories: absence and affordability of material needs, possession of household items such as a car, computer and washing machine and the experience of debt. The overall use of a multidimensional analysis rather than income poverty highlighted regional differences in economic expansion and within high income clusters there was greater polarisation between affluent and economically vulnerable groups.

Whelan and Maitre (2008) extended their static analysis to a dynamic one using the European Community Household Panel from 1994 to 1998. Latent class models were used to determine economic vulnerability which was defined as a heightened risk of multidimensional deprivation. The analysis covered nine countries; Denmark, The Netherlands, Belgium, France, Italy, Ireland, Spain, Portugal and Greece featuring 95,213 individuals over five years. The authors once again contrasted income poverty in various gradations of the median income to an index constructed using the enforced absence of 11 widely desired items. Whelan and Maitre (2008) categorised each country based on the type of welfare regime. Denmark and The Netherlands were considered social democratic, where the state has a substantial role in the redistribution of resources. Belgium and France were classified as corporatist, meaning that the role of the state is to mediate group based mutual aid by pooling risk, and welfare support is contingent

on being in the labour market. Ireland was categorised as a liberal welfare regime which means that state assistance is provided only when market solutions fail and assistance is means tested. Italy, Spain, Portugal and Greece were viewed as part of a southern welfare regime where family support was emphasised over state provision of welfare. The level of persistent economic vulnerability was found to vary by regime type with the lowest levels of persistent economic vulnerability found in social democratic and liberal welfare regimes. The authors also conducted a static analysis of social class on the basis of employment categories, the highest 'class' being professional and managerial and the lowest, routine operations. Belonging to the highest class offered protection against economic vulnerability.

Pirani (2011) used data from the Eurobarometer Survey in 2001 to perform latent class analysis to quantify the extent of social exclusion in the then 15 EU member states. The indicators of social exclusion included perception of social exclusion, perception of economic situation inferiority and own usefulness in society. Income quartiles, frequency of social contacts, participation in leisure or sport clubs, evaluation of medical services and social entitlements were also utilised to define the latent concept. Covariates on an individual level were age and employment status. Covariates at a regional level were perception of poverty (as an individual failing or result of social injustice), regional GDP and proportion of GDP spent on social protection. The covariates chosen were used to predict membership of latent classes. The research found that a positive perspective of economic situation can mitigate a low level of income and prevent perception of social marginalisation. Those with the highest probability of experiencing social exclusion lack a reliable social network as well as experiencing economic

exclusion that can be largely attributed to unemployment. Pirani (2011) extends the analysis from a micro level study of the individual to the EU regional level to examine the implications of multidimensional deprivation on a large scale. However like most current cross national studies it is only a static analysis.

Bossert et al (2007) placed a stronger emphasis on the dynamic aspects of social exclusion, arguing that a person experiencing persistent deprivation has fewer prospects if they are not able to participate fully in the society to which he or she belongs. The article contributes to the axiomatic framework utilised by this research constructing an index of multidimensional deprivation based on the arithmetic mean of individual dimensions that satisfy key axioms such as normalisation, deprivation additively, population proportionality and deprivation proportionality. A balanced panel of responding individuals was taken from the European Community Household Panel from 1994 to 2001 using dimensions such as financial difficulties, basic needs and consumption, housing conditions, health, social contacts and participation, and life satisfaction. All components were equally weighted. When ranking countries no attempt was made to control for the different types of welfare assistance across states. Portugal, Greece and Ireland had the highest levels of deprivation followed by Spain, Italy and France. The lowest rates of multidimensional deprivation were in Denmark and the Netherlands. However, the study did not disaggregate by the dimensions that drove this result. A later paper by Bossert et al (2013) uses the EU-SILC for 2005 to 2008 to compare a similarly constructed index of multidimensional deprivation to relative poverty measured by a headcount of households with less than 60 per cent of the median equivalized income. The measure of material deprivation was more stable over time than income poverty. Further the results were sensitive to

the use of weights. Bossert et al (2013) sought to reinforce the need to look beyond income only measures to determine wellbeing.

4.4 Indices of Multidimensional Deprivation

4.4.1 Indian Studies

Majumda and Subramainan (2001) attempt to change the focus of analysis from the individual to group disparities to draw attention to the fact that indices that do not account for the distribution of deprivation may understate the intensity of the problem. Their index is termed the adjusted capability failure ratio; it is an inequality adjusted measure of poverty in India that incorporates adult illiteracy rates, infant mortality rates and an adaptation of Sen's adjusted poverty headcount ratio. The ratio is calculated according to region, caste and gender. The research confirms that there are large and systematic differences between population groups and major states of India. However, the data used in the empirical component of the article dates back to the early 1980s which casts some doubt on the relevance of the findings. Kapur Metha (2003) also comments on the issue of data availability in India noting that even the data from the official national statistical agency may be less than fully reliable. Depending on whether the estimates were from 1993-1994 or 1999-2000 it has been approximated that between 260 to 320 million people live below the poverty line. Income poverty and multidimensional deprivation were found to be mutually reinforcing with several states with high levels of income poverty also performing poorly when assessed by indicators such as infant mortality, female literacy and access to public infrastructure. Such means that the persistence of poverty in areas is often intergenerational. The article reviews existing works with the aim of highlighting the chronic and multidimensional nature of poverty in India.

Mohanty (2011) used data from National and Family and Health Survey in 2005-06 designed to be nationally representative and a more reliable data set than the one conducted by the Planning Commission. Consumption data collected by the national statistical office is subject to different recall periods, changes to the fixed basket of goods and services and the price index applied. The most problematic issue was the revision of the appropriate minimum threshold which account for the variations in poverty estimates. Following a multidimensional approach, a range of indicators for education, health and wealth are chosen using the household as the unit of analysis. The household is considered abject poor if they are deprived in at least two of the three dimensions, moderate poor if they are deprived in one dimension and not poor if not deprived in any dimension. The results show that 52 per cent of the population is considered poor with 20 per cent of these in abject poverty. Trends within the data show that abject and moderate poverty decreases with age and educational attainment. However, the prevalence of multidimensional deprivation is higher in female headed households. Correlation in the wealth and education dimensions of deprivation was stronger than the correlation between wealth and health dimensions although still significant.

Mishra and Ray (2012) compare India and China using micro level data. The authors utilised the three rounds of National Family and Health Survey in India conducted in 1992-1993, 1998-1999 and 2005-2006. The Chinese data came from the China Health Nation Nutrition Survey using the years 1993, 2000 and 2006 for the sake of comparability. Dimensions included; access to drinking water, toilet facilities, electricity, cooking fuel, a bicycle and belonging to the poorest wealth quintile for measures of material deprivation. Other dimensions

included the education of the household head, presence of stunting or wasting in children as a result of malnutrition and the Body Mass Index (BMI) of the mother. The index was decomposed by urban and rural areas. The article found divergence between income poverty trends and trends in multidimensional deprivation. China outperformed India on a range of indicators but the recent gains in economic growth have translated into uneven levels of development in both countries. Mishra and Ray (2011) utilised both the National Sample Survey (NSS) and the National Family Health Survey (NFHS) data sets to compare the robustness of estimates of multidimensional deprivation. The NSS data covered the periods 1993-1994, 1999-2000 and 2004-2005 and the three rounds of the NFHS in 1992-1993, 1998-1999 and 2005-2006 that cover the period of economic reform in India in the 1990s. Both data sets show an overall decline in deprivation headcount ratios over time although rural areas experienced more consistent progress than urban areas. Lack of access to drinking water and fuel for cooking were the largest non-health contributors to deprivation and stunted children was the most significant source of health deprivation. The traditional income related measures contributed proportionately less to overall deprivation which indicates that a multidimensional approach better captures the nature of poverty in India.

4.4.2 Australian Studies

Using data available in the first seven waves (2001-2007) of the Household Income and Labour Dynamics in Australia (HILDA) survey Kostenko et al (2009) utilise 29 indicators of deprivation in seven categories. These categories include material resources, employment, education and skills, health and disability, social, community, and personal safety, of these 21 indicators are available in every

wave. These indicators are summarised into a single index of deprivation with the aim of examining social exclusion in Australia. The index is a function of the number of indicators in which an individual is considered deprived divided by the total number of indicators within each category. The maximum deprivation score is seven indicating deprivation in all indicators in all categories. To investigate the sensitivity of the estimates alternative weighting schemes are compared to the baseline case of equal weight for all categories. An alternative weighting scheme required that for individuals to be considered deprived they also had to report income that was less than 50 per cent of the median. Such a method gives prominence to the role of income in determining social exclusion. In a similar way twice the weight is assigned to the material resource category acknowledging that access to material resources is likely to be the most important contributing factor to the ability to participate in the economic and social life of a developed country. The authors also use a random effects logit model as part of a latent variable analysis to estimate the level of social exclusion experienced by an individual based on the presence of dimensions of deprivation.

The results show that between 20 and 30 per cent of the population aged 15 years and over are experiencing marginal exclusion that is a summary score of less than one. Of these four to six per cent were deeply excluded or had a score between one and two. Less than one per cent were very deeply excluded with a score of three or more during the period 2001 to 2007. Females experience higher rates of marginal exclusion than males and there appears to be a U-shaped relationship between marginal exclusion and age with the highest rates of marginal exclusion amongst those under 25 and over 55. Between 40 and 50 per cent of those over the age of 65 experienced marginal exclusion. There was also a strong correlation

between the results of the sum score and the latent variable analysis, which indicates that both techniques can detect trends in social exclusion. When the low income requirement is stipulated, rates of marginal exclusion decline to six to eight per cent of the population. However, deep exclusion is strongly associated with low income hence this result is unaffected by the low income requirement. An evaluation of trends over time was cursory at best in this research. However, 27 per cent of the population were marginally excluded for three or more years and five per cent were deeply excluded for three or more years. Females were more likely than males to have experienced marginal or deep exclusion for longer periods. When disaggregated according to age for marginal levels of exclusion younger people were more likely to experience transitory periods of exclusion whereas older people were more likely to be persistently excluded. Deeper levels of exclusion were distributed equally across age groups. The results presented in chapter 6 continue this line of inquiry more readily exploiting the nature of panel data to determine the impact of more frequent periods of deprivation for broad demographic groups in Australian society.

A recent Productivity Commission working paper (McLaughlin et al 2013) brought attention to the evolution of poverty measurement and new methods of researching multidimensional deprivation in Australia. A review of current work McLaughlin et al (2013) identified those who are unemployed, not in the labour force, those dependent on income support as well as single and lone parent households as groups in Australian society with a high prevalence of income poverty. McLaughlin et al (2013) also identified Indigenous Australians, lone parents, people with a long term health condition or disability and those whose main source of income is social security payments as groups in Australian society

that experience higher than average rates of multidimensional deprivation. The overlap in these outcomes indicates an association between deprivation and income poverty although the presence of one may not always require the other. For example single people of working age were found to have relatively high levels of multidimensional deprivation (25 per cent) but low levels of income poverty (nine per cent). It was noted that even when using HILDA data it is difficult to monitor changes in specific subgroups over time where characteristics are vary over time. Relatively few studies are able to determine the impact of prolonged deprivation using a multidimensional framework.

4.4.3 Cross National Comparisons

Alkire and Santos (2010) use household surveys to construct a Multidimensional Poverty Index (MPI) for 104 developing countries. There are ten dimensions that fit within the categories of the Human Development Index; that is, education, health and standard of living. The MPI is the product of a headcount component and the average breadth or intensity of deprivation. The paper is an early example of the multidimensional poverty measures M_α that would be formalised in Alkire and Foster (2011a) as outlined in the previous chapter. Data constraints require that the household rather than the individual is the unit of analysis. Two poverty cut-offs are used $k = 2$ and $k = 3$, meaning to be considered deprived in a multidimensional sense the sum of the weighted indicators must be at least 20 or 30 per cent of the total possible deprivation. Three data sets are utilised the Demographic and Health Survey (DHS), the Multiple Indicators Cluster Survey (MICS) and the World Health Survey (WHS). The authors state that one equivalized data set would be ideal but this was not feasible given the scope of the project. In order to ensure some measure of comparability standardised

procedures and technical assistance were provided to the administrators of the data in each country. Secondly a strict cross sectional analysis in a single time period was not possible, the DHS data provided information on 49 countries from 1999 to 2004, the MICS data provided information on 35 countries for 2000 and 2005-06 and the WHS data provides information on 19 countries for 2003. Not all indicators were available in every country meaning cross national comparisons are tentative. However, the results are a step towards greater acceptance of a multidimensional framework for the measurement of poverty.

The MPI is compared to the international standard poverty line of less than $1.25 per day and less than two dollars per day as well as a poverty line constructed within each country. The advantage of the MPI is that it captures information on key services such as water and sanitation, electricity, primary education, and housing which may be missed in income or consumption surveys. Some correlation exists between the MPI and domestic poverty lines but the correlation is stronger between the MPI and the standard international poverty lines. A cross tabulation of those identified as poor in a multidimensional sense and those classified as income poor reveals a low correlation between the two measures. The likelihood of being considered poor in a multidimensional sense but not by income is higher for very poor countries meaning the MPI is more effective in these instances. The relationship is not so strong for less poor countries meaning income becomes an important indicator as the level of development increases. The authors do not go so far as to insist on multidimensional indices replacing income measures, rather they suggest that it would be valuable to integrate income as a component of the multidimensional framework. As the analysis was static it was not possible to evaluate the effect of duration or persistence of

poverty across countries or amongst demographic subgroups. However, the paper is still important because it represents a fundamental shift in the evaluation of poverty as multidimensional deprivation.

4.5 The role of Capabilities and Functionings in Development Economics

A micro level focus on the individual represents a change in the development paradigm such that some of the emphasis has moved away from measures of material progress gauged by GDP or GNI to multidimensional indices such as the HDI that embrace Sen's framework (Fukuda-Parr 2011). Income is only a proxy for individual achievement and arguably a poor proxy because inequality would not be eliminated even in an egalitarian society with a perfectly equal distribution of income. The individual, social and systemic differences between groups in society such as males and females or the young and old means that there will always be differences in an individual's ability to achieve their own objectives even when allocated the same resources. The definition of human development is the expansion of people's freedoms and capabilities to lead lives that they value and have reason to value which embraces Sen's framework (UNDP, 2011). One of the oldest multidimensional frameworks still in use is the Human Development Index which is the weighted average of indicators of health, education, and national income. These indicators are life expectancy at birth, adult literacy rates, and GDP per capita. HDI values range from zero, indicating low levels of development, to one which is an extremely high level of development. The examination of empirical studies of multidimensional deprivation throughout this chapter illustrates the prominence of this framework within development economics.

4.6 Critique of Multidimensional Indices

A single multidimensional index of deprivation can obfuscate the performance of a country by subsuming the dimensions where performance is strong with those dimensions where performance is poor. Such can be overcome if the index is additively decomposable by dimensions as is the case for any poverty measure based on the Foster, Greer and Thorbecke (1984) framework. A strong critique of multidimensional indices comes from Ravallion (2011a) who states that the choice of dimensions is not examined closely enough. For instance, it can be argued that the health dimension may be viewed as intrinsically valuable that is its value is independent of one's command over commodities. However, such is not the case for all dimensions. To classify the education dimension as intrinsically valuable is more contentious. Such casts doubt over the premise that education poverty must have the same weight as health poverty as is often the case. Secondly, data constraints, when requiring one survey to collect information on a wide variety of categories, could mean that the selection of living standard variables may actually be less detailed than expenditure surveys that have hundreds of consumption items. Although it may be difficult to equivalize all dimensions when the household is the unit of analysis, intra-household distribution if assumed away, may lead to less accurate conclusions.

The most severe critique is reserved for the rejection of prices as relative weights in the method of aggregation of the dimensions into a single index. Given two dimensions health and education for instance, Ravallion (2011a) argues that it is unlikely that the relative trade-off between these two dimensions will yield the relative prices of each. Therefore it is difficult to calculate the implications of choice between two commodities at the poverty line. Without transparency

between alternative outcomes a single index conceals a very important detail. Alkire, Foster and Santos (2011) respond to these critiques firstly by emphasising that a multidimensional index of poverty does not attempt to capture all aspects of poverty rather it creates an alternative measure in which to calculate the extent of poverty. A multidimensional index can capture what an income only analysis may overlook. Therefore, it is of benefit to use both measures. Alkire et al (2011) refute the allegation of total rejection of prices and instead affirm that where applicable there is scope to include prices. However, prices may not be meaningful to all dimensions included in the index. Furthermore the 'dashboard' of indices that Ravallion (2011a) proposes, for instance a vector of education poverty, income poverty and health poverty, would not solve the problem of trade-offs between dimensions in a policy context. Similarly, the dashboard of indices could not determine the joint distribution of deprivation between dimensions whereas a multidimensional index could do so.

The most common critique of an index of multidimensional deprivation is that once aggregated into the index the dimensions that drive the results can be difficult to determine. Nevertheless, a dashboard of indicators can be just as difficult to interpret. Studies of multidimensional deprivation are also particularly sensitive to the value judgements made about any type of poverty analysis. For example, the choice of dimensions, the weights assigned to each dimension and the choice of threshold can drastically influence results. The means of overcoming this is to make underlying judgements clear and transparent so that the interactions between dimensions are well understood. Finally, to choose measures firmly grounded in evidence and informed community discussion

(McLaughlin et al 2013). The advantage of a multidimensional index however, is the ability to concisely express changes in the depth and severity of poverty.

4.7 Conclusion

This chapter briefly outlined the origins of multidimensional poverty analysis within the seminal work of Townsend (1979). Latent variable analysis is a popular alternative to poverty indices often utilised in European studies. Multidimensional indices are a newer means of measuring poverty but income must not be dismissed as obsolete. Kostenko et al (2009) combine a multidimensional index of deprivation and latent variable analysis to estimate impact of social exclusion based on deprivation levels. The availability of variables applicable to multiple countries is a limitation for cross national comparisons. However; Alkire and Santos (2010) have undertaken a significant study of 104 developing countries using a multidimensional poverty index. It reflects a movement in the literature towards Sen's capabilities and functionings framework, a significant example being the Human Development Index. The most severe critique of multidimensional indices is reserved for the rejection of prices as relative weights. Ravallion (2011a) argues that without such a level of transparency it can be difficult to calculate the implications of choice between two commodities at the poverty line. Although it is challenging it is vital to continue to work towards a means of measuring poverty that is accurate and informative.

Chapter 5 Description of the Data

5.1 Introduction

The use of two data sets is necessary to test whether the methodology outlined in Nicholas and Ray (2012) can deliver consistent results. The two data sets utilised are the Household Income and Labour Dynamics in Australia (HILDA) survey and a set of Cross National Equivalent Files (CNEF) for Australia, Germany, the United States of America and Switzerland. The testing of dynamic factors such as duration and persistence of deprivation can only be achieved through the use of panel or longitudinal data. The chapter is divided into two sections that discuss selection of the sample, dimensions and use of weights for each data set. The final section will illustrate the descriptive statistics that highlight the characteristics of the survey participants in the HILDA survey and the distribution of deprivation for both data sets.

5.2 Household Income and Labour Dynamics in Australia

The Household Income and Labour Dynamics in Australia (HILDA) survey is a government supported undertaking by the Melbourne Institute of Applied Economic and Social Research. The HILDA survey is highly detailed and hence the inclusion of a broad array of variables is possible. The HILDA survey began in 2001, each wave corresponds to the year it was collected. It is an indefinite life panel conducted annually that follows participants selected in Wave 1 based on a stratified sample of dwellings utilising 488 census collection districts. New sample members are inducted if they are born into the household of continuing sample members or they become partnered with existing sample members. In Wave 1 7682 households out of 11,693 within the scope of the survey responded. For individuals, 15,127 persons were eligible, of these 13,969 responded. In

2011, an additional 2,153 households were included in a top-up sample (Summerfield et al 2012). This type of data does have limitations for this analysis as it excludes the population subgroups that are more likely to be experiencing multiple deprivations including the homeless and those living in institutions such as aged care facilities or gaol. In addition those who might be expected to have high rates of social exclusion such as Indigenous Australians and recent immigrants are underrepresented in the sample (Kostenko et al 2009).

There are five survey instruments; the Household Form collects key identifiers that enable individuals to be followed over time. The Household Questionnaire; the Continuing Person Questionnaire for all persons over the age of 15 who have been previously interviewed; similarly the New Person Questionnaire is for all persons over the age of 15 who have never been interviewed. The Self-Completion allows for the collection of more personal and therefore sensitive information without the presence of an interviewer to influence responses. All dimensions of deprivation except employment status are taken from the Self-completion questionnaire.

5.2.1 Selection of the Sample

The selection of the sample is based on the availability of the dimensions of deprivation over time. Waves 1-9 and 11 are utilised corresponding to the years 2001 to 2009 and 2011. Wave 10 is dropped because of a mistake in the wording of a survey question which contributes four out of the eleven dimensions of deprivation in question. A balanced panel of individuals who have provided information on all of the dimensions of interest in each wave leaves a sample size of n=3,367.

5.2.2 Selection of Dimensions

The eleven dimensions are based on the dimensions selected in Nicholas and Ray (2012). They can be grouped into three broad categories including; health, access to material resources and employment status. The health category was generated by summary scores to responses from the SF-36. The SF-36 is a standardised health assessment survey that measures concepts such as behavioural functioning, perceived wellbeing, social and role disability, and personal perceptions of health in general (Ware et al 2005). There are eight summary scales in addition to the two utilised by Nicholas and Ray (2012), a further three subscales were included. Three subscales were omitted due to the very small proportion of the sample considered deprived using the threshold score selected. The dimensions are as follows:

Health Dimensions	i. General health ii. Physical health iii. Role physical iv. Role emotional v. Vitality
Access to Material Resources	vi. Inability to pay utility bills on time. vii. Inability to pay mortgage or rent on time. viii. Inability to raise two-thousand dollars in an emergency. ix. Unable to afford heating in the last year. x. Unable to afford meals in the last year.
Employment Status	xi. Those classified as unemployed are considered deprived.

5.2.2.1 Health Dimensions

The first health dimension is general health, a self-evaluation of personal health status ranging from a rating of poor and likely to get worse, to a rating of personal

health status as excellent. The physical health variable identifies and measures any limitations in the performance of everyday physical activities. The role physical variable measures the extent of disability in everyday activities due to health problems. Similarly the role emotional variable detects the degree to which problems with work or other daily activities occur as a result of emotional problems. The vitality subscale is a measure of how energetic the respondent reports themselves to be.

A score of 100 represents an absence of limitations or disability. For general health, vitality and mental health, a score of 50 defines the absence of limitations or disability. A score of 100 can be achieved when respondents report positive health states or favourably evaluate their health. The deprivation threshold chosen in Nicholas and Ray (2012) is a summary score of 20 or less. Such indicates the respondent received a minimum of one out of a possible five points when rating their general health status. Such is considered a theoretically defensible minimum score below which it is sensible to consider an individual is deprived. For consistency with the other health dimensions, a score of 20 or less is applied as the deprivation threshold. The mental health, bodily pain and social functioning subscales are excluded because with this threshold only a very small fraction of the population can be considered deprived. The continuous variable was then transformed into a binary score where one indicates the individual is deprived, that is, received a summary score of 20 or less and zero if the respondent's score was greater than 20. Whilst the impact of selecting this threshold is numerically significant, it is a relatively arbitrary exercise to determine the deprivation threshold. For example, when the general health threshold is set at a score of 50 or less, which corresponds to the mean score, the average headcount across the

time period 2001-2011 is 16.57 per cent of the sample population. When the threshold is set at a score of 20 or below the average headcount falls to 2.43 per cent of the sample.

5.2.2.2 Material Resources and Employment Dimensions

The binary nature of the material resource dimensions such as housing repayments, utilities, heating and food have a natural deprivation cut off built into the wording of the survey questions: "Since January (current year)[1] did any of the following happen to you because of a shortage of money?". The other material resource dimension asks: "Suppose you had one week to raise $3000 for an emergency [2] which of the following best describes how hard it would be for you to get the money". Responses ranged from "I could easily raise the money" to "I don't think I could raise the money" coded from one to four respectively. The deprivation threshold is set where respondents state that they are unable to raise the money, suggesting a maximum level of financial difficulty. The employment status variable follows the Australian Bureau of Statistics definition of unemployment, that is, those without work, actively seeking work and those who are also currently available for work (ABS 2007). Those who are unemployed are considered deprived for the purpose of this analysis.

5.2.3 Use of Weights

Despite the fact that the HILDA survey is designed to be nationally representative the potential for non-random attrition from the survey could impact the outcome of the analysis. The use of survey weights can help to correct this problem but

[1] Wave 10 is dropped from the analysis because the question was not updated, the question read "Since January 2009…" instead of "Since January 2010…" without this information these dimensions are not available. It was not feasible to include the year 2010.

[2] In Waves 1-8 this question asks the respondent if they are able to raise $2000 in an emergency and was updated to $3000 from Wave 9 onwards.

cannot mitigate it entirely. The use of longitudinal weights is also considered necessary for the calculation of means intended to be representative of the population. The characteristics of those who returned the self-completion questionnaire section of the HILDA survey are distinct from those who did not. On average those who supplied information are more educated. For example, 24.53 per cent of individuals within the sample completed a Bachelor degree or higher compared to 16.57 per cent outside of the sample. Similarly, 70.95 per cent of those in the sample are employed whereas only 58.89 per cent of those outside the sample are employed. Homeownership was slightly higher for those within the sample, 88.27 per cent compared to 82.21 per cent. The mean income of respondents was higher than the mean income of non-respondents $54,119.57 and $47,951.59 respectively. Such implies the possible underrepresentation of those who would be considered deprived. Therefore, estimates of multidimensional deprivation may be considered a lower bound.

5.3 Distribution of Total Deprivation Scores

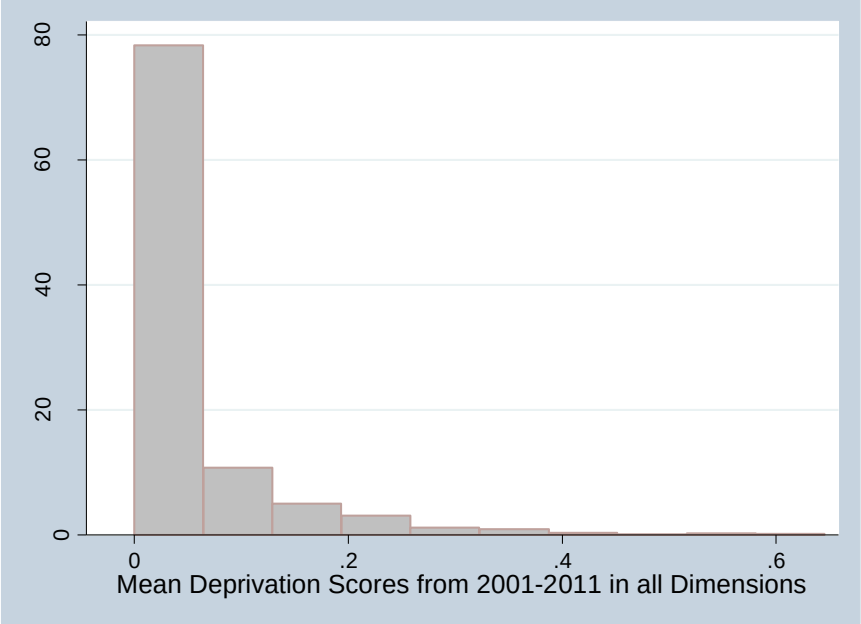
The distribution of deprivation is calculated for a cross section of the population over time. Figure 5.1 illustrates the distribution of total deprivation using HILDA data over the period 2001 to 2011. The distribution is skewed to the left indicating low levels of deprivation overall. Such is in contrast to Figure 5.2 which also shows the distribution of deprivation using data from the Cross National Equivalent Files. Deprivation scores are aggregated across three dimensions of deprivation in the alternating years from 2001 to 2009. Deprivation scores are also pooled across Australia, Germany, the United States, and Switzerland. The distribution of deprivation in this case is much more widely dispersed with a low percentage experiencing deprivation in all dimensions and in all time periods.

Table 5.1 Descriptive Statistics

	HILDA Respondent Sample	Included Sample	Excluded Sample
Observations	7229	3,367	3,862
Dichotomous variables (mean)			
Female	0.5460	0.5405	0.5455
Aborginal / Torres Straits	0.0149	0.0125	0.0124
Bachelor degree or higher	0.2055	0.2453	0.1657
Year 12, VET certs, advanced diploma	0.4251	0.4251	0.4251
Year 11 and below	0.3689	0.3294	0.4084
Employed	0.6492	0.7095	0.5889
Unemployed	0.0357	0.0276	0.0438
Out of Labour Force	0.3151	0.2628	0.3674
Major City	0.6181	0.6154	0.6208
Regional	0.2448	0.2432	0.2464
Remote	0.1371	0.1413	0.1329
Homeowner	0.8524	0.8827	0.8221
NSW	0.2959	0.2866	0.3052
VIC	0.2487	0.2510	0.2464
QLD	0.2047	0.2040	0.2054
SA	0.0975	0.0977	0.0973
WA	0.0981	0.1022	0.094
TAS	0.0303	0.0309	0.0297
NT	0.0076	0.0065	0.0087
ACT	0.0172	0.0211	0.0133
Continuous Variables			
Age	43.66	42.83	44.49
Household Income	51035.58	54119.57	47951.59
Number of Children	0.71	0.74	0.68
Number of Adults	2.20	2.23	2.17

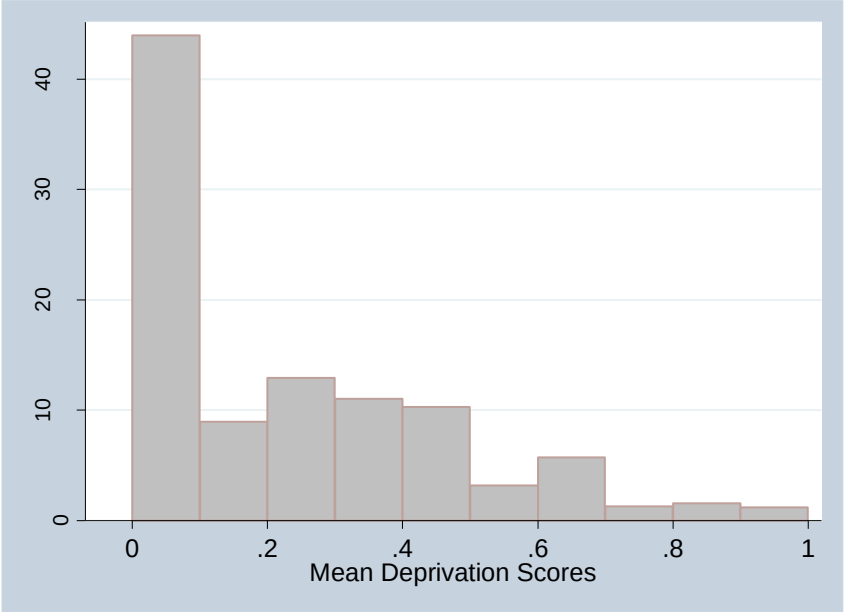
The table shows the weighted means of all relevant variables for those within the sample compared to those dropped from the sample. Those who have been excluded from the sample did not answer all of the relevant questions in each wave of the HILDA survey.

Figure 5.1 Distribution of Total Deprivation



Deprivation scores aggregated across all eleven dimensions over the period 2001 to 2011. A mean score of zero indicates no deprivation in any dimension in any time period and a mean score of one indicates deprivation in every dimension in every period.

Figure 5.2 Pooled Distribution of Deprivation



Deprivation scores aggregated across three dimensions of deprivation in the alternating years from 2001 to 2009. Deprivation scores are also pooled across Australia, Germany, the United States, and Switzerland. A mean score of zero indicates no deprivation in any dimension in any time period and a mean score of one indicates deprivation in every dimension in every period.

5.4 The Cross National Equivalent Files

The Cross National Equivalent Files (CNEF) Project, facilitated by Cornell University includes data from Australia[3], the United States[4], Switzerland[5], the Russian Federation[6], the Republic of Korea[7], Canada[8], Germany[9] and the United Kingdom[10]. The Cross National Equivalent Files are a subset of variables of the original household panels that have been harmonised for ease of comparison. The first iteration of the Cross National Equivalent File project began in 1991 with data from the Germany and the United States (Panel Study of Income Dynamics, PSID). It was soon expanded to include the United Kingdom (British Household Panel Study, BHPS) and Canada (Labour and Income Dynamics, SLID) in 1997. Australia (HILDA) and Switzerland (Swiss Household Panel, SHP) were added in 2007 (Frick et al 2007). The most recent additions are Korea (Korea Labour Income Panel Study, KLIPS) and the Russian Federation added in 2009 (Russia Longitudinal Monitoring Survey-Higher School of Economics, RLMS-HSE). The project was created to help overcome the difficulties in cross national comparisons due to the differences in the measurement of concepts such as income, employment and education under the influence of national institutions, laws and cultural patterns in each country.

5.4.1 Selection of the Sample

Only a subset of these countries was utilised due to the differing presence of key variables in each panel. In order to address this issue it was determined that all

[3] The Melbourne Institute of Applied Economic and Social Research (Melbourne Institute)
[4] Survey Research Center, Institute for Social Research, University of Michigan
[5] The Swiss Foundation for Research in Social Sciences, the University of Lausanne
[6] Demoscope and the Higher School of Economics in Moscow, Russia and the University of North Carolina at Chapel Hill
[7] The Korea Labor Institute
[8] Statistics Canada in Ottawa
[9] German Institute for Economic Research (DIW Berlin)
[10] Institute for Social and Economic Research (ISER) at the University of Essex

countries be compared in the same years, the chosen combination was the alternating years between 2001 to 2009 including Australia, Switzerland, Germany and the United States. Figure 5.2 highlights the availabilities of waves chosen for this analysis. The waves were selected if information on each dimension: post government household income, employment status and self-rated health status was available.

Figure 5.3 Availability of Dimensions within Cross National Equivalent Files

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Australia	0	1	1	1	1	1	1	1	1	1	1	1
Switzerland	1	1	1	1	1	1	1	1	1	1	1	1
Germany	1	1	1	1	1	1	1	1	1	1	1	1
United States	0	1	0	1	0	1	0	1	0	1	0	0
Korea	0	0	0	1	1	1	1	1	1	0	0	0
Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0
Canada	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	1	1	1	1	1	1	1	0	0	0	0	0
Total	3	5	4	6	5	6	5	5	4	4	3	3

Coding indicates availability of all dimensions for each country equals one if all information is present, equals zero if some dimensions are missing.

The combined cross national sample contains a balanced panel of 28,515 individuals from four countries. By country this equates to n=3,109 from Switzerland, n=5,695 from Australia, n=8,532 from the United States and n=11,215 from Germany in the alternate years between 2001 and 2009.

5.4.2 Selection of Dimensions

5.4.2.1 Income

Income as a proxy for material resources is one of the dimensions used in the cross national comparisons. Within the CNEF an income variable was constructed in order to account for all types of household income and transfers minus taxes, a similar variable was utilised in Rodgers (2010). The variable chosen was post government income which is defined as the sum of labour

earnings, asset flows, private transfers, public transfers, imputed rental value of owner-occupied housing, and other income of all individuals in a given household minus federal income and payroll taxes (Burkhauser et al 2000). Household income is equivalized using an international scale according to the formula $EI = D/S^e$ where equivalent income *EI* equals total disposable household income *D* divided by household size *S* raised to the power *e*. The value of e is set at 0.5 to align with the most commonly used value for international comparisons.

5.4.2.2 Employment Status

The employment status variable only defines those who are currently working and those who are not. Those who are not working could be temporarily laid off, looking for work, unemployed, retired, permanently disabled, keeping house or a student. Such accounts for the higher proportion of people considered deprived in this dimension in the cross national case compared to the Australian application. An individual was considered deprived if they were not working. Such is important as employment is known to be a key factor in keeping households out of poverty. Joblessness refers to households or families with children where neither parent (within a coupled family) or where a single parent is not working (Harding, Miranti et al 2010). Social exclusion can be the result of prolonged joblessness. Social exclusion is defined as a process whereby deprivation and hardship is reinforced which makes a state of disadvantage difficult to escape (Whelan and Maître, 2008). It precludes the individual or household from participating fully in the economic, cultural and social aspects of life (McLachlan et al 2013). Since educational attainment is high within each country being examined, employment rather than education was chosen as a dimension of deprivation.

5.4.2.3 Self-rated Health Status

Self-rated health status does present some issues as a stand-alone indicator of wellbeing. The harmonised CNEF survey question asks the participant to rate their health status at the time of the survey on a five point scale with one being excellent and five being poor. Self-reports are difficult to measure accurately because it can be challenging to model the role of observed resources, needs and latent behavioural choices that contribute to the outcome (Siminski and Yerokhin 2012). The response may also be influenced by endogenous factors such as personality, an optimistic person may be more likely to rate their health status favourably (Anand et al 2011). Nevertheless this variable was available in all countries with a CNEF except Canada.

5.5 Conclusion

A balanced panel of individuals who have provided information on all of the dimensions of interest in each wave of the HILDA survey leaves a sample size of n=3,367. The Cross National Equivalent Files (CNEF) Project includes data from Australia, the United States, Switzerland, the Russian Federation, the Republic of Korea, Canada, Germany and the United Kingdom. All countries are compared in the same time frame leaving Australia, Germany, the United States of America and Switzerland for the alternating years 2001 to 2009 due to the differing presence of key variables in each panel. By country this equates to n=3,109 from Switzerland, n=5,695 from Australia, n=8,532 from the United States and n=11,215 from Germany. The testing of dynamic factors such as duration and persistence of deprivation can only be achieved through the use of panel or longitudinal data. Issues associated with panel data include the selection of the sample, dimensions and use of weights. The final section highlighted the

characteristics of the HILDA survey participants and the distribution of deprivation for both data sets.

Chapter 6 Methodology utilised for Empirical Application of Multidimensional Deprivation

6.1 Introduction

The chosen methodology is based on the one outlined in Nicholas and Ray (2012) with incremental changes made to advance a greater understanding of the duration and persistence of deprivation in empirical applications. It begins by outlining the setting of thresholds based on the binary nature of the dimensions of deprivation. It then discusses the importance of the duration parameter α that allows the index to give increasing weight to more frequent counts of deprivation; α takes the values of zero to three in order to evaluate the stability of this parameter. This chapter also demonstrates with a simple example how the persistence parameter has been incorporated into studies of multidimensional deprivation.

6.2 Setting Deprivation Thresholds

In general terms the index is based on N individuals in the population of interest, it includes K dimensions of deprivation over T equally spaced time periods. An individual *i* is considered deprived in a particular dimension *j* at time *t* if they fall below the dimensional threshold which can also be written as $x_{ijt} < h_j$ where $i \in 1,2,\dots N,\ j \in 1,2,\dots K,\ t \in 1,2,\dots T$. For example, in typical one-dimensional poverty analysis, if equivalized household income is below 50 per cent of the median income, the household is considered poor. In this instance dimensions have been transformed into binary form where $x_{ijt} = 1$ if the individual *i*, is deprived in dimension *j* at time t and $x_{ijt} = 0$ if otherwise. The choice of where to set the deprivation threshold reflects the judgement of the researcher as the theoretical literature lacks consensus on the most important dimensions and the

threshold must be selected with respect to the dimension in question. The choice of threshold is tied to the identification method of those experiencing poverty. Nicolas and Ray (2012) utilise the union approach to identifying those in poverty meaning that if an individual is deprived in any dimension, in any time period they are counted as deprived. The most common critique of this approach is that it could lead to the over categorisation of people as poor. However, such was mitigated somewhat by the choice of dimensions which relied on data from the self-completion questionnaire.

For continuous, as opposed to binary variables, the depth of deprivation, that is, how far the individual's score is below the threshold, could also be included within the analysis as per the following criterion.

$$d_{ijt}^{\gamma} = \begin{Bmatrix} \left(1 - \frac{x_{ijt}}{h_j}\right)^{\gamma} if\ x_{ijt} < h_j \\ 0 \end{Bmatrix} \qquad 6.1$$

However, by setting $\gamma = 0$ the outcome is a binary relationship between those considered deprived and those not deprived. The dichotomous relationship comes at the expense of examining the depth of deprivation within a dimension. The emphasis in this work is on deprivation across multiple dimensions and over time rather than focusing on the extent of deprivation within a given dimension.

6.3 Constructing the Index

In the multidimensional framework deprivation ratios are arranged in a matrix such that the individual's deprivation profile is a combination of row vectors (dimensions) and column vectors (the outcome over time). Such can be shown by

$$D_i = \begin{bmatrix} d^0_{i11} & \cdots & d^0_{i1T} \\ \vdots & \cdots & \vdots \\ d^0_{iK1} & \cdots & d^0_{iKT} \end{bmatrix}$$

Each deprivation ratio d_{ijt} is between zero and one; if the individual *i* is deprived in a given dimension at a given time $d_{ijt}=1$ and $d_{ijt}=0$ if they are not deprived. Each individual deprivation score μ_i is a function of the individual's deprivation profile D_i. Deprivation scores are then aggregated into the population deprivation profile $\rho = (\mu_1, \ldots \mu_N)$. The index of multidimensional deprivation is a function of each population deprivation profile. The index denoted by Ω is normalised therefore takes a value of one for the maximum level of deprivation and zero being the complete absence of deprivation across all dimensions and over time. The index displays the property of monotonicity whereby the size of the index increases as the number of individuals who are considered deprived increases. Similarly, the index also increases if the number of periods in which an individual is considered deprived increases.

6.4 Sub-group Decomposability

One of the principle features of the index is the ability to decompose the index by population subgroup; each subgroup contributes proportionately to the overall index. The individual deprivation scores μ_i is summed across the whole population and, in order to maintain the property of normalization, the index is divided by the population of interest to give the average deprivation score. Such can be shown by the following equation.

$$\Omega = \frac{\sum_{i=1}^{N}(\mu_i/\mu_{max})}{N} \qquad 6.2$$

The use of a set of population sub groups tests the ability of the index to capture and highlight deprivation among multiple subgroups within the Australian population. Firstly, the index was subdivided according to the sex of the respondent. Secondly, the age of the respondent was used to subdivide the population according to the decade of their age with reference to 40-49 year olds. In the cross national case the population was disaggregated by country. These subgroups are distinct from those chosen in Nicholas and Ray (2012) who subdivided the population in terms of homeowners and non-homeowners, and also by geographical classifications of urban, regional and remote.

6.5 Duration Parameter

The parameter α allows the index to give increasing weight to more frequent counts of deprivation. When α= 0 the index defines a headcount of all individuals in the population who are deprived in at least one dimension and one time period. When α= 1 proportionately more weight is given to higher counts of deprivation. The analysis also includes α= 2 as an incremental adaptation from Nicholas and Ray (2012) who chose values of α= 0, 1, 3. The value of alpha gives greater weight to higher deprivation counts. The index is aggregated across the population by the counting approach, meaning the index is a summary of each individual's deprivation experience in each dimension and each time period. The counting approach yields the following equation for the index of multidimensional deprivation.

$$\Omega_\alpha = \frac{\sum_{i=1}^{N}\left(\sum_j^K \sum_t^T d_{ijt}^0 / (T \times K)\right)^\alpha}{N} \qquad 6.3$$

Where $i \in 1,2,\ldots N,\quad j \in 1,2,\ldots K,\ t \in 1,2,\ldots T$ this equation describes the summation of individual deprivation ratios $\left(d_{ijt}^{0}\right)$ first across dimensions, then across time. Such is then averaged across all time periods multiplied by all dimensions and then averaged again across the population of interest.

6.6 Persistence Parameter

In order to incorporate persistence, that is deprivation in a particular dimension in consecutive time periods; equation 6.3 is adjusted by multiplying the individual deprivation ratio by a factor, s, which represents deprivation spells. The persistence factor, s, is s a function of c_{ijt} , which is the length of a deprivation spell associated with a particular deprivation ratio d_{ijt}^{0}. The persistence factor, s, takes a maximum value of 1 if the deprivation in question is part of a c= T period spell.

$$\Omega_{\alpha} = \frac{\sum_{i=1}^{N}\left(\sum_{j}^{K}\left(\sum_{t}^{T}\left[d_{ijt}^{0}\times s\right]\right)/\left(T\times K\right)\right)^{\alpha}}{N} \qquad 6.4$$

For any individual, i in a dimension j and a period, the index increases as c_{ijt} increases. This property is known as durational persistence monotonicity. Given

$$s = \left(c_{ijt}/\,T\right)^{\beta} \qquad 6.41$$

The persistence parameter, $\beta \geq 0$ gives greater weight to longer deprivation spells.

This type of calculation is aided by the binary convention for deprivation status; if $x_{ij} < z_j$ then d_{ijt}=1 and the individual is considered deprived and d_{ijt}=0 if otherwise. For example, an achievement matrix Y is given by T= 3 periods (row vectors) and K=3 dimensions (column vectors). The matrix is modified such that

for the beginning of each consecutive period of deprivation a value of one is assigned, otherwise zero as shown by Y^1. In this example the matrix that identifies deprivation spells Y^2 is identical to Y^1 because $Y_{3\times3}$ however for the empirical analysis using HILDA data each individual had a matrix $Y_{11\times10}$ and for the analysis using the CNEF data $Y_{3\times5}$. Duration or c_{ijt} is the cumulative sum of the length of each deprivation spell shown by Y^3 the persistence factor; s is simply the value for duration divided by the total number of time periods in this example T=3 shown by Y^4

$$Y = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix} \quad Y^1 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad Y^2 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix} \quad Y^3 = \begin{bmatrix} 0 & 2 & 2 \\ 3 & 3 & 3 \\ 1 & 0 & 0 \end{bmatrix}$$

$$Y^4 = \begin{bmatrix} 0 & 2/3 & 2/3 \\ 1 & 1 & 1 \\ 1/3 & 0 & 0 \end{bmatrix}$$

6.7 Conclusion

This chapter has outlined the methodology defined in Nicholas and Ray (2012) to create a dynamic index of multidimensional deprivation with particular attention to several important aspects. Firstly, the setting of deprivation thresholds. Such is theoretically outlined using an arbitrary cut-off $h_j > 0$ which is akin to a poverty line. From this, the dimensions were transformed into binary variables where $x_{ijt} = 1$ if the individual i, is deprived in dimension j at time t and $x_{ijt} = 0$ if otherwise. The construction of the index is an aggregation of each individual's deprivation profile which is arranged in a matrix $D_{K\times T}$ where K is the number of dimensions and T is the number of time periods. The property of subgroup decomposability was also highlighted within the chapter. The choice of subgroups is distinct from those chosen in Nicholas and Ray (2012). As such it

represents one of the small modifications made to this methodology. Prominence is also given to the role of the duration parameter α which allows the index to give increasing weight to more frequent counts of deprivation. Four values of the duration parameter α= 0, 1, 2, 3 are incorporated into this analysis of multidimensional deprivation. Such is another small modification made to the methodology outlined in Nicholas and Ray (2012) made to enhance the understanding of the role of duration of deprivation in empirical applications. The chapter concludes with a description of the persistence parameter beta that gives greater weight to consecutive periods of deprivation.

Chapter 7 Results of Empirical Analysis of Multidimensional Deprivation

7.1 Introduction

This chapter is divided into several distinct segments as follows. The first highlights the correlations between dimensions for the Australian application using HILDA data and for the multinational comparisons using a set of Cross National Equivalent Files for Australia, Germany, the United States and Switzerland. The second section examines the distribution of deprivation for males and females and for each age group. The third section analyses the results of the duration augmented deprivation mean ratios for all case studies within the Australian application as well as the cross national comparisons. The fourth and concluding section analyses the results of the persistence augmented deprivation mean ratios for all sub groups.

7.2 Correlations between Dimensions

It is useful to note the correlations between dimensions of deprivation and equivalized income as it enables a better understanding of the relationship between dimensions (Klasen 2000). Table 7.1 shows the pairwise correlation of the average duration of deprivation with equivalized household income. The table illustrates the extent of association between the dimensions and equivalized income. Some measure of association between dimensions is expected as deprivation in one area is likely to reinforce deprivation in another. For instance inability to pay utilities on time is likely to be related to other measures of material hardship such as inability to pay rent or mortgage on time. Almost all correlations between variables are statistically significant except for the correlation between unemployment and some health variables which are likely

due to the aging of the cohort. In general, it would be expected that health status is related to labour market outcomes (Nickell 2004). The magnitude of the correlation between the material resource dimensions (heating, utilities, meals, ability to raise $2000 in an emergency and rent or mortgage repayment difficulty) is relatively high which suggests an association between dimensions in this category. Without this correlation the index would lose its ability to identify sources of deprivation. Income is negatively related to each of the dimensions consistent with Kostenko et al (2009) who found that correlation between their sum-score of deprivation and income was negative and low. It is also in line with Nicholas and Ray (2012) who noted that a relatively large increase in income is required to decrease the duration of deprivation.

For the cross national comparison Table 7.2 shows the correlations between the three dimensions; employment status, self-rated health status and income poverty measured within each country. There are positive and significant correlations between the dimensions in question. There exists a larger correlation between employment status and general health in the cross national comparison than there is for the Australia only study. Such is closer to the a priori result expected in (Nickell 2004). The most startling difference is the change in sign of the correlation between income and the other dimensions. In the cross national comparison deprivation in income is calculated using the standard relative poverty line of 50 per cent of median income constructed separately for each country. The difference in outcome may be due to variation in the definition of the employment dimension, deprivation is defined as all who are not currently working even if they are not in the labour market. Such does, however, have economic

significance as it suggests a strong association between not being in the labour market and being below the poverty line.

Table 7.1 Pairwise Correlation of Eleven Dimensions of Deprivation with Equivalized Income

	Heating	Meals	Raise 2k	Rent	Utilities	General Health	Physical Health	Role Physical	Vitality	Emotions	Employment
Heating	1										
Meals	0.5293	1									
	(0.00)										
Raise 2k	0.4048	0.3957	1								
	(0.00)	(0.00)									
Rent	0.294	0.4647	0.3446	1							
	(0.00)	(0.00)	(0.00)								
Utilities	0.3842	0.4787	0.4515	0.7026	1						
	(0.00)	(0.00)	(0.00)	(0.00)							
General Health	0.1951	0.1556	0.2012	0.0581	0.0959	1					
	(0.00)	(0.00)	(0.00)	(0.0007)	(0.00)						
Physical Health	0.1345	0.1262	0.1533	0.0576	0.0823	0.4369	1				
	(0.00)	(0.00)	(0.00)	(0.0008)	(0.00)	(0.00)					
Role Physical	0.194	0.1784	0.1956	0.0725	0.1195	0.5428	0.4707	1			
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)				
Vitality	0.1851	0.192	0.191	0.1285	0.1587	0.5954	0.4106	0.5139	1		
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)			
Emotions	0.2079	0.2838	0.2407	0.1761	0.2195	0.4384	0.329	0.6163	0.5083	1	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		
Employment	0.212	0.2094	0.3217	0.2221	0.2348	0.007	-0.015	0.014	0.0249	0.0722	1
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.6851)	(0.3827)	(0.4166)	(0.149)	(0.00)	
Income	-0.1478	-0.1376	-0.2396	-0.1385	-0.1992	-0.0989	-0.0934	-0.1905	-0.0976	-0.1665	-0.117
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table Notes: This table presents correlations of average duration of deprivation over the period 2001 to 2011 for the eleven dimensions of deprivation and financial year disposable household income. Household income is equivalized using the Modified Organisation for Cooperation and Development (OECD) scale. P-values are presented in brackets.

Table 7.2 Pairwise Correlation of Three Dimensions used in Cross National Comparisons

	Self Reported Health	Employment Status	Income
Self Reported Health	1		
Employment Status	0.3023 (0.00)	1	
Income	0.2451 (0.00)	0.2978 (0.00)	1

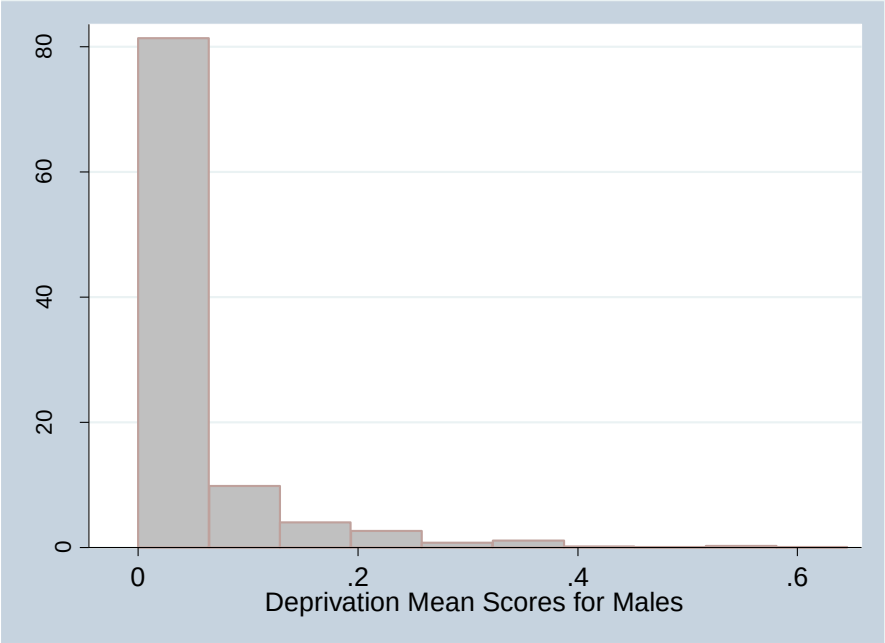
Table Notes: Correlations for average duration of deprivation are pooled across Australia, Germany, the United States and Switzerland for the years 2001-2003-2005-2007-2009. P-values are presented in brackets.

7.3 Distribution of Deprivation Scores by Subgroups

This section describes the extent of multidimensional deprivation over the period 2001 to 2011 for each sub group. Figures 7.1 and 7.2 show histograms of the index of multidimensional deprivation for $\alpha = 1$ disaggregated by females and males and by age group. It is necessary to examine the distribution of deprivation in order to determine where to set the duration and persistence parameters. In general the distribution of deprivation across all subgroups was skewed to the left indicating low levels of deprivation are common in the Australian population. Such is in-line with the findings of Kostenko et al (2009) who noted that the proportion of the population experiencing social exclusion declined as the value of their multidimensional deprivation sum-score increased. Recall the structure for the duration adjusted deprivation index, relatively low levels of deprivation mean that as higher weight is placed on individuals with higher deprivation counts, that is as the value of alpha increases in equation 6.3, the value of the index will tend towards zero. Such means that it is not practical to set the value of alpha above two or three. However, the persistence parameter beta is built into a persistence factor s hence it does not face the same limitations refer to equation 6.4 in chapter 6.

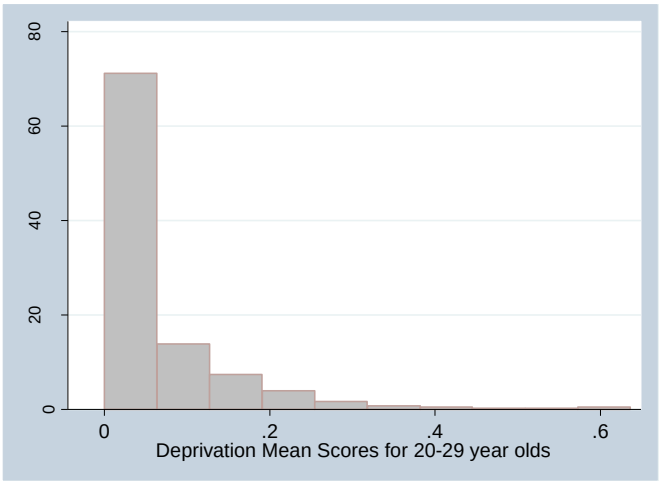
Figure 7.1 Distribution of Deprivation for Females and Males

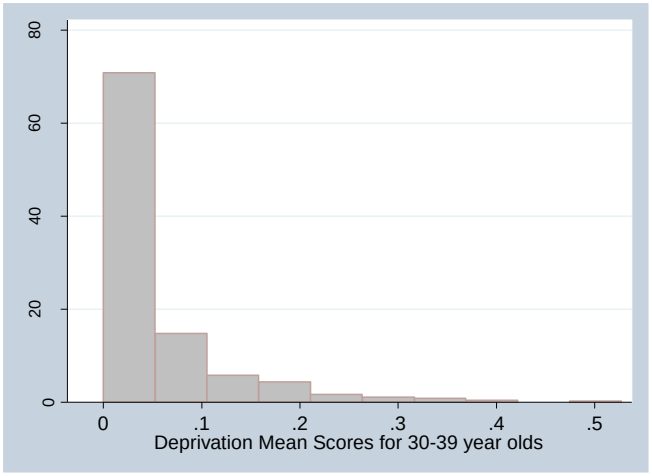
The histogram highlights the distribution of female deprivation over time. Using equation 6.3 for the duration adjusted deprivation index and $\alpha = 1$. A mean score of zero indicates no deprivation in any dimension in any time period and a mean score of one indicates deprivation in every dimension in every period.

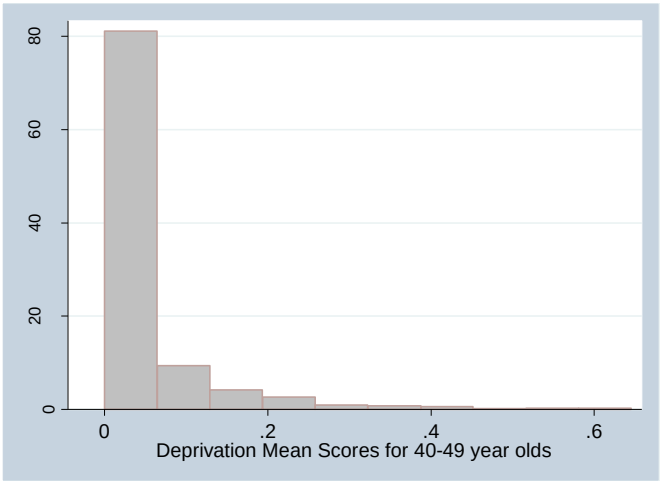


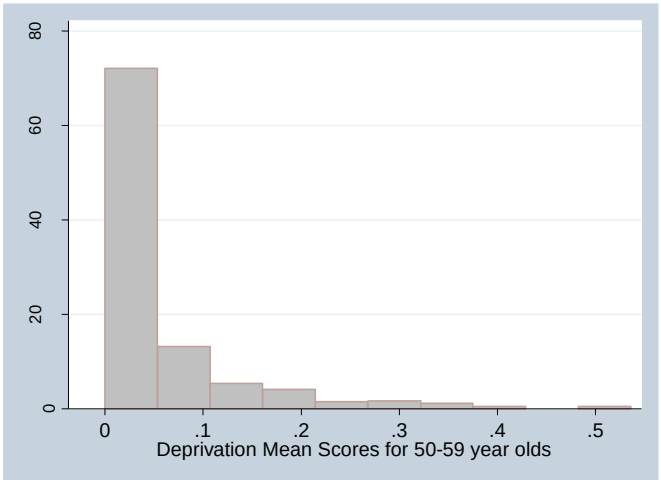
The histogram highlights the distribution of male deprivation over time. Using equation 6.3 for the duration adjusted deprivation index and $\alpha = 1$. A mean score of zero indicates no deprivation in any dimension in any time period and a mean score of one indicates deprivation in every dimension in every period.

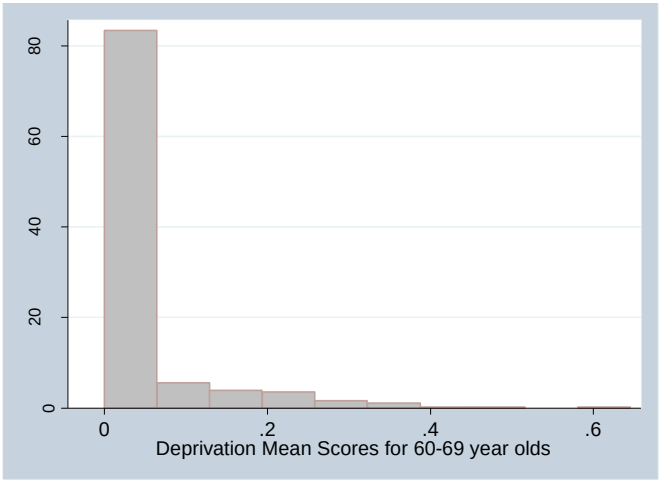
Figure7.2 Distribution of Deprivation by Age

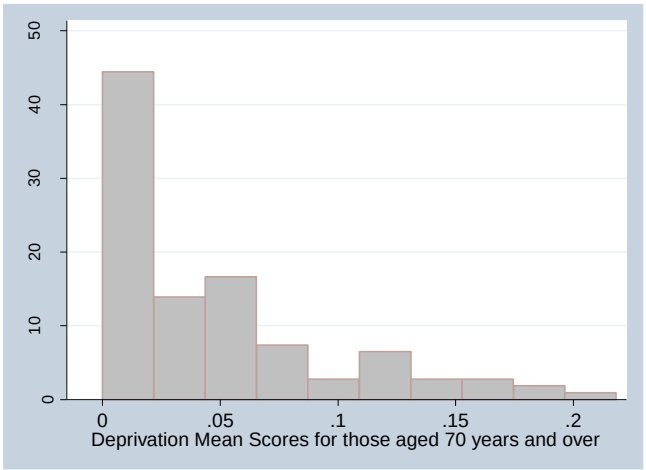












7.4 Duration Augmented Analysis of Deprivation

This section highlights the duration augmented analysis of deprivation using the results presented in Table 7.3. The first set of comparisons is between levels of deprivation for females and males. The choice of broad sub groups is intended to highlight the disparities that exist on an individual level. In the first row of Table 7.3, females appear to be more deprived than males and this disparity is exacerbated as the value of alpha increases from one to three, that is, as more weight is given to more counts of deprivation. Previous studies have identified that female headed households experience higher levels of poverty or deprivation than male headed households (Klasen 2000). The results illustrated in Table 7.6 are also consistent with development literature that identifies female poverty as more prevalent (Buddelmeyer and Verick 2008).

The second case study using HILDA data subdivides the population according to age. Each ratio of deprivation scores is with reference to 40 to 49 year olds as the subgroup on the denominator. The overall trends are less clear in this case. In Figure 7.3 the gradient of the line for $\alpha = 1$, which can be considered a cross section of the population over time, is fairly flat. Such means that relative deprivation is quite similar across age groups. Such is in contrast to Siminski and Yerokhin (2012) who found a clear negative relationship between age and level of hardship or multidimensional deprivation. Such can be partly explained by a different level of resources accumulated by each age group with older people being asset rich but income poor and vice versa for young people. Another factor could be the needs of each age group, for instance, those related to household composition. Behavioural choices also account for up to one third of the observed

age gradient. Siminski and Yerokhin (2012) did not find that reporting bias contributed to this result.

In an attempt to identify the source of a possible age gradient in line with Siminski and Yerokhin (2012) three dimensions were isolated for further analysis. The three material resource dimensions from the HILDA survey were: inability to pay utilities bill on time in the last year; inability to pay rent or mortgage on time last year and unable to afford heating in the last year. These dimensions were chosen as it was hypothesised that older people are more likely to experience persistent deprivation spells whereas young people are more likely to bounce back from a period of deprivation. In contrast to Figure 7.3, Figure 7.4 shows a distinct negative relationship between age and levels of material hardship. Those in the younger age cohorts, 20-29 and 30-39 experience relatively higher levels of deprivation whereas those in relatively older cohorts experienced relatively lower levels of deprivation compared to the 40-49 age group. Such can be seen through a comparison of rows 8-13 in Table 7.3. This relationship between age and levels of material hardship is reinforced when the duration of deprivation is taken into account.

Applying the methodology outlined in Nicholas and Ray (2012) to a new data set is a robustness test to determine if the choice of methodology confirms the conclusions discovered in the Australian application. A consistent result would show that the inclusion of duration of deprivation exacerbates the difference in outcomes between countries. For each multidimensional deprivation mean ratio Australia is used as the reference point in the numerator. Therefore values greater than one indicate that Australia is worse off relative to the other country. Overall,

Australia appears to be more deprived relative to the other countries. When duration of deprivation is incorporated the divergence in outcomes between Australia and Switzerland is increased. Introducing duration into the comparison between Australia and the United States exacerbates Australia's deprivation levels. For the relationship between Australia and Germany the duration of deprivation has a greater impact on Australia than Germany. Such is roughly in line with what was expected from the application of the methodology to Australian data.

Table 7.3 Duration Augmented Dimension and Time-Aggregated Deprivation Score Ratios

	$\alpha=0$	$\alpha=1$	$\alpha=2$	$\alpha=3$
Panel A Comparisons by Sex				
Female-Male[‡]	1.0849	1.3101	1.4681	1.5571
Panel B Comparison by Age including all Dimensions				
20-29[‡]	1.1270	1.2123	1.1331	1.3489
30-39	1.0400	1.1848	1.0328	0.8014
40-49	1.0000	1.0000	1.0000	1.0000
50-59	0.9896	1.1259	1.1291	1.0134
60-69	1.0154	1.0741	1.2153	1.3574
70+	1.1328	1.0594	0.5849	0.2515
Panel C Comparison by Age using subset of Dimensions				
20-29*	1.4958	1.8016	1.9140	1.8624
30-39	1.2838	1.5677	1.7062	1.7429
40-49	1.0000	1.0000	1.0000	1.0000
50-59	0.6811	0.5168	0.3439	0.2429
60-69	0.5428	0.3431	0.2518	0.2049
70+	0.2217	0.1021	0.0368	0.0128
Panel D Cross National Comparisons				
Australia[#]	1.0000	1.0000	1.0000	1.0000
Switzerland	1.0334	1.2417	1.8532	3.0151
United States	0.9967	1.0295	1.0591	1.0769
Germany	0.9465	1.0346	1.2473	1.5503

Table notes: As the value for alpha increases so does the weight given to individuals with higher deprivation counts.

Table Notes Continued:

The results are weighted to mitigate the impact of non-random attrition from the survey. The unweighted results for the mean deprivation score ratios by gender and age for all eleven dimensions of deprivation are presented in Appendix C.

[ł]First row shows the mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for females relative to males. A ratio of greater than one indicates that females are more deprived than males.

[ł]Rows 2- 7 shows the mean deprivation score ratios summarised across all eleven dimensions in the period 2001 to 2011 for each age group with reference to those aged 40-49.

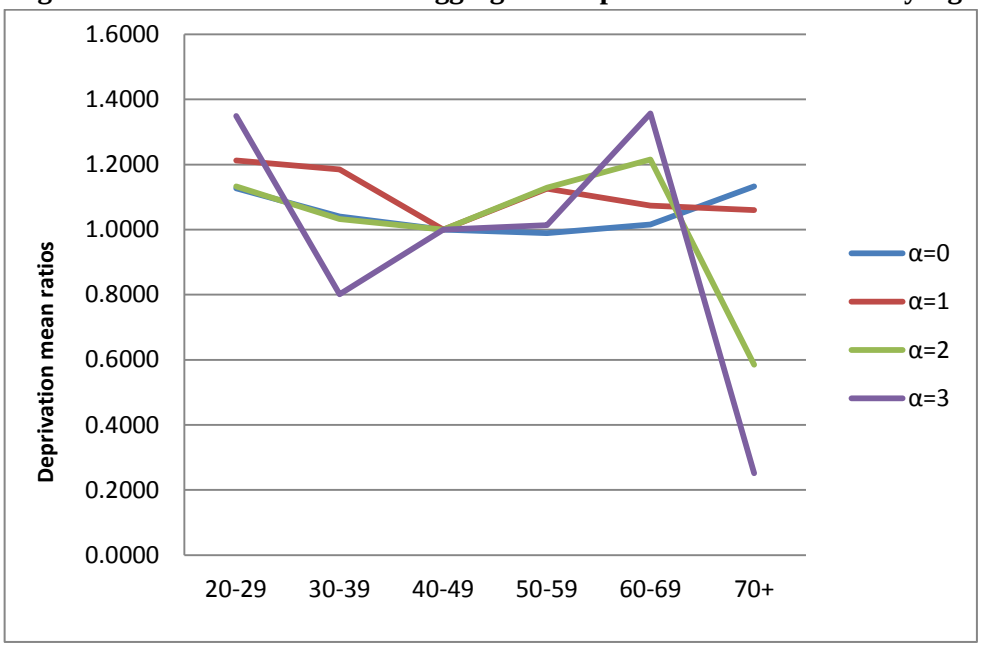
*Rows 8-13 shows mean deprivation score ratios are calculated for each age group with reference to those aged 40-49. The mean deprivation score is summarised across three material resource dimensions in the period 2001 to 2011.

[#] Rows 14-18 shows deprivations mean score ratios with reference to Australia for the years 2001-2003-2005-2007-2009. A value that is greater than one indicates that Australia is more deprived relative to the other country. Deprivation mean ratios are aggregated across all three dimensions income, self-rated health status and employment status.

7.4.1 Stability of the Duration Parameter Alpha

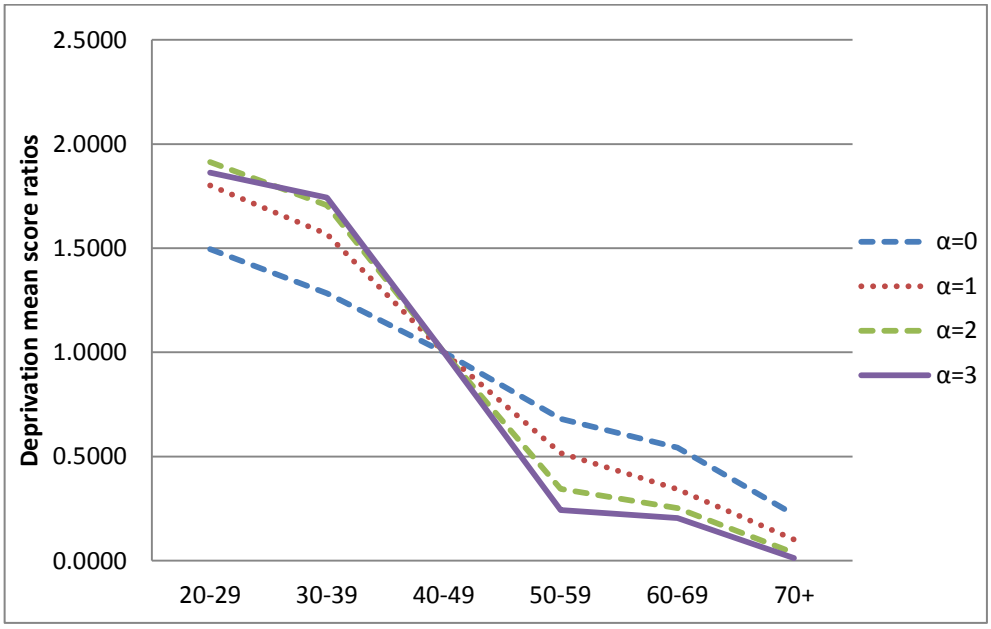
The four values of the duration parameter alpha enable the assessment of the stability of the index. The deprivation mean ratios are highly dispersed for values of $\alpha = 2, 3$. Figure 7.3 and Figure 7.4 show that the index is volatile for higher values of alpha. Such can be explained by the low levels of total deprivation for older age groups. Such is illustrated by the histograms in Figure 7.2 that show the distribution of deprivation by age. Such is an inevitable consequence of the index as it is designed to highlight extremes in the data meaning, individuals with higher deprivation counts are given more emphasis. Evidence of a volatile duration parameter is also illustrated in the comparison of females and males as shown in Figure 7.5. Low levels of total deprivation for females and males seem to drive fluctuations in dimension and time aggregated deprivation score ratios.

Figure 7.3 Dimension and Time Aggregated Deprivation Score Ratios by Age



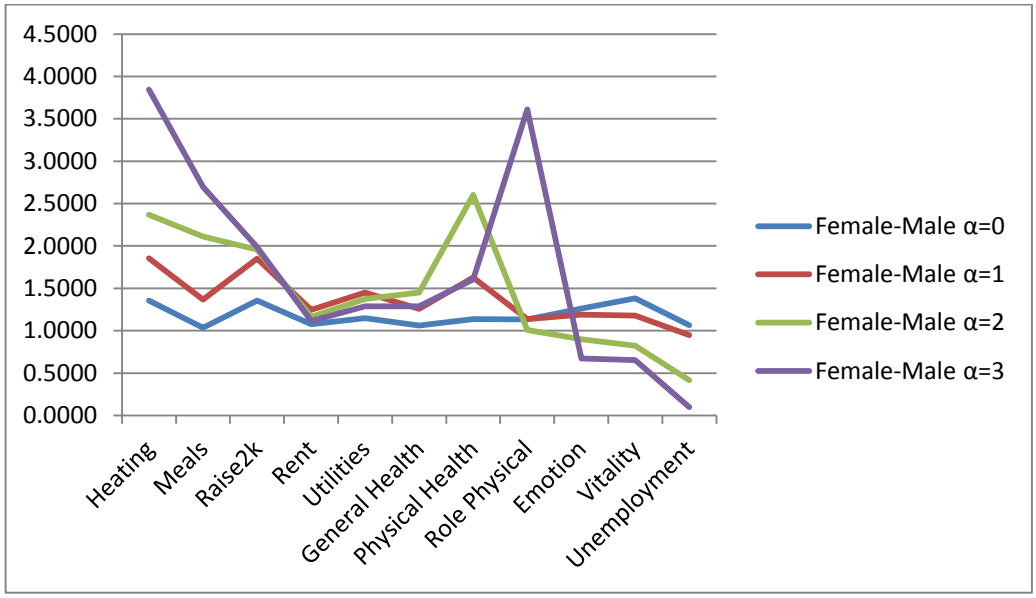
Deprivation scores ratios are shown on the vertical axis calculated as the mean deprivation score for each age sub group relative to those aged 40-49. Deprivation scores are calculated across all dimensions over the time period 2001 to 2011.

Figure 7.4 Dimension and Time Aggregated Deprivation Score Ratios by Age



Notes: This figure graphs mean deprivation score ratios calculated for each age group with reference to those aged 40-49. The mean deprivation score is summarised across three material resource dimensions in the period 2001 to 2011. Increasing values of alpha give higher weights to higher deprivation counts. There appears to be a clear negative relationship between age and mean deprivation score.

Figure 7.5 Variation in Deprivation Mean Ratios for Females versus Males Disaggregated by Dimension



Notes: Deprivation scores ratios are shown on the vertical axis calculated as the mean deprivation score for females relative to males. Deprivation scores are calculated for each dimension over the time period 2001 to 2011

7.5 Persistence Augmented Analysis of Deprivation

This section evaluates the impact of persistent deprivation among each sub group in the Australian analysis using HILDA data. It also examines the effect of persistence in the cross national comparisons using data from the CNEF. The inclusion of persistence or consecutive periods of deprivation is shown in Table 7.4. For the comparison of females to males shown in row one of Table 7.4, deprivation ratios increase slightly when $\alpha = \beta = 1$ also when $\alpha = 1 \; and \; \beta = 3$. The deprivation ratios actually decline slightly for higher values of α when persistence is incorporated into the analysis compared to row one of Table 7.3. This is interesting as it indicates that the inclusion of persistence of deprivation only contributes marginally to the disparity between females and males. The inclusion of persistence does have an impact on the age case studies using the HILDA data.

The outcome of the persistence augmented deprivation ratios according to age is not clear cut. Comparing rows 2-7 of Table 7.3 to rows 2-7 of Table 7.4 reveal an interesting result. For the younger cohort, those aged 20-29 and 30-39 deprivation score ratios were lowered when persistence was incorporated into the analysis. For the older age cohort, those aged 50-59 and 60-69 deprivation score ratios are increased when persistent deprivation was incorporated. Such confirms the hypothesis that older people are more likely to experience persistent deprivation spells whereas young people are more likely to bounce back from a period of deprivation. The result does not hold for those over 70 years of age but this could be because of the extremely low levels of deprivation recorded for that age group. Yet these results were not consistent when persistence augmented deprivation ratios are calculated for a sub set of material resource dimensions. For rows 8-13 of Table 7.3 and rows 8-13 of Table 7.4 the deprivation score ratios for younger cohorts was relatively higher than the deprivation score ratios for older cohorts. This relationship is illustrated in Figure 7.6. An analysis of the dimensions included in each case study is required.

The results of the cross national comparison of persistence augmented deprivation scores vary by country, comparing rows 14-18 in Table 7.3 to rows 14-18 in Table 7.4 when including persistence the outcome is mixed. For example, the value of the deprivation mean ratio for Australia and Switzerland when $\beta = 1$ declines. However, when $\beta = 3$ the value of the deprivation score ratios increases substantially. In contrast, the value of the deprivation score ratio for Australia and the United States when $\beta = 1$ increases. Nevertheless, when $\beta = 3$ the value of the mean ratios declines marginally. Only the value of the deprivation score ratio for Australia and Germany consistently increases when $\beta = 1 \; and \; \beta = 3$. It is

difficult to generalise the impact of persistence as its inclusion seems to have different impacts within each country.

Table 7.4 Persistence Augmented and Time-Aggregated Deprivation Score Ratios

	β=1				β=3			
	α=0	α=1	α=2	α=3	α=0	α=1	α=2	α=3
Panel A Comparisons by Sex								
Female-Male[t]	1.0849	1.3723	1.4243	1.4803	1.0849	1.3634	1.3949	1.4751
Panel B Comparison by Age including all Dimensions								
20-29[t]	1.1270	1.1189	1.0131	1.0110	1.1270	0.9645	0.8679	0.7055
30-39	1.0400	1.2172	0.8874	0.5286	1.0400	1.1914	0.7211	0.3382
40-49	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
50-59	0.9896	1.2342	1.2776	1.0767	0.9896	1.3416	1.2216	0.8067
60-69	1.0154	1.1903	1.5522	1.8780	1.0154	1.3917	1.4676	1.9288
70+	1.1328	1.0323	0.4713	0.1630	1.1328	0.9470	0.4224	0.1304
Panel C Comparison by Age using subset of Dimensions								
20-29*	1.4958	2.0246	2.3299	2.6483	1.4958	2.4203	2.8845	3.1444
30-39	1.2838	1.7934	2.2104	2.4748	1.2838	2.2106	2.5935	2.5634
40-49	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
50-59	0.6811	0.4112	0.2529	0.1668	0.6811	0.3171	0.2093	0.1262
60-69	0.5428	0.2518	0.1907	0.1494	0.5428	0.2545	0.2893	0.2351
70+	0.2217	0.0372	0.0031	0.0002	0.2217	0.0018	0.0000	0.0000
Panel D Cross National Comparisons								
Australia[#]	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Switzerland	1.0334	1.1391	1.7508	2.9744	1.0334	1.6725	4.3093	9.6207
United States	0.9967	1.0867	1.1529	1.1838	0.9967	0.9801	0.9844	1.0148
Germany	0.9465	1.0302	1.2989	1.6879	0.9465	1.2252	1.8074	2.4745

Table Notes: The beta parameter incorporates persistence whereby consecutive periods of deprivation are given more emphasis as the value of beta increases.

[t]First row shows the mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for females relative to males. A ratio of greater than one indicates that females are more deprived than males.

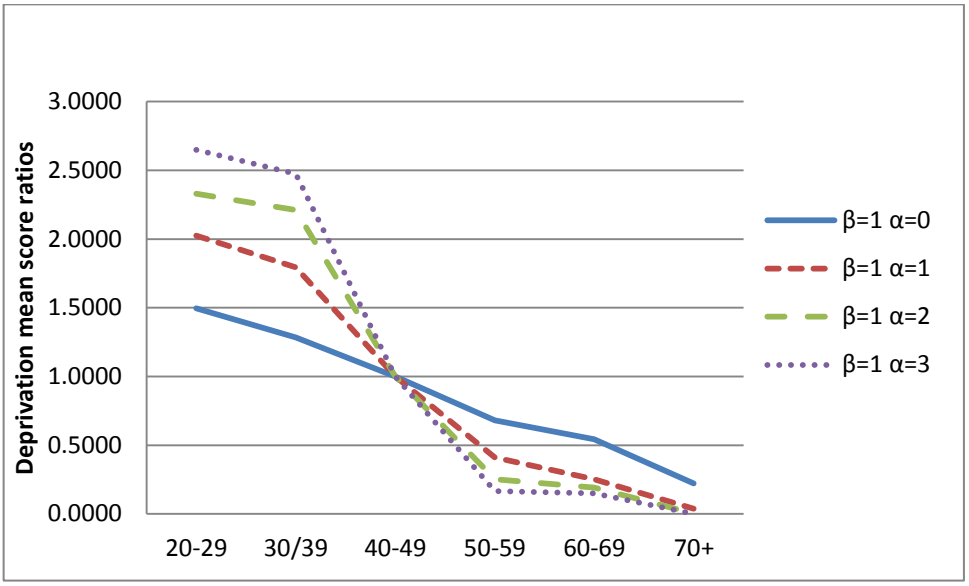
[t]Rows 2- 7 shows mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for each age group with reference to those aged 40-49.

*Rows 8-13 shows mean deprivation score ratios are calculated for each age group with reference to those aged 40-49. The mean deprivation score is summarised across three material resource dimensions in the period 2001 to 2011.

Table Notes Continued:

[#]Rows 14-18 shows deprivations mean score ratios with reference to Australia for the years 2001-2003-2005-2007-2009. A value that is greater than one indicates that Australia is more deprived relative to the other country. Deprivation mean ratios are aggregated across all three dimensions income, self-rated health status and employment status.

Figure 7.6 Persistence Augmented Deprivation Score Ratios by Age



This figure graphs the mean deprivation score ratios calculated for each age group with reference to those aged 40-49. The mean deprivation score is summarised across three material resource dimensions in the period 2001 to 2011. Increasing values of alpha give higher weights to individuals with higher deprivation counts. The beta parameter incorporates persistence that is consecutive periods of deprivation. The negative relationship between age and mean deprivation score is enhanced by the inclusion of persistence.

7.5.1 Persistence Augmented Analysis by Dimension for Cross National Comparison

This section attempts to disaggregate the effects of persistence within each country. Table 7.6 shows the persistence augmented deprivation score ratios for each dimension. A brief glance reveals that self-rated health status is driving the divergence in Australian and Swiss outcomes. The magnitude of this gap outweighs the fact of Australia's better performance in the employment status dimension but the income poverty result also overwhelms this positive outcome.

For Australia and the United States employment and health status are better outcomes from the United States perspective. However, income poverty is much higher in the US than it is in Australia. The inclusion of persistence seems to reinforce this gap which implies that chronic poverty is more of an issue in the United States than it is in Australia. For Australia and Germany employment outcomes favour Australia yet health and income dimensions show that Germany is better off relative to Australia. The following chapter will discuss the implications of choice of dimensions.

Table 7.5 Persistence Augmented Deprivation Score Ratios Disaggregated According to Dimension with Reference to Australia

	Self-Reported Health Status				Employment Status				Income Poverty			
	α=0	α=1	α=2	α=3	α=0	α=1	α=2	α=3	α=0	α=1	α=2	α=3
Australia	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Switzerland	7.3030	36.9332	81.3323	110.3495	0.8811	0.7466	0.7361	0.7337	1.6185	2.5334	3.2258	3.6789
United States	1.0628	1.0969	1.1124	1.1225	1.0434	1.3163	1.4026	1.4414	0.8557	0.7085	0.6836	0.6781
Germany	0.8605	1.0632	1.1548	1.1970	0.9027	0.8401	0.8353	0.8337	2.0328	2.9160	3.4066	3.6243

The table shows deprivations mean score ratios with reference to Australia for the years 2001-2003-2005-2007-2009. A value that is greater than one indicates that Australia is more deprived relative to the other country. The deprivation mean ratios are disaggregated across all three dimensions. The persistence parameter beta equals one is also included to give greater weight to consecutive periods of deprivation.

Chapter 8 Discussion and Conclusions

8.1 Introduction

This chapter seeks to outline the implications of a study of multidimensional deprivation for the understanding of poverty, its causes and consequences. It begins with a discussion of the dynamic component of the analysis, that is, the impact of incorporating duration and persistence of deprivation on the overall outcome. Secondly, it will reiterate the issues often associated with the empirical measurement of this concept. The subsequent section will highlight the implications of the choice of dimensions for developed and developing countries referring to the capabilities and functionings framework. It will conclude by addressing avenues for further research in this area.

8.2 The Importance of Duration and Persistence of Deprivation

The aim of this research was to determine the relevance of dynamic factors such as duration and persistence for the analysis of multidimensional deprivation. The aim of studies of multidimensional deprivation is to extend empirical measurements of poverty to incorporate the challenges of welfare measurement by taking into account the individual's capabilities. The choice of dimensions is a judgement that combines the capabilities and functionings theory and an understanding of the context under examination. To evaluate the extent of multidimensional deprivation in Australia ten waves of the Household Income and Labour Dynamics in Australia survey were utilised. The methodology outlined in Nicholas and Ray (2012) was incrementally extended by incorporating extra dimensions and an additional value for the duration parameter α to examine the stability of the index for empirical applications. Firstly, deprivation means were calculated for females and males and secondly by age with reference to 40-49 year

olds in Wave 1 of the survey in 2001. Applying the methodology to a set of Cross National Equivalent Files, was a means of testing the robustness of methodology to deliver conclusions consistent with those discovered in the Australian application.

The results of the Australian application tended to show females to be deprived relative to males and this result is exacerbated when the duration of deprivation is taken into account. In contrast, the result for deprivation levels by age was less obvious. The cross section of the population revealed a fairly proportional level of deprivation across age groups in the first case study when all eleven dimensions were included in the analysis. Siminski and Yerokhin (2012) found a negative relationship between age and levels of material hardship. This result was validated when a subset of material resource dimensions were examined in the second case study. For the cross national comparisons overall, Australia appears to be more deprived relative to the other countries and when the duration of deprivation is included, such exacerbates the divergence in outcomes. The examination of the impact of persistence augmented deprivation was less consistent in all case studies. Persistence reduces the disparity between levels of deprivation for males and females. For age groups, the effect of persistence was dependent on the set of dimensions included. An analysis of the dimensions included in each case study is required.

In the first case study a broad range of dimensions were included: health, access to material resources and employment status. In the second case study only three of the material resource dimensions were included. It is possible that the persistence effect is therefore closely related to the health dimensions included in

the analysis. This result is not particularly useful as age is associated with increasing health issues and this result cannot be unduly modified by policy intervention. Therefore, it can be concluded that the inclusion of persistence is less useful than the inclusion of duration in the analysis of multidimensional deprivation. This result aligns with that of Nicholas and Ray (2012) who found that the inclusion of persistence did not greatly alter the disparities highlighted between their chosen subgroups. The starkest contrast was between deprivation mean ratios for home-owners and non-homeowners. Incorporating persistence of deprivation only marginally increased these ratios which reaffirms the close association between these two ideas; meaning those who suffer prolonged periods of deprivation are also more likely to experience consecutive periods of deprivation.

It is widely acknowledged that episodes of chronic poverty are said to be more severe than transitory periods (Gradin et al 2012, Bossert et al 2011, Hoy and Zheng 2011, Rodgers and Rodgers 2009). The methodology outlined in Nicholas and Ray (2012) provided a means of empirically testing the effect of the duration of poverty in multiple dimensions using a duration parameter α akin to the "poverty aversion" α developed by Foster, Greer and Thorbecke (1984). As the value of alpha increased from one to three greater emphases were placed on those with higher counts of deprivation both in multiple periods and across multiple dimensions. This methodology was then applied to new data, a series of cross national equivalent files for Australia, the United States, Switzerland and Germany. The cross national comparisons tended to reveal a similar pattern of results whereby levels of relative deprivation between Australia and the other countries was exacerbated when the duration of deprivation was taken into

account. A notable example was the comparison of Australia and Switzerland, deprivation levels were considerably heightened when the duration of deprivation was taken into account. The inclusion of greater weight for persistent periods of deprivation tended only to marginally reinforce this outcome. Such confirmed the ability of the methodology to deliver consistent results.

8.3 Issues for Empirical Calculations of Multidimensional Deprivation

Although it would be desirable to apply the methodology outline in Nicholas and Ray (2012) to developing countries, the extent to which this is possible is limited by the availability of longitudinal household surveys. The application of a dynamic multidimensional poverty index to the cross national equivalent files appears to be a unique contribution to the literature at this point. International comparisons are often constrained by the assessment and availability of relevant "essential" variables that can be precisely compared across regions. With regard to the choice of dimensions, what is considered essential in one country may still be considered a luxury in other parts of the world. Computers and cars are examples of this (Boarini and d'Ercole 2006). Such presents a restriction for the cross national application of studies of multidimensional deprivation.

Despite the fact that each panel is designed to be nationally representative there are issues, such as the potential for non-random attrition from the survey that could impact the outcome of the analysis. The use of survey weights can help to correct this problem but cannot mitigate it entirely. Previous studies have identified several groups with an increased likelihood of experiencing multidimensional deprivation. Examples include those with income below the relative poverty line, the young, the unemployed or those with weak ties to the labour market, those with low levels of education, single person households and

lone parents, those with a disability as well as immigrants and welfare recipients (Boarini and d'Ercole 2006). These are the groups that are also less likely to remain in the survey hence there are implications for the representative nature of the panel. It would also be ideal to test the impact of duration and persistence on single parent families. However, it is difficult to track these individuals as relationship status can be quite volatile over time.

8.4 Implications of Choice of Dimensions

The most common critique of an index of multidimensional deprivation is that, once aggregated into the index the dimensions that drive the results can be difficult to determine. Studies of multidimensional deprivation are also particularly sensitive to the value judgements made about any type of poverty analysis. For example, the choice of dimensions, the weights assigned to each dimension and the choice of threshold can drastically influence results. The means of overcoming this are to firstly make underlying judgements clear and transparent such that the interactions between dimensions are well understood. Secondly, to choose measures firmly grounded in evidence and informed community discussion (McLaughlin et al 2013).

The choice of dimensions attempts to incorporate the limitations that poverty represents for an individual's "functionings", that is, the actual achievement of a person, and what they are able to accomplish given their circumstances in life. Capabilities represent an individual's freedom to choose between alternatives, or the set of functionings which may be restricted for reasons other than low income. The inclusion of the health dimension is motivated by these ideas. An example of a specialised set of dimensions is given in Ele-Ojo Ataguba et al (2013). A household survey was constructed for Nsukka local government area of Enugu

State Nigeria. It incorporated traditional demographic characteristics, education, health care and employment status. It also utilised five dimensions based on the Oxford Poverty and Human Development Initiative including employment, agency or empowerment, physical safety, ability to go about without shame and psychological wellbeing. These dimensions attempt to measure capabilities more directly. The results show that consumption poverty is correlated to these unique dimensions, meaning they contribute to the measurement of poverty.

Whilst the relevance of employment quality, empowerment, education, housing adequacy and the health dimensions is clear in this context for countries with a high level of human development such as Australia, the relevance of these dimensions is less clear. In proportional terms deprivation levels were quite low, especially within the health dimension when considering the results of the Australian analysis using HILDA data. In their ambitious cross national comparison Alkire and Santos (2010) noted that income poverty had increased relevance for the relatively wealthier countries. Similarly, Stevenson and Wolfers (2008) argue for a greater role of absolute incomes in determining welfare levels. These authors assert that there is a robust link between economic development and subjective wellbeing. The arguments presented in the aforementioned articles reinforce the need to modify the set of dimensions for developed countries.

8.5 Avenues for Further Work

Even within a multidimensional framework traditional concepts such as the poverty line are still in use. Each dimension had a threshold which was often set arbitrarily. The ordinal data was well suited to the binary convention of deprived or otherwise. Belhadj and Limam (2012) introduced fuzzy sets theory to the study of poverty. The broader application of this methodology may be a fruitful area for further research. As panel data becomes more readily available and the length of panels are extended a better means of tracking vulnerable groups over time would be of great benefit to the study of multidimensional deprivation. There is scope for further analysis of the dynamic aspects of multidimensional deprivation. A logical extension already adopted by Nicholas et al (2013) is to determine the impact of the path dependence on deprivation levels.

Appendix A

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Appendix B

B1. Cross National Equivalent File data availability

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Australia	0	1	1	1	1	1	1	1	1	1	1	1
Switzerland	1	1	1	1	1	1	1	1	1	1	1	1
Germany	1	1	1	1	1	1	1	1	1	1	1	1
United States	0	1	0	1	0	1	0	1	0	1	0	0
Korea	0	0	0	1	1	1	1	1	1	0	0	0
Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0
Canada	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	1	1	1	1	1	1	1	0	0	0	0	0
Total	**3**	**5**	**4**	**6**	**5**	**6**	**5**	**5**	**4**	**4**	**3**	**3**

The United States Panel of Income Dynamics is the longest running longitudinal survey in the world. It is distinct from the other panels in two key areas; firstly since 1997 the PSID is conducted biennially and only the head of the household is interviewed, from this information is collected for people who live with the original sample member. The original sample began in 1968 with 5,000 households initially low income individuals were over represented. Each household still in the survey has at least one of the original sample members or one of their descendants. Since 1997 two thirds of the low income over sample was dropped. The panel originally under represented immigrant families but a top-up sample in 1997 has corrected for this. However longitudinal studies are not well suited to studies of immigration, the HILDA survey also under represents the immigrant population. The content of the survey includes traditional concepts such as sources of income, employment, family composition changes as well as housing and food expenditure, consumption and more recently health, wealth and savings. The age of the PSID means that it has pioneered the tracking of sample members who have died by connecting with the US Public Health Services to incorporate information about the date and causes of death. The length of the PSID also facilitates intergenerational studies. For the purpose of cross national

comparisons however only the more recent waves between 2001 and 2009 have been included in this analysis (Frick et al 2007).

The German Socio-economic Panel began in 1984 with an initial sample of 5,921 households and 12,245 individuals in what was then the Federal Republic of Germany. In 1990 an East German supplement of 2,197 households was added. The rule for integrating new members into the sample is consistent with the other panels meaning original sample members and their children are included. Since 1988 those who reside or have a child with an original sample member are also added to the survey. Another defining characteristic of the SOEP is the number of top up samples to include different populations of interest for instance in an immigrant refreshment sample in 1995, an oversampling of high income households in 2002 and general top up samples in 1998, 2000 and 2006. The SOEP has made gains in assessing intra-partnership analysis by introducing wealth as a household variable. The SOEP was one of the first panels to introduce variables of interest in the study of multidimensional deprivation such as the SF-12, a concise version of the SF-36 psychometric health survey as well as objective measures and biomarkers including grip strength, personality traits and cognitive abilities (Frick et al 2007). The innovations of the well-established panels like SOEP have influenced the HILDA survey but progress towards harmonisation in the CNEF is limited by the inclusion of a diverse group of countries.

The Swiss Household panel began in 1999 with 5,094 households, sample members are interviewed from the age of 14. It was originally designed for use by sociologists and political scientists that could explain the presence of non-conventional variables such as psychological and physical health, social

participation, religion and leisure as well as political opinions, values and attitudes. The SHP has the highest rates of attrition of all panels included in this analysis. Only 49 per cent of Wave 1 households responded in Wave 2. This could be due to the phenomenon of "over surveying" by market researchers or administrators in a small country. A top up sample of 2,500 households was added in 2004 to compensate for this. The SHP is administered by the Centre of Research Infrastructure within the University of Lausanne which also oversees other international social surveys such as the European Social Survey, the Eurobarometer, and the International Social Survey Program. This indicates a high willingness for cooperation in the field of cross national comparisons for the purpose of social research.

Appendix C

C1. Unweighted Deprivation Score Ratios for the Australian Case Study

Data from the HILDA survey does have limitations for this analysis as it excludes the population subgroups that are more likely to be experiencing multiple deprivations including the homeless and those living in institutions such as aged care facilities or gaol. In addition those who might be expected to have high rates of social exclusion such as Indigenous Australians and recent immigrants are underrepresented in the sample (Kostenko et al 2009). The use of survey weights can help to correct this problem but cannot mitigate it entirely. The use of longitudinal weights is also considered necessary for the calculation of means intended to be representative of the population. The unweighted results are presented in Tables C1 and C2 are only marginally influenced by the use of weights. Augmented deprivation mean scores are not consistently increased or decreased by the use of weights.

Table C1 Unweighted Duration Augmented Deprivation Scores

	α=0	α=1	α=2	α=3
20-29	1.164	1.284	1.248	1.222
30/39	1.037	1.080	0.892	0.678
40-49	1.000	1.000	1.000	1.000
50-59	0.999	1.094	1.063	0.941
60-69	1.014	1.001	1.012	0.991
70+	1.134	1.040	0.558	0.236
Female-Male	1.098	1.261	1.371	1.480

Rows 1- 6 show the mean deprivation score ratios summarised across all eleven dimensions in the period 2001 to 2011 for each age group with reference to those aged 40-49.

Row 7 shows the mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for females relative to males. A ratio of greater than one indicates that females are more deprived than males.

Table C2 Unweighted Persistence Augmented Deprivation Scores

	β=1				β=3			
	α=0	α=1	α=2	α=3	α=0	α=1	α=2	α=3
20-29	1.1640	1.1979	1.1235	1.1149	1.1640	1.0520	0.9664	0.7702
30/39	1.0370	1.0465	0.7319	0.4378	1.0370	0.9311	0.5519	0.2692
40-49	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
50-59	0.9993	1.1739	1.1508	0.9397	0.9993	1.2273	1.0609	0.6876
60-69	1.0139	1.0547	1.0990	1.0785	1.0139	1.1216	1.1033	0.9968
70+	1.1344	1.0223	0.4668	0.1596	1.1344	0.9556	0.4087	0.1209
Female-Male	1.0981	1.2961	1.3745	1.5798	1.0981	1.2921	1.4355	1.7481

Rows 1- 6 show mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for each age group with reference to those aged 40-49.

Row 7 shows the mean deprivation score ratios summarised across all dimensions in the period 2001 to 2011 for females relative to males. A ratio of greater than one indicates that females are more deprived than males.

Appendix D

D1. Deprivation Means Ratios by Country

Table 7.14 presents the pooled cross national comparison of deprivation scores aggregated across dimensions. The trend for $\alpha = 0$ shows a slight increase in deprivation levels across countries. Whilst the level of deprivation seemed stable over time further analysis shows that there was variation between dimensions over the period. Tables 7.14.1 to 7.14.4 disaggregate this trend by country. Overall the increase in multidimensional deprivation levels seems to have been driven by increasing deprivation in Germany and the United States. For Switzerland overall deprivation levels decreased overtime. This was largely driven by the employment status dimensions meaning an increase in employment levels. Income poverty and self-rated health status were quite stable; reports of "fair or poor" health status were close to zero. For Australia there was a slight decrease in the number of people who were classified as working over the period hence an increase in deprivation in the employment status dimension. Similar to Switzerland self-rated health status were stable and low. For the United States a more marked decrease in employment levels was the strongest factor. Self-rated health status improved slightly and income poverty remained stable. Income poverty in the United States is the highest among all countries examined roughly twice that of Switzerland and almost four times higher than income poverty in Germany. German employment levels decreased slightly over time however income poverty was stable and low which indicates some form of welfare is present to bridge this gap. The largest increase in deprivation came from a decline in self-rated health status.

Table D1 Pooled Cross National Comparison of Deprivation Scores Aggregated Across Dimensions

	2001	2003	2005	2007	2009
α=0	0.4526	0.4618	0.4710	0.4682	0.4908
α=1	0.2019	0.2097	0.2184	0.2232	0.2368
α=2	0.1064	0.1129	0.1204	0.1270	0.1364
α=3	0.0666	0.0723	0.0786	0.0854	0.0924

Table Notes: Each row represents the mean deprivation score pooled across Australia, Germany, the United States and Switzerland with all dimensions of deprivation: income, self-rated health status and employment status aggregated. The increasing values of alpha indicate greater emphasis on deprivation scores in which an individual experiences more frequent periods of deprivation in any of the three dimensions.

Table D2 Deprivation Scores Aggregated Across Dimensions for Switzerland

SHP	2001	2003	2005	2007	2009
α=0	0.5117	0.5040	0.4883	0.4648	0.4577
α=1	0.1955	0.1911	0.1830	0.1733	0.1743
α=2	0.0819	0.0793	0.0747	0.0703	0.0732
α=3	0.0387	0.0372	0.0341	0.0322	0.0350

Table D3 Deprivation Scores Aggregated Across Dimensions for Australia

HILDA	2001	2003	2005	2007	2009
α=0	0.4375	0.4497	0.4395	0.4515	0.4570
α=1	0.2155	0.2251	0.2242	0.2345	0.2396
α=2	0.1271	0.1352	0.1368	0.1461	0.1495
α=3	0.0880	0.0951	0.0973	0.1060	0.1078

Table D4 Deprivation Scores Aggregated Across Dimensions for the United States

PSID	2001	2003	2005	2007	2009
α=0	0.4199	0.4233	0.4383	0.4382	0.4887
α=1	0.2005	0.2046	0.2185	0.2282	0.2543
α=2	0.1151	0.1195	0.1317	0.1438	0.1604
α=3	0.0785	0.0832	0.0937	0.1060	0.1185

Table D5 Deprivation Scores Aggregated Across Dimensions for Germany

SOEP	2001	2003	2005	2007	2009
α=0	0.4686	0.4854	0.5069	0.5003	0.5187
α=1	0.1979	0.2109	0.2251	0.2274	0.2394
α=2	0.0961	0.1060	0.1163	0.1204	0.1290
α=3	0.0544	0.0622	0.0701	0.0740	0.0806

Appendix E

E1. Multidimensional versus income only analysis

Table E1 compares income deprivation defined as the lowest income decile in any period to a broader subset of dimensions. An analysis of income only seems to overstate the extent of deprivation across both the age subgroups and the gap between males and females. This reaffirms the need to look at more than equivalized household income to identify vulnerable groups in society as the income poor do not necessarily overlap with those who are considered deprived in a multidimensional sense. Kostenko et al (2009) found that the income of the group experiencing the highest levels of social exclusion as a result of multidimensional deprivation was considerably higher than the bottom income quintile. Meaning there are people considered poor who are not excluded and people not considered poor who do experience social exclusion.

Table E1 Income Deprivation Score Ratios

	Income Only				Income Health Unemployment			
	α=0	α=1	α=2	α=3	α=0	α=1	α=2	α=3
20-29	1.151	0.819	0.614	0.522	1.051	1.109	1.108	1.106
30-39	1.078	1.033	0.971	0.903	0.985	1.060	1.064	1.060
40-49	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50-59	1.704	1.925	2.261	2.618	1.157	1.533	1.667	1.705
60-69	2.725	3.798	5.160	6.522	1.366	2.116	2.421	2.531
70+	3.416	5.430	7.997	10.377	1.486	2.636	3.062	3.192
Female-Male	1.1692	1.2365	1.2727	1.275	1.1047	1.1540	1.1609	1.161

Table Notes: values in the table are for the period 2001 to 2011. On the left hand side of the table the mean deprivation score ratios use income as the only dimension of deprivation. Values on the right hand side are the mean deprivation score ratios using income, health and unemployment as dimensions of deprivation. Increasing values of alpha give higher weights to higher deprivation counts.

Rows 1-6 represent each age group with reference to those aged 40-49.

Row 7 represents females relative to males. A ratio of greater than one indicates that females are more deprived than males.