An investigation of the measurement of inequality and the causal effects of the pro-poor national targeted programs on inequality in Vietnam

Van Phuc Phan

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An Investigation of the Measurement of Inequality and the Causal Effects of the Pro-poor National Targeted Programs on Inequality in Vietnam

Van Phuc PHAN

This thesis is presented as part of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

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This thesis analyses multidimensional inequality in Vietnam in the period 1993–2008. The theoretical framework of this work is Sen’s (1985a) capability approach. The capability theory argues that wellbeing, the result of personal capabilities, must be situated as the central focus of analyses of inequality. Inequalities in different dimensions of wellbeing should be incorporated into a single index, rather than in separate indices, to paint a clear picture of inequality. However, there are significant deficiencies in the literature on multidimensional inequality based on conventional measurements (i.e. Maasoumi’s two-stage and the Atkinson–Kolm–Sen approaches). As a result, existing studies on inequality cannot provide unique outcomes but give ambiguous (or even conflicting) conclusions of inequality. The research in this thesis proposes an alternative measurement of inequality based on polychoric principal component analysis to avoid the confusions that have arisen from conventional measurements. The chosen methodology is then applied to Vietnamese household wellbeing data.

The Vietnamese data showed that overall inequality increased significantly in the examined period (1993–2008). Inequality rose more rapidly in the 1990s than in the later phase. Urban areas experienced wellbeing divergence at a greater degree and faster pace than rural areas in the nineties. The magnitude of the increase in the within-rural inequality exceeded the decrease in the within-urban inequality which resulted in a marginal rise in overall inequality in the following decade. At the regional level, the northern mountainous areas showed a sharp rise in inequality making it the most unequal region by the ending point of the examined period, followed by the Southeast and Central Highlands, and the Red River. The Mekong River and the Central Coast were the least unequal regions. These results can explain the apparent contradiction that Vietnamese people are increasingly worried about a more unequal society while the income data showed a fair and stable level of inequality. Although income inequality was moderate and had levelled off,
inequalities in non-income dimensions of wellbeing were on the rise, and thus wellbeing inequality levels went upward.

Further, the thesis examines the extent to which the Vietnamese pro-poor National Targeted Programs (NTPs) impacted on inequality, poverty and wellbeing in the 2000s. Using a Generalised Method of Moments (GMM), the thesis finds a positive causal effect of NTPs on inequality but no statistically significant NTP–poverty and NTP–wellbeing relationships. These results can be explained by two issues. First, NTPs may influence poverty through another channel, that being economic growth. Different NTPs were also proposed to boost economic growth in the least developed communities; this growth in turn might lift the poor out of poverty circle. The second issue, however, is that misallocation of NTPs meant some benefits did not reach the poor but instead benefited ineligible, least in-need households which seriously distorted NTP implementation.

The thesis provides several recommendations to improve NTP efficiency. First, the impacts of different NTPs need to be appraised as a whole rather than independently because effects of a specific NTP could be offset by others. There is still a dearth of assessments of public policies towards poverty, inequality and wellbeing not only in Vietnam but also beyond the country’s borders. Second, given the case of corrupt behaviours and a lack of transparency in the public arena in Vietnam, asking local people to participate in various public–private cooperative projects could minimise losses of NTPs at the district and lower levels. Third, increased investments in education (making universal educational services available for poor children at shorter geographical distances, subsiding poor children’s schooling and upgrading the quality of the services) and health care (medical services, health insurance) in the least well-off areas are of vital importance to raise educational levels and health status of the poor, to reduce the gap to the rich.
ACKNOWLEDGEMENTS

I have completed this thesis with invaluable advice, support and encouragement from a variety of people whose names may not be fully acknowledged within this limited text. However, I reserve full responsibility for all shortcomings of my research.

I would like to express the deepest gratitude to my principal supervisor, Dr Martin O’Brien. Martin has provided countless hours of support in both academic and administrative activities during my PhD career at the University of Wollongong. He encouraged me to engage in essential subjects before conducting my doctoral thesis. His constructive comments on, and challenges to, my ideas were very robust, leading to the development of my thesis. Martin, an open-minded person, has also strengthened my research by adding very helpful co-supervisors to our research team.

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ACRONYMS

AKS  Atkinson–Kolm–Sen measurement of multidimensional inequality
ASEAN  Association of Southeast Asian Nations
BoP  Balance of Payments
CES  Constant elasticity of substitution
CPV  The Communist Party of Vietnam
DRV  The Democratic Republic of Vietnam (economic) model
FDI  Foreign Direct Investment
GDP  Gross Domestic Product
GE  Generalised Entropy
GMM  Generalised Method of Moments
GNP  Gross National Product
GSO  General Statistics Office of Vietnam
ICOR  Incremental Capital Output Ratio
i.d.d  independent and identically distributed
IV  Instrumental variable
HDI  Human Development Index
HEPR–JC  Hunger eradication, Poverty reduction and Job creation Programs
LAC  Latin America and the Caribbean
MDGs  The United Nations Millennium Development Goals
MOH  Ministry of Health of Vietnam
MOLISA  Ministry of Labour, Invalids and Social Affairs of Vietnam
OECD  Organisation for Economic Co-operation and Development
OLS  Ordinary Least Squares
NTPs  (Pro-poor) National Targeted Programs
PCA  Principal Component Analysis
PPP  Purchasing power parity
SES  Socioeconomic Status
SOEs  State-owned enterprises
SRV  Socialist Republic of Vietnam
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>SWFs</td>
<td>Social welfare functions</td>
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<tr>
<td>UN</td>
<td>United Nation</td>
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<td>UNDP</td>
<td>United Nations Development Program</td>
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<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>VASS</td>
<td>Vietnam Academy of Social Science</td>
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<td>VFF</td>
<td>Vietnam Fatherland Front</td>
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<td>VHLSS</td>
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<td>VLSS</td>
<td>Vietnam Living Standard Survey</td>
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<td>VND</td>
<td>Vietnamese Dong</td>
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<td>WB</td>
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1 INTRODUCTION

1.1 The multiple dimensions of inequality: An essential approach to research on inequality

Inspired by questions of ‘inequality of what’ and ‘why inequality’, the research in this thesis attempts to shed light on incorporating inequalities in plausible dimensions of wellbeing into a single index and uses these to examine the effects of public policies on inequality in Vietnam. There is a dearth of research on multidimensional inequality which synthesizes inequalities from various dimensions and thus creates an overall indicator of inequality, although there are a number of discussions on inequality in income distribution and a few other specific aspects of wellbeing. Based on Sen’s (1985a) capability approach, the current thesis examines inequality in wellbeing, a broad concept that goes beyond the utilitarian framework and relates to people’s attainment of their basic needs.

Sen’s (1985a) capability approach forms the foundation of the analysis of inequality in this thesis. Sen (2003a) critiques the inconsistent meanings of ‘utilitarian’ inequality. The problem with using the utilitarian approach is that this theory measures inequality based on personal preferences or desires. Critics argue that there is nothing mathematically wrong with the measurements of inequality derived from income, ‘but [to] interpret them as utility comparison…would be a complete non sequitur’ (Sen 1997b, p.392). Income and preference are necessary for wellbeing but they are not accurate measurements to derive interpersonal wellbeing comparisons or inequality (Sen 1985a), so inequality in wellbeing should be analysed based on the capability approach (e.g. being nourished, being sheltered).

First, we should examine what wellbeing is. This broad notion can be interpreted as real achievements in relation to external and internal conditions that impact a personal being. Wellbeing in such terms is feasible to render interpersonal comparisons. This wellbeing concept does not consider a subjective perspective of wellbeing that is formed by personal feeling or desires, but rather is comprised of material living standards (i.e. non sequitur: ‘a statement that is not connected in a logical or clear way to anything said before it’ (Merriam-Webster dictionary n.d.).

1
income, wealth), educational achievements and health outcomes. Inequality measured this way therefore captures multidimensional dispersions in levels of wellbeing.

Analyses of inequality are of vital importance because most modern societies struggle with inequality that persists in different ways. Stiglitz (2012, p.7) argues that ‘government policies have been central to the creation of inequality’. Similar arguments are found in Piketty (2006, 2014) who illustrate with historical evidence that inequality trends in the contemporary world did not materialise in a vacuum, but instead are the result of a series of policies. Therefore, this thesis endeavours to gain an insight into links between government policies and inequality in a specific context (i.e. Vietnam).

The thesis contributes to the literature on inequality in two main ways. The first novelty is estimating inequality in wellbeing by incorporating the inequalities of different wellbeing indicators into a single index which leads to consistent results. The literature on inequality shows the shortcomings of conventional methods which generate heterogeneous estimate outcomes even when using the same datasets. Heterogeneous or inconsistent outcomes are problematic in terms of policy implications because these do not deliver a definitive picture of wellbeing. This thesis however proposes an alternative that overcomes the problems of the conventional measurements of inequality, and reduces the ambiguities in the interpretation of wellbeing estimates. This makes it superior to the existing methods in painting a clear picture of inequality – not only in economic but also in non-economic dimensions of wellbeing.

The second main contribution of this study is solving the methodological problem in existing policy evaluations when identical policies targeted to needy groups are assessed separately in a particular country (i.e. Vietnam). The thesis elicits a causal relationship between anti-poverty programs and income inequality which may explain the reason behind the increase in inequality and the persistency of poverty in Vietnam from 1993 to 2010. This research suggests that examinations of inequality, in addition to poverty and wellbeing, need to be situated at the centre of anti-poverty policies because these policies may influence inequality and poverty in very different (or even conflicting) ways. In particular, Vietnam still needs a comprehensive assessment of the effects of the anti-poverty policies as a whole rather than isolated assessments of each policy.
1.2 Objectives of the thesis and the research questions

The first research question is: What is the appropriate analytical framework, methodologies and variables for estimates of multidimensional inequality?

The current thesis firstly seeks an appropriate way to overcome the confusions caused by the current measurements of inequality. The literature on inequality shows that existing estimations of multidimensional inequality suffer from two technical problems – the need to estimate both the degree of inequality aversion and the cross-dimension substitute ratio. The degree of inequality indicates social attitudes towards inequality. The greater the degree of inequality, the more a population is concerned about inequality. The cross-dimension substitute ratio deals with the weights of each dimension in the measurement of inequality. The majority of studies on inequality neglect these issues by using arbitrary values for the two parameters. As a result of this, research outcomes are highly dependent on the choices for these values made by often confused economists and policymakers. Additionally, because conventional methods were unable to synthesise plausible indicators into a single metric of inequality, they use a one-variable proxy for each dimension. Such methods cannot fully reflect the complete information for each dimension. In contrast, this thesis uses an alternative approach – polychoric Principal Component Analysis (polychoric PCA) – to measure unique levels of inequality by including plausible indicators representing different dimensions of wellbeing into the metric.

The second research question is: Has the Vietnamese Government’s pro-poor fiscal policies been effective with respect to inequality and poverty reduction targets?

The thesis further investigates the causes of inequality and evaluates the extent to which the Vietnamese Government’s anti-poverty and anti-inequality policies affect inequality, poverty and wellbeing by applying a Generalised Method of Moments (GMM) to dynamic panel data. This analysis is important because it bridges the gaps in research into poverty and inequality and, specifically, the simultaneous effects of fiscal policies on both. It could also explain why Vietnam has been successful at poverty alleviation but is unable to reduce inequality.
1.3 Preview of methodological selection

Analysing inequality based on Sen’s capability approach requires huge effort with intensive discussion about methodologies, indicator choices and interpretation of results. ‘The evaluation of inequality cannot but be purpose-dependent, and the important need is to provide an appropriate match between (1) the purposes of inequality evaluation, and (2) the choice of informational focus’ (Sen 2003a, p.71). To answer the question of how multidimensional inequality is measured and to evaluate currently implemented policies of inequality and poverty reduction, this thesis relies on two methodologies.

Modified PCA, namely polychoric PCA, has been chosen to assess the relative progress of, and inequality in, Vietnamese household wellbeing. As there is a consensus that household wellbeing measured by just income or personal preferences is inappropriate (see Sen 2003a, 2003b, Rutstein and Johnson 2004), wellbeing should be examined in multiple spaces. However, two questions need to be clarified first:

(1) to what extent do variables appropriately proxy for selected dimensions of wellbeing and inequality; and
(2) to what extent do indicators contribute to the wellbeing and inequality level.

Given that the overall wellbeing level can attributed to economic, education and health dimensions, the thesis seeks different indicators which can represent wellbeing levels in each domain. Polychoric PCA is superior to existing measurements of inequality because of its automatic variable weighting based on the fundamental information of indicators (i.e. frequencies, quantities and values). Using this technique, the measurement of inequality avoids discretion in indicator weighting (or degree of substitutability between dimensions) and inequality aversion. This advantage of the PCA approach results in less distortion in interpersonal comparisons.

To answer the question of how the Vietnamese Government’s pro-poor policies worked in the 2000s, the thesis applies an econometric regression model of dynamic panel data – GMM – as proposed in Arellano and Bond (1991) and others. This model aims to minimise biases in the coefficient estimates on the right-hand-side variables due to their dynamic nature associated with limited time. Another advantage is also its ability to
take into account variable endogeneity, heteroscedasticity and autocorrelation in observed entities (Roodman 2009b). These characteristics make the model optimally compatible with the Vietnamese datasets used in this research.

1.4 Country choice

Vietnam presents an interesting case study in inequality for several reasons. First, inequality is one of the most important socioeconomic concerns due to increasing dispersions in various dimensions of wellbeing, especially in living standards, since the transition from a centrally planned to a market-oriented economy. The absolute income gap between the rich and the poor has widened (Vietnam Academy of Social Sciences 2007) (although modestly) and a low level of relative inequality has been revealed over the period 1990–2010 according to conventional measurements of inequality (e.g. Gini) on consumption expenditure (Badiani et al. 2013, pp 165-175, World Bank 2014a). The gap between ethnic majority and minority groups, and between urban and rural regions in various dimensions tends to increase after the transitive point of time (Badiani et al. 2013, pp.152-156). The minor ethnicities do not progress as quickly as the majority group does; disadvantaged minorities contribute the lion’s share to the poor population. A protest in the Central Highlands in 2001 was a signal of the social disintegration resulting from inequality among different ethnic groups (Vinding 2002, pp. 285-291). Rising inequality has high costs for a country, such as less social cohesion, economic stagnation and unequal opportunities (World Bank 2014a). For these reasons, Vietnam should pursue specific policy implementations in order to reduce the divergence in wellbeing distribution.

Second, Vietnam shows considerably different results in terms of inequality depending on the specific variables used in the analyses. Zhuang et al. (2014, p.21) showed that while the expenditure indicator revealed a rather low inequality, income data demonstrated a much higher inequality level in 2008. The period 2002–2010 also witnessed a large gap and divergent trends in inequality when comparing the Gini coefficients of the two indicators. The level of inequality in household expenditure remained nearly unchanged at around 36 (on a 0–100 scale). In contrast, the Gini coefficient of income per capita increased continuously from 40 to 44 over the period (Figure 1.1). Badiani et al.(2013) also discovered conflicting trends in inequality when
using interview and statistical methods. Using the first method, inequality rose due to unfair access to financial resources and public services, and due to illegal activities. The statistical method, that is the Gini coefficient, however showed a fairly stable level of inequality at the normal level when compared with other developing countries. A lack of clarification of this contradiction raises the question of the actual status of inequality. This thesis thus challenges the idea that Vietnam should not be concerned about inequality. Results in Chapter 6 will show evidence of high and rising inequality in Vietnam, and thus the authorities need to address inequality as a matter of urgency.

**Figure 1.1: Ambiguous trends in inequality in Vietnam**

![Graph showing ambiguous trends in inequality in Vietnam](image)

*Source: VHLSS 2002–2010, author’s calculation*

Third, to get an insight on wellbeing inequality requires a comprehensive analysis that incorporates different dimensions of wellbeing. Such analyses are still insufficient in the Vietnamese context. This inadequacy is due to methodological difficulties. For example, Justino (2012) applied a multidimensional inequality index (Massoumi’s two-stage approach) to Vietnam, but her research outcomes are unclear with respect to trends in inequality. The other studies on inequality have produced different outcomes separately (i.e. income, education and health dimensions), or solely consider inequality in income as the variable of interest (e.g. van de Walle and Gunewardena 2001, Nguyen et al. 2012, Huong and Booth 2014). One can see that different dimensions of wellbeing are interdependent and multidirectional; thus, a simultaneous analysis of inequality corresponding to these characteristics is vital to present a more insightful picture of inequality in Vietnam.
1.5 The structure of the thesis

The remainder of the thesis is structured in seven chapters as follows. Chapter 2 deals with the theoretical choices. It provides an overview of two theoretical frameworks: the human capital framework and Sen’s (1985a) capability framework. The human capital theory proposed in Mincer (1958, 1974) and others is based on the strong relationship between income and personal human capital (accumulated knowledge and experience over time). This framework however has not been chosen for this thesis because of its weaknesses when inequality is analysed as a multidimensional issue. Sen’s capability refers to personal possible combinations of functioning or individual abilities of doing and being. The thesis is based on the capability approach as a theoretical framework because of its openness and compatibility with analyses of inequality in a multidimensional context.

Chapter 3 documents the background of Vietnam. The Vietnamese people and policymakers have been increasingly concerned about inequality since the date of transition from central planning towards a ‘socialist market’ economy in 1986. The perceptions of inequality are complex, impacting different dimensions and measurements and regardless of noticeable progresses in economic development and poverty alleviation. The literature on income inequality shows a stable disparity in consumption expenditure. However, the Gini coefficient of income per capita and the absolute income gap between the richest 20% and the poorest 20% increased unambiguously in the 2000s despite the government’s interventions. Another alarming issue is that the sluggish growth in the recent period\(^2\) may erode attainments in poverty reduction and impede the government’s efforts to attack inequality. This means the trends in inequality are still ambiguous and further research is vital.

Chapter 4 critically reviews the literature on inequality. Firstly, the two opposite hypotheses of inequality trajectories proposed by Karl Marx and Simon Kuznets are discussed. While Marx (1863-1883) advocates the complete replacement of the capitalist mode of production because of the resulting inequality, Kuznets (1955)

optimistically postulates a reduction in inequality after industrialisation. The chapter then surveys studies on inequality using various statistical approaches. The migration from income to multidimensional inequality is the central focus. The literature on inequality discusses both conventional and alternative approaches. The conventional measurements, Maasoumi and Atkinson–Kolm–Sen (AKS), are based on the current theories of income inequality. Applications of these measurements however lead to confusion because certain parameters are still ad hoc. An alternative measurement, using the PCA technique, illustrates a unique solution to the measurement of inequality which is more practical than the Maasoumi and AKS approaches.

Chapter 5 models specific measurements of inequality and econometric causal relationships between inequality and the Vietnamese pro-poor National Targeted Programs (NTPs). The first part will discuss the reason for the choice of the PCA-based measurement of inequality. Regular PCA is an instrument to decrease from numerous variables to principal components while still maintaining the vast majority of information from the original variables. The concentration of the measurement of inequality using this technique is the first component derived with PCA. Two feasible applications of PCA are analysed. First, the correlation coefficients of the first component on indicators, also known as variable weights, are used to compute wellbeing levels. Second, the first component records the greatest variation among the original variables; thus, it is used to estimate inequality across the population (McKenzie 2005). While regular PCA is designed for normally distributed data, modified PCA or polychoric PCA is compatible with both continuous and non-continuous indicators. Therefore, polychoric PCA is more suitable than measurements of inequality based on the regular PCA (Kolenikov and Angeles 2009).

The second part of Chapter 5 will apply Arellano and Bond’s (1991) system GMM estimator for an investigation of the causal effects of fiscal policies on inequality, poverty and wellbeing over a ten-year period. The system GMM estimators exploit two types of instrument (lagged differences and lagged levels) generated from the variables included in the model. The OLS estimators will be also presented for robustness checking purposes.
Chapter 6 applies polychoric PCA to calculate Vietnamese household wellbeing and inequality in wellbeing using data from the Vietnam Household Living Standard Surveys (VLSS and VHLSS) over the two periods 1993–1998 and 2002–2010. While other studies (Filmer and Pritchett 2001, McKenzie 2005, Ward 2014) concentrate on asset indicators as proxies for wellbeing, this thesis adds educational achievements and health status variables to represent wellbeing. The chapter ascertains that wellbeing levels computed by polychoric PCA with the chosen indicators are more reasonable than estimates obtained using only income. Inequality trajectories at national and regional levels are compared to the selected robustness checks.

Chapter 7 provides further insight on the causalities of inequality and the extent to which the government’s policies affect inequality, poverty and wellbeing. The system GMM model is used to analyse the causal relationship between the pro-poor national targeted expenditure and the explained variables. A robustness check is made by comparing the results of these estimators and the OLS method. Findings from this chapter are of vital importance to allow the government to improve the effectiveness of its attack on persistent poverty and inequality.

Chapter 8 concludes the thesis with a discussion on the research outcomes and possible implications to resolve the dual targets of poverty and inequality reduction. The thesis measures inequality by considering a broad list of variables and dimensions. It showed, as expected, that multidimensional inequality rose while income inequality was stable. This result provides the reason as to why the Vietnamese people continue to be worried about inequality even though the level of income inequality is neither high nor rising (as demonstrated in Badiani et al. (2013). An evaluation of the government’s pro-poor fiscal policies shows that inequality may have risen quite unintentionally from these programs, and meanwhile there is no substantial evidence of their positive effects on poverty. This outcome raises a question as to the efficiency (or lack thereof) of governmental pro-poor expenditure, and further research investigating the reasons for these inefficiencies is needed.
2 THEORETICAL FRAMEWORK FOR ANALYSES OF INEQUALITY

2.1 Introduction

At the very least, it is a requirement of scrutiny of the basis of the proposed evaluative system. It can also have considerable cutting power, in questioning theories without a basal structure and in rejecting those that end up without a basal equality altogether (Sen 2003a, p.24).

This chapter establishes the appropriate framework for inequality analysis. First, before embarking on this task, the chapter recalls the initial debate about inequality from Classical Political Economy. Economic theory documents two remarkably distinct nature and tendencies in inequality. Marx (1863-1883, Vol.3, Ch.15) considers inequality as an essential result of the capitalist mode of production and suggests the alternative social production model – communism – to cope with unfairness whereas Kuznets (1955) postulates a brilliant future of the capitalist society as inequality will reduce permanently after industrialisation.

However, both Marx’s and Kuznets’s analyses reveal weaknesses. Marx did not correctly assess the role of capitalist governmental policies that can adjust economic activities and decrease inequality. These adjustments could help an economy overcome various socioeconomic difficulties. In contrast, Kuznets expressed his over-optimism with limited evidence which could not represent the characteristic of the world economy. More importantly, when inequality is interpreted as multiple issues related to human wellbeing, one needs to seek a comprehensive framework rather than income distribution theory *per se*.

This chapter then revisits the human capital theory as a framework for the analysis of (income) inequality. A question is whether this theory is extendable and suitable for a multidimensional inequality analysis. Although several extensions have been found\(^3\), the core interest of human capital theory is the outcomes of investments in human capital. This theory explores a close relationship between educational achievement and earnings. Differences in personal schooling years, *ceteris paribus*, result in unavoidable

\[^3\] These extensions include effects of universal educations and the working experience accumulation on individual income.
income gaps across a population. However, differences in educational outcomes are also a component of multidimensional inequality rather than an exogenous explanatory variable. In this case, the theory could not provide an accurate guideline for an empirical analysis of inequality. Therefore, an alternative framework should be discussed.

Sen’s (1985a) capability approach is a potential replacement for the human capital theory in the context of inequality discussion. This approach is concerned with numerous factors which contribute to individual outcomes. One of its important assertions is that personal outcomes (wellbeing) must actually reflect a translation from individual potentials to real achievements associated with so-called ‘freedom conditions’. In line with this argument, differences in personal capabilities (including educational background) can explain inequality. The capability approach is thus likely to be suitable theoretical framework in this current thesis.

The chapter proceeds as follows: Section 2.2 focuses on an interpretation of inequality and the history of inequality theory. The human capital theory and its limitations are discussed in Section 2.3. An examination of Sen’s capability approach is the main task of Section 2.4. This part describes the development of the capability approach. Section 2.5 presents a comparison between the capability approach and the previous theory. A confirmation of the appropriateness of Sen’s capability concludes the chapter.

### 2.2 Inequality definition and the history of inequality theory

#### 2.2.1 A definition of inequality

In the Oxford Dictionary of Economics, inequality is the ‘differences in the distribution of economic stocks or flows among economic agents. For example, wealth inequality refers to the distribution of the stock of wealth, whereas income inequality refers to the distribution of the flow of income’ (Black et al. 2012). Inequality is broadly defined as the ‘unequal rewards or opportunities for different individuals within a group or groups within a society’ (Scott and Marshall 2009). This definition mentions two aspects of inequality: i) unequal rewards, or ii) unequal opportunities. Unequal rewards relate to personal outcomes or achievements while unequal opportunities are concerned with personal freedom to obtain alternative combinations of outcomes.
Individual outcomes are numerous (income, educational achievements, health status, or individual rights). Therefore, an empirical analysis should identify the space where inequality is analysed. Sen (1997b) reaffirms the importance of dimensional choices through several examples of differences between income and economic inequality which are commonly considered as the same issue by a vast majority of non-academic readers. An example is that a larger part of income distributes to a disabled individual could widen the income gap, but under a broader economic viewpoint, this unequal income distribution may be necessary for economic equality because a disabled person requires more commodities and services to obtain the same living standard as an able-bodied individual. In the question ‘equality of what’ (Sen 2003a, p.1), ‘what’ could be defined in a multitude of ways, and it leads to distinct outcomes. Decancq et al. (2015) mention two practical methods to choose a list of dimensions. The first is the objective view of what contributes to human wellbeing and proposes abstract dimensions of capabilities. Then, a complete list of variables could be derived from these basic spaces with a geographical and socioeconomic consideration. Alternatively, a formation of specific dimensions will be obtained after a publicly democratic debate of choices. Despite a variety of viewpoints, empirical proposals are largely identical for both the abstract and the specific level of dimensions, including material consumption and housing, health, employment status, social connections and natural environment (Decancq et al. 2015).

2.2.2 History of inequality theory

This section discusses the income distribution theories developed by David Ricardo, Karl Marx, and Simon Kuznets. While Ricardo and Marx believe in escalating inequality, Kuznets optimistically theorises a ‘bell curve’ trajectory of inequality that implies a decline in inequality after industrialisation. Ricardo regards inequality as a natural phenomenon that could not be influenced by human intervention. A continuous evolvement of capitalist economies (especially in Great Britain) led to exacerbating inequality and thus, many conflicts between the capitalists and the proletariat. Inspired by Ricardo’s inequality analysis, Marx (1995, Vol.1, Ch. 25) claims that capitalism systematically produces unfairness where inequality could not be reduced. Therefore, to resolve the problem essentially requires a dismantlement of the current social structure.
In contrast, based on the American data, Kuznets draws an inverted-U shape relationship between economic growth and inequality. However, his generalisation of this correlation is erroneous since inequality has increased in many developed countries currently\(^4\).

### 2.2.2.1 David Ricardo and Adam Smith

Ricardo develops his income distribution theory based on an assessment of Adam Smith’s work and interprets inequality as a result of the natural scarcity law. He criticises Smith’s viewpoint that prosperity depends on the quantity of labour a man can afford or how much money a person possesses. A wealthy individual is otherwise subject to ‘the abundance of necessaries and luxuries which he can command’ (Ricardo 1965). Although the equivalent money a man owns indicates the prosperity in modern economies, this situation is only correct when inflation is minor. That means using money as a measurement of the wealth is narrow and conditional. The real wealth of a society does not rely on the number of currency units (e.g. dollars) but the amount of goods and services produced.

Ricardo adheres to Smith’s analysis of income distribution in which the total income is shared by the three classes: landlords, capitalists, and proletariat. He also reaffirms and further discusses a negative relationship between wages and profits that is analysed by Smith (Ricardo 1965). While Smith pursues a liberal economic model that all shareholders (i.e. capitalists, landowners, and workers) would win or become more prosperous through limitless economic growth, Ricardo concentrates more on the extent to which national products are divided among beneficiaries (Skousen 2007).

The economy in Ricardian economics can be described as a cake where larger parts are given to capitalists and landlords and smaller shrinking slices are for workers. Thus, the iron law of subsistence wages is suggested to benefit the upper classes. Influenced by the Malthusian population theory, Ricardo supposes that wages must remain at the subsistence level and not necessarily expand. A reason for this is that wage increases

\(^4\) Piketty (2014) comments that rich countries, especially the America, have experienced a profound rise in inequality since the 1970s.
stimulate population growth. In turn, an expansion of the labour supply will lower wages. It also implies the population law rather than economic activities and the social system affect inequality. Therefore, mitigating inequality is infeasible.

The capitalists’ position in the Ricardian model tends to be relatively disadvantageous due to the ‘law of diminishing returns’. Rising capital investments shift up the demand for human power and raise the labour wage. This improvement in nominal wages in turn encourages workers to have more children. Consequently, an expending population requires more food that will be manufactured more expensively because of less fertile lands used. Therefore, higher wages will be required to maintain living standard for workers. Likewise, the capitalists might not gain proportionally as much benefit as they did on their extra investments because the profit rate would fall due to a higher labour cost. In this circumstance, only landowners are the winners as they achieved increasing rents when extra lands were cultivated.

Ricardo illustrates a specific kind of inequality: the landlords who do not contribute to any productive activities obtain social products increasingly while capitalists and workers receive comparatively smaller parts of the societal wealth. However, a limitation of Ricardo’s income distribution theory is his assumption on the determination of agricultural returns. He argued that a society cultivates lands orderly from the most to the least fertile level with a diminishing efficiency or decreasing profit rate. Then, the rate of return in agricultural areas dominates the industrial profit ratio. A drawback of his model is the ignorance of technological progress. The hypothesis of the relationship between agricultural and industrial rates of return is also powerless as the agricultural rate of return barely determines the profit rate in industrial areas.

2.2.2.2 Karl Marx

Karl Marx (1818–1883) – one of ‘the big three’ in economics (in the language of Skousen 2007) – is likely to be one of the most influential economist who concentrates on the nature of the capitalist economy and social inequality. In the view of the Marxist political economy, private property rights cause inequality in the capitalist system. This inequality is also the core reason of economic crisis because it creates a perpetual
imbalance between the total supply of and demand for commodities. In that society, the working class creates the entirely social added value which always exceeds its received wage payments. Due to private property rights, the capitalists earn the residual between the added value and the wage payment \(v\) – the so-called ‘surplus value’ \(s\) that, in turn, converts to new capital. Consequently, this accumulation of surplus value supports the capitalists to expand their production capacities whereas the total demand of the wage-workers for commodities barely keep up with the aggregate supply of commodities. Sooner or later, the economy suffers from superabundance, and markets are overwhelmed by commodities. An economic crisis is inevitable.

The ultimate reason for all real crises always remains the poverty and restricted consumption of the masses as opposed to the drive of capitalist production to develop the productive forces as though only the absolute consuming power of society constituted their limit (Marx 1863-1883, Vol. 3, Part 5, Ch.30).

The unique solution to inequality in the capitalist economy necessarily requires a complete political revolution that leads to a better and more equal society – communism. This present section however narrows itself to Marx’s analysis of economic inequality.

The cornerstone of Marxist political economy is the theory of surplus value. Unlike Smith and Ricardo who think that nominal wage is the price of labour commodity, Marx argues that the goods supplied by workers are the labour power. Marx comments on Ricardo’s (also Smith’s and others’) viewpoint of the value of labour:

…The value of labour is therefore determined by means of subsistence which, in a given society, are traditionally necessary for the maintenance and reproduction of the labourers.

But why? By what law is the value of labour determined in this way? Ricardo has in fact no answer, other than that the law of supply and demand reduces the average price of labour to the means of subsistence that are necessary … for the maintenance of the labourer…

Instead of labour, Ricardo should have discussed labour power (McLellan 2000, p.434).

According to Marx, neither land nor physical capital, but labour is the sole source of the surplus value. Therefore, profit, rent or any kind of non-labour earnings results from
unpaid labour, i.e. the workers produce value which exceeds what is paid to them. Marx implicitly demonstrates a measurement of inequality through the rates of surplus value:

\[
\text{Rate of surplus value } = \frac{s}{v}
\]

The rate of surplus value is a key indicator to reflect the exploitation degree of labourers by the capitalists. The higher the rate of surplus value, the more unequal in a distribution of added value created by workers, and that means a relatively less part of that value is attributed to them.

The Marxist theory of inequality has revealed weaknesses mainly resulting from a lack of analysis of the capitalism’s adaptable abilities and progresses. The subsistence level of wage has been increasing. Thus, an improvement of the living standards of labourers is continuing. Moreover, capitalist governments interfere and lessen inequality importantly in two ways. The first intervention is that capitalist governments have set up and maintained better social security nets that help vulnerable groups keep up with a decent living standard. The second is that almost all governments apply a redistribution policy through different channels (i.e. income taxes, subsidies, insurances) that may reduce the ‘extreme wealth’ and acute poverty in a society. For that reason, the labourers no longer experience more and more miserable lives in terms of absolute physical and spiritual conditions as Marx’s descriptions.

2.2.2.3 Kuznets – an optimistic inequality economist

While Marx predicted an apocalyptic end to capitalism, Kuznets (1955) forecasts a brilliant future of the capitalist mode of production as he believes that ‘a rising tide lifts all boats’. Kuznets illustrates the ‘bell curve’ trend in inequality which firstly increases when a country begins industrialising; reaches a peak at the end of this industrialisation process; and then decreases in the post-industrialised economy. A shift from agricultural and rural areas to industrial and urban areas leads to an increase in urban labourer income because of productivity improvements whereas agricultural productivities remain unchanged. Growth thus positively correlates with inequality at this stage. Conversely, in the second phase, the urban labour market absorbs agricultural labourers because of continuous urbanisation. A shrinking agricultural labour force additionally boosts the wage rate in the agricultural sectors. A combination of these effects reduces
the wage gap between two areas, and inequality negatively relates to growth (Barro 2000). In other words, it is not necessary to worry about inequality because an industrialised economy can automatically restrict inequality, and then inequality will decrease permanently. Kuznets’s analysis of the relationship between economic growth and income inequality is inspired by the result of observing income change in the United State between the two World Wars. Since his model of a nexus between growth and income inequality, there has been no agreement in the inverted-U trend. Results from his empirical analysis of the American income distribution (and two European countries: England, and Germany) for approximately thirty years (1914–1945) should not sufficient to generalise validly for the whole world\(^5\).

An explanation for an automatic fall in inequality in rich countries from 1914 to 1945 could be simply because of the World Wars, the great economic depression, and political shocks (Piketty and Goldhammer 2014). Many critiques (for instance, Anand and Kanbur 1993b) point out that there has been not an apparent and significant ‘bell curve’ relationship between economic growth and inequality within a country. Another evidence is an expansion in income gap in the Europe in the 1980s and 1990s (Doerrenberg and Peichl 2014). Even when supporting Kuznets’s hypothesis in the case of early stage of the transformation from agricultural to industrial economy, economists (e.g. Ahluwalia 1976, Barro 2000) cannot predict a turning point where income inequality stops accelerating, or when it starts to decline.

### 2.3 The human capital theory and its limitations

Human capital is defined as human capacity for goods and service production (Thurow 1970, Chiswick 1974). Investments in human capital are associated with costs. The first cost is to pay for educational services. The other is forgone earnings that individuals could earn if they undertake a job rather than spend time on studies. However, human capital is not just educational investments. Along with investments in schooling, essential training courses and expenditure on health improvement are also considered as human capital investments (Becker 1993).

\(^5\) See Chapter 4, Section 4.3.1.
Within the context of inequality, several deficiencies of human capital can be highlighted. First, human capital is defined as productive abilities endowed in a particular person. It is, *inter alia*, an economic input that can be used for production areas. In this situation, individuals are treated as means of production. However, persons are not only the means but also the target of social productions (UNDP 1990, Sen 1997b, 1999). Investments in human capital are just a vital stage to achieve a better life. The human capital theory could capture barely the connection between individual outcomes and differences in wellbeing (Chiappero-Martinetti and Sabadash 2012).

Second, since human capital considers individuals as productive input, it could not capture non-economic benefits of education. For instance, education not only affects income but also enables them to participate in social networks, increases interpersonal relationships, and improves their physical and mental wellbeing (e.g. better health). Thus, the human capital theory could not provide a sufficient viewpoint for an interpersonal comparison.

Another weakness of the human capital theory is that it does not consider differences in individual circumstances. Chiappero-Martinetti and Sabadash (2012) argue that with the same educational qualifications, disadvantaged individuals barely have as many job opportunities as their well-off counterparts. In addition, family origins and ethnicities also permanently challenge the worse-off to accumulate their human capital and reduce social gaps. Thus, the human capital theory could not provide a comprehensive framework for an inequality analysis.

### 2.4 Sen’s capability approach

#### 2.4.1 Sen’s theoretical transition from the utilitarian to his own capability approach and dimensions of inequality

Amartya Sen, the Nobel Prize winner in Economics in 1998, makes an extensive contribution to research in inequality. Among his publications in economics, On Economic Inequality (1973), Commodities and Capabilities (1985a), The Living Standard (Sen et al. 1985), and Inequality Reexamined (2003a) are seemingly the most important. These books also reflect a change in his economic thought from the
welfarism or utilitarian to the capability approach. He ‘later became one of the main critics of what he coined as welfarism, i.e., the approach in which the social evaluation is based solely on individual but interpersonally comparable levels of subjective wellbeing’ (Decancq et al. 2015, p.11). Qizilbash (2011) considers Sen to be in the first ‘generation’ who could form a novel scene for the ‘second generation’ economists working in an interdisciplinary paradigm. This subsection discusses Sen’s ideological movement to understand why his works affect different approaches to the economics of (multidimensional) inequality.

Sen develops his normative measurement of inequality based on the Atkinson’s (1970) index\(^6\). Atkinson launches the ‘equally distributed equivalent income’ method associated with the social welfare function (SWF)\(^7\). The main idea of this approach is that instead of an actual unequal distribution, a society wants a smaller amount of income to reach the same level of welfare when it is equally distributed. In other words, with the same aggregate income, the more the equality in income distribution the greater the social welfare will be. A vital assumption of Atkinson’s method is that the societal welfare is equal to the aggregation of all individual utilities. Sen (1973, p.1) distinguishes this method – a normative approach – from the positive measurements (i.e. Lorenz curve, and Gini coefficient) ‘that make no explicit use of any concept of social welfare’. While supporting a use of SWF, Sen argues that Atkinson’s assumption of a non-strictly concave utility function could be problematic as distinct income distributions could result in the same level of welfare. For instance, given two income vectors \(v_1(x_1, y_1), v_2(x_2, y_2), \) and \((x_1 + y_1 = x_2 + y_2, \text{but } x_1 \neq x_2 \text{ and } y_1 \neq y_2)\), the totals of social welfare are the same but it is unreasonable to think of a similar unequal level between \(v_1\) and \(v_2\). To resolve this deficiency, Sen illustrates the ‘generalised equally distributed equivalent income’ which is subject to the rankings of personal

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\(^6\) See Section 4.3.3 of the Literature Review.

\(^7\) The initial concept of SWF within the utilitarian framework is developed by Dalton (1920).
income in SWF. This revision makes SWF sensitive to any change in a distribution without a needed concern with individual utilities\(^8\) (1973, pp. 38-43).

However, Sen (1985a) later opposes the rationale of the social welfare approach in relation to the measurement of inequality. He scrutinises two drawbacks of the subjective welfarism, namely ‘physical condition neglect’ and ‘valuation neglect’. The first deficiency results from the fact that individuals’ utilities are solely based on the personal mental attitude. Given a consumption bundle, various utility levels could be derived corresponding to different personal physical conditions. For example, an ill person needs more things than a healthy man does to obtain a similar level of wellbeing.

The other weakness, ‘valuation neglect’, is that the value of commodities could not be determined by individual desire or command over them, but ‘valuation is reflective activity in a way that ‘being happy’ or ‘desiring’ need not be’ (Sen 1985a, p.29, also in Schokkaert 2009). That means personal desires could arise from the value of commodities rather than vice versa. A trouble of the utilitarian viewpoint occurs when making an interpersonal comparison. For instance, a deprived person regarding basic needs (i.e. foods, cloths) could learn to fulfil his desire at a lower level than a rich man does, so that a poor man feels even happier than a rich one when they consume the same things. However, this situation does not imply the happier man has a real economic status as good as a well-off person since he is, in fact, deprived. Due to these two deficiencies, the utilitarian social welfare approach could lead to incomplete and non-unique interpersonal comparison (Sen 1985a, 2003a).

Sen’s capability approach outperforms the utilitarian approach regarding measurements of wellbeing and inequality. The capability states: ‘I value it, and so I desire it’, but the utilitarian approach expresses: ‘I desire it, and so I value it’ (Sen 1985a, p.32). While the capability theory implies the objective wellbeing, the utilitarian describes wellbeing as a subjective consequence of individual feelings. Sen argues that the utility-based approach must be rejected as an interpersonal comparison ‘requires consideration of the

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\(^8\) Kolm also supports the Atkinson measurement using SWF. He develops this method substantially by illustrating a series of theorem, axioms for a case of multidimensional inequality (See Kolm 1976a, 1976b, 1977)
actual conditions of living of a person’, and ‘going beyond what the person is pleased or
pained by and also what he or she actually desires’ (1985a, p.22). ‘Interpersonal
comparisons of happiness cannot, of course, be done very precisely, nor through
standard specific methods’. Thus, he advocates the capability approach that seems to
become a better foundation for an analysis of inequality.

2.4.2 An insight of the capability approach

Capability, in Sen’s language, indicates the individual ability to obtain real
achievements in the relation to external and internal conditions that influence personal
transiting from possession of (private and public) commodities into personal wellbeing.

The capability of a person reflects the alternative combination of
functionings the person can achieve, and from which he or she can
choose one collection. The approach is based on a view of living as
a combination of various “doing and being” (Sen 2003b, p.31).

As ‘capability’ expresses a particular ability, ‘capabilities’ refer the number of abilities
from which a person can accomplish things he/she targets (Qizilbash 2011). With
respect to the freedom conditions, Alkire (2002b) finds that capability refers the extent
to which persons are free to promote valuable functionings. A complete interpretation to
the capability approach requires a survey of four essential components of Sen’s
capability: functionings, capabilities, freedom, and agency. This subsection discusses
these in turn and the relationships among them.

Functionings

‘Functionings’, initially rooted in Aristotle’s (2014) *Nicomachean Ethics*9, ‘reflects the
various things a person may value doing or being’ (Sen 1999, p. 75). In fact, it is little
unfamiliar for those who begin reading the capability approach. Alkire (2002b) explains
that a ‘functioning’ is likely to express a ‘mechanical action’ so that it tends to be more
deterministic than free. ‘Functionings’ describe personal successes in a transformation
from her commodity possessions to being benefited through using them, so that she can
increase her wellbeing. A being well-fed or physically healthy person is an example of

9 It is translated and edited by Roger Crisp.
fundamental functionings. Several other functionings are more complex like social integration (e.g. connecting with others, not being embarrassed in public areas) (Sen 2003b). A functioning, firstly, differs from possession because having a thing allows a person to use it, but that ownership does not guarantee him or her to have benefits from a thing. Nonetheless, as a functioning reflects a real (objective) attainment, it implies a successful exercise of good ownership. A functioning, secondly, is also dissimilar to having utility which describes as happiness, pleasure, or desired feelings generated by using a good (Sen 1985a, also restated by Sugden 1993).

In the relation to capabilities, functionings are a range of different achievements or ‘capabilities reflects the various combinations of functionings (“being”) he/[she] can achieve’ (Sen 1985a, p.14). While functionings record and transform from potentialities to real achievements, the capabilities refer individual abilities to choose the way of getting particularly collections of different activities that he pursues.

Capability is thus defined in the space of functionings. If a functioning achievement … is a point in that space, capability is a set of such points... The evaluation of a capability set may be based on the assessment of the particular n-tuple\(^{10}\) chosen from that set [n-tuples] (Sen 2003b, p.38).

He explains that the dimensions of capability are broader than the achieved functioning. Sen considers the later as a special case of capability when freedom conditions are assumed identical across individual. ‘Evaluation according to the achieved functioning combination is thus a “special case” of evaluation on the basis of the capability as a whole’(2003b, p.38). Depending on the question of objective of a discussion on inequality, a research can choose a set of capabilities or achieved functionings as a domain of analysis.

\(^{10}\) The notion of \(n\)-tuple may mean as an actual combination of different choices made by an individual in a particular society where there are \(n\) people with \(n\)-tuples (Sugden 1993). Qizilbash (2011) explains that n-tuples denote a collection of functionings with which a person can make a choice to illustrate his/her capability.
Freedom

According to Sen, capability also expresses the extent to which a person has opportunities to do what he follows. It reflects individual freedom. A discussion of wellbeing is unfinished if it only focuses on personal achieved functionings. Freedom is important as it relates to individual capabilities, and may broaden or decline real opportunities that a person faces (Alkire 2002b). ‘The “capability set”’ can be seen as the overall freedom a person enjoys to pursue wellbeing’ (Sen 2003a, p.150). It depends on social environment, individual position in a family and society, personal and social objective statuses (i.e. marriage, event operation) and physical distances (Sen 1985a, pp.13-26). That means freedom observes how a person is free to do or make choices contributing to individual objective wellbeing (Dang 2014). Real achievements or ‘beings’ obtained from a practice of functionings is subject to different choices of functioning combinations or the individual choices influence the capabilities. In addition, the capabilities are also impacted by non-choice determinants (e.g. legal system); thus, both choice and non-choice factors are determinants of capabilities and functionings. In Sen’s language, individual choices corresponding to the freedom conditions determine personal ‘advantage’.

Although freedom may be reflected in the number of cases with which a person can choose, Sen argues that a rise in choices does not always mean an increase in the freedom because additional options may not be what people value. That means ‘some types of choices can reduce our ability to choose life-styles that we may treasure’ (1985a, p.64). Sen also criticises the ‘revealed preference’ which is proposed by Samuelson (1938) despite actual choices and ‘preference’ are important and relate to freedom. The preference approach reflects consumer preferences through their real choices between at least two targets in a market. This approach has several weaknesses. A decision of buying something does not always reveal preferences. For instance, a consumer selecting a particular brand of milk does not mean he prefers that brand, but he may take it randomly while he needs a bottle of milk. Another example is that consumer choices sometimes depend on their thinking about the situation of employees or related groups (e.g. coffee pickers’ benefits from a coffee manufacturer) in a society.
rather than desires. Thus, choice behaviour could not result in a complete analysis of wellbeing comparison (Alkire 2002b).

Agency

The last crucial term relating to the capability theory is ‘agency’. Sen discusses ‘agency’ when distinguishing between ‘personal wellbeing’ and ‘personal advantage’. A change from an observation to individual ‘wellness’ defined as an ‘evaluation of the wellness of the person’s state of being’ to an assessment of individual success regarding his lifetime goals, which is an evaluation of agency achievement (Sen 2003b). Dang (2014) stresses that these goals may or may not positively relevant to personal wellbeing. For instance, a person decides to participate in a political protest that may negatively affect his/her wellbeing. This also implies that agency goals include the perspective of individual political attitudes, religious choices and social engagement. Thus, the contents of agency success are wider than and comprise the contents of wellbeing. In other words, wellbeing achievement is one dimension, *inter alia*, of ‘agency achievement’ which implies ‘the person’s success in the pursuit of the totality of her considered goals and objectives’ (Sen 2003a, p.56).

2.5 The capability approach – The conceptual framework for an analysis of inequality

2.5.1 A development of the capability theory

Despite income is an important factor of wellbeing, it could not capture other elements to make a quality of life that people are able to do or live in their favoured ways. In line with discussion, Deaton elucidates that wellbeing refer[s] to all of the things that are good for a person, that make for a good life. Wellbeing includes material wellbeing, such as income and wealth; physical and psychological wellbeing, represented by health and happiness; and education and the ability to participate in civil society through democracy and the rule of law (2013, p.24).

The capability approach considering major and multiple aspects of wellbeing could be placed in the centre of any assessment of poverty and inequality. Poverty and inequality
are then interpreted as a ‘failure of [and differences in] certain basic capabilities’, respectively (Sen 2006).

Sen introduces his own approach to make the individual wellbeing comparable. To shed light on this approach necessarily returns a relationship between the two core concepts: ‘capability’ and ‘functioning’. Sen (1985b) describes this correlation by a simple equation which is then slightly modified by Kuklys and Robeyns (2006) as follows:

\[
Q_i(X_i) = [b_i \mid b_i = f_i(c(x_i)) \mid T(i, s, e) \text{ for some } f_i \in F_i, \text{ and some } x_i \in X_i ] \tag{2.1}
\]

where: \(b_i\) denotes individual \(i\)’s ‘being’; \(f_i\) is a functioning, and belongs to \(F_i\) (vectors of individual’s functionings); \(c(.\) is a function of conversion from a vector of possession of commodities \((x_i)\) to their characteristics, \(x_i \in X_i\) (different sets of commodities); \(T\) is the transformation conditions. According to Kuklys and Robeyns (2006), \(T\) has three components, that is, individual circumstances – \(T_i\) (e.g. sex, physical ability), social factors – \(T_s\) (e.g. public policies), and environmental conditions – \(T_e\) (such as environmental pollution, weather).

In Equation 2.1, how ‘well’ personal ‘being’ is firstly depends on two elements: his commodity ownerships and his functionings. Given a bundle of commodities \((x_i)\), actually different choices in functionings vectors \((F_i)\) lead to varieties in the wellbeing level \((b_i)\). This expression is called the personal capabilities \(Q_i(X_i)\). Kuklys and Robeyns (2006) explain that \(X_i\) refers to all kinds of resources (both market and non-market commodities), and is subject to the personal budget constraint.

Jackson (2005) assesses Sen’s capability approach by comparing with the traditional welfarism which evaluates the value of commodities based on their utilities. While welfarists convert possession of commodities directly into individual wellbeing, Sen acknowledges that the achieved wellbeing requires other factors, in addition to entitlements as primary means. This procedure of transformation can be reproduced as in Figure 2.1. In this consequential relation, ownerships allow a person to have opportunities to pursue their goals, but entitlements do not guarantee actual achievements. Personal capabilities are translated into real achievements in the functioning stage that is affected by several internal and external conditions. These are
three groups of condition regarding individual, social, and environmental factors as described in Equation 2.1 above. The last ends in this model are the state of wellbeing that results from not only entitlements, but also personal capabilities, transformation conditions and functionings.

**Figure 2.1: Consequences of Sen's method**

![Figure 2.1: Consequences of Sen's method](image)

_Sources: Jackson (2005, Figure 1)_

Sugden (1993) advocates that valuing individual functionings should not rely on personal preferences or choices. Despite Sen’s capability approach is primarily based on the objective real achievements, this theory is ‘fuzzy’ objective because Sen does not provide a complete framework for ranking individuals’ functionings entirely. Sugden (1993) then claims that the approach seems not to quantify the contribution of freedom conditions to the wellbeing level, so that it is less practicable than the income approach. However, he himself also sees a potential application of the capability theory to poverty and inequality studies. By capturing several fundamental functionings (e.g. being well fed, being sufficiently sheltered) which are vital to make a decent life, the capability approach becomes undeniable and more applicable.

Kuklys and Robeyns (2006) prove that the capability approach is totally and directly operational with respect to freedom of choices. They also appreciate its extendable characteristic by adding plausible functionings such as ‘being educated’, and/or ‘being employed’. To make the theory more practicable, Dang (2014) suggests a concentration on the achieved functionings instead of a set of capabilities in the case of inadequate information about freedom conditions. Once the objective of measurement of inequality has narrowed to the achieved functionings or wellbeing, the remaining jobs are to
collect observed indicators or dimensions representing for wellbeing and choose an appropriate estimation of inequality.

Sen (2003a, p.53) sees difficulties of data collection relating to achieved capabilities or functionings. However, he reminds us that any practice should be careful in evaluation of the data and variable suitability and analytical methods associated with such data. A clarification of desirable data is vital, albeit data are not entirely achievable. A challenge is that Sen does not provide a specific discussion beyond that point. Instead, he recommends a solution to choosing dimensions, indicator weightings and methodology of a synthesis of indicators that contribute to wellbeing through a publicly democratic decision. That means any empirical research in inequality may be put in a given particular period and geographical context (Jackson 2005, Qizilbash 2011).

There are still remaining problems relating to the practical aspect of Sen’s capability. It is argued how Sen can further establish his capability as an operational framework although several empirical analyses of inequality prefers his approach (Sugden 1993). Analogously, Alkire (2002b) asks how capabilities can be measured.

[Does the capability approach provide adequate direction regarding (i) how to identify valuable\textsuperscript{11} capabilities; (ii) how to make strategic economic decisions that weight and prioritise capabilities; (iii) what to do when value judgements conflict; and (iv) how capability sets may be measured, such that one can evaluate changes brought about by economic initiatives? (Alkire 2002b p.11)

She develops an operationalisation of the capability in relation to poverty analyses. Due to an absence of consensus on the extent to which wellbeing is measured by a set of capabilities, a ‘presumption’ of achieved functionings is considered instead.

Before embarking on any empirical analysis, the questions of the extent to which a ‘presumption’ is made, and which data can be used must be clarified (Alkire 2002b, pp.181-182). She points out two groups of commodities with which capabilities are described. Regarding the basic capabilities such as being nourished, being free from

\textsuperscript{11}Original emphasis.
avoidable diseases, being sheltered, the first group may not vary regardless of different societal contexts. However, the other group relating to the ‘basic social capabilities’ (e.g. being appearing in public areas without shame) could differ utterly across communities and over time (2002b, pp.186-187). With respect to inequality analyses, she suggests that ‘[t]he objective is equality in persons’ capability to meet their basic needs that does not compromise their capability to enjoy non-basic valuable beings and doings’ (2002b, p.195).

In relation to the operationalisation of capability approach, Comim (2008) discusses principles of (a) parametric weights of variable determination; (b) the multidimensionality of wellbeing consideration; (c) data selection; (d) the aggregation of components of wellbeing. Choices of variable weights should consider the focal variable(s) used in an analysis, time stretch, differentiation methods, and unit of aggregation. With the multidimensional issue, a vector of measurements of wellbeing could take account of both variations across individuals (column or vertical dimension) and across indicators (row or horizontal dimension) which are used to calculate individual wellbeing. This discussion is analogous to Decancq and Lugo (2012a) who explore that the row-first is more advantageous than the column-first measurement of multidimensional inequality of wellbeing.

An important characteristic of the capability is its ‘incompleteness’ of a contribution of functionings which lead to the wellbeing level (e.g. Sugden 1993). A critique is that no one know how a public decision can decide on indicators and calculate their contributions to the level of wellbeing in a particular context (Dang 2014). Alkire (2002b) however claims that this incompleteness is not necessarily a shortcoming, but it is open for adaptations to the cultural and personal circumstances. She also appreciates Sen’s capability that does not dwell on a fixed subset of capabilities, but proxies for capabilities should be adjusted in favour of research perspectives. Sen himself believes that ‘the capability approach can often yield definite answers’ of the levels of individual wellbeing in such a case (Sen 2003a, p.46).
2.5.2 **Indicator choices and compatible methodologies of an analysis of inequality**

As wellbeing is multidimensional, indicators involved in an analysis of inequality in wellbeing must reflect its different aspects even when a study limits itself in a frame of basic capabilities. Regarding the macro level of wellbeing, Sen (1985a) focuses on six indicators which could be divided in three dimensions: living standards (GNP per capita); health status (life expectancy, infant mortality, and child death rate); and educational achievements (adult literacy rate, higher education ratio). Stiglitz *et al.* (2009) further consider the following dimensions: personal activities, political environment, social connections, natural environment, and insecurity of economic and natural conditions.

However, there is no consensus on a unified list of indicators at the micro level of wellbeing (Schokkaert 2009). A decision of specific indicators associated to a particular spatial and temporal condition can lead to unavoidably different variable choices. However, a chosen subset of indicators should retain identical information as in analyses at the macro level. Schokkaert (2009) requests more clarifications of a trade-off between adaptations of indicators specified due to different research contexts and a reflection of the general framework. In other words, differences in various empirical analyses should not be too large to generalise a theoretical framework for a wellbeing analysis. Despite several similarities in basic capabilities, Sen (2004) stresses that it is very dogmatic if a fixed and final list of capabilities used as a framework for any analytical practice is illustrated regardless of different geographical contexts and purposes. His example is that a focus on the internet access was unreasonable in 1947, but may be vital in the twenty-first century when examining the multidimensional poverty in India. Thus, a list of indicators used as representation for capabilities (or functionings) should depend on specific purposes and conditions of empirical analyses.

An important assumption of observed indicators which proxied for the wellbeing level is that they are interdependent to each other, so that any choice of variable syntheses should pay sufficient attention on this characteristic (Comim 2008). At present, there are several methodologies for a calculation of wellbeing and thus, of poverty and inequality based on the capability approach. These are the sum of different indicators (e.g. HDI), Factor analysis (see Haq and Zia 2013), PCA (see Klasen 2000), Fuzzy set theory (see
Lelli 2008), and others (Analysis of variance – ANOVA, Multivariate analysis of variance – MANOVA, Multiple indicators and Multiple causes – MIMIC, for example). It is also hard to state which method outperforms others. However, the PCA seems to be more applicable in favour of a discussion of inequality in wellbeing, especially when it is modified by incorporating with the polychoric correlation technique (see Kolenikov and Angeles 2004, 2009).  

2.6 Chapter conclusion

This chapter has mainly assessed a suitability of the human capital theory and the capability approach concerning inequality analysis. Human capital is considered as a framework for income related analyses. However, it limits itself in the income space, and could not be extended when the objective of inequality necessarily migrates to multiple spaces. That means the human capital may not be able to function as a framework when a discussion of inequality goes beyond the income dimension.

The capability approach developed by Amartya Sen in the 1980s is an alternative. Although subjective wellbeing based on personal feelings or desires is important, the capability approach rejects the use of such a theory for interpersonal comparisons because it could lead to incomplete and non-unique results. Inspired mainly by Aristotelian functioning, Sen builds up the capability approach with four integral components: capability, functioning, freedom, and agency. This approach can be called a ‘fuzzy objective system’ when Sen articulates that individual capabilities could be a suitable objective of an analysis of inequality.

An important trait of Sen’s capability approach is its ‘incompleteness’ or ‘fuzziness’ which infers an openness and adaptation to different purposes and changing contexts. This feature is both advantageous and challenging. It allows a particular study to make adjustments in a subset of capabilities (or functionings) corresponding to its target of analysis, and multiple conditions (i.e. socioeconomic, political, or natural) where a discussion is situated. This advantage makes the theory compatible with most of research contexts becoming more dynamic. However, this flexibility is also a challenge.

12 Discussion of this methodology is a task of the Methodology chapter.
for practitioners because there is no standard application using micro data for an estimate of wellbeing.

Under a light of the capability approach, an analysis of inequality could settle in a subset of basic and observed functionings rather than individuals’ capabilities that are more complex and require a huge effort for data collection. However, a clarification of appropriate data is needed irrespective of their unavailability. Depending on specific purposes and conditions, an analysis could select different functionings which can be represented by plausible indicators.

In practice, the wellbeing level corresponding with the capability approach could be computed in different ways. However, in relation to inequality, a possible method of information synthesis is PCA that functions in two ways: calculating the wellbeing level, and measuring differences in a wellbeing distribution. The modified PCA could be a suitable methodology because it considers not only interdependences of relevant functionings but also different weights of variables associated with their importance in the wellbeing contribution. That means it avoids any subjective choice of substitution ratio between indicators used for the calculation of wellbeing, which influences results and interpretation of inequality.
3 THE COUNTRY BACKGROUND

3.1 Introduction

This chapter presents some background on Vietnam before inequality in the country is analysed in greater detail in the rest of this thesis. General information about the country, such as the geography, the political system, and its economic, education and healthcare systems are covered. As the research concentrates on multidimensional inequality, preliminary information on inequality in these various dimensions is examined.

Then the socioeconomic renovation (known as the Doi moi) will be assessed. Vietnam started to reform its economy without any significant change in the political system with the Communist Party of Vietnam (CPV) continuing to rule the republic. The Doi moi began in 1986, and has been recognised as a breakthrough that would lead to profound growth and poverty reduction for the following 20 years. Since 2010, Vietnam has been classified as a middle-income country while, up until 1990, it was classed among the poorest nations. Two decades of intense growth has helped millions of Vietnamese people escape the poverty cycle and improve their standard of living.

Next the evolution of inequality in Vietnam is examined. It is very complex; different indicators used for measurements of inequality can provide conflicting results. For instance, the Gini coefficient of household expenditure reveals a slight rise in inequality in the 1990s but a marginal decline in the following decade; therefore, it would appear that inequality has remained fairly unchanged since the Doi moi milestone. It seems that the country has achieved a sustainable growth without any increase in inequality. However, the Gini coefficient of income indicates a seriously unequal distribution with a value for the index of over 40 on a 0–100 scale. Therefore, a reassessment of inequality in multiple dimensions will be meaningful. In particular, choosing an indicator that reflects major aspects of the population’s wellbeing is very important when measuring inequality.

The final task of this chapter is to briefly analyse several recent challenges to the Vietnamese economy which could negatively influence the national anti-poverty and anti-inequality strategies. The difficulties arise from both external and internal factors.
Internal obstacles including institutional weaknesses (e.g. corruption, bureaucracy and inappropriate policies), and poor progress in economic reform are the main reasons for stagnation. These problems may erode the effects of recently implemented programs for poverty and inequality reduction.

3.2 Overview of the country

3.2.1 Geographic description

Vietnam, a South East Asian country, is situated on the east edge of the Indochina Peninsula. It shares a northern border with China and a south-west border with Laos and Cambodia. The eastern edge of the country is the South China Sea (in Vietnamese known as the East Sea), heading towards the Pacific Ocean. The terrain is mostly mountainous with mountains and highland areas contributing to about three quarters of the total, approximately 332,000 square kilometres. The mainland is divided into eight geographical regions. The two northern regions, the North West and the North East, are mostly mountainous. The Red River Delta, which includes the capital city of Hanoi, is one of the most developed regions as measured by the national Human Development Index.

The Hai Van Mountain Pass naturally splits the central coast (and the country) into North and South which have different climatic features (SRV 2014). The North has the usual four seasons, while the South has only two seasons - the dry season (November to April) and the rainy season (May to October). The Central Highlands, along with the South Central Coast, has the advantage of industrial perennial crops such as rubber, coffee and tea. The Southeast, including the biggest city, Ho Chi Minh City, is the wealthiest and most industrialised area. Finally, there is the Mekong River Delta which supplies most of the agricultural produce, especially rice and farmed fish.
Figure 3.1: Geographical regions of the Vietnamese mainland

Source: nationsonline.org (n.d.)
3.2.2 Political system

The Communist Party of Vietnam

Since unification in 1976, Vietnam, a one-party country, has been governed by the Communist Party of Vietnam (CPV) which was founded in 1930. The party structure is parallel to the national administrative system at all levels (with central, provincial, district and communal units). Party cells are the primary divisions which may include dozens of members. An association of primary units in a commune contributes to the communal level. The next levels are the district and provincial (or municipal) divisions, managed by their committees. At present, the Central Committee (CC) consists of about 200 members who are in charge of the most important positions in the State and Party. Bureau members of the Politburo, which is the core power base of the CC, fill the positions of Prime Minister, General Secretary of the Party, President of the State, Chairman of the National Assembly and the most important Ministers (i.e. National Defence, Finance and Foreign Affairs) (CPV 2014a). The final decisions on who takes the leading positions of the State (Prime Minister, President of the State and Chairman of the National Assembly) must be approved by the National Assembly.

According to the Constitution, the CPV is legally defined as ‘the leading force of the State and society’. It directs the republic and socio-political organisations through two channels: (1) making decisions on political strategies, accounting for the implementation of the strategies and programs, and managing personnel; (2) strictly enforcing the CPV’s resolutions and directions on all party members. It observes indirectly the activities of the Government through those members who work in the public system, ensuring that these observations are compatible with the laws (SRV 2014).
The Government of Vietnam

Figure 3.2: The Vietnamese State’s agents

The National Assembly is the most powerful pillar of the State. It approves the Constitution and laws, and decides on strategies for socioeconomic developments, national defence and foreign affairs. The National Assembly is also responsible for supervision of policy implementation and efficiency of governmental activities. The Government is the administrative agency of the State that is accountable for all national aspects (e.g. socioeconomics, political issues, national defence and external relationships). The Prime Minister actually has more power in terms of country management than the State President who is the national leader. A unique division of the political system is the Vietnam Fatherland Front (VFF) which functions as a direct connection between citizens and the State. The VFF participates in various political tasks including legislating and introducing new laws, presenting candidates for judges and jury members for the courts, and supervising the State’s activities (Vietnam Fatherland Front 1999).

Source: Consulate General of Vietnam in Houston (2014)
3.2.3 *The Vietnamese economy: key indicators*

Vietnam has experienced political and socioeconomic hardships during a century of French domination (1858–1954), the anti-American war (Vietnam War) (1954–1975) and over a decade of poorly thought through economic policies (1975–1986). In the early 1980s, the vast majority of Vietnamese people lived in acute poverty. In 1985, 98% of national income was used for daily consumption purposes; therefore, income savings and wealth accumulation were negligible. Limited production and insufficient consumption commodities for the social demand led to weak foreign trade and a deep deficit of net export value. The export value was about 40% of the import value up until 1985. The country depended heavily on foreign aid from the Socialist Bloc (SRV 2014).

Since the start of *Doi moi*, the Vietnamese economy has made remarkable progress. Over 25 years, Vietnam has achieved fundamental successes in several socioeconomic dimensions to become a middle-income country since 2010. The size of the economy in 2010 was US$73.5 billion (at the 2005 constant price), about 4.7 times greater than in 1986 (15.7 billion) (World Bank 2013a). The contribution of agricultural products to GDP significantly declined from 40% (1986) to 19% (2010) with a simultaneous expansion of the industrial sectors from 27 to 37%. The value of exports rocketed from 2.5 to 50 billion (US$) in the 20 years after 1990 and about 30% of national income was dedicated to savings by 2010 (World Bank 2013a). More than 43 million people were freed from poverty in the period 1993–2008 (Badiani et al. 2013). Chronic poverty and starvation had been controlled while living standards and non-economic aspects of wellbeing improved substantially.

3.2.4 *The educational system: successes and obstacles*

The Vietnamese educational system includes primary and secondary education (from grade 1 to grade 12), vocational training and the tertiary level. Education for children under 5 is not compulsory but most children are encouraged to go to preschools. Compulsory education starts with the first 5 grades (primary 1–5), beginning when children turn 6 years of age. The secondary level ranges from grades 6 to 9; grades 10 to 12 are classified as high school. At present, the entrance exams for students to move from the last year of secondary to the first year of high school are necessary in rural
areas. However, these tests are the only way for students to enrol in public high schools in urban areas, especially in big cities. Besides the public system, private schools (also mostly located in urban areas) are encouraged and account for an increasing proportion of the total student population. At the tertiary education level, the number of universities and colleges (both public and private) has increased rapidly since 2000.

A notable educational achievement is that the adult literacy rate is high even though the income per capita is still modest. The literacy rate in Vietnam is as high as China and several of the other more developed Southeast Asian countries (e.g. Malaysia and Thailand) while Vietnam’s GDP per capita is far less than these. Vietnam’s literacy rates outperform Sri Lanka and Papua New Guinea whose incomes per capita are nearly double and triple Vietnamese income per capita on average. Looking at Pakistan, a country with a similar economic background, about half of Pakistani adults are illiterate, compared to adult illiteracy of only 6% in Vietnam (Table 3.1). The country also demonstrates gender equality in terms of access to educational services, with the literacy percentage of both male and female adults (aged 15–24) being the same (97%) in 2009 (World Bank 2013a).
Table 3.1: Literacy versus income in selected countries

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP per capita (current USD)</th>
<th>Literacy rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam (2009)</td>
<td>1232</td>
<td>94</td>
</tr>
<tr>
<td>China (2010)</td>
<td>4433</td>
<td>95</td>
</tr>
<tr>
<td>Indonesia (2011)</td>
<td>3470</td>
<td>93</td>
</tr>
<tr>
<td>Thailand (2010)</td>
<td>4803</td>
<td>96</td>
</tr>
<tr>
<td>Malaysia (2010)</td>
<td>8754</td>
<td>93</td>
</tr>
<tr>
<td>Sri Lanka (2010)</td>
<td>2400</td>
<td>91</td>
</tr>
<tr>
<td>Pakistan (2009)</td>
<td>987</td>
<td>55</td>
</tr>
<tr>
<td>Papua New Guinea (2012)</td>
<td>3680</td>
<td>63</td>
</tr>
</tbody>
</table>

Source: World Bank (2013a)

However, Vietnam faces still several serious deficiencies in the educational system, especially at the tertiary level. Vietnamese tertiary education is in crisis and needs an urgent revolution with all of its universities currently outside of any quality ranking lists (e.g. The Times Higher Education). Quality educational services in Vietnamese universities have lagged behind social demand. This restricted quality results mainly from governance issues (lack of autonomy, corruption, isolation, lack of accountability) and the historical reasons for these weaknesses have been acknowledged (Valley and Wilkinson 2008).

Furthermore, inequality in education is increasing across income groups and ethnicities. Higher education shows the largest divergence between income groups. The World Bank (2008) calculated that the proportion of tertiary enrolment in the richest quintile based on income distribution was, unsurprisingly, fourfold the poorest quintile in 2004. Students from minorities only accounted for 4% of total enrolments while ethnic minorities contribute to about 15% of the population. Inequality is also found in the outcomes of students from different income groups. For instance, the mathematics test scores of students aged 5–15 from the top 20% of wealthiest households are much higher than those from the poorest group, even at the primary level (World Bank 2013c). A similar pattern of inequality also exists between the major and minor ethnicities.
3.2.5 The healthcare system: contradictory trends in inequality

The healthcare system is organised bureaucratically and, at the top level, is managed by the Ministry of Health (MOH). The MOH directs more than fifty institutions including central hospitals, universities of medicine, health research centres and pharmaceutical companies (Priwitzer 2012). At the provincial level, the Departments of Health maintain the majority of medications including investigation of preventive and curative medicines, nursing training and management of pharmaceutical production. Provincial hospitals, usually located in provincial capitals, focus on necessary medical activities (e.g. curability). At the district level, important primary healthcare services are available but have they are restricted in capacity and quality. At the lowest bureaucratic level, the commune health stations offer fundamental services such as simple disease diagnostics and treatments, and universal vaccinations (Ladinsky et al. 2000).

A transition from solely public and heavily subsidised services to the coexistence of both public and private sectors improves service quality and increases a healthcare system’s capacity (MOH 2009). Public investments in the healthcare system have been focused on infrastructure and human resources. The vast majority of communes have healthcare stations with a medical doctor, a midwife and a few nurses (GSO n.d.). The number of public hospital beds, excluding communal health beds, increased by 28% in the period 1995–2010. The number of beds per 10,000 people rose steadily from 17.34 to 21.97 throughout the 2000s. In addition, the private sector considerably expanded to supply about 5800 beds (MOH 2009). National targeted programs relating to healthcare services contributed to improvements in the physical wellbeing of the population. Vietnamese life expectancy on average was relatively high at over 75, and infant mortality halved in the period from 1986–2010 (World Bank 2013a).

Litvack and Rondinelli (1999, pp.74-75) claim an increasing inequality in health outcomes due to a sharp decline in public funds in this sector. To cope with this inequality, the Government has established a health insurance system, operating since 1993, and free healthcare cards for the poor and children under 6 (The National Assembly Vietnam 2008). However, a constrained budget has negatively affected the quality of services delivered to these recipients who usually have to pay money to access better services. The national health insurance participation rate has grown rapidly
since the late 1990s. The proportion of the population using health insurance has soared from about 5% in 1993 to over 40% in 2007 (Priwitzer 2012).

Although supports from the Government aim to equalise individual opportunities to access the healthcare system, inequality in health outcomes has not reduced. The United Nations Children’s Fund (2010) uncovered a complex picture where inequality in health outcomes levelled off in several dimensions (child mortality, cumulative fertility and professional assistance in obstetric deliveries), but child nutrition status increased. This inequality is persistent due to two reasons. The first is that poor people need to pay the gap when they need intensive services because health insurance only pays for basic portfolios. Further, the communal healthcare infrastructure benefits the better-off, who reside closer to the commune centre, over the poor (Priwitzer 2012).

Second, the majority of specialised and high quality hospitals are located in big cities; thus, the gap between urban and rural areas in terms of healthcare is substantial. Priwitzer (2012) finds that all doctors do not want to work in rural district hospitals with insufficient facilities and low income. These obstacles impact on the national target to reduce inequality in the health dimension.

3.3 The socioeconomic renovation – Doi moi

The transition from a centrally planned to a market-oriented economy in Vietnam was not just the modification of a few programs but a transfer from one economic model to an almost opposite one (World Bank 1996). Starting in 1986, Doi moi focused firstly on the agricultural economy (i.e. farm de-collectivisation and market formulation) (Phan et al. 2006). Another important change was to prioritise light and export-led industries rather than the heavy industrial sectors that had been the subject of a previous economy-damaging industrialisation strategy. Additionally, the Party has progressively changed its political attitude towards private property rights and economic activities. The CPV (2014b) announced that they consider the private sector to be a vital part of the economy. In line with this attitude, domestic and foreign private sectors have been
protected and encouraged to participate widely in economic activities. The shifting of these CPV policies is the political foundation of Doi moi\textsuperscript{13}.

In order to reach a better understanding of the reasons behind Doi moi, it is important to review Vietnam’s macroeconomic conditions prior to 1986. After reunification in 1976, the Government adhered to a centrally planned economic model, the so-called Democratic Republic of Vietnam’s economic model – DRV, and therefore the Government directed most of the economic decisions, such as economic policies, commodity prices, production and consumption (Glewwe and Dang 2011). As a result of this and the consequent lack of economic incentive, the economy experienced stagnation for over ten years. At the same time, external help from and trade with the Council for Mutual Economic Assistance (CMEA) substantially declined in the 1980s and was broken off in 1991. GDP growth was marginal at 4.1% while the population’s yearly expansion was at 2.2% over the period 1976–1991 (Tran 2003). The situation became worse when the agricultural economy could not feed the booming population (Phan et al. 2006). A vast majority of the proposed economic targets for the second and third five-year-plans (1976–1980, 1981–1985) were not reached.

A major driver of the economy was the informal sector. This sector boosted economic activities partially thanks to overseas remittances that were worth approximately US$6–8 billion over 1975–1990 and US$2–3 billion annually in the early 1990s, although the official remittance data were not available until 2000. Doi moi was also fuelled by the success of the Chinese transformation which has also moved towards a market-oriented economy since the late 1970s (Pham and Le 2003).

In contrast to Eastern European transitional economies, Vietnam has made gradual structural reforms to state-owned enterprises (SOEs) and cooperative sectors so that

\textsuperscript{13} Doi moi was approved by the 6th Party Congress in December 1986 with the consolidation of this vital, urgent reform. Through this event, the CPV also changed its leadership mechanism from individual to collective regulation to minimise any seriously damaging decisions, which assured a continuing renovation (Rama 2008). Since that date, a party congress has been held every five years to review the achievements and to set the following five-year plan or adjust the existing development strategies.
these enterprises have been able to adapt well to the new macroeconomic environment. This ‘Gradualism’ approach has been widely approved, in contrast to the ‘Big Bang’ style transition that led to the collapse of the Socialist Bloc in 1991. In the early 1990s, the transition had occurred in most sectors of the economy with major transactions being based on voluntary exchanges and personal interests (Fforde and Vylder 1996).

Vietnam transited from DRV to its radical new economic model which had the following characteristics:

- Elimination of the two-price system (the official prices controlled by the government and the market prices); all prices are determined by markets, known as ‘getting the prices right’;
- Implementation of a new land law that allows households to use (not own) land permanently;
- Tightening the credit flow and application of the real interest rate to stabilise the currency and control hyperinflation;
- Opening up the economy and discarding the state monopoly on foreign trade;
- Establishing a flexible exchange rate;
- Shrinking fiscal policy to reduce the deep deficit budget;
- Welcoming foreign direct investments (FDI) and implementing FDI law;
- Restructuring and cutting subsidies for SOEs and establishing a legal framework for the private sector (Pham and Le 2003).

These characteristics can be summarised into four groups: macroeconomic stabilisation; price and market modification; reconfiguration of the role of the State including legal and institution reforms; and public provision of social security (Phan et al. 2006).

The two initially notable achievements of Doi moi in the 1990s were soaring economic growth and successful inflation control. Figure 3.3 shows the dramatic growth during the 1990s. Due to the Asian economic crisis (1997–1998), economic growth slowed down considerably to less than 5% in 1999, but recovered quickly and continued with a sustainable performance in the next stage. However, the economic acceleration in the
2000s was less impressive than in the early 1990s, and economic difficulties, indicated by a high and increasing ICOR (Incremental Capital Output Ratio), were evident. According to Pham and Vuong (2009), ICOR, considered to represent the efficiency of national economic activities, has been above 4.4 since 1998, especially in the public sector.

Figure 3.3: Annual economic growth (%) in the 1990s

The control of hyperinflation was another remarkable achievement of the Doi moi. A fundamental reason for this was the replacement of the stamp and coupon system to a market-based distribution system. In the mid-1980s, the State resolved the budget deficit by ordering the central bank to expand the money supply without any consideration of inflation. Nonetheless, social production capacity still lagged behind societal demand. As a result, the average inflation rate exceeded 200% for the period 1986–1992 (Pham and Vuong 2009).

However, the open economic policies stimulated the private sector and attracted FDI which increased production capacity rapidly. Furthermore, bank system reform with control of the money supply minimised inflation after 1993. The yearly inflation rate was less than 20% from 1993 to 1995 and even turned to deflation in some years (i.e. 2001, 2002) (Figure 3.4).
Additionally, the agricultural economy has not only been able to produce sufficient food for the population but also has exported since 1990. First of all, the Government’s unusual acceptance of market formations is behind this success. In the Vietnamese political context at that time, this attitude towards the free market was a great step forward because the socialist model considers markets as unique instruments of capitalism. This decision resulted in undisputable attainments when several agricultural markets were formulated. Furthermore, the land reform, which led to land redistribution, was a reinforcement of agricultural production. A consequence of food market deregulation and farmers’ autonomy was the elimination of long-lasting food shortages after the *Doi moi* (Rama 2008).

Moreover, dramatic increases in FDI and foreign trade witnessed that the reform was on the right track. Investments from overseas exceeded US$1 billion and have become an important sector since 1994. FDI has been a crucial component of the economy not only because of its increasing contribution to total GDP (nearly 20% in 2012) but also to the net-exporting surplus since 2000 (General Statistics Office n.d.). More importantly, the
*Doi moi* has offered a necessary incentive for all economic activities because stakeholders, rather than the Government, have been responsible for their decisions.

### Table 3.2: Income and foreign trade indicators (1986–2010)

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</thead>
<tbody>
<tr>
<td>GDP per capita (US$, constant 2005)</td>
<td>268</td>
<td>301</td>
<td>409</td>
<td>531</td>
<td>699</td>
<td>900</td>
</tr>
<tr>
<td>FDI, net inflows (BoP, current million US$)</td>
<td>0.04</td>
<td>180</td>
<td>1780.4</td>
<td>1298</td>
<td>1954</td>
<td>8000</td>
</tr>
<tr>
<td>Export of goods and services (% of GDP)</td>
<td>6.6</td>
<td>36.0</td>
<td>32.8</td>
<td>49.9</td>
<td>63.6</td>
<td>72.0</td>
</tr>
<tr>
<td>Import of goods and services (% of GDP)</td>
<td>16.5</td>
<td>45.2</td>
<td>41.9</td>
<td>53.2</td>
<td>67.0</td>
<td>80.2</td>
</tr>
</tbody>
</table>

*Source: World Bank (2013a)*

### 3.4 Poverty and inequality

#### 3.4.1 Poverty alleviation achievements

An unarguable success of the economic reform was poverty alleviation. The proportion of poor people has fallen rapidly since 1993 regardless of what measurements of poverty are applied. There are two competing methods of poverty measurement in Vietnam. The Ministry of Labour, Invalids and Social Affairs of Vietnam (MOLISA) uses the poverty lines as the criteria for budget allocation for NTPs. They applied a ‘bottom-up’ mix method that monitors the number of poor households in villages with village-level consultations from local authorities. Then the provincial poverty rate is estimated by aggregating these village poverty ratios.

The second method is constructed by the GSO based on household survey data. A GSO–World Bank (GSO–WB) cooperative team established a poverty line referring to food and non-food needs. Using the US$1.25 per capita/day (PPP) poverty line method, the poverty headcount ratio substantially decreased from over 63% in 1993 to less than 17% in 2008. Vietnam therefore met the United Nations Millennium Development Goal (MDG) of poverty reduction to eradicate starvation and half the poverty rate for the period 1990–2015 seven years before the deadline (Badiani *et al.* 2013).
Achievements in poverty reduction are also evident in non-income dimensions. Possession of assets and durable appliances recorded in the VHLSS (GSO 2002–2010) are compatible with progress in economic wellbeing. The proportion of households owning televisions, motorbikes, durable houses and using electricity has risen considerably, especially in the 2000s. The fraction of households living in shelters made from poor material was halved and the number of households using national electricity doubled simultaneously. Households possessing TVs and motorbikes become the vast majority of the total population (Figure 3.6). These indicators signalled better material wellbeing throughout the examined period.
The progress in poverty reduction in both economic and non-economic dimensions has been confirmed by the Vietnamese Human Development Index (HDI) improvement being greater than Vietnam’s economic performance (UNDP 2005). It rose from 0.617 in 1990 to 0.704 in 2003, and was ranked 16 higher than the GDP per capita (108th and 124th out of 177 countries). However, this upward trend was less impressive after 2005, which showed slower growth and a more unequal distribution in wellbeing. A key revision of the measurement of HDI, considering inequality in all its dimensions, showed that Vietnamese HDI was just 0.572 and Vietnam was in position 113/169 in 2010 (UNDP 2011, 2013). The lower ranking and smaller HDI reflect the current challenges in economic development and poverty and inequality reduction.

3.4.2 A new goal and challenges to poverty alleviation strategies

In 2010, the Government updated the poverty lines, so-called the GSO–WB lines, for the period 2011–2015, which made the current achievements of poverty reduction less impressive (Badiani et al. 2013, p.53). An individual is poor if his/her income is less than US$1.61 per day (constant 2005 equivalent) in urban areas, and US$1.29 in rural areas. The official ‘near-poor’ lines were also announced at US$2.24 and US$1.83 for urban and rural areas respectively. Based on these updated lines, a fifth of the population were poor in 2010. The revised poverty and ‘near-poor’ lines may help the Government re-interpret poverty and inequality issues as there are signs of greater inequality existing between different strata. The country is also not free from poverty,
so attacking poverty and inequality must again be placed at the centre of national priorities.

The poverty gaps between urban and rural areas, and the ethnic majority/minorities are persistent. Although rural residents have experienced a substantial improvement in their living standard, they still contribute to a large part of the poor population. Reduction in the poverty ratio was much slower in rural than urban areas (Vietnam Academy of Social Sciences 2007). In 2004, while just 4% of urbanites were living under conditions of poverty, a quarter of rural residents were considered to be poor people. The disparity in poverty measured by the updated GSO–WB lines remains high between the two areas with 6% (less than 1.6 million people) in urban areas and 27% (over 16 million people) in rural areas (World Bank 2013a).

With respect to the ethnicity dimension, 53 recognised ethnic groups residing mainly in remote areas (excluding the Chinese group) contributed to 15% of the population in 2010, but they accounted for around half of the poor. Epprecht et al. (2011) indicated that geographical and social-cultural remoteness, causing a shortage of productive inputs (capital, machinery, skilled labour), prevents minority groups from keeping up with the average living standard. Spatial disadvantages (van de Walle and Gunewardena 2001) and the language barrier are obvious obstacles to poverty and inequality reduction (Nguyen et al. 2012). Those studies suggest a specified strategy at the communal level is required for ethnic minorities based on their social and cultural characteristics.

Finally, the ‘near-poor’ households, those whose incomes are just slightly above the poverty lines, have a high risk of falling back under the poverty line (Badiani et al. 2013). Sources of vulnerability are numerous: joblessness; accidents; illness; climate change effects; global economic recession; and national economic crises. These shocks undesirably impact both the poor and near-poor. Households commonly cut their expenditure, require children to quit schooling or need to sell assets and lands to cope with these risks, which then pull the near-poor households back into poverty.
3.4.3 Inequality – A controversial story

While poverty reduction is widely of interest, inequality is less frequently discussed. There have been concerns related to the increase in inequality after Vietnam accelerated the transformation to a market-oriented economy in the early 1990s. Measures of inequality vary depending on the data and measurements applied. Inequality measured by the Gini coefficient of household expenditure was quite stable over the period 1993–2010. It increased slightly from 35 to 37 during 1993–2002, then decreased back to 35 by 2008 (World Bank 2013a).

However, inequality in income has increased significantly in the same time period. It expanded throughout the 2000s, and peaking at 43 in 2010 (General Statistics Office 2012). The absolute gap between the richest and poorest quintile widened rapidly as the income of the wealthy rose at a faster pace than the others. Figure 3.7 shows that during the period 2002–2010, while average income of the poorest quintile climbed from 108 to 369 (’000 VND) (3.4 times), the top 20% highest’s incomes soared from 873 to 3,410 (3.9 times). Consequently, the gap between these two groups increased to 9.2 in 2010, meaning that income distribution became more unequal in Vietnam (8.3 in 2004) than in Indonesia (5.2 in 2002), Malaysia (7.1 in 1999) and Thailand (7.7 in 2002) while the Vietnamese income per capita was much less than these neighbours. That indicates that inequality in Vietnam is a serious problem and growth tends to favour the well-off rather than the poor (Do 2008).

Figure 3.7: Monthly income per capita (’000 VND) by quintile

Source: GSO (2012)
A cause of this rising inequality is that the income gap within rural areas has expanded quickly from 2004. Over the period 2004–2010, although the urban–rural income gap shrank from 2.26 to 2.01, within the rural areas, the richest decile increased their income twice as quickly as the poorest 10% did. As a result, rural inequality increased from 36.1 to 41.3 while urban inequality was stabilised at 38.1 (Badiani et al. 2013).

Geographic conditions are a main source of ethnic inequality (Epprecht et al. 2011). In Vietnam, the ethnic minorities usually inhabit in the mountainous highlands where economic and social infrastructure (e.g. markets and main roads) are in relatively poor condition. Income sources for ethnic groups depend heavily on agricultural activities, but social and geographical deprivations hinder both production and trade. Furthermore, natural calamities exacerbate inequality in relation to the ethnicity dimension. Difficulty with water access is an obvious example of geographical disadvantage. In many highland areas, water resources are insufficient for agricultural purposes as they are highly dependent on rain water. Pandey et al.’s (2006) survey found that about 50% of minority ethnic group households in the northern uplands suffer from long-term food deficits in any year, with nearly one-third of them having experienced a greater than 2 months equivalent of food inadequacy during the previous 10 years.

The income gap then leads to unequal access to basic services such as education and health. Less well-off households find it difficult to afford these essential services, even with subsidies. The VHLSS 2010 (GSO 2012) indicated that education expenditure among the better-off was significantly greater than the worse-off at all educational levels. As a result, children from wealthier families were more likely to succeed in standardised tests and to obtain higher degrees than those from poor households (Badiani et al. 2013).

An identical pattern in inequality is also found in the health sector. Poorer households account for a majority of illness sufferers, yet their spending on healthcare is lower than the richer group (World Bank 2012a). Furthermore, the Government’s healthcare expenditure favours the rich. The Government’s efforts to reduce the gap by offering free basic health insurance for the poor is helpful, but inequality in healthcare remains persistently high between the different income groups (Badiani et al. 2013).
3.5 Challenges to inequality reduction since the latest global economic downturn (2007–2009)

3.5.1 The current global economic crisis and national economic growth

In the late 2000s, many financial institutions in the Western countries faced the risk of bankruptcy without governmental interventions. This global recession was also evidenced by national failures of payment in Iceland and Greece (Pham and Le 2003). The depression in the banking sector impacted production areas, leading to an economic downturn. Global growth was recorded at 4.0% in 2007, but plummeted to 1.5% and was negative 2.1% in the following two years (World Bank 2014b). Since 2010, a slow but fragile recovery has occurred, with no optimistic predictions since then.

The performance of the global economy directly affected Vietnam’s economy because of its noticeable national openness to the world. However, quantitative measurements of this effect showed a surprising resilience to the world recession, especially in the financial sector. Three reasons for this were identified. First, the domestic banking system had restricted relations with western banks; thus, the impacts on this sector were small. Second, the State Bank of Vietnam strictly controlled commercial banks, most of which were state-owned. Therefore, the Government’s stimulus package, estimated about US$4 billion, could be provided effectively. Finally, a change in monetary policies from restriction to relaxation in late 2008 increased total liquidity (M2) and short-term capital which compensated for the reduction in FDI due to the world downturn (Thurlow et al. 2011).

An obvious effect of the global downturn on Vietnam was a deceleration of growth. The economy had performed well during 2000–2007 at around 7.5% annually on average, but this declined to 5.7% and 5.4% in 2008 and 2009 respectively (World Bank 2013a). However, this economic stagnation has continued while the Asian developing economies made a greater recovery after the crisis (Figure 3.8). This circumstance therefore requires an examination in the internal, rather than the external, effects.
3.5.2 Internal problems of the economy and the necessity for further Doi moi (renovation)

The remaining question is whether the slow growth is a result of external effects or internal structural problems, especially given economic environments have improved globally. Vietnam’s economy weakly recovered between 2010–2011, but has remained slow since 2012. Critics argue that inner socioeconomic shortcomings prevent the economy from establishing sustainable growth (Pham et al. 2013, World Bank 2014a). The World Bank (2014c) has forecast a flattened tendency below 5.5% lasting at least until 2016. This projection was based on the vulnerability of the domestic private sector which is an important engine of the economy. Closed or postponed enterprises increased at about 10% between 2010–2013 thanks to the high cost of inputs, weak demand for outputs and restrictions on access to financial resources.

Figure 3.8: Vietnam's economic growth in global and regional contexts
(GDP annual growth rate, %)

![Diagram of Vietnam's economic growth in global and regional contexts](source)

Source: World Bank (2014b)

Although Vietnam made several achievements in economic development, the economy has faced many long-lasting difficulties. The slow progress in industrialisation challenges the target of becoming an industry-based economy by 2020. Over two thirds of Vietnamese people inhabit rural areas and the agricultural sector provided half of the aggregate demand for labour in 2012. However, agricultural productivity, measured by GDP/worker, lags far behind productivity of non-agricultural areas. This low agricultural productivity also exacerbates the urban–rural income inequality.
Another difficulty is that the re-structuring agenda of SOEs and the banking system has progressed much slower than intended. The SOEs, defined as the backbone of the economy, have proved much less profitable than other sectors. An essential strategy for SOE reform is equitisation which attracts external investments including both financial and human resources. However, only 117 companies were equitised from 2008 to 2011 (the same number as in the year 2007) (World Bank 2013b). This stagnation in restructuring the SOEs is a key reason for the slow growth (World Bank 2014c). The banking sector is also problematic as it remains highly fragile. While banking deposits are continuously increasing, commercial banks are reluctant to lend to enterprises with low return capabilities. Rather, they invest their money in government bonds. This ‘vicious circle of liquidity’ is cautioned as a threat of financial vulnerability (World Bank 2013c).

The lack of a skilled labour force is another serious problem for the Vietnamese economy. Although the incidence of illiteracy is negligible, unskilled labourers accounted for two-thirds of the total workforce in 2007 (MOLISA 2010). In addition, there are insufficient links between stakeholders in the labour market (e.g. universities and colleges, the vocational training system, students and employers) which leads to poor information, weak incentives and a lack of capacity in human resources (World Bank 2013c). Finally, these restrictions in the workforce and labour market discourage labour productivity and economic growth.

The institutional problems relating to governance, policies and corruption are ongoing. Although Vietnam has recognised its institutional weaknesses, which were in fact the reason for the launch of the institutional reform of Doi moi, any improvements in institutional effectiveness are debatable. Additionally, corruption, bureaucracy and rent seeking can erode the Government’s development strategies and policies. The World Bank (2013b) showed that while half of Vietnamese enterprises bribed public officials, their performance was worse than those who did not. Crony enterprises easily access resources (e.g. finance, land), but then turn to speculation on the stock market or in real estate markets rather than investing in production areas. Moreover, cross-possession between enterprises and commercial banks amplify the rent seeking problem and further distort resource allocations (Pham et al. 2013). Consequently, long-term economic
growth is predicted to be under its potential due to structural problems mostly coming from SOEs, economic policies, the banking sector and the shortage of skilled workers (World Bank 2014c).

3.5.3 Effects of the current shortcomings on poverty and inequality

Sluggish growth and the uncertain macroeconomic environment negatively impact the goal of the Government’s anti-poverty and anti-inequality policies. The first difficulty is the flattened growth with deteriorating job demand and an increasing labour force. As a result, the unemployment rate in urban areas was 3.59% in 2013, an increase of 11% compared with the previous year (GSO n.d.) (although these figures are claimed to be underestimated as the World Bank’s (2013a) calculation was 5.5% in 2012). Furthermore, the Government reports that the uncertain external environment and internal instability affects millions of labourers by reducing their working time and increasing the likelihood of being made redundant. The jobless rate also means that unemployed ‘near-poor’ people are likely to fall back under the poverty line.

The institutional shortcomings (e.g. corruption, rent seeking and cronyism) and the delay of the SOE and banking system reforms continue the unfair allocation of resources. Unequal opportunities in access to key resources including finance, land and information permanently hurt the recovery (Pham et al. 2013, World Bank 2014a). Additionally, weak institutions worsen economic distribution, especially between the top income group and the rest of the population, and between the majority and minority ethnicities. Individuals with fewer opportunities to obtain production resources and basic services (education, healthcare) are likely to fall behind, so that inequality in educational and health outcomes become persistent.

Last but not least, although the achievements of poverty reduction are widely recognised and lauded, the effects of public spending on poverty and inequality reduction programs are questionable. Despite the challenge of a budget deficit, budget expenditure on NTPs has increased substantially by an average of 20% in the period 2008–2013. However, the gap between the poorest regions and the well-off regions remains high. This divergence between social groups indicates that the public spending may be leaking.
3.6 Chapter conclusion

This chapter focused on providing background information on Vietnam with a glimpse of the national geography, political institutions and the education and healthcare systems. It briefly reviewed the Doi moi renovation process and achievements in economic growth and poverty reduction. Inequality in economic, education and health dimensions was also discussed. The current difficulties and their possible effects have been analysed to point out several challenges to poverty and inequality reduction policies.

In terms of the country overview, the chapter concentrated on five aspects. Geographical information was provided explaining how the country is divided into eight regions with different characteristics for economic activities and demographic and climatic conditions. The political system (ruled by the CPV) could reveal a reason for the successful reduction in poverty because the Party prioritised anti-poverty and anti-inequality policies. However, while Vietnam has achieved fundamental milestones in the educational and healthcare sectors, it still has some serious deficiencies. The weakest point in the educational system is at the tertiary education level because the quality of the services does not meet the requirements of society. Most of high quality healthcare services are available in the few large cities while rural areas struggle to maintain even a basic level of services. Insufficient investments in infrastructure and human resources are also shortcomings of this sector.

The chapter also discussed the socioeconomic renewal program – Doi moi. Due to the revolutionary decision at the sixth Party Congress, there have been significant transformations in the economy: acceptance of the permanent existence of a private sector; elimination of controlled prices and the stamp and coupon system; market-based prices of goods and services; and economic openness. The renovation positively affected economic activities. The economy achieved a high growth rate for about two decades (1990s, 2000s) with hyperinflation under control. Foreign trade increased at a two-digit rate and FDI became an important sector of the economy. The renovation has benefited society and shifted the country out of a socioeconomic crisis.
The high economic growth rate resulting from the *Doi moi* was accompanied by a success story of poverty reduction, but the current level of inequality in the country is still worrying. Poverty reduction achievements have also been confirmed by the rise in non-economic dimensions of wellbeing such as the educational and health sectors. However, the findings on inequality are contradictory when different measurements and data are applied. Inequality measured by expenditure data remains unchanged and is considerably less than inequality in income. The evolution of inequality in Vietnam needs to be explored and analysed further, not only in its economic dimension but especially with respect to other dimensions of the phenomenon, including education, health and the standard of living.

Finally, the chapter has highlighted several current challenges for the economy. Although external factors are important, internal problems such as weak public management, corruption and rent seeking all directly impact economic development policies. An obvious result of this is that the economy has been stagnant since 2009. Such anaemic growth could erode the present successes in anti-poverty and anti-inequality policies.
4 LITERATURE REVIEW

4.1 Introduction

The literature on measurement of inequality with respect to income has been the subject of much interpretation since the publications of the Lorenz curve and the Gini index in the early 1900s. Max Lorenz introduced a graphical estimation of wealth inequality for a finite number of individuals in 1905. This method is simple but powerful, and it has continuously attracted researchers concerned with the study of inequality (Cowell 1977, 2008). At the same time, Corrado Gini independently defended his PhD dissertation with a statistical examination of the male to female ratio of the new born babies. These coincident events have influenced contemporary knowledge of measurements of inequality. At present, most plausible reinterpretations and calculations of inequality refer these original theories (Cowell 2008).

Besides these well-known methods, other notable indices have been developed in the last few decades. An interesting measurement of inequality using an information dispersion theory was proposed in Theil (1967, 1979). The extension of Theil’s inequality decomposition technique, which reveals the components of total inequality, provides a useful instrument to examine the contributions of different sub-groups to total inequality in a particular case. Another important measurement of inequality is the Atkinson’s (1970) index which is also applied to generate multi-faceted inequality calculations.

In relation to multidimensional inequality, three approaches can be used: (1) the Maasoumi two-stage approach which is based on Theil’s generalised entropy, (2) the Atkinson–Kolm–Sen (AKS) index that uses a social welfare function (SWF), and (3) Principal Component Analysis (PCA). In addition, the generalised Lorenz approach is another possible way to analyse multidimensional inequality. Multidimensional inequality is an emerging topic in economics, so there are limited resources in both theoretical development aspects and empirical applications of the current measurements. Therefore, this literature review cannot provide a rich discussion about this issue. The approach of this chapter is instead to look from the past to present, from single to multiple dimensions.
The chapter is structured as follows: The next section reviews several of the most notable measurements of economic inequality and the important outcomes of empirical implementations. Trends in inequality in developing countries are discussed in Section 4.3. Section 4.4 examines existing research outcomes of multidimensional inequality developed by applying Maasoumi’s two-stage measurement, the AKS method and PCA. The chapter conclusion identifies the research gaps in the present literature.

4.2 Measurements of income inequality

The aim of this section is to summarise the major statistical measurements of inequality from the twentieth century. This era has witnessed a considerable evolution of inequality economics with a variety of measurements of inequality. Applications of mathematical techniques for research in inequality have had an advantage since data indicating inequality has been better recorded from the beginning of the twentieth century (Piketty and Goldhammer 2014). Furthermore, the exclusion of political elements in theoretical measurements of inequality allows the economics of inequality to focus entirely on economic issues. In fact, the political factor is treated as an explanatory variable of inequality. Specifically, the majority of economists no longer classify society into three classes (i.e. capitalists, landlords and proletarians). Grouping individuals is instead subjected to different criteria which are based on particular research contexts such as income, educational background, gender, age and ethnicity. Measurements of inequality have been widely applied to many countries in the final third of the twentieth century. Thus, the literature on economic inequality should reflect these empirical results of inequality measures.

This section looks at economic inequality despite the migration from unidimensional to multidimensional inequality analysis that has gone beyond simple economic aspects since the late 1970s. Multidimensional inequality literature will be reviewed in the next section. More specifically, this section deals with several of the most significant theories rather than discussing the outcomes of all the empirical analyses. The methodological aspect will be discussed in the Methodology chapter.
4.2.1 The Lorenz curve and Gini coefficient

4.2.1.1 The Lorenz curve

The Lorenz curve and the Gini coefficient are the most well-known measurements of inequality. The Lorenz curve is a unique graphical computation and which gives fundamental robustness to the Gini coefficient. An obvious significance of the curve is that it enables researchers to observe inequality levels across different countries simultaneously or historically. Lorenz (1905) highlights the essential consideration of population units (e.g. households) in any analysis of income distribution, and constructs a method to answer the question of whether inequality increases or decreases with respect to changes in a population accumulation. To do so, he plots a population distribution from poorest to richest on one axis corresponding to cumulative income on the other axis. In the case of extreme equal distribution, the Lorenz curve is a straight diagonal line (Figure 4.114). An unequal distribution makes the Lorenz curve bend in the middle; the more the curve is bent, the more unequal the distribution is.

Figure 4.1: The Lorenz curves and the intersection problem

14 This figure uses the artificial data for a discussion of the intersection problem of the Lorenz curve.
A deficiency of the Lorenz method is that it can create confusing interpretations of comparative analysis when the Lorenz curves intersect, for example A and A’. To resolve this problem, Atkinson (1970) outlines an adjustment to Lorenz’s measurement of inequality using a social welfare approach. However, his assumption of social welfare, which aggregates homogeneous individual utility functions, does not disentangle the shortcoming of the Lorenz approach. Because of this drawback, the Lorenz curve provides only a partial ordering of distribution (Kawani 1980).

Despite the intersection problem, with support from the mathematical consequence of majorisation, the Lorenz curve has been developed to measure multidimensional inequality. At present, several potential applications of Lorenz’s method in the multidimensional inequality context can be seen in Koshevoy and Mosler (1996) with the Lorenz Zonoid, and in Koshevoy (1998) with the Lorenz Zonotope. However, very few empirical applications of the multidimensional Lorenz method have been found due to limitations in the dimensional examination of these approaches (Arnold 2008).

4.2.1.2 The Gini coefficient

The Gini coefficient which was initially introduced in Corrado Gini’s dissertation and seminal article (1921) closely relates to the Lorenz curve. This measurement assumes that each individual owns the same unit of social income/wealth. Given a society with \( n \) members, an equal income distribution requires that every recipient receives \( \frac{1}{n} \) of the total income. If any distribution does not satisfy this assumption, inequality occurs.

There are various ways of calculating the Gini coefficient. Sen (1973, p.31) points out that the Gini coefficient is half of the relative mean difference in income. Thus, Sen estimates inequality as follows:

\[
G = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j|}{2n^2 \bar{y}}
\]

(4.2.1)

where:

61
\( G \) is the Gini coefficient; 
\( n \) is the number of population; and 
\( \bar{y} \) is the average income.

The Gini value varies from zero (complete equality) to one (extreme inequality). The Gini coefficient has been widely used in many recent reports of national and international income inequality.

However, the Gini coefficient has some issues. It provides no clue of the inequality’s causation (Ward 1978). Another critique is that this measurement does not consider relative sensitivity although it does satisfy the Pigou–Dalton transfer principle, that is that an income transfer from a rich to a poor person leads to a reduction in inequality (Sen 1973). In the case of an intersection of the Lorenz curves, one value of the Gini coefficient may correspond to different points in the Lorenz curves. In other words, it is possible to find more than one Lorenz curve for a given Gini value (Atkinson 1970). Cowell (1988) points out that Gini’s method is an inconsistent measurement when inequality is disaggregated in its components. Such a situation occurs when all mean subgroup incomes are invariant; subgroup inequality rises but overall inequality falls. Despite these drawbacks, Temkin (1993) reminds us that it is a mistake to ignore the Gini coefficient in the economics of inequality as it contains a huge intuitive appeal.

4.2.1.3 A glimpse of empirical applications of Gini measurements of inequality

The Gini coefficient and Lorenz curve have a close relationship and are widely discussed in inequality; the Gini coefficient however is preferred in terms of empirical analyses. Although having a variety of definitions, the Gini index has been applied in three main ways. First, it has been used as a statistical tool for estimates of inequality per se. The advantage of this kind of application is its simplicity as it can be used directly without any modification required. For instance, Barrett et al. (2000) use the Gini index to compute inequality in Australia in the seventies and eighties. This index is also chosen by Goerlich and Mas (2001) for an analysis of inequality in Spain in the

\footnote{It is also commonly multiplied by 100, so that its alternative measurement unit is a percentage on a 0 – 100 scale.}
period 1973–1991. They found a monotonic downturn in the inequality of expenditure per capita. The Gini value was 0.34 in 1973–1974, which gradually reduced to 0.33 in 1980–1981, and then to 0.32 in 1990–1991. These results were contrasted to the general inequality trend in Europe where there was an expansion in the income gap between 1980–2000 (Doerrenberg and Peichl 2014).

The second Gini application is the decomposition technique. For example, Yang (1999) explores inequality in China from 1986 to 1994 by disaggregating the Gini coefficient into three parts: within-rural, within-urban and sectoral discrepancy (between-inequality). Data from two Chinese provinces (Sichuan and Jiangsu) showed that within-inequality in both rural and urban areas did not affect an increase in overall inequality however between-inequality was a major contributor. In Jiangsu, the sectoral income changes accounted for more than 80% of the aggregated inequality. Similarly, these changes were responsible for the whole inequality rise in Sichuan province. Another Gini decomposition approach disaggregates inequality into three components \((G_w, G_b, G_t)\) representing inequality within-group \((G_w)\), between-group \((G_b, G_t)\), and the inequality trans-variation between groups or partial distributions respectively (Frosini 2012). This technique is used to classify income units in 14 classes and unequal weighted disaggregation of inequality in three Italian regions: North, Centre and South. The outcomes show that within-group inequality entirely contributed to the total inequality (0.34/0.35). This result is similar to the decomposition of the Theil T index. The extremely high contribution of within-inequality to total inequality was however different among regions and countries. For example, Sicular et al. (2007) illustrate between-inequality sharing about 30% in the case of China over the period 1995–2002; and Epprech et al. (2011) show that between-inequality accounted for one quarter when total inequality was decomposed into urban and rural areas in Vietnam in 1993. An important reason for selection of the decomposition technique is that it enables researchers to gain insight into structural inequality. Based on the criteria of sub-group choices, inequality disaggregation can indicate the roles of inequality inside and outside the group.

The third way of using the Gini index is to exploit it as a dependent (or an independent) variable in econometric models (e.g. least squares), which can reveal correlations.
between inequality and relevant indicators such as income, education, gender and policies. This application type is diverse as it depends on research targets and models. Li et al. (1998) examine the determinants of world inequality using a regression model and find a combined impact of civil liberties, education, financial markets and land distribution on inequality. Analogously, Chong et al. (2009) apply a regression approach to assess the extent to which inequality is influenced by foreign aid. The findings show that the relationship between foreign aid and inequality is weak when institutional transparency is controlled. This fuzzy correlation between equity and foreign aid can be explained by a misallocation of resources for the beneficiaries. Furthermore, some kinds of aid were aligned to specific political purposes (i.e. military partners, voting campaigns) and these are inconsistent with poverty and inequality reduction.

The empirical approaches to the Gini coefficient depended on the purpose of each study. If research only seeks an overview of inequality, the simplest application of Gini should be preferred. However, this first level of application is only a primary step because it does not determine causes of inequality. Results of the measurements can then be used in econometric models, so that studies can examine comprehensive contributions of intra-components and inter-components to overall inequality. Generally, with over a century of application and despite their deficiencies, the Lorenz curve and Gini index still are attractive to those who examine inequality because they are simple and stringent. There is however great potential for improvements in and utilisation of these two measurements.

4.2.2 The entropy measurement of inequality

Theil (1967) applied the theory of information and provided two indices, namely Theil T and Theil L as follows:

\[
T_T = \frac{1}{ny} \sum_{i=1}^{n} \left[ \ln \left( \frac{y_i}{\bar{y}} \right) y_i \right] 
\]

(4.2.2)

and

\[
T_L = \frac{1}{n} \sum_{i=1}^{n} \ln \left( \frac{y_i}{\bar{y}} \right) 
\]

(4.2.2')

where:
\( T_L \) is Theil L and \( T_T \) is Theil T; both indices vary from zero to infinitive; 
n is the total members of a subgroup; 
\( \bar{y} \) is the average income of the subgroup; and 
\( y_i \) is the income of the \( i^{th} \) member.

This technique is applied to analyses of comparative inequality such as urban–rural, within and between regions in a country, or within and between countries. For instance, Eastwood and Lipton (2004) use Theil’s technique to test a hypothesis of an offsetting trend in inequality (OTI) in that rising intrasectoral inequality is offset by a decline in intersectoral inequality. The results of urban-rural inequality from selected developing countries rejected the OTI hypothesis.

Bourguignon and Morrisson (2002) applied the Theil indices to a decomposition of world inequality spanning 1820–1992. Notwithstanding a similar phenomenon of increasing inequality, patterns in inequality were different from 1950 across the regions. With the Theil T index, total inequality only contracted from 0.81 to 0.78 in the fifties. In contrast, Theil L showed a general rise (despite a marginal decline in the 1950s and 1980s). The two Theil indices however had opposite tendencies in within-country and between-country inequality. While the contribution of within-inequality dramatically reduced from 89% in 1820 to 40% in 1992, the between-inequality rapidly escalated and thus shared six-tenths of overall inequality as measured by the Theil T index. Chotikapanich et al. (2012) use the Theil indices to measurement of world inequality in the 1990s. The contemporary world was shown to be highly unequal, albeit with a negligible decrease from 0.81 to 0.79 over the period 1993–2000. A decomposition of within-inequality and between-inequality highlighted an increase in the within-inequality contribution, but a sharp fall in the between-inequality component of the total inequality until 2000. The results of inequality disaggregation are, however, influenced by the size of sub-groups (Minot et al. 2003). Between-inequality can increase when total inequality is decomposed into larger numbers of sub-groups (e.g. from province to district unit).

The Theil indices are among the most preferred measurements of inequality because of the advantages of inequality decomposition. However, Sen’s (1973) critique of the Theil method is that it is not ‘exactly overflowing with intuitive sense’ because the original
form proposed in Theil (1967) \((x_i \log(1 / x_i))\) does not look like an individual welfare function.

### 4.2.3 Atkinson’s measurement of inequality

Atkinson (1970) illustrates an alternative measurement of inequality calculated as follows:

\[
I_A = 1 - \frac{y_{EDE}}{\mu} \quad (4.2.3)
\]

where:

- \(y_{EDE}\) is defined as ‘the equally distributed equivalent income’; and
- \(\mu\) is the average real income.

His distinguishing idea is to emphasize the relationship between inequality and social welfare based on the aggregation of individual utilities. Equal distribution only occurs when ‘the equally distributed equivalent income’, \(y_{EDE}\), is equal to the mean income. An absence of this ideal condition implies that \(y_{EDE}\) deviates from the mean, \(\mu\); the larger the difference between \(y_{EDE}\) and \(\mu\), the higher the inequality level. The result of this is that social wealth loss is proportionate to the level of inequality. For instance, if \(I_A = 0.2\), a society requires 80% of its actual income to achieve the welfare level associated with a completely equal income distribution.

Alternatively, using the social welfare function (SWF), inequality can be measured as follows:

\[
I_A = 1 - \left[ \sum_i \left( \frac{y_i}{\mu} \right)^{1-\xi} f(y_i) \right]^{1/\xi} \quad (4.2.3')
\]

In this equation, the level of inequality is clearly subject to changes in the inequality aversion degree \(\xi\). The greater the \(\xi\), the greater the weight dedicated to the lower end of the distribution. Using Equation 4.2.3’, Atkinson resolves the problem of the crossing of the Lorenz curve and estimates inequality with a partial ordering solution. With the income data of twelve countries, he showed that 50 out of 66 cases of pair-wise Lorenz
curve comparisons suffered from the intersection problem as presented in Figure 4.1. In these cases, measuring inequality with the Lorenz curve could not produce sensible results. However, by choosing $\mathcal{E}$ in the range of 1.5 to 2, the number of controversial comparisons was reduced to five cases. However, this approach depends heavily on the choice of a value for $\mathcal{E}$.

The Atkinson index is advantageous in terms of evaluation of lost value in economies due to inequity. This approach also provides a series of results depending upon the social attitude to inequality. The more a community is concerned about inequality, the higher the inequality aversion parameter ($\mathcal{E}$). Subsequently, the index will be greater, irrespective of the distribution being the same. However, when compared with the Gini coefficient and Theil indices, Atkinson’s measurement is unable to analyse inequality attributions to different subgroups; thus, it cannot be used as a decomposition technique for understanding within-inequality and between-inequality (Gisbert et al. 2009).

### 4.2.4 The standard deviation method

A simple measurement of inequality is an estimate of the deviations of every member of the population from the standard deviation. Given a population having $n$ individuals ($i$), with a semi-infinite income distribution (range from 0 to $+\infty$) and the mean income ($\bar{y}$), the variance of this distribution (var) is defined as the second moment about the mean or ‘the mean of squares of the deviations from the mean’ (Kendall and Stuart 1977, pp.42-47); it is computed as follows:

$$ var = \int_{0}^{+\infty} (\bar{y} - y)^2 \, dF = \frac{\sum_{i=1}^{n}(\bar{y} - y_i)^2}{n} $$ (4.2.4a)

Then the positive square root of variance is called standard deviation ($\sigma = |\sqrt{\text{var}}|$), which is also the root-mean-square.

Another measurement of inequality that can avoid the ‘arbitrariness of the units’ uses the standard deviation in the logarithmic form (SDL) (Sen 1973):

$$ SDL = \sqrt{\frac{\sum_{i=1}^{n}(ln\bar{y} - \ln y_i)^2}{n}} $$ (4.2.4b)
Yet, Sen (1973) finds that the measurement is not concave at the high income levels and only considers the distances between each of individuals’ income and the mean income. This could be a reason for the absence of applications of SDL for inequality analysis, which is also analogous to the case of the mean log deviation (Ravallion 2016).

4.3 Inequality in developing countries and investigation of causes and effects

4.3.1 General discussion about inequality in the developing world

Research on inequality has caused long-lasting arguments about the extent of trajectories of inequality in both developed and developing countries with respect to economic growth. The central question of this argument is whether inequality, within countries and the whole world, follows Kuznets’s (1955) hypothesis of the inverted U-shaped curve. Kuznets hypothesizes that inequality increases in the industrialising stage, but then it falls off after the industrial revolution is complete. Interestingly, there are an equal number of supportive documents both for and against, although there is less evidence from low income countries than from the developed world due to data availability issues. This section reviews the two streams of opposite discussions about inequality in developing countries.

An initial examination of inequality in low income countries over the long term can be traced back to Fields (1989) whose data spanning 1961–1982 does not support Kuznets’s hypothesis. The initial inequality level does not correlate to growth, inequality does not increase in the early stage, and nor does it even decrease after economies have successfully developed. In other words, the number of observed cases of inequality increase and inequality decrease are nearly the same, and these movements are not associated with either levels of income or growth (Fields 1994). With rich data resources from 120 countries over the period 1960–1989, Schultz (1998) indicates that the inverted U-curve trajectory of inequality will vanish if China is excluded. Analogously, Deininger and Squire (1996) and Barro (2000) critique the poor fit of Kuznets’s hypothesis when all countries are examined as a whole. While distribution in high income countries shows a reduction, the patterns are mixed in different regions of low income groups (Biancotti 2006, Alvaredo and Gasparini 2015).
Although there is a convergence in global inequality, meaning that higher (or lower) initial inequality rises (or falls) towards the average level, Ravallion (2001b) warns that this result must be carefully interpreted because of an absence of causes found for this inequality convergence; measurement errors and deviations from the mean for specific observations also need sufficient consideration. It is agreed that inequality, proxied by the Gini coefficient for consumption expenditure or income per capita, in developing countries rose over the 1980s and 1990s (Biancotti 2006, Alvaredo and Gasparini 2015) but has contracted, on average, since the starting point of the twenty-first century (Alvaredo and Gasparini 2015). However, Ravallion (2016, p.322) notes an monotonic upward trend in within-country inequality since the eighties with different patterns across regions.

In relation to the regional dimension, a plethora of studies exist that document substantial differences in the level of, and trends in, inequality among regions and countries. For the period 1961–1982, Latin America and the Caribbean (LAC) and East Asia experienced similar changes in regional inequality with higher inter-country and lower intra-country inequality shares, but inequality in East Asia was half as much as in LAC (Fields 1989). The trend in within-country inequality then turned conversely from the 1990s. In larger regions, including the Asian and Pacific economies, inequality increased in the period 1990–2010 due to the significant rise in inequity in China and Indonesia by 10 and 5 points respectively. The inequality widening in these two nations is attributable to economic sectoral changes from agricultural to non-agricultural areas, increased skilled–unskilled wage gaps, weak links between urban and rural areas and labour immobility (Alvaredo and Gasparini 2015). Cain et al. (2012) articulate an increasing inequality in relative form in 15 out of 21 Asian countries while the absolute gap between the richest and the poorest quintiles increased everywhere in the 1990s and early 2000s. Chotikapanich et al. (2012) surprisingly show that Asia, along with LAC, stands second highest in the most unequal regions in the nineties. The difference is that inequality is tending to increase in LAC but to decrease in Asia. Furthermore, results of a decomposition of the Theil index reveal that while within-country inequality accounts

16 Leigh and van der Eng (2009) emphasise the very high inequality in Indonesia where the richest 1% and 5% account for about one tenth and over a fifth of total national income respectively.
for a large part of total inequality in LAC, between-countries inequality is a more important driver of total inequality in Asia.

Two other regions, namely South Asia and Africa, share identical changes in within-country inequality that has followed the reverse U-shape although inequality in Africa was twice as high as South Asia, regardless of the point in time in the period 1960–1989 (Schultz 1998). Income distribution in South Asian countries started with a low initial inequality in 1980, but they have experienced a gradual increase since then (Alvaredo and Gasparini 2015). Chotikapanich et al. (2012) argue that inequality increases in Africa – the most unequal region in the nineties – show inequality between countries contributing the lion’s share to total inequality. There is also a complex picture of inequality in African countries with general features of high and stable inequality levels over 1990–2010 and large variations across countries (Alvaredo and Gasparini 2015). However, Ravallion (2016, p.322) finds that within-country inequality shows LAC to be persistently the most unequal region, followed by the Sub-Sahara African countries. The least unequal region is East Asia, but its inequality is increasing steadily over time.

Inequality rose in Eastern Europe and Central Asia in the 1990s after the collapse of the communist regimes. Although there was a slight decline in the following decade, inequality in 2010 was substantially higher than before the transition. The Middle East had a low and steady fall in inequity over the period 1980–2010 however, the absolute gap, measured by comparing the top and the bottom 10% of the whole Middle East population, was significantly higher than anywhere else. This could have been a driver behind the recent ‘Arab Spring’ (Alvaredo and Gasparini 2015).

At national levels, there are a variety of interpretations of inequality. Yet inequality is usually decomposed into spatial dimension components, that is, within-urban, within-rural and urban–rural. Liu (2010) examines discrepancies among studies with conflicting results of inequality in China, even though the same datasets were used. He forecasted stability or even a fall in the income gap after 2004, but empirical data has opposed this projection. Knight (2014) proved that inequality has accelerated since the late eighties, with China becoming one of the most unequal states. The Gini coefficient was around 50 in 2007, which by far exceeds inequality in other Asian countries, and
there has been no sign of a decline since then. Similarly, controversial findings of inequality have been found in Vietnam. On the one hand, Nguyen et al. (2007) and Fesselmeyer and Le (2010) find that urban–rural inequality rose in the 1990s. Huong and Booth (2014) also find that the urban–rural gap subsequently increased in the period 1993–2006. The increasing gap between urban and rural areas accounted for 96% of the national total inequality in the nineties but only accounted for two fifths in the following period (Vietnam Academy of Social Sciences 2007). In contrast, GSO (c2010) finds a steady decline in the income gap between the two areas over the period 1999–2010.

Needless to say, it is hard to come to a consistent conclusion about inequality levels and trends for regions and/or urban–rural inequality based on the present literature.

The different results of inequality measures are due to the following issues. The first is the data resources. Reliable data for analyses of inequality in developing countries, especially for international and intertemporal comparison purposes, are hard to source, at least until the early 1990s when household living standard surveys with World Bank technical support become popular (Fields 1994, Grosh and Glewwe 2000, p.6, Deaton 2003a). Second, competing measurement methodologies have led to a variety of interpretations of inequality. While a number of authors have been concerned with relative inequality – proportions of total income shared by different individuals or groups, others concentrated on absolute inequality or the gap in absolute income between the rich and the poor. Ravallion (2004) comments that relative methods show a drop while absolute measurements reveal a widening inequality gap between high and low income countries. Different choices for estimating inequality have caused disputes between for and against globalisation camps. Third, controversial explanations for inequality can also occur when different proxies are used. Two variables, income and consumption expenditure, are usually considered as the most suitable proxies for inequality estimates, but significant differences in results remain in many countries. This has caused unavoidably misleading comparisons of inequality due to the mixed use of these proxies. In the developing country context, Deaton (2003a) recommends using
consumption expenditure rather than income for measurements of poverty and inequality\textsuperscript{17}.

\subsection*{4.3.2 Causes and effects of inequality}

Arguments about inequality are persistent not only because of the diverse concepts of inequality and the measurements and data used but also because of covariations with other key issues (i.e. growth, poverty, human capital, health and social cohesion). The literature paints many different pictures of causes of inequality. At national levels, causes of inequality are various and highly interrelated. Many studies prove that urban–rural inequality is a main contributor to total inequality, and that this dispersion is attributable to education, age and household residency. Deaton and Dreze (2002) claim urban–rural disparity is due to agricultural wages increasing at a slower pace than GDP per capita in India. Bigotta \textit{et al.} (2014) states that education and household size, followed by employment status and household residency, are the main determinants of inequality. Cain \textit{et al.} (2012) and Knight (2014) explain that the agricultural and rural sectors progress at a slower rate than non-agricultural sectors which leads to a widening of the urban–rural wage gap. This gap accounts for half of the total inequality in most Asian countries. Acosta \textit{et al.} (2008) find that international remittances significantly reduced inequality and poverty in LAC. However, Stark \textit{et al.} (1986, 1988) argue that the extent of the impact of international remittances on inequality depends on types of migration (i.e. domestic or international), migration history, migrant education and the weights attached to different income groups.

With respect to the foreign trade perspective, an examination of the literature on inequality finds controversy as to whether trade reduces or worsens inequality. van Zanden \textit{et al.} (2014) claim that global inequality tends to be proportionate to the globalisation level. However, the effects of globalisation are complex. De-globalisation seems to decrease inequality in rich countries but extends the gap between rich and poor countries. On the other hand, globalisation increases within-country inequality but reduces the international income gap. In line with this discussion, Krugman (2008) rejects the common wisdom that international trade liberalisation benefits everyone as

\textsuperscript{17} Further discussion on this point will be presented in Chapter 6, Section 6.4.
there is no explicit causal correlation between trade openness and inequality. For example, theories of international trade have predicted an increase in unskilled wages in labour intensive countries, and thus the unskilled wage and skilled wage gap diminishes; but evidence from Mexico shows instead increasing inequality. Other LAC countries (e.g. Brazil and Argentina) also reveal this contradiction to the free trade theory. However, increasing inequality in a region does not mean openness is the cause of the inequality because inequality is stable in a number of export-led economies (e.g. South Korea and Taiwan). Therefore, it should be a mistake if LAC governments sought to reduce inequality by opposing international trade, rather they should implement trade liberation policies that favour the poor. Meschi and Vivarelli (2009) point out that inequality in developing countries can become worse when trading with developed countries. The negative effect can result from differences in applied technologies that in turn lead to a skill bias. This bias occurs when there are technological transfers from more advanced to less developed countries that shift skilled labour demand upwards, which then increases the wages paid to the skilled workforce more rapidly than unskilled wages. The widening wage gap subsequently increases inequality in developing countries.

Another reason relates to governmental policies. Ravallion (2016, p.498) explains how compulsory education played an important role in East Asia’s equitable growth, with inequality in this region lower than others. However, Cain et al. (2012) argue that urban-biased policies exacerbate inequality between urban and rural areas. Rural areas lack public investment in infrastructure and technology that in turn discourage private agricultural investments. Knight (2014) examines discrimination in the residence registration system, hukou, and structural reforms (state-owned enterprise privatisation) in the Chinese labour market, which subsequently increased urban–rural inequality.

Ravallion (2007) shows the effect of anti-poverty programs on inequality. He indicates the danger of decentralisation of anti-poverty programs, which can increase inequality. Local governments tend to set poverty lines lower than national lines due to resource constraints; thus, identical poor people can benefit differently from national programs with respect to geographic conditions. A suggestion is that national poverty lines or recipient eligibility needs to be applied universally. Furthermore, Hermes (2014) finds
that microfinance policies, which are considered as a channel for pro-poor programs, often have little influence on poverty and inequality. The reason is that the benefits from these programs can be negligible in absolute terms even though they may show a statistically significant positive impact on inequality reduction. Thus, microfinance processes should not be the basis of anti-inequality policies.

Furthermore, the impact of inequality on other aspects of human life is enormous, but the literature gives varying results. There are the controversial influences of inequality on growth; inequality tends to discourage growth in poor countries whose annual income per capita is less than US$ 2000 (1985 constant price), but it may foster growth in richer cohorts (Barro 2000). Ravallion (1997, 2001a, 2005) and Ravallion and Chen (2007) claim that an initial inequality level is an impediment to poverty reduction through two channels. First, in the case of a significant inequality–growth nexus, higher inequality decreases growth, lowering the probability of freeing the poor from poverty. Inequity nurtures intervention distortions which obstruct growth; more unequal distribution also causes persistent credit constraints for the poor who are then less likely or able to invest in more productive activities. Second, even when there is a weak relationship between inequality and growth, highly unequal distribution means that the achievements of the growth are less attributable to the poor in absolute terms. Thus, low inequality is better for the poor because it allows poor people to obtain more from economic growth while incurring fewer costs of contraction.

Li et al. (1998) reveal an inverted U-shaped relationship between health status and inequality, which implies that inequality in community levels can threaten health status. Deaton (2003b) also claims that inequality (in income and other dimensions) may be a hazard to a population’s health. He demonstrated a negative correlation between inequality and life expectancy (and also mortality and morbidity), irrespective of the country context. A multi-directional relationship between relative income and health is evident and thus public health policies can affect inequality. But this relationship becomes weak due to measurement errors in estimates of income inequality. An example is that the inequality–mortality relationship can vanish when education is controlled; the income inequality–life expectancy link will become statistically insignificant if income per capita is added as a control variable. Thus, it is important to
investigate further the extent to which income directly impacts health or whether it is impacted through other channels such as education and wealth.

Although the vast majority of research on inequality seeks reasons for and consequences of inequality (i.e. globalisation, economic crises, market reforms, technology and education, and fiscal and social policies), it is still far from providing a consolidation of globally universal drivers and causal effects of inequality. For instance, a number of people claim that globalisation causes inequality while others argue against this, such as in Ravallion (2004, 2016, ch.9). Debates on other potential reasons found in specific contexts continue also because of the interrelationship between causal factors. For example, Anderson (2005) explains that economic openness affects inequality through channels such as regional gaps and reductions of government fiscal policy in favour of equity. This situation means that generalisation of findings in research on inequality should be less based on international values due to countries’ differing contexts. Therefore, examination of inequality requires effort to paint a specific and appropriate picture of inequality for a particular case.

Economic inequality is interesting because the economic dimension is among the most important determinants of human wellbeing, so measurements of economic inequality provide a simple view of the extent to which social products are distributed among individuals. Specifically, income, representing the economic dimension, is likely to be a major contributor to the living standard, so income distribution could affect individuals as well as community wellbeing (Atkinson 1970, Sen 1973). Research in inequality is still of interest due to the persistence of its use in both within-country and between-country contexts (Champernowne and Cowell 1998, pp.5-13). Additionally, studies in economic inequality are needed for analyses of the relationships between economic inequality and other aspects (e.g. health, education). Economic research examines this kind of correlation where economic inequality functions as an explained or explanatory variable (e.g. Sen 2003a).

However, inequality is multidimensional per se (Sen 1985a); thus, it is restrictive if research in inequality concentrates only on the economic dimension. Likewise, Maasoumi (1999, p. 437) argues that a great emphasis on ‘income’ inequality becomes
confusing as individuals and households differ from each other regarding their characteristics and needs. Apart from tradable benefits, crucially non-monetised values which determine human wellbeing are unlikely to be considered if inequality is only measured within an economic dimension. Unidimensional inequality is a doubtful measurement in such a circumstance. Rather, it would be more meaningful to undertake a migration to multidimensional inequality that encompasses fundamental (e.g. economic and non-economic) contributions to wellbeing.

4.4 Literature on multidimensional inequality

Although the concept of multidimensional inequality can be traced back in Kolm (1977), it is still in its early developmental period. The literature has been steadily expanding since the date of Maasoumi’s (1986) measurement of multidimensional inequality. Weymark (2006, p.317), the co-author of a theory of a multidimensional generalised Gini index (Gajdos and Weymark 2005), also points out that ‘compared to the theory of univariate inequality measurement, the analysis of multidimensional inequality is in its infancy’. This relative lack of literature on multidimensional inequality could also arise from measurement limitations and data insufficiency. Any estimate of multidimensional inequality needs to handle a variety of aspects of wellbeing simultaneously, but cross-dimensional trade-offs and dimensional weights are still debatable. Additionally, apart from the economic space (i.e. income), variables proxying for other aspects of wellbeing could be inappropriate. Economic inequality using income data is simple as it does not face the difficulties of multidimensional measurements. However, in the framework of a multidimensional interpersonal comparison, it is vital to focus on inequality in wellbeing and its various components rather than solely on the income space (Sen 2003a, p.102).

Interestingly, the majority of current methods are primarily derived from the calculation formulae for economic inequality; thus, measurements of multidimensional and economic inequality share several characteristics and have similar desirable properties (e.g. the Pigou-Dalton transfer principle). Multidimensional inequality outperforms unidimensional inequality in terms of consideration of multiple dimensions and examining the interactions between them. Intuitively, application of a unidimensional measurement could lead to inverse inequality trends in different dimensions;
consequently, it could deliver a puzzling message on overall inequality levels. By contrast, with a multidimensional approach, inequality analyses are likely to deliver less controversial conclusions even with opposite directions of inequality across dimensions. As a result, multidimensional inequality should provide a more comprehensive interpretation in such circumstances because it can deal with compiled divergent tendencies in inequality.

This section assesses the current research in multidimensional inequality. First, the literature on multidimensional inequality derived from economic inequality theories (e.g. Gini, the Theil index, the Atkinson index) is reviewed. A main feature of multidimensional measurement is that it computes inequality through two steps: (1) choosing a way to capture the dimensions, and (2) estimating the inequality with modified methods rooted in measurements of economic inequality. Such measurements can be classified into the two main approaches: Maasoumi’s two-stage method and the AKS method. They both use SWF that ranks individual utilities for the calculation of inequality. While the former method applies the Theil index, the latter measurement is constructed from the contributions of Atkinson (1970), Sen (1973), and Kolm (1976a) in economic inequality. These two approaches can lead to varying (even conflicting) outcomes due to different variable weights and parameter values. For instance, the application of a Maasoumi index with two dimensions (consumption expenditure and education) to Vietnam showed that if the inequality aversion degree \( \alpha \) is 0 and the cross-dimension substitution coefficient \( \beta \) is 1, inequality increases; however, if \( \alpha \) is 1 and \( \beta \) remains unchanged, inequality falls (Justino 2012). Such conflicting results do not help policymakers who still face a series of uncertain choices.

Secondly, Subsection 4.4.2 concentrates on asset-based measurements of inequality. A motivation for using this approach is that (by definition) multidimensional inequality can use multiple variables where using a one-variable proxy cannot contain all the information for one dimension, even in the economic dimension (Sen 1997b). Estimates of inequality using a wellbeing index are desirable because such indices work with not only a large number of variables that contribute to wellbeing but also with variable

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18 This viewpoint is evidenced in most applied studies of multidimensional inequality (e.g. Justino 2012)
weighting schemes. That means, for example, PCA-based methods could significantly minimise the uncertainty of cross-dimensional substitutability, weighting variables and variants in variable scaling. However, construction of measurements in multidimensional inequality still needs refinement. Therefore, the literature on multidimensional inequality requires more discussion in order to discover an optimal method for empirical analysis.

4.4.1 The Maasoumi and Atkinson–Kolm–Sen approaches

4.4.1.1 The Maasoumi index

Maasoumi (1986) proposes an original measurement for multidimensional inequality by adapting Theil’s and Atkinson’s approaches. This is also the first approach using the simultaneous aggregative technique. While a dimension-by-dimension approach could produce inappropriate results in inequality due to inadequate examinations of interattribute correlations (see Nilsson 2010, Justino 2012), Maasoumi’s approach takes into account the contributions to inequality of different dimensions to a multidimensional inequality level simultaneously. The philosophy behind his method is the comprehension of individual overall wellbeing divergence. Maasoumi’s calculation is as follows:

\[ D_\beta (S, X, w) = \sum_{j} w_j \left\{ \sum_{i=1}^{n} S_i \left[ \frac{S_i}{X_{ij}} \right]^\beta - 1 \right\} / \beta (\beta + 1), \beta \neq 0, -1 \] (4.4.1a)

where:
- \( D_\beta (S, X, w) \) denotes an individual’s wellbeing distribution;
- \( S_i \) is the total wellbeing of individual \( i \);
- \( X \) is a vector of wellbeing dimensions;
- \( X_{ij} \) is the wellbeing of individual \( i \) \((i=1\ldots n)\) in dimension \( j \) \((j=1\ldots m)\), \( i \neq j \);
- \( w_j \) is the weight of dimension \( j \) ; and
- \( \beta \) is the cross-dimension substitutability parameter.
This function estimates dispersion in individual wellbeing \( (S) \) where the given matrix \( X \) contains a finite number of dimensions, \( w \) is the individual weight and \( \beta \) is the coefficient of replacement between different attributes. Seeking a solution to minimum \( D_\beta \), the distribution \( S \) should be proportional to \( \left( \sum_{j=1}^{m} w_j x_{ij}^{-\beta} \right)^{-1/\beta} \). Then, relative inequality in \( S \) is computed using the following equation:

\[
I_\alpha(S) = \frac{\sum_{i=1}^{n} p_i \left[ \left( \frac{S^*_i}{p_i} \right)^{1+\alpha} - 1 \right]}{\alpha(1+\alpha)}, \quad \alpha \neq 0, -1 
\]

(4.4.1a')

where:

\[
S^*_i = S_i / \sum_{i=1}^{n} S_i, \quad p_i \text{ is the proportion of population subgroup } i; \text{ and}
\]

\( \alpha \) is the inequality aversion.

Since the date of its publication, Maasoumi’s approach has been increasingly of interest. Maasoumi (1999) continues to refine his measurement and makes a comparison with other methods. A similar comparison is also found in Lugo (2007) who applies different measurements to the Argentine context. Applications of this index to Zambian and Vietnamese data are conducted by Nilsson (2010) and Justino (2012). As indicated earlier, outcomes using this measurement produced contradictory implications.

4.4.1.2 The Atkinson–Kolm–Sen method

The theories of inequality by Atkinson (1970), Sen (1973) and Kolm (1976a, 1976b) form the foundation of the AKS method. Atkinson’s (1970) idea of an ‘equal distribution equivalent’ is continued by Sen (1973) and further discussed in Kolm (1976a, 1976b). These studies inspire Tsui (1995) to establish the AKS relative and absolute multidimensional inequality indices. Tsui assumes the sum of a strictly concave function of individual utility that is equivalent to SWF. Corresponding to the two forms of utility function, the relative index of inequality \( (I_R) \) is:
\[ I_R = 1 - \left[ \frac{1}{N} \sum_{l=1}^{N} \prod_{k=1}^{K} \left( \frac{x_{ik}}{\mu_k} \right)^{r_k} \right]^{1/\sum r_k} \]  

(4.4.1b)

or

\[ I_R = 1 - \prod_{l=1}^{N} \left[ \prod_{k=1}^{K} \left( \frac{x_{ik}}{\mu_k} \right)^{r_k} \right]^{1/\sum r_k} \]  

(4.4.1b’)

where:

- \( N \) is the number of individuals;
- \( K \) is the quantity of attributes;
- \( x_{ik} \) is the value of attribute \( k \) for individual \( i \);
- \( \mu_k \) is the average value of \( x_{ik} \); and
- \( r_k \) is a parameter to ensure the strictly concave individual utility function.

Consequently, the absolute inequality (\( I_A \)) is as follows:

\[ I_A = \frac{1}{\sum c_k} \ln \left[ \frac{1}{N} \sum_{l=1}^{N} \exp \left( \sum_{k=1}^{K} c_k (\mu_k - x_{ik}) \right) \right] \]  

(4.4.1c)

In this equation, \( c_k \) is a selected parameter guaranteeing the concavity of the individual utility function.

Gajdos and Weymark (2005) contribute to this normative measurement by taking into consideration the axioms of AKS. They confirmed that Tsui’s decomposability axiom was controversial as it violated several particular contexts. The index is then further developed in two stages. Determinants of individual wellbeing were computed according to a generalised Gini SWF approach. Then, an aggregation of multidimensional inequality attributes is gauged. Analogously, Decancq and Lugo (2012a) illustrate the column-first and row-first AKS indices. The column-first index calculates inequality across individuals (for one dimension) and then across dimensions whereas the row-first index computes across dimensions (for an individual) before across individuals. They argue that the latter approach is preferable as it gives sufficient attention to interactions across dimensions.
This subsection reviews the contribution of current applied studies which follow the Maasoumi and/or AKS approaches to research multidimensional inequality. These applications share the synthesis of different unidimensional inequality levels into one index. They do not however reach an agreement as to the extent to which particular dimensions are incorporated in the final results. They also have methodological problems of parameter and variable choices. A discussion in detail about these shortcomings is likely to suggest that multidimensional inequality could provide a better measurement by providing unique and applicable results.

A motivation for development of multidimensional inequality is that it could reduce the difficulties of interpretation of inequality in a multidimensional space. Unidimensional inequality (the side-by-side method), by adapting measurement methods of economic inequality, can only produce separate indices for different dimensions that could not be brought to an incorporated result. However, multidimensional inequality measures inequality in different dimensions simultaneously and gives a unified result. The advantage of the multidimensional method has been proved by most applied research. For instance, world income inequality increased remarkably while inequality in education and longevity has declined over the period 1975–2000 (Decancq et al. 2009). This situation raises the question of whether overall inequality synthesised from multiple dimensions increases, decreases or stabilises. Unidimensional measurements could not reach a feasible answer. The multidimensional approach showed that world inequality had experienced a marginal fall. Therefore, this approach can shed light on movements in overall inequality which is considered as having multiple causes.

The substantial majority of studies focus on comparisons between the Maasoumi and AKS approaches, sharing the characteristic that research outcomes depend mainly on values selected for the two parameters $\alpha, \beta$. The inequality aversion parameter $-\alpha$, similar to risk aversion in uncertainty theory, defines the social attitude towards inequality. Assuming that this parameter is non-negative within the income dimension, the higher the degree of aversion, the greater concentration at the tail of the distribution and thus the greater weight for lower income groups. When inequality aversion
approaches infinity, it only focuses on changes in the very lowest income group. In contrast, if inequality aversion is equal to zero, a society would treat the transfer of income indifferently, regardless of which groups the transfer is made between (Atkinson 1970).

However, there is still a dearth of literature on how the inequality aversion degree is evaluated. In many cases, several values were selected for an inequality analysis without any clue that it must reflect the actual behaviour of a society towards inequality. Instead, these values were chosen simply because they did not violate the series of axioms (Decancq and Lugo 2012b). Additionally, Aristei and Perugini (2010) explicitly argue that a unified aversion could lead to erroneous results, especially in the context of international comparisons because of the heterogeneity of inequality attributes. Decancq and Lugo (2012b) support this argument when they surveyed categories of inequality measurement approaches. Yet there is still no obvious standard value for inequality aversion; value choices for aversion, depending on the research context, should be further scrutinised.

Similarly, the degree of substitutability between dimensions ($\beta$) is arbitrary and lacks theoretical guides. This parameter is defined as the trade-off ratio between dimensions provided that the same level in wellbeing is held. In fact, it is hard enough to quantify the importance of dimensions, let alone the trade-off between them in a multidimensional inequality index. Consequently, the literature shows diverse inequality results even when using a particular measurement, which could lead to more confusing interpretations. For example, Lugo (2007), who uses both the Maasoumi and AKS approaches, focuses on five outcomes associated with different combinations of these two parameters under the condition of desirable property satisfaction. If all axioms in the two models are satisfied, they produce opposite results of inequality in the Argentine case. Analogously, an analysis of inequality levels in four dimensions (i.e. expenditure, education, health and land property) in Zambia results in a variety of outcomes according to different selections of substitution degree (Nilsson 2010). Although the majority of choices of substitution degree between dimensions led to an increase in inequality, the paper is far from unambiguous on levels of inequality. Difficulties in making appropriate parameter choices could be one of the biggest
obstacles for studies in multidimensional inequality as researchers end up choosing parameters mainly based on their ‘common sense’ (Decancq and Lugo 2012b). While cautions for interpretation are regularly stated, they do not necessarily eliminate confusion for implementation of calculations for further research.

While the necessity of multidimensional measurement of inequality is a consensus, choosing variables for the dimensions is the subject of debate. The literature demonstrates that income and years of schooling are usually used as proxies for economic and educational achievements respectively whereas there are many different representatives for the health dimension. Although expenditure is commonly used as a proxy for the economic dimension, because expenditure data are currently available in most countries, its merits in terms of reflecting the living standard are debatable. With the education dimension, apart from schooling years, it is hard to find an additional reasonable proxy due to data limitations. Moser and Felton (2007, pp.11-12) suggest an alternative proxy for human capital, which includes both years of schooling and work experience, because human capital is likely to describe this dimension of wellbeing better than just years of schooling.

There is no universal recognition of a proxy for health status. Justino (2012) uses the number of healthy days out of 4 weeks. A similar proxy was also chosen by Aristei and Bracalente (2011, p.251) who applied the AKS approach to Italy in the years 2004 and 2007. However, Angelini and Michelangeli (2012) dropped this variable when they made a comparison of multidimensional inequality across the European continent. Decancq and Lugo (2012a) suggested a composite indicator based on three factors (health problems, lifestyle habits and health service accessibility). These differences in health dimension proxying affect the metric outcomes, even within the same geographical context. In general, a one-indicator proxy rarely reflects all information on human wellbeing in a particular dimension. Furthermore, the arbitrary choices of variables will not end to comparable results between different studies; therefore, variable choices of health status require a rich discussion.

\[19\] This point is further discussed in Subsection 4.4.2: Measurement of relative inequality.
Lugo (2007) points out several deficiencies in applying Maasoumi’s approach to determine a multidimensional measurement of inequality. Firstly, the Pigou–Dalton transfer principle, which indicates inequality will be mitigated if an income amount (that is not sufficient to convert individual positions from poorer to richer and vice versa) is transferred from a richer to a poorer person, could not be satisfied by this approach. Evidence of this violation is found in Dardanoni (1995, cited in Lugo 2007) who issued a counter example of the uniform majorisation (UM) test. The result of this test is that UM is only fulfilled with restricted values of parameters as individual wellbeing is not normalised by the mean of actual levels but by the mean aggregator. Thus, the nexus between the Maasoumi index and the social evaluation function of contributors is replaced by a new link with one of the aggregate utilities. For that reason, interpretations of outcomes become problematic. Furthermore, correlation-increasing majorisation is unlikely to be satisfied by the Maasoumi index. This controversy results using from the same value for individuals who participate in a transfer; therefore, the mean of the wellbeing value will be affected by the correlation-increasing transfer. To resolve this problem, Tsui (1995) outlines a conventional measurement that enables researchers to identify the value judgement invoked in parameter selections. However, Tsui’s technique reveals yet another shortcoming as it does not disentangle the difficulties of parameter interpretation.

In addition, in the vast majority of current studies, the inequality levels of each dimension are assumed to contribute equally to multidimensional inequality for simplicity purposes. However, the inequality degree of each dimension can significantly differ from others due to their scales. For instance, in any society, income inequality tends to be more serious than non-income dimensions because it varies at a considerably larger scale than any other. Given two men, A and B, whose incomes per capita are US$20,000 and US$40,000 respectively, it is nonsensical to think that B would live twice as long as A. Income can vary from zero (or even negative values) to US$40,000, US$60,000 and even higher, but educational achievements (proxied by school years) only range from zero to around 16–17. This scale dissimilarity creates problems for measurements of multidimensional inequality and this still has not been adequately discussed. As a consequence, the research outcomes can be confusing as to whether inequality goes upward or downward.
Although correlations between dimensions have been realised (Atkinson and Bourguignon 1982, Tsui 1995, Decancq and Lugo 2012a), their interdependency has not been adequately taken into account in estimates of inequality. Despite wellbeing being attributable to a series of factors which are usually reflected by fundamental representatives (i.e. income, life expectancy and years of schooling), the roles of these variables are currently analysed separately. As the influence of income on the other variables is inevitable, any computation of multidimensional inequality should allow for different weights for the variables which proxy for the dimensions involved. It is questionable to allocate an equal weight for all variables, as shown by the literature.

To conclude, while the multidimensional inequality approach is more convenient than a unidimensional inequality approach due to the incorporation of the results of inequality in different dimensions into a single index, it also reveals considerable shortcomings (i.e. parameter choices, limited number of variables and a lack of between-dimension correlations). These deficiencies are likely to weaken the usefulness of current measurements. The need for a better approach to measure inequality leads to the discussion of an alternative method: the wellbeing index. This is the central focus of the following subsection.
Table 4.1: Summary of current applications of the Maasoumi and AKS methods

<table>
<thead>
<tr>
<th>Study</th>
<th>Measurements</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lugo (2007)</strong></td>
<td>Maasoumi index, AKS approach</td>
<td>● Argentine data shows unclear changes in inequality.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Choices of social inequality aversion and dimension substitution degree affect the results.</td>
</tr>
<tr>
<td><strong>Decancq et al. (2009)</strong></td>
<td>Atkinson approach, Maasoumi’s two-stage procedure</td>
<td>● Global overall inequality fell steadily from 1975 to 2000.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● The extreme weight schemes produced a reverse trend in wellbeing.</td>
</tr>
<tr>
<td><strong>Nilsson (2010)</strong></td>
<td>Maasoumi’s approach, Non-aggregative method</td>
<td>● Major choices of substitution parameters lead to an inequality increase in Zambia.</td>
</tr>
<tr>
<td><strong>Aristei and Perugini (2010)</strong></td>
<td>AKS with inequality aversion ((E)) country specification technique</td>
<td>● Uniform (E) resulted in very misleading outcomes of inequality levels in Europe.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A flexible tool for societal preference of (E) value is suggested.</td>
</tr>
<tr>
<td><strong>Aristei and Bracalente (2011)</strong></td>
<td>Tsui indices</td>
<td>● Italian inequality fell because decreases in income and health inequalities cancelled out increases in education dispersion.</td>
</tr>
<tr>
<td><strong>Justino (2012)</strong></td>
<td>Maasoumi index, Stochastic dominance</td>
<td>Vietnamese overall inequality decreased with (\alpha = 0), but other choices of (\alpha) may not support this result.</td>
</tr>
<tr>
<td><strong>Angelini and Michelangeli (2012)</strong></td>
<td>AKS index</td>
<td>● Inequality changed negligibly between EU members although within-country inequality showed some divergences.</td>
</tr>
<tr>
<td><strong>Decancq and Lugo (2012a)</strong></td>
<td>AKS index, Tsui’s indices</td>
<td>● Confusing overall trend in inequality in Russia due to contrasting changes between and within dimensions.</td>
</tr>
</tbody>
</table>
4.4.2 Measurement of relative inequality

4.4.2.1 Capability approach and the possible dimensions for the measurement of multidimensional wellbeing

Applications of the capability approach as a foundation for inequality analysis is emerging currently. The reason for this is that Sen’s capability theory considering plausible dimensions of the human wellbeing in non-subjective dimensions can result in consistent interpersonal comparisons. Crow et al. (2009) confirm that Sen’s capability theory explaining the relationships between a series of pivotal concepts (i.e. entitlements, capabilities, functionings and freedoms) transcends the traditional theory of inequality based on the utility concept. In particular, capability inequality focuses on capability deprivation and depends upon different physical and social conditions. It provides a privilege of interpersonal comparisons regarding not only the resource availability but also the range of options that creates conditions for individual wellbeing whereas analyses of inequality with income proxy could not demonstrate an insightful picture of multifaceted inequality (Abel and Frohlich 2012).

Despite several questions of the public deliberation process suggested by Sen (1985a), various empirical studies of wellbeing dimensions and indicators seem to be similar (Alkire 2002a, Stiglitz et al. 2009, OECD 2013). The primary operationalisation of the capability should encompass economic dimension (material consumption, housing quality), physical and mental wellbeing (health, employment and leisure) and social and natural environments (social interactions and the quality of the natural environment) (Decancq et al. 2015). However, the final choice of dimensions and variables depends on the specific analytical contexts. Perrons (2012) considers four dimensions: health, knowledge, income and employment. Peruzzi (2014) further adds the political engagement dimension for a discussion on social exclusion whereas Rippin (2016) examine multiple poverty in six dimensions: education, health, employment, housing, individual mobility, income to measuring multiple poverty. More details of variables choices can be found in Burchardt and Vizard (2011) who suggest a list of ten domains for a measurement of multidimensional inequality: life, physical security, health,
education and learning, standard of living, productive and valued activities, participation, influence and voice, individual, family and social life, identity, expression and self-respect and legal security.

The literature on the operationalisation of the capability theory also shows different proxies for variables of wellbeing because of data availability. The health dimension, for example, is proxied by the mortality rate (Perrons 2012), individual health problems self-assessment (Peruzzi 2014, Rippin 2016), or both physical and mental health (Robeyns 2003, OECD 2013). Different choice of dimensions and variables are acceptable given that they follow several criteria. First, a chosen variable must reflect the human wellbeing in particular dimension. Second, it should be clear; people from various geographical contexts interpret it in the same way. Third, it could be critical and complete; a variable could represent any human value irrespective of dissimilar backgrounds across communities. Finally, it is independent from ‘personal view’ such as virtue or individual qualities (Alkire 2002a).

4.4.2.2 Wealth/asset indices and their use in measurements of inequality

The idea of using a wealth index for measurement of inequality can be traced back to Sen (1985a) which reflects household capabilities and freedom to do and to be. Despite using consumption expenditure (or income) data as proxies for household welfare, the drawbacks of an expenditure-based index are recognised (e.g. UNDP 1990, p.10, Sen 1997b, Rutstein and Johnson 2004, pp.2-3). Sen claims that the income indicator must be replaced when analysing inequality because it, inter alia, is just a means to many ends, even within the economic space.

Income’s importance lies in the fact that it helps the person to do things that she values doing and to achieve states of being that she has reasons to desire. The worth of incomes cannot stand separated from these deeper concerns, and a society that respects individual well-being and freedom must take note of these concerns in making interpersonal comparisons as well as social evaluation (Sen 1997b, p.385).

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20 Wealth and asset indices are assumed to be identical as they aim to reflect wellbeing. However, the wellbeing index in this present thesis should not be interpreted as having the same meaning as a wealth or asset index. This study extends the term by using indicators for educational and health dimensions in addition to asset indicators.
Moser (2008) confirms that assets are vital because not only are they used as means of livelihood but also they enhance the asset owners’ capability to be and act. Ward (2014) suggests that household assets indicate household capability or freedom, so an asset index could be a holistic proxy for wellbeing. An asset index would be a more accurate proxy for wellbeing as it reflects major facets of wellbeing which cannot be indicated by income or expenditure. More importantly, parameter choices in asset indices are automatic; therefore, it computes complete and unique results for inequality. An asset index provides a better method to draw a precise picture of inequality, especially when examined as a multidimensional factor.

While an asset index could be applied as a measurement of inequality, it is necessary to confirm its reliability and validity compared with the competing method of using income data. In fact, a direct comparison of the results of different measurements of inequality is not feasible because there is no unified robustness check for such a comparison. However, asset indices and expenditure data\(^{21}\) can be evaluated based on their ranking of household wellbeing status. Expenditure data are chosen as these are widely used for research in inequality. Sahn and Stifel (2003) show that an asset index performs as well as or better than expenditure data, irrespective of geographical contexts. Their findings are identical to other studies that use asset indices for estimates of inequality. For instance, using a bootstrap prediction method to appraise the merit of an asset index, McKenzie (2005) finds that this index is at least as credible as, or even more appropriate than, the predicted consumption expenditure for an inequality analysis. Using the Monte Carlo simulation also proves that a polychoric PCA-based asset index is of adequate quality for an analysis of inequality (Kolenikov and Angeles 2009). Ward (2014) uses the Spearman rank correlation method to additionally highlight that an asset index can reflect more dimensions of wellbeing than income even though both approaches reflected a similar upward trend in the wealth of Chinese households over time. Before that, application of Spearman rank correlation also

\(^{21}\) Expenditure data are not recognised as a ‘correct’ proxy for household wellbeing. Rather, this data type is simply one of several proxies for household welfare.
revealed the validity of asset-based measurements of inequality (Filmer and Pritchett 2001).

An asset index can be computed by PCA, factor analysis (FA) or multiple correspondent analysis (MCA). Although Booysen et al. (2008) claim that MCA and FA are more effective than PCA when handling categorical data, these methods are unlikely to produce different variable weights (Harttgen et al. 2013). Kolenikov and Angeles (2004) develop polychoric PCA to improve the effectiveness of PCA by the application of polychoric correlation across variables. This methodological improvement allows research to assign different weights for continuous and non-continuous (e.g. ordinal and cardinal) variables. Thus, polychoric PCA is currently the optimal construction for an asset index handling various types of variables.

The computation of inequality is undertaken by using the first component of the polychoric PCA. The first component of PCA captures the greatest amount of information on all original variables through a latent factor (component). It records optimal discrimination across households; therefore, it reflects inequality associated with the household wellbeing ranking (McKenzie 2005). Likewise, Kolenikov and Angeles (2009) argue that the first component is likely to compute the ‘size’ of wellbeing inequality whereas other principal components then reflect the ‘structure’ of inequality. The nature of measuring inequality using an asset index is similar to an application of the Lorenz curve to discrete data because the partial variance held by the first component is compared to the total variance in the original variables (Ward 2014). Chinese household data supported Kuznets’ inverted-U curve using this new measurement of inequality. This tendency in asset inequality is consistent with the wealth ‘parade’ diagram which states that an increasing fraction of the total wealth is shared by the lower income strata. Therefore, measurement of inequality using an asset index is preferable.

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22 The ‘parade’ diagram is created for observation of changes in income distribution over time. This idea is proposed by Jan Pen (1971, cited in Ward 2014).
Sub-indicator choices for asset indices are still not universally agreed although the advantages for measurement of inequality are verified. While Filmer and Pritchett (2001) and McKenzie (2005) use variables mainly regarding household characteristics, utilities and asset ownership, Ward (2014) treats all variables as forms of capital and this includes all kinds of household means of production and consumption in addition to durable goods. Haq and Zia (2013) claim that variables of educational attainments (adult literacy, net enrolment at primary level) and health status (child mortality, women’s delivery service participation), must be incorporated in the index as well as the economic dimension. Differences in variable choice are also found in other studies of poverty using asset indices. Sahn and Stifel (2003) and Hartgen et al. (2013) add human capital (years of schooling) to durable appliances and housing quality in their index whereas Booysen et al. (2008), and Ucar (2015) use an index without any human capital variables.

The variety of variable choices for the asset index could be due to the lack of a unified definition of wellbeing or to data restrictions. Researchers who proxy solely based on housing and durable asset variables for household wellbeing infer economic wellbeing (e.g. Ucar 2015) while the others (e.g. Haq and Zia (2013) interpret wellbeing as a concept which covers most dimensions of human life. There is an exclusive analysis that categorises asset indices into eight subgroups (housing, consumer durables, labour security, productive durables, transfer income, household and social capital (such as joint household leaders) and social group participation) (Moser and Felton 2007).

There is a consensus on the extent to which the inequality index is attributed to various indicators. One of the advantages of PCA for estimating asset indices is that this method can allocate different weights to variables recognising their contributions to the total variance in original variables. Filmer and Pritchett (2001) established scoring factors associated with the first component that can serve as weights of variables. Likewise, these scoring factors can express the way PCA assigns the contribution of an asset to wellbeing. That means the index can be used to classify a population into different subgroups based on wellbeing rankings. Furthermore, PCA could also automatically weight variables proportionately with respect to asset distribution for a given
population. This point is important in the theme of inequality analysis. For instance, if a motorcycle, considered as a valuable asset, is possessed by a small number of households, the weight of this variable should be relatively high in PCA so its contribution to household wellbeing ranking is positively significant. Thus, using an asset index can overcome the disadvantages of competing conventional measurements.

Kolenikov and Angeles (2004) argue that an asset index which is measured by regular PCA could be biased as it neither retains the rankings of ordinal variables nor considers the nature of cardinal variables. A solution to those problems is to use polychoric PCA which works well with a combination of continuous and discrete variables. This technical improvement provides more efficiency in determinants of variable contribution to total inequality estimated. Moser and Felton (2007) state that if an asset is more meaningful in terms of reflection of household wellbeing, its corresponding factor loading should be relatively high. Evidence from Ecuadorian data showed that the factor loading for owning a black and white television was about 0.6 in 1978 but this turned to -0.03 in 1992 and -0.3 in 2004. This indicator was a symbol of prosperity in the 1970s, but of poverty in the 1990s. In general, an asset index using polychoric PCA can describe inequality more specifically since categorical data can be handled.

Apart from the Maasoumi and AKS approaches, there are still very few studies of inequality using an asset index. Asset indices outperform computations of household wellbeing using a strictly monetary proxy. The drawbacks of the income proxy, similar to individual utility, for interpersonal comparison is not only the estimation problem but also the likelihood of creating misleading interpretations of results (Sen 1997b). Thus, the application of an asset index for inequality calculation can reduce the probability of being misled in an inequality analysis.

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23 Another example of an explanation for variable contributions to an asset index can be found in Sahn and Stifel (2003).
4.4.2.3 Assessments

Although measurement of multidimensional inequality using an asset index is still at an early development stage, it is probably the preferred approach because it substantially reflects the major dimensions of wellbeing. It also bridges the gaps of variable weighting and of the degree of substitutability between dimensions. Additionally, it does not have the requirement for inequality aversion choice as needed in other measurements. For instance, Haq and Zia (2013) use 21 variables to measure inequality in wellbeing across a number of Pakistani districts; Moser and Felton (2007) and Ward (2014) apply PCA to create estimates of inequality in wellbeing with over 30 indicators. In contrast, multidimensional inequality using either the Maasoumi or AKS approach have a limit of four variables in their measurements. A larger number of variables does not entirely guarantee the reliability of measurement. However, it is vital to use plausible variables for the analysis of dispersion in wellbeing, given the deficiencies of a one-variable proxy for a related dimension have been evidenced. Furthermore, the problem of variable weighting, which is currently not resolved in measurements of multidimensional inequality such as the Maasoumi and AKS methods, is overcome by using an asset index; thus, it is superior to other current methods in terms of variable extensions and weighting techniques.

However, there are some issues with an analysis of inequality using a PCA-based approach. One problem is that regular PCA is only constructed by the first component which cannot control all the information on original variables. The development of PCA with polychoric correlation is likely to substantially increase the proportion of variance held by the first component. Current literature proves that the first component accounts for approximately half the total variance. In PCA, a large number of variables could result in a smaller percent of partial variance being captured by the first component. Plus the combination of several principal components could lead to misleading results because the different components capture structural information differently. Perhaps research in inequality using a PCA-based index needs reliable robustness checks to validate the chosen measurements.
The cut-off number of variables that can be used in an asset index has not been finalised although some variables could lead to more comprehensive outcomes as the index can cover more aspects of wellbeing (Rutstein and Johnson 2004). The literature on asset indices shows a large variety of chosen variables ranging from 10 to over 30 without yet providing a serious theoretical guideline. This variety of variable choice also is partially subject to dissimilarities in the definition of asset indices and perspectives of inequality analysis (i.e. economic, multidimensional) pursued in particular cases. Thus, discussion about variable choices is a vital step in drawing a clearer picture of inequality.

Finally, research in inequality by applying an asset index dwells on the first component of PCA. One reason for this is that a comparison between partial and total variances is sufficient for a calculation of inequality. Another reason is the methodological difficulty of PCA when applied to inequality analysis (Ward 2014). The current literature on PCA does not give any interpretations beyond the first component. While the second component is suggested as a description of the ‘structure’ of inequality (e.g. an urban-rural dimension) (Kolenikov and Angeles 2009), more evidence and analyses of this suggestion are required.
### Table 4.2: Summary of the literature on the asset index

<table>
<thead>
<tr>
<th>Study</th>
<th>Methodology</th>
<th>Gaps</th>
</tr>
</thead>
</table>
| Filmer and Pritchett (2001) | Standard PCA, OLS, Pseudo-IV (using the asset index as an IV) | - Robustness checks of the asset index through classifying the population into three subgroups (lowest 40%, middle 40% and top 20%) are quite *ad hoc* as realised by the paper.  
  - An equation for an inequality index is still not defined even though the analysis implies a novel approach to inequality. |
| McKenzie (2005)         | Standard PCA, OLS-based bootstrap prediction method | - The first component of PCA retained information on original variables with a small proportion, thus the measurement of inequality did not cover all aspects of household wellbeing. |
| Moser and Felton (2007) | Polychoric PCA                                    | - Variables of social capital are debatable due to different geographic contexts. Variables like ‘hidden’ female-headed households or joint household leaders could be data not widely available.  
  - The calculation of overall inequality built on the different outcomes of the components of the asset index was not finalised. |
| Kolenikov and Angeles (2009) | Polychoric PCA                                      | - A discussion of variable choices and the effects of various variables on the results are ignored. |
  - The explanation of inequality seems weak as it lacks analytical evidence. |
| Ward (2014)             | Polychoric PCA                                    | - The fall in the inequality level explained by reduced urban-rural gaps could be weak as within-inequality in rural and urban areas could compensate for the between-inequality. |
4.5 Research gaps and conclusion

4.5.1 Current research gaps

The first gap is around variable choices. Measurements of multidimensional inequality which use expenditure could provide nonrepresentative results. Using expenditure data can lead to biased estimates of inequality when consumption by poorer and richer households is close in terms of selection of goods and services (especially in the same region/country). Furthermore, inequality in expenditure can be substantially different to inequality in income; thus, calculations of inequality using expenditure or income are ambiguous. Vietnam is an example of confusing inequality corresponding to the use of income and expenditure data being used. While the Gini coefficient of expenditure was 35 in 2008, that turned to 44 when using income data (Zhuang et al. 2014, p.22). This difference is unlikely to be resolved by the Maasoumi or AKS indices as these approaches continue to use expenditure as a proxy for the economic dimension.

Using an asset index applying PCA with numerous asset indicators could adequately identify differences in wellbeing. This approach has an advantage as it considers numerous variables to reflect many aspects of wellbeing. Yet, there are still diverse qualities of the same asset and their values vary considerably. For instance, the value of a car may range from several thousand to over one hundred thousand US$ depending on brands, quality and facilities. Intuitively, a rich family usually owns more valuable things than a poor one, but this difference is not taken into account in an asset index. As a result, the PCA method could draw biased outcomes (Harttgen et al. 2013 p.S41). However, this evidence is based on standard PCA which is believed to be ineffective when using discrete data (Kolenikov and Angeles 2004, p.1). Modified PCA – polychoric PCA – could improve PCA performance with non-continuous variables; thus, it may minimise possible biases.

Another gap is that current literature on inequality does not pay sufficient attention to the difference between income and wealth inequality when considering the economic dimension and the extent to which this difference impacts on the overall inequality level. Choosing yearly income as a proxy for the economic dimension can cause a
seasonal effect, especially in an economic downturn when many social strata could be negatively influenced (e.g. wage-earners being made redundant), or there could be an under-reporting problem (Rutstein and Johnson 2004, Ucar 2015). Wealth reflects the accumulation of income on a long-term basis; thus, inequality in wealth does truly represent inequality in the economic dimension. The shortcomings of using income are not considered in either the Maasoumi or AKS methods whereas using an asset-based approach could resolve this problem by using a broad number of household assets.

Furthermore, setting weights for variables is another potential gap in current research when applying the Maasoumi or AKS indices. For simplicity purposes, such studies often choose an equal weight for all dimensions. However, because the scales differ widely across dimensions, uneven weighting can occur in particular analyses. As economic wellbeing strongly influences other aspects of wellbeing, it can contribute more to the overall inequality level. Therefore, an advantage of PCA is the ability to assign variable weights based on their contribution to wellbeing (which should be appraised). Moser and Felton (2007, p.4) stress that if ‘ownership of one type of asset is highly indicative of ownership of other assets, then it receives a positive coefficient’ (or weight). That means PCA could fill this gap by allocating weights for variables according to their importance in the estimation of inequality.

The measurement of inequality using an asset index, however, still has a debate about variable choices. Variable selection differs among studies mainly for two reasons. First, there is still no final definition of an asset index. On one hand, the literature uses an asset index as a proxy for the economic dimension and makes comparisons of reliability between the expenditure variable and the asset index. On the other hand, some studies interpret an asset index with a broader context on the assumption that it can represent wellbeing. Although the different definitions are not necessarily wrong, it is vital to focus on the concepts of an asset index which is used for economic and multidimensional inequality. An asset index representing the economic dimension could be extended to multidimensional inequality.
Second, data availability could also affect variable choices. Although the asset index uses data mainly from demographic and health censuses or household surveys, these do not have entirely identical structures among countries and within countries over time. To overcome this challenge, the variables of an asset index should be firstly divided in subgroups as seen in Ward (2014). These subgroups should then allow for flexible variable options that will not affect the meaning of the index. However, this point has still not been discussed at present; thus, this thesis will attempt to make a clarification to fill this gap.

4.5.2 Chapter conclusion

The chapter has firstly surveyed the literature on economic inequality. The majority of methods of measuring inequality, including the Gini coefficient, the Lorenz curve, the Theil indices and Atkinson’s approach, have been discussed. Among them, the most common choice is the Gini coefficient as the method is obviously simple and stringent in terms of computation of inequality. Theil’s approach is a well-used measurement of inequality due to its decomposition function and Atkinson’s modelling is useful for evaluating social loss due to inequality. Numerous applications of these estimates to different geographical contexts have provided such varied stories of inequality that it is difficult to consolidate an inequality trajectory, even for those studies using the same datasets.

Multidimensional inequality, which takes into consideration primary dimensions of wellbeing (i.e. economics, education, health) simultaneously, is the central focus of this chapter. Compared to unidimensional inequality, multidimensional inequality literature is at a premature stage and has a great deal of room for further development. The majority of empirical analyses apply Maasoumi’s two-step approach and/or the AKS approach although research using asset indices is increasing. Maasoumi’s two-step process and the AKS measurement require the use of ‘common sense’ for choices of parameters. Additionally, they also suffer from the difficulty of dealing with increasing variable proxies which can influence measurement effectiveness by using additional dimensions of wellbeing. To resolve this weakness, the application of a PCA approach is a promising alternative method as it can compute inequality with numerous variables. Thus, a comparison between
Maasoumi, the AKS approach and using a PCA-based index is necessary to examine ways to interpret inequality.

The remaining gaps in the literature on inequality have been highlighted. First, variable choices need to be re-considered because of the high probability of differences between income and wealth which could impact considerably on the calculation of multidimensional inequality. Second, further discussion of parameter values and weight of attributes is needed as researchers who apply Maasoumi or AKS estimation have little choice other than to choose parameters based on their own ‘common sense’. As a result, normative approaches have been used to make a series of outcomes which lead to uncertain conclusions about overall inequality. Third, plausible variables could help develop a measurement to cover more aspects of wellbeing, but the Maasoumi and AKS approaches are limited to three or four variables. This could be resolved by using a PCA-based wellbeing index as this approach can handle a larger number of variables. This index also outperforms others with respect to variable weighting. More importantly, the possible biases, which are warned of in Harttgen et al. (2013, p.1), can be minimised by the incorporation of polychoric correlation in PCA when generating the modified index.
5 METHODOLOGY

5.1 Introduction

The methodology chapter is designed for two main tasks. First, it develops methodologies which will be applied to an analysis of inequality using Vietnamese data. In Chapter 2, Sen’s capability approach was chosen as a theoretical framework which leads to several differences in specific applications to a particular case; this current chapter continues to seek a superior method for a measurement of inequality. To do so, an assessment of current methods derived from Sen’s capability illustrates shortcomings which are also found in the Literature Review. These are plausible (and contrary) results on the level of multidimensional inequality even with the same measurement regarding different choices of cross-dimension substitution ratios, and inequality aversion parameters. More importantly, there is insufficient evidence of the extent to which the substitution and inequality aversion parameters are decided. These deficiencies are due to incompatible methods within Sen’s capability approach where the choices of indicators and relevant parameters could be open for public debates. In addition, numerous results in social policy making regarding the inequality level could raise confusion with policymakers. Thus, the methodology chapter concentrates on the PCA-based measurement of inequality which overcomes the listed shortcomings of other methods.

Second, as the current thesis aims not only to achieve a more appropriate measurement of inequality but also to assess determinants of inequality, the methodology chapter constructs an econometric model that investigates the causal relationship between anti-poverty and anti-inequality public policies and inequality. A preliminary diagnosis of the Vietnamese data shows that a dynamic panel model seems to be an advantageous one because most of the relevant indicators such as inequality, poverty, and public policies are dynamic in their nature. Additionally, the dynamic endogeneity violates the assumptions of exogeneity in traditional econometric models. A development of the Arellano-Bond panel data model is the most important focus of this task.

The remaining parts of the chapter follow the structure: Part 1 including Section 1 and 2 discusses the measurement of inequality. Section 1 assesses the existing measurements
of multidimensional inequality and points out their shortfalls. Section 2 introduces the PCA and discuss the extent to which the PCA-based measurement of inequality is superior to current other methods. Part 2 is dedicated to the Arellano-Bond method of dynamic panel data model.
Part 1: Measurements of inequality

5.2 Current measurements of multidimensional inequality and their shortcomings

5.2.1 A review of current measurements

A consensus is that the economic dimension is one of integral parts of human wellbeing but it is inadequate, *per se*, for a description of the wellbeing level. Therefore, research in inequality should seek new methods to provide the whole picture of the wellbeing inequality (see Kolm 1977, Sen 1985a, Maasoumi 1986, Quadrado *et al.* 2001, Gajdos and Weymark 2005, Justino 2012, Weymark 2013).

There are three types of normative analysis of multidimensional inequality: Maasoumi’s two-stage approach, AKS index, and multivariate Lorenz majorisation. These approaches however are influenced by Kolm’s (1977) analysis of the multidimensional egalitarianisms which indicates a social preference to a higher level of equality. He originally illustrated a series of fundamental theorems derived from the social welfare functions’ properties and the corresponding ordering of distributions. Then this normative approach is developed by Maasoumi (1986, 1989), Weymark (1981), Tsui (1995), Gajdos and Weymark (2005), Decancq and Lugo (2012a), Weymark (2013). Using the SWFs, they develop different multidimensional inequality indices. While Maasoumi uses the Theil-T index to measure the multidimensional inequality, the others modify the Atkinson index for an estimation of multiple inequalities. Another significant contribution to inequality studies are from Koshevoy (1995, 1998), Koshevoy and Mosler (1996, 1997) who illustrate the ‘convex analysis’ technique to measure inequality. However, since the date of their illustration, the convex analysis approach lacks empirical applications due to its theoretical complexity. In general, literature of multidimensional inequality concentrates on: (i) applied forms of the SWFs, (ii) the weight of attributes to a total inequality level, (iii) the substitute degree between examined dimensions of wellbeing, and (iv) the inequality elasticity to the welfare transfer across population subdivisions (Justino 2012). Before further discussion of these measurements, a series of desirable properties is essentially introduced.
Let $x, y$ are attributes to the wellbeing, $W(x)$ and $W(y)$ are welfare functions, $I(x)$ is the inequality function of $x$. $X = (x_{ij})_{n \times m}$, $Y = (y_{ij})_{n \times m}$ are distribution matrices of outcomes of $m$ dimensions for $n$ individuals.

**Monotonicity (MON):** $\forall x, y \in R^{++}, W(y) > W(x)$ if $y > x$.

**Continuity (CONT):** $W(x)$ is continuous on $R^{++}$.

**Anonymity (ANON):** For any $n \times n$ permutation matrix $B$, $I(X) = I(BX)$.

**Normalisation (NORM):** If any row of $X$ has the same value, $I(X) = 0$.

**Pigou-Dalton transfer and Uniform Pigou–Dalton Majorisation (UPD):** The Pigou-Dalton transfer shows that a transfer from a richer to a poorer person reduces the inequality. If the distribution $Y$ is (is not a permutation of $X$) derived from the distribution $X$ by the Pigou-Dalton transfer, $Y$ is called the Pigou-Dalton majorisation of $X$. Therefore, UPD implies that $I(Y) \leq I(X)$ where $Y = TX$ and $T$ is a transformation matrix; $T = \lambda I + (1 - \lambda)B$ (Lugo 2007, Weymark 2013).

**Uniform Majorisation (UM):** If $Y = BX$ where $B$ is a bistochastic matrix, not a permutation matrix, then $I(Y) \leq I(X)$. Note that $B$ matrix contains the transformation matrix $T$ so that UPD is included in UM.

**Maasoumi’s two - stage approach**

With respect to the generalised entropy (GE) method suggested by Theil (1967), Maasoumi (1986) computes the relative inequality and makes a decomposition of inequality which separates the ‘between’ and ‘within’ unequal distribution groups. In his seminal paper, Maasoumi considers the individual utility functions which aggregate attributes to personal wellbeing. This technique facilitates the multivariate inequality calculation based on its comparable functional forms. The variance in a distribution across individuals is apparently treated as inequality.
The Maasoumi’s method, known as a two-step approach, is advantageous in terms of an aggregation of dimensional contributors to the total inequality degree. In the first stage, the information theory is applied for a calculation of ‘ideal’ formulae:

\[ S_i \propto \left( \sum_{f=1}^{M} \delta_f X_{if}^\beta \right)^{1/\beta} \]  

(5.2.1)

In the equation (5.2.1), individual wellbeing \( (S_i) \) is a weighted geometric mean of different considered achievements \( (X_{if}) \). The sum of all dimensional weights \( (\delta_f) \) is assumed to be unity \( (\sum_{f=1}^{M} \delta_f = 1, where M is a number of dimensions) \). The weights indicate the extent to which the dimensions can be attributed to the individual wellbeing. The parameter \( \beta \) shows a degree of attribute complementarity. The greater the \( \beta \), the greater the substitutability between dimensions will be. That means under the condition of constant elasticity of substitution (CES), an individual sacrifices more of an attribute to obtain a unit of another attribute (Aristei and Bracalente 2011).

After an identification of the wellbeing composite indicator, the multidimensional inequality can be estimated following the Theil’ GE method:

\[ M_\alpha(S) = \frac{\sum_i^n p_i \left[ \left( \frac{S_i^*}{p_i} \right)^{1+\alpha} - 1 \right]}{\alpha(1 + \alpha)}, \alpha \neq 0, -1 \]  

(5.2.2)

where:

\( \alpha \) is the inequality aversion degree;

\( p_i \) is a population subgroup \( i^th \); and

\( S_i^* \) is the ratio of an individual welfare to the sum of all individual’s wellbeing; thus \( S_i^* = \frac{S_i}{\sum_j^n S_j} \).

A confusion of this technique is about the satisfaction of two distribution properties (UPD, and UM). More specifically, the Maasoumi’s index does not always follow UM. This violation is rooted from the method of normalisation of individual’s wellbeing by

The multidimensional Atkinson–Kolm–Sen or Gini indices

The indices are proposed by Weymark (1981) and developed by Gajdos and Weymark (2005), Decancq and Lugo (2012a), and Weymark (2013). The calculation of multidimensional generalised Ginis is derived from the SWF. Let $X = (x_{ij})_{n \times m}$ be a distributional matrix of outcomes of $m$ dimensions for $n$ individuals. The entity $x_{ij}$ denotes the outcome of dimension $i$ for individual $j$. Each row of the matrix reflects the situation of wellbeing for each person, and each column describes the various outcomes in one dimension across individuals. Two possible aggregations of social welfare are demonstrated through two reverse steps. In the column-first method, the welfare of each dimension across individuals is calculated as a single $m$-dimensional vector ($W_m$). The second stage is an aggregation of the welfare across dimensions ($W_{m \times n}$). However, Decancq and Lugo (2012a) claim that this procedure is ‘insensitive to the correlation between dimensions’, so that it is inaccurate in the multidimensional welfare quantification context. Thus, they prefer the second way – the row-first approach – of welfare examination which evaluates the individual welfare across dimensions ($W_n$) before a calculation of total welfare ($W_{n \times m}$) of a society.

$W_m$ is described as a CES function of aggregation across dimensions: $W_m(x) = \left( \sum_{j=1}^{m} w_j(x_j)^{\beta} \right)^{1/\beta}$, $\beta \neq 0, \in (-\infty, 1)$. The parameter $\beta$ implies a substitute ratio between dimensions. If $\beta = -\infty$, welfare dimensions are completely complemented. Conversely, when $\beta = 1$, there is a perfect substitution between these dimensions. Then, $W_n(x) = \sum_{i=1}^{n} \left[ \frac{r_i}{n} \delta - \frac{(r_i-1)}{n} \right] x_i$, where $\delta$ is a positive scalar, $r_i$ which is decreasing ordered indication of individual $i$’s position based on the level of $x$. As a result, the aggregation of row-first social welfare is as follows:
\[ W_{n \ast m}(x) = \sum_{i=1}^{n} \left[ \left( \frac{r_i}{n} \right)^{\delta} - \left( \frac{r_i - 1}{n} \right)^{\delta} \right] \left( \sum_{j=1}^{m} w_j(x_j)^{\beta} \right)^{1/\beta} \quad (5.2.3) \]

By generalising the univariate AKS inequality index for a multidimensional measurement which resolves the matrix equation: \( W_{n \ast m}(1-I(X))X_{\mu} = W_{n \ast m}(x) \), the result is:

\[ I(X) = 1 - \frac{\sum_{i=1}^{n} \left[ (r_i/n)^{\delta} - (r_i - 1/n)^{\delta} \right] \left( \sum_{j=1}^{m} w_j(x_j)^{\beta} \right)^{1/\beta}}{\left( \sum_{j=1}^{m} w_j(\mu(x_j))^{\beta} \right)^{1/\beta}} \quad (5.2.4) \]

This \( I(X) \) is called S-Gini multidimensional relative inequality index.

Gajdos and Weymark (2005) and Weymark (2013) suggests another estimation – so-called the absolute inequality index:

\[ I(X) = \frac{1}{\beta} \ln \left[ \frac{\sum_{j=1}^{m} w_j \exp(\beta \mu(x_j))}{\sum_{i=1}^{n} w_i \exp(\beta \sum_{j=1}^{m} a_{ij} \tilde{x}_{ij})} \right] \quad (5.2.5) \]

, where \( \tilde{x}_{ij} \) is a permutation of \( x \).

An important assumption of the SWF approach is that there is no correlation between dimensions. However, Atkinson and Bourguinon (1982) explore plausible correlation between them, which impact on the total inequality remarkably. This measurement approach thus may lead to misleading results unless it considers the correlation effects.

**The multivariate Lorenz majorisation**

An application of the multivariate generalisation of Lorenz curve for the multidimensional inequality research, namely Lorenz zonotope, is originally developed by Koshevoi and Mosler. Koshevoi (1995) applies the Lorenz zonotope for a definition of the majorisation and an examination of its properties. Let \( A = a_i^j \in \mathbb{R}_+^{m \ast n} \) be a matrix
of $n$ participants and $m$ attributes of wellbeing. The motivation of that paper is from a comparison of dispersion between two distributional matrices. If $A$, $B$ are two matrices, ‘which one contains the lower level of disparity?’ The author seeks a solution to his own question by firstly constructing a convex polyhedron in $\mathbb{R}_+^m$ that places the Lorenz curve in the $(m+1)$ dimensional spaces. For two matrices $A$, $B$, the Lorenz zonotope of them are $LZ(A)$ and $LZ(B)$ respectively. Then ‘$B$ is said to be Lorenz majorised by $A$ ($B \leq_{L} A$) if $LZ(A) \subseteq LZ(B)$’. However, this definition is not valid for any submatrix of $A$ and $B$; thus, the Lorenz and the uniform of majorisations are not the same.

The Lorenz zonotope and majorisation are further discussed in Koshevoy and Mosler (1996), and Koshevoy (1998). In the relation to an empirical analysis of multidimensional inequality, the Lorenz zonoids defined as a locus located between the dual multivariate Lorenz function and the figure of multivariate Lorenz is analysed. The Lorenz zonoids are also found to be equal to the directional majorisation which is called ‘price majorisation’ or ‘expenditure majorisation’ in the economic area (Koshevoy and Mosler 1996). Then, Koshevoy (1998) develop a geometric measurement of the multidimensional inequality. The Lorenz zonotope is defined as the region between the Lorenz curve and its dual. When the Lorenz zonotope is generalised for a probability distribution functions, the Lorenz zonoid is obtained. According to Salvalio (2013), this geometric approach is advantageous in the multidimensional inequality context as the finite number of dimensions can identify the majorisation matrices by using the notion of cone ordering. However, this method could not be generalised for a three- (and greater) dimension inequality.

5.2.2 Weaknesses of the measurements of inequality

The above normative measurement methods of multidimensional inequality reveal several problems when applying to a particular context. First, any research based on the Maasoumi’s two-stage approach, or/and AKS results to various outcomes which cannot be certainly finalised. These diverse results are due to different choices of parameters (e.g. attribute substitution, inequality aversion). Unfortunately, a universal standard of parameter choice is not feasible at present, which leads to a confusing insight into a reality of an actual inequality level. Second, the multivariate Lorenz majorisation
approach has not been helpful either to disentangle uncertain final results of an inequality degree measured or to achieve a successful application to an empirical analysis. The complicated and restricted opportunity of application prevents current economists from implementation of the multidimensional Lorenz majorisation as an alternative method of inequality measurement.

Third, an examination of a large number of variables is another issue of the normative approach. In the procedure of these measurements, a variable is used as a proxy for each dimension. This assumption is easily violated because one dimension may be characterised by a group of related indicators. As a result, the measurements based on this normative approach are probably biased as they could over- or under-estimate inequality. However, increase in an amount of variables over three is a dearth of this current normative model. This obstacle further lessens the appropriateness of the measurements.

5.3 Measuring inequality with the PCA-based method

5.3.1 A brief description of standard PCA

The standard PCA is initially a statistical method of variable reduction. This technique derives a few of newly orthogonal principal components from numerous original correlated variables with the optimal retention of variation in a data set. Retention of primary information is measured by percentages of variance which is kept by the derived set of variables, called principal components. These components are sorted based on their importance indicated by their proportion of a total variance in primary variables. In fact, the first component accounts for the largest percentage of variance and so on (Jolliffe 1986). This technique is very helpful when there are significant correlations among variables of a data set where other methods (e.g. least square regression) are inaccurate.

Given a data set with $m$ correlated variables describing wellbeing, PCA produces much fewer uncorrelated components as follows:
\[ z_1 = a_1' x_1 = a_{11} x_1 + a_{12} x_2 + \cdots + a_{1m} x_m = \sum_{i=1}^{m} a_{1i} x_i \]

\[ z_2 = a_{21} x_1 = a_{21} x_1 + a_{22} x_2 + \cdots + a_{2m} x_m = \sum_{i=1}^{m} a_{2i} x_i \]

\[ \ldots \]

\[ z_k = a_k' x_k = a_{1k} x_1 + a_{2k} x_2 + \cdots + a_{mk} x_m = \sum_{i=1}^{m} a_{ki} x_i \]

\[ \ldots \]

\[ z_p = a_p' x_p = a_{1p} x_1 + a_{2p} x_2 + \cdots + a_{mp} x_m = \sum_{i=1}^{m} a_{pi} x_i . \]

For a generalisation, given a derived component \( k^{th} (k = 1, 2, \ldots, p; p \ll m) \),

\[ z_k = a_k' x_k = \sum_{i=1}^{m} a_{ki} x_i \tag{5.3.1} \]

where \( a_k \) is eigenvector of \( x_k \) \((x_{1k}, x_{2k}, \ldots, x_{mk})\) regarding its greatest eigenvalue, \( \lambda_k \).

The variance of \( \sum_{i=1}^{m} a_{ki} x_i \) is \( \sum_{i=1}^{m} \sum_{j=1}^{m} a_i a_j \sigma_{ij} \) where \( \sigma_{ij} \) is the covariance between \( i^{th} \) and \( j^{th} \) variables. Using a matrix algebra, the variance of a linear composite can be found through finding eigenvectors of the matrix \( a_k' C a_k \) subject to the condition \( a_k' a_k = 1 \), where \( C \) is the covariance matrix (Vyas and Kumaranayake 2006).

Once \( a_k' a_k = 1 \), the variance of component \( k^{th} \) is equivalent to its corresponding largest eigenvalue, \( \text{var}(z_k) = \lambda_k \). (see Jolliffe 1986, p.1-5). In fact, among \( p \) components \((z_1, z_2, \ldots, z_p)\), it is expected that a vast majority of the total variance in original variables is explained by the first several components.

Besides the covariance matrix, PCA also uses the correlation matrix, namely \( R \), which is constructed using standardised variables. The technique using the correlation matrix is applied by McKenzie (2005) who alters original variables \( x_{ij} \) by \( \frac{x_{ij} - \bar{x}_{ij}}{s_{ij}} \) (\( \bar{x}_{ij}, s_{ij} \) are the mean and standard deviation of variable \( x_{ij} \) respectively) when modelling the relative economic inequality across Mexican households in 1998. Thus, PCA is a solution to the problem of multi-correlation by transforming from a large group of correlated variables.
to several uncorrelated principal components through using either the covariance or correlation matrix.

A major shortcoming of PCA is that this method gives greater weight to variables with larger variances. It is true that in many social sciences, including economics, choices of measurement units are quite *ad hoc*. Different measurement scales cause dissimilarities in variances and covariance of variables. Even when variables are measured with a unified unit, their variances may vary widely because of their relations to the means (Kaiser 1974, p.65). To minimise this drawback, research should use PCA with correlation matrix rather the covariance matrix (McKenzie 2005, Vyas and Kumaranayake 2006).

5.3.2 *The polychoric principal component analysis and the wellbeing index*

The standard PCA is originally constructed to handle continuous or normally distributed variables. An application of PCA to the discrete data (e.g. binary) may suffer from troubles. First, if research breaks a categorical variable into more than two dummies as found in Filmer and Pritchett (2001), PCA could create numerous spurious correlations. Second, a transformation from ordinal variables to dummies could not retain the ordinal feature of indicators so that the created dummies barely represent the original variables. More importantly, if categorical (i.e. ordinal) variables are treated as if they are continuous variables, a violation in the assumption of normally distributed variable in PCA is analogous to the case where discrete variables is used as independent variables in OLS estimator. A reason for this is that discrete variables do not have a density but high skewness and kurtosis (Kolenikov and Angeles 2004, 2009). These non-continuous variable features could devaluate the standard PCA. Thus, to work with discrete data that are commonly used in the socioeconomic research requires a modification of PCA.

Kolenikov and Angeles (2004, 2009) develop the *polychoric* PCA for non-continuous variables. While the standard PCA computes the eigenvalues and scoring factors

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24 Another extensional form of the PCA is the *polyserial* PCA when both continuous and non-continuous variables are added in the PCA. In the Stata module of polychoric PCA, Kolenikov
through a linear correlation technique, the polychoric PCA calculates them based on the non-linear – polychoric – correlation. Based on the Pearson and Pearson’s (1922) tetrachoric correlation which is defined as a bivariate normal correlation in a 2x2 cross-tabulation, Olsson (1979) elicits a generalisation of tetrachoric correlation and estimates this coefficient by the ‘two-step maximum likelihood’ technique. Kolenikov and Angeles (2004, 2009) present evidence that the polychoric PCA is superior to the naïve PCA since it minimises violation of normal distribution assumption when applied to discrete data. Because the polychoric PCA could assign various weights for different quantities and categories of indicators, it could describe more precisely the inequality level in wellbeing (Ward 2014); thus, it seems to be an advantageous methodology in the context of measurement of wellbeing inequality.

In the polychoric PCA, a coefficient of polychoric correlation is described in the following steps. First, two ordinal variables $x_i, x_j$ indicate asset ownership, educational outcomes, or health status. They are discretised in $d_k$ categories ($k = 1…m$), and $d_r$ categories ($r = 1…n$) respectively. Thus, the thresholds of $x_i, x_j$ are denoted as $\tau_i, \tau_j$ corresponding to $d_k, d_r$. It is also assumed that there are two latent continuous variables $x^*_i, x^*_j$ relating to $x_i, x_j$:

$$
x_i = k \ if \ f \ d_{k-1} < \tau_{ik} < d_k
$$

$$
x_j = r \ if \ f \ d_{r-1} < \tau_{jr} < d_r
$$

and $\tau_i, \tau_j$ strictly follow the order:

$$
-\infty = \tau_{i0} < \tau_{i1} < \tau_{i2} < \cdots < \tau_{i(k-1)} < \tau_{ik} = +\infty,
$$

$$
-\infty = \tau_{j0} < \tau_{j1} < \tau_{j2} < \cdots < \tau_{j(r-1)} < \tau_{jr} = +\infty.
$$

These assumptions result in a (n x m) cross-tabulation data. The statistical likelihood that an observation falls into cell (k r) is denoted as $a_{kr}$, and the frequency from the (n x m) table is $f_{kj}$. The likelihood for the sample is achieved:

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(2005) assumes that a variable with over ten categories is processed as a continuous variable. For the simplicity purpose, the thesis uses the term polychoric to refer the both two cases of PCA extension.
\[ L = a_{kr} f_{kr} \quad (5.3.2) \]

; hence,

\[ l = \ln(L) = \sum_{k=1}^{m} \sum_{r=1}^{n} f_{kr} \ln(a_{kr}) \quad (5.3.2') \]

and

\[ a_{kr} = \Phi(\tau_i, \tau_j) - \Phi(\tau_{i-1}, \tau_j) - \Phi(\tau_i, \tau_{j-1}) + \Phi(\tau_{i-1}, \tau_{j-1}) \quad (5.3.3) \]

, where \( \Phi \) is the joint cumulative distribution function with the unknown *polychoric* correlation coefficient \( \rho \).

Second, \( \rho \) is obtained by maximisation of \( l \) function with the thresholds \( \tau_i, \tau_j \) which are equal to the inverse cumulative distribution function of the observed proportion in unit \((k, r)\) in of the table (Olsson 1979):

\[ \tau_i = \Phi^{-1}(\hat{p}_i) \quad (5.3.4) \]

\[ \tau_j = \Phi^{-1}(\hat{p}_j) \quad (5.3.5) \]

Based on this theoretical framework, Ward (2014) resolves the factor loadings for variable \( x_i \) corresponding to the category \( d_k \):

\[ \beta_{i \mid d_k} = \frac{\left( e^{-\frac{\tau_{i-1}^2}{2}} - e^{-\frac{\tau_i^2}{2}} \right)}{\sqrt{2\pi}} \frac{\lambda_i}{\Phi(\tau_i) - \Phi(\tau_{i-1})} \]

or

\[ \beta_{i \mid d_k} = \frac{\left( e^{-\frac{\tau_{i-1}^2}{2}} - e^{-\frac{\tau_i^2}{2}} \right)}{\sqrt{2\pi} \Phi(\tau_i) - \Phi(\tau_{i-1})} \lambda_i \quad (5.3.6) \]

In equation (5.3.6), \( \beta_{i \mid d_k} \) is the factor loading of the polychoric PCA with \( x_i \) categorised in \( d_k \), \( \lambda_i \) is the first component of polychoric PCA assigned for \( x_i \). It is obvious that the
factor loadings vary across different categories (e.g. housing quality), quantities of a variable (e.g. one, or two motorbikes). This desired characteristic enables a research to estimate inequality in wellbeing across a population with different quantities of asset ownerships, various levels of education achievements, and wide range of health status.

Finally, the wellbeing index is derived as follows:

$$W_h = \sum_{i=1}^{X} \sum_{d_{k(j=0)}}^{d_{kn}} \beta_{i \mid d_{kj}} \cdot y(x_i \mid d_{kj})$$

(5.3.7)

where:

- $w_h$ is the level of wellbeing of household $h$;
- $X$ indicates variables representing household wellbeing;
- $d_{k1...kn}$ denotes $n$ categories of variable $x_i$; and
- $y(x_i \mid d_{kj})$ is the function of obtained indicator $x_i$ with specific $d_{kj}$.

In this equation, $\beta_{i \mid d_{kj}}$ could be interpreted as the weight of achievable position of $x_i$ associated with its particular class or quantity. In fact, $\beta_{i \mid d_{kj}}$ is monotonic within $k$ categories. For example, the wellbeing level of having two motorbikes is weighted greater than one motorbike. Thus, the welfare of a particular household depends on not only owning of $x_i$ but also the types or level of $x_i$.

The advantages of wellbeing index are that

- it is able to summarise a great deal of information in a single measure. In addition, an index circumvents some of measurement error, non-response and recall biases, as well as other problems commonly associated with using standard measures: because household survey questions on asset ownership or forms of capital generally take the form of discrete indicators, these data are generally believed to be more reliable (Ward 2014, p.4).

In short, the section has shown evidence of the polychoric PCA advancements when handling non-continuous variables. A serious drawback of using the regular PCA is that this technique is unlike to work well on such variables because it may generate spurious regressions. The polychoric PCA is evidenced to overcome such a shortcoming, so that its estimate of the wellbeing index could be more appropriate.
5.3.3 A measurement of inequality

With Equation (5.3.7), the wellbeing level for a particular household ($w_h$) could be calculated. However, for a measurement of inequality in household wellbeing, traditional methods such as the Gini coefficient, Atkinson, Theil indices are unable to be applicable because of the following two characteristics of wellbeing index with the weights generated by the PCA: $w_h$ could receive positive, negative, or zero value corresponding to the coefficient $\beta_{i \mid d_k}$, and zero-mean for the whole sample. In this circumstance, inequality could be measured by a difference between the variance in a particular subsample and in the whole sample:

$$I_t = \frac{\sigma_t}{\sqrt{\lambda}}$$

(5.3.8)

where $\sigma_t$ is the sample standard deviation of wellbeing level ($w_i$) across households at wave $t$, $\lambda$ is the first eigenvalue from the correlation matrix, and also interpreted as the variance of the first component across the whole population used for a computation of variable weights (McKenzie 2005, Ward 2014). An important standard of the PCA is that it maximises the variance in the data and records the maxima by the first eigenvalue – $\lambda$ corresponding to the first component; $\lambda$ thus informs both the largest eigenvalue derived from the correlation matrix and the difference in the fundamental wellbeing data. This method is called the ‘relative inequality’ because it calculates a comparative change in inequality across strata or a society for a period. That means the level of inequality is estimated by comparing the dispersion in wellbeing level across the population in a particular wave and the overall period.

McKenzie (2005) gives evidence that $I_t$ satisfies four desired properties as follows:

- Anonymity or scale invariance: $I_t$ is indifferent corresponding to rearrangements of the wellbeing indicators among households in the same community;
- Scale independence: $I_t$ does change if each of households’ wellbeing is multiplied by the same positive constants;
- Population independent: $I_t$ remains unchanged if the whole sample of population is replicated; and
• Pigou-Dalton transfer: a positive transfer from the better-off to the worse-off household in a community given that this transfer does not change these two households’ positions makes $I_t$ unchanged.

Equation 5.3.8 measures inequality over time by comparing the variance in wellbeing between a subgroup and the population at time $t$, and the inter-temporal variance of the whole sample. Ward (2014) argues that this approach is likely to be consistent with the Lorenz curve since it compares a partial variance with the total variance. A fixed total variance in a particular sample should be allocated for all particular waves. An extreme situation is that the variance of the whole sample over time gives only for a particular wave; that means, the relative inequality index in this year is equal to one, and other years are zero. By contrast, if the variance of the whole sample is evenly distributed over waves, the inequality index is invariant or inequality remains unchanged during an examined period.

In fact, an absolute inequality index is not obtained by the polychoric PCA, the value of index does not give any interpretation of inequality within this wave per se. Instead, it is totally meaningful when used for comparison purposes. For example, given a pooled data of two waves of the VHLSS, say 2002 and 2004, if inequality estimated for these two years are 0.4 and 0.5 respectively. It does not mean that inequality is quite high in both these two years. A feasible interpretation is that as the variance in wellbeing at the later wave is larger than in the previous wave, the inequality level seems to increase over 2002–2004. As the purpose of this chapter is to track changes in inequality over time, an unobtainable value of absolute inequality is not a necessary weakness of this measurement (McKenzie 2005).

An analogous comparison of inequality level within-group with a whole sample temporally could also be measured:

$$I_g = \frac{\sigma_g}{\sqrt{\lambda}}$$  \hspace{1cm} (5.3.8')

where $\sigma_g$ is the standard deviation of household wellbeing level in the subgroup $g$, $\lambda$ is also the largest eigenvalue in the correlation matrix in which the variable weights are
derived temporally (McKenzie 2005). For instance, concerning the extent to which the level of within-urban and within-rural Vietnam inequality change in 2002, a research could compare the standard deviation of the wellbeing across household within-urban with that of within-rural through their first (and also the largest) eigenvalues of the correlation matrix resulting from the polychoric PCA for the whole survey 2002.

An implementation of this measurement of inequality follows two steps:

At the first stage, a list of variables representing for multiple aspects of wellbeing is selected. Within the economic dimension, instead of income or expenditure, non-durable goods and fixed assets, and housing variables are chosen. This choice is also found in other studies which apply PCA for a measurement of economic inequality (e.g. McKenzie 2005, Haq and Zia 2013). It is believed that the economic wellbeing or living standard can be accurately reflected through an examination of household consumption diversification rather than only income or expenditure. As mentioned in the research context chapter, in Vietnam, income inequality has been rising and at the same expenditure inequality remained fairly constant during the study periods (1993–1998, 2002–2008). Choosing either income or expenditure could lead to disputable results. Therefore, a list of fixed assets and durable goods are utilised for an analysis of inequality. This choice of variables hopes to provide an improvement in a measurement of inequality.

Analogously, variables representing education and health dimension are carefully added in the model to observe changes in the multidimensional inequality. A technical difficulty in selection of these added variables is that the household survey provides limited indicators, apart from the economic dimension, which can be used for an analysis of multidimensional inequality. This current thesis tries to explore the extent to which inequality changes when variables proxied for different dimensions of household

25 This idea is found in a development of multidimensional poverty index (Alkire and Santos 2010). Before that, UNDP (1990) also clearly states a necessary consideration of a group of variables rather than just income when analysing human development. (UNDP 1990)
wellbeing are put all together in the model. Variable choices are therefore important and need to be checked before any finalised result.

Second, Equation 5.3.8 will be applied for an investigation of the trend in inequality over the 1990s and 2000s. Empirically, because the household survey is conducted biennially except the two waves in 1993 and 1998, the gap in inequality level between two waves in the 2000s could be expectedly smaller than in the period 1993–1998.

5.3.4 Tests of the polychoric PCA measurement of inequality

5.3.4.1 Internal method

The first test used as a robustness check for the goodness-of-fit is the Pearson’s chi-squared. Pearson’s (1900) chi-squared tests the null hypothesis \( H_0 \) that the deviation between the observed \( (O_i) \) probability and the expected \( (E_i) \) probability with the postulated frequency \( v_i \) of event \( i \) is negligible. Assume that \( n_i \), the amount cases of event with the probability of \( i^{th} \) event occurred, is \( p_i \) \( (i = 1 \ldots k) \), \( \sum_{i=1}^{k} p_i = 1 \), so that \( O_i = n_i p_i \), \( E_i = n_i v_i \). The Pearson statistics is as follows:

\[
\chi^2 = \sum_{i=1}^{k} \frac{(O_i - E_i)^2}{E_i}
\] (5.3.9)

Then, a comparison between \( \chi^2 \) and the critical value \( (c_\alpha) \), where \( \alpha \) is the significance level \( (0; 0.5) \), is the core of Pearson’s test. The null, \( H_0 \), is rejected if \( \chi^2 \geq c_\alpha \) or accepted otherwise. In this test, the critical value is the point where the level of significance is not less than the probability of the first kind of error\(^{26}\) (Greenwood and Nikulin 1996, p.6).

Instead of using \( c_\alpha \), an alternate approach is to use the estimated probability \( (p\text{-value}) \) of the observed statistic which is defined as ‘the lowest significance level at which a null hypothesis can be rejected’ (Gujarati and Porter 2009, p.122). That means the \( p\text{-value} \)

\(^{26}\) The first kind of error is occurred when research rejects the actually true hypothesis (Gujarati and Porter 2009, p.833).
inversely relates to $\alpha$ with a determined $c_\alpha$: $p\{\chi^2 \geq c_\alpha | H_0\} = \alpha$. The greater the $p$-value, the higher the probability of being wrong to reject $H_0$ if $H_0$ is a true null hypothesis. At present, the $p$-value is widely reported when the test of goodness-of-fit is applied.

Another way to test the validity of the polychoric PCA results is the likelihood ratio (or $G^2$) measured by the fraction between the maximum likelihood with regarding to the null hypothesis and the maximum likelihood of alternative hypothesis. The $G^2$ test is similar to the Pearson’s $\chi^2$ test in terms of comparing the observed and the critical level of a probability of events. In case of categorical data, $G^2$ test aims to check whether the actual frequencies of observation in each category follow the postulated counts (McDonald 2014, p.53). The likelihood ratio is:

$$l(n) = \frac{L(v_i | m)}{L(p_i | m)} = \left\{\frac{v_1}{p_1}\right\}^{n_1} \left\{\frac{v_2}{p_2}\right\}^{n_2} \ldots \left\{\frac{v_k}{p_k}\right\}^{n_k}$$ (5.3.10)

In the context of polychoric correlation and polychoric PCA in Stata, the Pearson’s test and the likelihood ratio test of goodness-of-fit are provided by Kolenikov (2005).

5.3.4.2 External validity method

**Spearman rank-order correlation**

The Spearman rank-order correlation test is introduced in Spearman (1904) to diagnose a possible correlation between two ranked variables. The test is computed by the correlation $\rho$ for $n$ individuals (Kendall et al. 1939, Zar 1972). Assume that the rank of individual $i$ is estimated by the first and the second method are $X_i$ and $Y_i$, the deviation between $X_i$ and $Y_i$ is $d_i$, $d_i = X_i - Y_i$. Then,

$$\rho = 1 - 6 \frac{\sum_{i=1}^{n} d_i^2}{n^3 - n}$$ (5.3.11)

If there is a perfect correlation between $X_i$ and $Y_i$, $d_i = 0$, for all cases, so that $\rho = 1$. By contrast, if $X_i$ and $Y_i$ change completely inversely, $X_i = Y_{n-i+1}$, so that $\rho = -1$. Therefore, $\rho$ ranges from -1 to 1 (Kendall et al. 1939). Finally, this test is robust to the $t$-statistic and $p$-value which are obtained from this Spearman rank correlation similar to the test in linear regression and correlation (McDonald 2014, p.209-212).
In the relation to the wellbeing index, a correlation between the rankings of individuals measured by the index and another method is analysed. For instance, McKenzie (2005) uses the Gini coefficient, the predicted nondurable consumption to generate the rank of inequality level across Mexican states. Then, this result significantly correlates with the inequality level estimated by the wellbeing index. A comparison of this method with the Atkinson index gains a similar result. Before that, Filmer and Pritchett (2001), Sahn and Stifel (2003) also shows a reliability of the Spearman rank correlation technique for an analysis of the wellbeing level. Results of tests from these studies also confirms that there is no reason to worry about the quality of wellbeing index as it performs as well as or better than other methods.

Regression correlation-based comparison method

This method is based on the idea of using the wellbeing index to test an empirical relationship guided by a particular theory. For example, since it is believed that the socioeconomic status is a causal factor of health behaviours (Kolenikov and Angeles 2009), the asset index and other regular variables (i.e. income) could be used as proxies for socioeconomic status (SES). Then the results of regression of health behaviour on asset index and income respectively are compared with the expected signs of correlation, and the significance of coefficients. Applying this technique, they make a comparison across different versions of the PCA-based asset index under a light of the theory that the fertility rate is negatively affected by the SES. The first type is called Filmer-Pritchett’s (2001) technique that breaks all categorical variables into dichotomous variables before adding them in the standard PCA. The second type is the ordinal PCA-based asset which transforms all categorical to ordinal variables. This type applies the regular PCA for an estimate of the asset index. Finally, the asset index which is computed by the polychoric PCA method is of interest. This robustness scheme proves a superior measurement of the asset index calculated by the polychoric PCA (Kolenikov and Angeles 2009).
Part 2: A dynamic panel data model for an investigation of the effects of pro-poor public expenditure in the relation to inequality, poverty and wellbeing

It is argued that dynamic relationships in socioeconomic activities are numerous; thus, an econometric model is likely to be advantageous if it can handle the dynamic adjustment in such activities (Baltagi 2005). A main feature of dynamic correlation is an existence of the lagged dependent variable in the right-hand-side of a regression that could lead to problematic results when using traditional models (e.g. OLS, fixed-effects). A simple reason is due to a correlation between the lagged dependent variable and the residuals regardless of an isolation of the individual fixed effect. With a deep panel, biased estimate may be minimised. However, an application of traditional models to a panel data with a limited time-series will be seriously biased and inconsistent. The Arellano-Bond model is built to resolve those problems.

5.4 The Arellano–Bond estimator

5.4.1 The problems of traditional econometric models with dynamic panel

A dynamic econometric model expresses as follows:

\[ y_{it} = \alpha y_{i(t-1)} + x_{it}'\beta + \mu_i + v_{it}, \quad i = 1, \ldots, N, \quad t = 1, \ldots, T \quad (5.4.1) \]

In Equation (5.4.1), \( \alpha \) is a scalar and less than 1, \( x_{it}' \) denotes independent variables which encompass current and lagged values, \( \mu_i \) is the fixed individual effects which are expected to have a statistical relationship with \( x_{it}' \), and \( v_{it} \) is the idiosyncratic shocks resulted from heteroscedasticity in specific individuals, which differ from the fixed-effects. Both two components of error terms are assumed to be independent and identically distributed (i.d.d) (Arellano 1989, Arellano and Bond 1991).

Once \( y_{it} \) depends on its lag, \( y_{i(t-1)} \), a correlation between \( y_{it} \) and \( v_{it} \) implies that \( y_{i(t-1)} \) correlates to \( v_{it} \) regardless of no serial correlation in \( v_{it} \). Unsurprisingly, OLS cannot work effectively in the situation with lagged variables as it should overestimate the coefficient of \( y_{it} \) on the right-hand-side variables. If the fixed-effects method is used, the individual effects, \( \mu_i \), can be isolated; however, the estimate is still (downward) biased as the correlation between \( y_{i(t-1)} \) and \( v_{it} \) remains in the within transformation. That means the fixed-effects estimator is likely to produce inconsistent
correlation coefficients due to the endogeneity problem (Plasman 2006, pp.305-6). Judson and Owen (1999) argue that even when T is equal to 30, a bias still occurred in these two regular regressions.

Similarly, bias is also found when using the random-effects model with dynamic panel data because this method cannot handle a correlation between the lagged dependent variable \( y_{i(t-1)} \) and the total residual which includes \( \mu_i \) and \( v_{it} \). To resolve this problem, the first difference (FD) transformation is suggested by Anderson and Hsiao (1981). This method deals with the relationship between \( y_{i(t-1)} \) and the total residual effectively when \( v_{it} \) is not a sequential disturbance. However, it is a critique of the effectiveness of the FD because neither have all moment conditions nor differenced structure of \( \Delta v_{it} \) been considered.

Arellano (1989) makes a comparison between the two instrumental variables: the difference of \( y_{i(t-2)} \) \( \Delta y_{i(t-2)} \) vis-à-vis \( y_{i(t-2)} \) itself, and explores that the later method is more effective than \( \Delta y_{i(t-2)} \) which leads to a much larger variance. Based on this result, Arellano and Bond (1991) develop Generalised Method of Moments or GMM by adding instruments, in addition to instrumental variables obtained by the FD method with respect to the moment (or orthogonality) conditions between the past realisation of dependent variables and the error terms.

5.4.2 **A construction of the Arellano–Bond model**

The Arellano–Bond GMM estimator is an econometric model of dynamic panel data with restricted time-series. The model can handle data with following characteristics: (1) dependent and independent variables are linearly correlated; (2) the explained variable is dynamic, which partially depends upon its previous value; (3) some right-hand-side variables are not strictly exogenous, meaning that they could relate to the past and current realisations of the error term; (4) a heteroscedasticity in within individuals remains unchanged, implying a situation that the individual idiosyncratic error is constant over time; (5) individual idiosyncratic errors are orthogonal to each other (Roodman 2009b).
From Equation (5.4.1), a simple case of the dynamic panel model is:

$$y_{it} = \alpha y_{i(t-1)} + \mu_i + v_{it}$$  \hspace{1cm} (5.4.1')

Differentiating (5.4.1') with respect to time:

$$y_{it} - y_{i(t-1)} = \alpha (y_{i(t-1)} - y_{i(t-2)}) + (v_{it} - v_{i(t-1)})$$  \hspace{1cm} (5.4.2)

or

$$\Delta y_{it} = \alpha \Delta y_{i(t-1)} + \Delta v_{it}$$  \hspace{1cm} (5.4.3)

or

$$\Delta y_{it} - \alpha \Delta y_{i(t-1)} = \Delta v_{it}$$  \hspace{1cm} (5.4.4).

If $t=3$,

$$y_{i3} - y_{i2} = \alpha (y_{i2} - y_{i1}) + (v_{i3} - v_{i2})$$

is obtained.

In the relation to instrumental variables, one can see that $y_{i1}$ becomes a valid instrument because it definitely correlates with $(y_{i2} - y_{i1})$ but is orthogonal with $(v_{i3} - v_{i2})$, or $E((v_{i3} - v_{i2})y_{i1}) = 0$. Analogously, if $t=4$, two possible instruments, namely $y_{i1}$ and $y_{i2}$, are feasible as they satisfy the moment conditions: $E((v_{i4} - v_{i3})y_{i1}) = 0$, $E((v_{i4} - v_{i3})y_{i2}) = 0$ respectively. Generally, if $t=T$, $(T-2)$ number of lags of $y_{it}$ can be utilised as instrumental variables (IVs) for the level equations. A computation by putting the vectors of these all IVs in a block of diagonal matrix $Z_i$

$$Z_i = \begin{bmatrix} y_{i1} & \cdots & 0 \\
: & [y_{i1}, y_{i2}] & : \\
0 & \cdots & [y_{i1}, y_{i2}, \ldots, y_{i(T-2)}]
\end{bmatrix}$$

associated with differenced error terms, $\Delta v_{it} = [(v_{i3} - v_{i2}), \ldots, (v_{iT} - v_{i(T-2)})]'$, is the nature of GMM moment conditions (Baltagi 2005):

$$E(Z_i' \Delta v_{it}) = 0, \text{ or } E(Z_i' (\Delta y_{it} - \alpha \Delta y_{i(t-1)})) = 0$$  \hspace{1cm} (5.4.5)
According to Arellano and Bond (1991), for a panel with \( N \) observations, the sample moments are defined as follows: 
\[
\sum_{i=1}^{N} Z_i' \Delta \nu_i = N^{-1} Z' \Delta \nu, \text{ where } Z = [Z_1', Z_2', \ldots, Z_N']', \Delta \nu = [\Delta \nu_1', \Delta \nu_2', \ldots, \Delta \nu_N']', t \text{ is suppressed for simplicity.}
\]

Then, an estimate of \( \alpha \) which leads to a solution, \( \hat{\alpha} \), requires an argument that minimises the squared space: \((\Delta \nu' Z) W_N (Z' \Delta \nu)\). The solution \( \hat{\alpha} \) is obtained following the equation:
\[
\hat{\alpha} = \frac{\Delta y'_{(t-1)} Z W_N Z' \Delta y_t}{\Delta y'_{(t-1)} Z W_N Z' \Delta y_{(t-1)}},
\]
where \( W_N \) is the maximum weighting matrix of the sample. Two different choices of \( W_N \) entail one-step and two-step GMM estimator. A setting of \( W_N = \left(\sum_{i=1}^{N} Z_i' H Z_i\right)^{-1} \), where \( H \) is a given (T-2) square positive definite matrix:
\[
H = \begin{bmatrix}
2 & -1 & 0 & 0 \\
-1 & 2 & -1 & 0 \\
0 & -1 & 2 & \ddots \\
0 & 0 & \ddots & \ddots & 2
\end{bmatrix}
\]
, yields to the one-step GMM estimator, \( \hat{\alpha}_1 \).

Instead of \( H \) matrix, one can use the residual of individual \( i \), namely \( \hat{\epsilon}_i \), obtained from the one-step GMM procedure to form an \( E \) matrix:
\[
\hat{E}_N = \frac{\sum_{i=1}^{N} Z_i' \hat{\epsilon}_i \hat{\epsilon}_i' Z_i}{N}
\]
Arellano and Bond (1991) argue that \( \hat{E}_N^{-1} \) is the optimal choice of \( H \), which is the fundamental matrix for the two-step GMM estimator. In the two-step GMM, the coefficient is built on this argument:
\[
\hat{\alpha}_2 = \frac{\Delta y'_{(t-1)} Z \hat{E}_N^{-1} Z' \Delta y_t}{\Delta y'_{(t-1)} Z \hat{E}_N^{-1} Z' \Delta y_{(t-1)}}
\]

When initial idiosyncratic error terms remain independent and homoscedastic across observations over time, a difference between the two estimators is asymptotic zero. However, Windmeijer (2005) criticises a downward bias existing in \( \hat{\alpha}_2 \) in a case of finite sample size due to a use of results from one-step estimators for a computation of weighting matrix for the two-step GMM. He adds additional terms to tackle the problem
and shows that this correction technique makes the two-step robust and more efficient than initial calculation.

### 5.4.3 Difference GMM vs. system GMM

The construction of GMM estimator described in Section 5.4.2 above is called *difference* GMM since it uses the differenced equations (5.4.1, 5.4.2) for a computation of correlation coefficients. However, Arellano and Bover (1995), and Blundell and Bond (1998) argue that the difference GMM could omit important information about original data; therefore, instruments with lagged levels are ineffective. In difference GMM style, when $\alpha$ approaches unity, the correlation between the instrumental variables with lagged realisation of $y_{it}$ and the levels of $y_{it}$ is powerless. The second problem weakening the instruments is a high relative variance of the individuals fixed-effects ($\mu_i$) compared with the remaining disturbance ($v_{it}$).

Blundell and Bond (1998) combine two approaches of exploitation of instruments: (1) lagged levels of $y_{it}$ as instruments for difference equations, and (2) lagged difference of $y_{it}$ as instruments for level equations, which is defined as the *system* GMM. They claim that system GMM is more advantageous than difference GMM when dependent variables are near a random walk.

The level equation is generated from (5.4.1’):

$$
\Delta y_{it} = (\alpha - 1)y_{i(t-1)} + \mu_i + v_{it}
$$

and interpreted as a rise or level in dependent variable (Roodman 2009b). In this equation, the expectations of individual fixed-effects, idiosyncratic disturbance, and covariance between $\mu_i$ and $v_{it}$ are zero. Blundell and Bond assume that $|\alpha| < 1$, and consider additional moment conditions, as well as the restrictions described by (5.4.5):

$$
E(\psi_{it}\Delta y_{i(t-1)}) = 0
$$

, where $\psi_{it} = \mu_i + v_{it}$, and $t = (3, 4, ..., T)$. That means $\Delta y_{i(t-1)}(= y_{i(t-1)} - y_{i(t-2)})$ is a potential candidate as instrument for $y_{i(t-1)}$ because it does not correlate to $v_{it}$. 

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However, a use of $\Delta y_{i(t-1)}$ as instrument requires a further restriction because $\Delta y_{i(t-1)}$ and $\mu_i$ which is comprised in $\psi_{it}$ are correlated. Blundell and Bond (1998) argue that the condition (5.4.7) can be retained if and only if with an intertemporal convergence of $y_{it}$ to $\frac{\mu_i}{1-\alpha}$ where the autoregressive coefficient and the fixed-effects compensate to each other across a panel. Thus, a value of moment $E(y_{it}\mu_i)$ remains stable over time. This condition entails that the deviation between $y_{it}$ and its convergent value is likely to be orthogonal with the fixed-effects (Roodman 2009b):

$$E\left(y_{it} - \frac{\mu_i}{1-\alpha}\mu_i\right) = 0 \quad (5.4.8)$$

Blundell and Bond (1998) utilise the moment condition (5.4.8), in addition to all the conditions which are exploited in the procedure of difference GMM estimators for a development of the system GMM estimators. First, they rearrange a data set which contains both the original and differenced observations. Then, the solution to $\alpha$, denoted as $\hat{\alpha}$, is estimated through a modification of the matrix $Z_i$, ($Z_i^*$), which is described as follows:

$$Z_i^* = \begin{bmatrix} Z_i & 0 & \cdots & 0 \\
& \Delta y_{i2} & 0 & \cdots & 0 \\
& 0 & \Delta y_{i3} & 0 & \cdots \\
& 0 & 0 & \Delta y_{i4} & \vdots \\
& 0 & 0 & \cdots & \Delta y_{i(T-1)}
\end{bmatrix}$$

Further steps of computation for the one-step and two-step correlation coefficients in the system GMM follow a similar consequence as in the difference GMM.

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27 Roodman (2009b) comments that this condition is analogous to the trade-off between a rise in investment and physical capital depreciation at a steady-state in the Solow growth model. The ratio $\frac{\mu_i}{1-\alpha}$ is obtained by solving the problem: $E(y_{it}\mu_i) = E(y_{i(t-1)}\mu_i)$, where $y_{it} = \alpha y_{i(t-1)} + \mu_i + v_{it}$.

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5.4.4 Tests of the model

Arellano and Bond (1991) claim that using lagged dependent variables as instruments could lose consistency when the error terms are still serially correlated; thus, validity of instruments and variables must be tested in the model. Three tests are suggested: second-order serial correlation test, Sargan/Hansen test of over-identification of instruments and Hausman specification test.

As the GMM estimators are based on a vital assumption of the absent correlation in the idiosyncratic error \( (v_{it}) \) in order. In fact, the first order of this disturbance in difference is correlated as they contain \( v_{i(t-1)} \). However, it is expected a non-correlation of the second-order of differenced \( v_{it} \). That means the condition of orthogonality must be hold in the lagged twice idiosyncratic residual in difference for a validity of instrumenting variables. Thus, the second-order serial correlation test hypothesises zero covariances between second-order and zero-order of \( \Delta v_{it} \): \( \text{Cov}(\Delta v_{it} \Delta v_{i(t-2)}) = 0 \). In practice, Arellano and Bond (1991) suggest to test the covariances on average under the null hypothesis of orthogonal relationship between \( \Delta v_{it} \) and its lagged twice value. Further descriptions of the test are found in Arellano and Bond (1991, Equation 8 and 9), and Roodman (2009b, pp.119-121). Roodman also recommends two key issues to guarantee a validity of the autocorrelation test. First, all time-dummies should be added in the model for prevention from the contemporary correlation across individuals. Second, small sample size (20 units or less) will violate the central limit theorem which is applied in this test.

Another robustness check of the GMM estimators is the Sargan/Hansen’s (1980)28 over-identifying restrictions test. The test investigates whether the number of orthogonality conditions are greater than that of estimated parameters in the GMM procedure (Hansen 1982). The residual \( \hat{v} \) which is yielded from the GMM two-step process will be used in this test:

---

28 An identical test is proposed by Hansen (1982)
\[
s = \hat{\vartheta}' Z \left( \sum_{i=1}^{N} Z_i \hat{\vartheta}_i \hat{\vartheta}_i' Z_i \right)^{-1} Z' \hat{\vartheta} \sim \chi^2_{p-k} \tag{5.4.9},
\]
where: \( s \) is the Sargan statistic test, \( p \) is the amount of columns in \( Z \), \( k \) is the number of independent variables, and \( \chi^2_{p-k} \) is the Chi-squared distribution with \( (p-k) \) degree of freedom.

Sargan (1980) further considers the test of misspecification (or Sargan’s difference test) based on the estimated results of two competitive models. The fundamental principle of this test is analogous to the Hausman’s (1978) specification test. Arellano and Bond (1991) apply these tests to GMM estimators through a comparison between two-step GMM estimators corresponding to the assumption that the error terms in level are moving average at zero-order (MA(0)) and first-order (MA(1)) respectively. The difference between two estimators due to using these two assumptions satisfies the asymptotic \( \chi^2_{p_1} \), where \( p_1 \) is the number of column in the derived matrix from \( Z \) when the errors in levels are MA(1).

In general, these essential robustness checks should be undertaken in any application of GMM. They identify the validity of lagged dependent variables in difference or/and levels as instruments. In the relation to the technological implementation, Roodman (2009b) attaches these three tests in the \textit{xtabond2} Stata command, so that their results of both estimators and tests are presented informatively in the same window.

### 5.5 Chapter conclusion

The chapter has discussed about the measurement of inequality level and the GMM model. The construction of measurement aims to avoid the current gaps existing in the current literature on inequality. The chapter explores several advantages of the PCA-based measurement of inequality level. Inequality is multidimensional in its nature; therefore, measurements of inequality must reflect multiple aspects of human wellbeing. Part 1 of this chapter built the index of inequality in wellbeing. Necessary tests of the validity of the index of inequality, namely Pearson statistics, Spearman rank-order
correlation and regression correlation-based comparison method are also presented in the first part.

In the second part, the chapter discussed the GMM model which is developed for a short time-series dynamic panel. The model originally chooses the lagged levels of dependent variable as instruments in the differenced equations; hence, it is called difference GMM. However, this estimator becomes less effective when the autoregressive correlation coefficient is near unity; thus, additional instruments with lagged dependent variable in difference are exploited in system GMM which improves its effectiveness of correlation coefficient estimate. In the relation to the validity of the GMM, three tests (autocorrelation of the second-order of error terms, Sargan/Hansen tests of over-identification, and of specification) are applied.
6 AN EMPIRICAL ANALYSIS OF MULTIDIMENSIONAL INEQUALITY IN VIETNAM

6.1 Introduction

This chapter analyses inequality using Vietnamese data over the period 1993–2008. Inequality is not exclusively intended as inequality in income but rather includes non-income dimensions of wellbeing when this concept goes beyond the material living standard. Several studies in inequality use income as a proxy for wellbeing based on the mainstream theory of welfarism that treats this indicator as monetised utilities. Sen (1997b, p.391) emphasizes that ‘[t]he difficult issue in basing inequality analysis on interpersonal comparison is not so much the impossibility of making such comparisons but the possibility of being misled by such comparisons’. In light of this discussion, this empirical analysis endeavours to draw a clear picture of multidimensional inequality by taking into account various indicators reflecting major aspects of wellbeing in the measurement. By doing so, the chapter avoids distortions in the interpretation of inequality exclusively based on income data.

A major problem of the literature on multidimensional inequality is that it provides diverse (and conflicting) results corresponding to different choices of parameters utilised in the estimation of inequality (e.g. inequality aversion), even when using the same method and datasets. Additionally, one-indicator proxy (income for the living standard, years of schooling for the educational achievements, and healthy days for the health status) could provide incomplete understanding of inequality as wellbeing is determined by a variety of factors. Besides, the assumption of non-interdependencies between variables is easily violated as there is plausible evidence of interrelations between economic, education, and health variables. Finally, the extent of the indicator weighting in computation of inequality has not been thoroughly examined. In other words, each variable is simply treated equally in terms of their contributions to multidimensional wellbeing. Such a postulation of equal weight of variables is likely to be inconsistent with the fact that variables may have unequal influences on wellbeing, and thus on the level of overall inequality.
To fill these gaps, this thesis chooses the polychoric PCA for an examination of inequality in wellbeing. For completeness and benchmarking, the constructed wellbeing index will be compared with the wellbeing level approximated using income. Then, an interpretation of inequality will be associated with outcomes from several unidimensional and multidimensional inequality measurements. With an application of the polychoric PCA, this chapter contributes to the existing literature in two main ways. First, it extends the analysis of inequality by including the various wellbeing components. There is still a dearth of research in multidimensional inequality applying the polychoric PCA. Instead of simply explaining that a calculation of multidimensional inequality requires several extra variables representing the educational and health, as well as an economic dimension in the model, this section considers the contribution of non-economic dimensions and the interactions of all indicators to an overall trend in multidimensional inequality. Furthermore, this chapter compares inequality trends over time and across different geographical areas. This study explores not only the inequality level across places at particular points in time but also a tendency of inequality within-regions. This research offers a further insight of the multidimensional inequality through using Vietnamese data.

The remainder of the chapter is organised as follows. The next section discusses the methodology and variable selection. Section 6.3 describes data resources and variables. Section 6.4 illustrates the advantages of the polychoric PCA through a comparison between the wellbeing index and the consumption expenditure indicator. Section 6.5 interprets the results of inequality measured by the chosen methodology. The conclusive section discusses the possibility to investigate potential ways to identify the causes of inequality.

6.2 Methodology and variable selections

As discussed in the chapter of literature review, a limitation of the measurements of multidimensional inequality using the Massoumi index and AKS is that these methodologies commonly choose one variable to represent each dimension (e.g. Justino 2012, Decancq and Lugo 2012a). This single proxy could lead to ambiguous conclusions because one dimension should be thoroughly described by a variety of
indicators. For example, although income is a popular proxy for household wellbeing, it reveals various weaknesses in inequality. Rutstein and Johnson (2004) argue that individual income could be reported erroneously since most of interviewees may not remember all sources of their income, or they do not want to report truthfully when interviewers work for governments. In addition, income data are less reliable in rural developing countries because homemade and self-consumed goods are popular but their values are hard to estimate. Expenditure data are considered a better resource for welfare analysis (Deaton 2003a, Nguyen et al. 2007). However, this type of data suffers from several drawbacks as well. First, the data are obtained via interviewing an adult member of households who could not completely remember expenditures of other members at the time of interview. Expenditure questionnaire focuses on daily consumption (e.g. food), so that collected data could not cover the long-term expenditure. More importantly, both income and expenditure solely focus on the economic aspect of wellbeing. Therefore, an examination of wellbeing should require plural proxies rather than just income or expenditure.

However, the conventional measurements of inequality are insufficiently concerned with plural proxies for wellbeing. For instance, Maasoumi and Nickelburg (1988) use the Maasoumi’s approach to measure inequality in wellbeing based on household nominal income, housing assets, and schooling year indicators. Firstly, they use PCA for variable weightings. Then these variables and their weights are added in the Maasoumi’s index for a computation of inequality. Because of single proxy for each dimension, such research in inequality considers PCA only as a complementary step (i.e. weighting instrument) for their multidimensional inequality index. In this two-step procedure, selected variables are firstly included in the estimation as weights for sub-indicators by the PCA technique. Subsequently, chosen sub-indicators and their weights are incorporated in the inequality index. Such a strategy is not chosen in this thesis. A reason for this is that a calculation of the level of, and inequality in, wellbeing using sub-indicators could be biased because sub-indicators might not retain all information about original variables. Then the overall estimated results become worse if the second step of measurement contents any bias. Additionally, a discussion of methodological shortcomings of the traditional approach has been clarified in the previous chapters. As
discussed in Chapter 4 and 5, the second stage of Maasoumi’ approach is uncertain with numerous choices of the inequality aversion and dimensional substitution.

The PCA-based measurement of inequality outperforms the existing methods in three main ways (McKenzie 2005). First, results of measurement are unambiguous. This aspect is more important in terms of policy implications. Second, while other measurements avoid resolving interrelationships across dimensions, the PCA-based measurement of inequality can consider a large number of interdependent variables, so that the wellbeing index takes into account the correlations between its components. Third, the PCA computes different weights of variables, which seems to be more reasonable than allocating the same weight for all variables. These advantages of the PCA enable the current research to go beyond the economic inequality and take into account the importance of different factors contributing to inequality.

An application of the regular PCA may have a problem of clumping and truncation, which could lead to an invalid metric. The matter of clumping occurs when households are automatically divided in number of clusters corresponding to chosen indicators. For example, categorizing asset variables in the housing, facilities, durable goods, McKenzie (2005) shows that one of these categories per se cannot identify the stratification in the whole sample. The truncation problem happens when the inequality index cannot capture distributional differences in a particular dimension. As a consequence, for the economic dimension, the index could not classify between the poor and the very poor, or the rich and the middle-class. Once the PCA suffers from these two problematic issues, its calculation of inequality becomes inaccurate. In other words, the measurement could not generate an appropriate interpersonal comparison because it is not aware of differences across individuals belonging to the same subgroups (e.g. within a decile). A solution to this disadvantage is to identify and combine sufficient variables representing various and fundamental dimensions of wellbeing (McKenzie 2005, Vyas and Kumararanayake 2006). Alternatively, research in inequality uses continuous (or normally distributional) variables like payments for household accommodation, in addition to discrete variables. Yet a combination between discrete and continuous variables may lead to insignificant results when the necessary
tests of PCA reject the credibility of variables. That means the regular PCA is problematic; it may invalidate the measurement of inequality. Thus, this research uses a series of adequate indicators and applies the polychoric PCA for an inequality analysis.

To measure inequality in wellbeing, the polychoric PCA assigns different weights obtained by the factor loadings (scoring coefficient on the original variables) of the first component for different indicators. These weights have dual functions. Moser and Felton (2007) explore a proportional contribution of variable weights to wellbeing. These weights show how an indicator is important to the wellbeing determination. In other words, the magnitudes of the correlation coefficient address the information of other indicators. An indicator with a very small coefficient is less relevant to household wellbeing and thus, it can be omitted.

An advantage of the polychoric PCA is that this method computes both negative and non-negative correlation coefficients. The side of the coefficient slopes firstly indicate the extent to which the information on whether a household achieves other wellbeing indicators. For example, an asset indicating the presence (absence) of other assets may be assigned a positive (negative) correlation coefficient value. Thus, an indicator with a negative weight means that a household is less likely to have other determinants of wellbeing so that it achieves a low level of wellbeing. The second role of variable weights indicates the inequality level in wellbeing distribution. Households are deprived in the particular aspects of wellbeing represented by indicators if coefficients on these variables are negative (Moser and Felton 2007). The higher the weights, the greater the share of variable in the total variance of the first component; thus, it broadens the gap across the population. If a variable has a minor standard deviation, it is assigned a small weight in PCA in the inequality index. For instance, if all (or no) households have the same asset (e.g. a TV), PCA treats it as zero-weight variable, so that TV is unlikely to be a contributor to inequality. Therefore, it is necessary to carry out a descriptive statistic of variables for obtaining information about their mean, frequency, and standard deviation. Based on the descriptive analysis, a decision of chosen variables in the PCA can be clarified (Vyas and Kumaranayake 2006).
6.3 Data and variable descriptions

6.3.1 Data sets

This chapter uses the Vietnamese household survey data including key aspects of individual characteristics, demographic information, education, employment, health, income and household production, expenditure, durable goods, asset, housing, and poverty. The Vietnam Living Standard Survey (VLSS) was conducted twice in the 1990s. The survey’s name was amended to the Vietnam Household Living Standard Survey (VHLSS) in 2002 and data were collected biennially from that date. These data sets have been utilised in many economic studies. For example, van de Walle and Gunewardena (2001), Nguyen et al. (2007), Liu (2001, 2008) and Justino (2012) use data from VLSS 1993, 1998 to analyse the urban–rural income gap, ethnic disparity, and multidimensional inequality, while Glewwe and Dang (2011), and Epprecht et al. (2011) use these data for poverty analysis. Similarly, Kang and Imai (2012), Huong and Booth (2014) use data from VHLSS for research in inequality and poverty areas. These studies confirm that VLSS and VHLSS data are suitable for a multidimensional inequality analysis as they are identical in terms of the questionnaire design.

A main feature of the surveys is that it combines the retrospective information on households who participated in the previous wave and information on the first-time additional participants. A longitudinal data set that is composed of more than two waves is weak as the number of observations substantially decreases, and this might cause measurement error. In addition, no households interviewed in the 1990s took part in the later survey in the 2000s. Therefore, this chapter does not create panel data sets. Rather, it uses pooled data and separates the analysis of inequality in wellbeing level in two phases: the 1990s and 2000s. The strategy of pooling data is initially recommended in McKenzie (2005), applied in Moser and Felton (2007) and Ward (2014). Initially, the VLSS 1993 and 1998 are pooled producing a list of variable weights used for a calculation of the wellbeing level and inequality.

Similarly, the VHLSS 2002–2008 data are combined and since the size of VHLSS 2002 is threefold as the size of any other wave, a random sample of 31% of its total
observations is created with a remaining proportion of observations between provinces and urban–rural. This technique of data combination generates unique weights for ordinal and cardinal variables over time, so that the wellbeing level and inequality could be comparable not only across households at one time but also inter-temporally.

In this analysis, not any regional price adjustment is made because of two main reasons. The first reason is about the data constraint. It is impossible to find reliable and official data for regional price adjustment in the case of Vietnam. Secondly, regional price adjustment could not affect the results of within-province inequality which is in the central of focus in this analysis.

6.3.2 Variables

Sen (1985a) emphasises the importance of using a ‘common standard’ of wellbeing, based on the valuation functions in the context of poverty analysis, in order to perform inequality analysis. He also states that the interpretation of wellbeing using the number of functioning, that is available for an interpersonal comparison, must be analogous to the ‘real income’, but not to the personal utility comparison. In light of this discussion, this chapter considers a variety of variable choices that reflects a change in the national wellbeing level. The variables are divided in three sub-groups: housing and assets, educational achievements, and health related variables. Chosen indicators vary from the 1990s to 2000s to adapt changes in ‘common standard of wellbeing’.

In this analysis, 21 and 25 variables are used as proxies of the wellbeing status in the 1990s and 2000s, respectively. Difference in the number of variables between two periods is due to data availability, instruction of variable choice, and movement in the standard wellbeing. Kuklys and Robeyns (2006) argue that survey data (like the

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29 Original emphasis.
30 Clark (2005) claims that there are no specific details of the standard of wellbeing for all communities over time, and a particular decision of the wellbeing components is opened for public debates. He also critiques an overlapping interpretation between Sen’s functionings and the welfarist concept of utilities. However, this argument could be inappropriate as Sen’s capability approach is based on the actual achievements which contribute to the objective wellbeing rather than individual desires.
VHLSS) do not include enough information corresponding to the Sen’s capability approach. Another difficulty is inadequate instruction for variable choice. In this circumstance, Rutstein and Johnson (2004) suggest to add any indicator which could reflect the household wellbeing status. Last but not least, the variables may appropriately relate to the standard of wellbeing in a particular society and time. That means necessary indicators used to analyse and to make an interpersonal wellbeing comparison could vary between countries and over time. This discussion is analogous to Sen’s suggestion of an opening solution to the variable selection31.

The variable representing multiple dimensions of household wellbeing presented in Table 6.1 (and Appendix A) share analogies with the current literature on inequality. Using the demography and health survey in 1992, Filmer and Pritchett (2001) select a bulk of durable goods including clock, bicycle, radio, TV, motorcycle, sewing machine, refrigerator, for the case of India which is similar to Vietnam in terms of economic background. McKenzie (2005) adds further items including a van, computer, and microwave in the list of durable variables for an analysis of the Mexican wellbeing inequality. These two empirical studies reaffirm that chosen indicators representing wellbeing should depend on the socioeconomic context. With respect to an adaptation to changes in the wellbeing level, this section predetermines whether variables used for the period 1993–1998 remain sensible in the following decade. Indicators with all correlation coefficients lower than 0.1, obtained from the first component of the polychoric PCA are considered as ‘no containing information’ (Moser and Felton 2007); thus, they are excluded from the model.

6.3.2.1 Asset indicators

This chapter chooses various household assets that can capture household capabilities or freedom:

In getting an idea of the wellbeing of the person, we clearly have to move on to ‘functionings’, to wit, what the person succeeds in

31 This point has been discussed in the Theoretical Framework.
**doing**32 with the commodities and characteristics at his or her commands (Sen 1985a, p.10).

Increasing the number of assets could raise household capabilities (Ward 2014). As wellbeing is multidimensional, these variables should be a reflection of household multiple attainments; they must be plausible to avoid biases in ranking wellbeing for a given population. Despite an absence of standard principles for variable choices, several guidelines are mentioned in the current literature. Assets need to be chosen carefully as changes in some asset ownership are inversely proportionate to the household wellbeing (Rutstein and Johnson 2004).

The magnitude of coefficients on original variables generated by PCA depend on the extent to which the partition of total information is captured by the corresponding indicators; the larger the coefficient, the more important it will be with respect to inequality. An example is that the probability of car possession in wealthier households is higher than in poorer families, but car ownerships become more widespread; thus, the scoring factors of the car indicator are positive and diminishing over time. McKenzie (2005) shows that a substantial coefficient implies a large variance in asset distribution; which implies a more unequal distribution across the population. This is an advantage of the PCA-based measurement of inequality because the chosen indicators indicate related variables that describe wellbeing irrespective of whether they are present in the measurement.

For instance, an evidence is that black and white TV is a signal of prosperity in 1978, but of poverty from the 1990s in Guayaquil, Ecuador (Moser and Felton 2007). This chapter also pre-investigates similar phenomena in the case of Vietnam. Over the period 1993–1998, two assets including bicycle, and radio have positive scoring factors. In this circumstance, these indicators are also likely to determine inequality in wellbeing among the population. In contrast, in the following decade, these two assets are less relevant for wellbeing (scoring factors are near zero) and therefore, these variables are dropped in the analysis of inequality for the later period. On the other hand, the measurement indicates large negative coefficients on the black and white TV variable;

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32 Original emphasis.
which means that this asset reduces the level of wellbeing, or that households owning this property lag behind the common standard of wellbeing.

The extent to which the role of ownership of these variables has changed could be explained by the socioeconomic conditions at a particular time. Specifically, possession of radio(s), wall clock(s), or electric fan(s) could be important parts of the standard wellbeing in the 1990s. When the annual gross national income per capita is only around US$ 200–300 (World Bank 2013a), people could expect to possess a fan, radio, and clock as essential things of a decent life. However, these assets become much less important in the twenty-first century as households with higher achieved functionings own more valuable items that generate identical utilities (such as colour TV, hand watch, air conditioner). Therefore, a list of indicators must be updated over time to avoid any inappropriate proxy for wellbeing

A reorganisation of the questionnaire in VHLSS, which updates information on asset ownership and several other dimensions of the household wellbeing, could also confirm this viewpoint. In addition, it is recognized that the number of variables used for a reflection of the wellbeing standard should be extended temporally as the society requires a larger bundle of commodities that adapt to a higher standard of well-being

In light of this discussion, several indicators are added in the model to calculate wellbeing in the 2000s. These are home phones, computers, colour TVs, and vacuum cleaners.

Besides these replaced and additional indicators, the remaining assets such as cars, refrigerators, air conditioners, and water heaters in the bathroom can strengthen the measurement and contribute to refine differences in wellbeing within population subgroups. This is consistent with Moser and Felton’s (2007) idea of a maximum

33 The other indicators are also suppressed from the variable list used for the later period: bike, and sewing machine.
34 Harttgen et al. (2013) make an adjustment of asset indicators due to differences in economic development between Zambia and Indonesia. However, they do not discuss a necessity of adaptation in variable choice for a long-term analysis. This neglect could result to an insignificant relationship between the asset indicators and expenditure.
number of indicators determining wellbeing. It also confirms McKenzie’s (2005) argument about the clumping and truncation problems of the measurement with restricted indicators.

This analysis also considers the quantities of the assets owned by the households, as these differences could be important in measuring inequality so that the level and inequality in wellbeing could be sensitive to any variance in assets. Ward (2014) clarifies that a consideration to asset quantity can raise the effectiveness of the polychoric PCA regarding the rankings of household wellbeing. For example, compared to a household owning one motorbike, a household having two motorbikes, *ceteris paribus*, is assumed to have achieved a higher wellbeing level.

In short, the asset indicators are chosen corresponding to Sen’s ‘common standard wellbeing’ and Moser and Felton’s (2007) suggestion of excluding irrelevant indicators, and including all variables relating to wellbeing. The criteria of relevance are however not a consensus. Including asset quantities in the polychoric PCA could enhance the measurement of wellbeing inequality as it captures both the cardinal and ordinal characteristics of asset possession rather than just treat them as binary variables.

### 6.3.2.2 Educational indicators

Education becomes more important determinants of wellbeing because knowledge and experience do not only reflect the household achieved functionings in the educational dimension itself but also influence other aspects of wellbeing. As can be seen in Becker (1993), education is an important input of economic outcomes (income). The evidence of educational causal effect on the health dimension is also enormous (e.g. Brunello *et al.* 2013, Hayward *et al.* 2015). Use of educational indicators is common in research in inequality. Moser and Felton (2007) consider the educational dimension as the human capital which contributes to the overall wellbeing. Similarly, Harttgen *et al.* (2013) use the mean of adult schooling years as educational component of wellbeing. Thus, an analysis of the level of and inequality in wellbeing would be inadequate if the educational dimension were not part of the evaluation.
This thesis selects two variables as a proxy for educational dimension (but only one for the 1990s due to inadequate data). In particular, the information about the person with the highest educational attainment in the household is utilised, rather than the education level of the households head or their spouses. The reason for this option is that the household wellbeing could be affected by the members with the highest level of education not only in the educational dimension itself but also with respect to the economic and health conditions. In the context of Vietnam, household heads are likely to quit schooling early (primary school) because of the war (if they reached school age around 1975), and poverty. However, parents encourage children’s studies even though they are classified in the poor stratum of society. As a result, there is a significant gap between parents and their offspring’s schooling (evidence of this gap is easily found in VHLSS). Specifically, the educational indicator shows the highest qualification obtained by households.

To conclude, it is vital to capture the educational indicators in a measurement of inequality in wellbeing. However, as noted in Kuklys and Robeyns (2006) household surveys only include limited indicators corresponding to Sen’s capability approach. This data limitation affects choices of variable for the educational dimension.

6.3.2.3 Housing and health related variables

The housing variables used in this analysis include housing characteristics and housing facilities. These variables could provide information on both the quality of accommodation and other conditions related to the health dimension. The earlier indicator refers the types of material used to build the house (i.e. wood, cement), and housing facilities refer to the quality of basic services consumed by households (e.g. types of drinking water). A consideration of housing indicators is found in similar studies in inequality underpinned Sen’s capability approach (Kuklys and Robeyns 2006, p.46) although there are different points of view on variable choices and the role of housing variables regarding wellbeing. McKenzie (2005) uses the number of rooms, house ownership, and the quality of walls and roofs, as proxies for housing dimension; Kuklys and Robeyns (2006) choose the indicators which investigate whether a household has problems of (water) condensation, rotting wood (windows or floors),
keeping the home warm, and the house capacity. Moser and Felton (2007), and Ward (2014) add lighting source, and toilet types in this group and name them as ‘housing capital’. In this thesis, the housing characteristics variables are combined with asset indicators.

In addition, housing facilities are interpreted as proxies for the health dimension because these variables can have significant impact on individual physical wellbeing. For example, using safe drinking water could minimise the probability of several infections. Unfortunately, this type of information is not available for the 1990s waves of the VHLSS and therefore, the number of sick days over a month is used as a proxy for the family health status.

In short, the choice of variables follows Sen’s capability approach and is analogous to the current literature on inequality using the similar method. However, the thesis makes two adjustments. First, variables should be replaced and extended for the rather long examined period, especially in the case of substantial improvement in both economic and noneconomic dimensions of wellbeing in Vietnam spanning 1993–2008. Second, health status is added in the model as this dimension is strictly related to the overall household wellbeing. The integration of household assets, education, and health outcomes can provide a novel picture of the household wellbeing.
Table 6.1: Variables used for a measurement of wellbeing level and inequality over the period 2002–2008

<table>
<thead>
<tr>
<th>Housing and Asset ownership</th>
<th>Assets (the quantities of asset owned by a household)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Housing variables</strong></td>
<td></td>
</tr>
<tr>
<td>Types of house: indicating</td>
<td>Car</td>
</tr>
<tr>
<td>the quality and characteristics of</td>
<td>Motorbike</td>
</tr>
<tr>
<td>material used to build a house</td>
<td>Home phone</td>
</tr>
<tr>
<td>Electricity: ordinal, indicating energy resources for the lighting purpose. Assuming that using national provision of electricity is the highest benefit to a household wellbeing.</td>
<td>Video player</td>
</tr>
<tr>
<td></td>
<td>Colour TV</td>
</tr>
<tr>
<td></td>
<td>Black and white TV</td>
</tr>
<tr>
<td><strong>Educational achievements</strong></td>
<td></td>
</tr>
<tr>
<td>Schooling years (in the official universal educational system, from the pre-school level to grade 12) of the most educated member of a household.</td>
<td></td>
</tr>
<tr>
<td>Highest educational qualification achieved by the most educated individual of a household.</td>
<td></td>
</tr>
<tr>
<td><strong>Health related indicators</strong></td>
<td></td>
</tr>
<tr>
<td>Drinking water: ordinal variable (ranging from 1 to 5) indicates the quality of water source for the drinking purpose.</td>
<td></td>
</tr>
<tr>
<td>Toilet: ordinal variable (ranging from 1 to 5) reflects the type of toilet used.</td>
<td></td>
</tr>
<tr>
<td>Garbage: ordinal variable (ranging from 1 to 4) expresses the kind of rubbish disposal.</td>
<td></td>
</tr>
</tbody>
</table>
6.4 The household wellbeing level: non-monetary vis-à-vis monetary indicator

It is important to evaluate both monetary and non-monetary indicators of well-being, in order to perform a complete analysis of inequality. In particular, this section makes a comparison between two proxies of wellbeing: non-monetary (wellbeing) indicators estimated by the polychoric PCA and a monetary variable – the expenditure on consumption. The theoretical approach behind this comparison is Sen’s\(^3\) (1985a) capability approach to measurement of inequality. Consumption expenditure has been chosen in many existing analyses on inequality. However, it does not represent multidimensional wellbeing Sen argues that money is a means but not an end (outcome of wellbeing); thus, an analysis using monetary variable could be misleading because income/expenditure ‘gives a very inadequate and biased view of inequalities’ (1997b, pp.384-385). On the other hand, the non-monetary indicators consider the level of wellbeing and reflect the translation from various dimensions, including but not limited to income.

This analysis differs from existing studies on multidimensional inequality using the PCA method (e.g. Ward 2014) because it includes specific variables that reflect household achievements in educational and health dimensions, in addition to asset indicators. The current thesis shares a similarity with McKenzie (2005) in analysis of inequality but it uses households rather than individuals as the main unit of analysis for two reasons. First, the expenditure data does not consider the economy of scale which arises from different consumption needs of adults and children, especially in large families. Second, in the case of Vietnam, there is no research on how the economy of scale is set, so using any adopted value of scale could create inappropriate results.

A relationship between household expenditure and the wellbeing index is described in Table 6.2. The two methodologies used for this comparison are the within quintile

\(^{3}\) He claims that inequality is a multiple issue, and an objective of any analysis of inequality may focus on wellbeing which comprises plausible factors rather than just economic outcomes represented by income or expenditure. Details of this discussion were presented in the chapter of theoretical framework.
ranking consistency and the Spearman-rank correlation technique. The population in each wave of survey is classified in five quintiles based on the household expenditure, and the household wellbeing indicator respectively. Then, an identification matching technique is used to record the part matched within the same quintiles by these two methods. As can be seen in the second column, the matching technique shows a level of consistency around 40% across these four waves. This means that about 60% of the wellbeing level measured by the non-monetary approach may not be covered by the expenditure variable. The third column reveals the ranking correlation between the household expenditure and the wellbeing index. Compared with the within-quintile matching, the Spearman-rank correlation method illustrates closer and significant correlation coefficients between the two proxies\textsuperscript{36}. This technique indicates that over two-thirds of households are consistently ranked by the wellbeing index and the household expenditure.

Results of the mismatch between the lowest quintile defined by the wellbeing index and the highest one identified by the expenditure data, and vice versa, are reported in the last two columns. The percent of mismatched households between two methods are negligible. An analogous approach to this kind of robustness checks is also evidenced in the literature on inequality. For example, Filmer and Pritchett (2001) verify the quality of the asset index by a comparison with expenditure data in the context of poverty analysis. They show that about two-thirds of the poorest 40% are classified consistently between two methods.

### Table 6.2: A consistency between the household expenditure data and the wellbeing index in household classification

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent matched within</th>
<th>Spearman coefficient on ranking</th>
<th>Wellbeing lowest quintile/ Income highest quintile\textsuperscript{37}</th>
<th>Income lowest Wellbeing</th>
</tr>
</thead>
</table>

\textsuperscript{36} All results estimated by the Spearman correlation coefficients are significant at the 1% level.

\textsuperscript{37} This fraction is estimated by the matching technique that expresses how many percentages of households categorised as highest expenditure quintile but as belong to the poorest quintile in wealth measured by the asset indicator approach.
Another confirmation of the quality of the wellbeing index is to compare its trend with changes in the household expenditure. As Vietnam did not experience any noticeable crisis (i.e. political conflict, or economic shock) which negatively affect the economic, health, or educational dimensions, the overall wellbeing level is expected to increase over the period 2002–2008. The results of the wellbeing level are obtained by using on the list of chosen variables defined in Section 6.2 added in the wellbeing index as follows:

\[
    w_h = \sum_{i=1}^{X} \sum_{d_{kj}} \beta_{i \mid d_{kj}} y(x_{i \mid d_{kj}})
\]

Based on the pooled VHLSS 2002–2008 data, this section calculates the wellbeing level for each wave. The polychoric PCA produces the zero-mean aggregated wellbeing values for the whole sample; hence, the wellbeing level of each wave could not be interpreted in its absolute values. However, it is evaluated relatively through its changes over the period. Table 6.4 shows variations in the mean of wellbeing value for the whole country and two selected regions. The national wellbeing level, placed in the first column, demonstrates an upward trend spanning 2002–2008. This trajectory is compatible with the actual socioeconomic progress in the Vietnamese society. This tendency seems to be similar to a variation in the average household real expenditure presented in the last column.

The following table also illustrates the regional level of wellbeing movement in two distinct regions. This section mainly targets of checking the robustness of the wellbeing index before presenting inequality results, only the Red River Delta and...
the North Mountainous regions are taken into account because of two reasons. There is a considerable contrast in the living standard between the two regions; therefore, the wellbeing differentials can be clearly compared and confirmed with the dispersion in the economic dimension. Second, adding more regions in this analysis is unnecessary to improve the quality of these checks, but it could produce an imprecise analysis as the central information of this chapter is inequality. While the households residing in the Red River Delta are among the best performers in functionings in all dimensions, families living in the North Mountainous have restricted achievements, especially in economic activities. The method of observation of changes in wellbeing at the regional level is analogous at the national level. This section pools data for each region over 2002–2008 before applying the measurement of wellbeing. The patterns of movement in wellbeing in both the two regions follow the trajectory of the national level of wellbeing. This evidence confirms that the wellbeing indicator generated by the polychoric PCA is a sufficiently good proxy used for an analysis of inequality. Regarding this comparison, the chapter shows an analogy with Ward’s (2014) analysis of the Chinese households’ wellbeing over the period 1989–2006. While Ward (2014) finds an improvement in the wellbeing level in both urban and rural areas, the current research shows evidence of improvement in wellbeing within regions. These similar results further support the merit of the wellbeing index generated by the polychoric PCA.

Table 6.3: Changes in wellbeing over the period 2002–2008

<table>
<thead>
<tr>
<th>Year</th>
<th>The national wellbeing level (W)</th>
<th>The wellbeing in the Red River</th>
<th>The wellbeing in the North Mountainous</th>
<th>Household expenditure (million VND)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>-.7502684</td>
<td>-.7822194</td>
<td>-.7643418</td>
<td>14.64</td>
</tr>
<tr>
<td>2004</td>
<td>-.1910074</td>
<td>-.1723805</td>
<td>-.2051175</td>
<td>19.36</td>
</tr>
<tr>
<td>2006</td>
<td>.2370399</td>
<td>.2149756</td>
<td>.2377183</td>
<td>24.62</td>
</tr>
<tr>
<td>2008</td>
<td>.7473937</td>
<td>.7784944</td>
<td>.7315027</td>
<td>31.33</td>
</tr>
</tbody>
</table>

Source: VHLSS 2002–2008; author’s estimation

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Figure 6.1 demonstrates an identical pattern and movements in the wellbeing level by applying the kernel density function. This graphical technique differs from other studies in the same topic. Using the bootstrap predicted Gini of non-durable goods constructed by a regression model, McKenzie (2005) shows a significant relationship between the relative inequality index based on the PCA measurement and the Gini coefficient. Ward (2014) uses the wealth ‘parade’ based on Pen’s (1971, cited in Ward 2014, p.19) initial idea of income ‘parade’ technique that assumes the distributional curve of a later wave is above the earlier wave. Instead of the wealth ‘parade’ technique, this section simply uses the kernel density distribution function for Vietnamese data. The value of wellbeing index increases across time as the distribution of later wave moves towards the right-hand-side. The wellbeing indicator generated by the polychoric PCA is reasonable and comparable. This analysis confirms the quality of the wellbeing indicator for inequality analysis.

![Figure 6.1: An estimate of wellbeing density for the period 2002–2008](source: VHLSS 2002–2008; author’s estimation)
6.5 The level of inequality in wellbeing

This section analyses inter-temporal and temporal changes in inequality for the whole country and specific geographical areas during the two decades 1990s and 2000s. Section 6.5.1 examines inequality over the period 1993–1998. Because the sample sizes of these two waves are rather small, an examination of the spatial inequality will only dwell on the urban and rural dimensions to guarantee the quality of the metric. As discussed in Section 6.3, inequality at the national level is measured based on the pooled data of VLSS 1993 and VLSS 1998. With respect to the within-urban and within-rural inequality, data of urban and rural households are merged over these two waves of survey.

The polychoric PCA is applied to calculate the unique variable weights in the wellbeing index. While generating these scoring factors for these variables, the PCA computes the greatest eigenvalue (λ) which is incidentally also the largest discrimination across the sample. Given a vector of indicators which represent various dimensions of wellbeing as defined in Eq. 5.3.7, the value of \( w_h \) is a combination of all existing amount or types of wellbeing determinants, \( y(x_{id_{kj}}) \), associated with their weights. By construction, PCA calculates the partial sample variance for each of components and the first eigenvalue also reflects the greatest proportion of the sample variance. The first principle component of PCA provides the maximum discrimination across a population according to the overall wellbeing level. Using these scoring factors as weights of variables, the household wellbeing level (\( w_i \)) and its standard deviation are estimated. Finally, an application of the Equation \( I_t = \frac{\sigma_t}{\sqrt{\lambda}} \) (5.3.8) illustrates the results of inequality levels, and a discussion about the trend in inequality by comparing with several regular measurements of economic and multidimensional inequality (Theil T, and Maasoumi’ index) could provide a clearer picture\(^{38}\).

Section 6.5.2 examines inequality over the period 2002–2008 with respect to the within-urban, within-rural, and the regional dimension. For the whole nation, this

\(^{38}\) By construction, the PCA-based measurement of inequality cannot directly provide the between-inequality results and thus, this chapter is unable to make a comparison between the economic and multidimensional inequality methods.
section uses the compiled data of VHLSS 2002–2008 with an adjustment for the size of VHLSS 2002 as mentioned in Section 6.3 above. In relation to the within-region inequality, unlike the GSO’s method of regional identification that separates the sample in eight zones, this chapter divides the country in five regions: (1) the Northern Mountain that includes the initial North East and North West; (2) the Red River; (3) the Central Coast consisting of both the North and South Central Coast sub-regions; (4) the Southeast and Central Highlands; (5) the Mekong Delta. This rearrangement of regional data is because of two reasons. Sub-regions sharing similar geographical and demographic characteristics could be grouped. For example, both the North East and North West are mountainous, among the least populous areas, and have a large portion of ethnic minorities in their total population. Additionally, sample sizes of the sub-regions are insufficient for an estimate of inequality using PCA method, and therefore the comparative results of inequality could be insignificant. The analytical strategy of regional inequality is analogous with that of national inequality; regional data are pooled over time and the inequality index is defined as a fraction of sample standard deviation at time $t$ and $\lambda$ obtained from the correlation matrix of combined data for a particular region. The outcomes of inequality are compared to inequality measured by several conventional methods (e.g. Gini coefficient).

We further check the robustness by comparing the single result of multiple dimensions of inequality with the inequality measured only by the asset dimension, which is presented in section 5.3. The ending section will discuss the contributions of our findings.

6.5.1 The trend in inequality over the 1990s

This subsection discusses changes in inequality for the period 1993–1998. Results of inequality are summarized in Table 6.4. In this table, $I_t$ defines inequality in household wellbeing, and is measured by Equation: $I_t = \frac{\sigma_t}{\sqrt{\lambda}}$ (5.3.8). Column 2 presents a substantial increase in inequality at the national level from 0.31 to 0.52. This upward trend is also found for within-urban inequality although the urban areas experienced a higher level of inequality than the whole country during the period.
1993–1998. In rural areas, despite a significant growth, the level of inequality is remarkably smaller than in the urban, especially in the 1998.

The Gini coefficient and Theil T index of the household real expenditure are presented as benchmarks. Results of these two measurements of income inequality show a similar trend although the Theil T index is preferable in favour of decomposition purposes. While $I_t$ reports a rising inequality, the Theil T index reveals a decrease in the within-rural inequality. The main drivers are credit dedicated to the rural poor and more equitable land reform policies in the rural areas. Moreover, budget decentralisation also supports inequality decline (Molini and Wan 2008). Regarding the urban areas, though both measurements illustrate a growth in inequality, the magnitude of inequality calculated using the Theil T is smaller than the one calculated using the wellbeing inequality index, $I_t$. The later measurement shows that the within-urban inequality level is even higher than national inequality level.

For further discussion, the section compares inequality estimated by the polychoric PCA approach and by the Maasoumi approach. Justino (2012) uses the Massoumi index to calculate the multidimensional inequality in Vietnam over the period 1993–1998. As mentioned in the two previous chapters, the results of Maasoumi’s estimates even with the same datasets are various because there are many possible combinations between two parameters ($\alpha$: the inequality aversion, $\beta$: the dimensional substitution). Among possible values of these two parameters, this chapter chooses two cases: $\alpha=0$, indicating that a society does not care about inequality, and $\alpha=1$, meaning that the society is increasingly concerned about inequality. The dimensional substitution, $\beta$, is fixed and equal to 1, implying that it is positive and proportional substitution between dimensions. Justino’s (2012) two-dimension inequality index (economic and educational) points out the uncertain outcomes computed by the Maasoumi method. As can be seen in the table, two choices of the inequality aversion ($\alpha$) produce conflicting results. When there is no aversion to inequality ($\alpha=0$), inequality could increase marginally. Nevertheless, if there is an existence of inequality aversion in the society, the inequality is likely to decline. The challenge is
that it is very hard to know the true value of $\alpha$ (and $\beta$) and therefore, the Maasoumi index cannot provide definite conclusions of inequality.
Table 6.4: Inequality in Vietnam in the period 1993–1998\textsuperscript{39}

<table>
<thead>
<tr>
<th></th>
<th>Whole country</th>
<th>Within-urban</th>
<th>Within-rural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$I_t$</td>
<td>Gini</td>
<td>Theil $T$</td>
</tr>
<tr>
<td></td>
<td>$\alpha=0$</td>
<td>$\alpha=1$</td>
<td>$\alpha=0$</td>
</tr>
<tr>
<td>1993</td>
<td>0.31</td>
<td>0.34</td>
<td>0.20</td>
</tr>
<tr>
<td>1998</td>
<td>0.52</td>
<td>0.36</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Source: VLSS 1993, 1998; author’s estimation; Results of Maasoumi’s index are in Justino (2012, Table 1).

\textsuperscript{39} Descriptive calculations of inequality are in Appendix B.
6.5.2 Inequality in the period 2002–2008

6.5.2.1 Within-urban and within-rural inequality

Using the compiled data from VHLSS 2002–2008, this subsection estimates the within-urban and within-rural inequality in household wellbeing and compares the results with the Theil T index, and the Gini coefficient of household expenditure. Results showed that there was a convergence in inequality at the national level, the urban, and the rural areas in the 2000s. As can be seen in Figure 6.2, during the period 2002–2004, inequality in the urban areas remained relatively high at around 0.55 and fairly unchanged, while inequality within rural areas showed a substantially lower value at 0.36 but with a faster growth pace. However, the absolute gap between two indices was still large. Since 2004, there have been two contrary tendencies in inequality between the urban and rural areas. The rural inequality continuously increased and reached a peak at the end of the studied period whereas the urban inequality declined gradually. The difference in the wellbeing inequality between the two regions was negligible in 2008; the results of inequality were about 0.50 and 0.46 for the urban and rural areas respectively.

Figure 6.2: Within-urban and within-rural inequality 2002–2008

Source: VHLSS 2002–2008; author’s calculation
The national inequality level is determined by the within-urban and within-rural components. The increased inequality in both areas in the period 2002–2004 caused a marginal rise in the national inequality. However, inequality in the household wellbeing decreased after that. In addition, the figure also implied that the inequality within rural and within urban areas rather than the urban–rural gap contributed major parts to the overall inequality in the 2000s. Ward (2014) claims that a decline in the urban–rural inequality could refer a situation where the wellbeing achievement in rural areas progresses with a faster rate than in urban ones, and the gap in wellbeing level between two areas is diminishing. His findings are contrary with most of current studies which conclude a reduction in inequality for the same period. Huong and Booth (2014) point out that the Gini coefficient of household expenditure remained unchanged from 2002 to 2004 and monotonically fell over the following two years. They also find opposing trends in the Gini coefficient of household expenditure between the urban and rural spaces. Figure 6.3 reveals that although the overall inequality in the whole country seems to be stable, the Gini coefficient results demonstrate a gradual increase in both within-urban and within-rural areas in 2008. The Theil T index also confirms this upward trend (Figure 6.4). The consistency between the Gini and Theil measurements is of importance to provide a preliminary information about inequality before using them as a benchmark for multidimensional inequality analysis. The conflicting trends of between the economic dimension and multidimensional inequality emphasize that income inequality itself should be not enough to paint a clear picture of inequality which needs to be discussed as a multi-faceted issue.

Different results of inequality estimated by the wellbeing index approach and conventional measurements are mentioned. One of the first dissimilarities is the inequality trend for the whole country. Both the Gini coefficient and Theil T index show that inequality reduced in the period 2002–2008 whereas inequality in the wellbeing distribution measured by the polychoric PCA rose steadily. A reason for this contrast is that inequalities in the other dimensions (i.e. education and health) could increase and cancel a decrease in income inequality; rises in non-income dimensions also determine the overall trend in multidimensional inequality.
Therefore, inequality of wellbeing increased while income inequality decreased in the period 2002–2008.

Another point is that the PCA method shows a higher level of inequality within urban areas than at the national level. There is a clear convergence in the inequality level among the whole country, in urban, and in rural areas. Nevertheless, the two regular measurements highlight a higher level of inequality for the whole country rather than urban areas, and urban households could suffer from a substantially greater disparity in wellbeing than rural families.
Figure 6.3: The Gini coefficient of household expenditure within-urban, and within-rural

Source: VHLSS 2002–2008; author’s calculation

Figure 6.4: The Theil T index of household expenditure within-urban, and within-rural

Source: VHLSS 2002–2008; author’s calculation
6.5.2.2 Regional inequality

This subsection explores remarkably different trends in the wellbeing inequality across the country. The inequality within-region, which is measured by Equation 5.3.8 shows that the Southeast and Highlands was the most unequal region at least until 2006. In contrast, the Northern Mountainous region experienced a rapid expansion in wellbeing inequality, and thus became the most unequal region in 2008. This upward trend could be explained by some demographic characteristics of the region. A high proportion of minor ethnicities experiencing socioeconomic disadvantages could widen the gap between the major and minor ethnic groups. This perspective is similar to the one proposed in several studies on the Vietnamese regional inequality. For instance, Takahashi (2007) finds that unequal educational background between the major and minor groups within regions is a main contributor to the regional inequality.

Starting at the same level of inequality in 2002, the Mekong Delta and the Central Coast were the regions with the lowest level of wellbeing inequality in 2008 although both regions have experienced an increasing trend in inequality in the observed period. The Red River Delta shows a marginal increased dispersion in household wellbeing in the selected period. Among the five regions, the Southeast and the Highlands were two exceptional areas where the degree of inequality slightly decreased. The ending point of the studied period shows narrower differences in the inequality level across the country.
6.5.3 Robustness checks

This section additionally checks robustness of the chosen measurement of inequality applied to Vietnamese data in the period 2002–2008. To do so, we compare our results with the estimates of inequality using the asset and housing indicators or the asset index which excludes the educational and health indicators. The reason for this is that the number of asset and housing variables is sufficient to generate a benchmark whereas those of the other two dimensions are too small to validate similar estimates. Additionally, asset variables were used as proxies for multiple dimensions of household wellbeing; therefore, a comparison between two indices could reinforce our findings above.

We firstly evaluate the quality of asset index by analysing their distribution with the Kernel density estimation technique (Figure 6.6). The results show a movement in the asset value from the left- to the right-hand-side, meaning that the economic dimension of household wellbeing evolves over time. However, with several clumps, the asset index would do a poorer job if it is used to compute inequality because a clumping indicator could not identify differentials across the population in the case that these variations are marginal (McKenzie 2005).
Finally, the robustness check is presented in Table 6.5. There is a similar upward trend in inequality in the asset dimension and wellbeing. It is noted that by construction, the absolute values of inequality measured by PCA content no meanings without a comparison. The nature of the index here is to observing the extent to which changes in the asset and wellbeing distributions in a particular time versus the entire examined period. The similar increases in the two indices confirm the consistency between asset-based and wellbeing multiple indicators including education and health dimensions and the privilege of wellbeing index in terms of investigating inequality.

**Figure 6.6: Kernel density estimate of asset distribution**
Table 6.5: Checking robustness of the inequality index

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{\text{ASS}}$</td>
<td>.415</td>
<td>.446</td>
<td>.452</td>
<td>.454</td>
</tr>
<tr>
<td>$I_t$</td>
<td>.453</td>
<td>.498</td>
<td>.498</td>
<td>.504</td>
</tr>
</tbody>
</table>

Note: $I_{\text{ASS}}$ is inequality calculated based on the asset dimension, $I_t$ is the preferred inequality index. Source: VHLSS 2002 – 2008; author’s calculation

6.5.4 The contribution of the findings to the literature on inequality

This subsection discusses the extent to which the results of inequality measured by the wellbeing indicator uniquely contribute to the literature. In order to do that, it is necessary to return to the hypothesis of the trend in inequality in Vietnam\(^40\). It is also important to restate the concept of inequality chosen in this thesis, that is supported by Sen’s (1997b) argument. Inequality of wellbeing is a multidimensional concept; therefore, an analysis of inequality should cover several dimensions of wellbeing.

Chapter 3 presented the country background and (Section 3.4.3) indicated conflicting results about the level of inequality because of different methods, data, and dimensions (e.g. Badiani et al. 2013). A measurement of inequality based on income or consumption expenditure data is not necessarily incorrect. However, expenditure is just a means, albeit important, to many ends of wellbeing; therefore, the results of inequality in expenditure could not describe the overall wellbeing inequality reasonably (Sen 1997b, pp.34-35, Sen 2006). The same problems have been found with the multidimensional inequality indices (e.g. Maasoumi’s approach) that cannot give an appropriate explanation for inequality because their results are subject to a variety of choices of parameters. This evidence shows a substantial gap in the literature on trends in wellbeing inequality in specific countries (e.g. Vietnam)

The findings of this section contribute to fill this gap by presenting new results on the increase in multidimensional inequality in the period 1993–2008. This chapter shows that inequality steadily increased over the 1990s. With respect to the period 2002–2008, Badiani et al. (2013) presents contradictory results showing that income

\(^{40}\) This hypothesis was stated in the chapter of introduction.
inequality remained fairly constant in Vietnam but the non-income inequality increased at the same time. The Gini coefficient of income per capita illustrates a substantially higher and rising inequality level than that of expenditure per capita\textsuperscript{41}. This shows that an evaluation of inequality should considers not only the non-economic (education, and health) but also the economic outcomes. In this circumstance, the findings of this section are novel and important.

The contribution of findings of this analysis to the literature is even more meaningful with respect to different developing country contexts which include, but are not restricted to Vietnam. Empirical evidence from several countries show contradictory results of inequality even within the economic dimension. Zhuang et al. (2014, pp.21-22) point out that income and expenditure proxies are regularly mixed in analyses of inequality in Asian countries, which could lead to seriously inconsistent cross-country comparisons. Polychoric PCA and a consolidation on the indicators used in a measurement of wellbeing and inequality is crucial to reach unambiguous research outcomes. One can use polychoric PCA method to compare inequality across countries with similar development levels (e.g. low income group) and achieve conclusive results.

To conclude, Section 6.5 has filled a gap in the literature on multidimensional inequality. First, the results presented in this section considerably decrease the confusion of made by the current measurements of multidimensional inequality (e.g. Maasoumi’s index). Second, these results possibly resolve the conflicting trends in income and non-income inequality in Vietnam and therefore, they could explain why inequality in household expenditure is relatively small, but the common perception of Vietnamese society is that inequality may continue to increase. These findings also suggest that the Vietnamese Government should be concerned about the importance of inequality despite the stable trend of the Gini expenditure index and other similar measures over the examined period. This implies that an investigation of the effectiveness of current inequality related policies is needed. This issue is however further analysed in the following chapter.

\textsuperscript{41} See Figure 3.6 in Chapter 3.
6.6 Chapter conclusion

This chapter has analysed inequality in Vietnam in the 1990s and 2000s. The measurement of inequality using the polychoric PCA is superior to other existing measurements such as the Maasoumi two-stage approach and the multidimensional Ginis. It provides new results on inequality level; uses a broader list of variables, which are likely to reduce distortions in the estimates; considers and allows correlations across dimensions getting involved in the measurement. Compared to other studies in inequality applying PCA, this chapter offers further insight of studies in inequality in two main ways. First, while previous research only focuses on the economic aspect of inequality, this chapter provides an overview of multidimensional inequality including wealth, educational, and health dimensions. This extension beyond the economic aspect is necessary to reach more comprehensive understanding of multiple-inequality in particular contexts. This idea is also supported by Sen’s capability approach. Second, the chapter observed the level of inequality over time, in addition to across places temporally, so it offers more information on inequality that can be used for further analyses in favour of inequality reduction policies.

Inequality in Vietnam has substantially increased over the studied periods. Although inequality within regions shows different patterns, most of the regions follow the national trend which has marginally extended over time. There has been, however, a reduction in within-urban and within-rural inequality but the urban–rural gap has expanded. Based on these results, the research sheds light on inequality in multiple dimensions. These results of inequality will be used for an evaluation of causal factors of inequality and the relevant policy implementations.
Chapter 6 discussed about the trend in inequality in Vietnam over the 1990s and 2000s. It argued that is inequality in wellbeing neither fairly low nor stable as what the Gini coefficient of household expenditure indicates. Inequality rises over time, which raises a caution to the Vietnamese Government that it should not be free from concerning about inequality. However, the research is ambitious to go beyond the point of observing the trends in inequality.

The primary objective of this chapter is to shed light on the extent to which the governmental pro-poor expenditure influences income inequality, poverty reduction and household wellbeing simultaneously. Effective antipoverty policies should address inequality because a more equitable economy stimulates the poorest groups to accumulate assets (World Bank 2001). Ravallion (2005) and the World Bank (2005) show that countries with low inequality perform substantially better in reducing poverty, and furthermore that excessive inequality erodes the positive effect of economic growth on poverty reduction. Rising inequality impedes poverty reduction in the long run because it prevents the poor from socioeconomic advancement (Ravallion 2004). Additionally, inequality is harmful for growth itself since it obstructs the accumulation process of human capital of poor households (Cornia and Court 2001). Thus, assessing the independent link between and among pro-poor expenditure and inequality, poverty reduction, and household wellbeing is an important undertaking because poverty reduction may come at the expense of a more unequal distribution of income and lower level of wellbeing, on average.

Research on the simultaneous impact of pro-poor spending on both poverty and inequality is limited. Up until 2010, only four studies consider total public expenditure as an explanatory variable for economic inequality (Afonso et al. 2010). Among these four studies, only Gustafsson and Johansson (1999) concentrate on a regression between the budget dedicated to social security and inequality in 16 selected OECD countries, but the main results are statistically insignificant. Li et al.
(2000) apply nonparametric methods to analyse the inequality–economic growth correlation and treat government spending as a control variable. Data from a large panel of countries show evidence that public expenditure reduces inequality over the period 1960–2000.

Evidence from the Asian region seems to support the statement of conflicting trends in inequality and poverty. Inequality has increased steadily in a number of developing countries although the poverty incidences fell over time. Inequality rises because income of the richest group grew at a faster pace than those at the lower tail of the income distribution (Zhuang et al. 2014, p.35). The International Monetary Fund (2014, pp.30-31) notes that the effects of social assistance programs in Asia Pacific are ambiguous with respect to poverty reduction since they often overlap with growth enhancing policies (e.g. educational services, and infrastructure capacities).

The paucity of evidence is a result of a number of factors: (1) overlapping objectives usually implies that different ministries and government agencies get involved, which makes implementation complicated; (2) mistakes in identifying beneficiaries (pro-poor programs were leaked to non-poor households); (3) low coverage of various programs; (4) and reliance on poorly justified in-kind and price subsidies. This ambiguity implies that evidence on the extent to which specific pro-poor programs are helpful in reducing poverty and inequality within an Asian context like Vietnam is in demand and indeed highly policy relevant.

Furthermore, research on the impact of pro-poor spending on wellbeing at the national level has not much established, and it is still far from a consolidation. Note that wellbeing is a multidimensional matter in its nature; thus, using a form of wealth (i.e. GDP, income) as a proxy for wellbeing, which is commonly seen in various studies (e.g. Deaton 1980)\(^42\), should not paint a synthetic picture of the level of wellbeing. This chapter adheres to the estimates of wellbeing generated in the previous empirical chapter (Section 6.4) by using the polychoric PCA method. The question is that whether pro-poor programs designed to improve the household

\(^42\) However, he then emphasizes the multi-facet characteristic of wellbeing including ‘freedom, education, autonomy, dignity, and the ability to participate in society’, and ‘wellbeing cannot be judged by one or more of its parts without looking at the whole’ (2013, p.9).
wellbeing for the poor could inhibit progress in the level of national average wellbeing. Thus, in addition to the relationship between anti-poverty, and inequality and poverty reduction, the anti-poverty programs–wellbeing causal relationship should be an essential part in any assessment of the pro-poor expenditure.

This chapter contributes to the literature by using data from Vietnam to compute these causal relationships. Vietnam presents an interesting case study for two reasons. First, the country is known as a good example of poverty alleviation as the poverty headcount ratio (HCR) decreased substantially from 58% in 1993 to lower than 14.5% in 2008 (Badiani et al. 2013, p.1) based on the US$1.25 (PPP) poverty line. Despite this success, both inequality and poverty are still explicitly targeted by the Government which have applied pro-poor policies and directed financial resources towards these priorities. Second, the total budget dedicated to inequality and poverty reduction is shared by over sixty provinces based on information collected by the central government. A corresponding proportion between the poverty incidence and targeted budget spending allows an intensive evaluation of the NTP efficiency at the within-province level.

To estimate the effects of NTPs on poverty, inequality, and wellbeing, a dynamic panel estimator, particularly the system generalised method of moments estimator is used. This estimator is the most appropriate for the unbalanced longitudinal data with a short time dimension where the fixed-effects and the ordinary least-squares (OLS) methods could perform ineffectively. System GMM computes correlation coefficients through both the level and difference equations where the lagged first differences are used as instruments in level equations and lagged first levels used as instruments in difference equations (Bun and Sarafidis 2013). System GMM exhibits less bias than the fixed-effects and least-squares estimators when variables are dynamic (Arellano and Bond 1991). For completeness and benchmarking, estimates from OLS estimators are also presented.

The rest of the chapter is structured as follows. The next section provides a background of Vietnamese programs of poverty and inequality reduction. Section 7.3 examines the data and describes the methodology. The empirical analysis is in
Section 7.4. Discussions about the results are in Section 7.5 that also concludes with policy suggestion.

7.2 Background of the Vietnamese Pro-poor National Targeted Programs

The Pro-poor National Targeted Programs (NTPs) are a group of strategies, policies, and financial investments delivered by the Vietnamese Government to improve multiple aspects of human wellbeing of communities and households who are most vulnerable (i.e. SRV 1998). These comprise: (1) Program 135\(^43\); (2) Hunger Eradication, Poverty Reduction, and Job Creation (HEPR-JC); (3) Safe water and Rural sanitation; (4) Family planning; (5) Sociocultural enhancement; (6) Education and Training\(^44\). Financial resources for increasing the number of programs have risen subsequently since 2000. The Government approximately tripled the expenditure on NTPs from over 4200 to more than 14 000 in billion VND (273.8 to 739.5 million current US$ equivalent)\(^45\) which accounts for 1.7% of the total annual budget over the 2000s on average (Figure 7.1). An exception is in the financial year 2006 when this indicator shows a drop by about one third compared with 2005\(^46\). The central government allocates NTPs to provinces based on preliminary information on the socioeconomic status and the amount of poor households. For instance, a thorough investigation of communes and households suffering from extreme hardship was prepared carefully for Program 135 approval (SRV 1998). Decisions and implementations of the other programs also follow an analogous procedure to Program 135. Details of the size of provincial NTPs are documented in Appendix F.

\(^{43}\) It is a pro-poor policy with three tasks: improvement in the transportation capacities; provision of subsidy in-kind for targeted households; and reallocation of cultivation lands for landless households, which the Government targeted directly to the least developed communes across the country in 1998 (SRV 1998).

\(^{44}\) The other national targeted programs that do not concentrate on poverty and inequality are exclusive.

\(^{45}\) The exchange rate is as follows: 1 USD = 15 337 VND (2002), and 18 932 VND (2010) (Ministry of Finance 2002, 2010b).

\(^{46}\) This decline could be because of the phase gap in the policies. The governmental documents evidence expirations of the initial HEPR–JC, set for the period 2001–2005, and the first stage of Program 135 in 2005. Although the renewals of these two programs were approved in 2006, updated details of implementation and the instruction were released in the following year.
Despite remarkable economic growth, the poverty ratio in Vietnam remained high in the 1990s irrespective of any poverty line used. Approximately half of the population lived with less than US$1.25 per day in 1998 (Badiani et al. 2013, p.10), whereas income inequality has increased simultaneously. In addition, Nguyen et al. (2007) point out that an increase in the urban–rural gap contributes to the lion’s share of the overall rising inequality across the country between 1993 and 1998. Income inequality also exists persistently between the majority and minority ethnic groups (van de Walle and Gunewardena 2001). The Government tackled these issues first with the announcement of Program 135 whose concentration is a robust socioeconomic development in the areas suffering from ultimate disadvantages over three stages (1998–2005, 2006–2011, and 2012–2015). The Government then set up a series of supportive programs (The Program on Hunger Eradication, Poverty Reduction, and Job Creation (SRV 2001); on Safe water and Sanitation in Rural Areas 2006–2010 (SRV 2006); on Employment by 2010 (SRV 2007); Population and Family planning by 2005 (SRV 2002); Education and Training by 2010 (SRV 2008). These programs, in most cases, are deployed together at the provincial and district levels (Ministry of Planing and Investment and MoF 2014).

The different NTPs share the objective to help the poor by boosting economic productivity, and to narrow the income dispersion across the nation. Such twin

Figure 7.1: Total nominal budget expenditure on the NTPs over the 2000s (in billion VND)

purposes of poverty and inequality reduction are explicitly stated in the vast majority of pro-poor programs. For instance, HEPR–JC (SRV 2001) attacked poverty in multiple socioeconomic dimensions of the poor’s livelihood: provision of a financial package for housing construction; establishment of a microcredit program for small new business start-ups; provision of free training courses; provision of free healthcare services and school fee exemption for children. Through these programs, the Government pursues the ultimate goal which is declared in its political mission: ‘Rich people – strong nation – equitable, democratic and civilised society’ (Beresford 2008, SRV n.d). It is expected that NTPs influence poverty, inequality, and wellbeing but an evaluation of their causal effects has not been quantitatively assessed thus far. This paper analyses the financial aspects of the six components of NTPs as a whole because of data availability.

However, pro-poor spending in Vietnam could exacerbate inequality (van de Walle 2004). In the 1990s, public expenditure intended for the most vulnerable groups might be leaked to those whose were least vulnerable. van de Walle (2004, p.5) claims that the National Development Programs (later amended as NTPs) tend to foster economic growth rather than provide social protections for the poor. Fritzen (2002) and Ravallion (2006) critique the NTPs for governance reasons. Various divisions and levels of the Government were in charge of program practices, but a huge gap remained in many localities. The failure of pro-poor programs could entail a widening within-province income gap.

Although positive effects on several economic aspects of NTPs are discussed (Fan et al. 2004, Kang and Imai 2012)\footnote{Fan et al. (2004) find a decline in the poverty rate due to the public investments in agricultural (e.g. irrigation), and rural areas (e.g. roads). Their study is, however, limited to agricultural investment. Kang and Imai (2012) assert that the substantial drop in poverty rate could result from these programs. However, they lack appraisals of the specific linkage between NTPs and poverty decline.}, those are insufficient to reach a consensus of poverty and inequality affected expectedly by NTPs as a whole. Research in poverty and inequality also has concerns about NTP outcomes because they were employed via various *ad hoc* schemes in the 1990s (Fritzen 2002, van de Walle 2004, Ravallion 2006). These decision-making processes seem to be applied to a large number of
programs in the following decade. It is a danger as the pro-poor expenditure is continuously extended without adequate convincing evidence of its effectiveness at achieving as stated objectives.

7.3 Data and Methodology modification

7.3.1 Data and variable description

7.3.1.1 Data sets

This chapter uses biennial panel data from 2002 to 2010 for approximately two thirds of 63 Vietnamese provinces and municipalities (called provinces for simplicity)\(^{48}\). In this panel, province is the unit of analysis. First, the data of NTPs are obtained from the online documents of the Ministry of Finance of Vietnam (MoF) (2005a, 2006, 2008, 2010, 2012). Provincial overall budget expenditure and its partition dedicated to NTPs are retrievable at MoF website\(^{49}\). Because of large variances in the provincial population size, instead of the annual total NTP amount, the NTP per capita is used as the variable of interest.

Second, data of expenditure per capita, poverty, inequality, and wellbeing are extracted from five waves of the Vietnam Household Living Standard Survey (VHLSS) 2002–2010 to compute the mean values for provinces. VHLSS\(^{50}\) is collected by the General Statistics Office of Vietnam (GSO) with technical advice from the World Bank. It contains microdata for 9000 households such as demographic information, expenditure, income, educational achievements, health status, and poverty across the country. The data of provincial population and values of industrial and agricultural output products are from the online database of GSO (2015).

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\(^{48}\) Data are unavailable for approximately a third of provinces simply because of statistical shortage, implying that these provinces did not properly record NTPs in detail. Missing observations occur randomly among the population and over time; it may affect the interpretation if the sample does not represent the whole population. Section 5 will return this problem.

\(^{49}\) At http://www.mof.gov.vn/portal/page/portal/mof_vn/1351583/2126549/2115685

\(^{50}\) The VHLSS 2002 is an exception, surveying about 29000 households.
Variables

The wellbeing variable is constructed from 25 indicators of the household assets, housing features, and educational and health outcomes. The value of household wellbeing is obtained by the polychoric PCA developed in Kolenikov (2005) as discussed in the Methodology chapter (Section 5.3, Eq.(5.3.7)):

\[ w_h = \sum_{i=1}^{X} \sum_{d_{i(=0)}}^{d_{in}} \beta_{i \mid d_{kj}} y(x_{i \mid d_{kj}}) \]

In this equation, \( X \) indicates the variables representing for household wellbeing; \( d_{i(=0)} \ldots \) \( d_{in} \) denotes \( n \) quantities or categories of variable \( x_{i} \); \( y(x_{i \mid d_{kj}}) \) reflects the obtainable situation of a household ownership of assets, educational achievement, health status; \( \beta_{i \mid d_{kj}} \) could be interpreted as the weight of the achievable situation of \( x_{i} \) association with its particular class or quantity. As the chapter pursues to observe whether the ranking of provincial wellbeing evolved corresponding to related factors, the z-score technique is used for the normalisation of the ranked wellbeing in individual wave, with which the province with the highest level of wellbeing receives the lowest score.

The Gini coefficient of expenditure represents income inequality. The Gini coefficient provides a unique level of inequality across a distribution. Expenditure represents a better measurement of the standard of living than income for a variety of reasons, such as income underreporting and transitory shocks to income (Deaton and Zaidi 2002, pp.11-13, Nguyen et al. 2007, Glewwe and Dang 2011). The mean value of Gini coefficient for the whole sample is 31.8; it varies largely across provinces from 21.8 to 46.8. In addition, notwithstanding stability in inequality at the national level, the within-province disparity in income distribution presents a gradual increase over the 2000s. Starting at 30.5 in 2002, the index climbed to 32.3 in 2006, followed by a fluctuation in the later phase, and ended at 32.4 in 2010. With respect to the regional dimension, mountainous and highland provinces with high rates of minor ethnicities out of the total population suffered from greater degree of inequality than the Mekong and Red River delta located ones.
Table 7.1: Within-province inequality\textsuperscript{51} in Vietnam in the period 2002–2010 at the national level

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Gini</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>30.5</td>
<td>3.22</td>
<td>21.8</td>
<td>37.8</td>
<td>42</td>
</tr>
<tr>
<td>2004</td>
<td>31.8</td>
<td>3.98</td>
<td>25.0</td>
<td>39.6</td>
<td>47</td>
</tr>
<tr>
<td>2006</td>
<td>32.3</td>
<td>4.32</td>
<td>23.8</td>
<td>41.7</td>
<td>49</td>
</tr>
<tr>
<td>2008</td>
<td>32.1</td>
<td>4.34</td>
<td>25.9</td>
<td>46.8</td>
<td>47</td>
</tr>
<tr>
<td>2010</td>
<td>32.4</td>
<td>4.79</td>
<td>23.9</td>
<td>42.1</td>
<td>43</td>
</tr>
<tr>
<td>Whole sample</td>
<td>31.8</td>
<td>4.19</td>
<td>21.8</td>
<td>46.8</td>
<td>228</td>
</tr>
</tbody>
</table>

Source: VHLSS 2002–2010, authors’ calculation

\textsuperscript{51} Inequality measured by the Gini coefficient of household expenditure per capita is calculated using Araar and Duclos's (2013) ‘Distributive Analysis Stata Package’ version 2.3. This Stata package is suggested for measurements of poverty and inequality (e.g. Haughton and Khandker 2009).
Table 7.2: Within-province inequality in Vietnam over the period 2002–2010 at regional level

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean Gini</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red River Delta</td>
<td>28.5</td>
<td>4.22</td>
<td>21.8</td>
<td>38.7</td>
<td>38</td>
</tr>
<tr>
<td>North East and West</td>
<td>34.1</td>
<td>4.21</td>
<td>27.2</td>
<td>42.7</td>
<td>59</td>
</tr>
<tr>
<td>North Central</td>
<td>32.0</td>
<td>2.27</td>
<td>28.0</td>
<td>36.9</td>
<td>14</td>
</tr>
<tr>
<td>South Central</td>
<td>30.3</td>
<td>2.83</td>
<td>25.9</td>
<td>38.0</td>
<td>25</td>
</tr>
<tr>
<td>Central Highland</td>
<td>36.9</td>
<td>4.10</td>
<td>31.9</td>
<td>46.8</td>
<td>13</td>
</tr>
<tr>
<td>Southeast</td>
<td>32.0</td>
<td>3.20</td>
<td>27.1</td>
<td>40.5</td>
<td>33</td>
</tr>
<tr>
<td>Mekong Delta</td>
<td>31.0</td>
<td>2.77</td>
<td>26.6</td>
<td>39.2</td>
<td>46</td>
</tr>
<tr>
<td><strong>Whole sample</strong></td>
<td><strong>31.8</strong></td>
<td><strong>4.19</strong></td>
<td><strong>21.8</strong></td>
<td><strong>46.8</strong></td>
<td><strong>228</strong></td>
</tr>
</tbody>
</table>

*Source: VHLSS 2002–2010, authors’ calculation*

With regard to the poverty variable, the GSO–WB poverty lines with inflation adjustments as announced in GSO (2011, p.693) is used to calculate the poverty incidence (%). The GSO–WB poverty lines have been constructed by a collaborative team between GSO and the World Bank based on the VHLSS data (Badiani et al. 2013)52. In 2002, there was only one poverty line applied to both urban and rural areas; urban and rural poverty lines were repeatedly identified and updated afterwards. The population weights between these two areas are also considered in these estimates of poverty incidence.

52 See Appendix E
Table 7.3: Variable description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{it}$</td>
<td>Average HCR (%) of province $i$, being subject to the national poverty lines adjusted by the inflation rate at wave $t$</td>
</tr>
<tr>
<td>Gini</td>
<td>The Gini index of consumption expenditure per capita within province $i$ at wave $t$, varying in the $0$–$100$ scale</td>
</tr>
<tr>
<td>$W_{it}$</td>
<td>average level of household wellbeing in province $i$, generated by the PCA method at wave $t$</td>
</tr>
<tr>
<td>$nthp_{it}$</td>
<td>Natural logarithm of average NTPs spending per capita of province $i$ at time $t$</td>
</tr>
<tr>
<td>$exp_{it}$</td>
<td>Natural logarithm of average annual expenditure per capita for province $i$ at time $t$</td>
</tr>
<tr>
<td>$edu_{it}$</td>
<td>Average school grades completed by adults aged 15 or over in province $i$ at time $t$</td>
</tr>
<tr>
<td>$ia_{it}$</td>
<td>Ratio of production output value between industrial and agricultural sector in province $i$ at time $t$.</td>
</tr>
</tbody>
</table>

Poverty reduced significantly from 29% to around 14% over the period 2002–2010 on average (GSO 2011 693). The research sample is at 28.6% and 11.5%, respectively. The poverty incidence substantially varies across regions; negligible poverty ratios can be found in more urbanised provinces whereas the poor resides mainly in geographically disadvantaged areas.

The chapter hypothesises that poverty, inequality, and wellbeing are determined partially by their one-period lags denoted as $(t - 1)$, meaning that they are persistent. Litchfield and Justino (2004) reveal such a characteristic in poverty in the Vietnamese economy through a comparison between two earliest waves of the living standard survey (VLSS 1992/3, 1997/8). Two other Southeast Asian countries, Thailand and the Philippines, also demonstrate an autocorrelation phenomenon in poverty, inequality, and economic growth (Kurita and Kurosaki 2011).
The main explanatory variable of interest is the natural logarithm of NTP per capita ($ntp_{it}$). Because the current value of NTPs depends upon the previous socioeconomic condition, it is as an endogenous variable. Additionally, time gaps exist in NTP application and effectiveness, meaning that any change in the poverty incidence, inequality, and level of wellbeing could result partially from the first lagged rather than the contemporary NTPs. Analyses of NTPs thus should consider its lagged values. In this study, the causal effects of NTPs are examined carefully at both the current and one-wave lagged ($t-1$).

Additional variables (expenditure per capita, educational attainment, and industrial–agricultural output ratio) are included as a control vector. The real consumption expenditure per capita, $exp_{it}$, is a proxy for the living standard. Despite debates regarding directional effects on poverty and inequality, a plethora of research finds significant relationships between consumption expenditure and poverty and inequality (e.g. Ravallion 2004, Khan et al. 2014). It is argued that the previous amount of consumption expenditure affects the current level of inequality and poverty ratio (Kurita and Kurosaki 2011).

The education variable ($edu_{it}$) records the average school grade of adults from the age of 15. Education is a key determinant of poverty reduction; therefore, research in poverty suggests that equal access to public educational services is a solution to poverty alleviation (e.g. Baye and Epo 2015). Yet, the contribution of education to inequality is ambiguous. Under Mincer’s (1958) theory, the education–inequality nexus is not obviously unidirectional. In fact, worse-off households invest restrictedly in education, which in turn leads to lower earnings from their activities compared with the well-off. That means the poor is unlikely to catch up with the rich due to a long-standing shortage of financial resource. An agreement is that if governments distribute the educational services more equally, the education factor could mitigate the income gaps (e.g. Nguyen et al. 2007, Liu 2008). Ravallion (2016, p.498) emphasises compulsory education as a solution to equitable growth based on the empirical results from Asian newly industrialised economies. For the Vietnamese case, OECD (2014) shows an exception that, on average, Vietnamese students aged 15 outperforms those even from selected developed countries with the same tests.
despite the relative poverty of the country. This result implies that economic conditions (e.g. income) are less likely a determinant of educational achievements. Thus, in the relation to poverty and inequality as dependent variables, our approach is to treat education as an exogenous explanatory variable.

The last regressor is the industrial–agricultural output value fraction, $ia_t$, which represents the level of provincial industrialisation. This variable is considered in the specific models corresponding to Kuznets (1955) inequality hypothesis expressing that the income distribution and the domination of the industrial sector in provincial economies follows the inverted-U shape; the more industrialised the economy, the less the contribution of agricultural sector to the total economic output. In the case of Vietnam, $ia_t$ differs greatly across provinces. In several agriculture-led provinces, the ratio is less than one whereas in the most advanced areas, it is over 30. The variable $ia_t$ is treated as an exogenous variable.

### 7.3.2 A specification of the Arellano–Bond model

This present paper applies the system GMM estimator developed in Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). The estimating equations are as follows:

\[
Gini_{it} = \alpha_{11} Gini_{i(t-1)} + \alpha_{12} ntp_{it} + \alpha_{13} ntp_{i(t-1)} + \alpha_{14} exp_{it} + \alpha_{15} exp_{i(t-1)} + \alpha_{16} ia_{it} + \alpha_{17} edu_{it} + \text{timedummies} + v_{Gi} + \epsilon_{Git} \tag{7.1}
\]

\[
p_{it} = \beta_{11} p_{i(t-1)} + \beta_{12} ntp_{it} + \beta_{13} ntp_{i(t-1)} + \beta_{14} exp_{it} + \beta_{15} exp_{i(t-1)} + \beta_{16} ia_{it} + \beta_{17} edu_{i} + \text{timedummies} + v_{pi} + \epsilon_{pit} \tag{7.2}
\]

\[
W_{it} = \gamma_{11} W_{i(t-1)} + \gamma_{12} ntp_{it} + \gamma_{13} ntp_{i(t-1)} + \gamma_{14} exp_{it} + \gamma_{15} exp_{i(t-1)} + \gamma_{16} Gini_{it} + \gamma_{17} edu_{i} + \gamma_{18} ia_{it} + \text{timedummies} + v_{wi} + \epsilon_{wit} \tag{7.3}
\]

System GMM uses two sources of exogenous variation: (1) lagged levels of the dependent variable as instruments in difference equations, and (2) lagged differenced

---

\[^{3}\] It may raise a concern about feasible effects of NTPs on consumption expenditure in the right-hand-side of equations 7.1–7.3. A diagnostic test for both each wave and the whole panel (Stata command collin ntp pcexp) however shows that there is no existing correlation between these two variables. Therefore, I do not consider an additional equation which focuses on this relationship in the model.
of the dependent variable as instruments in level equations. In addition, it exploits instruments from a variety of orders of eligible independent variables provided these do not correlate with the part of disturbance relating to the idiosyncratic shocks from heteroscedasticity in specific individuals.

The chapter uses system GMM for two reasons. First, the panel data used are dynamic and short, facts that compromise the quality of estimates of correlation coefficients when using traditional models (e.g. OLS, fixed-effects, or random-effects GLS). OLS cannot deliver efficient and consistent estimates with lagged dependent variables. In fact, a correlation between the lags of dependent variables \((Gini_{i(t-1)}, p_{i(t-1)}, \text{and } W_{it})\) with the fixed effects \((v_{Gi}, v_{pi})\) in Eq.(7.1), Eq.(7.2), and Eq.(7.3) results in Nickel’s (1981) ‘dynamic panel bias’. Roodman (2009b) points out that overestimates for the autoregressive coefficient occurs in OLS exactly reflect the problems of this endogeneity. If the fixed-effects method is used, the fixed individual effects can be differenced out from the data. However, the estimate could be (downward) biased as a correlation between past realisation of dependent variables and idiosyncratic error terms remain in the within transformation (Baltagi 2005). Similarly, bias is also found when using the random-effects estimators for a dynamic panel because of the presence of lagged dependent variable (Anderson and Hsiao 1981).

System GMM, however, relaxes the exogeneity assumption and uses internal instruments exploited from the past realisations of dependent and independent variables in absolute values and in difference. Intuitively, such instruments are feasible because they closely correlate with instrumented variables but not with disturbances, provided these errors are not serially correlated. For instance, in the autoregressive form of Eq.(7.1), both \(Gini_{i(t-2)}\) and \(\Delta Gini_{i(t-2)}\) are used in the GMM estimators for a computation of autocorrelation coefficients through two following equations:

\[
\Delta Gini_{it} = \alpha_{11}\Delta Gini_{i(t-1)} + \Delta \epsilon_{Git} \tag{7.11}
\]

\[
\Delta Gini_{it} = (\alpha_{11} - 1)Gini_{i(t-1)} + \mu_{i} + \epsilon_{Git} \tag{7.12}
\]
In Eq.(7.11) and Eq.(7.12), $Gini$ and $\Delta Gini$ at period 1 are used as instruments for period 3, respectively. Additional instruments generated from other independent variables are added in the model subject to the dynamic nature of data as discussed by Roodman (2009b).

Second, Blundell and Bond (1998) show that the difference GMM developed in Arellano and Bond (1991) which applies only the lagged levels as instrumental variables for difference equations could omit essential information in original data. In the difference GMM style, when the autocorrelation coefficient between a dependent variable and its lags in the right-hand-side approaches to unity, a nexus between the instrument with lags and the levels of dependent variable becomes powerless. In contrast, system GMM maintains the efficiency and consistency even when the dependent variable is near a random walk. Blundell et al. (2000) stress that the symptoms of weakly exogenous covariates, considerable sample bias and imprecise information in the difference GMM estimators are significantly reduced in system GMM.

The one-step rather than two-step system GMM is preferred in our estimates for the causal effects of NTPs on poverty and inequality. Albeit the two-step GMM estimators increase the efficiency, it exploits many weak instruments which are created by a quadratic equation in the time dimension (Newey and Windmeijer 2009, Acemoglu et al. 2015). Roodman (2009a) further claims that the computed matrix of instruments in two-step GMM subject to all moment conditions is poor in small samples. Thus, this paper uses the one-step GMM with the assumption of independent and identical distribution in the original residuals.

Two essential internal checks are undertaken, namely autocorrelation in the idiosyncratic disturbance and over-identification of instruments. Roodman (2009b) notes two key issues regarding the validity of the autocorrelation test. First, the researchers should add all time dummies in the model to prevent contemporary correlation across individuals. Second, it is essential to consider the number of individuals in the sample because a small sample size (20 units or less) will likely violate the central limit theorem that is invoked in this test. The instrument over-
identification is tested using the Sargan/Hansen test, investigating whether the number of orthogonality conditions is greater than that of estimated parameters in the GMM procedure (Hansen 1982). Finally, a comparison of results with estimates from the corresponding OLS estimator is presented as a robustness check.

7.4 Empirical results

7.4.1 Inequality model

Table 7.4 shows that the lags of the variable of interest (NTP) statistically significantly correlate with inequality. Unexpectedly, the Gini coefficient of expenditure within-province is likely to increase due to a rise in public funds for poverty and inequality reduction. This result reflects the fact that ineffective pro-poor targeted policies have been continuously applied in Vietnam from the 1990s regarding the inequality dimension. van de Walle (2004) claims that poor households are likely to receive less than the nonpoor in terms of absolute amount of money from the Vietnamese social transfer policies, which could be a key reason for a positive correlation between inequality and NTPs in the following decade unless the procedure of NTP allocation has been improved. Another supportive evidence of this counterintuitive relationship is found in Klump (2006), who finds that the financial resources of Program 135 were misused with respect to the participatory determination and program supervision. There is also an urban bias in social welfare distribution that shares identical purposes with NTPs. Nearly half of total spending on social welfare (social insurance, social subsidies, school fee exemption, poverty alleviation fund, NGO income) was allocated to urban areas where only about one fifth of the total population and 6% of the poor resided in 1998 (van de Walle 2004).

<table>
<thead>
<tr>
<th>Table 7.4: Determinants of within-province inequality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable: Gini</td>
</tr>
<tr>
<td><strong>Gini</strong>(_{(t-1)})</td>
</tr>
<tr>
<td>(0.057)</td>
</tr>
<tr>
<td><strong>ntp</strong>(_{t})</td>
</tr>
<tr>
<td>(0.449)</td>
</tr>
<tr>
<td><strong>ntp</strong>(_{(t-1)})</td>
</tr>
<tr>
<td>(0.498)</td>
</tr>
<tr>
<td><strong>exp</strong>(_{t})</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
\[
\exp(t-1) \quad -6.626^{**} \quad -3.722^* \\
(2.989) \quad (4.115)
\]

\[
iat_t \quad 0.024 \quad -0.052 \\
(0.050) \quad (0.070)
\]

\[
edu_t \quad -0.626^{**} \quad -0.787^{**} \\
(0.266) \quad (0.377)
\]

\[
\begin{align*}
2010 & \quad (.) \quad (.) \\
2008 & \quad -0.411 \quad 6.826 \\
& \quad (1.880) \quad (13.356)
\end{align*}
\]

\[
\begin{align*}
2006 & \quad -0.788 \quad 8.178 \\
& \quad (1.103) \quad (11.836)
\end{align*}
\]

\[
\begin{align*}
2004 & \quad 0.120 \quad 9.929 \\
& \quad (0.657) \quad (10.780)
\end{align*}
\]

\[
\begin{align*}
2002 & \quad 10.627 \\
& \quad (9.858)
\end{align*}
\]

Constant \quad 12.257^{***} \\
(3.509)

Source: MoF online data of budget spending; VHLSS 2002-2010; GSO’s Statistical Yearbooks (various years); author’s calculation

Note: SE in the bracket; * \( p < 0.1 \), ** \( p < 0.05 \), *** \( p < 0.01 \)  
Adjusted R2 (OLS) = 0.462; Observations = 159.  
For system GMM, Instruments =37; Sargan/Hansen \( p \)-value\n\( =0.566/0.350 \); \( p \)-value of test of AR(1) = 0.048; for \( \text{AR}(2)=0.120 \)

7.4.2 Poverty model

Table 7.5 illustrates a insignificant causal effect of NTPs on poverty. That means these programs could be implemented inappropriately. Likewise, van de Walle (2004) explores that targeted transfers have no effects on poverty while social insurance, social subsidy, and school fee exemption did not reveal any role of the safety net as their initially proposed goals in Vietnam in the 1990s. She finds complex schemes of NTP decision with participants from different ministries getting involved. Unfortunately, this type of administrative schemes seems to remain the same over the following decade.
Table 7.5: Determinants of within-province poverty incidence

<table>
<thead>
<tr>
<th>Poverty HCR ($p_t$)</th>
<th>OLS</th>
<th>System GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{(t-1)}$</td>
<td>0.666***</td>
<td>0.371***</td>
</tr>
<tr>
<td></td>
<td>(0.074)</td>
<td>(0.150)</td>
</tr>
<tr>
<td>$n_{tp_t}$</td>
<td>-1.667**</td>
<td>-2.189</td>
</tr>
<tr>
<td></td>
<td>(0.788)</td>
<td>(2.084)</td>
</tr>
<tr>
<td>$n_{tp_{(t-1)}}$</td>
<td>3.506***</td>
<td>3.007</td>
</tr>
<tr>
<td></td>
<td>(1.080)</td>
<td>(1.953)</td>
</tr>
<tr>
<td>$exp_t$</td>
<td>-23.533***</td>
<td>-29.379***</td>
</tr>
<tr>
<td></td>
<td>(5.064)</td>
<td>(6.546)</td>
</tr>
<tr>
<td>$exp_{(t-1)}$</td>
<td>3.472</td>
<td>-7.068</td>
</tr>
<tr>
<td></td>
<td>(5.297)</td>
<td>(6.786)</td>
</tr>
<tr>
<td>$ia_t$</td>
<td>0.400***</td>
<td>0.666***</td>
</tr>
<tr>
<td></td>
<td>(0.092)</td>
<td>(0.185)</td>
</tr>
<tr>
<td>$edu_t$</td>
<td>-0.633</td>
<td>-1.549**</td>
</tr>
<tr>
<td></td>
<td>(0.441)</td>
<td>(0.677)</td>
</tr>
<tr>
<td>2010</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>2008</td>
<td>0.238</td>
<td>86.867***</td>
</tr>
<tr>
<td></td>
<td>(3.383)</td>
<td>(20.053)</td>
</tr>
<tr>
<td>2006</td>
<td>-1.063</td>
<td>78.063***</td>
</tr>
<tr>
<td></td>
<td>(2.000)</td>
<td>(17.389)</td>
</tr>
<tr>
<td>2004</td>
<td>-6.085***</td>
<td>69.153***</td>
</tr>
<tr>
<td></td>
<td>(1.342)</td>
<td>(15.452)</td>
</tr>
<tr>
<td>2002</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>constant</td>
<td>35.624***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6.689)</td>
<td></td>
</tr>
</tbody>
</table>

Source: MoF online data of budget spending; VHLSS 2002–2010; GSO's Statistical Yearbooks (various years); author’s calculation

Note: SE in the bracket; * $p<0.1$, ** $p<0.05$, *** $p<0.01$. For OLS, Adjusted $R^2=0.92$, N=159. For system GMM, Instruments=38; Sargan/Hansen $p$-value =0.055/0.439; $p$-value of test of AR(1) = 0.001; for AR(2)=0.790
This unexpected finding is consistent with Cuong (2008), who argues that the microcredit program targeted to the poor is not really pro-poor as better-off households account for a majority of fund receivers. One important sign of inefficiency could be due to the serious corruption which creates distortions in the financial packages of NTPs. Olken (2006) claims that redistribution programs in developing countries may promote corruption whose economic deadweight losses generated outweigh benefits received by the targeted recipients.

In addition, a gap between the proposed plans and implementation of anti-poverty programs substantially decreases their influence. This mismatch is because of several reasons: administrative capacity deficiencies; benefits captured by more powerful non-poor groups; objectives of organisations during program implementation (Matin and Hulme 2003). This also means that inequality is harm for anti-poverty strategies. Ravallion (2006) explains that poverty is persistent in the case of high inequality which leads to unfair decision-making in public spending dedicated to poverty reduction. The more unequal the distribution is the more biased anti-poverty programs will be.

Education, again, is a contributor to poverty decline. Gaining more knowledge helps the poor not only to decrease the income gap with the rich but also to improve their living standard. Over 20% of the public budget was devoted to education expenditure in 2010 (World Bank 2014b). There is also equal access to educational services between male and female. This result confirms the common wisdom that equal opportunities in the approach to public educational services could be an important driver of the positive effects of educational achievements on poverty mitigation.

The industrial–agricultural output ratio positively significantly correlates with the poverty incidence. The higher share of industrial sector in provincial economies does not guarantee a lower poverty ratio because of two reasons. First, more industrialised provinces are likely to be less targeted in terms of poverty reduction in both the number and the financial size of programs. The role of the service sector is not taken into account in this variable due to statistical limitations. In fact, low quality service activities could be the poor’s important livelihoods in a developing country; hence,
the non-agricultural–agricultural output ratio could be a better indicator to explain poverty reduction.

These results are analysed in a comparison with those calculated by OLS estimators. While OLS estimates show that the correlation coefficient on the lagged poverty HCR is twice as high as the GMM results, it seems to lower the coefficients on consumption expenditure, education, and industrial–agricultural output ratio. Additionally, the fact that education does not significantly relate to poverty incidence could be a sign of model misspecification. In contrast, GMM shows a statistically significant correlation between poverty reduction and education.

7.4.3 Wellbeing ranking model

Table 7.6 reports a positive but statistically insignificant relationship between one-wave lagged NTPs and the average ranked household wellbeing. The complex effects of NTP could be because different targeted programs benefit various groups. This result is consistent with the evidence of mixed impacts of Program 135 in Cuong et al. (2015). They find that the program improved the household income, and reduced poverty status of the ethnic minorities but it did not show such positives effects on the ethnic majority (i.e. Kinh ethnic) which account for over 85% of the total population. However, the paucity of research on relationships between NTPs and other dimensions of the household wellbeing cause difficulties to make comparison with the outcomes from this study.

The expenditure per capita raises the household wellbeing; as a consequence, the household wellbeing ranking will be higher. This relationship confirms that increasing income nurtures the overall social progress in the Vietnamese case. Note that general economic achievements (i.e. income or GDP per capita) and the (individual/national) wellbeing level do not always move with the same direction because the wellbeing is influenced by various indicators rather than just solely income itself (Allin and Hand 2014, pp.5-6). Likewise, Deaton (2013) suggests that wellbeing should be examined in multiple aspects such as income, health, education, freedom, autonomy, social connection.
Education also indicates positive and statistically significant effects on the household wellbeing. By contrast, the industrial–agricultural output ratio negatively influences the wellbeing level; however, the correlation coefficient is not significant at the 5% level.

Table 7.6: Results for explanatory variables of wellbeing

<table>
<thead>
<tr>
<th>Dependent variable: ( W_t )</th>
<th>OLS model</th>
<th>System GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>( W_{t-1} )</td>
<td>0.810***</td>
<td>0.620***</td>
</tr>
<tr>
<td></td>
<td>(.051)</td>
<td>(.125)</td>
</tr>
<tr>
<td>( pcexp_t )</td>
<td>-0.206 ***</td>
<td>-0.285**</td>
</tr>
<tr>
<td></td>
<td>(.052)</td>
<td>(.112)</td>
</tr>
<tr>
<td>( pcexp_{t-1} )</td>
<td>0.117***</td>
<td>0.058</td>
</tr>
<tr>
<td></td>
<td>(.039)</td>
<td>(.050)</td>
</tr>
<tr>
<td>( ntp_t )</td>
<td>-0.294</td>
<td>0.819</td>
</tr>
<tr>
<td></td>
<td>(.460)</td>
<td>(1.21)</td>
</tr>
<tr>
<td>( ntp_{t-1} )</td>
<td>0.183</td>
<td>-1.136</td>
</tr>
<tr>
<td></td>
<td>(.305)</td>
<td>(1.30)</td>
</tr>
<tr>
<td>( edu_t )</td>
<td>-0.105***</td>
<td>-0.164***</td>
</tr>
<tr>
<td></td>
<td>(.032)</td>
<td>(.046)</td>
</tr>
<tr>
<td>( ia_t )</td>
<td>0.007</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>(.005)</td>
<td>(.016)</td>
</tr>
<tr>
<td>2010</td>
<td>.</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(.)</td>
</tr>
<tr>
<td>2008</td>
<td>-0.189</td>
<td>2.397**</td>
</tr>
<tr>
<td></td>
<td>(.194)</td>
<td>(1.024)</td>
</tr>
<tr>
<td>2006</td>
<td>0.115</td>
<td>2.202***</td>
</tr>
<tr>
<td></td>
<td>(.095)</td>
<td>(.759)</td>
</tr>
<tr>
<td>2004</td>
<td>-0.08</td>
<td>1.874***</td>
</tr>
<tr>
<td></td>
<td>(.079)</td>
<td>(.613)</td>
</tr>
<tr>
<td>2002</td>
<td>.</td>
<td>1.689***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.496)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.852***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.237)</td>
<td></td>
</tr>
</tbody>
</table>

Source: MoF online data of budget spending; VHLSS 2002-2010; GSO’s Statistical Yearbooks (various years); author’s calculation

Note: The wellbeing variable is ranked, and transformed using inverse-normalisation technique. SE in the bracket; * \( p<0.1 \), ** \( p<0.05 \), *** \( p<0.01 \); Adjusted R2 (OLS) = 0.90; Observations = 159; For system GMM, Instruments = 29; Sargan/Hansen \( p \)-value = 0.497/0.713; \( p \)-value of test of AR(1) = 0.0; for AR(2) = 0.745

54 The consumption expenditure per capita and the national targeted pro-poor program per capita variables are in million VND.
7.4.4 Internal tests and robust checks

The results obtained by OLS estimators are generally robust to GMM estimates. OLS cannot however purge the endogeneity dynamic problem arising from lagged variables. Regarding the Arellano–Bond autocorrelation test of the first order (AR(1)) and second order (AR(2)) autocorrelation in the idiosyncratic disturbance, the p-values for both AR(1) in two cases of poverty and inequality dependent variable are significant at the 1% level, meaning that the results reject the null hypothesis of no serial correlation in the first order of error terms in difference. However, the outcomes for AR(2) in both cases are not significant at the 5% level, implying that there is insufficient evidence to reject the null hypothesis of no serial correlation in the second order of the disturbance in difference. These results render a valid application of the GMM estimators to the empirical analyses. Additionally, the Sargan/Hansen over-identification test p-values do not provide adequate evidence to reject the null hypothesis of valid instruments, implying that the instruments generated in the system GMM approach satisfy the orthogonality conditions involved.

7.5 Chapter conclusion

To pursue a social economy with less inequality and higher level of wellbeing, the Vietnamese Government has implemented a series of policies, called NTPs, which possibly affect poverty, inequality, and wellbeing since the late 1990s. NTPs have profoundly extended since that date, but applications of these programs are fragment, and there is a shortage of post-evaluation of their efficiency. A restriction in the financial effectiveness of NTPs could entail a bad consequence when poverty are not affected, but inequality and the national debt expend$^{55}$. The empirical exercise shows that the NTPs have had limited effectiveness. Inequality is likely to widen when NTPs increase, ceteris paribus. There is not adequate evidence to support the NTPs – poverty reduction, and the NTPs –

$^{55}$ The Vietnamese public debt per capita nearly tripled over the period 2004–2010, and the total debt is over the half of the national GDP in 2010 (The Economist 2015).
wellbeing relationships. We argue that these results could arise from implicit effects of NTPs on poverty through the third factor (i.e. income), which also highly relates to the explained variable. A reason for this argument is that NTPs include various components that also favour economic growth (van de Walle 2004). The ambiguous impacts of NTPs could also be the result of governance issues. Corruption circumvents the original direction of NTPs (e.g. Olken 2006), while multiple decision-makers are costly and make NTPs more complex but less observable (e.g. Klump 2008). These findings suggest that the Government should make the NTPs more transparent, that financial support goes correctly to the households and communities in need.

As education could be useful with respect to poverty and inequality reduction, and wellbeing, the Government needs to concentrate on improving the capacity of the educational system and consider it as a vital pillar of NTPs. A concern is that inequality in education between urban and rural areas, and between the rich and the poor (World Bank 2008) could depreciate these positive effects of education. Therefore, lowering inequality in access to education, and improving the quality of educational services in the poor areas are useful.
8 POLICY IMPLICATIONS AND THESIS CONCLUSIONS

8.1 Summary of thesis contributions

Inequality is often a consequence of progress. Not everyone gets rich at the same time, and not everyone gets immediately access to the latest life-saving measures, whether access to clean water, to vaccines, or to new drugs for preventing heart disease (Deaton 2013, p.1).

This thesis has analysed wellbeing inequality and the relationship between public policies and inequality using Vietnamese data. Sen’s (1985a) capability approach, rather than utilitarian theory, was chosen to form the theoretical foundation of this research. Utilitarian economics is entirely based on individual preferences. By its nature, individual preference cannot derive feasible interpersonal comparisons and thus any analysis of inequality using the utilitarian approach can be misleading. Another problem arising from utilitarian theory is the use of an income proxy for wellbeing. Although income is one important dimension of wellbeing, wellbeing consists of many factors that include non-monetary factors such as educational achievements and health status. Using only an income proxy can therefore lead to debatable inequality research outcomes. In contrast, the capability approach defines wellbeing in non-subjective dimensions as being composed of different objective factors which can be used for interpersonal comparisons. Using this approach, the thesis constructs an inequality index with respect to plausible dimensions of wellbeing that include material living standards, educational achievements and health status. In other words, inequalities in multiple aspects of wellbeing are integrated in a single multidimensional inequality index. Using this measurement, the thesis contributes to economics by computing consistent results for inequality.

Readers are reminded that the literature on multidimensional inequality provided inconsistent outcomes derived from Maasoumi’s and the AKS measurements even when they were using the same data. The results of these conventional measurements are subject to choices made in the parameters used in the models. Particularly, the literature review shows ambiguous patterns in inequality when analysing Vietnamese household wellbeing. Although the conventional measurements recognise the necessity for using a number of variables proxied for dimensions included in estimations of inequality, their use in practice reveals weaknesses. This paper’s
chosen methodology – polychoric PCA – outperforms conventional measures by being able to account for a large number of continuous and discrete indicators proxying for plausible aspects of wellbeing. The PCA-based inequality index precisely informs the extent to which wellbeing is distributed in a society without the requirement for debatable assumptions (i.e. social inequality attitude, dimensional substitutions) and thus it provides a unique measure of inequality.

This thesis has also argued that asset only indicators, which are found in many studies on multidimensional inequality using PCA-based measurements, do not cover non-economic dimensions of wellbeing. Therefore, a panel of more than twenty variables comprising household assets, educational achievements (schooling years and degrees), and health related variables (sources of drinking water, types of toilet, garbage disposal and the number of unwell days) were added to the measurement of wellbeing inequality. The Kernel density estimation of wellbeing progress is robust for the chosen method and variables added in the measurement of inequality.

Using Vietnamese data, the analysis in this thesis should reach a more consistent conclusion. In contrast to the negligible change in inequality as measured by conventional methods, this thesis showed a sharp rise in inequality in the 1990s. In the following decade, inequality has continuously increased, albeit at a slower pace. Badiani et al.’s (2013) findings of more unequal distribution in non-economic dimensions match what was found in this research.

Another novelty is that this is the first time the efficiency of different anti-poverty and anti-inequality policies have been evaluated as a whole for a particular country (i.e. Vietnam) with respect to inequality, poverty and wellbeing. The thesis has argued that isolated assessments of different NTPs could result in misleading policy suggestions due to possible conflicting influences occurring in the policies. Additionally, there is still a gap in the research on poverty and inequality as there is no examination of possible unintentional effects of policies. Because of the close relationship between inequality and poverty, any particular policy directed towards either poverty or inequality should be analysed with respect to, at the very least, these two objectives. Then the effects of these policies should also be scrutinised in
relation to economic growth and wellbeing to paint a more complete picture of policy impacts. In line with this discussion, the research outcomes derived from the GMM model applied to the Vietnamese data showed that the NTPs were not effective. There is an insignificant link between the poverty rate and NTPs and between wellbeing and NTPs, but there was a significant positive inequality–NTP correlation. The thesis further investigated two possible reasons for this policy ineffectiveness. First, the effects of one NTP can be cancelled by others. Second, weakly managed and less observable NTPs can distort their directions, meaning that these NTPs therefore do not reach the targeted audience but rather go to unintended, ineligible individuals.

8.2 Policy implications

This section outlines recommendations on how anti-poverty and anti-inequality policies (i.e. NTPs) should be amended to keep progress moving in combating poverty and inequality. Inequality, both in economic and non-economic dimensions, has increased even though the number of Vietnamese households living in poverty decreased remarkably. As discussed in Chapter 7, the rise in the income gap was partially attributable to NTPs that were planned to tackle inequality and poverty. A decline in the poverty incidence is also unlikely to be connected with NTPs, but rather is linked to economic growth and educational investments.

Less efficient NTPs on poverty and inequality reduction are also evident. An increasing concern about NTPs arises from the capacity of public governance. Different agencies of the government being involved in the complicated process of NTP implementation may slow down the applications, and make NTPs less observable. The paucity of improvement in confronting corruption is another issue. Because of the monetary loss in policy implementation, financial resources proposed to assist the poor did not reach the targeted households but instead went to richer, ineligible households. Failure to gain access to NTP benefits significantly hindered progress in poverty alleviation.
8.2.1 Recommendations with respect to NTPs

The proposed recommendations here fall under the three themes of policy connections, authorities’ participations and the coverage of NTPs. Vietnam has established a variety of policies against poverty and inequality which are less consistent and supportive when examined together. Additionally, unnecessarily numerous decision makers from different government agencies complicate the process of policy implementation. The less efficient NTPs could be significantly impacted by these shortcomings. There are however several pieces of evidence on significant positive relationships between income, education and wellbeing. In the case of Vietnam, material affluence is an important observable determinant of wellbeing. Additionally, better education and healthcare also enhance wellbeing, so NTPs could extend their coverage to these aspects of wellbeing.

The simultaneous effects of all NTPs should be carefully evaluated before any additional pro-poor programs are implemented. Chapter 7 proved that policy applications are disconnected because the specific programs were developed independently. Targeting poverty reduction achievements should not exclude the effects of policies on inequality because of a close causal relationship between inequality and poverty reduction. Excessive income inequality hurts the poor in two ways: hampering growth and thus reducing opportunities for the poor; and preventing the worse-off from getting proportionate benefits from growth.

Another vital issue is the reduction in the number of different government agencies in charge of NTP decisions and implementation. Problematic bureaucracy increases the costs of the pro-poor policies and reduces the benefits reaching the poor. The Vietnamese Government realised the shortcomings of its complex bureaucratic administrations in the 1990s, but very limited progress in public management has been made since then. One effort of the National Assembly Vietnam (2015) is the decision to combine different NTPs into just two amended programs to be applied to the period 2016–2020. However, the simplification of decision making of the two updated programs is questionable. Under this approval, three ministries (Planning and Investment, Agriculture and Rural Development, and Labour – Invalids and Social Affairs) are ultimately responsible for these two programs. The extent to
which these programs will be appropriately implemented and their processes checked is questionable.

As decentralisation of anti-poverty programs could increase inequality (Ravallion 2007) and the compensatory reallocation between Program 135 and other NTPs is evident (Cuong et al. 2015), this thesis suggests that the allocation of NTPs need to be decided by the central government, and not influenced by local authorities. Targeted communes and households need to be assured of receiving benefits from particular pro-poor programs without considering whether or not they are involved in other NTPs.

As education is certainly important to fight poverty and inequality and to increase wellbeing, public investments in universal education need to be prioritised in the least developed areas. One common policy, *conditional cash transfers* which has now been implemented in over thirty countries, shows unambiguous benefits to the poor (Ravallion 2016, p.575). The idea of this program is to provide incentives to poor parents to keep their children in school for a certain amount of time. The positive effects of such pro-poor educational programs are myriad. Better education for poor children can help them free from poverty, engage them in the labour market, and enable them to catch up with the better-off in the future.

In the case of Vietnam, the government has made efforts to apply a *conditional cash transfer* policy through providing fee exemptions, free meals and accommodation for poor children during schooling time. The current educational strategies with respect to NTPs however are fragmentary and lack direction. It is also common to see a considerable time gap from policy proposal to implementation. Additionally, the magnitude of revised educational finance for the anti-poverty and anti-inequality policies tends to decrease. That impacts the poor and, perhaps, the equitable distribution of educational services.

Early childhood education also has a documented positive effect on reductions in poverty and inequality (Ravallion 2016, pp.176-180). Therefore, in order to tackle poverty and inequality, sufficient investment in the pre-school sector is needed. Only about a half of the children aged 36–59 months from the poorest quintile (based on
income distribution) were in pre-schools in 2014 (General Statistics Office and UNICEF 2015, p.179), while this percentage is much higher (over 85%) for children from households in the top quantile. Learning materials (e.g. books, media and toys) are also limited in worse-off families, and poor children often face a shortfall of care, especially in rural areas. Thus, early childhood education needs to be considered in the development of a comprehensive strategy to cope with poverty and inequality and to boost wellbeing.

Since health is an essential component of wellbeing, the government should take further consideration of public health care in relation to inequality and poverty. The nexus between income and health is multi-directional. Income inequality is a hazard to individual health (e.g. life expectancy), and poor public healthcare fuels inequality (Deaton 2003b). There are arguments for and against free healthcare for the poor. The defensive side shows that poor families are very sensitive to health care fees so governments need to subsidise the poor to access these necessary services. Conversely, critics argue that it is a ‘moral hazard’ if the poor are heavily subsidised. Ravallion (2016, p.488-490) emphasises that healthcare policies need to focus on preventive diseases, and watch for overuse (and misuse) of medication due to substantial subsidies.

Yet, as can be seen in Section 3.2.5, no progress in reducing the unequal access to health care is evident in Vietnam. The limited choices for poor people to access medical services are due to household financial and medical service constraints. Universal healthcare insurance targeting a coverage of 70% of the population by 2015 (Socialist Republic of Vietnam 2013) seems not to have had any success. Another challenge in equalising the healthcare supply is the poor distribution of quality services in rural areas.

8.2.2 Implications with respect to non-NTP policies

This subsection emphasises the institutional issues which impact major aspects of economic growth, poverty and inequality. Good institutional performance forms the

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There was no national report on this project in 2016, but several health insurance departments revealed a lower proportion of participants than the proposed targets.
foundation for nations to develop (Banerjee and Duflo 2011, Acemoglu and Robinson 2012, World Bank and Ministry of Planning and Investment of Vietnam 2016). Conversely, numerous countries have failed because they were unable to fix their institutional systems (Acemoglu and Robinson 2012).

Even the most well-intended and well-thought-out policies may not have an impact if they are not implemented properly. Unfortunately, the gap between intention and implementation can be quite wide. The many failings of governments are often given as the reason good policies cannot really be made work (Banerjee and Duflo 2011, p.235).

The question is how policies can attack poverty and inequality in the case of a considerably corrupt or weakly institutional country like Vietnam where there are countless examples of serious misallocation of NTPs due to corruption. Several domestic and international efforts to tackle corrupt behaviours in Vietnam have been instituted. A joint report reveals the limited awareness of the rights and obligations of communal officers and villagers in the implementation of Program 135 (Norwegian Agency for Development Cooperation et al. 2011) and the National Anti-corruption Strategy Towards 2020 (announced in 2009) are two examples, but weak implementations continue to challenge these efforts. Because of an absence of application of the law of access to public information, there is no transparency and citizens cannot observe the misuse of public investments. Furthermore, current penalties against corruption are not strong enough to decrease corrupt behaviours, which erode and distort public assistance for the poor. Transparency International (c.2015) reports no improvement in the corruption score (31/100, where 0 indicates no corruption and 100 is the most corrupt) and the level of corruption (i.e. the Corruption Perception Index) over the period 2012–2015 (112th out of 167 countries in 2015), and the World Bank (2015b) too is pessimistic as Vietnam’s performance in controlling corruption has decreased slightly in the twenty years after 1994.

To combat corruption requires time and massive effort. One solution is to call for transparent announcements of any program, and for people to participate in program

57 With a bitter title ‘Những con gà... u mê, những con dê... làm đường, lạc lối!’ [The dummy chickens and the misdirected goats], Dan Tri, a Vietnamese newspaper, detailed the seriousness of petty corrupt communal officials who embezzled even chickens and goats from NTPs. Yet, no clear actions against these corrupt persons were taken (Tam 2015).
observations to reduce possible losses in NTPs. Criteria of eligible recipients should be announced publicly to ensure an equitable approach to the programs. The World Bank (2003, pp.46-51) suggests that the appropriate solution to poverty (and inequality) is to empower all clients of public services (including the poor) to ‘control the service providers’. Gencer et al. (2011) report on the obvious achievements of the Vietnamese national electrification program based on the so-called model of ‘State and People Working Together’, although the success of the implementation of a community participation solution is internationally doubted (Banerjee and Duflo 2011, p.248). The ‘State and People Working Together’ model calls for contributions of people to various projects at the communal levels (e.g. village roads, bridges, electrical facilities). Local participants also directly oversee the implementation of the projects which reduces the probability of financial losses due to corruption. The model is, however, only suitable for the communal level, and such oversight is not likely for the higher levels.

NTPs are not enough to fight poverty and inequality unless public services (e.g. education, health care) are provided at a decent and even quality. Ravallion (2016, p.580) warns that the low quality of schooling services available to poor children could perpetuate inequality in education and economic dimensions.

8.3 Limitations and further research

8.3.1 Limitations

8.3.1.1 Limitations of data resources

Data used in Chapter 6 are from the Vietnamese household living standard surveys (VLSS and VHLSS). The major difficulty for any analysis of inequality is that household participants in surveys vary considerably over waves, so that establishing a longitudinal data set is not feasible for a 4-wave timespan. Several studies have employed two-wave panels with a large drop in observations despite the modest sample sizes of surveys compared to the population (approximately .1%). Small sample size also raises several concerns when inequality is decomposed into subgroup dimensions (i.e. urban–rural and within-region inequality). Therefore, this thesis uses pooled cross-section data for two phases (1990s and 2000s).
Additionally, VLSS and VHLSS are unable to provide full details of household wellbeing, in particular in regards to health status, to correspond to the capability approach. This thesis focused on the extent to which inequality has changed since *Doi moi* with respect to multiple dimensions but the surveys mainly provided data on material living standards.

Chapter 7 used various data resources, in addition to VHLSS, to create a short panel. The additional data had missing observations due to fewer obligations on local governments in reporting specific details of NTPs. Although the amount of expenditure on NTPs was released, people did not know how it was allocated for different programs. It would be much better to measure effects of particular programs on poverty, inequality and wellbeing in the same context, and to point out the reasons for the reduced effectiveness of different NTPs, but it is not achievable with the data at hand. This limitation may also create bias in estimates of the correlation coefficients of the variable of interest on the left-hand-side variables.

8.3.1.2 Limitations of methodologies

The use of PCA to measure inequality also poses several challenges. PCA cannot estimate absolute inequality, only the relative inequality index; therefore, the interpretation of inequality is based on the contribution of the partial variance to the total variance. This methodology enables the observation of inequality trajectories without the initial levels. Another limitation of PCA-based measurement of inequality is that it is a non-decomposition technique. That means it only estimates dispersion within a population but is unable to gauge inequality between subgroups. Because of this shortcoming, Chapter 6 could not paint a picture of urban–rural and between-region inequality. Alternatively, these dimensions of inequality are implicitly understood through a comparison between the divergence intra-subgroups and the national level of inequality at the same time.

In addition, measurement of inequality using the first component of PCA may not fully exploit information from initial variables. PCA generates components with respect to various criteria that categorise the variety of information on initial variables in its components. It is unclear about the extent to which this computation
is based on what exact criteria. This thesis however analyses inequality using only
the first components. Although the modification of the original PCA (to polychoric
PCA) improves its performance in handling discrete asset variables, it is possible that
bias still arises from the non-continuous data used.

There are also several possible limitations arising from the GMM applied in Chapter
7. Despite the fact that GMM is exclusively designed for short time panel data, the
small number of individuals (N=40) and time series (T=5) used in this metric could
limit benchmarking analyses so that the outcomes are less robust in spite of the
statistical significant of the internal tests (i.e. serial autocorrelation in residuals, over-
specification of instruments). The exogenous or endogenous characteristics of
variables are assumed with limited evidences while various options in the GMM
model could affect the correlation coefficients estimated.

8.3.2 Future research
In relation to the measurement of multidimensional inequality, the health dimension
deserves further enquiry. Existing data are unable to provide an insightful analysis of
the contribution of health status to wellbeing. It is also suggested that the VHLSS
needs to collect more intensive data on this dimension to improve our knowledge on
wellbeing distribution. Future research should seek better proxies for the health
status dimension added in the metric.

Research on inequality currently shows very little emphasis on the relationship
between inequality and climate change, which increasingly impacts on our lives in
many ways. Climate change matters to inequality because its effects are
disproportionate to various communities and individuals; poorer people are likely to
be less able to adapt the change. Therefore, the worse-off face an additional, high
risk of being further lagged behind the better-off. This branch of research is even
more meaningful for Vietnam which is one of the biggest victims of global warming.

The current revision of NTPs into two programs applied nationally for the period
2016–2020 may be released in late 2016. An evaluation of NTP effects needs to be
continued and compared to the previous periods. Additional data, including
provincial governmental performance (i.e. Provincial Competitiveness Index), and the survey of small and medium sized enterprises could reveal several reliable indications for the decreased effectiveness of NTPs due to public governance (i.e. bureaucracy, corruption, governmental performance). Thus, future research could explain how governance and corruption impact the NTP effects. The case study of Vietnam may contribute further to the literature on inequality and poverty with respect to public interventions. International comparisons between Vietnam and other developing countries that apply identical pro-poor policies can enrich our insights into inequality and the growth – inequality – poverty triangle.
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APPENDIX A: VARIABLES FOR AN ANALYSIS OF INEQUALITY IN THE PERIOD 1993–1998

**Housing and Asset ownership**

<table>
<thead>
<tr>
<th>Housing variables</th>
<th>Assets (the quantities of asset owned by a household)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of house: indicating the quality and characteristics of material used to build a house</td>
<td>Car, Radio, Electric fan</td>
</tr>
<tr>
<td>Electricity: ordinal, indicating energy resources for the lighting purpose. Assuming that using national provision of electricity is the highest benefit to a household wellbeing.</td>
<td>Motorbike, Air conditioner, Refrigerator</td>
</tr>
<tr>
<td>Bike</td>
<td>Bike, Washing machine</td>
</tr>
<tr>
<td>Video player</td>
<td>Video player, Electric cooker</td>
</tr>
<tr>
<td>Black and white TV</td>
<td>Black and white TV, Camera, Sewing machine</td>
</tr>
</tbody>
</table>

**Educational achievements**

Highest educational qualification achieved by the most educated individual of a household.

**Health related variables**

Drinking water: ordinal variable (ranging from 1 to 5) indicates the quality of water source for the drinking purpose.

Toilet: ordinal variable (ranging from 1 to 5) reflects the type of toilet used.

Ill day: the aggregated ill individual cases over a year.

First, using the pooled data of VLSS 1993–1998, the polychoric PCA generates the scoring factors as weights of variable as follows:

<table>
<thead>
<tr>
<th>k</th>
<th>Eigenvalues</th>
<th>Proportion of the total variance explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.551527</td>
<td>0.407216</td>
</tr>
</tbody>
</table>

The eigenvalue of the first component (\( \lambda \)) is 8.55 – the greatest partial variance shared by a component. It explains for over 40% of the total variance in information on the original variables. Then, the wellbeing value is calculated by the following equation:

\[
W_h = \sum_{i=1}^{X} \sum_{d_{kn}} \beta_{i,ld_{kj}} y(x_{i,ld_{kj}})
\]  

(5.3.7)

The components of wellbeing \( y(x_1...x_{21}) \) corresponding to their coefficients generated by the polychoric PCA, and the total wellbeing value in 1993 (\( w_{93} \)) and in 1998 (\( w_{98} \)) are achieved as follows:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>STD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>( w_{93} )</td>
<td>4126</td>
<td>-.4721587</td>
<td>.8987751</td>
<td>-2.005263</td>
<td>5.827002</td>
</tr>
<tr>
<td>( w_{98} )</td>
<td>4007</td>
<td>.4849564</td>
<td>1.508148</td>
<td>-2.076992</td>
<td>8.310781</td>
</tr>
</tbody>
</table>

Finally, using the measurement of inequality function, \( I_t = \frac{\sigma_t}{\sqrt{\lambda}} \) (5.3.8), to estimate inequality in 1993 and 1998:
Inequality within urban, within rural is estimated following the above methodology.

Similarly, inequality in the 2000s is measured based on the polychoric PCA. The pooled data of VHLSS 2002–2008 includes 4 waves with the large number of observations (43,100 households all together). The first and largest eigenvalue is obtained after the polychoric PCA generates the scoring factors ($\beta_{1,dkj}$) associated with the type (of ordinal) or quantities (of continuous) variables. Based on these scoring factors, the wellbeing value and its standard deviation ($\sigma_t$) in each wave are computed. Finally, the relative inequality is obtained by using Equation 5.3.8 above.
APPENDIX C: TABLES FOR FIGURES 6.2–6.4

Table C1: The calculation for Figure 6.2

<table>
<thead>
<tr>
<th>Year</th>
<th>Whole country</th>
<th>Within urban</th>
<th>Within rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.4529087</td>
<td>0.5364704</td>
<td>0.3650048</td>
</tr>
<tr>
<td>2004</td>
<td>0.4984993</td>
<td>0.5488468</td>
<td>0.4057922</td>
</tr>
<tr>
<td>2006</td>
<td>0.4979</td>
<td>0.5306813</td>
<td>0.4256045</td>
</tr>
<tr>
<td>2008</td>
<td>0.5036282</td>
<td>0.5198613</td>
<td>0.4578832</td>
</tr>
</tbody>
</table>

Table C2: The Gini coefficient of household expenditure for Figure 6.3

<table>
<thead>
<tr>
<th>Year</th>
<th>Whole country</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.36793</td>
<td>0.362811</td>
<td>0.307867</td>
</tr>
<tr>
<td>2004</td>
<td>0.354918</td>
<td>0.342204</td>
<td>0.300843</td>
</tr>
<tr>
<td>2006</td>
<td>0.348039</td>
<td>0.326867</td>
<td>0.309919</td>
</tr>
<tr>
<td>2008</td>
<td>0.345809</td>
<td>0.340624</td>
<td>0.312044</td>
</tr>
</tbody>
</table>

Table C3: The Theil T index of household expenditure for Figure 6.4

<table>
<thead>
<tr>
<th>Year</th>
<th>Whole country</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.242326</td>
<td>0.226401</td>
<td>0.16052</td>
</tr>
<tr>
<td>2004</td>
<td>0.219882</td>
<td>0.193793</td>
<td>0.15695</td>
</tr>
<tr>
<td>2006</td>
<td>0.210107</td>
<td>0.183709</td>
<td>0.164636</td>
</tr>
<tr>
<td>2008</td>
<td>0.211684</td>
<td>0.200328</td>
<td>0.170342</td>
</tr>
</tbody>
</table>

Table C4: Calculation of inequality for Figure 6.5

<table>
<thead>
<tr>
<th>Year</th>
<th>Red River</th>
<th>Northern Mountain</th>
<th>Central Coast</th>
<th>Southeast and Highland</th>
<th>Mekong River</th>
<th>Whole country</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>0.4669526</td>
<td>0.38671347</td>
<td>0.4160445</td>
<td>0.524984</td>
<td>0.414525</td>
<td>0.452909</td>
</tr>
<tr>
<td>2004</td>
<td>0.4971162</td>
<td>0.47814737</td>
<td>0.4792521</td>
<td>0.529409</td>
<td>0.450341</td>
<td>0.498499</td>
</tr>
<tr>
<td>2006</td>
<td>0.5056278</td>
<td>0.49868467</td>
<td>0.4738354</td>
<td>0.515937</td>
<td>0.442991</td>
<td>0.4979</td>
</tr>
<tr>
<td>2008</td>
<td>0.503764</td>
<td>0.52483951</td>
<td>0.4743864</td>
<td>0.49508</td>
<td>0.447085</td>
<td>0.503628</td>
</tr>
</tbody>
</table>
APPENDIX D: DISTRIBUTION OF WELLBEING IN VIETNAM IN THE PERIOD 2002–2008

APPENDIX E: POVERTY LINES (THOUSAND VND) AND POVERTY INCIDENCE (%) IN THE PERIOD 2002–2010

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official rural GSO-WB line</td>
<td>160</td>
<td>170</td>
<td>200</td>
<td>290</td>
<td>400</td>
</tr>
<tr>
<td>Official urban GSO-WB line</td>
<td></td>
<td>220</td>
<td>260</td>
<td>370</td>
<td>500</td>
</tr>
<tr>
<td>Official poverty rate</td>
<td>28.9</td>
<td>18.1</td>
<td>15.5</td>
<td>13.4</td>
<td>14.2</td>
</tr>
</tbody>
</table>

APPENDIX F: DESCRIPTIVE STATISTICS OF SELECTED INDICATORS FOR AN INVESTIGATION OF THE EFFECTIVENESS OF NTPS

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2004</th>
<th>2006</th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>42</td>
<td>47</td>
<td>49</td>
<td>47</td>
<td>43</td>
</tr>
</tbody>
</table>

**Poverty headcount ratio (%)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>28.56</td>
<td>19.53</td>
<td>17.25</td>
<td>13.79</td>
<td>11.52</td>
</tr>
<tr>
<td>SD</td>
<td>17.18</td>
<td>15.38</td>
<td>15.40</td>
<td>12.39</td>
<td>10.80</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Max</td>
<td>73.66</td>
<td>64.70</td>
<td>67.65</td>
<td>53.92</td>
<td>44.11</td>
</tr>
</tbody>
</table>

**Expenditure per capita (million VND/year)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.46</td>
<td>4.32</td>
<td>5.71</td>
<td>7.31</td>
<td>12.77</td>
</tr>
<tr>
<td>SD</td>
<td>1.48</td>
<td>1.75</td>
<td>2.00</td>
<td>2.22</td>
<td>3.56</td>
</tr>
<tr>
<td>Min</td>
<td>1.82</td>
<td>1.94</td>
<td>2.6</td>
<td>4.09</td>
<td>7.98</td>
</tr>
<tr>
<td>Max</td>
<td>9.55</td>
<td>10.64</td>
<td>12.79</td>
<td>15.48</td>
<td>24.4</td>
</tr>
</tbody>
</table>

**National pro-poor targeted expenditure (thousand VND/head)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>50.48</td>
<td>68.85</td>
<td>95.52</td>
<td>127.58</td>
<td>218</td>
</tr>
<tr>
<td>SD</td>
<td>43.55</td>
<td>67.49</td>
<td>102.17</td>
<td>110.82</td>
<td>232.32</td>
</tr>
<tr>
<td>Min</td>
<td>7.1</td>
<td>6.29</td>
<td>6.47</td>
<td>13.57</td>
<td>21.46</td>
</tr>
<tr>
<td>Max</td>
<td>203.63</td>
<td>324.64</td>
<td>508.02</td>
<td>451.24</td>
<td>967.77</td>
</tr>
</tbody>
</table>

**Average schooling years of adults aged 15 and over**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>5.66</td>
<td>5.95</td>
<td>6.15</td>
<td>6.27</td>
<td>6.26</td>
</tr>
<tr>
<td>SD</td>
<td>1.14</td>
<td>1.18</td>
<td>1.89</td>
<td>1.17</td>
<td>1.06</td>
</tr>
<tr>
<td>Min</td>
<td>2.68</td>
<td>2.93</td>
<td>3.08</td>
<td>3.14</td>
<td>3.12</td>
</tr>
<tr>
<td>Max</td>
<td>8.27</td>
<td>8.18</td>
<td>8.35</td>
<td>7.9</td>
<td>8.28</td>
</tr>
</tbody>
</table>

**Ratio between industrial and agricultural output value within-province**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>2.54</td>
<td>2.93</td>
<td>3.6</td>
<td>3.8</td>
<td>6.27</td>
</tr>
<tr>
<td>SD</td>
<td>6.01</td>
<td>7.11</td>
<td>8.71</td>
<td>9.35</td>
<td>13.88</td>
</tr>
<tr>
<td>Min</td>
<td>0.09</td>
<td>0.09</td>
<td>0.13</td>
<td>0.17</td>
<td>0.35</td>
</tr>
<tr>
<td>Max</td>
<td>33.82</td>
<td>40.63</td>
<td>49.6</td>
<td>57.34</td>
<td>75.66</td>
</tr>
</tbody>
</table>

Source: VHLSS 2002–2010, author’s calculation