Abstract

This thesis proposes analytical and practical frameworks for the analysis of human development that are useful for policy purposes. The main theoretical underpinning is Sen's Capability Approach, which advocates a pluralistic view of human life and the expansion of freedom as a normative rule towards the public good. The thesis comprises three chapters: in the first one, Sen's approach is theoretically supplemented with elements of J. Roemer's Equality of Opportunity approach to provide concrete suggestions of policy configurations for improving livelihoods with justice. In the second chapter, economic and econometric frameworks are proposed for this theoretical combination. As many elements that are intertwined in this vision of human development are hard to directly observe, a Simultaneous Equation Model with latent variables is developed and implemented using Bolivian data. The third chapter focuses on one specific aspect of human development, namely work-related wellbeing based on J. Heckman's technology of skill formation.

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CAPABILITIES, OPPORTUNITIES AND PUBLIC POLICIES: ANALYSES THROUGH SIMULTANEOUS EQUATION MODELS WITH LATENT VARIABLES

by

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Abstract

This thesis aims at contributing to the operationalisation of Amartya Sen’s Capability Approach for practical use and policy purposes. We focus on suggesting new frameworks for the assessment of (a) the social justice aspect of policy actions and (b) the role of skills as mediators between investments in their formation and work advantages. The novelty of our frameworks consists in the practical account of the multiple informational spaces that are cornerstone to understand individual wellbeing according to the Capability Approach, namely resources, conversion factors, wellbeing freedoms, achieved lifestyle outcomes and their value to a person, as well as the different relationships among them. This pluralistic view of individual wellbeing is practically translated to Simultaneous Equation Models (SEM) with latent variables, which are included to represent concepts that are often difficult to observe directly and/or completely based on most existing micro-level datasets. In this thesis, these variables include a person’s wellbeing freedom (also termed capabilities), the amount of effort that she exerts in life and the multiple skills that she possesses.

The thesis is divided in three chapters. The first one presents a theoretical framework combining virtues and strengths of Capability Approach and the ex-ante point of view of the Equality of Opportunity approach for analysing public policies that aim at improving individual wellbeing and social justice. We show that it is particularly useful to combine the two approaches because Sen’s pluralistic view of human life is blended with the more formal insights of the other approach on how to configure public policies to achieve social justice and increase individual wellbeing from a normative perspective. Unlike most related literature, efforts are explicitly modelled in our framework as they play a crucial conceptual role for individual wellbeing in that they influence and are influenced by individual capabilities. We construct a framework that allows to identify optimal policy for improving wellbeing with justice, aiming to equalise expected wellbeing freedoms across different groups, characterised by circumstances, through a maximin algorithm.

The second chapter builds upon the theoretical framework presented in the previous one to develop a suitable econometric counterpart, which is implemented it using Bolivian data. We gauge the effect of public expenditure on infrastructure and social services on material wellbeing and satisfaction with life. We identify the direct impact of different characteristics beyond an individual’s control on these dimensions of wellbeing as well as the indirect effect of these circumstances through their influence on effort. We go on to derive policy configurations that would nullify the direct and indirect effects of circumstances on individual wellbeing, finding that the current policies are quite distant from this optimal level.

The last chapter analyses the role of cognitive and non-cognitive skills in the relationship between educational investments and labour market advantage, while considering the latter as a multifaceted concept reflecting the characteristics of a job that are available for a worker. The theoretical underpinning of this chapter is a combination of the Capability
Approach and Heckman’s technology of skill formation. We formulate a corresponding econometric model that also takes account of possible endogeneity of investments. Applying it to Bolivia, we confirm that different dimensions of work advantage are significantly influenced by cognitive and non-cognitive skills. We find that relatively advantaged people in terms employment opportunities and earnings, as well as safe work environments are heavily concentrated in the highest quintiles of the distributions of both types of skills. Relatively disadvantaged people in terms of decent working time are highly concentrated in the lowest quintile of the cognitive skills distribution. Completion of primary school situates an individual in the above-average group of people in terms of stocks of non-cognitive skills, a condition requiring an undergraduate college degree with respect to cognitive skills.
Résumé

Ce travail vise à faire une contribution à l’aspect opérationnel de l’Approche par les Capacités d’Amartya Sen pour des analyses socioéconomiques et la formulation de politiques publiques. On propose des cadres analytiques pour l’évaluation de (a) la justice sociale dans les politiques publiques et (b) le rôle des habilités comme facteurs médiateurs entre les investissements et les capacités dans le travail. La principale contribution des cadres que l’on propose est l’inclusion pratique des multiples espaces d’information nécessaires pour la compréhension du bien-être individuel d’après les approches par les capacités: les ressources, les facteurs de conversion, la liberté en termes de bienêtre, les résultats de vie observables et leur valeur pour les individus, ainsi que les différentes relations entre ces éléments. Cette vision multidimensionnelle de bienêtre individuel se traduit ensuite en un Modèle à Equations Simultanées (SEM, en anglais) avec des variables latentes représentant des concepts abstracts qui ne peuvent pas s’observer directement ou complètement à l’aide des bases de données au niveau individuel régulièrement disponibles. Dans ce travail, parmi ces variables latents l’on considère la liberté de bienêtre individuel (appelée aussi *capacité*), l’effort réalisé par un individu et les différentes habilités dont il dispose.

Ce travail est composé de trois chapitres. Le premier présente un cadre théorique combinant l’Approches par les Capacités et la version ex-ante de l’Approche d’Egalité d’Opportunités pour analyser des politiques publique visant à améliorer le bienetre individuel et la justice sociale. On fait ressortir l’utilité de cette combinaison qui tient compte de la vision multidimensionnelle de la vie humaine proposée par Sen et des suggestions formelles de l’autre approche en termes des configurations des politiques publiques d’un point de vue normatif. A différencé de la plupart de la literature académique sur ce sujet, on modélise explicitement les efforts pour tenir compte de leur relation avec le bienêtre individuel en tant que facteurs que influencent et sont influencés par les capacités des individus. Ainsi, on propose un cadre qui permet d’identifier les configurations optimales des politiques publiques pour améliorer le bienêtre individuel et la justice sociale par le biais de l’égalisation des espérances de bienêtre parmi différents groupes d’une population à travers d’un algorithme maximin.

Le deuxième chapitre est basé sur le cadre théorique du chapitre précédent et propose une contrepartie économétrique appropriée, qui est implémentée à l’aide de données boliviennes. On mesure l’effet des dépenses publiques en infrastructure et en service sociaux sur le bienêtre matériel et la perception de satisfaction avec la vie (bienêtre subjectif). On identifie l’effet de différentes caractéristiques qui ne sont pas sous le contrôle des individus, appelées des *circonstances* telles que le genre et les caractéristiques des parents, sur les deux dimensions de bienêtre considérées. On fait des analyses séparées des effets directs des circonstances et des effets indirects passant par les influences de ces dernières sur les efforts des individus. On identifie les configurations des dépenses publiques qui contribuent à annuler les effects directs et indirectes des circonstances et on trouve que
ces configurations idéales sont assez différentes des configurations actuelles.

Le dernier chapitre présente une analyse du rôle des habilités cognitives et non-cognitives dans la relation entre les investissements en éducation et la capabilité dans le marché du travail, considérant cette dernière comme un concept multidimensionnel que reflète, en partie, les caractéristiques des postes de travail qui sont offerts à un individu. La théorie sous-jacente de ce chapitre est une combinaison de l’Approche par les Capabilités et la technologie de formation d’habilités de J. Heckman. On formule le modèle économétrique correspondant, tenant compte de la possibilité endogénéité des investissements en éducation. En appliquant ce cadre analytique au cas de la Bolivie, on confirme que différentes dimensions de la capabilité dans le marché du travail sont significativement influencées par les habilités cognitives et non-cognitives. On trouve que les personnes qui ont un avantage relatif en termes d’opportunités de travail et de recompenses monétaires, ainsi qu’en termes d’un environnement de travail sécurisé sont fortement concentrées dans les quintiles de plus hauts des distributions des deux types d’habilités. On trouve aussi que les personnes qui ont un désavantage relatif en termes de temps de travail sont concentrées dans les quintiles les plus bas de la distribution d’habilités cognitives. La conclusion de l’école primaire permet aux individus d’avoir un stock d’habilités non-cognitives les octroyant un avantage relatif par rapport au reste de la population; un avantage comparable en termes d’habilités cognitives n’est atteint qu’à l’acquisition d’un diplôme universitaire.
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To the greatest gift of my life: my family.
Introduction

When this thesis started, the target date for the achievement of the United Nations’ Millenium Development Goals (MDG) was close. Since they were established in 2000, these goals helped set a practical framework for public action and international cooperation, fostering important progress in human development worldwide (UN, 2015). Although progress was important, it was uneven, both between and within countries. The prevalence of extreme poverty in the world, which is an indicator of the first MDG, declined significantly between 1990 (47%) and 2015 (14%) in the set of developing regions. This progress, however, was mainly driven by remarkable performances of China and India, while other regions such as sub-Saharan Africa and Western Asia still lag behind. Furthermore, UN official reports warn that progress at the country-level has not translated to the micro-level in correspondence with notions of social justice: despite many successes, the poorest and most vulnerable people are being left behind. (UN, 2015 pp. 8). Many people remain at a disadvantage because of their sex, ethnicity, skin colour or whether or not they were born in rural areas.

Thus post-MDG’s development agendas have been conceived around the necessity to put even more emphasis on the need to successfully meet human needs with inclusion and fairness, paying special attention to achieve sustainable wellbeing for the most vulnerable people and transform economic environments accordingly (UN, 2012). Thus governments have been rightfully challenged to set up targeted and specific public efforts to redress this situation.

It is now well accepted in academic and political spheres that wellbeing is multidimensional in nature and that reducing it to monetary considerations or any other one-dimensional indicator implies taking an extremely narrow view on the subject (Sen, 1985, 1999, 2009). It is also well accepted that there are important associations between different dimensions of wellbeing (Chiappero Martinetti & Salardi, 2008; Krishnakumar, 2007), thus public policies aiming at improving one specific wellbeing dimension may have important effects over other dimensions as well (Van de Gaer et al., 2013).

In this context, this thesis was developed with the intention to make a contribution on ways of evaluating individual wellbeing and its relation to public actions, accounting for a multidimensional view of wellbeing and the interconnectedness of these dimensions. We aim at setting up useful analytical frameworks that are able to shed clear light on the efficiency of public interventions to improve people’s livelihoods with justice based on a) sound theoretical foundations and b) adequate and consistent econometric methods.

From a conceptual perspective, this thesis builds upon one the most recognized approaches to wellbeing and human life in academic and political spheres, namely the Ca-
pability Approach (CA). This approach was developed by Nobel Laureate Amartya Sen and it strongly advocates a pluralistic and multidimensional view of human life in wellbeing assessments. This vision is widely accepted in political and academic spheres, one example being the multidimensional nature of MDG’s and post-MDG’s global development agendas. All throughout the document, we follow the main ideas of the CA and thus we aim at staying in line with a people-centred conception of development and account for multiple informational spaces for the assessment of individual wellbeing. First, we stand for the fact that individual wellbeing increases with the expansion of realistic chances and options of lifestyles amongst which a person can choose according to what she has reason to value. This rules out negatively valued options for human life, such as threats to one’s health or physical integrity. Second, we put strong emphasis on the idea that the actual lifestyle of a person must respect individual heterogeneity and individual decisions. Third, we stress the need to focus on a multidimensional conception of wellbeing as the evaluative space for public interventions that aim to expand or improve people’s livelihoods.

Concerning the technical strategy adopted in this thesis, we advocate for a latent variable approach to the analysis of individual wellbeing, building on previous works by Anand et al. (2010); Di Tommaso (2007); Krishnakumar (2007); Krishankumar & Ballón (2008); Wendelspiess (2013), among others. We argue that different dimensions that are important to understand wellbeing often cannot be directly or completely grasped by observable indicators; they only manifest themselves partially through sets of observable lifestyle outcomes (Krishnakumar & Nagar, 2007). Furthermore, we stress the need to account for interactions between the different dimensions of wellbeing and with other latent concepts such as individual efforts and skills. We develop context-dependent ways to specify these interactions in structural frameworks, which are in fact extensions of Structural Equation Models (SEM). These models allow to draw causal inference on latent variables by appropriately incorporating exogenous elements in a system of equations and combining the latter with measurement equations that link the latent variables with their observable manifestations.

This document is divided in three main chapters; each one of them is conceived as an independent academic article, thus they present complete analyses on their own.

In the first chapter, we propose a theoretical framework for the analysis of the relation between wellbeing and public policies on the grounds of social justice criteria. For this, we identify the elements of the Capability Approach that can be combined with one of the fastest growing normative theories on justice regarding individual wellbeing, namely the Equality for Opportunity Approach (EOp) developed by Roemer (1998). Throughout this chapter, we argue that the Capability Approach provides a rich pluralistic view of human wellbeing and advocates the acknowledgement of its complex nature. Thus it sets up a notion of the public good that should be promoted by policymakers. In turn, the Equality of Opportunity Approach brings about the specific characteristics of public interventions that are optimal for increasing individual wellbeing and promoting social justice at the same time, thus helping achieve better states of public good.

Willingly-taken actions and decisions, called efforts in Roemer’s theory, play a crucial role in the combination of these theories, because they influence and are influenced by what a person is capable of doing and being. The related literature does not tend to account for the role of efforts and treats them as part of random error terms (Cogneau & Gignoux, 2008; Bourguignon et al., 2007). We propose a way to model efforts and thus include them as essential components of our analysis.
The need for a practical framework that allows modelling latent (unobservable) variables is made evident in this chapter, as we take the view that most of the currently available datasets do not provide a complete informational basis for understanding wellbeing according to the CA. We stress that concepts of paramount importance to understand wellbeing such as capabilities and efforts often cannot be directly or completely observed; in most available datasets, only partial manifestation of these concepts are available for empirical counterparts of the theoretical framework that we propose.

In the second chapter, we develop an economic and empirical counterpart of the theoretical framework presented in the previous chapter. First, we propose a general economic model that accounts for public policies as means to foster equality of opportunity for advantage, i.e. potential states of wellbeing. Then, we use Bolivian data to focus on two dimensions that are important aspects of individual wellbeing: to live in adequate material conditions (objective wellbeing) and to feel satisfaction with life (subjective wellbeing). We analyse the extent to which previous policy efforts have contributed to improve equality opportunity for the acquisition of advantages in these dimensions of wellbeing. We focus on two policy variables, namely social expenditure and investment in infrastructure and propose municipality-specific configurations of these variables that are compatible with perfect equality of opportunity against unfair social disparities.

Throughout this chapter we show that Simultaneous Equations Models with latent variables are suitable techniques to identify optimal configurations of policy variables and to grasp the intended causal relations, provided that they are built upon credible and sound identification strategies.

Among the most salient results, we find that being indigenous severely hinders advantage for material living conditions and the exercise of efforts. However, we find that public expenditure on infrastructure and social services have contributed to some extent in the mitigation of these unfair inequalities of opportunity. We carry out simulation exercises to demonstrate this statement. As an example, simulating a reduction of 50% in social expenditure and re-assessing the impact of being indigenous, we see that the magnitude of the negative impact on advantage for material living conditions increases around 38% in the simulated scenario thus confirming that the expenditure on social services does contribute to diminishing unfair inequality of opportunities caused by being indigenous. We then go on calculate the optimal configuration of policies according to the EOp rationale for different circumstance variables. For instance, we identify that expenditure on social services should rise, on average, by around 303% per person each year in order to avoid unfair disparities in advantage for material living conditions caused by being indigenous. In general, we find that the optimal levels are quite high and far away from current policy configurations.

In the third chapter, we build upon the theoretical and empirical results presented in previous chapters to analyse wellbeing in the particular context of labour markets. We argue that the labor market is cornerstone to understand personal wellbeing and that it is a particularly important institution for human development. We reason that, although time spent in formal educational programs is often perceived as crucial private and public efforts to improve and expand work advantage, skills (cognitive and non-cognitive) are important mediators in this relation. Using Bolivian data, we measure the extent to which investments in skill formation, such as schooling and earlier insertion in formal education, are effective drivers of better and wider stocks of skills. We also measure the extent to which different skill stocks determine the work advantage.

In this chapter we demonstrate the versatility of the theoretical and practical logic that
we propose in this thesis, showing that the Capability Approach can be combined with another (normative) theory on the efficiency of investments for skill formation throughout the lifecycle, proposed by Heckman & Cunha (2009). As skills can be grasped only partially through some observable indicators, we provide further support for the appropriateness of latent variable modelling techniques in the quest of an adequate assessment of wellbeing. We rely on Simultaneous Equation Models to capture the causal relations that we described, paying particular attention to avoid endogeneity bias and to impose adequate identification restrictions.

Among our most salient empirical results, we find that different dimensions of work advantage are significantly influenced by cognitive and non-cognitive skills. We find that relatively advantaged people in terms of employment opportunities and earnings, as well as safe work environments are heavily concentrated in the highest quintiles of the distributions of both types of skills. Relatively disadvantaged people in terms of decent working time are highly concentrated in the lowest quintile of the cognitive skills distribution. Completion of primary school situates an individual in the above-average group of people in terms of stocks of non-cognitive skills, a condition requiring an undergraduate college degree with respect to cognitive skills.
Chapter 1

Public policies for wellbeing with justice: A theoretical discussion based on capabilities and opportunities

This chapter\(^1\) presents a theoretical framework combining virtues and strengths of Capability Approach (CA) and Equality of Opportunity (EOp) Approach for analyzing public policies that aim at improving individual wellbeing and social justice. We show that neither approach is sufficient on its own for this goal. It is particularly useful to combine the two approaches because the CA offers a positive way of thinking about what wellbeing is, whereas the EOp Approach provides more formal insights on how to configure public policies to achieve social justice and increase individual wellbeing from a normative perspective. We make the case that EOp in its original (ex-post) conception is too heavily centered on lifestyle outcomes and oblivious to individual heterogeneity. However, we argue that it contains elements that are compatible with the CA rationale from an ex-ante point of view. Individual efforts play a crucial conceptual role in our proposed combination because they influence and are influenced by individual capabilities. Our optimal policy for improving wellbeing with EOp is one that aims to equalize expected capabilities across different groups, characterized by circumstances, through a maximin algorithm. We provide a technical analysis of our optimal policy taking into account the influence of circumstances and policies on efforts and capabilities.

1.1 Introduction

If one is to intervene, then the significant life chances that people have constitute a key variable on which the State should focus. (Anand et al. (2005); p4 including emphasis).

Today, the increase of collective wellbeing combined with justice is perceived as an essential ingredient of any development paradigm and it will not be an exaggeration to say that its importance is steadily increasing. Perhaps an interesting reflection of the consensus that this paradigm enjoys in the international arena is the UN’s set of

\(^1\)This chapter is published as an academic article in the International Journal of Wellbeing 5(3): 44-62. doi: 10.5502/ijw.v5i3.3
Chapter 1. Public policies for wellbeing with justice: A theoretical discussion based on

Millennium Development Goals (Kabeer, 2010), which not only pushed forward the idea that wellbeing is multidimensional in nature but also included some aspects of inequality and fairness among its goals. All current dialogues on the post-2015 agenda, such as the 2013 Rio+20 summit, the 2014 Beyond 2015 meeting of CSO’s in South Africa and the UN’s High Level Panel on post-2015 Development Agenda, are converging towards the need for emphasizing even further the sustainability and social justice dimensions of development in future agendas. Even in countries that currently articulate public policies around some seemingly alternative conceptions of development, such as Bolivia with its Vivir Bien (Ministerio de Planificación del Desarrollo, 2006), Ecuador with its Buen Vivir (Senplades, 2009) or Bhutan with its Gross National Happiness (Ura et al., 2012), the improvement of collective wellbeing and its just distribution remains the common goal.

The goal may be a common one, but of course, the means prescribed by governments and international organizations are different, because needs, priorities, contexts and concerns are also different. Tax regime changes, conditional transfers, offer of public health services and goods, better nutrition, improvements in education and social security regulations are among the various recipes utilized to achieve better states of collective wellbeing and social justice. The natural heterogeneity of societies has always forced discussions around appropriate ways to foster wellbeing though public policies to be quite controversial (Ravallion, 2010, 2012).

There are, however, some international theoretical agreements upon such issues of a normative nature. Many modern internationally accepted frameworks for wellbeing assessment are grounded on the Capability Approach (Sen (1985, 1999), abbreviated CA), which is deeply influential amongst development scholars and in political spheres. Well-known initiatives such as UNDP’s Human Development Index (Haq, 1999; Anand & Sen, 1993; Sen, 1999), OPHI’s Multidimensional Poverty Index (Alkire & Foster, 2011) and the MDG’s attempt to account for one the two of the most important features of the CA, namely a pluralistic view of human life and the multiplicity of informational spaces for the assessment of wellbeing. The CA has also been the theoretical stepping-stone for research on novel methodologies for its operationalisation in recent years (see e.g. Anand et al. (2007, 2009, 2010); Kuklys (2005); Krishnakumar (2007); Krishankumar & Ballón (2008)). This approach is rightfully praised for its positive way of thinking about what individual wellbeing is (Sen, 1985, 1999, 2009); its contribution on policies for improving wellbeing is much more humble. On this matter, Robeyns (2003) states (p. 45-46): … the CA is an approach to interpersonal comparisons which argues for functionings and capabilities as the relevant evaluative space, where each application (be it theoretical or empirical) can, and probably has to, be supplemented with other theories. These other theories are normative theories (for example a normative theory of choice or a theory on the normative relevance of class, gender or race), which are in turn based on positive theories of human behavior and agency and societal process (emphasis own).

Although powerful, the theoretical approach that is the core foundation of modern wellbeing analyses was not conceived to give insights about ways to improve wellbeing with justice through policymaking. The CA does not explicitly advocate for any specific public intervention or algorithm in the quest for increased social justice and hence it is not a normative theory in that sense. In fact it strongly recommends a context and time-dependent assessment of the relevant wellbeing dimensions and their relative importance (Anand et al., 2005; Arneson, 1989; Robeyns, 2006). However, when thinking of public policies, supplementing the CA is an issue that should not be left lingering. Inspired by Fleurbaey (2007), we make the case that when aiming at fostering wellbeing with justice,
1.1. Introduction

policymakers inevitably face two fundamental questions:

1. While pursuing increases in collective wellbeing with justice, what is it that needs to be less unequal?

2. Amongst a very broad set of feasible situations, which social states are better/more just and should be promoted by public action?

Answers to both questions are needed for effective policymaking. However, these answers are never straightforward, because the very concepts of wellbeing and social justice are intrinsically normative and tightly linked to ethical reasoning. It is such a complex matter that, as we have established, one single approach to wellbeing, even as sound as the CA, has proven incapable of giving precise answers to both of them. Following the above quotation from Robeyns, the CA goes as far as bringing about an answer to the first question that we have raised, in the way of clearly stating that reduction (even elimination) of capability deprivation is required for a less unequal state of affairs.

There is however, another influential theoretical framework for policymaking, namely the Equality of Opportunity Approach (Roemer (1998), abbreviated EOp), that has rapidly gained recognition over recent years and that has the potential of bringing a sound answer to the second question that we have raised. The EOp offers well established formal insights on what should be done in order to achieve social justice from a normative perspective, saying that one needs to eliminate the influence of circumstances beyond one’s control in the process of achieving a desired outcome. This approach, however, has always been rather nuanced around what individual wellbeing is (Vallentyne, 2005), so it seems to have the potential of only bringing about an answer to the second question. For an operationalisation of EOp in the context of optimal taxation see Roemer et al. (2003); for evaluations of public policies for children’s health see Jacquet & van de Gaer (2011) and Van de Gaer et al. (2013); for an identification of fair and unfair income inequalities in Latin America see Bourguignon et al. (2007) and Ferreira & Gignoux (2008).

Thus we see powerful complementarities between the two approaches, as one excels where the other one comes short. There are still few attempts to build a framework combining CA and EOp for analyzing policies for wellbeing at the empirical level, two recent attempts being Krishnakumar & Wendelspiess (2011) and Wendelspiess (2013). One has to acknowledge that there are notable similarities between the two approaches (Vallentyne, 2005; Igersheim, 2006), which have often led scholars to perceive that they provide similar elements of analysis regarding wellbeing and social justice and not push forward a theoretical combination. However, as stated by Chiappero Martinetti (2009)², there are also substantial conceptual and practical differences between the two approaches, as the mechanisms that lead to personal lifestyle outcomes and wellbeing, and their possible links to public policies, are quite different from one theory to the other.

In this paper, we defend the idea that combining these theories sheds new and useful light to understand wellbeing and its relation to public policies, because of the way they complement positive and normative reasoning, giving answers to both our questions. Throughout this document, we make the case that neither CA nor EOp, on its own, presents a combination of wellbeing and justice that can provide formal policy guidelines for improving wellbeing with justice through an appropriate principle that is able to point towards a particular configuration of such a policy. We present arguments in search of

²Chiappero-Martinetti analyzes differences and similarities between the two theories, but never attempts a combination
clear answers to both our questions and show that an ordered integration of elements from both approaches leads to a plausible solution.

The paper is structured as follows: in section 2 we present some basic statements of Sen’s and Roemer’s theories, briefly recalling their essentials. In sections 3 and 4 we analyze plausible responses to the two questions raised in these introductory paragraphs, respectively, around the CA and the EOp approach. In section 5 we propose a theoretical combination as well as a technical derivation of our optimal policy and illustrate its usefulness. Finally section 6 concludes.

1.2 Brief Review of Basic Statements of Sen and Roemer

In modern development economics literature, Sen’s and Roemer’s theories are often categorized within the same framework of wellbeing and social justice contributions (Vallentyne, 2005). Indeed, there are clear similarities between them. They both have origins in criticism towards utilitarianism and a monetary approach to wellbeing, i.e. the only consideration of personal satisfaction or wealth as equivalent measures of personal wellbeing, and coincide in advocating for paying attention to other aspects that make an individual’s life such as the nature of her occupation, living conditions, health status, education, the social and institutional setup, etc. They both have philosophical origins in Rawls’ principles for social justice (Rawls, 1971, 1999): a) everyone is entitled to an adequate set of liberties, so long as they are compatible with the same liberties for others, and b) social and economic inequality must be arranged so that everyone is entitled to a fair equality of opportunities in terms of positions and offices, while providing the greatest benefit to the least advantaged members of a population. They also coincide in acknowledging that one should go beyond outcome indicators and rather look at the underlying choice sets and circumstances.

However, the CA’s strength relies in helping to understand better what individual wellbeing is, i.e. it is a positive theory of wellbeing, whereas the EOp contributes greatly to the ways for improving individual wellbeing with justice, i.e. it is a normative theory of policymaking. Let us briefly recall the fundamentals of each theory to support this idea and bring out the different elements of answer to our guiding questions.

1.2.1 Essentials of the Capability Approach

Sen’s CA has become a very important theory in modern economic studies defining what we currently understand as human development (see for example, Anand et al. (2005)). In this approach, human development and wellbeing are related to the sets of doings and beings from which a person has the ability to choose; the notions of liberty and freedom are neuralgic within Sen’s theory. In order to understand the richness and the broad way of thinking offered by the CA, it is key to briefly recall the distinctions among the different key concepts of Resources/Means, Functionings and Capabilities.

Functionings are life states and activities, objective and subjective (Vallentyne, 2005; Alkire, 2013), that are willingly and freely chosen, given a set of means and resources as well as social, political, family and cultural conditions. Capabilities are the set of all potential (feasible) functionings from which a person can freely chose. Thus, capabilities determine achieved functionings by a process of free choice by the individual in a
particular setting. Capabilities are essentially unobservable, since they regroup possible non-materialized functionings with the effectively realized ones. Within this approach, an individual’s potential wellbeing is increased when her capabilities are increased, as the latter have an intrinsic value in terms of the freedom to choose a valued life among different chances and options.

Capabilities are personal and individually formed by converting the means and resources a person has, which include social and cultural characteristics, public/private endowments, commodities, services, norms, etc. (Comim, 2001). The conversion process for the internalization of these resources and means is personal and heterogeneous (Chiappero Martinetti & Salardi, 2008).

Thus, the approach is essentially ethically individualistic (Robeyns, 2006) in the sense that it puts the human being’s freedom to choose at the heart of any wellbeing assessment, over and above considerations at a group level or governmental actions.

Figure 1.1 presents a diagram that summarizes the above statements regarding the process of construction of an individual’s wellbeing within the CA. The capability set for a generic individual $i$ is formally expressed as follows (Sen, 1985):

$$Q_i = \{b_i | b_i = f_i(c(x_i, z_i))\}$$

with the notations being defined in the Figure 1.1.

We denote as $b_i$ the vector of achieved functionings, which is a particular vector-element of $Q_i$ chosen by the individual.

The approach’s concentration on individual heterogeneity is evident and marks one of its most celebrated contributions to social justice literature. Nevertheless, the approach does not fail to recognize the importance of social constructions and relations for the whole process leading to the determination of these freedoms, such as legal rights, family history, culture and religion. Public policies are a part of these pertinent surrounding conditions that shape an individual’s wellbeing, yet, as we have shown, the CA does not advocate for any specific public actions that might be better for increasing individual wellbeing, while fostering social justice at the same time.

### 1.2.2 Essentials of the Equality of Opportunity Approach

Roemer’s EOp approach has become a recognized pillar of normative public policymaking and assessment. It has introduced a way of thinking about public policy that is coherent
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with an economic development with justice, promoting the equalization of life chances amongst individuals, arguing that an individual’s lifestyle should be a function of her effort and choices, but not of characteristics she cannot or could not control.

Indeed, the EOp approach builds on the differentiation of aspects that are beyond an individual’s control but influence her lifestyle outcomes or advantages, called circumstances, from aspects that have their origin in autonomous and willingly taken decisions that also exert such an influence, which Roemer proposes to call efforts. In the EOp approach, people sharing the same circumstances are grouped within a type. The lifestyle outcomes observed in a type constitute the achievable advantages for any member of the type and constitute their -common- Opportunities Set. Within a type, differences in outcomes can only be attributed to differences in efforts and constitute ethically acceptable differences between personal lifestyles.

Although not originally proposed by Roemer (1998), many groundbreaking empirical operationalizations of the EOp approach have successfully proven that one needs to take into account the fact that individual effort is significantly influenced by circumstances (Bourguignon et al., 2007; Ferreira & Gignoux, 2008). Building on Bourguignon et al. (2007), we propose the schematic representation in Figure 1.2 of the EOp approach for a generic individual $i$.

![Equatity of Opportunity Approach in a diagram](image)

This diagram can be translated into the following system of equations:

$$y_i = f(x_i, e_i, p)$$  \hspace{1cm} (1.2)
$$e_i = g(x_i)$$  \hspace{1cm} (1.3)

Within a type $t = 1...T$ characterized by some circumstance variables $x_{i,t}$ (say, gender or ethnicity), advantages $y_{i,t}$ are a function of the degree or amount of effort exerted $e_{i,t}$ and public policies $p_t$, which could be thought to be type specific (Roemer, 1998), i.e. $y_{i,t} = y_t(e_{i,t}, p_t)$. As effort is hard to observe directly, one can consider a distribution of efforts within each type $t$ and divide it into centiles, identifying the level of effort, or relative effort, exerted by each individual in this type compared to all the other individuals within the same type. Since, within a type, differences in outcomes are attributable only to difference in degree of effort exerted, the effort distribution is conceptually merged to that of the outcomes of the type. Because of this perfect correspondence, it is possible to represent the outcomes of type $t$ as $y_{i,t} = y_t(\pi, p_t)$, where $\pi$ is a centile of the effort distribution.
1.3. While pursuing increased collective wellbeing with justice, what is it that needs to be less unequal?

The EOp advocates for the recognition of the ethical fact that an individual should not be held responsible for what is beyond her control and/or choice; thus individual responsibility and absence of impact of circumstances beyond control are put upfront in the assessment of a person’s lifestyle (Igersheim, 2006). It is around this recommendation that the EOp approach has managed to develop a practical and logical formalization for policymaking yielding several empirical studies on optimal public interventions for social justice (Jacquet & van de Gaer, 2011; Van de Gaer et al., 2013; Roemer et al., 2003; Cognéau & Gignoux, 2008). However, we have established that, while concentrating on normative aspects, this approach does not present an enriched positive concept of individual wellbeing.

1.3 While pursuing increased collective wellbeing with justice, what is it that needs to be less unequal?

Evidently, this question is far from being novel, but different answers are still in debate (cf. e.g. Ruggeri-Laderchi (2003)). Amongst others, in 1980, Sen had famously analyzed it in one of his most influential academic pieces, *Equality of What?* and within his remarkable series of academic contributions a path-setting answer was given: welfarist/utilitarian and rawlsian viewpoints put too much emphasis on perception of satisfaction and primary goods as synonyms of human needs in the search for the moral good against inequality, whereas it is crucial to pay attention to equality in terms of the extent to which each person is able to do certain basic things; in his early studies, Sen calls this the *Basic Capability Equality* (Sen (1980), pp. 218).

From the beginning, Sen’s concern was linked to his disagreement with a somewhat tacit public consensus around the articulation of public policies seeking to equalize perceptions of individual satisfaction, as mandates utilitarianism and/or equalize basic goods (which include individual liberties and material resources), as mandates Rawlsian prescriptions. According to Sen, equality of resources fails to take into account differences amongst individuals in terms of needs, desires and abilities, which, as we have stressed before, he considers to be fundamental for understanding individual wellbeing and ultimately, social justice. Indeed, for Sen, the concept of individual wellbeing is far too complex and rich to be merged solely to the concepts of wealth or utility (satisfaction) and, above all, to be considered one-dimensional.

Among development scholars and policymakers, Sen’s ideas have managed to overpower other approaches to wellbeing among some philosophers, social scientist and development scholars as well as practitioners. One such other approach is the monetary conception of wellbeing that sees consumption capacities as synonym of wellbeing (Ruggeri-Laderchi, 2003) and another one is the neoclassical welfarist point of view that focuses on the concept of utility, synonym of individual perception of satisfaction, thus as wellbeing (Blackorby & Bossert, 2008; Schokkaert, 2007). Although consumptions capacities are an important part of wellbeing and the concept of utility, being the basic pillar of neoclassical microeconomics, constitutes one of the most useful constructions in welfare economics, it is clear that they have important limitations for wellbeing and social justice analyses (Alkire & Foster, 2011). Neither concept pays attention to the underlying factors from which those rational choices emerge because they are essentially one-dimensional (Robeyns, 2006), thus, offering a *thin informational basis* (Anand et al., 2009) for wellbeing assessment. Sen has contributed greatly to today’s consensus that wellbeing is

By virtue of the CA, it is now accepted that personal capability sets are cornerstone to understand individual wellbeing, but that people’s capabilities are hard to observe directly given its counterfactual nature. In general, studies on measurement of capabilities fall under two categories: a) studies that directly measure capability sets through questionnaires on people’s choices and functionings (e.g. Anand et al. (2005, 2009); Anand & Van Hees (2006), and Simon et al. (2013); Ferrer et al. (2014) for health analyses), b) studies that consider the observed functionings as partial manifestations of the capability set and resort to latent variable methodology for making inference on capability sets using the observed indicators as well other as exogenous determinants of capabilities (Krishnakumar, 2007; Di Tommaso, 2007; Krishankumar & Ballón, 2008; Anand et al., 2010).

The same richness in perspective regarding individual wellbeing is not explicit in Roe-mer’s work and neither is there an explicit recognition of lifestyle heterogeneity. Thus the search for equality of opportunity in the original sense of Roemer (1998) does not provide suitable elements for answering the question at hand in this section. Let us present the following arguments supporting this affirmation.

First, even if the EOp is equally critical towards utilitarianism for social justice appraisal, it has mainly tended to consider one-dimensional outcomes such as education, health or wealth except for a very few recent empirical operationalizations with multidimensional observable outcomes. Perhaps some of the most prominent amongst the latter are efforts in Yalonetzki (2012) for creating a Dissimilarity Index for inequality assessment, in Wendelspiess (2013) for using a multidimensional latent variable approach and in Brunori et al. (2013) for making international comparisons of inequality of opportunity. Aside these exceptions, the vast majority of empirical applications of EOp follow the traditional Romerian flow by proposing one specific outcome for equalization in the quest for social justice and only one at a time (Igersheim, 2006).

Second, we perceive a clear distinction between the concepts of opportunity and capability. On the one hand, as suggested by the EOp, an opportunity is a situation that presents itself to an individual making use of which, and depending on her own efforts and skills, she will be able to achieve a certain outcome or lifestyle. Thus opportunities are not individual but common to a group of individuals that share the same circumstances (i.e. to each type in Roemer’s terminology). On the other hand, the CA stresses that the concept of capability is unequivocally individual and personal. The concepts of opportunity and capability, therefore, operate at different levels of measurement and only the latter tend to take into account individual heterogeneity.

Third, according to the EOp, every member of a certain type can seize opportunities without distinction between each other. In effect, the only difference in terms of outcome between individuals of the same type is their effort and therefore, their own responsibility (Roemer, 1998). However, building on the CA, we stress that each individual always seizes opportunities differently from another, and that each individual personally (although, also influenced by factors other than personal) forms her own set of capabilities.

Let us close this section illustrating the superiority of the CA to answer our first question by virtue of its multidimensional and individually heterogeneous conception of wellbeing. In practice, it is usual to target a specific aspect of wellbeing when designing and implementing a public policy. However, spillovers around the target are undeniable and should never be left aside, for it could imply a drastic underestimation of the impact
1.4. Which social states are better/more just and should be promoted by public action?

and blur possible ways of improving or correcting the policy. Take for instance a public policy aiming for improving nutrition of children aged 0-6, such as a complementary nutrition program. The impacts of such policies go far beyond the children’s nutrition status as measured, for instance, by ratios combining variables such as height, weight and age; it enhances learning possibilities, recreational capacities and talent development opportunities in sports, music and so on, all of which are unobservable aspects of the children’s wellbeing and will always be imperfectly captured, even when resourcing to multidimensional observable outcomes assessment. Furthermore, the children’s wellbeing is undeniably influenced by their household characteristics, values, culture and habits and few would agree on taking these important characteristics as homogeneous within a certain type, say, female indigenous children living in rural areas.

Therefore, in view of the fact that we adopt the CA for wellbeing analysis, stressing the need to pay special attention to freedom to achieve, which is in turn represented by the capability set, we would like to put forth the idea that capability sets (i.e. potential functionings) and not achieved functionings or outcomes should be the object of equalization in the quest for social justice. We stand by this argument, even if capability sets are heterogeneous and may not be directly observed due to their potential nature, thus posing a formidable challenge for practical purposes. Policy assessment and design based only on EO$p$, leaves important theoretical gaps concerning suitable answers to our first question.

1.4 Which social states are better/more just and should be promoted by public action?

Once one establishes the need for special attention to individual capability sets, it is clear that an expansion and, ideally, an equalization of individuals’ capability sets should be the ultimate social objective for development. Turning to the second question that guides us through this paper, the CA, by itself, does not go further to elaborate on actual ways of achieving these goals. Sen (2009) himself has stated (p. 232): *The capability perspective does point to the central relevance of the inequality of capabilities in the assessment of social disparities, but it does not, on its own, propose any specific formula for public decisions.*

The CA’s major strengths, namely the broadness and the context-based character of the framework that it offers, might just be at the origin of its lacking in possible suggestions on what can or should be done to increase social justice. The CA limits itself to advocate for the equalization of capabilities as a normative rule for social justice, implying that a fair distribution of potential functionings amongst members of a society ought to be the public goal (Fleurbaey, 2007). The need for further elements other than those depicted in the CA is evident for giving a plausible answer to our second question.

We stress that these elements cannot come from traditional normative prescriptions inspired from neoclassical welfare economics. Although they are deeply influential for choosing the *right* social states, these prescriptions rely heavily on the extrapolation of the notion of individual utility to that of social utility. General equilibrium modeling fits well as a wide-known example of such practice (Davarajan & Robinson, 2002). This approach to social choice, which is heavily influenced by utilitarianism, has also been criticized for having a thin informational basis, focusing exclusively on individuals’ satisfaction or happiness for the maximization of some aggregation of the latter, prior to
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the search of the best allocations of lifestyle outcomes. Because of these facts, we argue that traditional normative and theoretical schemes from neoclassical welfare economics are clearly unsuitable supplements to the CA in the sense described in the introductory paragraphs by Robeyns (see the quotation on p.2, with own emphasis).

According to Pignataro (2012), the last 15 years have witnessed a notable revolution in terms of thinking about social justice and what should be perceived as a fair social state and how to promote it. Roemer’s EOp stands out in this evolution of thinking and provides a suitable supplement to the CA in our opinion. In the remainder of this section, let us present ordered arguments supporting this idea and formally identify the elements of the EOp that are compatible with the CA rationale.

The principal ideal of EOp is to achieve a social state in which circumstances do not bear any influence on people’s outcomes, neither directly nor indirectly through influences over the efforts they make to achieve them. This irrelevance of circumstances is a condition for a Romerian leveling of the playing field conception of social justice. This just society may be utopic, but this way of thinking has undeniably shed a clear light on plausible governmental interventions towards this ideal. For instance, Roemer et al. (2003) have assessed the extent to which reigning fiscal regimes in eleven countries contribute to equalizing opportunities for income acquisition based on the EOp approach. Also based on this approach, but within a different empirical framework and operational model, Betts & Roemer (2005) have analyzed the contribution of an educational finance reform in the USA to the equalization of opportunities for education. Indeed, in the EOp there exists a notion of optimal public policy for social justice, and it is the one entailing equality of opportunities to achieve a certain outcome.

Today, the discussion on the selection of such socially optimal public policies is of great importance in academic circles (Pignataro, 2012). According to Ramos & van de Gaer (2012), there are two conflicting practical programs for identifying EOp optimal public policies. The first one was proposed by Roemer himself in 1998 and aims to eliminate inequality of outcomes for individuals exerting the same effort, regardless of their type. This program is called ex-post equality of opportunity.

Mathematically, the operationalization of ex-post equality of opportunity builds directly on Rawls’ prescription of focusing on the least advantaged people. According to the ex-post EOp, the optimal public policy is formed by a set of specific public actions \( p_\pi \), where \( \pi \) is a centile of the effort distributions of all types, so that every \( p_\pi \) maximizes the outcome of the least advantaged individuals having exerted the same degree of effort \( \pi \) in all types. Using the notation introduced in 1.3, this is formalized by:

\[
\max_{p_\pi} \min_{\text{across types}} y_t(\pi, p_\pi) \quad (1.4)
\]

Evidently, as it is impractical to find an optimal public policy for every centile, Roemer invokes outcome-based tools to define a single optimal public policy compatible with social justice, \( p \), as the one that helps achieving maximization of the average advantage of the least favored across every degree of effort. Formally, this policy solves the following optimization program:

\[
\max_p \sum_{\pi} \min_{\text{across types}} y_t(\pi, p_\pi) \quad 'or' \quad \max_p E[\min_t y_t(\pi, p_\pi)] \quad (1.5)
\]

The arguments that we have presented make it clear that this program is too heavily centered on outcomes, leading to clear theoretical incompatibilities with the CA. As the
ex-post program is the original program proposed by Roemer, this is perhaps, one of the reasons why economic and human development scholars have neither insistently pushed forward to build a mix of Sen’s and Roemer’s theories, nor searched for empirical endeavors founded on such a possible mix. In effect, this program compares outcomes across individuals and explicitly seeks to pull the least advantaged individuals upwards, identifying these people based on their outcomes. The ex-post framework follows the compensation principle, suggesting public policies that contribute to the equalization of outcomes for individuals exerting the same level of effort under different circumstances (Pignataro, 2012).

There is however, a second program for achieving equality of opportunity, whose advancement is generally attributed in the literature to Van de Gaer et al. (2013) and is concerned with the equalization of prospects of outcomes for every individual, regardless of their type. This program is called ex-ante equality of opportunity and it advocates in favor of a policy allowing the maximization of the prospects of outcomes (potential outcome) of the least advantaged type in a society, as measured by the average of the outcomes over all the members of that type:

\[
\max_p \min_{\pi} \sum_{\pi} y_t(\pi, p_x) \quad \text{‘or’} \quad \max_p \min_{\pi} E[y_t(\pi, p_x)]
\]  

(1.6)

Even if the formalization of this program differs only on the inversion of the sum and min operators, the implications for a conceptual compatibility between the EOp approach and the CA are of paramount importance. In the ex-ante approach, the degree or level of effort are to be left unobserved, as was proposed in the original Romerian EOp conception but remains what ultimately determines the differences of outcomes within a type; it respects individual heterogeneity. The ex-ante program builds on the reward principle of analyzing differences in outcomes for individuals under the same circumstances (Pignataro, 2012). Implicitly, there should not be any kind of public intervention attempting to equalize outcomes that originate from each individual’s responsibility.

Therefore the answer to our second question is that public policies should foster equality of opportunity, conceived as a situation where sets of possible outcomes are the same for every type within a society. Furthermore, policy priority is given to pulling up the least-advantaged type distribution of outcomes and for that, it is a Rawlsian conception of equality of opportunity.

1.5 Combination

Based on the preceding discussion, we propose to deepen the consideration of individual capability sets as the multidimensional unobserved outcome of an EOp based theoretical framework in the quest for policymaking for wellbeing with justice. We believe that this constitutes another step forward in the operationalization of the CA for policymaking. We propose the conceptual scheme in Figure 2.1 to represent the theoretical linkages that will be highlighted in this section.

Let us start our reasoning and the explanation of the scheme recalling that potential wellbeing, measured by the capability set, is multidimensional and often cannot be directly observed due to its counterfactual nature and, according to EOp, it is determined by individual efforts, which are also unobservable and reflect an individual sense of responsibility. Thus efforts are essential for understanding wellbeing, as is emphasized by Roemer throughout his work (Roemer, 1998; Roemer et al., 2003; Betts & Roemer, 2005).
Nevertheless, in most empirical EOp-based work the amount of effort exerted by a person has been treated as a residual error term, with no further consideration for its estimation (see for example Cogneau & Gignoux (2008); Bourguignon et al. (2007)). Therefore the combination that we propose introduces a causal relationship between unobservable or latent variables that remains empirically understudied in public policy and economic development literature and we make the case that it can deliver important results for understanding and assessing the role of public policies for wellbeing.

We postulate the existence of a two-way relationship between capabilities and efforts which together lead to multiple achieved outcomes or functionings, thus capturing the CA’s multidimensional essence. We argue that efforts are shaped by capabilities by virtue of the individual nature of the decision-making process on efforts. We reason that potential feasible lifestyle outcomes of a person configure the practical choices and actions she makes in order to achieve the outcomes that suit her best, according to her needs, tastes and desires. Efforts, in turn, can affect capabilities by bringing in more potential outcomes within the capability set, expanding lifestyle possibilities for people to choose from.

Both efforts and capabilities are in turn influenced by individual characteristics and surrounding features, called circumstances. These include: i) individual characteristics such as gender, ethnicity and age; ii) other multilevel aspects concerning her family and household, such as the composition, living conditions, religion and culture. In our combination, public policies are also a part of the environment as mandates the CA, and according to the ex-ante framework of the EOp, they should aim at equalizing opportunities by reducing the role played by circumstances beyond one’s control in the determination of capabilities and efforts. Thus public policies may not explicitly shape circumstances such as gender, household composition or language spoken in the community, but they do shape the extent to which these circumstances affect individual’s capabilities and efforts.

Thus, building on Rawlsian maximin rationale, which states that a society would achieve justice and equality when prospects of life for the least fortunate are as great as they can be (Rawls, 1971, 1999), an optimal policy for equalization of capability sets across types \( t = 1 \ldots T \) would be given by:

\[
\max_p \min_{\text{across types}} \sum_{i \in \text{type } t} Q_{i,t} \quad \text{’or’} \quad \max_p \min_E Q_{\text{min}} \quad (1.7)
\]
where $Q_{i,t}$ is the capability set of the i-th individual belonging to type $t$ and $EQ_{\text{min}}$ is the average capability set of the least advantaged type.

Here we would like to recall some key equations introduced by Sen (1985) for defining capabilities so that we are clear as to what is being maximized. Let $x_i$ be the commodity vector possessed by an individual $i$. The individual makes use of the characteristics of the commodities in order to convert the resources into a functioning, i.e., a being or a doing. We take the term commodity in a large sense including personal resources as well as social and institutional infra-structural support or circumstances i.e all that enters the conversion process. The conversion function is written as:

$$b_i = f_i(c(x_i))$$ (1.8)

Note that given the same $x_i$ the achieved functioning can be different from one individual to another due to the dependence of $f$ on $i$ as the personal characteristics such as age, gender, health status, tastes, and the effort put in by the individual, all play an important role in the conversion process. The set of all functionings that can be potentially achieved using the commodity vector is called the capability set:

$$Q_i = \{b_i | b_i = f_i(c(x_i))\}, \text{ for some } f_i \text{ and for some } x_i$$ (1.9)

Thus we are not maximizing utility in equation 1.7, neither are we maximizing resources or outcomes (achieved functionings). It is indeed the set of feasible functionings of an individual, in other words her freedom to achieve valued things in life, which is sought to be maximized in our approach.

In our setting, each individual $i$ belongs to a type $t$ and hence every individual will have a double index $i, t$ from now on. As expressed in equation 1.7, our optimal policy for wellbeing with justice is one which maximizes the capability sets (feasible outcomes) for the least favored. In our model, the capability set depends on personal circumstances and efforts, and the efforts themselves can in turn be influenced by circumstances. Thus

$$Q_{i,t} = Q_{i,t}(x_{i,t}, e_{i,t}(x_{i,t}))$$ (1.10)

where circumstances are included in $x_{i,t}$ and $e_{i,t}$ denotes the effort. In Roemer’s reasoning, the most disadvantaged type identifies the least favored and hence it represents a group rather than a single individual. Thus we take the expected feasible outcome (or the expected capability set) of the least favored type as our objective function in order to be consistent with the ex-ante EOp approach. Then the optimization program can be written as:

$$\max_{p} \min_{\text{across types}} E(Q_{i,t}(x_{i,t}, e_{i,t}(x_{i,t}))|x_{i,t})$$ (1.11)

For simplicity of notation, let us denote the expectation as:

$$EQ_{i,t} \equiv E(Q_{i,t}(x_{i,t}, e_{i,t}(x_{i,t}))|x_{i,t})$$ (1.12)

and the minimum as:

$$EQ_{i,\text{min}} = \min_{\text{across types}} EQ_{i,t}$$ (1.13)

In a very general setting, $E(Q_{i,t}(x_{i,t}, e_{i,t}(x_{i,t}))|x_{i,t})$ can be different from one individual to another and hence we keep the index $i$ in the expectation. Thus the optimal policy will
be given by \( p^*_i,\text{min} \) such that \( EQ_{i,\text{min}} \) is maximum\(^3\), i.e. we should have \( \frac{\partial EQ_{i,\text{min}}}{\partial p} = 0 \) at \( p = p^*_i,\text{min} \). Note that the solution could also vary from one type to another. Thus, \( p^*_i,\text{min} \) denotes the optimal policy applied to an individual \( i \) belonging to the least favored type\(^4\).

Now, rather than deriving the optimal policy, if we want to see how effective a policy is in promoting EOp (or reducing inequality of opportunity) following Roemer’s idea, we can evaluate to what extent the policy is able to change the impact of a generic circumstance variable \( x_{i,\text{min}} \) of an individual \( i \) belonging to the least favored type on her expected capability set \( EQ_{i,\text{min}} \). The effect of circumstance for the least favored type can be computed as:

\[
\frac{dEQ_{i,\text{min}}}{dx_{i,\text{min}}} = \frac{\partial EQ_{i,\text{min}}}{\partial x_{i,\text{min}}} + \frac{\partial EQ_{i,\text{min}}}{\partial e_{i,\text{min}}} \frac{\partial e_{i,\text{min}}}{\partial x_{i,\text{min}}} + \frac{\partial EQ_{i,\text{min}}}{\partial e_{i,\text{min}}} \frac{\partial e_{i,\text{min}}}{\partial p} \equiv k_{i,\text{min}}(p^*_i,\text{min})
\]

where the derivatives are to be calculated using equation (10). Let us denote:

\[
\frac{\partial EQ_{i,\text{min}}}{\partial x_{i,\text{min}}} = g_{i,\text{min}}(p^*_i,\text{min}) \quad \frac{\partial EQ_{i,\text{min}}}{\partial e_{i,\text{min}}} \frac{\partial e_{i,\text{min}}}{\partial x_{i,\text{min}}} = h_{i,\text{min}}(p^*_i,\text{min})
\]

The first function above depicts the direct impact of circumstances on expected capability sets and the second depicts their indirect impact through effort. Thus the total effect of circumstances as a function of public policies is given by:

\[
\frac{dEQ_{i,\text{min}}}{dx_{i,\text{min}}} = g_{i,\text{min}}(p^*_i,\text{min}) + \frac{\partial EQ_{i,\text{min}}}{\partial e_{i,\text{min}}} h_{i,\text{min}}(p^*_i,\text{min}) \equiv k_{i,\text{min}}(p^*_i,\text{min})
\]

Therefore, the condition that a public policy must fulfill in order to be EOp-optimal, i.e. to nullify the effect of circumstances on expected capability sets for the least favored type is given by:

\[
k_{i,\text{min}}(p^*_i,\text{min}) = 0
\]

denoting this optimal policy as \( p^*_i,\text{min} \).

Now, if we would like to derive the optimal policy for any type \( t \) in general and not necessarily the least favored one, we would just need to replace \( \text{min} \) by \( t \) in the above derivation and the optimal policy would then be given by \( p^*_i,t \) such that:

\[
k_{i,t}(p^*_i,t) = 0
\]

with

\[
k_{i,t}(p_i,t) = \frac{dEQ_{i,\text{min}}}{dx_{i,\text{min}}} = g_{i,t}(p_i,t) + \frac{\partial EQ_{i,\text{min}}}{\partial e_{i,\text{min}}} h_{i,t}(p_i,t)
\]

As an illustration we present a case in which the above relations take a linear form, the policy value is common to all individuals belonging to a given type, and the coefficients are also invariant within a given type. Let

\[
EQ_{i,t} = x'_{i,t}(A_t + B_t p_t) + c'_{i,t}(C_t + D_t p_t) + z'_{i,t}F_t e_{i,t} = x'_{i,t}G_t + z'_{i,t}H_t
\]

where \( z'_{i} \) represents a vector of personal characteristics

\(^3\)A policy \( p \) has an impact on wellbeing through its influence on the effect of circumstance variables on capabilities or efforts (see later)

\(^4\)In practice, the policy variable will probably take the same value for all individuals belonging to the same type. However, here we present a very general theoretical setting in which it can vary from individual to another.
1.5. Combination

Then,

\[ k_{i,t}(p_{i,t}) \equiv \frac{dEQ_{i,min}}{dx_{i,min}} = g_{i,t}(p_{i,t}) + \frac{\partial EQ_{i,min}}{\partial e_{i,min}} h_{i,t}(p_{i,t}) = (A_t + B_t p_t) + G_t(C_t + D_t p_t) + z_i^t F_t \]  

(1.21)

and the optimal policy is \( p^*_t \) such that:

\[ A_t + B_t p^*_t + G_t(C_t + D_t p^*_t) = 0 \]  

(1.22)

Let us stress that the observable aspects of a person’s lifestyle, call them outcomes or functionings, are not the essence of the optimization program. The reason is two-fold. First, according to the CA one needs to pay attention to potential lifestyle outcomes to understand individual wellbeing. Second, a person’s actual lifestyle is related to an act of personal choice, even if it may be influenced and conditioned, to some extent, by social, cultural and political surroundings. In other words, we advocate for a theoretical framework in which public policies do not directly aim at influencing a person’s lifestyle but act in an indirect way by promoting the enabling factors of capabilities and efforts (potential lifestyles), leaving the actual choice to the individual thus respecting her freedom.

In order to clarify the difference between the proposed theoretical framework and separate EOp and CA-based theoretical frameworks, let us consider the following example. There are important public policies, more precisely social policies, built around conditional cash transfers for students, that aim to diminish rates of school abandonment, increase their academic performance and ultimately, their wellbeing and promote justice within society (Bolivia’s Bono Juancito Pinto is an example of such a policy, see Yañez (2012)). In this concrete case, the two questions that have guided our discussion could take the following form:

1. What are we making less unequal through this conditional transfer?

2. What is the adequate amount for the cash transfer to promote equality?

A plausible answer to the first question from a pure EOp perspective would state that one needs to identify one observable outcome or advantage enjoyed by the beneficiaries that has a link to the cash transfer, say the schooling gap, defined as the difference between the years of schooling a person should have given her age and her actual years of schooling. This variable would constitute the proxy of opportunities for education and ultimately wellbeing, which is what the cash transfer aims at equalizing.

A traditional EOp based theoretical framework adopting an ex-ante program for equality of opportunity would bring about an answer to the second question stressing that the cash transfer has a direct impact on the expected schooling gap. It would go on to advocate for seeking an amount of the transfer so that expected schooling gap is minimized (i.e. opportunities for education are maximized) for the least favored type of people, say indigenous females. Within this type, schooling gap differences, i.e. wellbeing differences, would then be of the absolute responsibility of the beneficiaries or fruit of their efforts, as they all are supposed to share the same circumstances.

A CA only-based framework would stress that schooling gap is a rather oversimplified proxy of the beneficiaries’ wellbeing and that the latter should be measured, for instance, as their capability to be educated (not to be confused with individuals’ inherent abilities like intelligence). A single observed outcome for gauging such a broad concept is clearly insufficient and unnecessary; the policy might also influence other aspects of wellbeing that
can be observed, such as their ability to read and to understand abstract logic reasoning (by increasing the possibility of buying more books using the extra cash and/or hiring a tutor) or their ability to read foreign languages (by increasing the possibility of entering a language institute). The CA would go on to stress that the actual schooling gap is, to some extent, a choice among other feasible options of the beneficiaries. Thus it would suggest only an indirect impact of the cash transfer on the schooling gap, through the expansion of the beneficiaries’ capability to be educated.

However, due to the absence of any prescriptions regarding how to go about achieving equality of opportunity in these multidimensional aspects, the CA does not give a plausible answer for the second question apart from the statement: the greater the capability to be educated for all beneficiaries, the better.

The combination that we propose would in fact lead to a precise and operational answer to both the questions combining remarkable elements of both approaches. To answer the first question, the combined approach would advocate for the multiplicity of outcomes for gauging wellbeing, inheriting the logic of the CA that we just presented. Not only would our approach would take into account the multidimensional aspect of wellbeing, but would also respect the beneficiaries’ freedom to choose, suggesting only an indirect influence of the transfer over all outcomes.

To answer the second question, our combination would inherit the rationale of the EOp, arguing in favor of the equalization of capability to be educated by searching for an amount of the transfer that maximizes this capability for the least capable across different types and ideally annuls the effect of circumstances on the capability of being educated. The combination would not suggest an equalization of any outcome, in respect of individual’s freedom to choose. Furthermore, the search of this adequate amount of transfer would not let effort be considered as a residual variable; it is an important determinant of actual outcomes. Effort would be, at least, partially gauged by some observable indicators, such as daily hours of study and frequency of visits to the school library. Thus effort would not be considered as an absolute personal responsibility; either of the effort indicators that we mention is surely influenced by the beneficiaries’ capability to be educated and the converse is also true.

1.6 Concluding Remarks

The quest for improved collective wellbeing with justice has always been a priority for most of the economic and political constructs that we know of. In this paper, we have attempted to show that there exist powerful philosophical and theoretical frameworks that contain important elements, which can and should be combined to come up with operational answers to this question. In particular, we rely on two theories that have recently gained an overwhelmingly increasing visibility in academic and policy circles, namely the Capability Approach and the Equality of Opportunity approach.

One of the main contributions we want to make in this paper is to put on the table some ordered arguments for the fact that neither of these leading theories alone is capable of guiding policymaking for wellbeing with justice with enough theoretical elements of discussion. Thus we advocate for a theoretical construction that builds on these two approaches for providing insight on how to design and evaluate policies for improvement of wellbeing with social justice. We show how the similarities and differences between the two approaches are complementary to each other and how they can help to set a solid theoretical basis for the assessment and design of public policies that seek to improve
social justice. Consequently, there are ways to explore the issue without having to build an entirely new approach. The particular manner in which we propose to combine the two theories has, to our knowledge, not been explored in the related literature.

We show that the ex-post framework of the Equality of Opportunity approach, which is its original conception, is too heavily centered on people’s lifestyle outcomes, with too little theoretical consideration for individual heterogeneity and choice. However, the ex-ante framework of the Equality of Opportunity approach depicts elements that are compatible with the logic of the Capability Approach, in the sense that both respect individual heterogeneity and freedom, and do not aim at equalization of results as a social justice paradigm.

In the combination that is proposed, we argue for the need to explicitly consider the role of efforts while analyzing public policies and their link to wellbeing and justice. Indeed, the line of reasoning that we present makes the case that individual efforts influence and are influenced by individual capabilities, but to our knowledge, there are no theoretical attempts in the existing literature to relate these two key variables in the understanding of wellbeing. Efforts have often been treated as a residual variable in most empirical applications of the Equality of Opportunity Approach, due to its unobservable nature. We stress that this is not an insurmountable obstacle as, even if potential achievements cannot be observed due to their counterfactual nature, there are empirical endeavors that have successfully taken account of this feature in their operationalization methodology. A similar approach can also be followed for operationalizing effort. In other words, technical difficulties for gauging bidirectional causal relations between unobservable variables should not hinder theoretical developments that can shed important light for understanding wellbeing and its relation to public policies.

Therefore, while designing and assessing public policies, if equality is a moral concern, then we argue that one should tackle inequality in terms of what people can do or be, i.e. their capabilities, rather than their actual outcomes. This is done through a maximin algorithm that maximizes the capability set of the group that is the least favored in terms of circumstances while taking into account the influence of circumstances and policies on capabilities and efforts, and explicitly incorporating interdependencies between the latter two variables. We define this potential wellbeing with justice problem in a technical way and discuss the solution from an optimal public policy angle.

We are aware that the main challenges for the empirical application of our theoretical framework concern the development of a rigorous econometric model that helps to identify the complex structural relations that we have proposed in this paper, as well as the existence and quality of adequate information for its implementation. Nevertheless, we believe that these challenges should be faced and we intend to attempt a practical implementation of our framework in a future study, as we are convinced that the theoretical discussion, although enriching, needs to be strengthened by empirical investigations.
Chapter 2

Do public policies promote equality of opportunity for wellbeing? An econometric analysis using Bolivian Data

We present a practical framework that builds on a theoretical combination the Capability Approach and the Equality of Opportunity Approach for assessing the social justice aspect of public policies that aim at improving individual wellbeing. We develop a suitable econometric counterpart and implement it using Bolivian data. Our econometric strategy consists in the estimation of a Simultaneous Equation Model (SEM) with latent variables. We gauge the effect of public expenditure on infrastructure and social services on material wellbeing and satisfaction with life. We identify the direct impact of different characteristics beyond an individual’s control on these dimensions of wellbeing as well as the indirect effect of these circumstances through their influence on effort. Each of these wellbeing dimensions is considered from a pluralistic viewpoint, in the true spirit of the Capability Approach. We go on to derive policy configurations that would nullify the effect of circumstances on these dimensions of individual wellbeing, finding that the current policies are quite distant from the optimal level.

2.1 Introduction

The literature on the effect of public policies on people’s wellbeing is fast growing and recent years have seen numerous empirical endeavours to measure their impact on inequality of opportunity (Bourguignon et al., 2007; Ferreira et al., 2011; Ferreira & Gignoux, 2011, 2008; Figueiredo & Ziegelmann, 2010) and what can be done in terms of policy efforts to diminish it (Betts & Roemer, 2005; Coco & Pignataro, 2010; Jacquet & van de Gaer, 2011; Roemer et al., 2003). The need for policies aiming at increasing wellbeing with justice is evident and needs no further justification, even if different theories and approaches have different viewpoints on the notion of justice (see e.g. Sen (1980)). Yet achieving this goal is complex for several reasons.

An important issue is the difficulty in the adoption of a precise definition of wellbeing. It is now widely accepted that the concept of wellbeing transcends material considerations

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and that it cannot only be linked to monetary aspects (Sen, 1980). No doubt material poverty is still an issue of primary concern, but ignoring the other aspects of wellbeing and deprivation would be taking a narrow view on the subject (Comim et al., 2008). Furthermore, it is also widely accepted that the concept of wellbeing is too complex to be assessed through the lens of one-dimensional approaches (Alkire, 2011, 2013), which is very often the case in studies that build upon traditional mainstream economic tools such as computable general equilibrium modelling. In these exercises, human behaviour is conceived as conscious and willing actions in the quest of improving wellbeing, which is associated to a subjective perception of satisfaction, i.e. utility. (see e.g. Dixon & Jorgenson (2013)). Other conceptual developments, however, have taken a strong stand against utility as the adequate evaluative space of human wellbeing, one of the most prominent and influential among them being the Capability Approach (CA, Sen (1980, 1985, 1999, 2009)). This approach embraces a multidimensional conception of human life, defining wellbeing as a manifestation of the freedom to choose from several potential lifestyle outcomes. According to this definition, understanding wellbeing requires knowledge of what a person can potentially achieve besides what she actually is and does. These ideas have been a main inspiration for many modern conceptions of human wellbeing, such as the human development concept put forward by UNDP (1990), and OECD’s Better Life Index (2011).

Once a wellbeing definition is adopted, it is also important for policymakers to have a clear statement of a normative rule guiding their interventions and the state of the world that should be promoted with regard to equality. In this connection, it is known that the capability approach advocates for a pluralistic view if one aims at designing policies to improve wellbeing, but it does not provide any practical criterion to pinpoint a particular configuration of such policies, which may limit its practical scope in the perspective of effective policymaking (Robeyns, 2003). Aiming for equality of outcomes may sound appealing at first sight but a deeper analysis would bring out its insensitivity to the freedom or choice aspect of wellbeing (Arneson, 1989). Similarly, equality of resources is also not advisable because it does not take into account individual heterogeneity in the ability to convert the resources into wellbeing (Schokkaert, 2007). A third alternative namely equality of opportunity (EOp) (Roemer, 1998) has been gaining ground in recent years by virtue of its focus on giving an equal chance to everyone to achieve valued outcomes by the elimination of influences of conditions or situations that are beyond an individual’s control on the outcome. In the EOp framework a fair society is defined on the basis of this levelling the playing field idea, condemning disparities that are caused by differences in gender, ethnic condition or family background. The EOp stresses that differences in observable outcomes caused by differences in individual effort or willingly taken decisions may not be considered as unfair. Thus this approach provides a clear basis for a certain configuration of public policies that can be considered optimal. However, empirical applications of this principle do not tend to take into account the multidimensional nature of wellbeing (Pignataro, 2012).

This paper builds on the idea that a combination of CA and EOp can provide a useful and practical solution to the problem of effective policymaking for wellbeing with justice. It implements a theoretical framework, developed by Krishnakumar & Nogales (2015) to combine CA and EOp, which is based on the reasoning that the CA offers a positive way of thinking about what wellbeing is, whereas the EOp approach provides more formal insights on how to configure public policies in order to achieve social justice and increase individual wellbeing from a normative perspective. Following this idea, we...
2.2 Theoretical Background: Opportunities and Capabilities

Put forth an economic structure describing the relationships between capabilities, efforts, circumstances and public policies. This structure is then translated into an econometric model that allows for an empirical assessment of inequality of opportunity in prospects of multiple lifestyle outcomes (termed *capabilities* or *advantages* in the CA) and the extent to which this inequality is corrected by a public policy. We implement our econometric model for Bolivia in order to evaluate to what extent public infrastructure and social expenditures are able to reduce inequality of opportunity in people’s material wellbeing and life satisfaction capabilities.

The paper is structured as follows: Section 2 recalls basic statements of CA and EOp and discusses the theoretical basis of our framework. Section 3 describes the econometric framework that we propose for assessing the links between opportunities, capabilities and public policies. Section 4 presents an empirical application using Bolivian data and Section 5 summarizes our main findings and presents concluding remarks.

2.2 Theoretical Background: Opportunities and Capabilities

There are increasing research efforts on inequalities regarding different aspects of wellbeing that build upon the EOp theoretical core (Betts & Roemer, 2005; Bourguignon et al., 2007; Jacquet & van de Gaer, 2011; Krishnakumar & Wendelspiess, 2011; Ramos & van de Gaer, 2012; Roemer, 1998; Roemer et al., 2003; Pignataro, 2012; Wendelspiess, 2013). According to this approach it is key to distinguish between fair and unfair inequalities of opportunity to achieve any lifestyle indicator that may be considered a proxy of wellbeing, whether it is income level, school grades, housing conditions or perception of satisfaction. EOp recognises two main sets of determinants; the first are called circumstances and are beyond an individual’s control such as race, native language or family background. The second are called efforts and can be influenced, to some extent, by each individual, such as her occupation, level of education or migration dynamics. In this framework, public policies play a crucial role in determining lifestyle indicators because they are instruments that can be used for levelling of the playing field in presence of inequalities. Roemer (1998) formalises the preceding discussion as follows:

\[ y = f(C, F, \text{pol}, w) \]  

(2.1)

where \( y \) is one observable indicator of lifestyle or outcome, \( C \) is a vector of circumstances, \( F \) is a vector of efforts, \( \text{pol} \) is a vector of public policies and \( w \) represents all other determinants of \( y \). To the best of our knowledge, when analysing inequalities of earnings in Brazil, Bourguignon et al. (2007) were the first to complement the above formalisation allowing efforts to be partially caused by circumstances:

\[ y = f(C, F(C, v), \text{pol}, v) \]  

(2.2)

with \( v \) representing all other determinants of efforts. The latter equation ultimately depicts a reduced form that relates circumstances to lifestyle indicators, letting efforts to be merged with the other residual explanatory factors of these indicators:

\[ y = g(C, \text{pol}, e) \]  

(2.3)

where \( e = g_e(w, v) \).
Based on this general framework, the body of empirical literature building on EOp can be divided in two large groups: the ex-post and the ex-ante assessment of inequalities of opportunity (Pignataro, 2012; Ramos & van de Gaer, 2012). The ex-post framework was first proposed by Roemer considering differences in observable lifestyle outcomes that originate from differences in circumstances. This means that perfect equality of opportunity for achieving \( y \) occurs when \( \frac{\partial f}{\partial C} = \frac{\partial g}{\partial C} = 0 \). This equation states that perfect equality of opportunity arises when there is no circumstance that exerts a direct or indirect effect on an individual’s potential to achieve outcome \( y \). The extent to which this condition is violated can be considered as a measure of unfair ex-post inequality of opportunity because it means that individuals’ lifestyle is affected by characteristics they cannot or could not control. According to this framework, the optimal public policy compatible with equality of opportunity is the one that promotes equalisation of lifestyle outcomes for individuals who have exerted the same level of effort relative to their circumstances. Practically, it amounts to focusing on the least advantaged, i.e. people experiencing the lowest levels of outcomes, and maximising their outcome as a rule for social justice.

The ex-ante framework (Van de Gaer et al., 2013) advocates for a focus on the set of possible lifestyle outcomes when assessing inequality of opportunity, rather than observed lifestyle outcomes themselves. For taking this important nuance into account, equation (2.3) can be modified to (Ooghe et al., 2007):

\[
E[y] = \tilde{g}(C, pol, \xi)
\]  

(2.4)

where the outcome expectation is taken over a group of people sharing the same circumstances, called a type, and \( \xi \) is a function of the moments of \( w \) and \( v \). In this setting, perfect ex-ante equality of opportunity arises whenever \( \frac{\partial \tilde{g}}{\partial C} = 0 \). Similarly, the extent to which this derivative deviates from zero is a measure of unfair ex-ante inequality of opportunity. Perfect ex-ante equality of opportunity arises when the set of potential lifestyle outcomes is equalised for all individuals, regardless of their circumstances. Differences in observed lifestyle outcomes are then of individual responsibility. In practical terms, public policies that promote an expansion of the set of potential outcomes for the least favored people and bring it closer to those of the rest of the population are considered optimal.

Empirical applications of the ex-ante and ex-post frameworks have taken separate pathways. Building on the ex-post framework, sound measures of unfair inequality of opportunity have been created for income inequality (Bourguignon et al., 2007; Ferreira & Gignoux, 2008; Figueiredo & Ziegelmann, 2010), access to credit markets (Coco & Pignataro, 2010), living conditions (Ferreira et al., 2011), educational levels (Asadullah & Yalonetzki, 2012; Ferreira & Gignoux, 2011) and health (Jusot et al., 2013; Van de Gaer et al., 2013) amongst others. This body of work relies on the empirical estimation of (2.15) in order to construct counterfactuals for \( y \) in conditions of perfect equality of specific circumstances, ignoring the role of efforts by associating them with residual stochastic elements. These ex-post EOp-based empirical applications have even been elegantly refined and corrected for omitted variable bias (Wendelspiess, 2013) and the identification of direct and indirect impact of circumstances over observable outcomes (Bourguignon et al., 2007).

To our knowledge, there is much less empirical work around how the ex-ante EOp approach can be helpful to understand what can be done in terms of public policy to reduce unfair inequalities and enhance individual wellbeing. Notable exceptions that build on a theoretical basis similar to the core of the ex-ante EOp framework are Yalonetzki (2012); Krishnakumar & Wendelspiess (2011); Wendelspiess (2013). A possible reason
for fewer empirical studies on the ex-ante framework could be its focus on the set of potential lifestyle outcomes, which are intrinsically counterfactual in nature. However, by virtue of the widespread acceptance of the Capability Approach (CA) as an appropriate theory of wellbeing in academic and political spheres, one-dimensional approaches are now commonly perceived as limited frameworks (Comim et al., 2008). According to the CA, individual freedom and ability to choose among different possible outcomes are synonyms of wellbeing. Actual lifestyle outcomes, called achieved functionings, are observed outcomes that have been willingly and freely chosen from a set of potential outcomes, called the capability set. The CA rationale advocates for an expansion of capabilities as a development paradigm, but it is hardly explicit on ways of achieving this goal through policy actions.

Building on Krishnakumar & Nogales (2015), we make the case that CA and the ex-ante framework of EOp are theoretically compatible and their combination can lead to a framework in which capabilities or advantages (equivalent terms) replace observed lifestyle outcomes as variables of interest and sources of individual wellbeing. Efforts play an important role in this combination of CA and EOp, because freedom and agency for the selection of particular functionings from the capability set are of paramount importance in the Capability Approach. These willingly taken actions that affect individual wellbeing are exactly what efforts depict in the EOp rationale.

This theoretical combination can be represented through a set of three vector equations:

\[
\begin{align*}
  y &= f_y(y^*, F, k_1, e_1) \\
  y^* &= f_{y^*}(y^*, C, F, pol, k_2, e_2) \\
  F &= f_F(y^*, C, F, pol, k_3, e_3)
\end{align*}
\]  

(2.5)

where \(k\) are other relevant observable explanatory factors and \(e\) are vector residual elements. The first set of equations indicates that multiple functionings have to be considered simultaneously while assessing wellbeing, in order to account for its multidimensional nature. This equation also depicts the link going from capabilities \((y^*)\) and efforts \(F\) to the vector of functionings \((y)\).

The second set of equations shows that capabilities are influenced by circumstances, efforts and public policies, in the spirit of the original equation in the EOp framework (2.1), except that the focus is on potential lifestyle outcomes (i.e. advantages or capabilities), as mandates both CA and ex-ante EOp, and not on actual outcomes, \(y\). We take into account the fact that capabilities are inter-dependent. The inclusion of efforts in this equation captures the fact that they may expand the set of potential lifestyle outcomes. Let us stress that public policies are included in this equation in a way that respects freedom of choice as advocated by the CA: public policies may shape capabilities, i.e. the set of potential lifestyle outcomes from which a person can make choices, but they may not directly influence lifestyle outcomes because the latter are ultimately a personal choice.

The third set of equations takes into account the fact that efforts are influenced by circumstances and public policies, as mandates EOp. It also captures the fact that the existence or not of some capabilities may itself lead to certain specific actions by an individual to realize some of the potential outcomes, should they be appealing to her.

In this setting, perfect ex-ante EOp arises when \(\frac{dy^*}{dC} = 0\), which is calculated using the second and third sets of equations, meaning that EOp implies that the characteristics that are beyond an individual’s control do not affect, either directly or indirectly, the set of
possible lifestyle outcomes of an individual. The above discussion is represented in Figure 2.1, which shows that public policies may not bear a direct influence on capabilities or efforts because we argue that the latter are the result of an individual and free process of conversion of environmental resources (economic, social, cultural, political etc.) into possible outcomes and the aim of public policies is to facilitate this conversion.

Figure 2.1: Schematic representation of a Sen-Roemer based approach for individual wellbeing assessment

Source: Krishnakumar and Nogales (2015)

2.3 Opportunities, Capabilities and Public Policies: 
an Econometric Framework

We operationalise the above framework by formulating an appropriate econometric model, which is in fact an extension of what is known as a structural equation model (SEM) in the literature (Muthén, 1983, 1984, 2002, 1988). In our framework, capabilities and efforts are variables of fundamental importance but are not directly observable. However, they manifest themselves partially and indirectly in the form of observed outcomes and actions.

For a generic individual $i$, let us denote by vectors $y_i^* (n \times 1)$ and $\nu_i^* (p \times 1)$, the respective latent capabilities and efforts. Let $y_i (m \times 1), m > n$, denote the observed indicators of latent capabilities and $\nu_i (q \times 1), q > p$, those of the latent effort variables. For a more compact notation, let us collapse these elements into vectors $\theta_i \equiv (y_i, \nu_i)'$ and $\theta_i^* \equiv (y_i^*, \nu_i^*)'$ of size $((m + q) \times 1)$ and $((n + p) \times 1)$, respectively. Finally, let us denote by the $(d \times 1)$ vector $x_i$ the surrounding characteristics, which include public policies.

Our model has two components: the first is the set of measurement equations which relate $\theta_i$ to $\theta_i^*$; the second is the set of structural equations, which relate all the elements of $\theta_i^*$ to each other and to $x_i$.

2.3.1 The Measurement Equations

The measurement equations represent the fact that the observed outcome indicators are partial manifestations of the latent variables. Thus they describe the link between the
2.3. Opportunities, Capabilities and Public Policies: an Econometric Framework

latent and observed variables:

\[ \theta_i = h(\theta_i^*) + \epsilon_i \]  

(2.6)

The measurement errors are captured in a vector \( \theta_i \) that is assumed to have zero mean and a full variance-covariance matrix denoted as \( \Omega \). The functional form of \( h(.) \) depends on the type of indicator that is observed. When assessing individual wellbeing, one usually encounters two types of observable indicators of efforts and capabilities: continuous, such as income level or discrete, such as the educational level (categorical) and speaking a language other than native (dichotomous). When the indicators are continuous, linear measurement relations are postulated. Regrouping all continuous indicators into \( \theta_{1,i} \) of size \( (m_1 + q_1) \times 1 \), where \( \theta_{1,i} \) denotes a sub-vector of \( \theta_i \), the measurement equations are given by:

\[ \theta_{1,i} = \Lambda_1 \theta_i^* + \epsilon_{1,i} \]  

(2.7)

where matrix \( \Lambda_1 \) of size \( (m_1 + q_1) \times (n + p) \) contains the factor loadings that link latent capabilities and latent efforts to their observable continuous manifestations. The factor loadings capture the force of the relationship between these two sets of variables. Vector \( \epsilon_{1,i} \) is the corresponding sub-vector of \( \epsilon_i \).

The measurement equations take a nonlinear form when the observed indicators are discrete. Let us denote by the vector \( \theta_{2,i} \) sized \( (m_2 + q_2) \times 1 \) the values taken by all the discrete indicators in \( \theta_i \), so that \( m_1 + m_2 = m \) and \( q_1 + q_2 = q \). In this case, the link between \( \theta_{2,i} \) and \( \theta_i^* \) goes through a set of corresponding underlying continuous latent response variables \( \tilde{\theta}_{2,i} \), \((m_2 + q_2) \times 1 \) such that:

\[ \tilde{\theta}_{2,ij} = h_j(\theta_i^*) + \epsilon_{2,ij} = \lambda_{2,ij} \theta_i^* + \epsilon_{2,ij}, \forall j = 1, \ldots, (m_2 + q_2) \]  

(2.8)

Function \( h(.) \) depicts a relation from each latent variable to the latent continuous response variable underlying each discrete indicator, which in turn explains the observed values taken by the latter. For instance, consider a generic \( j-th \) element of \( \theta_{2,i} \), namely \( \theta_{2,ij} \), composed of \( C_j > 1 \) categories coded as 1, \ldots, \( C_j \). The measurement equation of this indicator is composed of two parts. The first part is an equation representing the relation between the latent concept and a continuous latent response (2.8). The second equation describes the link between latent continuous response and the observed discrete categorical variable:

\[ \theta_{2,ij} = \begin{cases} 
1 & \text{if } \mu_{j,C_{j,0}} < \tilde{\theta}_{2,ij} \leq \mu_{j,C_{j,1}} \\
2 & \text{if } \mu_{j,C_{j,1}} < \tilde{\theta}_{2,ij} \leq \mu_{j,C_{j,2}} \\
\vdots & \\
C_j - 1 & \text{if } \mu_{j,C_{j,C_j-2}} < \tilde{\theta}_{2,ij} \leq \mu_{j,C_{j,C_j-1}} \\
C_j & \text{if } \mu_{j,C_{j,C_j-1}} < \tilde{\theta}_{2,ij} \leq \mu_{j,C_{j,C_j}} 
\end{cases} \]  

(2.9)

where elements \( \mu_{j,.} \), which we regroup in vector \( \mu_j = (\mu_{j,C_{j,0}}, \ldots, \mu_{j,C_{j,C_j}}) \), are thresholds for intervals in the domain of \( \tilde{\theta}_{2,ij} \) defining the value taken by \( \theta_{2,ij} \); \( \lambda_{2,ij} \) is the \( (1 \times (n + p)) \) vector of loadings for this specific indicator and \( \epsilon_{2,ij} \) is the specific scalar measurement error. If we assume that is \( \epsilon_{2,ij} \) is a normally distributed stochastic term with zero mean, the above equations imply that:

\[ \text{prob}(\tilde{\theta}_{2,ij}) = C_j = \int_{\mu_{j,C_{j+1}}+h_j(\theta_i^*)}^{\mu_{j,C_{j}}} -h_j(\theta_i^*) \phi(\epsilon_{2,ij}) d\epsilon_{2,ij}, \forall r = 0, \ldots, j - 1 \]  

(2.10)
where $\phi(.)$ is the univariate normal density function. Thus equations (2.9) and (2.10) define a non-linear relation between the observed discrete indicator and the latent capability or effort. Similar expressions relate all the discrete observed indicators to latent capabilities and efforts. Therefore, we can deduce a vector expression for (2.8):

$$\tilde{\theta}_{2i} = \Lambda \theta_i^* + \epsilon_{2i} \quad (2.11)$$

where matrix $\Lambda$ of size $((m_2 + q_2) \times (n + p))$ and vector $\epsilon_{2i}$ of size $((m_2 + q_2) \times 1)$ are column arrangements of elements $\lambda_{2,j}$ and $\epsilon_{2,ij}$.

2.3.2 The Structural Equations

Whether capabilities and efforts manifest themselves through continuous or discrete observable indicators, the relations amongst these latent variables, as well as the relations between them and the circumstances (surrounding factors) are given by the structural equations of the SEM (Skrondal & Rabe-Hasketh, 2004). Let us denote these equations as:

$$A \theta_i^* - T x_i - B k_i - e_i = 0 \quad (2.12)$$

where $A$ is a $((n + p) \times (n + p))$ matrix containing the coefficients that describe the interdependencies among capabilities and efforts. Matrix $T$ of dimension $((n + p) \times d)$ contains the impact coefficients of circumstances $x_i$ on each of the endogenous latent variables $\theta_i^*$ in the model. $k_i$ is a vector of exogenous variables and their impact coefficients are captured in matrix $B$. $e_i$ is a vector of errors assumed to be of zero mean and a full variance-covariance matrix $\Sigma$ that is individually invariant. Also note that vector $e_i$ is assumed to be uncorrelated with $\epsilon_i$ in the measurement equations.

Ex-Ante Inequality of Opportunity Assessment

In our framework, public policies aim to reduce or eliminate the impact of circumstances on capabilities and efforts. Thus they act on the coefficient matrix $T$:

$$T = f(pol_i) = \Gamma + \Pi pol_i \quad (2.13)$$

where $pol_i$ is a $(g \times d)$ matrix that represents values of policy variables or instruments for the $i$th individual. In this relation, $\Gamma$ is a $((n + p) \times d)$ matrix of constant elements, $\Pi$ is the $((n + p) \times g)$ matrix measuring the force of relation between public policies and the impact coefficients. Substituting (2.13) into (2.12) yields:

$$A \theta_i^* - (\Gamma + \Pi pol_i) x_i - B k_i - e_i = A \theta_i^* - \Gamma x_i - \Pi z_i - B k_i - e_i = 0 \quad (2.14)$$

where $z_i \equiv pol_i x_i$ represents the interactions of public policies and policy-sensitive circumstances$^2$.

Comparing equations (2.12) and (2.14), matrix $T$ has been divided into matrices $\Gamma$ and $\Pi$, where the first captures the direct impact of circumstances and the latter captures the indirect impact of public policies through their interaction with policy-sensitive circumstances.

$^2$Matrix $\Pi$ contains null-valued elements whenever a circumstance is not policy-sensitive.
Using the reduced form of the modified structural equations in (2.14), public policies represented by \( pol_i \) can be evaluated with respect to their contribution to equality of opportunity from an ex-ante EOp perspective. The reduced form of (2.14) is:

\[
\theta^*_i = A^{-1}\Gamma x_i + A^{-1}\Pi pol_i x_i + A^{-1}Bk_i + A^{-1}e_i
\]

(2.15)

Let us consider a specific element of \( \theta^*_i \) related to a specific capability \( h \), say \( \theta^*_i,h \). Also consider a specific policy instrument, \( pol_{i,k} \) and a circumstance that is sensitive to this policy say \( x_{i,j} \) and is a determinant of \( \theta^*_i,h \). The total effect of \( x_{i,j} \) on \( \theta^*_i,h \) is given by:

\[
\frac{d\theta^*_i,h}{dx_{i,j}} = b_{h,j} + \sum_{k=1}^{g} \gamma_{h,j}^k pol_{i,k}
\]

(2.16)

where \( b_{h,j} \) is the individually-invariant element of matrix \( A^{-1}\Gamma \) associated to \( x_{i,j} \) and thus represents the direct impact of this circumstance on \( \theta^*_i,h \). Coefficients \( \gamma_{h,j}^k \) are also individually-invariant and represent the elements of matrix \( A^{-1}\Pi \) that are associated with the interaction term between \( x_{i,j} \) and the \( k-th \) policy instrument\(^3\). The value taken by \( pol_{i,k} \) would represent an ex-ante EOp optimal configuration of the \( k-th \) public policy if it helps to achieve \( \frac{d\theta^*_i,h}{dx_{i,j}} = 0 \), because this means that the total effect of circumstance \( x_{i,j} \) over \( \theta^*_i,h \) is null. From this ideal configuration of public policy, assuming that \( pol_{i,k} > 0 \), there are three possible effects of under-optimal policy configurations:

- The policy configuration contributes to the attenuation of unfair inequality of opportunities if \( b_{h,j} \) and \( \gamma_{h,j}^k \) have opposite signs.
- The policy configuration contributes to the exacerbation of unfair inequality of opportunities if \( b_{h,j} \) and \( \gamma_{h,j}^k \) have the same sign, or \( b_{h,j} = 0 \) while \( \gamma_{h,j}^k \neq 0 \).
- The policy configuration has no effect over unfair inequality of opportunities if \( \gamma_{h,j}^k = 0 \) regardless of the sign of \( b_{h,j} \).

Once one identifies a policy that has an attenuating configuration over a specific circumstance having a negative impact over a specific capability, one can derive a set of ex-ante EOp optimal policy configurations. Let us note \( pol^*_i,r(x_j) \) the optimal configuration of the \( r-th \) policy instrument for the \( i-th \) individual relative to the \( j-th \) circumstance for the \( h-th \) capability. Building from equation (2.16), one can deduce that:

\[
pol^*_i,r(x_j) = -\frac{b_{h,j}}{\gamma_{h,j}^r} - \sum_{k=1,k\neq r}^{g} \frac{\gamma_{h,j}^k}{\gamma_{h,j}^r} pol_{i,k}
\]

(2.17)

Since this optimal configuration of the policy instrument nullifies a negative impact over a capability, it is compatible with a maximization of this capability.

\(^3\)Note, however, that even if the coefficients are individually invariant, the total effect of \( x_{i,j} \) on \( \theta^*_i,h \) has an inter-group variance, where a group is formed by the individuals for which \( pol_{i,j} \) takes the same value. For example, if we consider municipal public expenditure on education as a policy instrument of interest, the individuals that live in the same municipality would form a group.
Chapter 2. Do public policies promote equality of opportunity for wellbeing? An econometric analysis using Bolivian Data

2.4 Empirical Application using Bolivian Data

Our empirical analysis concerns Bolivia for which we wish to gauge the effect of public infrastructure expenditure (which includes sanitation, water, electricity, roads and communication) and social expenditure (including health and education) occurred in period 1999-2003 on the equality of opportunity for wellbeing in 2009, while taking a multidimensional conception of the latter concept. These expenditures are available at the municipal level.

2.4.1 Description of Data

Our data come from UNDP’s Household Survey for Social Stratification and Mobility (HSSSM) carried out in 2009 at an individual level. The reason to choose this dataset is twofold. First, HSSSM contains information about household characteristics when respondents were 14 years of age, providing a rich set of exogenous variables useful for identification purposes. Second, the survey captures both objective and subjective perceptions on different aspects of quality of life, thus enabling us to take account of both these aspects of wellbeing. Information from this dataset is combined with municipal-level official public records from UDAPE.

We focus on a specific sub-population of individuals who fulfil the following conditions: i) they are either household heads or their spouses, so they can be held responsible for some household characteristics, and ii) they are at least 18 years old, because they are mature enough to be legally responsible for their actions.

Taking these characteristics into account, we work with 1184 individuals in the sample. Based on data availability, we consider two dimensions of wellbeing: i) material wellbeing, which is reflected by observed monetary and tangible aspects of individual life, and ii) satisfaction with life, which supplements the first dimension with self-assessed wellbeing. Building upon the CA terminology, in the remainder of this chapter we will refer to the first dimension as advantages for material conditions and to the second dimension as advantages for perception of life satisfaction.

Advantages for material conditions are measured by four variables: i) residency equipment, ii) residence quality, iii) basic living conditions and iv) crowding. Advantages for perception of life satisfaction are, in turn, measured by self-assessed fulfilment with i) wealth, ii) environment, iii) community relations and iv) affection. The conceptual and statistical descriptions of these variables are presented in Table 2.1.

Since effort is a manifestation of agency and individual responsibility depicting willingly taken decisions and actions, we consider that effort may be captured through four variables included in our dataset: i) age at first job, which may depict, to some extent, commitment and willingness to be better prepared for taking up a job, for instance, through the acquisition of better and wider job skills; in other terms, this variable may depict commitment to take educational chances that may be available; ii) share of income that is generated from formal working conditions, which represents consciousness and concern for material stability in the long-run and effort in job search process and acquisition of job competencies. Formal positions offer all due social security benefits, whereas informal positions are more risky for workers and typically unstable over time; iii) category of occupation that represents effort at working place as well as labor productivity and

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4 Bolivian government’s Unit for Economic Policy Analysis: http://www.udape.gob.bo
efficiency; iv) years of schooling, depicting all efforts exerted for attaining higher levels of education and commitment towards human capital and knowledge acquisition.

All the indicators that we propose for measuring effort arise, at least partially, from willingly taken decisions. However, we are well aware of the fact that surrounding circumstances also influence them and we do not omit to take into account this fact in our structural model.

We consider five circumstances: i) gender, ii) ethnicity, iii) age, iv) family background and v) living or not in rural areas. In this particular empirical application, our considering of living in a rural area as a circumstance and not as a choice variable is justified by the technical fact that 98% of the cases that are used for estimation of our model live in the place where they were born. Thus the latter variable may also be interpreted as an indicator for whether the individual was born in a rural area.

Our two policy variables are public infrastructure expenditure and public social expenditure. As we are interested in the effect of public policy in reducing inequality of opportunity, i.e. the extent to which policy instruments reduce the influence of circumstances on advantages as well as efforts, we not only introduce the policy instruments as such in the structural equations but also interact the circumstance variables with them. The interactions capture the extent to which our policy instruments affect the way in which each of the five circumstances impact on advantages as well as efforts. We reason that both our policy instruments have the potential to bring about equality of opportunity for individual wellbeing. We argue that public expenditure on infrastructure fosters chances of improving individual wellbeing by enhancing and broadening access to basic services such as water, sanitation and energy, as well as enabling good communication with other communities through quality roads and efficient technology. Similarly, public expenditure on social services such as health and education facilitates acquisition of human capital necessary for improving material conditions of living and can also contribute positively to the perceived feeling of wellbeing through a sense of increased self-confidence.

<table>
<thead>
<tr>
<th>Component</th>
<th>Notation</th>
<th>Concept</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>ν₁</td>
<td>Material independence</td>
<td>Age at first job</td>
<td></td>
</tr>
<tr>
<td>Effort</td>
<td>ν₂</td>
<td>Formal working conditions</td>
<td>Share of personal income from formal salary</td>
</tr>
<tr>
<td></td>
<td>ν₃</td>
<td>Occupation</td>
<td>10-scale variable, 1=Best ... 10=Worst</td>
</tr>
<tr>
<td></td>
<td>ν₄</td>
<td>Education</td>
<td>Years of schooling</td>
</tr>
<tr>
<td>y₁,1</td>
<td>Residency equipment</td>
<td>Index of non-basic equipment: fixed phone, mobile, internet</td>
<td></td>
</tr>
<tr>
<td>Material Conditions</td>
<td>y₁,2</td>
<td>Residency quality</td>
<td>Construction materials: ceiling, walls, floor</td>
</tr>
<tr>
<td></td>
<td>y₁,3</td>
<td>Basic living conditions</td>
<td>Index of basic services: drinking water, water distribution inside, water-closet, electric power, cooking fuel</td>
</tr>
</tbody>
</table>

Table 2.1: Description of observed indicators for latent variables
Chapter 2. Do public policies promote equality of opportunity for wellbeing? An econometric analysis using Bolivian Data

<table>
<thead>
<tr>
<th>$y_{1,4}$</th>
<th>Crowding</th>
<th>Number of bedrooms per household member</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y_{2,1}$</td>
<td>Wealth</td>
<td>Self-reported Likert scale:</td>
</tr>
<tr>
<td>$y_{2,2}$</td>
<td>Community relations</td>
<td>$1=Very unsatisfied ... $</td>
</tr>
<tr>
<td>$y_{2,3}$</td>
<td>Environment</td>
<td>$10=Very Satisfied$</td>
</tr>
<tr>
<td>$y_{2,4}$</td>
<td>Affection</td>
<td></td>
</tr>
</tbody>
</table>

2.4.2 Identification, Inclusions and Exclusions in Structural Relations

Based on our theoretical framework and the available data, we pay particular attention to impose the adequate identification and exclusion restrictions that allow our model to effectively capture the intended causal relations. Let us recall that the set of structural equations (2.14) has the following form: $A\theta^*_i = \Gamma x_i - \Pi z_i - Bk_i - e_i = 0$, where $\theta^*_i$ has three elements: the first one depicts advantages for material conditions, the second one depicts advantages for perception of life satisfaction and the third depicts efforts.

- Matrices $\Gamma$ and $\Pi$ are fully composed of free parameters, as we intend to gauge all the effects of circumstances and policy variables on both advantages and efforts.

- Matrix $A$ is given the following configuration:

$$A = \begin{bmatrix} 1 & a_{2,2} & a_{1,3} \\ a_{2,1} & 1 & a_{2,3} \\ 0 & 0 & 1 \end{bmatrix}$$

where $a_i$ are free parameters. Advantages are allowed to be influenced by each other and by efforts. However, as our observable indicators of effort have taken place before 2009, neither of the considered advantages may be a cause of efforts. This implies the exclusion of both advantages in the equation for efforts, as depicted by the zero-valued elements in the third row of the matrix above.

- In $k_i$ we include three strictly exogenous variables, namely: i) housing conditions at age 14, captured by an index of basic and non-basic services ($k_{i,1}$), ii) a dummy variable indicating if the person has ever felt discriminated ($k_{i,2}$); and iii) perception of economic status of household at age 14, captured by a 10-scaled variable where 1=worst ($k_{i,3}$). We exclude perception of discrimination and perception of economic status of household at age 14 from the equation of advantages for material conditions, because these variables represent subjective conditions at a particular point in time in the past that may not have any long-lasting effect on current tangible/material aspects of wellbeing. We argue that any impact of these variables on current objective material conditions may only come indirectly through their influence on people’s actions and behaviour, i.e. efforts, which is accounted for in our setting. We include housing conditions at age 14 as a possible direct determinant of current advantages for material conditions as it may realistically expand possibilities of heritage and family endowments.
Next, we exclude housing conditions at age 14 and perception of economic status of household at age 14 as direct determinants of current advantages for perception of life satisfaction, as the latter is a perception that is often related to more personal and immediate aspects of life. We reason that any effect of these variables on this advantage may come indirectly through personal actions and decisions, i.e. effort, for which we account in our setting. We include perception of discrimination as a direct determinant of life satisfaction capability, as it may have lasting negative effects on self-esteem and perception of social acceptance/approval (Anand et al., 2010).

Finally, we emphasise our inclusion of all three exogenous variables as possible direct determinants of efforts, as they depict willingly taken actions and decisions in the past that may have been shaped by perceptions and situations that have also taken place in the past.

Thus the configuration of matrix $B$ is the following:

$$B = \begin{bmatrix} b_{1,1} & 0 & 0 \\ 0 & b_{2,2} & 0 \\ b_{3,1} & b_{3,2} & b_{3,3} \end{bmatrix}$$

where $b_i$ are free parameters.

These restrictions satisfy the necessary and sufficient rank condition for exact-identification of the model, as matrices of rank 2 can be formed by the coefficients of the excluded exogenous and endogenous variable in each equation (Muthén, 1983, 1984).

### 2.4.3 Estimation Results

Our analytical procedure yields a quite rich set of results. In order to maintain parsimony in this document and effectively illustrate the usefulness of our framework for policy purposes, we will limit ourselves to highlight the most relevant ones according to our understanding of the Bolivian case. The standardised structural parameters of the estimated model are presented in Table 2.2. They only give the direct impacts of the considered variables on the latent ones because these effects do not incorporate relations among the latent variables.

**Table 2.2: Selected Structural Coefficients (standardized)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.145 ***</td>
<td>0.096 **</td>
<td>0.077</td>
<td></td>
</tr>
<tr>
<td>Indigenous</td>
<td>-0.162 ***</td>
<td>-0.068</td>
<td>-0.025</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.171 ***</td>
<td>-0.164 ***</td>
<td>0.061</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>-0.359 ***</td>
<td>-0.159 ***</td>
<td>-0.022</td>
<td></td>
</tr>
<tr>
<td>Parents’ Schooling</td>
<td>0.118 ***</td>
<td>0.489 ***</td>
<td>0.139</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Indigenous</th>
<th>Age</th>
<th>Rural</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interac. Exp. Infra.</strong></td>
<td>0.127 ***</td>
<td>-0.143 ***</td>
<td>-0.105 ***</td>
<td>0.116 ***</td>
<td>-0.125 ***</td>
</tr>
<tr>
<td></td>
<td>-0.031</td>
<td>0.035</td>
<td>-0.031</td>
<td>-0.029</td>
<td>0.027</td>
</tr>
<tr>
<td></td>
<td>-0.032</td>
<td>0.126</td>
<td>0.126</td>
<td>-0.045</td>
<td>0.146 *</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Indigenous</th>
<th>Age</th>
<th>Rural</th>
<th>Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interac. Exp. Soc.</strong></td>
<td>-0.048</td>
<td>0.184 ***</td>
<td>0.068</td>
<td>-0.101</td>
<td>-0.055</td>
</tr>
<tr>
<td></td>
<td>-0.052</td>
<td>-0.154 ***</td>
<td>0.217 ***</td>
<td>-0.042</td>
<td>-0.131 **</td>
</tr>
<tr>
<td></td>
<td>-0.093</td>
<td>-0.118</td>
<td>0.141 *</td>
<td>-0.050</td>
<td>-0.098</td>
</tr>
</tbody>
</table>

|                        | Yes           | Yes        | Yes          |
| Control Variables      |               |            |              |
| R-Squared              | 0.79          | 0.60       | 0.18         |

In Table 2.2 control variables refer to the inclusion of pertinent variables to assure identification of each equation, namely a) only housing conditions at age 14 in the equation of advantages for material conditions, b) only perception of discrimination in the equation of advantages for perception of life satisfaction, and c) both variables mentioned above and perception of economic status of household at age 14 in the equation for efforts.

Being born in a rural area and being indigenous both hinder advantages for material conditions. These results reflect the limitations of rural areas to offer a wide range of services and goods for a good quality of life, as well as persisting shades of ethnic disparities. In that sense, our results are in line with a wide literature on unfair deprivation of material wellbeing among ethnic minorities (for recent empirical evidence see Telles et al. (2015) and ˜Nopo (2012)). In a contrasting fashion, having a privileged family background expands advantages for material conditions and it is the most favourable circumstance for the exercise of efforts. This is a reflection of the existence of imperfect intergenerational social mobility in the country, which is also extensively documented (see e.g. Choque et al. (2011)).

Age also expands advantages for material conditions through a natural process of personal and professional growth as well as experience acquisition. Efforts, in turn, reduce with age. This result may be interpreted as a less restricted access to education and good working conditions for older people. Interestingly, being male expands efforts while it hinders this advantage. We consider the positive impact of being male on this variable to be a manifestation of discrimination against women in labor markets and education acquisition. This particular aspect of gender discrimination in the country has been extensively analysed in the literature; the results that we present here are in line with findings in Mercado et al. (2015) and Capdevila et al. (2016).

We find that, in descending order, the groups suffering the most from unfair inequality of opportunity for advantages for material conditions are: people living in rural areas, younger people and indigenous people. Similarly, there are groups of people suffering from unfair inequality of opportunity for making efforts towards wider and better advantages; in descending order these groups are: people coming from unprivileged family backgrounds, younger people, people living in rural areas, females and indigenous people.

The two public policies that we consider contribute quite differently to redress these unfair situations. For instance, we find that the current configuration of the municipal public expenditure per capita on infrastructure has contributed to diminish the unfair
inequalities for advantages for material conditions generated by four out of five circumstances, namely gender, age, having a privileged family background and living in a rural area. However, this policy is configured in a way that exacerbates the negative impact of being indigenous on this advantage. This reflects the fact that non-indigenous people benefit more of infrastructure advances in the country than indigenous people. Although somewhat striking, this result is in line with similar findings for other countries such as Pakistan and India Keefer & Khemani (2005), South Africa Mershon (2015) and other developing economies such as China, Russia and Indonesia Gomez (2015). One possible explanation for this fact can be found in imperfect political decisions that force flows of public expenditures towards powerful minorities, and another one in the considerable geographical difficulties to access the poorest and most vulnerable part of the population.

We find that municipal public expenditure on social services has also contributed to diminishing inequalities of opportunities in the country through different channels. This policy has reduced unfair disparities in terms of advantages for material conditions caused by being indigenous; it has also contributed to diminish the impact of age and of unprivileged family backgrounds on efforts.

As for the goodness of fit, on the grounds of values taken by R-squared, the proposed model fits best for explaining advantages for material conditions and has a good explanatory power for Efforts; it presents a lower goodness of fit for advantages for perception of life satisfaction. Indeed, perceptions have often proven difficult to be explained in related empirical literature because they may be influenced by the situation during the interview or even an emotional state of mind (Anand et al., 2010). When analysing subjective dimensions of wellbeing, Halliwell et al. (2015) also find that internal and external factors (other than income) play a crucial role, but they also stress limitations for establishing causal links relying solely on cross-sectional data, which is precisely our case.

Going deeper in the analysis of our results, we highlight the fact that effort has positive effects of both dimensions of wellbeing. In fact, effort has the highest positive impact on advantages for material conditions, which proves the important contribution of this variable to this dimension of individual wellbeing. We prove that if public policies promote equality of opportunity for the exercise of efforts, as measured by material independence, access to formal working conditions, chances of attaining high occupational status and access to education has important indirect effect on both objective and subjective dimensions of wellbeing. To better illustrate our results, let us focus on the latter causal link.

The importance of efforts for material conditions capabilities brings out important indirect effects of circumstances over the latter variable that are usually omitted in other studies, as they do not explicitly include effort variables in their analysis. These indirect effects can be calculated as the difference between the reduced-form parameters, which depict the total effect of circumstances on both capabilities and efforts, and the corresponding structural parameters. Figure 2.2, depicts the importance of these indirect effects in comparison to the direct ones in the case of advantages for material conditions.

Taking into account both direct and indirect effects of family background, this variable has the highest positive impact on advantages for material conditions. Actually, as depicted in Figure 2.2, the greater part of the total effect is indirect and comes from efforts (58%). This result denotes important shades of low social mobility in the country and a general tendency for perpetuation of intergenerational levels of wellbeing, whether this is high or low, caused by limitations for the exercise of efforts towards wider advantages for material conditions. In a contrasting fashion, being indigenous and living in rural areas
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Figure 2.2: Effects of circumstances on Material Conditions

These results show that conditions in rural areas still hinder advantages for material conditions in comparison to opportunities offered by urban areas; they also show that ethnic discrimination is still a problem in Bolivia in the quest for equality of opportunity for material conditions. Our results provide further support for recent research on the extent to which ethnic minorities still lag behind in the Bolivian process of economic development. For instance, Núñez & Villegas (2016) also stress the importance of two channels for disadvantages of ethnic minorities in labor market outcomes and material wellbeing. The first is a differential of productivities and human capital endowments in favour of non-indigenous populations, which in our case reflects the indirect mechanism of inequality of opportunity going through efforts. The second is pure discrimination in the labor market on the ground of ethnic backgrounds, which relates to the direct mechanism of inequality of opportunity in our framework. Furthermore, Yashar (2015) suggest that reverting this unequal state of affairs may be pressing challenge not only for Bolivia, but for other Latin American countries as well, in the quest of promoting faster and sustainable social/economic inclusion of their large indigenous populations.


As we have established, having an indigenous language as mother tongue, which is our proxy for being indigenous, proves to be one of the most hindering circumstances for the enhancement of advantages for material conditions. Figure 2.3 shows that there is a clear stochastic dominance of the distribution of this advantage in favour of non-indigenous people. The mean advantage score of non-indigenous people is 0.72 and that of indigenous is -0.58, depicting an average reduction of -181%.

We also establish that expenditure on social services does contribute to diminish unfair inequalities of opportunities caused by being indigenous. In order to illustrate this affirmation, we simulate a reduction of 50% in this expenditure and assess the reconfiguration of the impact of being indigenous. Originally, the average negative impact of being
2.4. Empirical Application using Bolivian Data

Figure 2.3: Cumulative distributions of Material Conditions Scores

indigenous is -0.32. This negative impact gets stronger (in magnitude) in the simulated scenario (-0.44). Thus if social expenditure would have been 50% lower, the negative impact of being indigenous would be, on average, 38% stronger. The cumulative distributions of the current impact and the impact resulting from this simulation are depicted in Figure 2.4.

Figure 2.4: Cumulative distributions of Material Conditions Scores

Despite the positive effect of public expenditure on social services in helping redress unfair inequality of opportunity caused by being indigenous, the policy does not achieve optimal ex-ante EOp levels. This optimal level for public policy is calculated following (2.17), recalling that the policy remains municipal-specific because expenditure on infrastructure is held constant for all individuals within a given municipality. As shown in Figure 2.5, there is a considerable gap between current expenditure on social services and EOp-optimal expenditure on social services against ethnic disparities. The range of variation of EOp-optimal per capita expenditure on social services is narrower than that of current expenditure, going from 10 to 38 USD/year, with a mean of 14 USD/year.
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These values are considerably far away from the current expenditure on social services, ranging from 0 to 24 with a mean value of 6 USD/year respectively. This means that, on average, per capita annual expenditure on social services would need to increase by 303% in order to be EOp-optimal against the unfair negative effects of being indigenous.

Figure 2.5: Densities of current level of Expenditure on Social Services and EOp level against impact of Being Indigenous

Policies and Equalisation of Opportunities: Investigating the Impact of Expenditure on Infrastructure on the Influence of Family Background on Advantages for Material Conditions

Among all considered circumstances, having a privileged family background is the most important one for the expansion of advantages for material conditions. Let us recall that the proxy used for family background is completed years of school of the head of the household when respondents were 14 years old, which is normally one of the parents. As depicted in Figure 2.6, the average factor score of this advantage tends to improve as parents’ schooling increases. Parents’ education are considered to be as strong predictor of their children’s educational and occupational success (see e.g. Dubow et al. (2009)), as it may foster better family interactions, reduce probability of child aggression and enhance teenage motivation and aspirations. Our results grasp the positive effect of having educated parents on both educational and occupational success, as they are two indicators of effort that are explicitly accounted for.

In order to evaluate the marginal impact of one year of schooling of the respondent’s parents on advantages for material conditions, we simulate advantage scores with one additional year of schooling of the household head. The difference between mean advantage scores of actual and simulated advantage is presented numerically in Table 2.4.3. One additional year in parents schooling always results in better and wider advantages. We find that, in general, this improvement of family background conditions would mostly benefit people having the most underprivileged background; for instance one additional year of schooling results in a mean increase of advantages for material conditions of 8.8% when the household head does not have any schooling and of 0.8% when they have 15 years of schooling.
2.4. Empirical Application using Bolivian Data

Figure 2.6: Parental schooling and Material Conditions

<table>
<thead>
<tr>
<th>Years</th>
<th>Mean Latent Score</th>
<th>Actual</th>
<th>Simulated</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-0.37</td>
<td>-0.34</td>
<td>8.8%</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.41</td>
<td>0.43</td>
<td>4.7%</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.29</td>
<td>0.31</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.42</td>
<td>0.45</td>
<td>6.7%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.45</td>
<td>0.48</td>
<td>6.2%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.76</td>
<td>0.79</td>
<td>3.8%</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.80</td>
<td>0.81</td>
<td>1.2%</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.12</td>
<td>1.13</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.06</td>
<td>1.07</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1.06</td>
<td>1.08</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.23</td>
<td>1.25</td>
<td>1.6%</td>
<td></td>
</tr>
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<td>0.86</td>
<td>0.87</td>
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<td></td>
</tr>
<tr>
<td>12</td>
<td>1.27</td>
<td>1.28</td>
<td>0.8%</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>1.08</td>
<td>1.09</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>1.48</td>
<td>1.50</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1.28</td>
<td>1.29</td>
<td>0.8%</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>0.88</td>
<td>0.90</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>1.49</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.3: Marginal Impact of Parents’ Schooling on Material Conditions

Although our results prove that intergenerational social immobility is strong in the country, municipalities have, indeed, managed to reduce this unfair trait that hinders enhancement of advantages for material conditions through expenditure on infrastructure. More and better basic services such as water, sanitation and electricity have contributed to expand this advantage by helping mitigate the negative effect of having unprivileged family backgrounds. In order to support this affirmation, we have simulated a reduction of 50% in this public expenditure and found that it yields an increase of intergenerational social immobility in the country. In this case, the marginal impact of parents’ schooling
is greater than the ones observed with the current configuration of this policy. Originally, the mean impact is 0.030 whereas it goes up to 0.035 (17%) in the simulated scenario. Based on Figure 2.7, let us highlight the fact that municipalities that have attained lower unfair disparities caused by different family backgrounds suffer the greatest drawback in the simulated scenario. Municipalities that currently have the strongest shades of social immobility are less affected by the reduction of expenditure on infrastructure.

Figure 2.7: Cumulative distributions of impact of Family Background on Advantage for Material Conditions

These results prove that, although expenditure on infrastructure has contributed to intergenerational social mobility in the country, it is far from the stage of promoting perfect mobility. This EOp-optimal situation could be attained, though, by means important increases in this expenditure, even if municipal expenditure on social services is held constant. As shown in Figure 2.8, expenditure on infrastructure would need to range between 9 and 24 USD per habitant per year, around a mean of 19 USD. These values are considerably distant to current public expenditures, which range between 0 and 33 USD per habitant per year, around a mean of 8 USD.

2.5 Conclusions

The mechanisms through which public policies for development succeed in improving individual wellbeing are a primary concern for policymakers. It is increasingly accepted that a fair and developed society is one in which individuals have the freedom to choose between different potential states of personal wellbeing which are all available to them regardless of the circumstances in which they live. This paper is an empirical investigation of the extent to which public policies contribute to the reduction of inequality of opportunities for different dimensions of wellbeing through an econometric implementation of a theoretical framework that combines Sen’s Capability Approach and Roemer’s Equality of Opportunity approach. Combining the salient features of CA and EOp and arguing for an equalisation of potential outcomes as the rule for wellbeing EOp, we build a theoretical framework describing the relationships between capabilities (or advantages), efforts, circumstances and public policies and formulate a corresponding econometric model that allows evaluating policies from a capability EOP angle.
Our econometric framework is a Simultaneous Equation Model in which capabilities and efforts, mutually dependent and endogenous, are assumed to be latent and manifesting themselves through observed outcome and action variables. The model further allows for influences of circumstances on both these variables, and of public policies on the impact coefficients of circumstances. Thus we are able to identify direct influences of circumstances on wellbeing, as well as indirect impacts that come from the influence of circumstances over efforts. This framework enables us to assess whether public policies promote ex-ante equality of opportunity, i.e. whether they reduce the impact of circumstances that hinder the enhancement of individual capabilities. It also allows us to identify the optimal configuration of public policies that foster perfect ex-ante equality of opportunity, meaning that they completely nullify the influence of hindering circumstances over individual capabilities and the efforts they make to expand them.

We implement our model for Bolivia to examine the impact of municipal public expenditure on infrastructure (including sanitation, water, electricity, roads and communication) as well as public expenditure on social services (including health and education) on opportunities for personal wellbeing. We concentrate on two dimensions of wellbeing: material wellbeing (objective) and life satisfaction (subjective). We show that there is inequality of opportunities in the two wellbeing dimensions but public expenditures reduce it to a certain extent.

We confirm the presence of unfair inequality of opportunity in the country. Among our findings, we highlight strong shades of intergenerational social immobility, as having educated parents is one of the most favourable circumstances for the expansion of advantages for material conditions and for the exercise of efforts. Also, we find that living in rural areas severely hinders these advantages and efforts.

However, we find that public expenditure on infrastructure and social services have contributed to some extent in the mitigation of these unfair inequalities of opportunity for wellbeing. We carry out simulation exercises to demonstrate this statement. As an example, simulating a reduction of 50% in social expenditure and re-assessing the impact of being indigenous, we see that the magnitude of the negative impact increases around 38% in the simulated scenario thus confirming that the expenditure on social services does
contribute to diminishing unfair inequality of opportunities caused by being indigenous.

We go on calculate the optimal configuration of policies according to the EOp rationale for different circumstance variables. For instance, we identify that expenditure on social services should rise, on average, by around 303% per person each year in order to avoid unfair disparities in advantages for material conditions caused by being indigenous. In general, we find that the optimal levels are quite high and far away from current policy configurations. This naturally leads to important policy concerns regarding ways to improve the current situation. A direct reading of our findings would imply that the level of expenditure be increased to the required extent. However, it may be practically infeasible given the huge extra amount of public resources needed to reach the optimal levels. Another option is to make the policies more effective, i.e. increase their effect on the impact coefficients of circumstances. This could be a more desirable solution, especially if resources are limited, but it needs a deeper insight on the mechanisms through which the policies impact on individual lifestyles which goes beyond the scope of the current study.

The results that we highlight in these concluding remarks prove that it is possible to quantify important relations between policy actions and individual wellbeing through an appropriate model that takes into account the bidirectional relations that exist between efforts and capabilities as advocated by theory. No doubt the renowned theoretical and conceptual developments that we build upon have already been deeply influential among policymakers. However, we believe that one can go a step further in combining and operationalising these theoretical frameworks to arrive at practical ways for achieving wellbeing with justice. It is in this spirit that we have carried out this research in order to come up with a theoretical framework and an econometric model that enable us to take this extra step and make specific quantitative suggestions for effective policymaking with justice. We hope that our contribution is useful for discussions on the role of public policies for the promotion of wellbeing with justice, both at theoretical and technical levels. We believe that further case-specific empirical evidence on this subject is required so that we are able to truly understand these complex relations, which is fundamental for effective policymaking towards a more just society.
2.A  Parameter Estimation Procedure

The econometric framework that we presented in this paper requires the estimation of the following elements:

- vectors $\mu_j \forall j = 1 \ldots (m_2 + q_2)$
- variance-covariances of the residual vectors $\epsilon$ and $e$, respectively denoted as $\Omega$ and $\Sigma$
- impact coefficients, also called parameters of interest, in matrices $\Lambda, A, \Gamma, B$ and $\Pi$
- latent capabilities and efforts ($\theta^*$) $\forall i = 1 \ldots N$.

These elements can be estimated by adapting a three stage procedure described in Muthén (1983, 1984) to our setting:

Step 1: Estimation of the parameters relating to the means, thresholds and the variance-covariance structure of the latent response variables, using sample moments;

Step 2: Estimation of the asymptotic variance-covariance matrix of the sample moments;

Step 3: Estimation of the parameters of the model by minimizing the difference between the theoretical expressions of moments and their sample counterparts, weighted by the inverse of the asymptotic variance-covariance estimated in the previous step. This method corresponds to a limited information multi-staged weighted least squares (WLS) based on Muthén (1983, 1984).

Once the parameters of the model are estimated, one can estimate the individual capabilities and efforts through the Empirical Bayes method. We will only present the most important steps of this estimation below.

2.A.1 First stage: Empirical Mean and Variance-Covariance Structures

Building from (3.16) and (2.12), let us collapse all the linear relations in the measurement equations as following:

$$\tilde{\theta}_i = h(y^*_i) + \epsilon_i = \Lambda\theta^*_i + \epsilon_i$$ (2.18)

with $\tilde{\theta}'_i \equiv (\theta_{1,i}, \tilde{\theta}_{2,i})$, $\epsilon'_i \equiv (\epsilon_{1,i}, \epsilon_{2,i})$ both of size $((m + q) \times 1)$ and $\Lambda' \equiv (\Lambda_1, \Lambda_2)$ of size $((m + q) \times (n + p))$. In this equation, vector $\tilde{\theta}_i$ is the response vector for the $i$ - th individual. Note that $\theta_{1,i}$ is observed and $\tilde{\theta}_{2,i}$ is latent.

Taking into account the statistical assumptions on vectors $e$ and $\epsilon$ combined with equation (2.14), we can get the first and second moments of the latent response vector, $\tilde{\theta}_i$, conditional on $x, z$ and $k$ as:

$$\left\{\begin{array}{l}
E[\tilde{\theta}_i | x_i, z_i, k_i] = \Lambda A^{-1} \Lambda x_i + \Lambda A^{-1} \Pi z_i + \Lambda A^{-1} B k_i \\
V[\tilde{\theta}_i | x_i, z_i, k_i] = \Lambda A^{-1} \Sigma A^{-1} \Lambda' + \Omega \equiv \Theta
\end{array}\right.$$ (2.19)

Muthén (1983, 1984) proposes to divide the estimation of the above two moments into two limited information maximum likelihood procedures: a first one aiming to estimate the parameters for the first moment of the response vector, and the second aiming to estimate the elements of the second moment of this vector, taking the results of the first ML procedure as given.
First Limited Information Maximum Likelihood

Let \( E[\hat{\theta}_i|x_i, z_i, k_i] \) be the \( j-th \) element of \( E[\hat{\theta}_i|x_i, z_i, k_i] \) and \( \Theta_{jj} \) be the \( j-th \) element in the diagonal of matrix \( \Theta \), which correspond, respectively to the first and second conditional moments of the \( j-th \) latent response variable. Considering a generic \( j-th \) latent response variable, say \( \hat{\theta}_{2,ij} \), associated with a discrete indicator, say \( \theta_{2,ij} \) composed of \( C_j > 1 \) categories coded as \( r_j = 1 \ldots C_j \), let us define the following dummy variables:

\[
d^k = \begin{cases} 
1 & \text{if the k-th variable is continuous} \\
0 & \text{otherwise} 
\end{cases} \quad \forall k = 1 \ldots m + q \tag{2.20}
\]

\[
e_{r,i}^j = \begin{cases} 
1 & \text{if } \theta_{2,ij} = \gamma_{r,i} \\\n0 & \text{otherwise} 
\end{cases} \quad \forall r,i = 1 \ldots C_j; \forall i = 1 \ldots N; \forall j = 1 \ldots m_2 + q_2 \tag{2.21}
\]

Assuming normality, we can specify the element of the log-likelihood function corresponding to the \( j-th \) indicator and the \( i-th \) individual as follows:

\[
\max_{s_{1,j}} L_j^i = d^i \ln(\phi(\epsilon_{1,ij})) + (1 - d^i) \sum_{r,j,i=1}^{C_j} e_{r,i}^j \ln(\text{prob}(\theta_{2,ij} = \gamma_{r,i} | x_i, z_i, k_i)) \tag{2.22}
\]

where \( \phi(\cdot) \) denotes the normal density function. The conditional probability in the second term of the above expression is given by:

\[
\text{Prob}(\theta_{2,i} = \gamma_{r,i} | x_i, z_i, k_i) = \int_{\mu_j, c_j}^{\mu_j, c_j+1} E[\hat{\theta}_i|x_i, z_i, k_i] \phi(\epsilon_{2,ij}) d\epsilon_{2,ij} \forall r,j,i = 1 \ldots C_j \tag{2.23}
\]

Assuming individual independence, we can write the set of \( m + q \) first limited information maximum likelihood problems corresponding to all the elements of the response vector:

\[
L_j = \sum_{i=1}^{N} L_j^i \forall j = 1 \ldots m + q \tag{2.24}
\]

The control variable of each optimization problem is \( s_{1,j} = (\mu_j; K_{1,j}; K_{2,j}; K_{3,j}) \), where the components depict, respectively:

- the thresholds defining the cut-off points of the latent variable underlying the \( j-th \) indicator, should the latter be discrete. If the \( j-th \) indicator is continuous, this element represents its mean (Muthén, 1984).

- the estimators of the set of parameters that define the conditional expectation in (2.19), which we have denoted as \( K_{1,j}, K_{2,j} \) and \( K_{3,j} \) and which represent, respectively, the \( j-th \) rows of matrices \( \Lambda A^{-1} \Gamma, \Lambda A^{-1} \Pi \) and \( \Lambda A^{-1} B \).

We collect the estimators provided by these programs in vector \( \hat{s}_{1,ML} \equiv (\hat{s}_{1,1}, \ldots, \hat{s}_{1,(m+q)}) \) with \( s_{1,j} = (\mu_j; K_{1,j}; K_{2,j}; K_{3,j}) \) for every \( j \), to be used in the next step of the estimation procedure.

Second Limited Information Maximum Likelihood

In order to estimate the elements of the variance-covariance matrix \( \Omega \), we will take the estimations of the first limited information ML problem as given and construct a set of second limited information ML problems to focus specifically on each element of the
variance-covariance matrix presented in (2.19). For this, we have to consider pairs of
variables and the set of \((m + q)(m + q - 1)\) ML programs will take the following form:

\[
\max_{s_{2,jl}} L_{j|l|x,r} = \sum_{i=1}^{N} \ln \phi(\epsilon_{2,ij}, \epsilon_{2,il}) \forall j = 1 \ldots m + q; \forall l = 1 \ldots m + q; \forall l \leq j \quad (2.25)
\]

where \(\phi(\cdot)\) is the bivariate normal density and \(s_{2,jl}\) is the element in the \(j - th\) row
and \(l - th\) column of the variance-covariance matrix in (2.19). Each program is solved
separately using the relevant information of the ML programs presented in the previous
section. Note that if \(j = l\) and both error terms are associated with continuous observable
indicators, the program yields an estimator of the variance of that element; if \(j \neq l\) and both
error elements are associated with discrete indicators, the value of \(s_2\) is known a
priori and equal to unity as the latent response variables do not have any specific scale
of measure; if \(j \neq l\) and both elements associated with continuous observable indicators,
the program will yield an estimator of the Pearson correlation between these elements,
and if \(j \neq l\) and only one of the error elements is associated with a continuous observable
indicator, the program will yield an estimator of the polychoric correlation between these
two elements.

The solution of this optimization program yields \((m + q)(m + q - 1)\) estimates of all
the distinct values in the variance covariance matrix in (2.19), taking into account that it is
symmetric. We collect these solutions in the following vector \(\hat{s}_{2,ML} = (\hat{s}_{2,1|1}, \ldots, \hat{s}_{2,(m+q)|(m+q-1)})\).

Although we now have estimates for every parameter of the reduced form of the
structural equations and the elements of the variance-covariance matrix of the response
vector, the above procedure does not allow us to estimate the structural parameters of the
model. The following stages of the estimation procedure deal with this issue.

### 2.A.2 Second stage: The Weighting Matrix

Let us define the vector of all the first order conditions of each limited information ML
program in the first stage (Muthén, 1983, 1984):

\[
g(\xi) = \left( \frac{\partial L_1}{\partial s_{1,1}}, \frac{\partial L_2}{\partial s_{1,2}}, \ldots, \frac{\partial L_{m+q}}{\partial s_{1,m+q}}, \frac{\partial L_{1|(m+q)}}{\partial s_{2,1}}, \ldots, \frac{\partial L_{1|(m+q)}}{\partial s_{2|(m+q)}}, \frac{\partial L_{2|(m+q)}}{\partial s_{2,2}}, \ldots, \frac{\partial L_{(m+q)|(m+q)}}{\partial s_{2,(m+q)|(m+q)}} \right) \quad (2.26)
\]

where \(\xi \equiv (s_{1,1}, \ldots, s_{2,g(p-1)})\) is the vector of all the parameters in the two ML programs
of the first stage of the estimation procedure. By construction, we have \(g(\hat{\xi}) = 0\) for the
ML estimators of \(\xi\) found in the first stage. Applying a first order Taylor expansion of
\(g(\hat{\xi})\) around \(\xi\) (the true values of the control variables):

\[
g(\hat{\xi}) \approx g(\xi) + \frac{\partial g(\xi)}{\partial \xi}(\hat{\xi} - \xi) = 0
\]

we obtain

\[
\sqrt{N}(\hat{\xi} - \xi) = (\frac{-N^{-1}\partial g(\xi)}{\partial \xi})^{-1}g(\xi) \sim N(0, M) \quad (2.28)
\]

with \(M = R^{-1}HR^{-1}\), \(R = \frac{-N^{-1}\partial g(\xi)}{\partial \xi}\) and \(H \equiv V(\frac{g(\xi)}{\sqrt{N}}) = \frac{1}{N}V(g(\xi)) = \frac{1}{N}E[g(\xi)g(\xi)']\). Both
matrices can be estimated using the limited information ML estimations presented in the

first stage: \( \hat{R} \equiv \frac{-N^{-1}g(\hat{\xi})}{\sigma_{g(\xi)}} \) and \( \hat{H} = \frac{1}{N}E[g(\hat{\theta})g(\hat{\theta})'] \), allowing us to construct an estimator of the theoretical variance of \( \hat{\xi} \), \( \hat{M} = \hat{R}^{-1} \hat{H} \hat{R}^{-1} \), whose inverse will be the weighting matrix.

2.A.3 Third stage: The objective function for parameter estimation

The third and final stage for estimating the structural parameters in the SEM consists of finding the parameter values that minimize the difference between the theoretical vector \( \xi \) and its estimate \( \hat{\xi} \) derived above:

\[
\min_{\Lambda, A, \Sigma, \Omega, \Pi} (\xi - \hat{\xi})\hat{M}^{-1}(\xi - \hat{\xi})' 
\tag{2.29}
\]

We recall that the weighting matrix found earlier is a suitable estimator of the asymptotic variance of \( \hat{\xi} \), so rescaling the difference in the objective function by the inverse of this matrix means weighting the respective parameters according to the inverse of their variance.

Estimation of Latent Scores for Individual Efforts and Capabilities

Having estimated all the parameters of the SEM following the above three-step procedure, the latent variables \( \theta^*_i \) are estimated by making use of the following result. Given a model

\[
a_i = HF_i + Rw_i + u_i \quad \forall i = 1 \ldots N 
\tag{2.30}
\]

where \( F_i \) is latent, \( a_i \) is observed and continuous, and \( w_i \) a vector of exogenous covariates, the Empirical Bayes estimator of \( F_i \) is given by (Skrondal & Rabe-Hasketh, 2004):

\[
\hat{F}_i = (\hat{\Sigma}^{-1}(\xi - \hat{\xi}))^{-1}(a_i - \hat{R}w_i) \quad \forall i = 1 \ldots N 
\tag{2.31}
\]

We follow further developments of this expression in Krishnakumar & Nagar (2007) to adapt, in turn, this result to our SEM. For this, let us derive the reduced form of our SEM by substituting the reduced form of the structural equation (2.14) into the measurement equations (2.18) to obtain:

\[
\hat{\theta}_i = \Lambda D + \Lambda A^{-1} \epsilon_i + \epsilon_i \quad \forall i = 1 \ldots N 
\tag{2.32}
\]

To simplify notations, let us define the following elements: \( D \equiv A^{-1}\Gamma x_i + A^{-1}\Omega z_i + A^{-1}Bk_i \), and recall that \( V(\epsilon) = \Omega \) and \( V(\epsilon) = \Sigma \). Thus

\[
\hat{\theta}_i = \Lambda D + \Lambda A^{-1} \epsilon_i + \epsilon_i \quad \forall i = 1 \ldots N 
\tag{2.33}
\]

Associating the elements of (2.33) to those of (2.30), the Empirical Bayes estimator of \( \epsilon_i \) can be written as:

\[
\hat{\epsilon}_i = \Sigma A^{-1}\Lambda'(\Lambda A^{-1}\Sigma A^{-1}\Lambda + \Omega)^{-1}(\hat{\theta}_i - \Lambda A^{-1}\Gamma x_i - \Lambda A^{-1}\Omega z_i - \Lambda A^{-1}Bk_i) \\
= \Sigma A^{-1}\Lambda'(\Lambda A^{-1}\Sigma A^{-1}\Lambda + \Omega)^{-1}(\hat{\theta}_i - \Lambda D) \quad \forall i = 1 \ldots N 
\tag{2.34}
\]

Replacing this result into the reduced form of the structural equation (2.14) we get the estimators of the individual latent scores for capabilities and efforts:

\[
\hat{\theta}^*_i = D + A^{-1}\hat{\epsilon}_i \quad \forall i = 1 \ldots N 
\tag{2.35}
\]
The variance of the latent scores can be calculated noting that $\hat{\theta}_i - \Lambda D = \Lambda A^{-1} e_i + \epsilon_i$, thus $V(\hat{\theta}_i - \Lambda D) = V(\Lambda A^{-1} e_i + \epsilon_i) = \Lambda A^{-1} \Sigma A^{-1} \Lambda' + \Omega$, given that $e_i$ and $\epsilon_i$ are assumed to be orthogonal. Thus:

\[
V(\hat{\theta}_i^*) = A^{-1} V(\hat{\epsilon}_i) A^{-1} = A^{-1} \Sigma A^{-1} \Lambda' (\Lambda A^{-1} \Sigma A^{-1} \Lambda' + \Omega)^{-1} \Lambda A^{-1} \Sigma A^{-1}
\]  

(2.36)
Chapter 3

Skills as mediators in the relationship between education and work advantage

In this chapter, we explicitly introduce cognitive and non-cognitive skills in the relationship between educational investments and work advantage, while considering the latter as a multifaceted concept covering different characteristics of a job simultaneously. We propose a theoretical combination of two deeply influential contributions in the field namely Sen’s Capability Approach and Heckman’s technology of skill formation. We formulate a corresponding econometric model that also takes account of possible endogeneity of investments. Applying it to Bolivia, we confirm that different dimensions of work advantage are significantly influenced by cognitive and non-cognitive skills. We find that relatively advantaged people in terms employment opportunities and earnings, as well as safe work environments are heavily concentrated in the highest quintiles of the distributions of both types of skills. Relatively disadvantaged people in terms of decent working time are highly concentrated in the lowest quintile of the cognitive skills distribution. Completion of primary school situates an individual in the above-average group of people in terms of stocks of non-cognitive skills, a condition requiring an undergraduate college degree with respect to cognitive skills.

3.1 Introduction

There is a vast academic literature on the relation between labor market outcomes and education, both of which are essential aspects of human development (see e.g. a literature review by Goldberg & Smith (2008)). As stated in Heckman et al. (2003), a large number of empirical studies on this subject build upon the classic works of Mincer (1974) and Becker (1993), in which success in the labor market is traditionally measured by earnings, which in turn is directly associated with educational achievements such as years of schooling. In this study we take a stand that a) labor market success cannot be described by a single measure, and b) the direct relation between labor market outcomes and wages should be qualified to include skills and abilities, which are the direct determinants of earnings and other work related aspects. Our argument builds upon two pioneering contributions that have shaped scientific thinking on human development, namely Sen’s capability approach (see e.g. Sen (2009)) and Heckman’s theory of skill formation (see e.g. Heckman et al. (2006)).
Mincer’s approach to study returns to schooling essentially considers years of education to be the key determinant of labor market success measured by earnings. However, years of schooling or more generally, time spent in formal educational programs, reflect first-order educational attainments that influence other characteristics such as abilities or skills (Fasih, 2008), which relate more closely to human capital than years of schooling. Even if the time dedicated to formal education gives important signals to employers about a person’s abilities and skills, it does not account how these years have effectively been converted into skills and abilities by different individuals. However, it is these latter aspects of human capital that may transform into productivity and generate labor market returns (Heckman et al., 2006; Kautz et al., 2014; Lindqvist & Vestman, 2011). Thus the relation between education and labor market outcomes goes through skills and abilities; this needs to be explicitly taken into account in the assessment of this relation. There is a rapidly increasing body of literature on this subject, spearheaded by Nobel Laureate in Economics James Heckman (see e.g. Cunha et al. (2010)), which focuses on the process of skill formation in childhood and adolescence as fundamental elements to understand adult outcomes.

Next, we defend the idea that success in the labor market is a multidimensional concept and its assessment calls for a theoretical framework that does not reduce it to one single aspect. Indeed labor market success goes beyond the state of having a job or earning income and includes other aspects such as job stability, work conditions and access to social security. Thus it is more appropriate to consider overall wellbeing at work, which is multidimensional by nature. In fact, this line of reasoning conforms to modern approaches to wellbeing and human development that advocate a multidimensional vision of human life. A pioneer in this field is another Nobel Laureate, Amartya Sen, who defines development as the process of expansion of freedom to choose the life that one has reason to value (Sen, 1980, 1985, 1999, 2009). According to his Capability Approach, wellbeing is the manifestation of capabilities, which are composed of all the potential valued lifestyle outcomes that one can freely choose from. In Sen’s conception, these capabilities are also termed advantage. Many international initiatives such as the UNDP’s Human Development Index (UNDP, 1990), UN’s Sustainable Development Goals (UN, 2015) or the ILO’s Decent Work concept (Ghai, 2008) take this multidimensional perspective on human life and have also managed to convince many policymakers around the world to adopt this broad vision of development. This approach has been successfully applied to analyse quality of employment (see e.g. Ruiz-Tagle & Sehnbruch (2015); Lugo (2007); Sehnbruch (2007), thus providing useful complements to traditional Mincerian approaches to the assessment of labor market outcomes. Building on the ideas of Amartya Sen, some actual job quality indicators are considered to be the observable manifestation of a wider and richer set of work advantage, which regroup these observable manifestations with non-materialised ones. In that sense, we make the case that work advantage may be known to the individual who possesses them, but they are often not entirely known to an external analyst.

In the spirit of the Capability Approach, in this paper we lay emphasis on work advantage as the adequate evaluative space of work wellbeing while interpreting the former as the set of potential characteristics of a job. We propose a theoretical framework that explicitly introduces skills and abilities as a crucial link in the relationship between schooling and work advantage, while taking a multidimensional view of the latter. We develop an economic framework, formulate a suitable econometric model and present an empirical validation using Bolivian data.
We believe our contribution to be manyfold. First, we build upon Heckman’s body of work taking a step further towards the assessment of labor market success by simultaneously taking into account multiple work dimensions. Second, we develop a consistent econometric framework that allows us to lay emphasis on the potential characteristics of a job as the evaluative space of wellbeing, explicitly making the assumption that some observed indicators may be only partial manifestations of work advantage. Third, we provide novel empirical evidence for the mediating role of skills in the Bolivian case that may be useful for policy purposes. Fourth, we believe that adopting a pluralistic viewpoint of work-related wellbeing, explicitly attempting to go beyond observable aspects of actual job quality, implies a considerable step forward in the empirical investigation of labor market success using Sen’s Capability Approach.

The paper is structured as follows: in Section 2 we present our theoretical framework in detail. In Section 3 we develop the econometric strategy for the empirical implementation of this framework, alongside the treatment of data. The results of the application of this framework to the Bolivian case is presented in Section 4. Finally, in Section 5 we present our most relevant concluding remarks.

### 3.2 Theoretical Framework

#### 3.2.1 Skills and work advantage

Human development is a broad concept that can be roughly described as the expansion of richness in human life. Two major recent theoretical frameworks have been deeply influential in shaping the current way of thinking in the field of human development. Both approaches converge towards the importance of the individual as the focus of any development process, over and above aggregate measures of wellbeing. In our view, both approaches have theoretical and practical elements that can be suitably blended together to yield powerful analytical tools for understanding human development in general, and wellbeing in the work dimension in particular. Let us briefly highlight the salient features of both theoretical frameworks before proposing our combination.

A first theoretical framework is one which advocates a multidimensional concept of human development covering economic, social, political, cultural, environmental and all other relevant aspects of life. There is now a wide consensus in academic and policy circles on the necessity to adopt a multidisciplinary viewpoint for evaluating human progress in all domains. A pioneering theoretical contribution in this field is Sen’s Capability Approach (see e.g. Sen (2009)), which defines human development as the expansion of people’s choices to live the lives that they value. In this setting, wellbeing is the manifestation of the set of potential lifestyle outcomes that can be achieved by an individual (called capabilities or advantage), as determined by her personal, family as well as socio-economic and political circumstances. If we follow the same approach for the work dimension, we need to go beyond monetary considerations and one dimensional approaches for the definition of the evaluative space of work-related wellbeing; the Capability Approach advocates a pluralistic view for the assessment of a person’s job, that allows to simultaneously account for multiple indicators and the various surrounding factors that influence them.

The second major theoretical development related to the above considerations is Heckman’s recent work on the process of skill formation (see e.g. Heckman & Mosso (2014)),

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1Here richness is to be understood in the broad sense of a ‘rich’ life and not in the narrow sense of monetary richness.
which asserts that the kind of job that a person is able to obtain in her adult life is strongly determined by the skills acquired during her early stages of life. Thus understanding how a person acquires and/or develops her skills is cornerstone to understanding human development.

Personal abilities and skills also have an important role to play in the Capability Approach as they are the instruments through which a person converts her endowments or resources into potential outcomes. But this approach does not address the question of how these abilities are acquired, which is exactly what Heckman’s model addresses. Thus a useful combination of the original conception of Sen’s Capability Approach and the dynamic process of skill formation proposed by Heckman & Cunha (2007, 2009) and Cunha et al. (2010), can shed significant light on the driving forces behind good labor market outcomes.

### 3.2.2 Model formulation

Let vector $Q$ denote an individual’s work advantage; each element of this vector is a dimension of this advantage. Let us denote as $r$ the endowments or resources at her disposal to create or expand this advantage; we take the notion of resources in a large sense to include personal resources, such as personal abilities and social capital, as well as social and institutional infrastructural support.

An individual acquires skills in her early life, which help her to increase her work advantage in adult life. Many studies on skills and labor outcomes stress that skills are multiple in nature (Bowles et al., 2001; Borghans et al., 2006; Heckman et al., 2006). Traditionally speaking, *cognitive skills*, defined roughly as intelligence or acquired knowledge are considered important determinants of job characteristics (Cawley et al., 1996, 1998; Kautz et al., 2014; Heckman et al., 2006; Nisbett et al., 2012). However, a growing body of research suggests that *non-cognitive skills*, defined as personality traits or socio-emotional abilities that are intrinsic to the individual (say perseverance, attentiveness or empathy), may be just as important as cognitive skills in terms of enabling a person to have a *good* job (Heckman & Cunha, 2007, 2009; Duncan & Magnuson, 2011; Hall & Farkas, 2011). In this study we take both types of skills into account.

Let us split the timespan of skill formation of an individual into $T$ development stages that we will denote as $t = \{1 \ldots T\}$, and assess work advantage in period $T + 1$. Let us divide the vector of available resources, $r_{T+1}$, into two elements: $r_{T+1} = (\theta_{T+1}, x_{1,T+1})$, where $\theta_{T+1}$ is the subset of $r_{T+1}$ depicting the individual’s stock of cognitive and non-cognitive skills acquired up to that moment, i.e. $\theta_{T+1} = (\theta^C_{T+1}, \theta^{NC}_{T+1})$; $x_{1,T+1}$ depicts all other relevant resources. Then the relations describing the ‘conversion’ of resources into work advantage (i.e. potential work-related outcomes) can be represented as follows:

$$Q_{T+1} = f_1(\theta_{T+1}, x_{1,T+1}, e_{T+1})$$  \hspace{1cm} (3.1)

where $e_{T+1}$ is an error term.

We have argued earlier that work advantage, $Q_{T+1}$, is often hard to be directly observed, as it consists of all feasible potential outcomes; however, we can observe various characteristics of the person’s actual job that reflect different dimensions of this advantage. Denoting the set of observable characteristics as $Z^Q_{T+1}$, we have the following measurement equations:

$$Z^Q_{T+1} = f_2(Q_{T+1}, v_{1,T+1})$$  \hspace{1cm} (3.2)
where \( f_2(.) \) integrates the process of choice of a particular set of characteristics from the capability set, and \( v_{t,T+1} \) represents shocks or unobservable factors that may have an influence on the observable indicators, \( Z_{T+1}^Q \). There is a vast literature about the type of indicators that go into \( Z_{T+1}^Q \) for adequately capturing different aspects of the quality of a job (Anker et al., 2008; Drobnic et al., 2010; Sehnbruch, 2007). Perhaps, one of the most influential ideas in recent times is the concept of Decent Work put forward by ILO (Ghai, 2008), which incorporates employment opportunities, labor rights, access to social protection and exercise of social dialogue. The latest Human Development Report (HDR, 2015) argues along the same lines of promotion of workers’ rights and broader social protection for a comprehensive assessment of work wellbeing.

The Process of Skill Formation

According to Heckman & Cunha (2007, 2009); Kautz et al. (2014); Heckman et al. (2006), cognitive and non-cognitive skills are also unobservable in nature, much to the resemblance of work advantage. Cognitive skills may manifest themselves through some intelligence test scores or school grades, which we will denote by \( Z_t^C \). Non-cognitive abilities, in turn, may be partially measured through some actions or reactions to psychological tests, which we will denote by \( Z_t^{NC} \). Psychologists have developed different taxonomies for these personality traits and behavior (Borghans et al., 2006; Almlund et al., 2011; Kautz et al., 2014). One of the most widely used taxonomies is the Big Five (John & Srivastava, 1999), which includes Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. Thus regrouping all the observable indicators of both types of skills into vector \( Z_t^S \equiv (Z_t^C, Z_t^{NC}) \), we can write:

\[
Z_t^S = f_3(\theta_t, v_{2,t})
\]

where \( v_{2,t} \) represent unobservable elements that have an influence on skill indicators and \( f_3() \) the transformation process of skills into observable indicators.

Turning now to the formation of skills, Heckman represents it as a dynamic process that evokes an overlapping generations model. Parents and family play a very powerful role in this process, specially during childhood and adolescence, not only because they endow genetics, but also because they define the child’s environment in which the process takes place and decide if, when and how they make investments for the success of this process. The skill formation dynamics of one individual is represented as follows:

\[
\theta_{t+1} = g_t(\theta_t, I_t, \theta^p, \nu_t), \forall t \leq T
\]

where \( I_t \) denotes the investment made by the child’s family (usually her parents) in period \( t \) to improve or expand skill stocks in the next period, \( t + 1 \). As time elapses and the child grows older, she gains autonomy with respect to investments; thus \( I_t \) may also represent own efforts put into the skill formation process when \( t \) represents periods in time when the child is more mature and makes her own decisions. \( \theta^p \) represents parental background, which is considered to be invariant during the lifespan of the child. \( \nu_t \) represents shocks or other unobservable inputs in the process of skill formation. Allowing for generality, the technology of skill formation, \( g_t(.) \) may vary in time. Equation (3.4) shows that there is interdependence between skills over time: together, greater skills in period \( t \) induce greater stock of skills in the next period. This is called the self-productivity phenomenon (Heckman et al., 2006).
Possible endogeneity of investment and model identification

One crucial aspect highlighted in this literature concerns possible endogeneity of investments, $I_t$ (see e.g. Cunha et al. (2010); Heckman et al. (2011)). This may arise from two sources: on one hand, it may not be tenable to affirm that some shocks or unobservable inputs included in $\nu_t$ are not related to investments, whether these are made by the parents or by the own individual. On the other hand, skills themselves may affect investments for their formation dynamics, inducing reverse causality. Schooling is one type of investment that is often referred to as a result of own skills (see e.g., Heckman et al. (2006, 2011)). Hence, schooling, for instance, cannot be considered as a strictly exogenous investment for skill formation; on this matter, Heckman et al. (2006) (pp. 6) state ‘... schooling is a choice variable and any convincing analysis must account for endogeneity of schooling.’ Thus Cunha et al. (2010) propose to divide the vector $\nu_t$ in two elements: $\nu_t = (\pi_t, \epsilon_t)$, where $\pi_t$ represents the unobservable inputs in the skill formation process that motivate decisions on investments while being orthogonal to the other elements of technology $g_t(\cdot)$. Thus equation (3.4) may be rewritten as:

$$\theta_{t+1} = g_t(\theta_t, I_t, \theta^p, \pi_t, \epsilon_t), \forall t \leq T \quad (3.5)$$

An additional investment model or an investment policy function is required to account for endogeneity of investments (Cunha et al., 2010); it may be expressed as:

$$I_t = h_t(\theta_t, \theta^p, \pi_t, y_t), \forall t \leq T \quad (3.6)$$

where the presence of $y_t$ solves the identification issue, and it is supposed to include observable determinants of the investment decision, say family income, assets, constraints or other socioeconomic background variables, that do not directly affect skills.

As the above equation explicitly accounts for a contemporaneous influence of skills on investments, one can obtain a (partial) reduced form by replacing the investment policy function in technology $g_t(\cdot)$:

$$\theta_{t+1} = g_t(\theta_t, h_t(\theta_t, \theta^p, \pi_t, y_t), \theta^p, \pi_t, \epsilon_t) = \tilde{g}_t(\theta_t, \theta^p, y_t, \pi_t, \epsilon_t) = \tilde{g}_t(\theta_t, \theta^p, \nu_t) \quad (3.7)$$

Cunha et al. (2010) suggest the use of standard IV techniques to tackle the endogeneity problem. This involves a first stage regression of investments on socioeconomic background variables, $y_t$ or its lagged values as instruments for skills, along with parental characteristics and socioeconomic background variables. We will denote as $\tilde{I}_t$ the predicted values of investments from this regression. In a second stage, actual investment measures are replaced with $\tilde{I}_t$ in the technology of skill formation to yield:

$$\theta_{t+1} = g_t(\theta_t, \tilde{I}_t, \theta^p, \nu_t), \forall t \leq T \quad (3.8)$$

and estimated using classical procedures\(^2\).

In what follows, we present a general formulation that allows for both the options of possible endogeneity or exogeneity of investments. We rewrite equation (3.4) as:

$$\theta_{t+1} = g^*_t(\theta_t, I^*_t, \theta^p, \nu_t), \forall t \leq T - 1 \quad (3.9)$$

\(^2\)It is also possible keep the investment policy function as it is and simultaneously estimate the technology of skill formation, the investment policy function, and the generation of capabilities.
where, $I_t^*$ may have different configurations. If investments are exogenous, then $I_t^* ≡ I_t$ and $g_t^* ≡ g_t$. If investments are endogenous, we would have two possibilities: 1) the reduced form option in which explicit measures of investments are eliminated as regressors in the technology of skill formation, thus $I_t^* ≡ y_t$ and $g_t^* ≡ \tilde{g}_t$, or 2) the two-stage option in which investments are replaced by their estimates deduced from the investment policy function estimation, thus $I_t^* ≡ \tilde{I}_t$ and $g_t^* ≡ g_t$.

Recursive resolution of equation (3.9) shows that skill stocks in any development stage in the skill formation process, i.e. $∀t ≤ T$, is given by:

$$\theta_t = m_t(I_{t-1}^*, I_{t-2}^*, ..., I_1^*, \theta^p, \tilde{\nu}_t)$$ (3.10)

where $\tilde{\nu}_t = f_ν(\nu_{t-1}, \nu_{t-2}, ..., \nu_0)$ and we have normalized initial skill stocks to 1 without loss of generality, because skills do not have an explicit measure of unit, as they are unobservable (latent). The effects of schooling investments on the different types of skills in this equation is related to the the extent to which these skills are malleable by the schooling process; there is mixed evidence on this subject due to its evident context dependance (see e.g. Carneiro et al. (2007)). According to Carneiro & Heckman (2003), non-cognitive skills are often likely to be more malleable than cognitive skills, specially among young children. However, Carlsson et al. (2015) proved that some aspects of cognitive skills (or technical intelligence in their terms) in adult populations can be effectively improved by short schooling periods. In our study, we propose a framework that is flexible enough to provide useful data-driven evidence about the malleable aspect of each type of skills, which is why we do not impose a-priori exclusion restrictions in equation (3.10) and allow for the possibility of all types of investments at different times to be drivers of both types of skills.

### The full system

Regrouping all our equations into a system which reflects our theoretical combination of the Capability Approach and the technology of skill formation, we have:

$$\begin{cases} Q_{T+1} = f_1(\theta_{T+1}, x_{1,T+1}, e_{T+1}) \\ \theta_{T+1} = m_T(I_T^*, I_{T-1}^*, ..., I_1^*, \theta^p, \tilde{\nu}_T) \\ Z_{T+1}^Q = f_2(Q_{T+1}, v_{1,T+1}) \\ Z_{T+1}^S = f_3(\theta_{T+1}, v_{2,T+1}) \end{cases}$$ (3.11)

The first two vector equations represent the **structural** relations: the first one relates the different dimensions of work advantage to skill stocks based upon the Capability Approach and the second one relates investments in skill formation to skill stocks based upon Heckman’s body of framework. The other vector equations represent the **measurement** relations for the unobservable (latent) elements in our system, namely the different dimensions of work advantage, and cognitive and non-cognitive skills.

We make the case that both structural relations in this system are important in their own right in the quest for understanding human development. Thus we defend the idea that both functions $f_1(.)$ and $m_T(.)$ should be estimated and go on to propose suitable means to do so. However, a modified (simpler) form of the structural equations is given by:

$$\begin{align*} Q_{T+1} &= f_1(\theta_{T+1}, x_{1,T+1}, e_{T+1}) \\ &= f_1(m_T(I_T^*, I_{T-1}^*, ..., I_1^*, \theta^p, \tilde{\nu}_T), x_{1,T+1}, e_{T+1}) \end{align*}$$ (3.12)
We present this equation only because it is useful to explicitly show that in this theoretical framework, investments in skill formation only have an indirect effect on work advantage through their effect on skill stocks.

To illustrate the logic of this framework, let us now be more specific about the particular context that we treat in our empirical application concerning the Bolivian case. Based on data availability, we consider 3 periods in the lifespan of an individual: \( t = 1 \), depicting early childhood and the period when the child is confronted with the initial process of skill formation; \( t = 2 \), depicting the period of attendance to formal school programs going from primary school to tertiary school. These two periods are the two stages in the skill development process, thus \( T = 2 \). In the next period, \( T + 1 = 3 \), the individual is an adult belonging to the (potentially) economically active population and uses the results of her skill formation process up to its current stage.

Regarding investments in skill formation, we do not have an extensive set of information on time spent with the child by parents (caregivers) as in Heckman & Mosso (2014). In period \( t = 1 \), investments in skill formation may be represented by an indicator relating to the schooling-start gap, considering that children start school regularly at age 6. Thus negative values of this indicator depict enrolment in school programs before age 6, i.e. pre-school, and positive values depict late start of schooling. Denoting this investment as \( F \), we have \( I_1 = F \). In period \( t = 2 \), family may motivate and promote enrolment and continuity of the child in formal education programs, including primary, secondary or tertiary education, denoted as \( S \), thus \( I_2 = S \).

The measurement equations use a) observable indicators of the job \((Z^Q_3)\) and b) observable indicators of cognitive and non-cognitive skills in adult life \((Z^\theta_3)\); the first are given by test scores and the second by self-assessed personality tests and behavioural characteristics. In this particular setting, the system of equations in (3.11) allowing for possible endogeneity of the investments variables, may be written as:

\[
\begin{align*}
Q_3 &= f_1(\theta_3, x_{1,3}, e_3) \\
\theta_3 &= m_2(I^*_1, I^*_2, \theta^p, \tilde{\nu}_2) \\
Z^Q_3 &= f_2(Q_3, v_{1,3}) \\
Z^\theta_3 &= f_3(\theta_3, v_{2,3})
\end{align*}
\]

These equations define a framework in which observable and unobservable elements are combined through structural relations. In our setting, the observable elements are \( Z^Q_3, Z^\theta_3, x_{1,3}, I^*, S, \) and \( \theta^p \), as well as instruments for investments \( y_i \) if they are required. The unobservable elements are work advantage in adult life, \( Q_3 \), the skill stocks in adult life, \( \theta_3 \), as well as shocks captured in \( e_3, v_{1,3}, v_{2,3}, v_{3,3} \) and \( \tilde{\nu}_2 \). We now develop a suitable econometric framework for the empirical implementation of this particular theoretical setting.

### 3.3 Empirical Strategy

#### 3.3.1 The Econometric Framework

Let \( \eta_i = (\theta_{i,3}, Q_{i,3})' \) be the vector of latent variables containing, respectively, quantitative representations of a) non-cognitive skills, b) cognitive skills and \( m \) dimensions of work advantage for the \( i-th \) individual in adult life; thus \( \eta_i \) is sized \((m + 2) \times 1\). Also, let \( W_i \) be a \( p \times 1 \) vector containing quantitative representations (direct or indirect) of the investments in skill formation in both development stages, i.e. \( W_i = (I^*_1, I^*_2) \). Denoting
as $p_1$ and $p_2$ the number of quantitative representations of investments in the first and second stages, respectively, we have $p_1 + p_2 = p$. Finally, let $X_i$ be a $k \times 1$ vector containing exogenous control socioeconomic characteristics that may have an influence on any of the elements in $\eta_i$, i.e. $X_i = (x_{i,1}, \theta^p)$. Denoting as $k_1$ the number of elements in $x_{i,1}$ and as $k_2$ the number of elements in $\theta_p$, we have $k_1 + k_2 = k$.

We propose linear forms for functions $f_1(.)$ and $m_2(.)^3$. Under these assumptions, the structural equations that relate the elements of $\eta_i$ to each other as well as to the elements of $X_i$ and $W_i$ for the $i-th$ individual can be expressed as:

$$A\eta_i - \Gamma W_i - BX_i - u_i = 0 \quad (3.14)$$

where $A ((m + 2) \times (m + 2))$, $\Gamma ((m + 2) \times p)$ and $B ((m + 2) \times k)$ are impact coefficient matrices and $u_i$ is a $m \times 1$ vector containing the residual elements in the structural system. We denote the corresponding matrix from of (3.14) as:

$$A\eta - \Gamma W - BX - u = 0 \quad (3.15)$$

with $E(u) = 0$, $V(u) = \Sigma$ and matrices $\eta ((m + 2) \times n)$, $W (p \times n)$ and $X (k \times n)$ contain information coming from $n$ individuals.

Our inclusion and exclusion restrictions are given by the theoretical framework that guides us through this study. Both types of skills have a direct impact on work advantage; investments (or their proxy measures) have a direct impact on both types of skills; parental skills have a direct impact on their children’s skills, and surrounding circumstances in adult working life have a direct impact on work advantage. The mathematical translation of these theoretical restrictions imply the following configuration of elements in the structural equations (3.14):

$$\begin{bmatrix} I & 0 \\ a & I \\ m \times 2 & m \times m \end{bmatrix} \begin{bmatrix} \theta_{i,3} \\ \gamma_{1} \\ \gamma_{2} \end{bmatrix} \begin{bmatrix} 2 \times p_1 \\ 2 \times p_2 \\ m \times m \end{bmatrix} - \begin{bmatrix} \eta_i \\ \Gamma X_i \\ \Gamma W_i \\ \Gamma - \Gamma \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} 2 \times k_2 \\ 2 \times k_1 \\ m \times k_1 \end{bmatrix} + \begin{bmatrix} \rho_p \\ \eta \\ \epsilon \end{bmatrix} \begin{bmatrix} k_1 \times 1 \\ k_2 \times 1 \\ m \times 1 \end{bmatrix} = 0 \quad (m + 2) \times 1$$

where $a, \gamma_1, \gamma_2, b_1$ and $b_2$ are free parameters, and $I$ depict identity matrices.

In corresponding notation to our theoretical model, let $Z_{i,1}'$ and $Z_{i,3}'$ depict the vectors containing, respectively, the observable indicators of work advantage and the skill stocks in adult life of individual $i$. These indicators are related to the correspondent latent variables through the following linear-form measurement equations (as we have continuous indicators):

$$Z_i = \Lambda \eta_i + \epsilon_i, \quad (3.16)$$

where vector $Z_i' = (Z_{i,1}', Z_{i,3}')'$ regroups all the observable indicators for the $i-th$ individual, matrix $\Lambda$ contains the factor loading coefficients that capture the relation between the latent variables and the observable indicators, with only one latent variable loading to each indicator; $\epsilon_i$ is a vector of residual elements. The corresponding matrix form of equation (3.16) is:

$$Z = \Lambda \eta + \epsilon \quad (3.17)$$

where $E(\epsilon) \equiv 0$, $V(\epsilon) \equiv \Omega$.

Equations (3.15) and (3.17) form a simultaneous equation model and its parameters can be estimated following a three step procedure comprised of limited-information maximum likelihood programs (Muthén, 1983, 1984). Building on these parameter estimates,

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3We will show in our empirical application that the assumption of linearity in parameters does not imply linear effects.
individual latent factor scores can be estimated in turn using Empirical Bayes estimators (Krishnakumar & Nagar, 2007):

\[ \hat{\eta}_i = \hat{A}^{-1}(\hat{\Gamma}W_i + \hat{B}X_i) + C(Z_i - \hat{A}^{-1}(\hat{\Gamma}W_i + \hat{B}X_i)) \]

\[ = (\hat{A}^{-1}\hat{\Gamma} - C\hat{A}\hat{A}^{-1}\hat{\Gamma})W_i + (\hat{A}^{-1}\hat{B} - C\hat{A}\hat{A}^{-1}\hat{B})X_i + CZ_i \]  

(3.18)

where \( C \equiv \hat{A}^{-1}\hat{\Sigma}\hat{A}^{-1}\hat{\Lambda}'(\hat{\Lambda}\hat{A}^{-1}\hat{\Sigma}\hat{A}^{-1}\hat{\Lambda}' + \hat{\Omega})^{-1} \). In order to simplify our notation, let us define the following matrices:

\[ D \equiv \hat{A}^{-1}\hat{\Gamma} - C\hat{A}\hat{A}^{-1}\hat{\Gamma} \]

\[ E \equiv \hat{A}^{-1}\hat{B} - C\hat{A}\hat{A}^{-1}\hat{B} \]

so we may rewrite equation (3.18) as:

\[ \hat{\eta}_i = DW_i + EX_i + CZ_i \]  

(3.19)

Thus the set of latent factor estimators for the latent variables in our framework (skills and work advantage) is given by:

\[ \hat{\eta} = DW + EX + CZ \]  

(3.20)

### 3.3.2 Data and Variable Definition

For our empirical application, we use data from the Bolivian household survey of the World Bank’s Skills Towards Employability and Productivity (STEP) program, which was collected in 2012 and is publicly available through the World Bank’s Microdata Catalog\(^4\). Data includes 2433 individuals and is representative of the urban labor force in the country’s three main metropolitan areas, namely La Paz, Cochabamba and Santa Cruz. We use this dataset because it fits perfectly for the construction of an empirical counterpart of our theoretical framework, and it is the only survey that is specifically designed to capture individual human development in a comprehensive manner.

**Measuring cognitive skills**

In order to measure cognitive skills, our data contain six observable indicators that result from written examinations, which form part of our vector \( Z_i^S \) in equation (3.16).

The first indicator is called *Vocabulary*, which is calculated as the ratio between the number of correct responses in a 6-question written assessment and the time needed for completion of the test. This test was designed to determine whether the respondent is able match written words of common everyday usage by adults with their corresponding figures. By construction, this variable is continuous and greater values indicate greater cognitive skills.

The second indicator is called *Sentence Processing* and it is calculated as the ratio between the number of correct responses in a 11-question written assessment and the time needed for completion of the test. In this test, respondents were asked to make a dichotomous judgment about the sentence with respect to general knowledge about the state of world (true or false) or about the logic of the sentence (makes sense or does not

\(^4\)website: data.worldbank.org
3.3. Empirical Strategy

make sense). This variable is also continuous and greater values are indicators of greater cognitive skills.

The third indicator is *Comprehensive Reading*, which is calculated as the ratio between the correct responses in a 17-question written assessment and the time required for the completion of the test. Greater values of this continuous variable are associated to greater cognitive skills. The test is comprised by three passages based on the kinds of text types that adults typically encounter. The respondents were required to choose the word that best completes a sentence in a passage.

The fourth indicator is called *Reading (Self-reported)*, which captures the number of pages (size) of the last document that the person recalls having read in the last 12 months, whether at work (if she is employed) or outside of work. This variable takes up the maximum value between these two options, thus ranging from 0 to 5; greater values of this variable are considered to be a manifestation of greater cognitive skills.

The fifth indicator is called *Writing (Self-reported)* and it is very similar to variable *Reading* (self-reported), as it captures the number of pages (size) of the last document that the person recalls having written in the last twelve months whether at work or outside of work. This variable also ranges between 0 and 5 and greater values are also considered to be a manifestation of greater cognitive skills.

The sixth indicator is called *Numeracy (Self-reported)* and it adds up scores for numerical calculations performed by a person whether at work or outside of work. Different scores have been assigned according to the complexity of these calculations: 0=none, 1=measuring sizes, weights or distances, 2=calculating prices or costs, 3=using fractions, decimals or percentages, 4=performing multiplications or divisions, 5=using advanced math. The variable takes up the maximum value between the scores obtained for numerical calculations at work or outside of work, thus ranging from 0 to 15. Greater values of this variable are considered to be a manifestation of greater cognitive skills.

**Measuring non-cognitive skills**

Non-cognitive skills are measured by means of five personality traits in the Big Five taxonomy (conscientiousness, openness to experience, neuroticism, agreeableness and extraversion) supplemented by three socio-emotional traits that go beyond the Big Five personality traits that have demonstrated a more adequate representation of a person’s non-cognitive skills when trying to understand and predict life-style outcomes (see e.g. Borghans et al., 2008); these socio-emotional traits are defined as grit, hostile attribution bias and decision-making.

The survey includes three questions for each personality trait or personality domain; each question is answered directly by the respondent using a four-point frequency scale going from *almost never* (1) to *almost always* (4). Thus the part of our vector $Z_i^S$ in equation (3.16) that is associated to the measure of non-cognitive skills is composed of one measure of each personality trait constructed as the simple average of the response to the corresponding three questions.

Regarding the Big Five taxonomy, the domain of *conscientiousness* is defined as the propensity to follow socially prescribed norms and rules, as well as to be goal-directed. One of the questions is *When doing a task, are you very careful?* The domain *openness to experience* is defined as enjoyment of learning and being confronted to new ideas. One of the questions is *Do you come up with ideas other people haven’t thought of before?* The domain *neuroticism* refers to the tendency to feel negative emotions. One of the questions is *Do you worry a lot?* The domain *agreeableness* refers to the degree of orientation
Chapter 3. Skills as mediators in the relationship between education and work

towards cooperation and empathy with other people. One of the questions is Do you forgive other people easily? The domain extraversion refers to the ability to be sociable and dominant while engaged in social interactions. One question is Are you talkative?

The three domains that complement the Big Five taxonomy are each grasped by three questions referring to specific definitions. The domain grit refers to perseverance for achieving long-term goals. One question is Do you enjoy working on things that take a very long time (at least several months) to complete? The domain hostile attribution bias refers the tendency to perceive hostile or mean intentions on the part of other people, even if, actually it is not the case. One question is Do people take advantage of you? Finally, the domain of decision-making refers to the degree of thinking and consideration of multiple options when making important decisions that affect themselves or other people. One of the questions is Do you think about how things you do will affect you in the future?

Measuring work advantage

While the multidimensional nature of work-related wellbeing is now widely acknowledged in academical and political spheres (see e.g. Anker et al. (2008)), the precise evaluative dimensions and their quantitative representations are still far from stage of reaching worldwide consensus (Vosko, 2002). In this study, we build upon the concept of Decent Work endorsed by ILO (Ghai, 2008) as the conceptual ground for the identification of the work-related wellbeing indicators and dimensions that can be captured by data at hand.

Let us start mentioning that ILO’s Decent Work agenda includes ten substantive elements (ILO, 2012) or decent work dimensions regrouped in four broad strategic pillars relating to a full and productive employment, respect of rights at work, access to social protection and the promotion of social dialogue. According to this taxonomy, we are able to partially measure three out of these ten substantive elements of decent work namely i) employment opportunities and earnings, ii) decent working time and iii) safe work environment.

First, STEP data provides us with multiple indicators of our first dimension, employment opportunities and earnings, which is concerned with the availability of work positions and their adequate aspect in terms of compensation, both monetary and non-monetary. We measure this dimension using three indicators: i) hourly earnings in logs ii) having access to social benefits and iii) the firm size by number of workers. The rationale underpinning the latter indicator is drawn from vast evidence suggesting that smaller firms tend to trail larger ones in terms of stability, level and growth of wages as well as their capacity to offer formal positions in developing countries (see e.g. Page & Soderbom (2015); Meghir et al. (2015)).

Next, our second dimension, decent working time, is measured by one single indicator: hours worked by week beyond the hours established by law in the country, i.e. 48 hours for men and 40 hours for women. This indicator gauges the balance between working time and personal/leisure time. Higher values of this indicator depict lower advantage for decent working time.

Finally, STEP data provides us with multiple indicators about the physical strain at work. According to health-related literature, physical intensity is an important risk factor at workplace (see e.g. Widanarko et al. (2015)). Precisely, the third dimension that we consider, safe work environment, is concerned with the extent to which a job offers conditions that preserve and promote the physical integrity of a worker, among others. Thus we partially gauge this dimension using three indicators: i) the perception of the extent to which the current job is perceived as physically demanding, ii) whether
3.4. Results

or not the job requires lifting items weighing above 50 pounds on a regular basis and
iii) the worker’s occupational category, ranging from 1= Soldier or unskilled worker to
10=Directive position in private or government offices.

Investments in skill formation

In period $t = 1$ we consider the age of school-start gap with respect to the norm, which
is 6 years of age. We reason that parents may foster earlier start to the schooling process
through preschool, which imply greater efforts for the skill formation process. Conversely,
parents who postpone the start of the schooling process would be making less efforts for
the skill formation process. In period $t = 2$ we consider years of education, depicting time
spent in formal education programs, including primary, secondary and tertiary programs.
Without accounting for endogeneity, these variables would form vector $W_t$.

As suggested in Cunha et al. (2010), we consider socioeconomic and family background
variables as possible instruments for our quantitative representation of investments, and
thus they enter as regressors in the investment policy function (3.6). Based on data
availability, these variables include: i) a 10-scaled variable grasping the perception of
relative economic status when the respondent was 15 years of age (1=poorest; 10=richest),
ii) the number of siblings in the household when the respondent was 15 years of age, and
iii) the number of economic shocks experienced in respondent’s household before she was
15, which may include robbery or bankruptcy.

Control variables

Parental skills ($\theta$) are gauged using a 4-scaled variable indicating the highest level of
completed education of both mother and father according to the International Standard
Classification of Education (ISCED) established by UNESCO in 1997 and revised in
2011, in order to bring about comparability across countries and with other adult literacy
surveys. In this scale, 1=no formal education, 2=six years of primary education, 3=last
three years of upper secondary education, and 4=post-secondary education or higher.

Other relevant resources and environmental conditions influencing the capability of
having a good job ($x_{1,3}$) include: i) a dummy variable indicating if the person works in
a sector where work tends to use manual force (Agriculture/Fishing/Mining or Manu-
facturing/Construction) as opposed to other non-manual abilities (Commerce and other
services), ii) age in linear and quadratic forms, iii) gender, and iv) a dummy variable
indicating whether or not the individual has an indigenous language as a mother tongue,
which is considered as a proxy of her ethnic condition.

3.4 Results

Let us begin by making a case for the usefulness of a Capability Approach-based assess-
ment of work advantage. If we adopt a one dimensional monetary approach to wellbeing,
we may simply measure work advantage by the level of income. This is in fact a simplified
version of our proposed framework in which $Q_3$ has one dimension and $Z_3^Q = Q_3 = \text{income}$.
This viewpoint yields the set of results depicted in panel (a) of Table 3.1. In this case, after
correcting for the endogeneity bias related to schooling using the IV procedure discussed
earlier, only cognitive skills should be considered as effective drivers of work advantage,
as we are unable to detect significant effects of non-cognitive skills. In other words, this
would lead to conclude that there are no returns to non-cognitive skills in the country. We argue that this is a hasty bold claim and that this one dimensional framework does not allow us to adequately grasp the relative importance of both types of skills for work advantage, as it builds upon an oversimplified conception of the latter concept. In effect, according to Ghai (2008); ILO (2012) and others, there are other suitable indicators of the dimension of work advantage that is purported to be completely measured by earnings, namely employment opportunities. If we consider, for instance, access to social security as a one dimensional indicator of this work advantage, results change considerably as depicted in panel (b) of Table 3.1. In contrasting fashion, both cognitive and non-cognitive skills are effective drivers of work advantage as measured by this alternative indicator.

Table 3.1: Selected estimation results (non-standardized) of one-dimensional approaches to work-related wellbeing

<table>
<thead>
<tr>
<th></th>
<th>Work advantage measured by:</th>
<th>(a) Hourly earnings (log)</th>
<th>(b) Access to social benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>WA</td>
<td>CS</td>
</tr>
<tr>
<td>Cognitive skills</td>
<td></td>
<td>0.105 ***</td>
<td></td>
</tr>
<tr>
<td>Non-cognitive skills</td>
<td></td>
<td>-0.026</td>
<td></td>
</tr>
<tr>
<td>Years of schooling</td>
<td></td>
<td>0.470 ***</td>
<td>0.342 ***</td>
</tr>
<tr>
<td>Age school-start gap</td>
<td></td>
<td>-0.089 ***</td>
<td>-0.021</td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>$R^2$</td>
<td></td>
<td>0.02</td>
<td>0.53</td>
</tr>
</tbody>
</table>

WA: Work advantage; CS: Cognitive skills; NCS: Non-cognitive skills
***: p-value < 0.001

We make the case that these figures go on to show that it is beneficial to assess work advantage through the lens of the multidimensional and pluralistic approach for which we stand in this document, by simultaneously considering different dimensions of this concept. For this, we present in Tables 3.2 and 3.3, estimates of two variants of our SEM (3.11), which consider the three dimensions of work advantage that we have described earlier, namely i) employment opportunities and earnings, ii) decent working time and iii) safe work environment. The difference between the two variants of our SEM lies in the treatment of investments for skill formation. The first variant (model a) considers investments as exogenous, thus $I^*_1 = \text{school-start gap}$ and $I^*_2 = \text{years of schooling}$. In case this assumption is not suitable, estimates of this model are inconsistent.

The second variant (model b) also considers investments as endogenous and estimates the investment policy function (3.6) in a simultaneous equation IV estimation procedure. Since we consider different investments for the two stages of development of skills, we estimate one investment policy function for each of them. Regressors in the investment policy functions include: i) parental characteristics, ii) perceived socioeconomic status of household at age 15 as a quantitative representation of $y_t$, and iii) number of siblings at age 15 and number of economic shocks before age 15 as instruments for both types of skills. Choosing one instrument for each type of skill secures exact identification of original structural equation (3.5) through the reduced structural equation (3.7). The reason for choosing these instruments is twofold. From a theoretical perspective, we follow Cunha et al. (2010) to consider the economic status of the parents before acquisition of child’s skills as suitable instruments for the latter. Furthermore, from an empirical perspective, estimates of the policy investment functions indicate that these variables are significant predictors of both types of skills.
### Table 3.2: Selected structural parameters (standardized): skills and work advantages

<table>
<thead>
<tr>
<th></th>
<th>WA1</th>
<th></th>
<th>WA2</th>
<th></th>
<th>WA3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
<td>(b)</td>
</tr>
<tr>
<td>Cognitive skills</td>
<td>0.251 ***</td>
<td>0.193 ***</td>
<td>-0.129 ***</td>
<td>-0.124 ***</td>
<td>0.184 ***</td>
<td>0.174 ***</td>
</tr>
<tr>
<td>Non-cognitive skills</td>
<td>0.230 ***</td>
<td>0.128 ***</td>
<td>-0.000</td>
<td>0.012</td>
<td>0.178 ***</td>
<td>0.144 ***</td>
</tr>
<tr>
<td>Control variables</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.19</td>
<td>0.14</td>
<td>0.03</td>
<td>0.04</td>
<td>0.19</td>
<td>0.18</td>
</tr>
</tbody>
</table>

WA1: Employment opportunities and earnings; WA2: Decent working time; WA3: Safe work environment

***: p-value < 0.001

### Table 3.3: Selected structural parameters (standardized): investments and skills

<table>
<thead>
<tr>
<th></th>
<th>CS</th>
<th></th>
<th>NCS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
<td>(b)</td>
</tr>
<tr>
<td>Years of schooling</td>
<td>0.381 ***</td>
<td>0.373 ***</td>
<td>0.393 ***</td>
<td>0.346 ***</td>
</tr>
<tr>
<td>Age school-start gap</td>
<td>-0.091 ***</td>
<td>-0.930 ***</td>
<td>-0.007</td>
<td>-0.345</td>
</tr>
<tr>
<td>Control variables</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.47</td>
<td>0.45</td>
<td>0.24</td>
<td>0.20</td>
</tr>
</tbody>
</table>

CS: Cognitive skills; NCS: Non-cognitive skills

***: p-value < 0.001

A Hausman test comparing structural estimates of models (a) and (b) rejects exogeneity of investments and thus consistency of model (a) results. It is for this reason that we retain model (b) for our analysis of the Bolivian case. The parameter estimates for the measurement equations of the chosen model are presented in Table 3.4, and they confirm that the observable indicators that we have proposed are coherent measures of the three latent variables. It is worth mentioning that *Hostile Behaviour* reflects lower stocks of soft skills, as opposed to all the other proposed indicators for this type of skills.

#### 3.4.1 The effects of skills

The structural model results confirm that cognitive and non-cognitive skills expand work advantage in general, although they have quite different effects over the three considered dimensions of this wide concept. Cognitive skills expand all dimensions of work advantage; they exert the highest positive effect over employment opportunities and earnings, followed by safe work environment and finally, decent working time. In turn, non-cognitive skills exert the highest positive effect over safe work environment, followed by employment opportunities and earnings; they do not have a significant effect on decent work time. Digging deeper into these results, we build upon equation (3.20) and calculate standardised latent scores distributions of skills and the considered dimensions of work advantage. Let us stress that standardised scores distributions have zero mean, thus positive valued scores depict individuals situated above average in the corresponding distribution; the converse is true for negative valued scores. Furthermore, the standardised scores distributions have unity standard deviations, thus the value of the scores represent the extent to which the considered individual deviates with respect to the ‘average’ individual in the distribution.

We begin the discussion of our results based on the figures at Table 3.5, which show
Table 3.4: Estimations of Measurement Equations (standardized parameters, model b)

<table>
<thead>
<tr>
<th></th>
<th>WA1</th>
<th>WA3</th>
<th>CS</th>
<th>NCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>0.622***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentence processing</td>
<td>0.851***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comprehensive reading</td>
<td>0.875***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading (self-reported)</td>
<td>0.394***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing (self-reported)</td>
<td>0.517***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numeracy (self-reported)</td>
<td>0.344***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grit</td>
<td>0.366***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision making</td>
<td>0.387***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hostile behaviour</td>
<td>-0.133***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraversion</td>
<td>0.379***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>0.362***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Openness to experience</td>
<td>0.508***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional stability</td>
<td>0.174***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreeableness</td>
<td>0.273***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hourly earnings</td>
<td>0.119***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to social benefits</td>
<td>0.823***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>0.730***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical demand at work</td>
<td>0.673***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not heavy weight lift at work</td>
<td>0.763***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational category</td>
<td>0.333***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WA1: Employment opportunities and earnings
WA3: Safe work environment; CS: Cognitive skills; NCS: Non-cognitive skills
***: p-value < 0.001

Let us first focus on our first dimension of work advantage, i.e. employment opportunities and earnings and consider the average advantaged individual in this dimension as the reference, for which the score is zero (see Figures 3.4.1 and 3.4.1 for a visual representation of the corresponding values in Table 3.5). The median individual in the fifth quintile of the cognitive skills distribution has an advantage that is 0.418 standard deviations higher than the reference. In contrast, the median individual in the first quintile of the relation between skills and work advantage.

Table 3.5: Median standardised latent scores of work advantage by quintile of skills

<table>
<thead>
<tr>
<th>quintile</th>
<th>Cognitive skills</th>
<th>Non-cognitive skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WA1</td>
<td>WA2</td>
</tr>
<tr>
<td>1 (lowest)</td>
<td>-0.958</td>
<td>-0.155</td>
</tr>
<tr>
<td>2</td>
<td>-0.414</td>
<td>0.333</td>
</tr>
<tr>
<td>3</td>
<td>-0.202</td>
<td>0.333</td>
</tr>
<tr>
<td>4</td>
<td>-0.003</td>
<td>0.517</td>
</tr>
<tr>
<td>5 (highest)</td>
<td>0.418</td>
<td>0.486</td>
</tr>
</tbody>
</table>

(*): Not statistically significant relation
WA1: Employment opportunities and earnings
WA2: Decent working time
WA3: Safe work environment
the cognitive skills distribution has an advantage that is 0.958 standard deviations lower than the reference. We confirm that the effect of non-cognitive skills on this dimension of work advantage is qualitatively similar but weaker in magnitude. The median individual in the fifth quintile of this type of skills has an advantage that is 0.392 standard deviations higher than the reference; the corresponding figure is 0.707 lower for the median individual in the first quintile. Our results show that the lack of both cognitive and non-cognitive skills is highly associated with a relative disadvantage in terms of employment opportunities and earnings, as this advantage is highly concentrated among people having the highest levels of both types of skills. To support this claim, let us make a case for the fact that the median individual in the fourth quintiles of the distribution of both types of skills and the reference are practically equally advantaged.

Figure 3.1: Standardised latent scores of Employment Opportunities and Earnings by quantiles of skills cognitive skills

Let us now consider our second dimension of work advantage, namely decent working time, and the average advantaged individual in this dimension as the reference (see Figures 3.4.1 and 3.4.1 for a visual representation of the corresponding values in Table 3.5). We will only assess the effect of cognitive skills as we do not find evidence for significant effects of non-cognitive skills on this dimension. It is worth noticing that only the median individual in the first quintile of the cognitive skills distribution has an advantage that is 0.155

Figure 3.2: Standardised latent scores of Employment Opportunities and Earnings by quantiles of non cognitive skills
standard deviations lower than the reference. This shows that the relative disadvantage in this dimension is heavily concentrated among people with the lowest levels of cognitive skills.

Figure 3.3: Standardised latent scores of Safe Work Environment by quantiles of Cognitive skills

Finally, let us consider our third dimension of work advantage, namely safe work environment and the average advantaged individual as the reference (see Figures 3.4.1 and 3.4.1 for a visual representation of the corresponding values in Table 3.5). Individuals who possess levels of cognitive skills corresponding to the third quintile or higher in their distribution have an advantage that is higher than the reference. For instance, the median individual in the fifth quintile has an advantage that is 0.774 standard deviations higher than the reference. Once again, we find that the individuals suffering a relative disadvantage in terms of safe work environment are heavily concentrated in the lowest quintile of the non-cognitive skill distribution (0.366 standard deviations lower). A level of non-cognitive skill corresponding to the second quintile or higher allows enjoying a relative advantage that may go up to 0.748 standard deviations higher than the reference.

Let us now discuss the effects of both types of skills relative to each other. Our results show that cognitive skills have greater positive effects compared to non-cognitive skills over all dimensions of work advantage; the effect of cognitive skills on employment

Figure 3.4: Standardised latent scores of Safe Work Environment by quantiles of non-cognitive skills
opportunities and earnings, and safe work environment is, respectively, 1.5 and 1.2 times that of non-cognitive skills (see Table ??). The superiority of cognitive skills over non-cognitive skills for the expansion of all the considered dimensions of work advantage is, to the best of our knowledge, a quite novel and striking finding for the Bolivian case. However, it is in line with research conducted in other Latin American countries; for instance, Díaz et al. (2012) showed that the Peruvian labor market does not seem to give monetary rewards to non-cognitive skills such as agreeableness and cooperation, whereas it does reward basic cognitive skills similar to the ones that we measure here. Similarly, using the Colombian dataset of the World Bank’s STEP program (i.e. the exact corresponding information in our dataset), Acosta et al. (2015) showed that cognitive skills are greatly associated with higher earnings and holding a formal job or a high-qualified occupation, while non-cognitive skills appear to have little direct influence on these labor market outcomes. It is interesting to make a case for similar results in OECD countries; referring to high-level cognitive skills, raises in this type of skills seem to outweigh raises in non-cognitive skills in terms of their contributions to better income and employment in Norway, Sweden and Switzerland, among other developed countries (OECD, 2015).

We believe that one plausible explanation for this result in the Bolivian case lies in the fact that, in a 0-1 scale, the median worker has a latent factor score of 0.64 for non-cognitive skills and 0.25 for cognitive skills. Furthermore, as shown in Figure 3.6, the cumulative distribution of non-cognitive skills stochastically dominates that of cognitive skills.

This leads us to state that the superiority of returns to cognitive skills relative to non-cognitive skills may be due to the fact that adequate stocks of cognitive skills may be scarcer among candidates applying for a certain position in the job market. Thus people with greater stocks of this type of skills may tend to be more valued by their potential employers. This result is particularly important as it reflects the importance of improving basic cognitive skills for expanding work advantage in the country. Banerji et al. (2010) provide support for our statement, as based upon the 2006 PISA test for assessing quality of education, they show that 56% of students in lower middle-income countries have a *deficient* education in the sense that they face serious difficulty in using mathematics effectively to succeed in further education or work.
Chapter 3. Skills as mediators in the relationship between education and work advantage

3.4.2 The effects of investments in skill formation

Years of schooling have significant direct influences on both cognitive and non-cognitive skills and through them, on work advantage. Greater levels of education induce greater levels of both types of skills and hence, expand this advantage. To have an idea about the magnitude of these influences, let us consider the individuals with average stocks of skills as the references.

To be considered as a person who possesses a relatively abundant stock of cognitive skills, it is required to have at least 12.5 years of schooling, which in the country corresponds to completion of high school and short pre-college workshops. Shades of educational inequality that have been stressed by Andersen (2001) among others, are evident in light of this result, when we notice that only 26% of individuals in our data possess more than 12.5 years of education. As depicted in Table 3.6, years of education above this level induce stocks of skills that may end up being 1.523 standard deviations greater than the reference, which is the case of individuals having 23 years of schooling, a time period that would normally allow them to possess the highest tertiary academic degree. The median individual having finished undergraduate college studies, which normally takes 17 years of schooling in the country, has a stock of cognitive skills that is 0.69 standard deviations greater than the reference. Conversely, people having less than 12.5 years of education are at a relative disadvantage in terms of their stock of cognitive skills. The median uneducated individual (zero years of schooling) has a stock of cognitive skills that is 1.9 standard deviations lower than the reference. We highlight the important negative effect of absence of schooling on non-cognitive skills; we argue that this may be due to some kind of limiting effect of the self-productive nature of skills. Absence of education may be a severe obstacle for the kind of exposure required to develop these skills and the maturity to nurture them (Kautz et al., 2014).

Concerning the effect of years of schooling over non-cognitive skills, let us stress that
relative abundance of this type of skills is associated with people having more than 8 years of education, which corresponds to the time required for completion of primary education. We confirm that non-cognitive skills are distributed less unequally compared with cognitive skills, as 66% of individuals in our dataset have completed primary education and thus have a relatively abundant stock of non-cognitive skills. The median individual having the highest level of education (23 years) has a stock of non-cognitive skills that is 1.976 standard deviations greater than the reference. Conversely, the median uneducated individual has a stock of non-cognitive skills that is 1.446 lower than the reference. The important magnitude of the effect on non-cognitive skills may be an indication of the fact that even if formal schooling programs in the country tend to focus explicitly on the expansion of cognitive skills, they are, indirectly, important promoters of favourable personal traits through social interactions and involvement in situations that are useful to forge better attitudes and behaviour. In that sense, our results provide novel empirical evidence for the Bolivian case that support similar findings in Kautz et al. (2014).

<table>
<thead>
<tr>
<th>Years of schooling</th>
<th>Cognitive skills</th>
<th>Non-cognitive skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1.900</td>
<td>-1.446</td>
</tr>
<tr>
<td>1</td>
<td>-1.704</td>
<td>-1.619</td>
</tr>
<tr>
<td>2</td>
<td>-1.586</td>
<td>-0.928</td>
</tr>
<tr>
<td>3</td>
<td>-1.510</td>
<td>-1.162</td>
</tr>
<tr>
<td>4</td>
<td>-1.382</td>
<td>-0.725</td>
</tr>
<tr>
<td>5</td>
<td>-1.183</td>
<td>-0.743</td>
</tr>
<tr>
<td>6</td>
<td>-1.006</td>
<td>-0.794</td>
</tr>
<tr>
<td>8</td>
<td>-0.344</td>
<td>-0.447</td>
</tr>
<tr>
<td>11</td>
<td>-0.009</td>
<td>0.185</td>
</tr>
<tr>
<td>12</td>
<td>-0.099</td>
<td>0.027</td>
</tr>
<tr>
<td>12.5</td>
<td>0.350</td>
<td>0.119</td>
</tr>
<tr>
<td>15</td>
<td>0.323</td>
<td>0.492</td>
</tr>
<tr>
<td>16</td>
<td>0.290</td>
<td>0.495</td>
</tr>
<tr>
<td>17</td>
<td>0.690</td>
<td>0.806</td>
</tr>
<tr>
<td>19</td>
<td>1.066</td>
<td>1.134</td>
</tr>
<tr>
<td>23</td>
<td>1.523</td>
<td>1.976</td>
</tr>
</tbody>
</table>

To assess the effects of school-start gaps on cognitive skills, let us consider the individual who possesses an average stock this skills as the reference (see Table 3.7). We find evidence for the fact that a late start of the schooling process is associated with lower stocks of cognitive skills. The median individual with 8 years of school-start gap has a stock of cognitive skills that is 1.436 standard deviations lower than the reference. Conversely, we find that the avoiding school-start gaps and promoting an earlier insertion in schooling programs (i.e. negative school-start gaps) are beneficial situations for non-cognitive skills acquisition. The median individual with 2 years of pre-school (kinder garden) has a stock of skills that is 0.164 standard deviations greater than the reference. The negative effect of school-start gaps over cognitive skills goes in line with Kautz et al. (2014), who argue that children who start behind, stay behind (p. 11) as it becomes increasingly difficult to compensate for negative environments as children grow older; cognitive skills may be better, easier and more solidly built at early ages.
Table 3.7: Median standardized latent scores of cognitive skills by school-start gap

<table>
<thead>
<tr>
<th>School-start gap</th>
<th>Cognitive skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>0.164</td>
</tr>
<tr>
<td>-1</td>
<td>0.250</td>
</tr>
<tr>
<td>0</td>
<td>0.141</td>
</tr>
<tr>
<td>1</td>
<td>-0.439</td>
</tr>
<tr>
<td>2</td>
<td>-1.145</td>
</tr>
<tr>
<td>3</td>
<td>-1.242</td>
</tr>
<tr>
<td>4</td>
<td>-1.514</td>
</tr>
<tr>
<td>5</td>
<td>-1.474</td>
</tr>
<tr>
<td>6</td>
<td>-1.674</td>
</tr>
<tr>
<td>8</td>
<td>-1.436</td>
</tr>
</tbody>
</table>

3.5 Concluding Remarks

This paper aims at providing useful analytical tools to face the methodological and operational challenges for investigating the role played by skills and their formation process in determining work advantage, defining the latter as a multidimensional concept. We build upon Heckman’s ideas to account for abilities or skills as crucial elements for success in the labor market. We supplement this idea with that of Sen’s to stress that labor market success should be measured by her potential to have a quality job and we term this potential as work advantage.

We develop a general simultaneous system of equations linking a multidimensional conception of work advantage, skills and investments based on a suitable combination of these two deeply influential lines of thought. Our general model consists of two sets of equations; the first are structural equations, which explicitly integrate the process of skill formation formulated by Heckman in the relationship between educational investments and work advantage. As skills and advantage are hard to observe directly, we add a set of measurement equations which link them to multiple indicators representing various aspects of these latent concepts. Further, we consider possible endogeneity of investments in skill formation, and introduce theory-based identification restrictions drawing inspiration from Heckman’s body of work leading to family background and other socioeconomic variables as possible instruments for investments.

Our empirical strategy consists in the estimation of two versions of our structural model building on two different specifications of our Simultaneous Equation Model (SEM) with latent variables. The first variant considers investments for skill formation as exogenous; the second variant considers these investments as endogenous and introduces investment policy functions to model decisions to invest in the skill formation process, applying a structural IV estimation procedure to estimate the whole system. Using the World Bank’s STEP program unique data for Bolivia (2012), we find that an appropriate Hausman test rejects exogeneity of our two investment variables: years of schooling and school-start gaps, thus we retain the second variant of our SEM as the adequate structure for assessing the Bolivian case.

Building from a combination of ILO’s Decent Work conceptual framework and available data, we define and assess three dimensions of work advantage, namely employment opportunities and earnings, decent working time and safe work environment. Among our most salient empirical results, we find that:
3.5. Concluding Remarks

- Cognitive skills have positive effects that are greater than that of non-cognitive skills. In fact, we do not detect significant effects of the latter skills on decent working time. Results in the literature are mixed concerning which type of skills is more important for acquisition of a multifaceted viewpoint of a quality job. To the best of our knowledge, in this document we provide the first empirical evidence on this debate coming from the Bolivian case. Our results are in line with other studies that use the STEP program data.

- The median individual in the highest quintile of distribution of cognitive skills has an advantage of employment opportunities and earnings that is 0.42 standard deviations greater than the average advantaged individual in the population; the median individuals in all other quintiles of these skills are at a disadvantage with respect to this person of reference. We find a very similar qualitative relation between this dimension of work advantage and non-cognitive skills; the corresponding figure for comparing the median individual in the fifth quintile with the person of reference is 0.39. This shows the extent to which this dimension of work advantage is heavily concentrated within a skilled elite in the country.

- Disadvantage in terms of decent working time is concentrated among people in the lowest quintile of the cognitive skills distribution. The median individual in this quintile has an advantage that is 0.16 standard deviations lower than that of an average advantaged individual in this dimension.

- Similarly, the lowest quintile of the non-cognitive skills distribution concentrates the individuals that are at a disadvantage in terms of a safe work environment, as measured by the physical strain that it implies for the worker.

- Years of schooling, i.e. time spent in the formal education system, are effective drivers of both cognitive and non-cognitive skills, but with different intensities. Relatively advantaged individuals with respect to their stock of cognitive skills are concentrated among people who have spent at least 12.5 years in the educational system (completed secondary education plus short pre-college courses). Similarly, these relatively advantaged individuals in terms of their stock of non-cognitive skills are concentrated among people who have completed primary education (8 years of schooling).

- Avoiding school-start gaps with respect to the norm in the country (6 years of age) is another driver of cognitive skills only. The median individual with 8 years of school-start gap is at a disadvantage in terms of her stock of this type of skills that is quantified as 1.4 standard deviations lower than the average advantaged person in the distribution of these skills.

The coherence of our empirical results lends support to the adequacy of our theoretical and methodological frameworks, demonstrating the relevance of explicitly bringing out the different parts of the process that goes from educational investments to a multidimensional conception of work advantage. Thus we find evidence for the sequence: education - skills - work advantage - a quality job. We hope to be able to apply and test our model in the future, in different empirical contexts for robustifying its formulation to suit various practical settings.

The quest to foster human development with justice and equality is now recognised as a key objective of development and policy agendas throughout the world; these notions
are rapidly gaining their rightful attention as fundamental social and economic long-term goals. Providing sufficient opportunities for skill acquisition in the early stages of life to be able to get a good job in the adult phase is an integral part of the human development process and needs to be addressed by all policy makers. A proper understanding of the strength of these mechanisms is crucial to the design of an adequate policy. We hope that our study would have succeeded in making a small move towards drawing attention to the usefulness of such an analysis for an efficient action on the ground.
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