Wellbeing and Macroeconomics

A SAGE approach

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September 2020

Acknowledgements

I am deeply grateful for the help and support I have received during my Master's program and in preparing this mémoire. I would especially like to thank my supervisor, Professor Xavier Ragot, for the stimulating environment he provided and his interest in my ideas. My fellow Master's students Danell, Alberto and Simeon have willingly provided programming support and entered into helpful discussions as I developed the ideas central to my thesis, but I am especially grateful for their friendship. Likewise, the members of my Master's class have provided a wonderful community at Sciences Po that I have enjoyed for the past two years, and I thank them all and wish them the best for the future. I would also like to thank very much Professor Marco Cucculelli for his guidance and encouragement. Finally, I am infinitely grateful for the support and help from my family during this time of pandemic that has been stressful for everyone.

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September 8, 2020

Abstract

The aim of this project is to develop an economic model that improves on existing ones in capturing wellbeing outcomes stemming from economic shocks. The premise is that personal welfare depends on more than just preference satisfaction and that the other determinants, which are affected by economic choices may not be captured by standard models. A theoretical approach for representing wellbeing more completely, the SAGE framework, is presented as the basis for this analysis and adapted to a Bewley-class model. Some parameters are derived from data while others are calibrated in an equilibrium state, and then a modest productivity shock is simulated to understand how groups in different wealth categories respond and what the wellbeing implications are. While the model needs further development, the results follow some general patterns observed in economic data and offer insights into behaviour of the different wealth groups, including a decoupling of personal welfare dimensions following a productivity shock. In general, the introduction of wellbeing into the model shows promise for future development that better encompasses the motivations of groups and their responses to changes in their economic environments.

1 Introduction

The persistent and significant popular malcontent that is evident in much of the West (and not only) can be attributed to a myriad of reasons, many of which are idiosyncratic and multifaceted. Nevertheless, sizeable portions of people across the board are feeling that their wellbeing, in a general sense encompassing socio-economic outcomes and psychological states of mind, has decreased subject to these reasons (Fukuyama, 2020; Guriev, 2018). In addition to the well-described wealth inequality dynamics, other forms of inequalities such as with regards to education (attainment and participating in higher education), geography relating to territorial cohesion, and gender relations posing deep

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questions about the actual progress our society is making, are further revealing the seeming disaggregation in Western society. These form a vicious cycle, contributing to the malfunction of the mechanisms geared towards evening out society's outcomes, as seen by the stall of social mobility. Furthermore, several staggering observations about the subjective wellbeing of individuals are emerging, as displayed by the OECD's 2020 *How's life?* survey. For example, they find that 7% of the OECD population reports very low levels of life satisfaction with 15% women and 12% of men feeling more negative than positive feelings in a given day, a similarly concerning statistic as in the previous edition (OECD, 2020). Deaths of despair (suicide, alcohol and drug overdose, or liver disease stemming from alcohol abuse) have increased for several countries to three times the level of road deaths and six times that of homicides (OECD, 2020). Anne Case and Angus Deaton pry deeper to describe the disparate effects of such deaths in the United States, exposing a staggering evolution for middle-aged white women: in 1992, those lacking a university degree had a three-fold greater likelihood of dying from heart disease than death of despair. Today this relationship has inverted, with the likelihood of suicide now 30% higher. While behaviour certainly has changed (such as less smoking), the authors explain this by the increasing psychological distress derived from eroded employment prospects and social isolation (Case, 2020). Furthermore, 40% of OECD households today are at risk of economic hardship: if they lose their income for three successive months they risk falling into poverty (OECD, 2020). This is particularly worrisome considering the current COVID-19 crisis.

On the other hand, before the pandemic the same countries were largely recovering from the Great Recession in terms of GDP and unemployment (almost 80% of OECD-country adults hold paid positions today and average adjusted household income has increased by six percentage points since 2010) (OECD, 2020). This suggests that individual wellbeing and economic outcomes are behaving differently. In their 2020 paper *Recoupling Economic and Social Prosperity*, authors Katharina Lima de Miranda and Dennis Snower indeed demonstrate this decoupling empirically. In particular, they show that for developed countries over the time period of 2007-2017, an indicator of social affiliation comprising measures of social support, trust in others and giving behaviour diverged substantially from the trend of real GDP per capita. To a slightly lesser extent, another indicator for individual empowerment including measures of employment insecurity, life expectancy, years of schooling and confidence in national institutions also diverged significantly over the same period (Snower and Lima de Miranda, 2020). If the assumption is that social affiliation and the ability to pursue desires are important to personal wellbeing, and that they cannot be completely made up for by consumption or other economic gains, then this presents an issue. Decoupling between the factors constituting wellbeing is what the authors propose to be the source of the observed malcontent, as will be discussed below.

At the same time as the rise to power of the myriad populist leaders, new, multidisciplinary descriptions of welfare intended for research and policy use are emerging. The most recent wave was sparked by the Fitoussi-Sen-Stiglitz report of 2009, which promoted a statistical and measurement paradigm shift. In light of the impending environmental crisis and the inadequacy of GDP to stand in for personal wellbeing particularly in its economic, environmental, and social dimensions, they propose to shift the benchmark measurement system from focusing on measuring economic production to people's wellbeing placed within a context of sustainability instead (Stiglitz et al., 2009). This involves looking at real household income rather than GDP, include non-market activities, factor the distributions of these, and consider the sustainability of the levels, among others. Other statistical indices take this further by drawing from interdisciplinary research. For example, the OECD's Better Life Index (BLI) is an interdisciplinary index comprising 24 indicators such as income and financial wealth, housing conditions, health, education, community, civic participation and job security to name a few. This certainly represents a more global vision of what constitutes an individual's wellbeing. In practical terms, some countries like New Zealand, Iceland and Scotland have made strong commitments to a wellbeing agenda where their economic policy goals are to promote collective welfare. In 2019, New Zealand introduced "Wellbeing Budget" whose focus was on improving the quality of their citizens' lives rather than output specifically. Given the observations and the burgeoning commitments to alter wellbeing's perception and role in policies, this begs the following questions: are the real-life wellbeing outcomes stemming from economic shocks consistent with those predicted by standard models? More to the point, could it be that some consequences are not captured in conventional lenses, and so wellbeing is misrepresented? As we will see below, the macroeconomic literature has focused mainly on adapting standard principles of human behavior, individual preference-satisfaction for utility maximization, to model wellbeing. Very little research has looked at interdisciplinary notions, and the goal of this mémoire is to explore such an avenue.

The analysis of these questions rest on a discussion about what constitutes welfare and how to represent it for economic modelling, ultimately converging to a novel conception, the SAGE framework of Lima de Miranda and Snower, and on its subsequent adaptation in a theoretical macroeconomic context. The resulting model, which displays some of the expected characteristics of economic models in addition to insights about the interplay with individual empowerment and social cohesion, provides a basis for seeing the decoupling observed in the data. The paper is structured as follows: Section 2 provides further context for the issue at hand, both through academic studies and a brief empirical survey, Section 3 presents the economic literature regarding how wellbeing is being treated, highlighting areas for improvement, Section 4 presents the SAGE framework, Section 5 introduces a partial equilibrium model that incorporates the framework and discusses its properties, Section 6 presents a computationally solved version and showcases a simula-

tion of an unanticipated aggregate productivity shock, Section 7 discusses the results and Section 8 concludes.

2 Further Context

In the last half century the world has experienced significant economic transformations in the form of technological advancement with the digital revolution and automatisation, deregulation in line with a neoliberal conception of public management and, as a backdrop, the cementification of a globalised society with the establishment of global production chains optimised for profit. In essence, these profound economic shocks have reshaped economic outlooks, political objectives and industrial organisation along with cultures and, more generally, society. The economic consequences have been widely studied[1]. What is of interest for this research is the ramifications beyond their economic channels, *i.e.* the social, physical and psychological domains which also constitute individual wellbeing. If anything, the current COVID-19 crisis has shown that the mandated restrictions in behaviour are seriously distressing for people. Even in light of the serious health consequences (and spurred by inefficient official communications), the magnitude of the effect on the other domains of wellbeing push many to defy them.

We can start by looking at technological innovation, which explains the decrease in hours worked in the last century and a half (Huberman and Minns, 2007; Irmen, 2017). By increasing real wages and also the varieties of goods available, the consumption of goods raises the value of leisure and so people will trade hours worked for it. So, technology has affected the degree to which people control their time. With greater leisure, people can dedicate themselves more to other aspects of life which are rewarding, such as their hobbies, families and social life. Duhautois et al. (2018) find that technological innovation (both regarding the product and the production process/organisation) has an overall positive effect on the quality of employment in France, Spain and Germany, as described by higher wages and job stability. The former can generate personal satisfaction and the latter reduce feelings of economic vulnerability. However, when looking at process/organisational innovation specifically, the authors reveal firms' tendency to favour low-paid work and part-time jobs, which are precarious in nature. So, the effects of the shock are more nuanced: with the increase in wages, different people can have opposite psychological consequences, and thus their wellbeing is affected disparately.

One can also explore how economic changes affect society, and individual health directly. Much of the standard discourse regarding the effects of trade (and economic policies in general) is on how they affect the "size of the economic pie" (Pareto improvements) and to whom changes accrue to (Autor, 2018). Globalisation has opened massive doors for the exchange of ideas, goods and services, from which significant innovations,

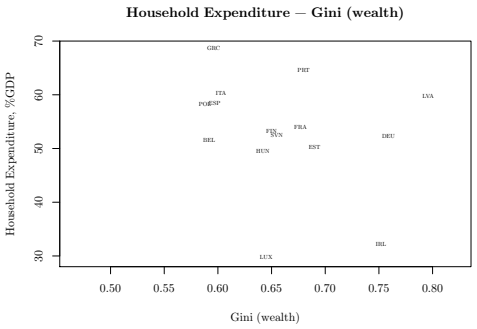
[1] See Mills (2009) for a comprehensive review of the economic and sociological literature

cultural sharing and wealth have arisen. However, without adequate protective infrastructure, it has also resulted in the loss of jobs to international competition and technological advancements, and some fundamental public services and support are cut due to welfare retrenchment as a means to maintain competitiveness. For instance, loss of employment results in lower expenditure in the local economy and so less tax receipts. Local governments thus spend less on local services such as education or public goods. As Dani Rodrik points out, the inadequacy of standard policy remedies to this (increasing job flexibility albeit there being low geographic mobility, or social transfers to increase consumption with low feasibility given the neoliberal climate) make it so that people stay in affected areas and suffer the personal and social consequences (Rodrik, 2018). Sociological and medical studies have demonstrated significant associated psychological wellbeing consequences. For instance, much research reveals a positive correlation between public spending and mental health (Burgard and Kalousova, 2015; Catalano et al., 2011; Margerison-Zilko et al., 2016; Suhrcke and Stuckler, 2012). As public spending decreases from strategic welfare retrenchment, lowering tax burdens, this impacts the mental health of those who depend on it most, especially those who cannot afford to purchase alternatives through private markets. The reason is that austerity measures decrease social safety nets while raising vulnerability (McKee et al., 2012). The same has been demonstrated with regards to the austerity measures passed following the Great Recession, where the rates of deaths of despair increased in the hardest hit countries like Greece, Portugal, Spain and Ireland (Antonakakis and Collins, 2014, 2015; Tapia Granados and Rodriguez, 2015), and with regards to reactions to natural disasters such as the Great East Earthquake in Japan (Matsubayashi et al., 2020). Further research has shown that when the countries with more public spending to begin with decrease their expenditure in healthcare and social protection services, the impact on suicide rates and mental health is lower, suggesting a regional gradient of effects (Toffolutti and Suhrcke, 2014). Effects can also be social: Putnam (2016) has shown that shocks like globalisation have broken up local and regional communities' social ties, as these areas were centred around manufacturing which disappeared due to competition.

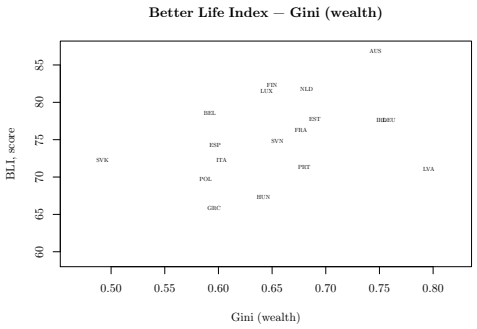
On the other hand, while little-to-no research exists on the positive psychological consequences of globalisation, it is not without foundation to assume that it is experienced. For example, greater skill may lead some individuals to better take advantage of new technology in the digital revolution, or make their work have a more global reach, which can be deeply satisfying on a personal level. In essence, what this highlights is that trade-related changes have a deeper effect on individual wellbeing than simply consumption preference satisfaction by affecting potentially several of its dimensions. Thus, any change in the economic pie that is accompanied by structural reorganisation can yield profoundly different wellbeing consequences for different people.

So, from these examples we see that social and personal consequences stemming from

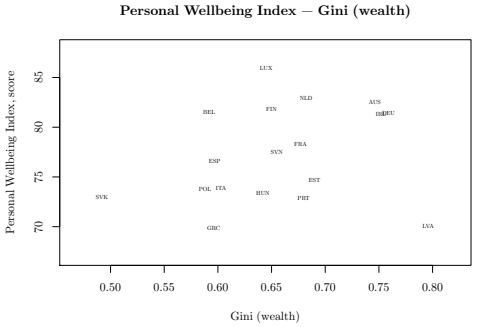
Figure 1: Wellbeing and Wealth Inequality, 2017



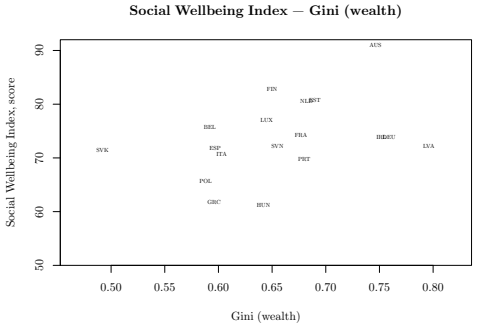
(a) Household Expenditure - Gini (wealth)



(b) Better Lives Index - Gini (wealth)



(c) Personal - Gini (wealth)



(d) Social - Gini (wealth)

or exacerbated by economic shocks significantly affect personal welfare. One of the currently predominant arguments for the channel through which this occurs, at least in developed countries, is wealth inequality. Certainly this is a factor, as psychological wellbeing is affected when one experiences both being priced out of various desired market outcomes, and economically insecure while seeing others who aren't, especially when it is increasingly so. Furthermore, public goods of quality are less and less enjoyed by the public as private counterparts beyond reach replace them. Personally, this generates frustration, disenfranchisement and hopelessness, while socially this creates divisions between groups of people, fostering alienation and 'us-versus-them' entrenchments. Lima de Miranda and Snower show, through a cross-sectional analysis of specific interdisciplinary dimensions of wellbeing, that there is no generalisable relation between them and income inequality in several mid to high income countries (see Appendix A for a similar cross sectional analysis with different parameters and countries). The same is true when comparing wellbeing measures to wealth inequality levels. This is seen in Figure 1.

Wealth inequality is represented by a Gini Index relating how financial and asset

wealth is distributed in the economy, calculated with data from the second wave of the European Central Bank's *Household Finance and Consumption Survey*. All data is from 2017. Subfigure (a) shows the relationship between household expenditure as a percentage of GDP and the level of wealth inequality. This standard wellbeing measure, taken from the OECD's National Accounts, encompasses the amount of spending on what consumption can offer: both the goods necessary for life (sustenance, bills, rent) and for leisure. Subfigure (b) takes the BLI mentioned above as the reference wellbeing measure, which is the average of all indicators represented as a score out of 100. Subfigure (c) takes the indicators of the BLI directly pertinent to personal welfare, such as employment, wealth and income, education for economic success, but also health and safety, for instance. Finally, Subfigure (d) takes those indicators of the BLI which relate to social side of life, namely the perceived quality of support networks and civic engagement. There is no evident trend in any of these cross-sections. Of course, differences across countries would need to be controlled for in a more in-depth study of the effect of wealth inequality, but what this highlights is that it is only part of the reason for wellbeing differences. The large dispersion suggests that other factors, which themselves could be influencing wealth inequality, are at play.

3 Literature Review

To recapitulate, the wellbeing areas which are being affected from economic shocks globally involve physical and mental health, social belongingness and community as well as economic prosperity. While the latter is the central focus in the economics literature and yields important intuitions, the rest are touched upon disparately and in unrelated contexts. Three strands of the literature that study the connection between these differently are explored.

The representative utility-maximising agent conception assumes that the optimal bundle of goods and services maximising a person's utility function directly defines their welfare level. There is significant evidence that consumption levels and subjective wellbeing are linked, making this a realistic assumption. In a study spanning 20 years and covering European countries along with the United States, Tella et al. (2003) find a positive correlation between GDP and self-reported wellbeing. Furthermore, they find that 'happiness equations' have a monotonic relationship with income. However, preferences are typically unconnected to social setting, and environmental constraints only affect consumption choices through prices instead of the continued and sustainable pursuit of values. This is important because people are not motivated by preference satisfaction alone, but also by purposes driven by morals (discussed in greater depth in Section 4). Examples of these are social affiliation and conformity, altruism, status attainment and free, independent thought and action. In situations where consumption choices also lead to these value-

motives being fulfilled, the individual's needs are being satisfied globally. But as shown by Lima de Miranda and Snower, this no longer seems to be the case. There are also many studies reflecting the negative wellbeing consequences when agents focus on the former and not the others, namely with regards to materialism.[2] These medical findings suggest that there is no reason why the two should go hand-in-hand.

Furthermore, the opioid crisis in the United States is highlighting a significant portion of middle-class people who, in terms of consumption levels or income appear to be doing relatively well, but are being predatorily prescribed very strong medicine to which they become hooked immediately. Their quality of life is not as high as those who have the same wages or levels of consumption, but who are not addicted. Yet, their appearance in utility terms is the same: the standard utility fails to represent reality. So, wellbeing and consumption dynamics can match up under certain conditions, but in others not. This warrants analysis with a more complete conception of human behaviour which builds from the core of what constitutes wellbeing.

While suffering from the same intrinsic issues as the standard conception, the evolution towards heterogeneous agents models provides a markedly important improvement by directly incorporating distributional determinants and dynamics— one that this research associates itself with methodologically. This allows to better understand the ramifications of macroeconomic shocks and tailor policies to a given population or goal. For example, Baum and Koester (2011) find that the timing of the fiscal shocks in the business cycle is important because of the increased risk and possible credit constraint agents can face in times of negative output gaps. In such a scenario, some people and firms are faced with tight credit constraints since banks want to eliminate credit lines or increase the risk premia on interest rates for loans. Thus, those most credit-constrained adjust their spending considerably in reaction to changes in disposable income. One can imagine three potential wellbeing consequences not covered in the standard framework: the added stress from greater economic vulnerability, frustration from losing freedom to pursue personal satisfaction, and a decrease in community affiliation from working more to afford to live. Navarro and Ferriere (2016) find that when income taxation is more progressive, the associated government spending multiplier is greater. This is because high earners have a greater opportunity cost for leaving the labour force and so will be less responsive to an increase in taxes. In other words, the government is crowding the private sector out less and the fiscal multiplier will be greater than if the tax were flat. With regards to employment levels, Meghir and Phillips (2008) find that low earners' labour participation is more elastic than that of high earners and Zidar (2019) finds that increases in taxes reduce total employment of the 90% lowest earners significantly, but not that of the top 10%. In other words, employment grows when tax cuts are implemented for lower-income

[2]See Schroeder and Dugal (1995) for a study on its correlation with depression and Wachtel and Blatt (1990) for social anxiety.

groups. At the same time, the greater flexibility in labour supply of lower income individuals means, as above, that they are eager to trade the alternative to work, such as leisure or social interactions, to better afford the physical means to live. Thus, these individuals are forgoing important personal relationships, free time for rest, relaxation or pursuing hobbies more than their richer counterparts, which can be frustrating, isolating and disenfranchising. Standard preference-utility models represent the disutility from work through a catch-all parameter that includes any and all negative consequences, yet it can be misleading. In the case of low earners, it must be small to account for their high labour supply elasticity. Yet, in so-doing it either misses the fact that significant determinants of wellbeing are foregone (which raise the adverse consequences from working more, especially if there are feedback effects), or reduces the alternative's importance so much that it ends up under-representing the breadth of these individuals' lives, and so warping their wellbeing representation. This suggests the need to add a component of utility functions which directly represents this factor of wellbeing.

Inequity Aversion, by representing an intersection of the standard individual preferences framework and societal considerations, offers a way to connect preferences to the agent's context. Taking from Fehr and Schmidt (1999), this strain of research takes agents to be, as imbedded within a community, socially 'responsible': in optimising their bundles they are motivated by an overarching bias towards more equitable allocations of gains. The richer one is relative to the median agent, the more they will feel guilty and won't want to be as well off. On the flip side, poorer individuals will feel prompted to work harder. While this penchant could be a subconscious human bias motivating in part the existence of welfare states (or explaining the Veil of Ignorance of Rawlesian memory) and so reflecting a psychological link between individual wellbeing and societal imbalance, it nonetheless presents some incompatibilities with the aim of this research. Firstly, by categorising being wealthier as intrinsically bad, it doesn't allow for agents to feel prideful regarding their financial successes, nor poor people to feel downtrodden and de-motivated by their standing. This artificially limits the range of human reactions and seems incompatible with the feelings of the disenfranchised, the existence of increasingly unequal societies, the seeming political apathy to this divergence (representing the inequity averse citizen unsuccessfully taking civic action against this) or the observed reduction in monetary donations as inequalities increased (the same concerned citizen seemingly not taking matters into their own hands)[3]. If anything, this bias seems to have a very slight effect on behaviour or exist solely when conditions permit (like financial comfort). Thus, this makes Inequity Aversion a non-generalisable human preference, and

[3]Carroll et al. (2005) find that donations in money terms in Ireland have decreased, as measured by the percentage of disposable income of a household that is donated in the 1990's. The same has been found in the UK (Pharoah and Tanner, 1997). This is occurring as households are getting richer, evidencing a decoupling between economic growth and donations to charitable institutions (18% growth in donations as opposed to 93% in economy).

thus the adaptation is unsuited to a general wellbeing framework.

There is also a significant branch of research that departs from the preference utility-wellbeing interchangeability. The Capabilities Approach pioneered by Amartya Sen posits that each individual has a set of capabilities which are the means to achieve the states of being that constitute wellbeing. The realisation of their potential depends on conditions which affect the degree to which they are able to do so. While the objectives and the manners depend on moral values (either left to be defined by society as per Sen or by a minimum list including physical and mental health, social affiliation, and mental skills as per Nussbaum (2000)), crucially the Capabilities Approach is less interested in the completion of these wellbeing goals as the main objective of an individual. Instead, the emphasis is on the degree of freedom they have to do so, even if the chosen course of action may not necessarily be wellbeing-enhancing. An extreme example of this seeming paradox is the distinction between a starving person and someone who is fasting: while both actions are equally physically devastating, the latter is the outcome of an actively taken choice and limiting this free will would go against that person's desire, which is itself deleterious. What freedom provides in a real-life context is essentially the access to the civic, communal and economic spheres of a society that foster the necessary environment for wellbeing to thrive (rights, equality, fair electoral process, schools, healthcare, communities and support networks, etc...). Given the curbing of agency by repressive authoritarian regimes or hostile environments for example, an adaptive agent operating under a reduced set of choices can be seen as achieving an optimal bundle by the standard framework albeit it being coerced. The lack of freedom will yield actually sub-optimal allocations, and so is debilitating before the choice even takes place. This has made the Capabilities Approach more suited for analysing developing countries (although Anand et al. (2009) have operationalised it for developed countries). Nevertheless, the cornerstone of the framework— the freedom an individual has in achieving their impulses— and the fallout from it being curtailed, is common to all people and represents a very important conceptual tenet to better inform wellbeing conceptions. This will be expanded upon in the following section.

Social Capital, the idea that belonging to social groups or communities fosters the creation of networks through which conventional economic benefits are increased, can offer insights into the connection between society and individuals within economic models. For example, Pereira et al. (2017) find that Social Capital is influential in describing the wide heterogeneity of constrained borrowers, as it influences how individuals looking for credit perceive their situation (do they have a familial safety net?), how they are perceived by potential lenders (are there prejudices, socio-economic or other?), and the types of loans available (family-backed, low interest, time for repayment to name a few). In fact there are several types of credit constrained individuals, such as those who are discouraged from applying for a loan because they expect a refusal, either directly (Ibrahim et al. (2007)

and Kohara and Horioka (2006)) or because of the complicated nature to get one (**?**), or because they don't expect to pay it back. Social Capital thus directly influences these perceptions and abilities. This particular example showcases how personal perception and self-worth (relating to agency) along with the community around us (associated with social cohesion) can influence individuals' borrowing abilities and so their economic security beyond the amount of collateral they can front. This also warrants distinctions to be made both for between and within-country analysis.

Putnam's famous article "Bowling Alone" reveals a 40-year decline in group participation along many lines in the United States arguing that it decreases quality of life (Putnam, 1995). This builds upon research (Helliwell and Putnam, 1999) which finds that civic engagement and the speed of economic growth are positively correlated in Italy. So, the claim is that decreases in Social Capital are bad for the economy and for wellbeing. However, as explained in Sobel (2002), if it arises from drops in dollar donation, this could also be due to changes in marginal tax rates and not a lower commitment to one's society. Expanding upon this argument, it could also be that the amount of government spending in the sectors where donations go, such as food programs, healthcare or education may influence people's perspective about whether they need to help others or not (in fact, we see that the more generous Scandinavian welfare state countries have the smallest third sector (Archambault, 2009)). This is thus a question of values and goes beyond the incidence of taxes lower disposable income for donations, which is discussed in Inglehart (1997). Furthermore, if the emphasis is on how society helps one gain economic advantages, there is nothing to say about how it directly also influences one's social needs, at best placing this under "non-market gains". While interacting with people can increase the chances of success for a goal, provide new ideas or aim better goods/services, it can also simply make people happy without anything having to do with consumption. So, as Social Capital does not aim to explain this more psychological dimension of life, it cannot then be used to describe the full extent of welfare deriving from social affiliation.

Finally, Behavioural Macroeconomics presents an intriguing synthesis between social psychology and macroeconomic performance, particularly by including the effects of unemployment on individuals' wellbeing. In Darity and Goldsmith (1996), authors combine the neoclassical rationality of individuals view with a psychological counterpart to directly incorporate wellbeing observations that had been otherwise ignored or taken to be exogenous. Specifically, taking from studies like Eisenberg and Lazarsfeld (1938) or Theodossiou (1998) which describe the emotional toll that unemployment can have on individuals namely by causing depression, anxiety, or strained interpersonal relationships, or Lane (1991) who finds that self-esteem is the most important personal opinion and so characteristic for job success, the authors introduce psychological factors as determinants of both labour demand and supply beyond wages. The assumption is that demoralised people with decreased senses of self-worth have more difficulty looking for new jobs, or

are less effective while working because of psychological pain. The former affects the supply of labour, as it is contingent on job attachment defined in part by the individual's work-leisure preferences and by their emotional state. The latter lowers productivity, and so the demand for labour. The resulting model has a job market and a component of subjective wellbeing coexisting at the same time, with the two spheres directly linked. Although this branch of research has been more focused on labour economics questions, it is nevertheless an inspiration for a broader framework appropriate for more situations and reactions.

Ultimately, what emerges from this literature review is that agency and social affiliation do indeed intersect with the economic variables of a model, yet they are not taken to be intrinsic to or standalone dimensions of agents' wellbeing. So, a novel conception taking from established psychological research– where these are all represented– may yield new and potentially far-reaching analyses. This is what the SAGE approach of Snower and Lima de Miranda is about.

4 SAGE Framework

The SAGE Dashboard proposed in Snower and Lima de Miranda (2020) offers a novel theoretical approach to modelling wellbeing where individuals are motivated contemporaneously by needs and human purposes. As it is rooted in psychological, sociological and economic principles, the authors' vision of welfare is thus a global concept suitable for examining a variety of scenarios. The authors present it as the result of two crucial tenets:

1. Wellbeing depends on factors from various dimensions of life, which individuals pursue separately as 'decision objectives' (akin to utility maximisation)

2. Wellbeing is given by the allostatic balance of these, not the weighted sum

In other words, agents select goods, services, or actions so that both preferences and intrinsic purposes defined by values are satisfied sustainably. Through this representation, many of the critiques mentioned in the literary review are resolved and the qualitative results are in the same direction of the observations in the introduction.

With regards to the first tenet, the motivations behind individual behaviour take from the seminal *Value Circumplex* (1994) of social psychologist Shalom Schwartz, who defines 10 universal moral values present in all humans which motivate value-driven purposes, and from the standard individual preferences influencing the consumption of goods and services (Schwartz, 1992). It is important to see how the former are not necessarily related to, or covered by individual consumption preferences: because they have to do with meaning in everyday existence and being embedded within a society, they specify

aspects of life that are otherwise either implicit or not considered. For example, if working allows one to be integrated in a community, a characteristic that is important to them, or the job is personally rewarding, then the level of consumption deriving from that labour effort is accompanied by social and personal gratification– the satisfaction both of purposes and choice allocation. However, the same individual with the same preferences and psychological needs that works a different job where they are isolated and which is not personally fulfilling will only be satisfying the latter. Given this distinction, four dimensions of wellbeing are gathered from related universal moral values: ***S***ocial Cohesion encompassing affiliation and belonging, ***A***gency which is the ability to control or influence one's fate through their own actions, Material ***G***ain covering the physical needs for survival, and a Sustainable ***E***nvironment in which to live (the capital letters forming the 'SAGE' framework).

The equilibrium of these separate dimensions is what defines wellbeing, thus forming the second tenet. This notion is comparable to the dashboard of an airplane for instance or the functioning of the human body, where the concert of processes working together ensures success. Importantly, it is the departure from this equilibrium (just like homeostasis for bodily functions or the right levels of fuel, thrust, and structural integrity of the plane) that is harmful. Furthermore, one function cannot make up for another. Thus, while the dimensions are interconnected, they exist independently and are not mutually exclusive.

In their paper, the authors present a sketch of the framework. Each dimension of welfare is represented by utility functions, added together to create a global one. Certain aspects have been selected and adjusted to match the scope of this research, yet the foundation and the intellectual background is maintained throughout. An explanation of this modified SAGE framework follows, with any change justified in the footnotes. The most apparent one is the omission of the Environmental Sustainability dimension, as in the original paper. Given that it is understood simply as an effect on prices, this is done to streamline the analysis. Its involvement would not greatly alter the qualitative results.

S - social solidarity and cohesion

Humans do not live in a vacuum, they exist in an increasingly dense environment that poses both dangers to life and opportunities for fulfilment. Over the course of human evolution, situations have steered interactions towards cooperation for survival such as the development of language communication or choosing to band with others, or to influence the environment for mutual gain. These outcomes are 'ultimate' causes for sociability. The link to Social Capital is clear, both in desires for civic engagement to make the community more resilient and offer more return or by receiving aid during complicated economic times, such as at credit constraints. Yet sociability goes beyond this, as there

are also 'proximate' reasons such as caring for others or wanting to belong, associated with values of conformity, universalism and benevolence from the $Value\ Circumplex$. These depend on morals rather than individual preferences, and the meaning they provide imbues behaviour and life with vigour. Furthermore, being affiliated with others pushes people to want to belong in a community, creating a choral feedback solidarity for its members. Generous welfare states do not detract from this sense of affiliation (as posited in Inglehart (1997) regarding personal contributions). In fact, Snower and Lima de Miranda find that the Scandinavian countries with renown generous welfare states do not appear in the top 10 of rankings of countries with regards to their Social Cohesion score (including measures of quality of support network, giving behaviour and trust in other people).

Social cohesion can be modelled as such: as an alternative to working, people contribute their time to their society. Real life examples are spending time with one's family and friends, volunteering, helping out neighbors and conforming to norms or traditions. These activities contribute to what is essentially a public good that benefits everyone[4]. The more one contributes, the greater it is and the more society's agents can enjoy it. So, a public good Q can be represented by the sum of contributions by the N members of society:

$$Q = \sum_{i=1}^{N} q_i$$

where the individual i's time is divided between effort of working, e_i, and the social contribution, q_i. Normalising it to 1, their time constraint is thus:

$$e_i + q_i = 1 \tag{1}$$

An alluring, yet deceptive proxy for this element may be a country's non-profit sector. In fact, motivations of benevolence and altruism are some of the motives for donating one's money and time for the greater good. It elicits a 'warm-glow' effect. However, as shown above in the Inequity Aversion discussion, the richest are the ones dominating this sector in terms of money contributions, meaning that low income individuals' social dimension is vastly under-represented. Recalling Inglehart (1997) differences in welfare state generosity will influence the degree to which someone may want to donate, but this doesn't make them a less altruistic person. Furthermore, as shown by Auten et al. (2002), much of the wealthiest donors' donations go to higher education which is not a public good. Also, where donations are going is important for purposeful redistribution. In terms of income, Brown and Ferris show that the richest 2% of American households'

[4]The distinction between the benefit from the act of contributing and receiving, as described by Lima de Miranda and Snower, is fused in this research due to lack of data for calibrating both parameters, for different agents. Nevertheless, as these factors are additive, they are included in benefiting from society as a whole package

contribution (4.4% of income) accounts for 37% of total donations, with education and wealth being important determinants of giving as these determine how much money one has and can give, and the social circles to which people belong, which in turn influences giving. As for wealth, households worth $1 million (7% of households) make up 50% of donations. The target of these is universities: 66% of the total individual giving goes to higher education. According to the 2002 *Charitable Giving and the Ultra-High-Net-Worth : Reaching the Wealthy Donor* (report of the Spectrum Group), the amount that the education sector (the largest) received is more than eight times what went to social organisations and six times that for the healthcare sector. Since in countries like the US the poorest do not have access to either, this donating behaviour does not do much for reducing inequalities and rather may be associated with status seeking or, at best, in-community altruism. Likewise, the same authors find that the poorest favour animal shelters, which is certainly altruistic but has also virtually no effect on a public good. For these reasons, the model will focus for the time being on a representative public good that is defined simply by the sum of people's time without calibrating it to any value.

The way in which the public good is enjoyed can differ through people: its benefit is thus subject to a sensitivity parameter, $B_i \in [0, 1]$. Thus, the utility of social cohesion is:

$$U_i^s(q_i) = B_i \sum_{i=1}^{N} q_i = B_i Q \tag{2}$$

From this utility function, we see that agents are dependent on the actions of others. Rewriting Q as $q_i + \sum_{j \neq i}^{N} q_j$, we see that drops in agent j's contribution q_j will lower the utility of i by making the public good smaller.

A - agency and empowerment

Humans are also motivated by individualistic predispositions such as achieving objectives, status, influence and recognition, and simply fulfilling personal desires. These are reflected in the *Value Circumplex* by the values of power, achievement, hedonism and self-direction. The degree to which people can influence their fortunes by their own hand is their agency. Greater agency will imply greater personal satisfaction through more success in attaining what one seeks (relating to Sen's Capabilities Approach premise and which, in its financial declination contradicts the premise of Inequity Aversion), and less stress from economic hardship, better ability to find a job if unemployed, and better productivity when employed if it is gratifying (covering the issues raised by Behavioural Macroeoconomics). On the other hand, losing a job to global production-chain reshuffling, international competition or automatisation can leave people feeling powerless as they have no control over the decision, and profoundly disenfranchised and alienating when it is government or society-sanctioned. As mentioned above, knowing that 40% of

the total OECD countries' population risks poverty if they lose their income for three subsequent months highlights the degree to which the stresses from economic vulnerability are widespread.

Concretely, as a first approach agency can be represented by a parameter which influences an individual's ability to transform their labour effort into income. Denoted $\alpha \in [0, 1]$ and calculated to be representative of the conditions which hamper control over economic fortune, like labour market insecurity, household budget less housing expenses, skill level and health, one can see how as these worsen, the ability to make empowered choices drops. In other words, a smaller α will lead to reduced bundles, lowering the utility of consumption.[5] For example, an individual i's disposable labour income, y_i, is defined as:

$$y_i = \alpha_i e_i z_i \tag{3}$$

where z_i represents that individual's wage proportional to their productivity for labour effort e_i.

G - material gain and economic prosperity

In addition to pursuing value-driven motives, people must still cover their fundamental material needs. For this purpose, the standard consumption-leisure trade-off based on individual preferences works fine: the utility from consuming, U_i^c which depends on consumption and labour effort, can be represented by any appropriate functional form. It is important to note that removing the utility of social cohesion, U_i^s, along with the agency parameter α in the budget constraint, the model returns to being standard.

Together, the sum of the consumption and social cohesion decision objectives form the global utility function of the agent. However, agents may give different importance to each dimension, for socio-economic, historical or cultural reasons. We can weight each component then by weights $\Gamma_i, \Lambda_i \in [0, 1]$. Thus, the global utility function U_i is:

$$U_i = \Gamma_i U_i^c + \Lambda_i U_i^s \tag{4}$$

Wellbeing

Agents maximise U_i. However, the resulting optimal level of utility does not represent wellbeing, as this depends on the degree to which the decision objectives are individu-

[5] Lima de Miranda and Snower propose an additional separate utility function that increases as the risk of economic hardship decreases. This has been omitted to keep the model simple. However, the additional dimension being additive in the total utility function and affecting it in the same direction as how α is understood in this mémoire (greater economic vulnerability implies being less free to consume or partake in meaningful activities, which undermines purposes of self-enhancement like power and achievement), it does not change the first-order conclusions of the model. However, a potential conceptual complexity is discussed below.

ally satisfied vis-à-vis an optimal balance. In other words, wellbeing is treated as being allostatic (referring to allostasis, an organism's process for keeping the physical and psychological conditions for reacting to their environment). Within certain bounds, any deviation from the balance won't be harmful to the individual, yet past them the domains become unsubstitutable and the reference point becomes the domain least taken care of. For example, wellbeing can be maintained when small drops in one dimension are made up by gains in others, such as giving up a bit of leisure or socialisation to work more so as to afford greater consumption, but past a certain threshold (consuming in total isolation as an extreme case) there is no longer mutual exclusivity.

For calculating wellbeing, the Social Cohesion and Material Gain dimensions reached at the stationary equilibrium form the balanced dashboard reflecting an individual's optimal balance. For this first pass of the SAGE framework, the decision objectives are optimised for at the beginning of the period and wellbeing is calculated at the end, as the fallout from individual decisions and those of their peers. This allows agents in this model to remain utility-maximising and not wellbeing-maximising, which may require extensive research on what that means. In fact, one can imagine a benevolent social planner wanting to maximise total wellbeing rather than total utility, as a means to analyse what the optimal allocation for the domains of people's welfare and how this relates to the status quo. This may be the subject of future work.

5 Model

The adapted SAGE framework from above is introduced in a Bewley-type model. First, the dimensions will be incorporated into utility framework for the maximisation of the decision objectives as agents face uninsurable idiosyncratic risk, and second welfare will be analysed based on how the dimensions vary with respect to their equilibrium (the balanced wellbeing dashboard). Each individual takes an income endowment as given by a transition matrix, an exogenous interest rate, and faces idiosyncratic risk to their income process. The resulting infinite-horizon partial equilibrium model is described below, and then a simulation of a productivity shock is run.

5.1 Model Environment

Households

The economy is populated by a unit-mass of agents (no firms). Individuals can either be in low income or high income states given by their productivity level: $z_i \in (z_l, z_h)$, where $z_h > z_l$. The subscript t for time is introduced. An agent's utility of consumption today, $U^c_{i,t}$, is described by a Greenwood-Hercowitz-Huffman functional form where consumption

$c_{i,t}$ and the alternative to labour effort $e_{i,t}$ are traded off as such:

$$U^c_{i,t}(c_{i,t}, e_{i,t}) = \frac{c^{1-\gamma}_{i,t}}{1-\gamma} - \phi \frac{e^{1+\psi}_{i,t}}{1+\psi} \tag{5}$$

where parameters γ is the coefficient of relative risk aversion, ϕ is the disutility of labour and ψ the inverse Frisch Elasticity of Labour Supply.

The second dimension of households' wellbeing, social cohesion, is represented as in (2). Given the unit-mass of agents, the public good Q_t (now with the time subscript) is represented by an integral over the distribution $\lambda(a_t, z_t)$ of agents in the economy by wealth and state. This is because these will affect the amount of time people choose to dedicate to their community. Thus, $U^s_{i,t}$ is:

$$U^s_{i,t}(q_{i,t}) = B_i \int_{\lambda(a_t, z_t)} q_{i,t}(a_t) d\lambda(a_t) \tag{6}$$

Finally, each dimension is multiplied by the weights for their importance, Γ_i and Λ_i, as above. Combining these with equations (5) and (6), the expected inter-temporal total utility function is:

$$\mathbb{E} \sum_{t=0}^{\infty} \beta^t \Big[\Gamma_i U^c_{i,t}(c_{i,t}, e_{i,t}) + \Lambda_i U^s_{i,t}(q_{i,t}) \Big] \tag{7}$$

where $\beta \in (0, 1)$ is the discount factor.

$U_{i,t}$ follows the characteristics of other utility functions: it is strictly increasing, strictly concave and twice continuously differentiable. This is because as $U^s_{i,t}$ increases in $q_{i,t}$, $e_{i,t}$ must consequently decrease and so lower $c_{i,t}$.

Idiosyncratic Risk

Idiosyncratic productivity defines each individual's labour income, which follows an AR(1) process with persistence ρ and dispersion η, as $z_t = \rho z_{t-1} + \eta_t$ (income and productivity, to refer to agents' state, will be used interchangeably henceforth). Agents can switch productivity level independently from others with a certain probability, given by a transition matrix. This continuous stochastic process is discretised with the Rouwenhorst Method, as per Rouwenhorst (1995), resulting in a discrete-space Markov Chain Π replicating perfectly the main moments of the original process.

Constraints

In addition to consuming positive amounts, individuals can save via a riskless bond a_{t+1} that generates interest through an exogenously set gross interest rate R (equal to $1 + r$), maturing the following period. The total resources available come from their remunerated labour effort $y_{i,t}$ and from previous period wealth, $a_{i,t}$. As defined in (3) the level of agency

α_i affects how much of the labour income is enjoyed. This is represented as an amount of labour income being removed on the Left Hand Side (LHS) of the flow budget constraint, leaving the full labour income on the Right Hand Side (RHS).[6] Second, some agents are credit constrained and thus cannot borrow (credit constraint at 0). Thus, the flow budget and credit constraints are:

$$\begin{cases} c_{i,t} + a_{i,t+1} + (1-\alpha_i)e_{i,t}z_{i,t} & \leq e_{i,t}z_{i,t} + Ra_{i,t} \\ a_{i,t+1} & \geq 0 \end{cases} \tag{8}$$

Finally, we recall the time constraint of (2), the choice between labour effort and social contribution:

$$e_{i,t} + q_{i,t} = 1 \tag{9}$$

5.2 Dynamic Programming

Solving for the Euler Equations is done through dynamic programming. Given the stochastic productivity, households seek to maximise their expected intertemporal utility as such:

$$\max_{\{c_{i,t}, a_{i,t+1}, e_{i,t}, q_{i,t}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\Gamma_i U_{i,t}^c(c_{i,t}, e_{i,t}) + \Lambda_i U_{i,t}^s(q_{i,t}) \right] \tag{10}$$

$$\text{s.t.} \begin{cases} c_{i,t} + a_{i,t+1} + (1-\alpha_i)e_{i,t}z_{i,t} & = e_{i,t}z_{i,t} + R_t a_{i,t} \\ a_{i,t+1} & \geq 0 \\ e_{i,t} + q_{i,t} & = 1 \end{cases} \tag{11}$$

We can write the Bellman Equation by taking into account the probability of switching state at each time period, $\mathbb{P}(z_{i,t+1}|z_{i,t})$, as given by the Markov Chain Π. Summing for every possible outcome, we get rid of the Expectation operator. Replacing the time subscript t with a $'$ to denote the next period for clarity, and with Value Function $V(a_i, z_i)$, the Bellman Equation is:

$$V(a_i, z_i) = \max_{c_i, a_i', e_i, q_i} \Gamma_i U_i^c(c_i, e_i) + \Lambda_i U_i^s(q_i) + \beta \sum_{z' \in \mathrm{z}} \mathbb{P}(z_i'|z_i) V(a_i', z_i') \tag{12}$$

where z is the set containing all possible realisations of z'. The Euler Equations are:

$$c_i^{-\gamma} \geq \beta \sum_{z' \in \mathrm{z}} \mathbb{P}(z_i'|z_i) c_i'^{-\gamma} R \tag{13}$$

$$\phi e_i^{\psi} - \frac{\Lambda_i}{\Gamma_i} B_i e_i = c_i^{-\gamma} \alpha_i z_i \tag{14}$$

[6] This is equivalent to simply having (3) define disposable labour income, but allows to better see that the budget constraint is held.

Euler Equation (13), which defines the intertemporal substitution of consumption for agents, is described with an equality for non-credit constrained individuals and with the inequality for constrained individuals, due to the credit constraint being binding. Equation (14) counters the marginal gain from working more (RHS) through greater consumption to the marginal loss of doing so (LHS), namely its disutility and the lesser benefit from the public good.

5.3 Description of Equilibrium

Because there is no production side, agents' savings can only be equal to others' borrowing and so aggregate savings S equals 0. However, since the credit constraint is also equal to 0, there is no borrowing in this economy and so no savings, and consequently no financial. Therefore, agents are consuming the entirety of their income and the goods market clears. Furthermore, as there are no firms demanding labour, there won't be any labour effort supplied and so no labour market. Finally, the stationary distribution can be described as the optimal distribution of agents for the given state and control variables, $\lambda^*(a, z)$ such that it is invariant: $\lambda^*(a, z) = \lambda^{*\prime}(a', z')$. This is represented as the sum of the realisation of the states given their probability of occurring, over all the possible levels of wealth, for each starting state, as follows:

$$\lambda^*(a, z) = \sum_{z \in \mathrm{z}} \int_{a' \in \xi} \sum_{z' \in \mathrm{z}} \mathbb{P}(z'|z)\lambda(da)$$

where ξ represents the set including any possible realisation of a' given the state variables.

So, the equilibrium of the economy can be described by the optimal policy functions solving the households' optimum problem, the goods market clearing, and the time invariant optimal stationary distribution $\lambda^*(a, z)$.

6 Model Simulation

To solve this model, Value Function Iteration is used, employing the computational language Julia. This method is rigorous and relatively simple to implement, especially for a control space of two dimensions. Some numerical instability emerged, and calculating the policy rules through simple mathematical operations like divisions and subtractions further compounded these, which decreased the accuracy of results. For this, some post-fact smoothing was required. Nevertheless, to confirm the validity of the computational method and the code's output, a simpler version of the model (with only one control variable, consumption, and exogenous labour), was run using the Endogenous Grid Method giving the same results.

6.1 Calibration

The model is configured to match 2017 French data with an annual recurrence. The parameters to calibrate are: $\beta, \gamma, \phi, \psi, \alpha, B, \Gamma, \Lambda, R, \rho$, and η.

The discount factor β and the Coefficient of Relative Risk Aversion, γ, are set to standard values for annual models. The disutility of labour ϕ is set to have a neutral effect and the inverse of ψ is chosen to match findings regarding the Frisch Elasticity of Labour Supply, which is typically around 0.25 for macroeconomic models.

The next four parameters, for the SAGE components, are calculated from the latest edition of the OECD's BLI report whose data was collected mainly in 2017. Importantly, this dataset is differentiated by socio-economic inequality: there is a distinction between people with less than secondary education and those with tertiary and up. This fits in nicely with the two states in the model economy, and allows to tailor the SAGE parameters to each state. The agency parameter α is calculated as the average of the indicators pertaining to personal empowerment that were consistently reported for France and other OECD countries (for future comparisons– as of now, all parameters are calibrated for nine Eurozone countries). These are labour market security, measured as 1 less the percentage of expected earnings loss occurring with unemployment (depending on the risk of losing one's job, expected duration of unemployment, and the degree of unemployment transfers) thus giving the degree to which income is guaranteed; self-reported health, the percentage of the population reporting a level of health that is "good" or better; and student skills, the score in the Programme for International Student Assessment (PISA) as a percentage of the highest achieving country, as skill is correlated with higher paying jobs with less unemployment risk, and so future earnings.[7] With regards to B, the only variable that was consistently reported with the skill discrimination was quality of support network, covering the percentage of people reporting to have a community (relatives and friends) to depend on in case of need. The parameters pertaining to each state, low and high, are denoted with subscripts l and h. As for the weights for each wellbeing dimension, Γ and Λ, a preliminary calibration is used. This is because the socio-economic, historical or cultural reasons for the relative importance of each dimension are very subjective and so are hard to measure. Nevertheless, the OECD collects data on how people voluntarily rank the 11 categories of the BLI, umbrellas grouping the 24 indicators mentioned above by theme. This is not done in a particularly random setting as there is certainly a bias from the type of people who participate. In fact, one must already know about the Index and, given that it is online, have the technology to access it. However, it is the only data found to date where the relative importance of each dimension of wellbeing is directly revealed (rather than construed from assumptions about household survey variables). Furthermore, given that over 16,000 people in France participated, some of

[7] The exam does not have an upper limit on scores.

the bias may be diluted. Ultimately, given that the values are relatively close to each other, this should not affect the model much, and removing them doesn't cause any qualitative reversal. With future editions of the BLI that hopefully provide more data, it will be more possible to calculate these parameters from a fuller range of indicators. Otherwise, membership to big data analytics organisations like Gallup may be required. The simplifying assumption is that the relative importance is the same for all agents in a given society, and the Social Cohesion importance is calculated relative to the ranking of Material Gain.

Finally, the gross interest rate R is calculated from the European Central Bank Statistical Data Warehouse's long-term interest rate (10-year treasury bonds) for France, converted into real terms via a Consumer Price Index measure of inflation published by the OECD. The persistence and dispersion of productivity, ρ and η, are matched endogenously through an algorithm whereby two of the model's key statistics, the level of wealth inequality (Gini index for wealth) and the percent of people at the credit constraint, match values of French society. This is done through an optimisation of the model by selecting the ρ and η which minimize a normalised difference between the modelled statistics and those in the data, ε:

$$\varepsilon = \min_{\{\rho,\eta\}} \mathcal{A}\|gini_{fra} - gini_{model}\| + \mathcal{B}\|\%constrained_{fra} - \%constrained_{model}\|$$

where $\mathcal{A}, \mathcal{B}$ are chosen to make the two indicators be on the same scale. The former multiplies the Gini index by 100 as it is between (0,1), and the latter keeps the percentage, multiplying by 1.

With a plethora of starting values and using two different optimisation routines (Nelder-Mead and Limited-memory Broyden–Fletcher–Goldfarb–Shanno (LBFGS)), the algorithm is 100% precise for the percent of people at the credit constraint but off by approximately 15% for the Gini index. This suggests that some parameters in the model are blocking the convergence, and further research will attempt to get beyond this. However, for the purposes of this mémoire, the model will use different values for R, ρ, and η that are nonetheless reasonable, but reflect a more egalitarian society. The reason is that the relative size of the welfare dimensions are not obvious at present (the size of the public good is not equivalent to the non-profit sector), and with a more unequal society agents are more concerned with their economic safety than the public good if it is small in size. With such a calibration, Social Cohesion's dynamics are very small compared to those of Material Gain albeit following the same dynamics as the other calibration, and so is simply hard to read (for instance, for high income individuals the social contribution is reduced to coming from only the richest 25%, and so the makeup of the public good is approximately 98.2% from low income individuals, which is unrealistic). So, until a criterion exists for sizing the public good appropriately with relation to the economy, this

model will focus more on the dynamics and directions, and it is easier to present them with these other parameters (they still contribute to a utility function which satisfies the necessary requirements, and we have that $\beta R < 1$).

The following tables summarise the parameters and their values:

Table 1: Standard Parameters

β	γ	ϕ	ψ	R^{cal}	ρ^{cal}	η^{cal}	R	ρ	η
0.99	1.5	1.0	4	1.0085	0.7600	0.0336	1.01	0.9	0.1

Table 2: SAGE Parameters

α_l	α_h	B_l	B_h	Γ	Λ
0.765	0.911	0.80	0.94	1.0	0.876

6.2 Stationary Equilibrium

The Value Function Iteration of the model yields optimal policy rules of consumption, labour effort, savings and social contribution for each productivity-type of agent and for each given level of starting wealth. This state variable is discretised on a 200-index asset grid indexing the level of previous wealth exponentially. This means that low values are sampled much more finely than higher ones, reflecting the greater number of poor individuals than rich. The policy rules, along with the Marginal Propensities to Consume (MPC), Saving/Dissaving and other steady-state characteristics are presented below. Afterwards, the optimal wellbeing dashboard for the different agents in the economy is explored.

Policy Rules and Distributions

In any graph hereafter, the color blue will be assigned to low income individuals and orange to high income people. Shades of these will refer to the same productivity state but at different quartiles, or elements pertaining to them.

Figure 2 presents the optimal policy rules at stationary equilibrium. In the top left plot, we see the consumption policy rules for low and high income individuals of different levels of prior assets held. While faint, consumption of high income individuals is always greater than that of their counterparts. We see that the shape of the policy rule function starts off concave until it slowly transitions to being linear. The convex part in the middle

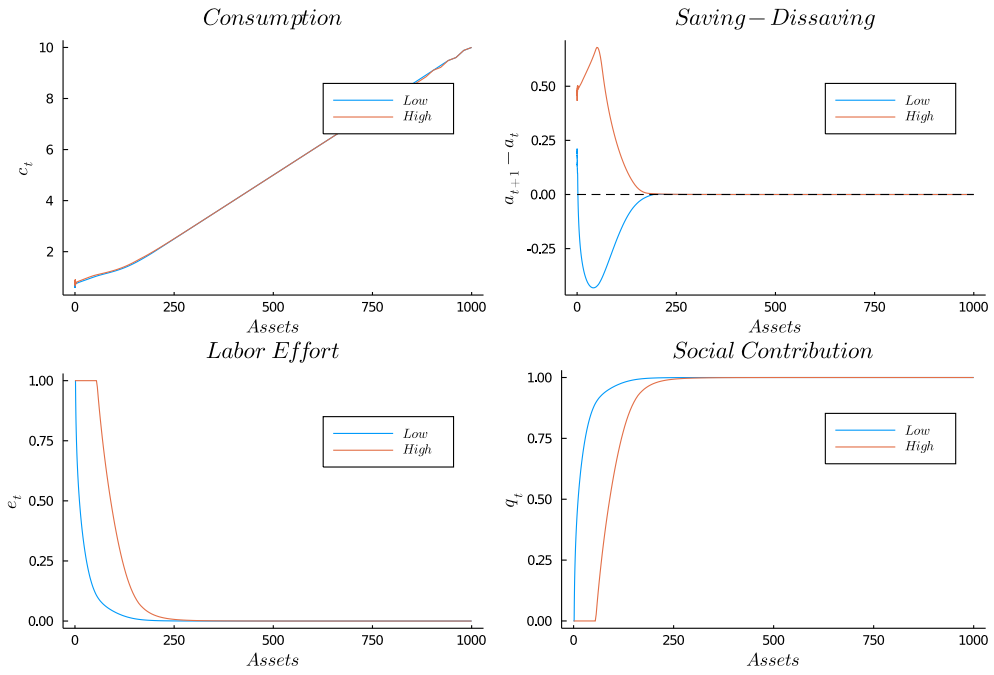


Figure 2: Policy Rules

occurs around an inflection point at the ergodic limit, at which point it transitions to the purely mathematical result of consumption being financed entirely by assets held, hence the straight line.[8] Turning clockwise in Figure 2, we see a plot of the saving-dissaving behaviour of the agents. The dashed line represents the saddle point where agents are neither saving proportionally more nor less of what they have already accumulated. This is the ergodic limit of the economy. We see that virtually no low income individuals are increasing their savings beyond what is already accumulated, which implies that they will be more susceptible to income fluctuations. Furthermore, the probability of switching state is very small, meaning that they are essentially unable to accumulate wealth. But, as they start off wealthier their budget increases, so they dissave less. This later increase in the blue line could be because the increments in wealth overcome the lesser labour remuneration from lower agency. While before this point agents have to ensure consumption and so dip into their reserves (hence the heavy dissaving), as asset wealth gradually weighs more in their budgets, those who would otherwise want to save more now can. High income individuals on the other hand are able to save from the onset. We see that for the lower wealth levels they are increasingly accumulating assets as insurance in case of switching state, until a point when they begin dissaving.

[8]The change is not immediate with a discontinuity because at the end of the ergodic limit, some agents are still working.

This suggests that beyond it any level of accumulated wealth will keep consumption smooth. Moving now to the bottom row, we see the policy rules of labour effort and social contribution, which are mirror images of one another. For the former, high income individuals are working significantly more than their counterparts for all levels of wealth past the beginning of the ergodic set. In fact, for the lowest levels of wealth, both types of agents are working 100% of their time.[9] However, as a_t increases high income individuals maintain this level while low productivity agents almost immediately begin working less. This is due to the greater return for their effort, recalling Euler Equation (14), given that $\alpha_h > \alpha_l$, $z_h > z_l$ and $B_h > B_l$ not changing the direction. In other words, the opportunity cost of not working is higher. As soon as the accumulated assets are enough to sustain consumption, low income agents' labor effort will taper off in favor of public good contribution, even if they enjoy it less than high income. This is seen in the final graph of the figure.

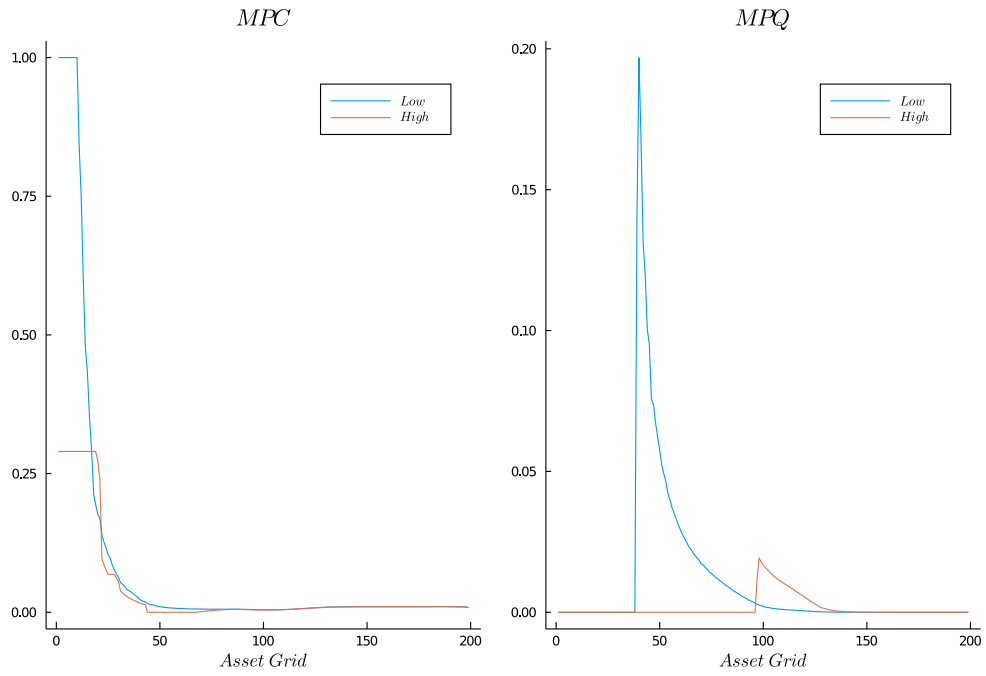


Figure 3: MPC and MPQ

The Marginal Propensity to Consume (MPC) depicts the rate of change in consumption for an increase in wealth. As we see in Figure 3, the poorest low income individuals fully transfer their income into consumption (the MPC is plotted on the asset index grid rather than on a_t for clarity). However, in so-doing they are not saving at all. This means there is no consumption smoothing, causing significant susceptibility to income

[9]The discontinuity exhibited by high income is a numerical byproduct of restraining effort to $\in [0, 1]$.

fluctuations for such people. At the same point, high income individuals have a much lower MPC, approximately 0.29. Their greater income allows them to save and be less economically vulnerable. Richer people convert less additional wealth into income for both states. It is important to mention that because of the numerical instability generated by VFI, in particular for consumption at the lower asset grid indices, this MPC is the result of smoothed consumption policy rules using a mean filter.

Along these lines, a hypothetical 'marginal propensity to contribute to society' or MPQ can be calculated like an MPC:

$$MPQ_i = \frac{\Delta q_i}{\Delta a_i}$$

The purpose of this is to examine at what wealth levels agents start switching their focus from working to socially contributing. The model's MPQ is plotted alongside the MPC, also on the asset index grid. Before the peaks, no incremental increase in wealth has any effect on social contribution, highlighting both states' commitment to fulfilling their material needs through labour. However, once a certain level of wealth is attained, priorities shift as consumption can be funded by past savings. This threshold is much lower for low income agents given that they enjoy the fruit of their labour less, which means that once they have attained an acceptable level of consumption for their means, the draw to the public good is greater as it maximises their utility more. For high income individuals this occurs much later as their effort is remunerated more, and the draw is significantly smaller. In other words, this model reflects the tendency to begin focusing more on community only once a certain economic security is attained, which seems realistic.

Since VFI does not yield a theoretical distribution directly, a simulation of an agent living five million periods and selecting optimal levels of a_{t+1} at each time point, as calculated from their optimal value function, provides a simulated empirical one. We can use these measurements of successive states for one agent as instead two states of 2.5 million agents, thus simulating a population. Transition Matrix Π ensures the agent is in each state about half of the times, and the level of a_{t+1} selected for the given a_t and productivity is saved. These counts are then turned into the probability density function. The validity of this method was tested by comparing the distribution of the simpler model with the endogenously solved one using the Endogenous Grid Method. The results are identical. Also, we recall that $\lambda^*(a, z) = \lambda^{*\prime}(a', z')$.

The distribution of agents in the economy for their wealth in a_{t+1} is given in Figure 4. Immediately we see a stark difference at the bottom: low income individuals are much more concentrated here with a large mass at zero. These are credit constrained individuals who are unable to save as they consume their entire budget (called 'hand-to-mouth'). High income agents' distribution features many less credit constrained ('wealthy

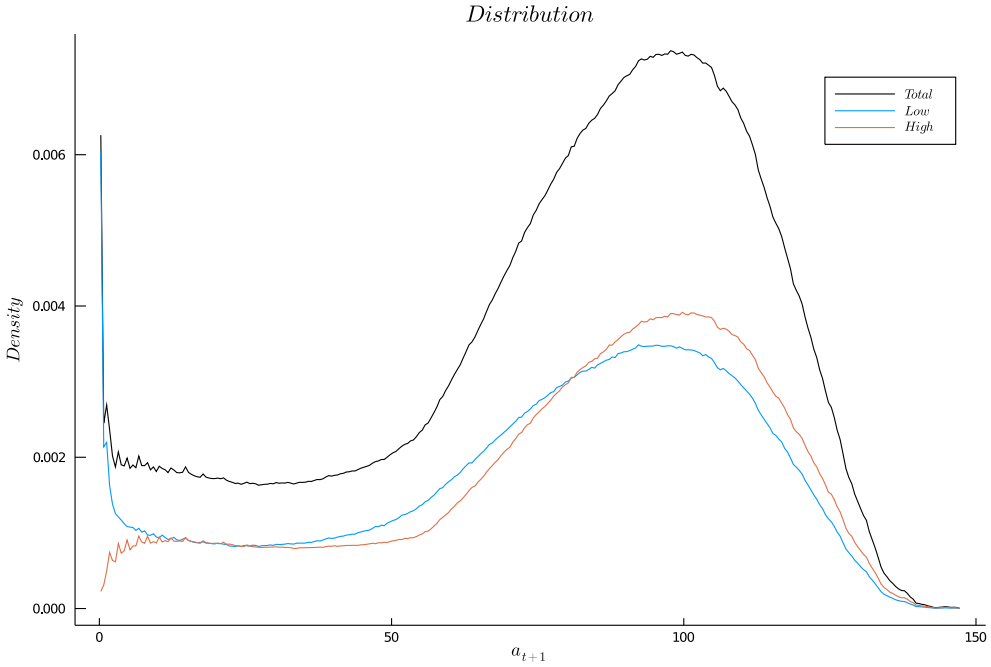


Figure 4: Distribution

hand-to-mouth') and a greater representation in the largest wealth levels. As explained above, this economy is more egalitarian than reality: the percent of people at the credit constraint is 1% , while it was 8.1% in 2017 France, and the Gini index for wealth is 0.236 compared to the measured 0.676.

Figure 5 displays the policy rules aggregated by quartiles, which divide up the population in four based on wealth. While this may be a broad stroke, the heterogeneity may be viewed without it getting too distracting. However, there is sure to be heterogeneity within each quartile, and it would be interesting to delve deeper in future work (such as by decile). Nonetheless, the purpose of grouping by quartile is to examine heterogeneity within a state.

For low income individuals, we see that consumption increases slightly from the 25% poorest to the second quartile and flattens out thereafter. Because the higher quartiles start off wealthier, they have less of a need to work to ensure consumption as it is largely funded by the matured previous assets. Given the greater cost of working, they thus work increasingly less, as seen in the bar chart below for labour effort. High income individuals on the other hand have increasing consumption in each quartile as their effort is better remunerated. It is afforded by labor income together with greater wealth. Yet, as the consumption of low income agents stabilises, their savings increase. In fact, we see a relatively big jump in the level of the poorest 25% and the second poorest quartile, with

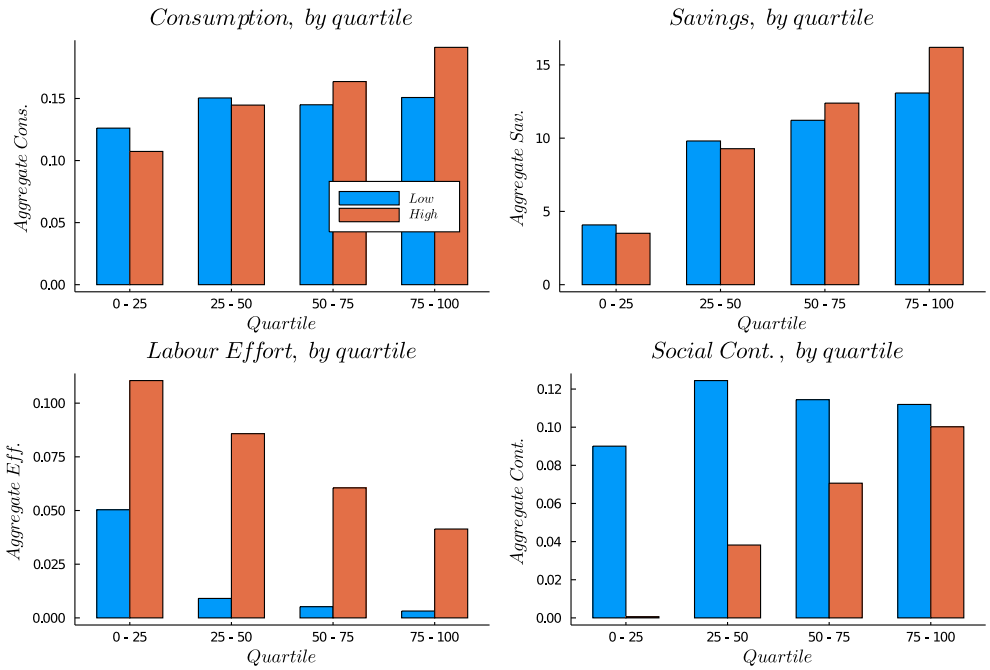


Figure 5: Policy Rules by Quartile

much smaller ones after. This suggests that a maximal amount of consumption is attained where the concerns for economic vulnerability become prioritised. In other words, the lesser agency seems to preclude having the desired insurance at the lowest wealth levels and, once sufficient assets are accumulated, greater consumption is traded for smooth consumption. This would help explain the shape of the blue line in the Saving-Dissaving graph of Figure 2. Said otherwise, greater material prosperity is exchanged for lesser insecurity.

Finally, we see a large difference in social contribution between the states. Low income agents are contributing much more to society than high income people who only do so at the wealth levels where the cost of working outweighs the benefit, reflecting the MPQ. As a consequence, Social Cohesion is more important to low income people in terms of the maximisation of $U_{i,t}$.

This is reflected by Q_t. The public good is calculated iteratively through an exterior loop around the VFI. Essentially, a guess of its size is added to the utility function and the model is solved through. From the resulting distributions and optimal $q_{i,t}$ policy rules, Q_t is calculated and updates the original guess. The model is re-solved until the difference between the input and output Q_t is below an error tolerance set at 0.001. For this economy, the public good size is 0.720, and its composition is described in Figure 6. As we see in the pie chart, it is made up primarily by low income individuals' participation.

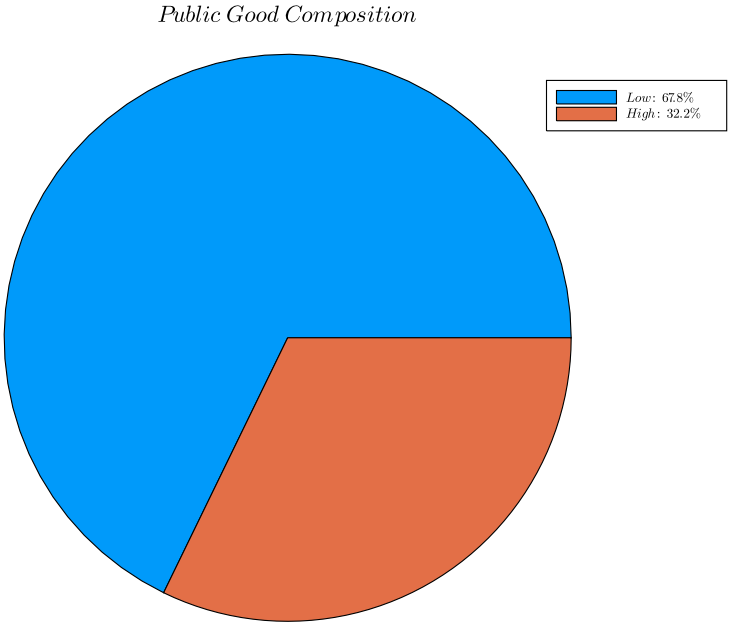


Figure 6: Public Good

Given that $B_l < B_h$, low income agents are contributing more to the public good even though their enjoyment of it individually is less. This will have a distinct consequence regarding wellbeing.

In essence, the optimal choices of the decision objectives deriving from the adapted SAGE framework showcase an economy with similar characteristics to standard models and logical intuitions about the interplay between the wellbeing dimensions. The public good represents an alternative to the utility of consumption and is favored by those who gain less from working. The agency parameter exacerbates the states' different attachment to labour effort, allowing high earners to consume more at the cost of social contribution. Disparities in wealth make these differences sharper, as richer low income individuals are eager to stop working, while only the richest of their counterparts are motivated to do so. As such, the community is dominated by low income individuals' time.

Wellbeing

We can now analyse what the optimal decision objectives mean in terms of individual welfare, and set up the optimal wellbeing profile. To recall, wellbeing is understood as a dashboard where the components, in their own right and at levels congruent with satisfying their value-driven purposes and preferences, define it in unison rather than by the sum of the optimal utility. Deviations from this are potentially harmful. To construct

the optimal wellbeing dashboard, we calculate the utility functions $U^c_{i,t}$ and $U^s_{i,t}$ defined in (5) and (6) and describing the Material Gain and Social Cohesion dimensions by plugging in the optimal policy rules. The dashboard, with each optimal dimension aggregated again by quartile, is presented in Figure 7.

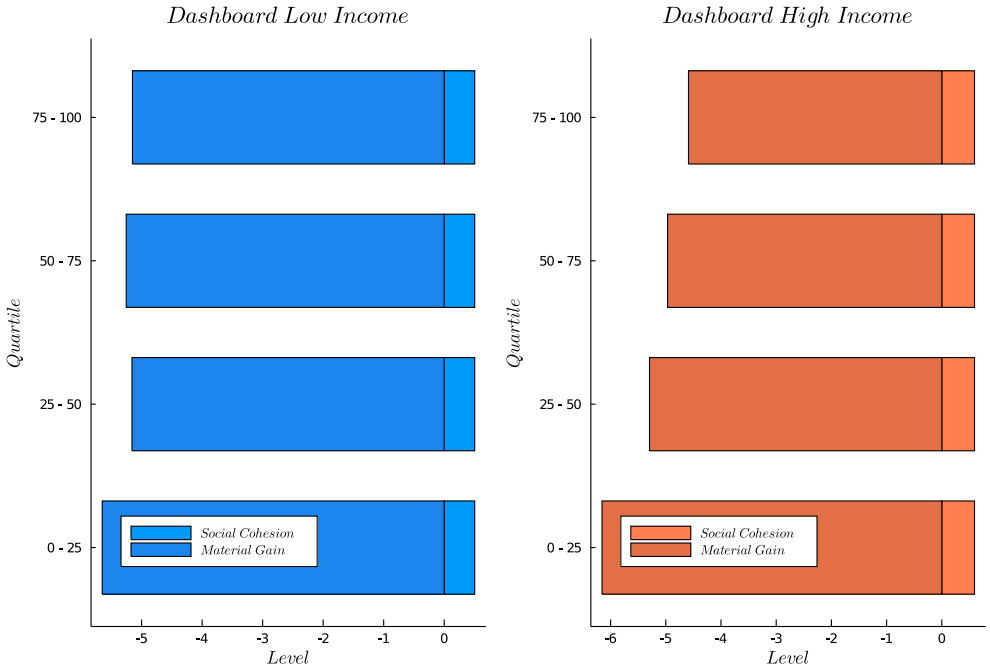


Figure 7: Balanced Wellbeing Dashboards

We immediately notice that the dimensions have different sizes– these are arbitrary at this point. As stated, significant further research is required to ascertain their relative proportions. Once this done, a proper calibration strategy could involve matching Q_t to the magnitude of the real life public good in relation to aggregate consumption (a sort of $\frac{Q_t}{GDP}$), in addition to wealth inequality and percentage of credit constrained people.

For both agents in the economy, we see that the Material Gain dimension has a tendency to improve as people are richer. This is particularly the case for high income individuals who, by virtue of large effort commitments and low consumption levels from lesser wealth, experience more strongly the labour disutility when poorer but promptly recover as they consume more. In fact, they have both the lowest and the highest aggregate Material Gain levels, in the extreme quartiles (ranging from -6.16 to -4.59). Low income individuals' utility of consumption is more similar across wealth quartiles (-5.65 to -5.15) and approximately levels off for the three highest. This maintains the dynamic highlighted in Figure 5 of these agents having less of a draw to work and funding their consumption increasingly by savings. In this particular case the forces work together to

create virtually no change.

Social Cohesion on the other hand is constant for everyone in a state as it is defined by the interaction between Q_t and B_i. As mentioned above, low income individuals are contributing much more time to the public good than high income people, yet their individual benefit from it is lower. In fact, the optimal Social Cohesion dimension is ≈20% bigger for high income (0.50 as opposed to 0.59). Because this profile is assumed to be the optimal one, it must be that the agents in the economy are fully satisfied by it. This means that given low income agents' means (lesser agency and productivity, and also their lesser benefit of the social good), this allocation is their feasible one. So, from their point of view they are satisfying their individual preferences and value-driven purposes. This provides a basis for introducing more realism through concepts like inequality of social cohesion or in-group solidarity. A sketch for an approach will be presented in the shock.

Overall, this dashboard captures a profile of how the optimal choices agents make in accordance to their preferences, means and value-defined needs comprise their wellbeing. Assuming the economy starts from a clean slate, the dashboard will serve as the reference point for analysing the consequences of changes.

6.3 Productivity Shock

We now turn to the simulation of an unannounced aggregate shock that increases the productivity of both types of agents by 1%. This is to analyse how the wellbeing dimensions fare relative to one another when people overall get richer by a proportional amount, thus testing the hypothesis of the two becoming disconnected.

Agents have no expectation of the shock and do not anticipate further ones when they are experiencing it. The shock is described by the following Law of Motion:

$$Z_{t+\tau} = Z_\tau + \zeta\mu^{\tau-1}, \quad \forall\tau \geq 1$$

where Z multiplies the idiosyncratic productivities z_l and z_h, μ refers to the persistence, ζ to the shock itself and τ to the indexing of the time periods after it has arrived. Since the shock occurs at $\tau = 1$ (thus $t+1$), in order to get Z_{t+1} to be equal to 1.01 at the first period (its peak), μ is set to 0.9 and ζ to 0.011. Given that $\mu \in (0, 1)$, the economy will eventually revert to its stationary equilibrium ($Z_{end} = 1.0$).

The shock is simulated over 100 periods. To solve for this simulation computationally, the model is worked out backwards from the restored equilibrium through to the beginning of the shock. This is done because the stationary equilibrium values are known and can be used to update agents' expectations. At every period the replacement occurs incrementally to ensure convergence, and $Q_{t+\tau}$ is inputted as a path of guesses, recalculated at every period and plugged in again, forming a transversal loop until its values

collapse to fixed points.

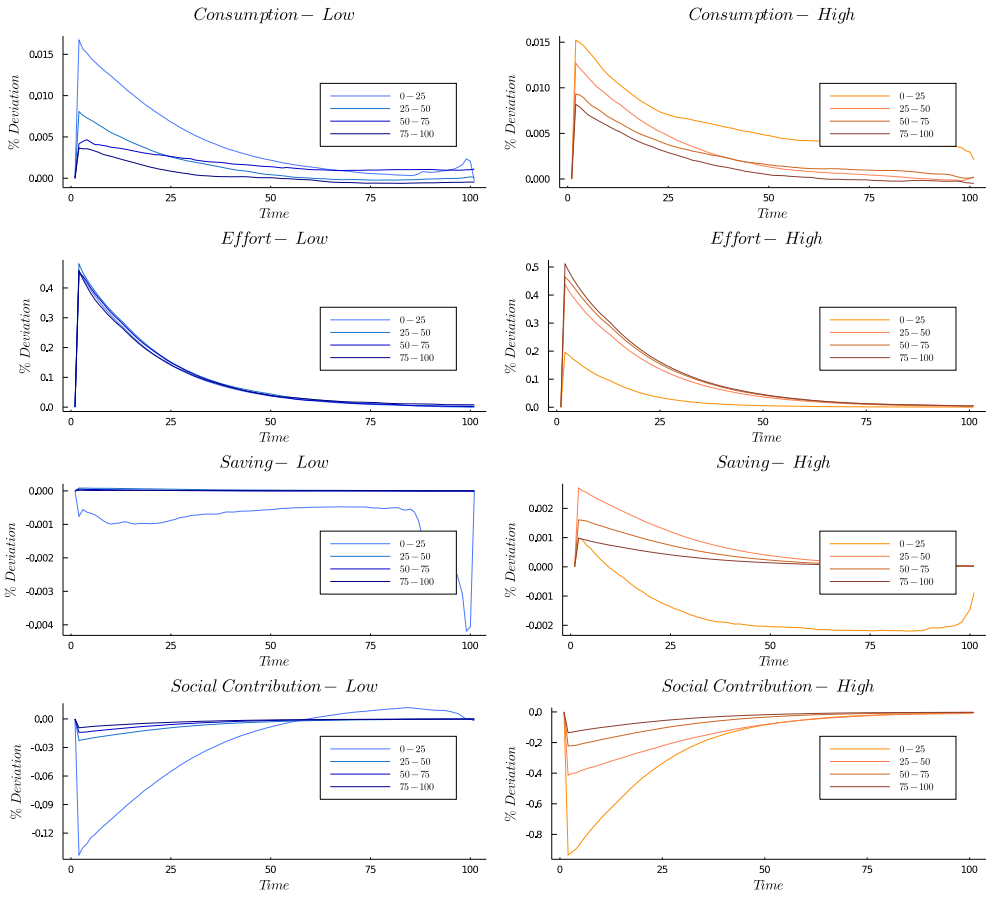


Figure 8: Policy Rules per Quartile, Through Shock

Figure 8 depicts how the rise in productivity affects the policy rules in terms of percent deviations from equilibrium values. Consumption, labour effort and savings all increase before they return to their equilibrium levels, as expected in models with standard utility functions. In terms of consumption, we see that the least wealthy increase their consumption the most for both states, since even a small rise in level will be proportionally big. Richer low income individuals drop off from this increase much more than their counterparts as they still aren't working as much. Looking at savings, significant numerical instability at the lowest levels of wealth make the first quartile impossible to decifer. We see very faintly that the increase is greatest for the second poorest low income quartile as any residual burden of being 'hand-to-mouth' is lifted, and much more pronounced for high income people. As people of both states are richer, their reaction on savings is proportionally smaller, which is logical. However, not much more beyond this can be

said.[10]

As for labour effort, we see an opposite trend between the states. For low income people, all quartiles increase their effort by almost the same percentage, with the lowest peaking slightly above them. Since they are already at low effort levels across the board, the increase in productivity nudges them all to work more. For high income individuals it's the lowest quartile that increases the least. This is due the greater disutility of labour the poorest agents face, as their consumption depends mainly on work and not accumulated wealth. Since low income individuals of the same wealth quartile work less, the disutility is not felt as much and so the proportional increase is greater. The contributions to the public good are also different. We see the poorest low income people decrease their contribution by a significantly greater proportion than any quartile in either state. This suggests that the increase allows those most in need of ensuring material needs, the poorest low income individuals, to do so to a better degree. But, these are also those who will be contributing less to society. As in the case with savings, numerical instability plagued this shocked policy rule series, making the results less accurate and describable.

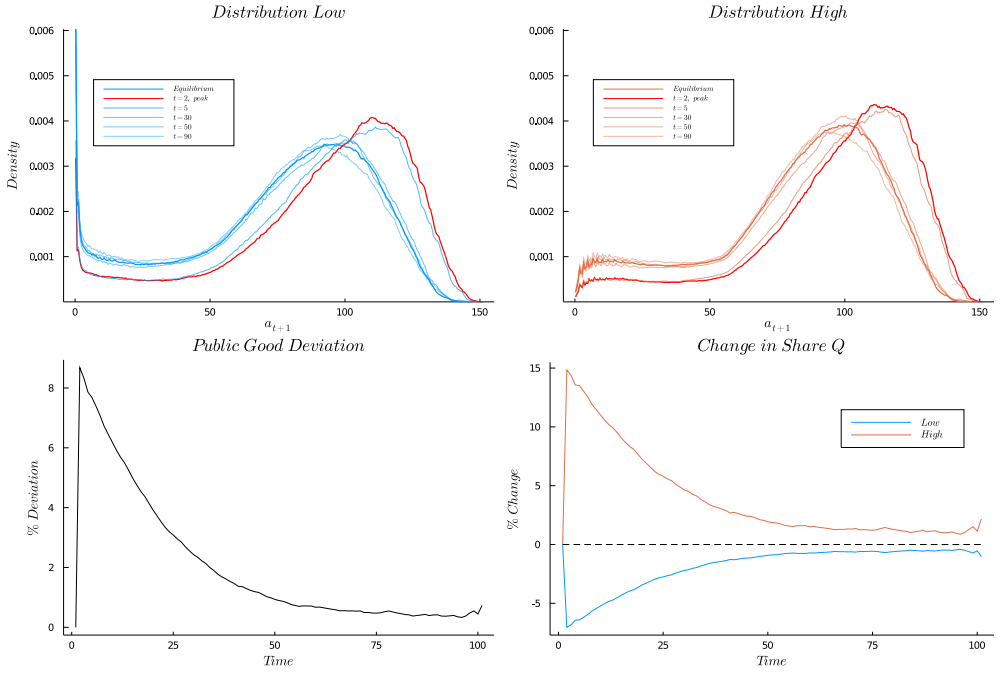


Figure 9: Distribution and Q Changes, Through Shock

The increase in productivity makes people richer, which shifts the distribution of agents in the economy outward. This is seen in the top graphs of Figure 9 where the

[10]The instability occurs from the inaccuracy of the policy rules around zero, where the sampling at the lowest wealth values can oscillate around 1×10^{-8} and 1×10^{-7}– virtually zero at this scale– yet by whole orders of magnitude greater.

red line indicates the distribution at the height of the shock. As the shock dissipates, it returns back to the stationary distribution (the bold line). Thus, there are less people at the lowest levels of wealth as seen in the drop of the credit constrained for the low income state, and a greater concentration further up. While the added wealth is important for consuming more along with easing smoothing and economic vulnerability concerns, it will also be consequential for the composition of the public good, in two ways. Looking at the bottom row of Figure 9, we see first that the public good gets bigger by ≈9% at the height of the shock. The changes in distributions indicate that this is due to the greater concentration of wealthier people of both states who can afford to work less. But, crucially, the different states do not contribute equal proportions: in fact, we see in the bottom right graph that the share of contributions by high income individuals increases by ≈15%, and that for low income individuals decreases by ≈8%. With a constant B_i, the utility of social cohesion is not affected by differently distributed Q. But, a more refined understanding concerning the different types of solidarity may lead to contrasting conclusions. This sets up a wide foundation for exploring different concepts of how solidarity is exercised.

To analyse personal welfare changes, we calculate the wellbeing profiles for each quartile and compare them to the optimal wellbeing dashboard from the stationary equilibrium, as shown in Figure 10. This allows us to see how they deviate from it, recalling that any change inside certain bonds does not affect the allostatic balance of an individual and so their wellbeing, but if these are exceeded then there may be potentially negative consequences to personal welfare. Since there is as of yet no research informing what it should be, such a 'homeostatic' equilibrium is set up hypothetically as a 10% change in either direction of the dimensions. We see that the deviations in the Material Gain dimension and Social Cohesion are within the bounds for this calibration, which is logical for a small productivity shock. This implies that while the dimensions are varying from their optimal balance, we cannot say that welfare decreases. Lower wealth quartiles see the greatest rise in material gain owing to a lower reference point, and low income individuals generally benefit more in this dimension than their counterparts from less labour disutility. As in the static case, Social Cohesion depends entirely on the public good size, so all quartile deviations will match those of Q. Thus, the model provides a clear measure for the ramifications of the shock both on the economic and social determinants of wellbeing.

In the real world, one can imagine that the composition of the public good, as it is understood in this framework, will influence who enjoys it. For example, desires for conformity are less fulfilled when there are less similar people around. Likewise norms and traditions. Furthermore, socialisation occurs mainly at the workplace and around the home, which regroup people of similar characteristics. These are not very permeable spheres: low skilled people won't be working the same jobs as high skilled, nor will poor people be living in rich neighborhoods. Naturally, social attachments are formed more

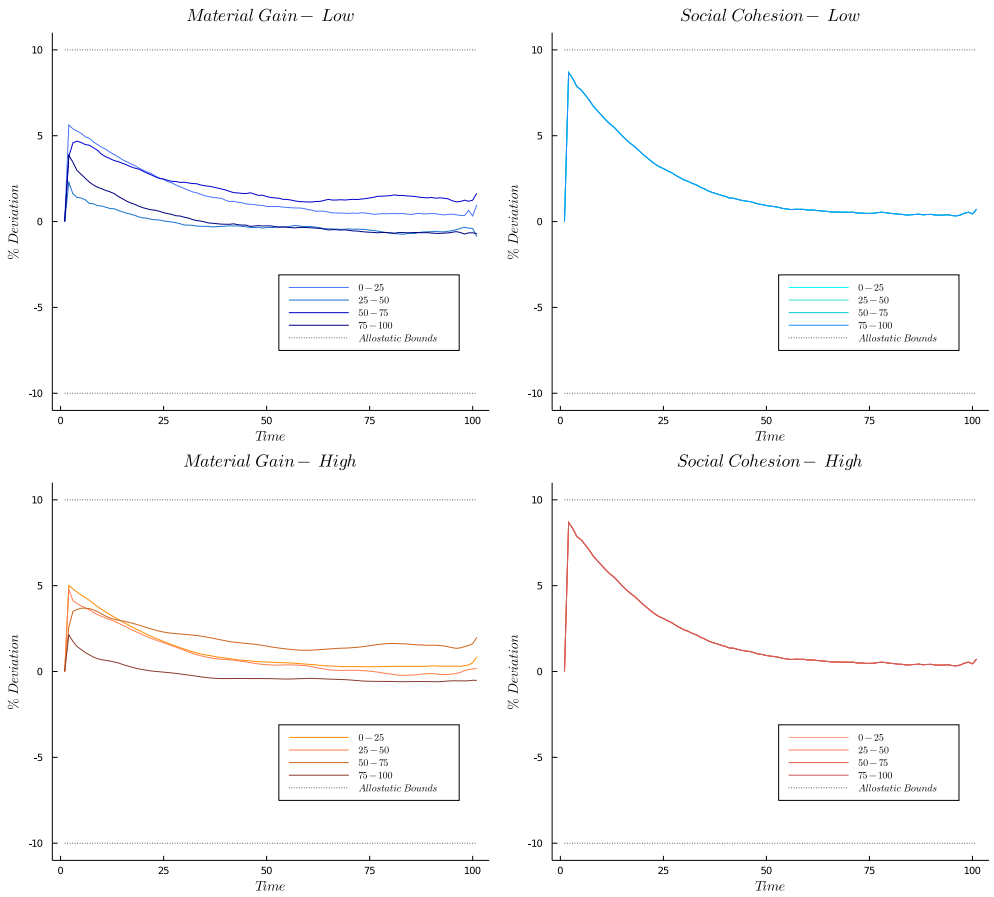


Figure 10: Public Good and Composition, Through Shock

strongly to those who surround and reflect us more. This is akin to Emile Durkheim's notion of organic solidarity, whereby social affiliation and belonging are rooted in difference with others, notably in labour. Given the large specialisation of society and interdependence of its parts, the premise is that this is the main form of social solidarity. So, for illustrative purposes let's suppose that the different states' benefit from Q change in lockstep with the composition of Q: as one state is more represented, the public good 'belongs' to them more and so their enjoyment of it increases proportionally. Benefits B_l and B_h are thus changed in the same way as the composition of the public good: for example, high income's contribution to Q increases by 15% at the height of the shock, so B_h is raised by the same percentage.[11] The consequence is displayed in Figure 11 for the utility of Social Cohesion, where the two alternate understandings of social solidarity are contrasted. Given the greater benefit from the second representation, Social Cohe-

[11] Both benefits are capped so that they are contained within [0,1].

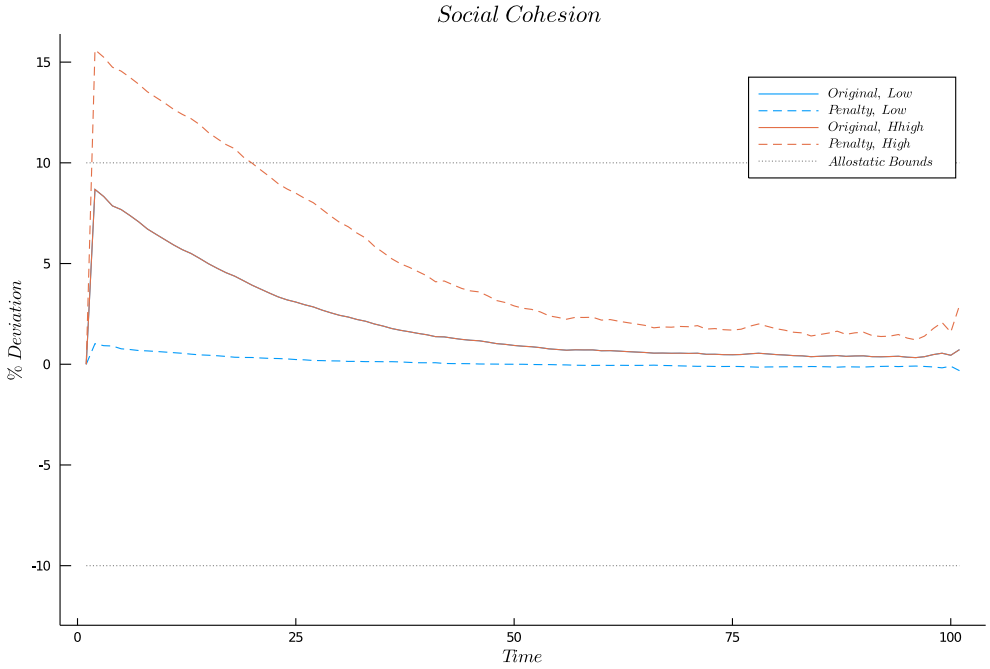


Figure 11: Social Cohesion, alternatives

sion for high income individuals increases more than in the original case to beyond the allostatic balance bounds. For low income people, the utility from social affiliation is now essentially null.

We can see what this means for welfare in Figure 12. For high income people both dimensions increase, markedly for Social Cohesion. For low income individuals there is a big divergence between Material Gain and Social Cohesion: the former improves while the latter does not change. In other words, with such a calibration and conceptualisation of affiliation, the shock increases the welfare derived from economic prosperity for both states but only improves the social belonging of high income people. Any definite judgement about the personal welfare consequences would depend on a thorough study of socio-psychological literature, yet the significant findings on materialism mentioned above point to the focusing on consumption more than other value-driven purposes to be detrimental to physical and emotional health, and this would be a starting point for further work. Nevertheless, we see that the adapted SAGE framework model is successful at simulating a decoupling between the personal welfare dimensions following a productivity shock.

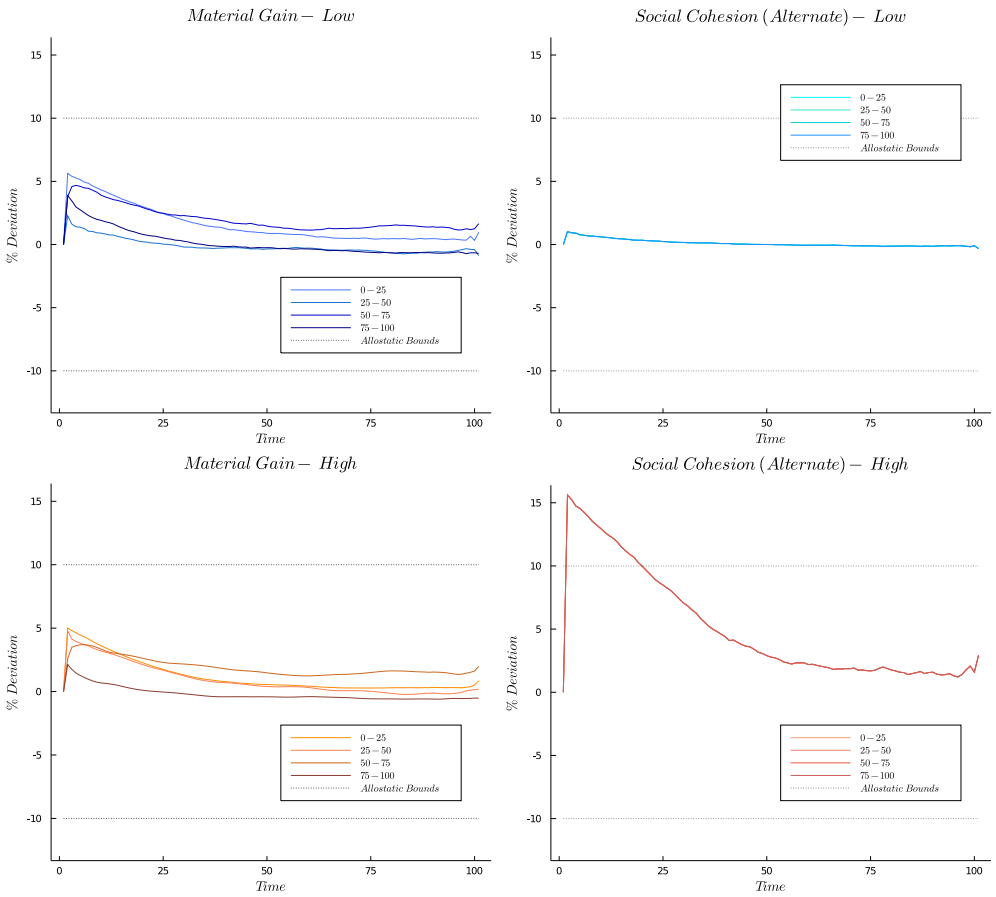


Figure 12: Public Good and Composition, Through Shock

7 Results

The welfare consequences of the productivity shock rest on the distinction between low and high productivity agents' income processes. By limiting the benefit of working, low income agents will be incentivised to consume just enough to meet their material needs, and then focus their energy to contribute to society. High income individuals on the other hand are more motivated to act upon their better capabilities, which they enjoy more, and so their social commitment is lesser. With the inclusion of wealth, we observe variation within the states as defined by the degree to which they can fund their consumption needs by starting wealth rather than labour effort. The distribution of agents is thus different: low income are more concentrated at lower wealth levels, particularly at the credit constraint, while high income individuals populate richer positions. All of these characteristics are logical, and the static optimal wellbeing dashboard which is made

from them reflects a gradual increase in wellbeing for richer people in terms of economic prosperity, which is greater for high income individuals, along with a greater enjoyment of the public good as due to a larger benefit parameter. This indicates that while low income individuals contribute more to society, what they get out of it is reduced here too. Overall, their wellbeing profile is smaller than that of high income individuals.

The productivity shock goes some ways towards improving the Material Gain condition of low income individuals, who see a greater proportional increase than their counterparts. In fact, wealth level does not detract them from raising their effort allocation, as a percentage deviation from their equilibrium optimal level. This results in greater consumption and savings, assuaging economic vulnerability. However, the trade-off is in the Social Cohesion dimension, as their state overall decreases the time spent contributing compared to an overall increase by their counterparts. This culminates in a public good whose composition is more represented by high income people. If one takes the assumption that the benefit from society depends on socialising with similar people, then for the given calibration this results in a negation of the increase in Social Cohesion for low income individuals, and an even greater increase for high income people. The consequence is a decoupling of economic prosperity and social cohesion, akin to the one described empirically by Lima de Miranda and Snower. Thus, this model is able to replicate a similar dynamic in a firmly economic foundation.

Overall, the results show that agency has an important consequence for wellbeing in its own right. The way it is included only serves to restrict consumption, yet its effects are more nuanced conceptually. As we see in the static results, the consumption of low income individuals is curtailed in favour of savings, a direct attempt to lower economic vulnerability in exchange for lowered consumption today. In fact, we see low income's poorest quartile increases their consumption proportionally the most during the shock, suggesting that their material needs are met the least. This occurs with them also saving the least, so the vulnerability they experience is significantly greater than any other quartile. Given the staggering statistic regarding poverty risk of OECD households, low empowerment is affecting a significant portion of its population beyond that around the credit constraint. To capture this emotional distress, the full breadth of agency's impact would be ascertained by the introduction of a third dimension of wellbeing concerned with empowerment. For example, following Lima de Miranda and Snower, we can consider that when an individual's income falls below a certain level, they experience economic hardship. This causes them to be unable to meet certain demands pertaining to the economic sphere today, to secure future prosperity, creating stress. Similarly, losing a job to global production-chain reshuffling, international competition or automatisation can leave people feeling powerless, especially when these are government-sanctioned. The economic hardship threshold, $\bar{y}_i$, can be depicted as such: if $y_i < \bar{y}_i$, then individual i is experiencing economic hardship and their agency is reduced. For a given probability p_i

of falling into hardship which depends on personal agency, labour effort and the distance from $\bar{y_i}$, the utility of agency can be:

$$U_i^a = \alpha(1 - p_i)$$

This would help reveal agency's psychological connection to individual wellbeing and potentially tie it to labour market repercussions as highlighted by the Behavioural Macroeconomics literature.

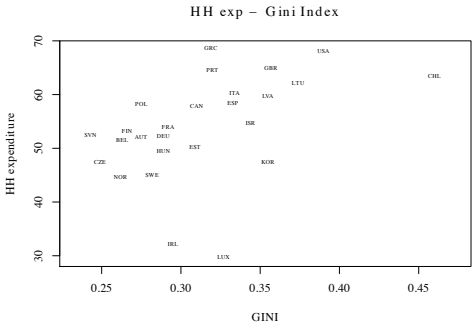
8 Conclusions

This paper introduces a new conception of wellbeing to analyse how different people's personal welfare changes during a productivity shock. The partial equilibrium model, while intended to lay the groundwork for a more comprehensive model, nonetheless does follow some key behaviors observed in the data, namely a difference in the economic and social dimensions' trends following a shock. The Value Function Iteration approach used for the computational solving is feasible but has instabilities that need to be understood. Cubic Spline interpolation of the value function inside the optimisation loop can be used to increase accuracy (but at the cost of speed). Future work would seek to improve the model's stability, further refine parameters against specific country data, and more comprehensively model populations (more income levels, deciles instead of quartiles, and enhancements of the utility function to match the multidimensional nature of wellbeing). An interesting development, once the addition of a utility derived from individual empowered is added, would be to examine the way in which preexisting agency determines future agency. For example, pursuing tertiary education today enables greater empowerment tomorrow and so the ability to make more empowered decisions, such as further studying which increases again agency. Another would be to affect the benefit from the public good by the inequality in who is contributing rather than simply by productivity, as the difference in wealth quartiles highlight people with significantly different consumption and labour effort choices. Finally, one could also examine social groups rather than individuals as the main agents in the economy. In the framework discussed above, agents are directly affecting others' wellbeing. As this interdependence increases, perhaps looking at group dynamics rather than on a singular scale would be revealing. This would allow to decline where individuals' solidarity is going (to similar nations or classes and not others) and also whether the agency harms selectively people outside one's group rather then their own. Snower and Lima de Miranda give monopolies as examples of this kind of inward agency. Ultimately, such a model can serve as a basis for analysing wellbeing dimensions in parallel to standard models, and thus provide accompanying policy proposals to ensure personal welfare.

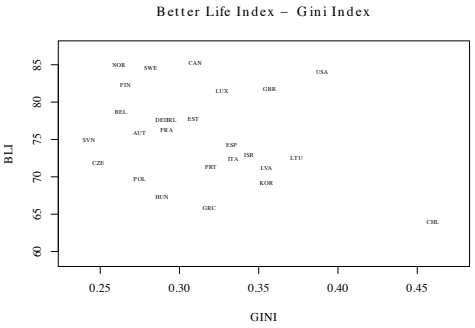
Appendix

A Further Cross-Sectional Analysis

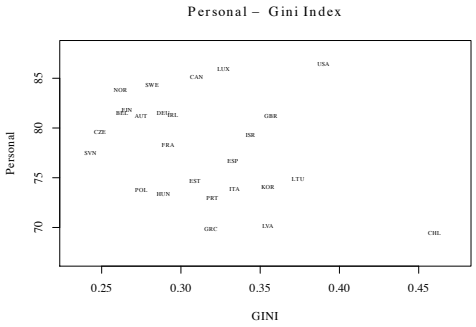
Figure 13: Wellbeing and Income Inequality, 2017



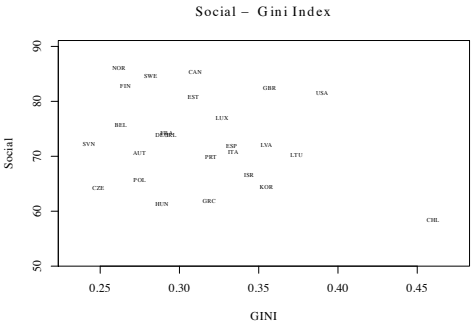
(a) Household Expenditure - Gini (income)



(b) Better Lives Index - Gini (income)



(c) Personal - Gini (income)



(d) Social - Gini (income)

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