The Living Standards Framework and Innovation

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Abstract

The paper argues that Treasury's Living Standards Framework needs to be developed further and put innovation and its well-being effects at its centre. The current relative neglect of innovation in the Framework is, to a certain extent, understandable, given the underlying theoretical model (the capital approach to development) and the lack of a welfare theory of innovation. It is argued that one must go beyond standard welfare analysis and use a model of the innovation - subjective well-being (SWB) nexus in order to assess the many, potentially very complex, well-being implications of innovation.

The paper first provides a brief overview of the Framework and comments on some conceptual and measurement issues associated with the capital approach. It then introduces a conceptual model of the innovation-SWB nexus and briefly discusses its building blocks (the major concepts and some of the linkages between them). This is followed by a discussion of some recent contributions that lend further support to the view that exploration of the nexus is an idea that is 'in the air'. The concluding section speculates about how such a wider perspective on innovation might get integrated into policy analysis. It also highlights the issue of potential resistance by policy-makers and analysts to any suggestion to do so.

Key words: Living Standards Framework, capital approach, innovation, subjective well-being.

1. Introduction

The New Zealand Treasury has developed and adopted a *Living Standards Framework* (henceforth 'the Framework') to be used as a complimentary input into the policy process. This is in response to criticisms of being too focussed on income (GDP) as the overriding policy goal, developments in economics and other social sciences, as well as developments in policy thinking by other New Zealand government agencies, overseas treasuries and organisations like the OECD. In short, the Framework is part of wider developments that reassess how to judge 'economic growth', 'progress' and 'well-being', and what impact this should have on policy-making.

The Framework, outlined in Gleisner et al. (2011), is meant to help Treasury to

> "… consistently provide Ministers robust, theoretically-grounded and evidence-based advice that aims to improve the lives of all New Zealanders…
>
> The Framework is underpinned by a range of theoretical approaches, including welfare-based economic theories, capability approaches, sustainable development and subjective wellbeing." (ibid., p 1).

Treasury (2012) and related background notes (Treasury, 2013b), as well as earlier related work by other agencies (Statistics New Zealand, 2008), make it clear that the sustainable development model underlying the Framework is firmly based on the capital approach to development, an approach also promoted by the World Bank (see World Bank, 2006, 2011). For example, Treasury (2013b, p. 1) states:

> "The sustainable development model seeks to integrate the four capitals– natural, economic (physical and financial), human and social by understanding the interrelationships and dependencies between them. The policy challenge is maintaining viable levels of all the capitals in a world looking for higher living standards."

Treasury should be congratulated for adopting such a wider perspective. I agree with much of it. However, it has its own limitations which reduce its usefulness. In particular, the Framework needs to put innovation and its well-being effects at its centre, the simple reason being that living standards are intrinsically linked to innovation. Without it, maintenance of (let alone increases in) livings standards are unlikely.

Many economists have commented on the pre-eminence of productivity growth for rising standards of living. Helpman (2004, p. 33), for example, states "there is convincing evidence that total factor productivity plays a major role in accounting for the observed cross-country variation in income per worker and patterns of economic growth". A major driver of productivity differences is innovation, in combination with the quality of institutions that support it (i.e. the innovation system in the wider sense). By not putting innovation at the centre of the Framework, the major engine that drives living standards is left out. The relative neglect of innovation is somewhat surprising, given that in many other contexts, Treasury, as

well as other government agencies, share the view that productivity is the driver of living standards (see, for example, Kidd, 2008, Procter, 2011).

An additional potentially powerful argument for putting innovation and innovation policy at the centre of the Framework at this point in time has been made by Perez (2013). She argues that the current world economic and financial crisis is not unique, but just the latest example of a crisis at the midpoint of the diffusion of a major new technology, in this case Information and Communication Technologies (ITCs). Since the beginning of the industrial revolution there have been four similar crises, all followed by a new 'golden age' of prosperity. If history is any guide, return to an active state that implements polices that unleash the vast innovation potential installed during the pre-crisis 'installation period' could lead us to a new golden age during the 'deployment period' of ICTs, one that, in this case, is "unavoidably global and necessarily sustainable" (ibid., p. 10).[1]

However, innovation is characterised by Schumpeterian *creative destruction*, a term that immediately suggests positive as well as negative impacts of innovation. Capitalism involves constant change. It is 'restless' because knowledge is restless (Metcalfe, 2001). Progress and equilibrium are incompatible. Such thinking seems absent from the Framework. By using a Framework mostly based on neoclassical economic theory, the real sources of 'progress', i.e. what drives capitalism, are noticeable mostly by their absence.

Therefore, the current relative neglect of innovation in the Framework is, at least to a certain extent, understandable, given the underlying theoretical model, and also because mainstream and various alternative schools of economics, as well as (inter-disciplinary) innovation studies, do not (yet) have a welfare theory of innovation.[2] Such a theory should consider, as much as possible, the many different impacts of the process of creative destruction, a task that Schumpeter himself abandoned. However, researchers have begun to address the normative dimensions of the many different impacts of innovation. So far, arguably the only major attempt using the neoclassical economics framework seems to be Baumol (2010).[3] Researchers that regard mainstream economics as too restrictive for this purpose and, instead, use broader approaches, include Swann (2009), Martin (2012), Hawkins and Davie (2012),

[1] Perez (2013) argues this would require many changes in policy, e.g. a redesign of the financial architecture, fiscal and monetary policy that supports the 'real' economy and investment, massive investment in education but also major reforms of education systems, promotion of R&D but also of grass root entrepreneurship etc. Environmental constraints, while undoubtedly the greatest challenge, might also be the greatest opportunity for massive green innovation and changes towards sustainable lifestyles that usher in a new golden age.

[2] This is only a slight exaggeration. For further elaboration of this point, see Engelbrecht (2012c).

[3] Baumol (2010) extends neoclassical welfare economics to capture the impacts of innovation ('innovative entrepreneurship') and emphasizes the enormous beneficial spillovers and other externalities from innovation that accrue to people not directly associated with innovation. This implies that, contrary to the standard view, zero spillovers are incompatible with optimality. Baumol also emphasizes the 'unavoidable trade-off' between increased innovation and the distribution of its benefits across society. In short, an improvement in the income distribution results in a greater disincentive to innovate (Baumol, 2010, p. 98). This trade-off implies that intertemporal welfare theory of innovation has to be substantially different from static welfare analysis (ibid.).

Engelbrecht (2012c), Dolan and Metcalfe (2012) and Schubert (2012a,b, 2013), among others.

It is time to explore the linkages between innovation and its many, potentially very complex, well-being implications in new ways. I argue that one must go beyond standard welfare analysis and use a model of the innovation – Subjective Well-Being (SWB) nexus. Such an approach seems opportune for a number of reasons. They include the increasing demand that innovation contribute to solving major societal challenges, the issue of mental well-being, major advances in SWB or 'happiness' research over the last few decades, the reporting of SWB data by national and international agencies and proposals to develop SWB accounts. Recent, diverse research seems to indicate that exploring the linkages between innovation and SWB is an idea that is 'in the air', i.e. an idea not yet fully developed, but currently worked on by an increasing number of researchers.

This does not imply that policy-makers should aim to maximise SWB. The issue is much too complex for that.[4] I simply argue that better and more comprehensive knowledge of the innovation-SWB nexus should be of interest to policy-makers concerned with living standards. I advocate measurement of SWB impacts of innovation as an additional aspect of policy assessment. This might lead to new insights which could, as the case may be, result either in strengthening or modifying already existing policy prescriptions, or in novel policies.

The paper is organized as follows. Section 2 briefly introduces the Framework. Section 3 discusses some issues associated with the capital approach that question its usefulness, or at least highlight the need for improvement. Section 4 first discusses in more detail the relative neglect of innovation in the Framework, and the role of SWB. Next, a slightly modified version of the conceptual model of the innovation-SWB nexus from Engelbrecht (2012c) is introduced. It undoubtedly needs to be modified and developed further. This would ideally happen in the context of implementation. Section 5 discusses some recent literature related to the normative turn in innovation studies to further support the claim that development of a 'wellbeing theory of innovation' is 'in the air'. Section 6 concludes with some suggestions about how one might integrate and apply a well-being analysis of innovation in policy analysis and argues that this does not make one a Neo-Luddite!

2. The New Zealand Living Standards Framework: A Brief Overview

Gleisner et al. (2011, p. 2) summarise the five elements recognised by the Framework as follows:

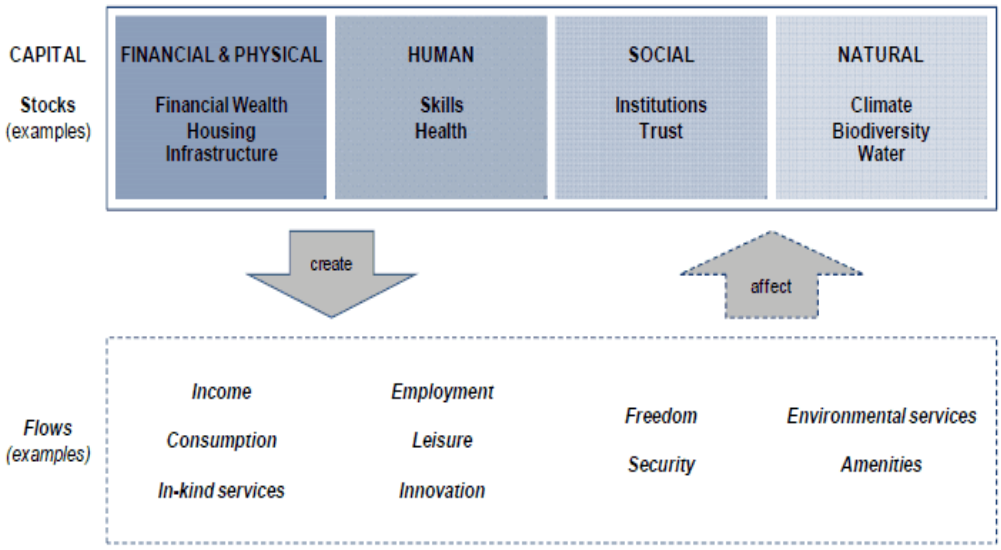
- "there is a broad range of **material and non-material determinants** of living standards (beyond income and GDP);

[4] There is a large literature on the issue of whether policies should, or should not, maximise happiness/SWB. Hirata (2011) provides a good overview of the debate.

- **freedoms, rights and capabilities** are important for living standards;
- the **distribution of living standards** across different groups in society is an ethical concern for the public, and a political one for governments. It also has efficiency implications, into which empirically-based economic analysis can provide useful insights;
- the **sustainability of living standards** over time is central to ensuring that improvements in living standards are permanent, with dynamic analysis of policy needed to weigh up short and long-term costs and benefits; and
- measuring living standards directly using self-assessed **subjective measures of wellbeing** provides a useful cross-check of what is important to individuals."

Moreover, Treasury has adopted a capital stock and flows approach as the basis for its Framework (ibid.). This is illustrated with the help of Figure 1. The annex to Gleisner et al. (2011) presents some stock and flow data for New Zealand and some other OECD countries. When using the Framework, Treasury intends to take into account information on levels, distribution and interaction of the capital stocks, as well as their changes over time.

Figure 1: Treasury's Living Standards Framework



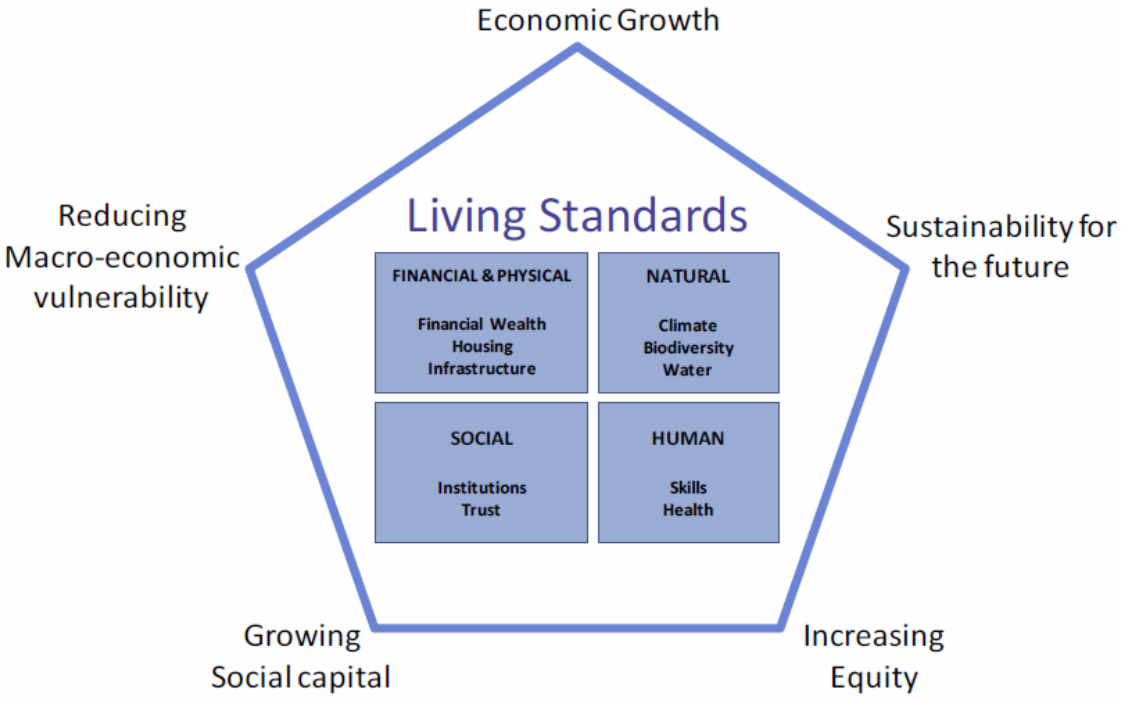
Source: Gleisner et al. (2011, Figure 1, p. 3).

The next step in Treasury's work on living standards is presented in a 2012 conference paper (Treasury, 2012). There, the case for, and details of, a 'practical' living standards tool designed to assist policy analysts in their day-to-day work is introduced. Figure 1 depicting

the Framework is slightly extended.[5] Importantly, five major focus areas for policy that Treasury believes are important for living standards, central to its own role, and amenable to policy, are identified. They are economic growth, reducing macro-economic vulnerability, growing social capital, increasing equity and sustainability for the future. The focus on these five was found necessary because the Framework itself is too complex for practical policy advice. They are acknowledged to be value judgements by Treasury about what are the important aspects of and drivers for improving New Zealand living standards, and they are to be regularly reviewed. Innovation, arguably the most important driver of living standards, is not explicitly included, despite the fact that basically all policies associated with the five key policy aspects affect innovation (and are affected by it), either directly or indirectly.

The policy tool is shown as a Pentagon (see Figure 2). Each corner is associated with one of the five main policy areas. The impacts of policy changes can be indicated on the axes and compared to the status quo, or it can be used to asses New Zealand's performance in terms of the five goals over time and/or across country (for examples, see Treasury, 2012).

Figure 2: Living Standards and the Five Key Policy Aspects



Source: New Zealand Treasury (2012, Figure 6, p. 11).

[5] SWB is now explicitly included (as a row across the bottom of the Figure), as is the distribution within the population and over time (added across the right-hand side of the figure). Otherwise Figure 1 is unchanged. Innovation is still only indicated as one of the flows associated with human capital.

Treasury has also produced draft analyst guides and some background notes or further readings for each of the five major policy focus areas of the Framework (Treasury, 2013a,b,c,d,e), some aspects of which will be discussed in Section 4.1. First, however, we discuss some unresolved issues associated with the capital approach to development.

3. Some Issues with the Capital Approach

The capital approach to development sees development as a process of building wealth by efficiently managing a portfolio of different capital stocks, in particular using natural resource rents to build up other forms of capital (World Bank, 2006). As mentioned in the Foreword to World Bank (2011), "development is, at heart, a process of building wealth – the produced, natural, human, and institutional capital which is the source of income and wellbeing" (Andersen and Canuto, 2011, p.xi).

The capital approach is undoubtedly a major contribution to the measurement of the comprehensive wealth of nations and sustainable development, using the neoclassical economics paradigm. However, the measurement of total wealth and its major sub-categories of natural capital, produced capital and intangible capital (the later includes human and institutional capital, among others) is a work-in-progress. Current estimates depend, by necessity, on numerous theoretical and empirical assumptions that can and have been questioned. Also, many important resources, like water and fishery, are left out of the accounts presented in World Bank (2006, 2011); others, like ecosystem services, are only partially included.[6]

I shall raise but a few of the conceptual and empirical issues associated with the capital approach (the stock and flow model underlying the Framework) that should be kept in mind. They arise more at the aggregate level of analysis used in World Bank (2006, 2011), where capital stocks are expressed in monetary terms. Never-the-less, they should alert policy-makers to potential issues that might arise in particular applications of the Framework.

3.1. How to calculate total wealth?

World Bank (2006, 2011) use total wealth per capita (TWpc) as a measure of social welfare[7] and focus on changes in the composition of wealth across countries and over time, and the role of natural capital in development (see Appendix Table 1 for the composition of wealth for Australia and New Zealand in 1995 and 2005). Total wealth is calculated as the present value of (sustainable) future consumption. Natural capital and produced capital are estimated

[6] I have discussed some of these issues elsewhere (see Engelbrecht, 2009, 2012a, 2013). For detailed accounts of major efforts to measure total wealth, see World Bank (2006, 2011) and Arrow et al. (2012).

[7] Strictly speaking, this is only correct if some restrictive assumptions are satisfied, e.g. constant returns to scale in production, constant population growth, per capita consumption being independent of population size (World Bank, 2006).

directly. Intangible capital is then obtained by subtracting the latter two from total wealth, i.e. it is a residual that captures all measurement errors and items that should have been included in natural and produced capital, in addition to what it is supposed to measure. In World Bank (2006) it also includes net foreign assets.[8] In World Bank (2011), they are excluded from intangible capital and listed separately.

When determining sustainable consumption to derive total wealth, the issue arises whether consumers could have spent their money more wisely. Frank (1999) emphasises negative effects on human well-being of conspicuous consumption and spending on goods we easily adapt to, and argues that more wealth would be good, if only we spend it in better ways! There is increasing evidence that alternative ways of consuming might lead to higher levels of human well-being (Welsch and Kühling, 2011, Dunn et al., 2011). This is not properly addressed in the World Bank's estimates. Moreover, the issue of capital gains, and asset bubbles in general, potentially affecting all forms of capital, needs to be explored further.

An alternative way to derive total wealth is to estimate all capital stocks separately and then add them up using shadow prices (Dasgupta, 2009, Arrow et al., 2012). This circumvents the need to have a good forecast of future consumption, which according to Arrow et al. (2012, p. 329) "amounts to assuming that we know how sustainable the economy is, when that is what we are trying to determine". However, implementing the alternative approach is currently impossible for most countries.[9]

Once wealth stocks have been estimated, the question arises how to interpret differences in growth rates of GDPpc and TWpc, and what that might imply for productivity measures. For example, if, as suggested in World Bank (2006, 2011), TWpc, and not GDPpc, is the more appropriate measure of social welfare, growth of the former is the important variable to focus on, not growth of GDPpc. Although highly correlated across countries, the growth rates can differ a lot for particular countries. However, this does not seem to have been the case in New Zealand over the period 1995-2005, with both growth rates being very similar (see Appendix Table 2). Arrow et al. (2012) find substantial differences in the two growth rates for the five countries they analyse.

3.2. Schooling and health human capital estimates

The major forms of capital subsumed under intangible capital are human capital, social capital and institutional capital. World Bank (2006, chapter 7) report that schooling-based human capital and institutional capital, the latter captured by an index of the rule of law, account for the majority of the variation in intangible capital across countries. Using data for three years, World Bank (2011, chapter 5) finds that health quality adjusted schooling-based

[8] Net foreign assets are total assets minus liabilities, i.e. the sum of foreign direct investment (FDI) assets, portfolio equity assets, debt assets, derivative assets and foreign exchange reserves, minus the sum of FDI liabilities, portfolio equity liabilities, debt liabilities and derivates liabilities (World Bank, 2011, p. 150).

[9] Arrow et al.'s (2012) introduce a number of innovations when estimating capital stocks, e.g. they allow for total factor productivity to differ between countries. They also include an additional form of capital, i.e. health capital.

human capital is the dominant form of intangible capital in rich countries, and the only statistically significant production factor in high-income OECD countries. World Bank (2011, Table 5.3, p. 100) reports Intangible Capital per capita (ICpc) and Human Capital per capita (HCpc) estimates for a select number of countries, including the G7 countries. For Canada and Japan, the reported values for HCpc are larger than those for ICpc (by 18% and 4%, respectively).[10] I am not sure these findings are reasonable. What can explain the estimates for Canada and Japan? Presumably social and institutional capital is not negative in either country. Instead, it might indicate problems with some of the assumptions made in deriving the estimates.

For a number of years, the OECD has been conducting a human capital project, the purpose of which is to provide numerical capital stock estimates that can be compared across countries and across time. They are derived from the lifetime income approach, i.e. they are more comprehensive than an educational proxy. Liu (2011) reports that for a sample of fourteen OECD countries, the estimates for human capital are substantially larger than those for physical capital. The ratio of human capital to GDP ranges from around eight to over ten. Liu explicitly points out the importance of developing a temporal volume index of human capital for measurement of sustainability in the capital approach to development.[11]

Hamilton and Liu (2013) go a step further. For thirteen mostly high-income countries, they adjust Liu's (2011) human capital estimates and explicitly combine them with the 2005 measures of total wealth reported in World Bank (2011). This enables them to subtract comparable human capital stocks from the intangible capital estimates. In short, they calculate the intangible capital residual, or the 'residual of the residual', given that intangible capital itself is measured as a residual. The new residual is interpreted as the stock equivalent of total factor productivity (TFP). They find a mean share of human capital in total wealth of 62%, which is four times the value of produced capital (and 15 times the value of natural capital).

It turns out that New Zealand's share of its 'residual of the residual' in total wealth is only 1%, compared to an average of 18% across countries.[12] This result is obtained for an annual real discount rate of 4.58 for natural and human capital, which is the uniform rate used for all countries. They also conduct a sensitivity analysis, using 4% and 5%, respectively. In that case, New Zealand's 'residual of the residual' makes up -5.5% and +5.2%, respectively (ibid., Annex III, Tables 4 and 5). Considering that the intangible capital estimates reported in World Bank (2011) also include items that should have been included in other types of

[10] For all of the poorer countries listed, the value of HCpc is far greater than ICpc (but country fixed effects have large negative values).

[11] Liu finds that although human capital stocks have increased over time, human capital per capita has declined in some countries (Israel, Korea, Norway and the US), due to population aging outweighing increases in education levels. It has remained broadly stable in Australia, Canada, France and New Zealand.

[12] Hamilton and Liu (2013) exclude Korea as an outlier when calculating the average share of the intangible capital residual across countries. It is the only country in the sample with a negative share for the residual. This is probably due to the human capital estimate being unreasonably high (it is by far the highest at 116.4% of total wealth), due to data issues.

capital, like fresh water and fish, one may wonder whether New Zealand's 'residual of the residual' is really close to zero. Can it be that New Zealand's stocks of social and institutional capital, and TFP, are so small?[13] Would a smaller negative stock of net foreign assets rally be associated with a smaller intangible capital residual, as simple mathematics would suggest?

Human capital also raises major issues in Arrow's et al. (2012) alternative approach to measuring wealth. They include both a schooling-based human capital variable as well as a health capital variable (which is also a type of human capital) and find that inclusion of health capital makes a huge difference. It turns out to be twice as large as all the other forms of capital combined, and its growth rate largely determines the growth rate of comprehensive capital. Arrow et al. (2012) acknowledge that there are major unresolved issues about how to measure and interpret health capital in the context of the capital approach and of the measurement of sustainable development that require much more research. Health capital seems to be the ultimate 'anthropocentric turn' in the measurement of total wealth. If, as seems to be the case, it dwarfs everything else, what does that really imply in terms of economic progress and living standards?[14]

3.3. Economic sustainability indices

Gleisner et al. (2011) correctly acknowledge that consideration of sustainability has led to new approaches to measuring living standards, in particular the capital approach to development. This approach seems to be the major pillar of the current Framework. For example, the guide on 'sustainability for the future' (Treasury 2013b) states that measurement of capital stocks, flows and sinks are used as key indicators of sustainability.[15] This, of course, presumes that they can be measured. While progress in measurement is being made in many areas, the issues raised in the previous two sections indicate that for monetary macro-level capital stock measures, this might be a rather optimistic assumption. However, in principle, changes in total wealth are an important indicator of whether development is economically sustainable or not. Problems arise when trying to implement these ideas and concepts in practice.

Measurement issues are further aggravated by conceptual diversity with regard to economic sustainability indices. For example, there are a number of sustainability indices associated with the capital approach. Engelbrecht (2013) compares five of them for OECD countries in 2005. They are: Adjusted net savings as percent of GNI (ANS); adjusted net savings per

[13] Hamilton and Liu (2013) cannot explain the intangible residual estimate for New Zealand. They comment that "There are no obvious explanations for this low share … New Zealand stands out … as having the highest share of human capital after Korea, in spite of a projected real income growth of only 0.77% ... The other notable feature for New Zealand is the large negative figure for net foreign assets, more than 5% of total wealth" (ibid., p. 13).

[14] Some of Arrow et al.'s (2012) results might be due to their use of schooling-based human capital instead of a more comprehensive human capital measure, as do Hamilton and Liu (2013). On this and other criticisms of Arrow et al.'s approach see, e.g., Hamilton (2012).

[15] It is also being implemented by Statistics New Zealand as one of its main approaches to measuring sustainable development. See Statistics New Zealand's website on sustainable development at: http://www.stats.govt.nz/sustainabledevelopment (accessed 2 May 2013).

capita (ANSpc); change in 'total wealth' as reported in World Bank (2011) (ΔPWp)[16]; change in total wealth calculated as the difference between total wealth reported in World Bank (2011) for 1995 and 2005 (ΔTWpc); change in Natural Capital per capita, 1995-2005 (ΔNCpc). The first two indices are widely used internationally. The third index, despite its name, only accounts for changes in some capital stocks. The fourth measure includes changes in all wealth subcategories. While the first four indices are used to provide an indication of economic sustainability, the fifth is closer related to the measurement of environmental sustainability (although it should be supplemented by physical measures of critical natural capital).

Engelbrecht (2013) finds that different indices derived from the capital approach provide different messages about economic sustainability, even for OECD countries. In particular, correlations between the conceptually preferred measure ΔTWpc and the commonly used ANSpc and ANS, as well as ΔPWpc, are quite low. Moreover, although ANSpc, ANS and ΔPWpc are highly correlated with each other, they produce conflicting messages for some countries. Another finding is the disconnect between ΔNCpc and the other indices derived from the capital approach. Appendix Table 3 reports values for the five sustainability indices for Australia and New Zealand.

4. The Innovation – Subjective Well-Being Nexus

In the capital approach, productivity is treated either as the 'residual of the residual', or it is added to the growth rate of total wealth, using exogenous estimates (as in Arrow et al., 2012). Innovation is not explicitly acknowledged and modelled.[17] That, of course, is one of my major criticisms of the approach. Furthermore, I argue that the many impacts of innovation on SWB should be assessed. Before introducing my conceptual model of the innovation - SWB nexus, I first highlight the few occasions where innovation and SWB are mentioned in the Framework documents.

4.1. Innovation and subjective well-being in the current Framework

Gleisner et al. (2011, p. 28) state that "Treasury's Framework is supplemented by insights from the subjective wellbeing literature… subjective measures of wellbeing have been used … primarily as a useful cross-check to ensure that the objective measures are the right ones". This mainly refers to an acknowledgement of the linkages between SWB and health,

[16] This measure includes only changes in tangible capital, i.e. it is only a measure of change in partial wealth (ΔPWp). This contradicts the concept of 'change in total wealth'. For example, Stiglitz et al. (2009, p, 29) clearly include intangible capital: "… wealth is an important indicator of the sustainability of actual consumption … To know what is happening in the economy, we need to ascertain changes in wealth. Changes in wealth entail gross investments (in physical, natural, human and social capital) minus depreciation and depletion in those same assets."

[17] World Bank (2006, 2011) have no entry for innovation in their indices. World Bank (2011) has one reference to technical progress, which is proxied by a time dummy. This is in the context of decomposing intangible capital (ibid., p. 99).

employment and social capital, as well as how people feel about distributional issues. This is further elaborated in subsequent publications.

Treasury (2012, Figure 5, p. 9) lists the key determinants of SWB as highlighted in the World Happiness Report (Helliwell et al., 2012). Although this report is meant to provide a summary of the state of the art of SWB research, a word search reveals that 'innovation' and 'invention' are not mentioned in the document. 'Technological progress' is mentioned once, in the introduction by Sachs (2012, p. 3):

> "… the world's economic superpower, the United States, has achieved striking economic and technological progress over the past half century without gains in the self-reported happiness of the citizenry. Instead, uncertainties and anxieties are high, social and economic inequalities have widened considerably, social trust is in decline, and confidence in government is at an all-time low. Perhaps for these reasons, life satisfaction has remained nearly constant during decades of rising Gross National Product (GNP) per capita."

While the issues highlighted in the quote are important, they are only part of a much larger innovation-SWB nexus, as will become clear in Section 4.2. There is only one hint in the rest of the World Happiness Report of some potential connection between innovation and the Framework, i.e. 'technology' is mentioned in the context of social inclusion. The latter is the suggested third pillar of the Sustainable Development Goals to be developed after the Rio+20 Conference:

> "The third pillar should be **social inclusion**, the commitment of every society that the benefits of technology, economic progress, and good governance should be accessible to everybody,… Happiness must not be the preserve of a dominant group. The goal should be happiness for all." (Sachs, 2012, p. 7)

In short, while some linkages between technology, equity and SWB are mentioned, they are not explored in much depth. The innovation-SWB nexus is largely neglected in the World Happiness Report. Therefore, it is not surprising that this is also the case in the current version of the Framework. However, some linkages that are important in our model of the nexus are already acknowledged, either directly or indirectly, in Treasury's publications explaining the Framework and its use. It is worth pointing them out in detail in order to ease the transition to the conceptual model introduced in Section 4.2.

The link between paid employment and SWB is explicitly mentioned in Gleisner (2011) and Treasury (2012c). Both potentially positive and negative effects are acknowledged. So are SWB effects of unpaid employment. Also directly acknowledged are linkages between SWB and some of the major functions provided by public institutions, such as rights, freedoms and security (Gleisner, 2011, p. 25). The link between natural capital and SWB is acknowledged indirectly, via the amenity value of natural capital (ibid., 26). Treasury (2012) hints at, or explicitly mentions, a number of linkages between elements of the Framework and SWB: The quality of the environment and mental well-being (p. 10); the controversy about economic

growth and SWB (p. 12); the strong correlation between social capital and SWB (p. 15); the finding that perceptions of unfairness reduce SWB (p. 16).

Turning to the acknowledgement of innovation in the Framework documents, Gleisner (2011, p. 23) devotes a whole paragraph to its importance as a major determinant of economic growth. This is in the context of discussing human capital. When it comes to the illustrative attempt to measure New Zealand's progress using Figure 2, innovation and innovation related indices again are not mentioned, and neither is SWB (see Treasury, 2012, Figure 8, p. 21). However, innovation is mentioned in the context of discussing beneficial effects of social capital (ibid., p. 15).

Treasury's (2013a) 'short guide to economic growth' does mention innovation, but only as one of many factors related to the Framework. It is not given a central role. This despite the fact that "New Zealand's average GDP per capita growth for the last six decades has been poorer than all other OECD countries" (ibid., p. 4). The 'short guide to sustainability for the future' (Treasury 2013b) does not discuss how capital stocks, flows and sinks are related to innovation. This seems increasingly inappropriate, given the emphasis on 'green innovation' and 'green growth'. Treasury's (2013c) 'short guide to increasing equity' again does not mention innovation, but it does mention 'technological progress' (on p. 16) in the context of summarizing international research findings that show that ICTs in particular affect different income groups differently. The 'short guide to social infrastructure' acknowledges that linkages between social infrastructure or social capital and economic growth are complex (Treasury, 2013d). The 'short guide to managing risks' (Treasury 2013e) is probably the most disappointing of all the guides. It should have been extended to cover not only risk but also (Knightian) uncertainty[18]. Although innovation is mentioned in association with human capital in Figure 1, a low level of innovation or a badly functioning innovation system are not identified as one of the risks.[19] It is no accident that both innovation and uncertainty are almost entirely absent from the Framework, as they are fundamentally related.

To summarise, although there are hints in the Framework documents about the importance of innovation for living standards, innovation does not seem well integrated into the Framework. If there is an 'elephant in the room' with regard to the Framework, it surely is innovation.

4.2. The conceptual model of the innovation - subjective well-being nexus[20]

Engelbrecht (2007, 2012b) laments the lack of mutual acknowledgement of the policy discourses about knowledge-based economies and about SWB, and then discusses their more

[18] See Knight (1921). While uncertainty is mentioned at least twice in Treasury (2013e), it is not highlighted or elaborated, i.e. it seems more like an afterthought and a nuisance one has to contend with in 'risk management'.

[19] Innovation is only mentioned once, and then with a negative connotation: "The amount of risk an organisation is prepared to accept, tolerate, or be exposed to at any point in time… allows for an appropriate balance between uncontrolled innovation and excessive caution." (Treasury, 2013e, p. 4).

[20] Much of this section is taken from Engelbrecht (2012c).

obvious interfaces represented by the nexus of education, work, innovation and SWB.[21] While of major importance, they are just part of a much more complex system that connects innovation and SWB. Prompted by the question 'does innovation cause SWB or does SWB cause innovation?', a first attempt at a conceptual presentation of such a complex model is presented in Engelbrecht (2012c). It builds on an earlier contribution by Swann (2009, chapter 19) that introduces a complex 'everything relates to everything else' model of innovation and wealth creation, where 'wealth' is broadly understood in a Ruskinian sense.[22]

I will briefly introduce a slightly modified version of the model in Engelbrecht (2012c). The systems thinking inherent in the model should not be alien to advocates of the Framework, as it also emphasises the crucial importance of interactions among its various components, and the accompanying trade-offs and/or synergies.

4.2.1. The model

The conceptual model is shown in Figure 3. It highlights a multitude of possible direct and indirect linkages between innovation and SWB, and other relevant concepts. An important feature of the proposed model is the inclusion of multiple SWB impacts of *processes* as well as of *outcomes*. The former are manifestations of what Frey et al. (2004) call procedural utility, i.e. the "noninstrumental pleasures and displeasures of processes" (ibid., p. 378). Procedures and institutions under which people live and work (hierarchies, labour laws) affect SWB. Procedural utility is neglected in orthodox economic welfare analysis that focuses on instrumental outcomes.

In this and the following section I briefly discuss the concepts and some of the possible linkages (see Engelbrecht, 2012c, for a more extensive discussion). Each concept can be proxied by a number of alternative and/or complementary variables. Selection of the particular concepts is a question of judgement and, therefore, contestable, just as in case of the elements highlighted in the Framework.

Invention, R&D, entrepreneurship, creativity and luck are all potential inputs into the innovation process. Depending on the specific application, one can argue about whether some of them should be split into separate concepts. *Innovation* is generically defined as putting an invention to first commercial use, but the model should be able to accommodate all types of innovation.

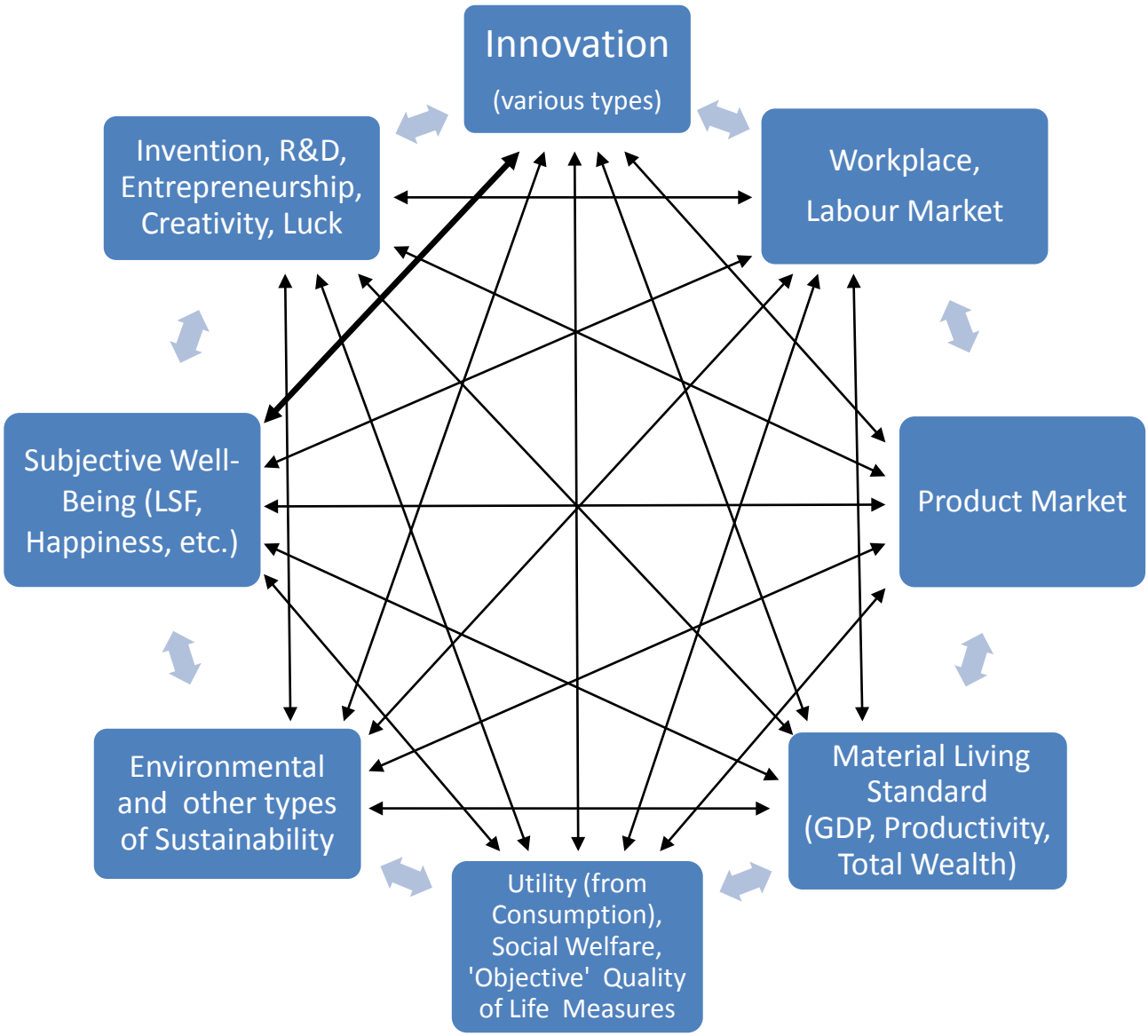
The *workplace and the labour market* are included because for many people the work domain is an important, if not central, part of their life and identity. It potentially receives, as well as generates, many of the SWB impacts associated with innovation. Work can create a lot of stress and illness in people's lives (OECD, 2011a). It is also known that a certain level of

[21] Similarly, Dolan and Metcalfe (2012) argue that innovation should improve people's lives, but that the link between innovation and SWB has rarely been made. They see a large gap in the literature with respect to the degree to which resources allocated to innovation improve SWB.

[22] Ruskinian wealth is named after John Ruskin, the British philosopher and art historian, who advocated a broad view of 'wealth' that seems closer to 'quality of life', both in an objective and subjective sense. I prefer to clearly distinguish between objective and subjective wealth.

stress can help people succeed in challenging tasks, creating 'flow' experiences (Csikszentmihalyi, 1990). Ng et al. (2009) suggest that research should explore how to maximise the benefits of stress without increasing its negative effects. Over the last decade or so, the intimate and diverse relationships between work and SWB have been the subject of many different strands of research.[23] The impact of unemployment on SWB is usually more straightforward, i.e. negative.

Figure 3: The Conceptual Model of the Innovation – SWB Nexus



[23] See, e.g., Helliwell and Huang (2011) and Dewe and Cooper (2012). Research on workplace SWB and productivity is also multifaceted and has a long history. For a survey, see Zelenski et al. (2008). They find that despite there being many inconsistent findings, overall there seems to be a positive relationship between the two.

Markets for goods and services (*Product Market*) are an essential part of the model, given the generic definition of innovation. Relationships between innovation and markets are complex. Different market structures influence innovation in different ways, and innovation also influences market structure, for example by affecting the degree of firm concentration.[24]

Material living standards are proxied by traditional economic performance measures, such as GDP and productivity, as well as alternative measures like TWpc and its major subcategories, which are at the centre of the Framework.

The concept of 'objective' wellbeing tries to capture all wellbeing and social welfare indicators other than SWB indicators and those specifically related to sustainability. It includes consumption-based *utility* and *social welfare*, i.e. mainstream economics welfare criteria, and also a multitude of *'objective' quality-of-life indicators* (for example, health, education, and social indicators, including measures of inequality) and wellbeing indicators collected by many government and non-government organisations (see, for example, Stiglitz et al., 2009; OECD, 2011b; New Economic Foundation, 2011; ONS, 2013).

Living in the Anthropocene, any conceptual model of the innovation-SWB nexus has to include as one of its concepts *sustainability* in its different forms (economic, environmental, social etc.). This is also one of the five factors selected by Treasury in its trail of the Framework as a policy tool.

The concept of SWB is diverse, capturing different aspects of people's subjective experiences.[25] It can be measured for 'life as a whole', for specific life domains (such as work, family life), for particular groups of people in society, for particular job facets (Warr, 2007). The different measures arguably convey different but complementary information about SWB of use to policy-makers. When implementing the model, due consideration needs to be given to the appropriate choice of the SWB measure(s).

The concepts and linkages depicted in Figure 3 are also affected by many additional factors. One should think of Figure 3 as being embedded within a box or frame that captures broad societal factors ('framework conditions'), such as institutions, values and culture, that influence innovation, SWB, the other concepts, and the linkages between them.[26] More specifically, in the context of the National (and other) Systems of Innovation, this includes, for example, the Intellectual Property Rights regime and opportunities and incentives for talented individuals. Income distribution effects could be traced through a number of linkages, but they will also be influenced by framework conditions, like the extent of the

[24] See, e.g., Swann (2009, chapter 18).

[25] I suggest using life satisfaction (LSF). It captures longer-term considerations of the 'good life' and its ethical dimensions. A detailed discussion of different SWB measures is beyond the scope of this paper. For further discussion see, e.g., Diener et al. (2009), Helliwell et al. (2012).

[26] See Helliwell (2012) on the importance of the social context for SWB, and the implications for the management of public and private institutions.

welfare state, support for retraining, etc.[27] In short, additional (national and/or international) factors impacting the concepts and linkages in Figure 3 might need to be added.

4.2.2. Some linkages

Figure 3 contains the old linear model of innovation as a special case, with causation going from invention, to innovation, to the workplace, resulting in new products or processes, enabling new, improved and/or cheaper products being sold in the market, thereby increasing material living standards and utility/welfare. Note that this assumes that invention precedes innovation and that innovation increases welfare/well-being only if it increases consumption.

Even in cases where this largely discredited model does apply, its wellbeing implications become less clear and more complex once procedural utility is admitted. It is easy to imagine that the net impact of innovation on SWB might be weakened or even become negative if procedural utility impacts counteract outcome utility. As noted earlier, conditions in the workplace directly impact on SWB. On the one hand, there could be negative impacts due hierarchies[28], stress etc. On the other hand, there could also be large positive SWB impacts. Phelps (2009) has argued that the distinctive merit of capitalism is not its power to create wealth, but its ability to create engaging and rewarding work due to its emphasis on innovation, thereby enabling self-actualization and self-discovery. Swann (2009) also strongly suspects that much creativity contributes to wealth creation through different channels than those emphasized in the linear model. He mentions direct linkages from creativity to the workplace: Companies might allow staff to spend half-a-day a week to pursue their own blue sky projects, which might, or might not, result in invention and/or innovation. However, if this increases SWB it is likely to raise work morale and productivity.

Some innovations bypass the workplace and create a direct link to the product market, i.e. those directly affecting the organisation of markets. Swann (2009) gives as examples the invention of the supermarket and e-business replacing smaller shops, increasing the need for travel by car and increasing the carbon footprint (thereby creating further linkages from the product market to SWB and environmental sustainability).

There could also be SWB impacts associated with the process of consumption, i.e. due to consumption externalities (more garbage, lower amenity values, depleted resources) and status effects (keeping up with the Joneses, the hedonic treadmill). Schwartz (2004) suggests that the process of purchasing final goods and services itself might reduce SWB if an abundance of choice produces anxiety. Swann (2009) points out that the market place can have SWB impacts other than those associated with consumption, for example people might derive pleasure from browsing.

It should also be acknowledged that not every innovation is acceptable to all consumers. For example, nuclear energy, genetically modified food, cloning, chlorination of drinking water

[27]Income inequality seems to have a complex relationship with SWB. However, much of the conflicting empirical evidence might be due to estimation issues (see Verme, 2011).

[28]Frey et al. (2004, p. 385/6) argue that "hierarchy constitutes a procedural disutility because it interferes with innate needs of self-determination".

etc. might reduce SWB for some, especially if consumers cannot circumvent adoption. In contrast, von Hippel's (1988, 2005) user innovation by intermediate or final consumers can create another set of linkages connecting creativity, invention, product market and consumption.

There are many other linkages which might be of importance when analysing the innovation-SWB nexus. Some of the more obvious ones are, in brief, as follows: (a) The impact of economic growth on sustainability. (b) The positive link from the environment (natural capital), due to its amenity value, to SWB. (c) The negative links from environmental pollution (even at levels well below current regulatory standards) to SWB, human capital formation, job performance and economic growth (Graff Zivin and Neidell, 2013). (d) Swann (2009) mentions that how and what we consume affects the environment in different ways (house insulation, recycling, extent of car use etc.). (e) Social capital is known to directly and positively affect SWB (Helliwell and Putnam, 2004; Helliwell and Wang, 2009). (f) There might also be a direct link going from social capital to innovation (Akçomak and ter Weel, 2009). (g) Swann (2009) mentions a number of linkages emanating from wealthy individuals: Creativity, invention and innovation might be supported by business angles or through philanthropy (for example large donations to universities). (h) There might be a connection between entrepreneurship and SWB. However, the literature reports conflicting findings on this issue.[29]

Figure 3 also highlights why the relationship between economic growth and average SWB in advanced economies, i.e. the Easterlin Paradox, is contested. [30] It is not clear a-priori what the net effect of all the linkages connecting the 'material standard of living' and SWB would be, even if the direct impact of the former on the latter were known to be positive. However, in any application of the model, some of the concepts and linkages shown in Figure 3 will be more important than others, requiring researchers to go from the general (everything is potentially connected) to the specific. Choices and compromises will have to be made, depending on the focus of the analysis and on data availability. Another important issue that can only be mentioned is the question of what time horizon to use when applying the model. In practice, this will depend on the innovation analysed and data availability. This will again dictate a pragmatic approach.

5. Innovation and Subjective Well-Being, an Idea that is 'in the Air'

In this section I discuss some recent contributions that lend further support to the view that exploration of the innovation-SWB nexus is an idea that is 'in the air'.

[29] See, e.g., Uhlaner and Thurik (2007) for findings derived from macro-level cross-country data, and Block and Koellinger (2009) and Carree and Verheul (2012) for findings obtained using micro-level data.

[30] For an introduction to the controversy about the Easterlin Paradox, see Clark et al. (2008) and Easterlin et al. (2010). If it is accepted that economic growth in developed economies is mostly due to productivity growth (which itself is mostly due to innovation), the literature on the Easterlin Paradox is highly relevant to the analysis of the innovation-SWB nexus.

Martin (2012), a well-known innovation researcher, reviews the main contributions of innovation studies since its inception approximately half a century ago and proposes 20 challenges for the coming decades (see Appendix Table 4). They are to jolt the reader "from taken-for-granted orthodoxies and cosy assumptions" (ibid., p.1). Many of the challenges are related to the concepts and linkages associated with the model of the innovation-SWB nexus. The most obvious ones are probably challenges 7 to 9:

- Challenge 7: *From risky innovation to socially responsible innovation.* Martin mentions risks and unintended consequences for the environment, less desirable working conditions, or other adverse effects on the quality of life.[31]
- Challenge 8: *From innovation for wealth creation to innovation for well-being.* In his discussion of this challenge, Martin refers to the Easterlin paradox and happiness, i.e. SWB. He suggests (Martin, 2012, p. 14) that: "Such a transformation in our concept of progress and in societal goals will require fundamentally new policies, and these, in turn, require the development of appropriate empirical methods, indicators, analytical approaches and conceptual frameworks. Work on such issues has been begun by a few, but the next generation of IS *[Innovation Studies]* scholars will need to build on these foundations if the shift to innovation for well-being is to be achieved."
- Challenge 9: *From 'winner take all' to 'fairness for all'?.* Martin (ibid., p. 15) "would argue that we do …. have a duty at least to explore whether we can say something about how corporations and others might generate innovations that, rather than turning a few individuals into billionaires, instead result in greater 'fairness for all'."

Others challenges that immediately relate to my model include challenge 1 (to account for so far largely invisible forms of innovation), challenge 5 (the shift to innovation for sustainability or 'green' innovation), and challenge 6 (the shift from innovation for economic growth to innovation for sustainable development).

Martin's tenth challenge is the development of an entrepreneurial role for the state, i.e. he sees government not just as a fixer of market failures, but as a strategist, lead investor and risk-taker during early stages of the development of a technology. This is similar to the main argument put forward by Atkinson and Ezell (2012) that Western governments need to develop coherent innovation policies (as distinct from 'industrial policy'). They further suggest the need for recognising and counter-acting the emergence of 'innovation mercantilism' (i.e. zero-sum, beggar-thy-neighbour innovation policy) wherever it arises.

Turning to procedural utility, empirical evidence of its importance has been accumulating. Frey and Stutzer (2005), who developed the concept, find that people gain procedural utility from political participation rights. Block and Koellinger's (2009) findings suggest that entrepreneurs who strongly value independence and creativity might extract procedural utility out of their entrepreneurial work itself, in addition to financial returns. Schneck (2012)

[31] Past research in this vein has been carried out under labels such as constructive technology assessment, the public understanding of science, the ethical, legal and social implications of research, the precautionary principle, and mechanisms such as consensus conferences and citizen juries, resulting in a call for 'responsible innovation' (for references, see Martin, 2012, p. 13).

provides cross-country evidence from 25 European countries that a large part of the differences in job satisfaction between paid employees and the self-employed can be explained by procedural utility associated with job autonomy and creativity.

Furthermore, evolutionary and Schumpeterian economists are trying to develop a normative theory of creative destruction, and some focus (at least partly) on SWB and procedural utility. For example, Binder (2013) argues that research on SWB has progressed to a stage where SWB measures can be used to assess the welfare effects of innovative change. Theories of SWB enable "a nuanced and comprehensive assessment of the effects that innovativeness has on a society" (ibid., p. 561).

In a number of papers, Schubert (2012a,b, 2013) argues for an evolutionary (Schumpeterian) theory of well-being that incorporates aspects of SWB and procedural utility, but goes beyond them. Schubert (2012a) proposes a well-being measure that focuses on 'effective preference learning', i.e. on a person's motivation and ability to learn new preferences in all domains of life. Innovation is worth promoting as long as it contributes to such preference learning. However, it is not made clear how preference learning can be measured empirically. Schubert (2012b) prefers the 'constitutional' approach to SWB politics that focuses on procedural sources of SWB arising from the design of the institutional framework of society over the 'hedonic maximisation approach', but argues it needs to be extended because the pursuit of happiness transcends procedural utility. More specifically, the constitutional approach should include anticipation of hedonically valuable outcomes, as well as preference learning. Arguably, this extended approach leads to very different policy implication. According to Schubert, it provides libertarian paternalism with a normative basis. There needs to be enough novelty (uncertainty) so that people can learn new preferences. However, the conflict between more uncertainty and its effect on SWB is not highlighted. Schubert (2013) tries to further strengthen his case for using effective preference learning as a well-being measure by taking guidance from the master himself. Like Schumpeter, he tries to distance himself from SWB measures. This dismissal seems too hasty, given the development of SWB research. It remains an open question whether his approach can be empirically implemented. Moreover, preference learning is not the same as welfare or well-being. It will have its own SWB impacts, which are part of the dynamic relationships of the innovation-SWB nexus.

While conceptual and other theoretical efforts to develop a well-being theory of innovation are continuing, empirical research that explicitly focuses on linkages between innovation and SWB is still rare, but it is also beginning to emerge. For example, Dolan et al. (2008) try to find out whether higher SWB is conducive to creativity and whether working in an innovative environment (proxied by work in the R&D sector) is conducive to higher SWB. They find positive correlation between SWB and creativity, and between SWB and work in the R&D sector. In a more recent study, Dolan and Metcalfe (2012), using a representative survey of the British population and new primary data, find a strong link between innovation (proxied alternatively by being original and having imagination) and SWB (in the workplace and in life generally). They point out that more research is needed to determine causation. Also, there is a need for new datasets to examine the innovation-SWB nexus. We could not agree

more. Commenting on the implications of their findings, Dolan and Metcalfe (2012, p. 1497) argue that:

> "In fact, these relationships have potentially important implications for productivity and economic growth. For instance, a 33% increase in life satisfaction is associated with 8% higher imagination. If this relationship from SWB to creativity is causal, then changing people's SWB could be a very effective way of increasing productivity and economic growth. In the aggregation of individuals, SWB could be a vital missing piece in the debates and research in innovation and economic growth."

The explanatory variables used in Dolan et al. (2008) and Dolan and Metcalfe (2012) mostly capture personal attributes, some of which can be mapped into the model of the innovation-SWB nexus, but many potentially important factors are not included. Further empirical studies are needed to build up our knowledge of the innovation-SWB nexus.

6. Concluding Comments

The purpose of this paper is to stimulate discussion of how to improve the Framework. My major concern is the relative neglect of innovation and its diverse well-being implications. Arguably, the latter can now be assessed not only in terms of 'objective' well-being measures, but also in terms of SWB. For that purpose, I have put forward a conceptual model of the innovation-SWB nexus. The model should either be incorporated into the Framework, or at least be used alongside it as an additional input into the policy development and evaluation process. It might be instructive to explore a particular policy using (a) the current Framework, and (b) the Framework in conjunction with the model of the innovation – SWB nexus, in order to determine whether this is likely to produce very different results. A pragmatic approach will be required when implementing the model. In each application, analysts should determine the most important variables and linkages, and also indicate what should but cannot be measured. Only the accumulation of case studies is likely to enable us to make progress in understanding the innovation – SWB nexus.

Currently many policy-makers and analysts seem to resist considering wider definitions of wealth and SWB in the context of innovation. Swann[32] mentions that policy makers seem to dislike his model of innovation and wealth creation. This might be due to the view that something only counts as innovation if it is producer-driven innovation sold in markets. However, efforts like the Framework would suggest that (at least some) policy-makers are moving beyond such a narrow view, which is basically the old view that the only progress that counts is measured by economic growth. Many policy-makers also still seem to hold the view that innovation is always and everywhere a good thing.

[32] Personal communication, 30 April 2013.

Undoubtedly, there is a great potential for misunderstanding. For example, Atkinson and Ezell (2012) give the impression that exploration of the innovation-SWB nexus is synonymous with being Neo-Luddite. Consider the following:

> "A wide array of groups and individuals ideologically oppose innovation. For example, neo-Luddites … view innovation not as a force for progress to be encouraged, but as something to be stopped. They want a world in which a worker never loses a job; consumer rights trump all else, even lower prices; no personal information is shared, even if sharing benefits society and enables a vibrant Internet ecosystem; the environment is protected whatever the costs; and cities are designed for residents who live in apartments and travel by transit to patronize small, local merchants. In short, they want a world in which risk is close to zero, losers from innovation are few, and change is glacial and managed." (Atkinson and Ezell, 2012, p. 279/280)

Such caricatures of anti-innovation views have to be taken seriously, not least because they indicate the strengths of arguments and views that seem to make it difficult to discuss any well-being analysis of innovation in a rational and considered manner.

In my view, exploration of the innovation-SWB nexus does not (necessarily) contradict the 'three key principles' of innovation economics as stated in Atkinson and Ezell (2012, p. 296/297), i.e. that (a) the central focus of economics should be on growth instead of business cycles and allocative efficiency, (b) that innovation drives growth and (c) that market processes need to be supplemented with strong public innovation policies. Arguably, incorporating instead of ignoring insights from SWB research should strengthen, rather then weaken, innovation policies and their impacts. Of course, getting innovation policy right is not easy. Atkinson and Ezell (p. 301/2) suggest it "depends on finding the right balance between three key sets of potentially competing factors: (1) individual versus collective interests, (2) current versus future generation interests, and (3) stability versus dynamism." A Framework that has the innovation-SWB nexus at its core should be helpful for exploring and improving the trade-offs.

To summarize, the presumption is not that the nexus needs to be explored because innovation is assumed to have negative impacts on SWB and therefore needs to be reduced in some way. Rather, it needs to have central place so that any negative SWB impacts can potentially be addressed by policy. This might help overcome powerful interests in society that might otherwise resist innovation. Arguing in favour of exploring the innovation-SWB nexus should not be interpreted as being Neo-Luddite, although entrenched 'innovation is always good' advocates might suggest so. It should simply be seen as a contribution to the development of better evidence-based policy in an age where SWB research has come of age, innovation studies are taken a normative turn, and innovation policy arguably has to re-assessed to counter innovation mercantilism (Atkinson and Ezell, 2012) and facilitate transition to a new 'golden age' in the face of major environmental constraints (Perez, 2013).

Appendix:

Appendix Table 1: Share of NCpc, PCpc and ICpc in TWpc, 1995 and 2005: Australia and New Zealand						
	Australia			New Zealand		
Year	NCpc (%)	PCpc (%)	ICpc (%)	NCpc (%)	PCpc (%)	ICpc (%)
1995	7.1	21.8	74.7	16.2	19.8	70.6
2005	7.7	21.5	74.5	12.8	18.4	73.9

Data sources: Wealth data are from World Bank (2011).
Notes: NCpc = Natural Capital per capita; PCpc = Produced Capital per capita; ITpc = Intangible Capital per capita.
Net foreign assets are not included in ICpc. Therefore, the capital shares shown do not add up to 100.

Appendix Table 2: Annual growth rates of GDP per capita and wealth per capita variables, Australia and New Zealand, 1995-2005					
Country	GDPpc	TWpc	NCpc	PCpc	ICpc
Australia	1.075	0.955	1.314	0.892	0.940
New Zealand	0.883	0.893	-0.120	0.570	1.095

Data sources: GDP per capita data are from the World Development Indicators database; wealth data are from World Bank (2011). Net foreign assets are not included in ICpc.
Notes: See appendix table 1; TWpc = Total Wealth per capita.
Source: Engelbrecht (2013, Appendix Table I, p. 25).

Appendix Table 3: Sustainability indices, Australia and New Zealand, 2005					
Country	ANSpc	ANS	ΔTWpc	ΔPWpc	ΔNCpc
Australia	2,217	2.9	102,411	655	10,438
New Zealand	496	8.4	76,975	-501	-1,490

Notes: ANSpc, ANS and ΔPWpc indicate annual changes (2004 to 2005). ΔTWpc and ΔNCpc indicate 10 year changes (1995 to 2005).
Source: Engelbrecht (2013, Appendix Table IV, p. 28)

Appendix Table 4: Ben Martin's 20 challenges for innovation studies

1	From visible innovation to 'dark innovation'
2	From innovation in manufacturing to innovation in services
3	From 'boy's toys' to 'women's liberation'
4	From national and regional to global systems of innovation
5	From innovation for economic productivity to innovation for sustainability ('green innovation')
6	From innovation for economic growth to innovation for sustainable development
7	From risky innovation to socially responsible innovation
8	From innovation for wealth creation to innovation for well-being (or from 'more is better' to 'enough is enough')
9	From 'winner take all' to 'fairness for all'?
10	From government as fixer of failures to the entrepreneurial state
11	From faith-based policy (and policy-based evidence) to evidence-based policy?
12	Balancing the intrinsic tensions between intellectual property and open source
13	Balancing the intrinsic tensions between exploration and exploitation
14	Balancing the intrinsic tensions between closed and open innovation
15	Balancing the intrinsic tensions between competition and cooperation
16	Pricking academic bubbles
17	Identifying the causes of the current economic crisis
18	Avoiding disciplinary sclerosis
19	Helping to generate a new paradigm for economics – from Ptolemaic economics to ???
20	Maintaining our research integrity, sense of morality and collegiality

Source: Martin (2012), Table 6, p. 29.

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