# As Innovativeness Drives Economic Growth, Does It Also Raise Well-Being?

**Martin Binder** [*)] **and Ulrich Witt** [§)]

[*)] *Bard College, Berlin*
[§)] *Max Planck Institute of Economics, Jena, Germany*
*Email* **witt@econ.mpg.de**
This version: February 2014

## Abstract

There is little doubt that large-scale innovativeness yields competitive advantages and drives economic growth. Fostering innovations on a whole-sale basis is therefore often unconditionally approved by innovation researchers and policy makers alike. However, the welfare effects of large-scale innovativeness are far from being clear. Apart from innovation-induced pecuniary and technological external effects, the assessment of the welfare effects faces the problem that innovations trigger preference changes. A consistent measuring rod for inter-temporal welfare comparisons is therefore difficult to construct. We discuss which welfare conceptions can be suggested to resolve the problem, what their limitations are, and finally what welfare effects they predict.

*Key words*: innovations, growth, welfare, well-being, preference change

JEL-classification: D63, I31, O00

## 1. Introduction

It is widely accepted now that large-scale innovativeness has been the true driver of technological progress, productivity increases and, ultimately, the growth of per capita income (Rosenberg and Birdzell, 1986; Dosi, 1988; Mokyr, 1990; Nelson, 1996; Aghion and Howitt, 1998; Metcalfe, 1998; Steinmueller, 2010). Since new knowledge flowing from innovativeness is often considered a public good that is not sufficiently privately provided (Gustafsson and Autio, 2011), innovation-fostering policies are currently high on the public agenda when it comes to suggesting growth-enhancing measures (Flanagan et al., 2011). However, the question of whether innovativeness not only enhances economic growth but also raises well-being (well-being understood as how well an individual or society fares, i.e. as a synonym for individual or societal welfare) is still an open question. In terms of what

variable(s) and on what scale(s) can welfare-enhancing effects, implicitly or explicitly presumed in much of the innovation policy literature, conceptually and empirically be documented? As we will argue in this paper, an assessment of the effects of innovativeness on well-being is beset with difficulties. If large-scale innovativeness indeed fosters economic growth, this can be argued to raise well-being *on average*. However, *individual* well-being – normally considered the relevant welfare measure – is not necessarily also improving, at least not within an agreeable time frame (Witt, 1996). As Schumpeter (1942, p. 84) already recognized, large-scale innovativeness results in a "perennial gale of creative destruction". This means that benefits and costs of innovations are quite unevenly distributed within the economy and over time. Obviously, successful innovations make many market participants better off. But they regularly also produce "losers" in terms of what is euphemistically described as "pecuniary externalities". For those affected by these consequences, a decline in well-being is – at least temporarily – inevitable, and a future compensation by the effects of economic growth does not always occur.

Moreover, by the very fact that innovative products, production processes, and resource uses are new, it is not possible to anticipate all their implications and consequences. They therefore not only induce pecuniary externalities. They can also turn out to cause negative *technological* externalities, e.g., in the form of more or less severe damages to health or the environment with negative welfare effects. Indeed, examples of how innovations "bite back" are surprisingly frequent (see, e.g., Tenner, 1996).

Another major difficulty for assessing the effects of innovativeness on well-being arises from the fact that the measuring rod for well-being may itself be changing under the experience of innovations (Elster, 1983). Under the standard welfare economic view, individual well-being is represented by an individual's given and unchanging preferences. When preferences are invariable, states at different points in time can be compared with respect to the individual's preference satisfaction in those states. However, by their very nature, innovations offer new, hitherto unknown opportunities on which preferences first need to be formed. This is quite obvious in the case of many radically new products for which consumers must first learn to appreciate them. In adapting one's preferences it is very likely, however, that the preferences on all other action possibilities are also affected. As a consequence, innovations tend to make preferences that prevailed at an earlier point in time unsuitable as measuring rod for changes in individual well-being over time. Is there an alternative measuring rod for welfare, one that is able to cope with time inconsistencies of preferences (see Binder, 2010, McQuillin and Sugden, 2012)?

The present paper is devoted to discussing the two mentioned complications in more detail and to draw some conclusions with respect to the question in the title. Given that the complications are very different in nature, it is useful to analyze each of them in isolation. This means that we will discuss the first complication – the ambivalence of

innovativeness with respect to individual well-being arising from pecuniary and technological externalities – within the standard welfare economic framework. To keep track of the externalities and their consequences and to assess their inherent normative relevance is much easier if, for the sake of the argument, individual preferences are taken to be invariable while the externalities unfold. Similarly, when turning to the second complication – the difficulties of assessing changes of well-being over time when, as a result of innovations, preferences change in the course of time – we will abstract from the externality problems.

Thus, in Section 2 we start by highlighting the role of pecuniary and technological externalities caused by large-scale innovativeness. Even in the absence of preference change there is not much consensus in the literature on what the desirable features of a welfare measure are (McQuillin and Sugden, 2012). Difficulties increase by orders of magnitude once preference change is taken into account. For this reason, dealing with the second complication means, before all, to take stock on the major concepts of well-being that could, in principle, be used. We first review in Section 3 what are called "objective list" notions of well-being which basically postulate a welfare measure that is independent of, though not necessarily in discord with, individual subjective evaluations of well-being. In Section 4 we discuss recent pleas for taking the individuals' opportunity set and its change over time as a welfare measure. Section 5 reports on hedonistic notions of well-being and their plausibility. As a measure of well-being that can cope with innovation-induced preference change, we conclude, none of the reviewed concepts is fully satisfactory in all respects. In Section 6 we argue that a – perhaps somewhat disillusioning – answer to the question in the heading can nonetheless be given, if one starts from the empirically observed role that hedonic adaptation and preference learning play in the presence of innovations. Section 7 offers some tentative conclusions.

## 2. Whose Welfare Will Be Raised by Innovations?

What do we understand by "welfare"? As can be seen from the etymological roots of the term, the notion refers to – broadly speaking – how well an individual or society fares. Hence, it implies an assessment of well-being or the quality of life individuals have, and about how good certain states or developments are with respect to a certain measuring rod. Ultimately, the soundness of any theory of welfare hinges on its definition of the nature of welfare and the measuring rod that it suggests for assessing well-being. In order to categorize the different theories of welfare it is therefore useful to focus on what they conceptually mean by "welfare" on the one hand and on what they suggest as an empirical measure on the other hand. We follow a taxonomy that has been suggested by Parfit (1984,

pp. 493-503), dividing theories of welfare into mental state accounts (hedonistic theories), preference satisfaction theories, and objective list theories.[1]

In the standard economic framework, the preference satisfaction view is the predominant theory of welfare. It is intimately linked to increases in income: assuming invariable preferences, increased income is ordinally equivalent to increased satisfaction of preferences, i.e. higher utility, under certain technical assumptions (see, e.g., Slesnick, 2001). Since technical progress and innovations have been identified as main drivers of the per-capita income increases of the past, it seems straight forward to extend the argument to imply that it is ultimately innovativeness that induces increased satisfaction of preferences and thus raises welfare.

In a similar vein (though not explicitly referring to welfare-theory), Schumpeter (1942, p. 84) had pointed to the "standard of living of the masses" which the incessant innovative transformation of capitalism had raised to historically unprecedented levels (see also Metcalfe, 1998). Innovations raise productivity which, in turn, results in higher per-capita income and eventually an on average greater ability to pay for whatever one chooses to consume. Subscribing to such a causal relationship between innovativeness and rising welfare or, for that matter, standard of living, the quest for policy measures that support and help to foster innovativeness seems only logical.

However, as already mentioned in the introduction, on a closer look, the logic is less compelling than it appears. Apart from the fact that the inference from rising income to rising welfare is by no means unproblematic,[2] the effect of innovations on well-being in the economy is ambiguous. The increases in per-capita income that have been observed in the past as a result of large-scale innovativeness did increase the average ability to satisfy one's preferences. Yet this fact not withstanding many agents – in extreme cases the majority – may not have benefitted or may even have suffered losses in income and welfare at least in the short or medium run. The reason is that innovations in production techniques, products, or services selectively improve the competitive position of single firms or single industries and induce substitution processes at the expense of other firms or industries competing for the same customers' spending. As a consequence of such "pecuniary externalities", specific investments made before an innovation was known may be devalued or even lost. Capital owners may face losses of expected returns. Labor may face being laid

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[1] Preference satisfaction accounts are sometimes also called desire theories, which is a somewhat more general term. Desires are directed at one object of desire, while a preference in the economic context is always a binary relation, where one of two objects is preferred over the other object. We abstract from this distinction and focus on preference satisfaction views in the following.

[2] For example, higher income can fail to increase welfare when well-being heavily depends on relative consumption, i.e. on positional concerns (Frank, 1999). Or individuals may simply lack information about how to make a welfare-enhancing use of additional income (Qizilbash, 2006). The problems are even larger if the motivational and the experiential side of utility are distinguished (see Witt and Binder (2013).

off and forego expected returns on human capital investments when forced to accept employment elsewhere.

It is true that under competitive conditions, the gains from an innovation are usually larger for the economy as a whole than what the competitors lose from pecuniary externality. (This is the very reason for why innovativeness *does* result in growth of per capita income.) However, innovations also change the personal distribution of income in the economy, and thus the distribution of welfare gains and losses, in an unforeseeable way. Moreover, it is uncertain whether those who suffer the losses in the short and medium run will in the long term be (more than) compensated by the overall increase of income. Schumpeter's claim that capitalism raises the standard of living of the masses seems to suggest such a long term compensation. Yet, it cannot be excluded that also in the longer term some agents will miss out on any welfare gains. Nor can we be sure that the overall compensation through innovation-driven per capita income growth that could be observed in the past can also be expected to materialize in the future.

In the case of *pecuniary* externalities of innovations there is thus a major contingency logically preventing the conclusion that more innovativeness and per-capita income necessarily mean greater welfare: the unknown changes of the personal income distribution. In the case of negative *technological* externalities that cannot be excluded *ex ante* to emerge from innovations the situation is even more uncertain. The social costs can then by far exceed the sum of the private gains of the agents who benefit from an innovation. Moreover, these excessive costs often only turn out with a considerable time delay (see, e.g., Tenner, 1996, on many examples how innovations "bite back" and have completely unintended negative consequences hard to cope with). In terms of Coase's (1960) classical formulation of the problem of social costs, the inevitable risk of yet unknown negative technological externalities of innovations means that there are inherent, irreducible transaction costs. They exclude the possibility of *ex ante* negotiations as a way of efficiently internalizing the social costs either by the innovator who may cause the externality or those who would be affected. As a consequence, the big unknown is in this case not only the resulting personal income distribution, but also the possible direct utility or welfare losses due to damages from external effect.

## 3. Circumventing the Problem of Endogenous Preferences by Objective Lists Concepts of Well-Being

For expository convenience, the welfare effects of pecuniary and negative technological externalities of innovations have so far been discussed under the assumption that individual preferences do not change over time. However, in the light of how humans learn to adapt to new action possibilities this is a counterfactual assumption. The "discovery and application of better ways of doing things to satisfy our wants" (Boulding, 1958, p. 23)

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usually does not leave our wants unaffected. Indeed, in the case of new products and services with previously unknown features it is usually even necessary to first develop a preference for their properties before the innovation is fully appreciated. The theoretical difficulty that results from the malleability of individual preferences for preference satisfaction as the traditional welfare economic measuring rod is obvious. To cite Nelson and Winter (1982, p. 369), we face here "a central welfare economic problem that needs to be addressed – a problem that is absent from a static world but strikingly present when information is incomplete ... and when tastes and values are constantly being reformed." The problem is that preferences tend to become endogenous to the process of innovative change in the economy. Put differently, the preferences by which individual well-being is assessed are shaped through the very processes whose welfare effect they are supposed to evaluate. As a consequence, the way in which the individual subjectively experience satisfaction of their preferences may no longer reflect the individuals' objective situation.

A radical solution to the problems arising from the fact that preferences are endogenous to the process of innovative change is to disconnect the notion of well-being from the individuals' subjective valuations. Well-being could instead be assessed according to a list of "objective" constituents that may contain several elements. A prominent example for such an extended objective list conception is the capability and functionings approach developed by Amartya Sen (1985a, b). A major motivation for his approach is the contention that the informational basis of utilitarianism is too narrow. To overcome that limitation, Sen suggests to draw on empirical facts about human behavior and to evaluate well-being on the basis of further criteria and ethical considerations.

Sen's approach is thus decidedly normative (a more exhaustive discussion of the approach is given in Binder, 2010, p. 63-69). It departs from the utility concept *in toto* and replaces it with a dual conception of "functionings" and "capabilities to function". Living is seen as consisting of a set of functionings, Sen argues, that can be seen as aspects of life; what a person does and is. These functionings include "being nourished", "avoiding premature mortality" (Sen, 1992, p. 39) or "being in good health", "being well-sheltered", "being educated" or being able to "move about freely" (Kuklys, 2005, p. 10). In Sen's view, such functionings have intrinsic value and cannot be reduced to other, more basic values. The list of values is seen as open-ended and supposed to contain "the plurality of our concerns" (Sen, 1992, p.70). Accordingly, for the assessment of a person's well-being, Sen proposes to measure the extent to which certain functionings can be satisfied.

The well-being of an individual *i* can then be characterized by the states and activities which a vector $\mathbf{b_i}$ of functionings represents (see Sen, 1985b and Kuklys, 2005 for the following). $\mathbf{b_i}$ is assumed to be a function

$$\mathbf{b_i} = f_i(c(\mathbf{x_i})|\mathbf{z_i}, \mathbf{z_e}, \mathbf{z_s}), \tag{1}$$

of the commodity vector $\mathbf{x}_i \in X$ that is feasible for individual $i$. (The commodity space $X$ includes non-market goods and services.) $\mathbf{x}_i$ is mapped into the space of characteristics (Lancaster, 1966) via the conversion function $c()$ so that $\mathbf{c} = c(\mathbf{x}_i)$ denotes a characteristics vector of a given commodity vector $\mathbf{x}_i$. Sen assumes that the characteristics of a commodity are the same for all individuals. But not every individual can benefit equally from the characteristics. For example, having a disease or disability might entail that one can benefit less from the same set of characteristics than someone healthy (Sen, 1985a, p. 9). This difference is reflected by the conversion function of an individual $f_i$ that maps a vector of characteristics into the space of functionings. The conversion depends on factors that represent individual ($\mathbf{z}_i$), social ($\mathbf{z}_s$) and environmental ($\mathbf{z}_e$) influences.[3] These conversion factors can be seen as non-monetary constraints so that the functionings an individual can achieve are not only determined by the vector of commodities that are feasible for that individual but also by some non-monetary constraints.

The union of all functioning vectors that are feasible to an individual $i$ is called the capability set $Q_i$. It represents the individual's substantive *opportunities* to achieve well-being and is usually considered more important for assessing well-being than the vector of functionings actually chosen by an individual on the basis of her possibly idiosyncratic preferences. But it is not altogether clear how to evaluate one's capability set. In order to evaluate $Q_i$ one can postulate a valuation function $v = v()$ that assigns a numerical value to each $\mathbf{b}_i \in Q_i$. A possbility would be to evaluate a vector according to the best element. Sen calls such a rule "elementary evaluation". The rationale behind it is that a wider choice set is only valued because there is a higher chance of choosing a better element (Sen, 1985a, p. 61). The value of the set is thus the value of the best element of the set (a different possibility would be to evaluate the capability set according to the number of elements in the set, a "cardinality valuation", Sen, ibid.).

The fact that the capability approach assesses well-being in terms of opportunities rather than outcomes makes it radically different from traditional welfare economics.[4] It may be asked, however, whether the items on the list are all weighted equally by everyone and, if this is not the case, how different weights attached to the functionings in the set – probably chosen differently by different individuals – are to be justified. Sen (1993, pp. 46-9) evades the question by claiming that his notion does not need to say much about those weights because, as he puts it, well-being is a "broad and partly opaque concept". Related to this question is the objection that any attempt to construct an objective list runs the risk of

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[3] See Kuklys (2005, p. 11). Individual factors could be gender, intelligence, or the mentioned physical (dis)abilities, etc. Social influences could comprise for example legal regulations. An example for an environmental factor would be climate or the level of pollution of one's surroundings.
[4] However, in the empirical works of the proponents of this approach difficulties in measuring capabilities often lead to measuring outcomes instead, namely the extent to which functionings have been achieved.

issuing paternalistic claims (Sugden, 2006, p. 50). It is conceivable that a (partial) list of functionings that is chosen as an allegedly objective reflection of individual well-being differs from what the affected individuals actually value or experience as rewarding.[5]

In view of these problems it seems highly implausible that a list of relevant functionings that we might be able to agree on today would also have found equal consensus in the past, or will do so in the future. The allegedly "objective" list of intrinsically valued functionings is especially likely to change under the influence of further innovations (as it did in the past), unless this list is reduced to a few basic needs corresponding to unchanging human nature. However, the capability approach offers no clear answer in this respect (Binder and Witt, 2012). If innovativeness sufficiently alters an economy over time, different functionings might become valued or existing functionings might lose relevance. But an allegedly objective list of relevant functionings that is variable over time is prone to take a "subjective turn" (Sumner, 1996, p. 66) when being forced to answer the question whose preferences determine what functionings should be on the list at what time?

## 4. The Opportunity Set as a Measure of Well-Being?

If the process of innovative change in the economy is to be evaluated in terms of changes of individual well-being, then it would be desirable to have a measuring rod for well-being that is not itself influenced by that process of change. As discussed in the previous section, the arbitrariness inherent in determining what items should be on the list of capabilities and functionings and for what reasons proved to be an obstacle for accepting Sen's "objective" list approach as a solution to the problem. In reaction to that arbitrariness, some economists have proposed to avoid detailing a list and to measure changes in individual well-being in a global, undifferentiated form instead by changes in the set of opportunities an individual is able to command. Increases in individual opportunities and liberties then appear as welfare improvements (Hayek, 1960; North, 1999; Sartorius, 2003). In terms of Parfit's (1984) taxonomy of theories of welfare, an opportunity view of welfare would have to be classified as a (degenerate) objective list concept with "opportunities" as the only item that makes it onto the list. An opportunity set is, of course, a very special item, namely a placeholder for a plethora of possible individual choices.

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[5] Sugden (1993) and Nussbaum, (2003) ask who decides on what functionings are to be included in the list. Even if, as Sen (1993, pp. 31-2; 46-9) stresses, it is a question of the concrete purpose of the examination of which functionings are to be included, the question remains who decides on this. Nussbaum (2003, pp. 41-2) tries to derive a list from Aristotle's concept of a commonly shared eudaemonia ("human flourishing"). Yet, this is a notion from Aristotelian ethics which, as a normative claim, is not "objective" in the sense of necessarily being universally shared.

One recent version of the opportunity set approach has been defended by Robert Sugden (2004). Sugden's core intuition is to specify the notion of consumer sovereignty for an exchange economy without the assumption of coherent individual preferences – "an apparently simple normative intuition: it is good that each person is free to get what she wants" (Sugden, 2004, p. 1016). He claims that the size of an individual's opportunity set is a better object of inquiry than a distorted notion of preference satisfaction.[6] From his perspective, any increase in the lifetime opportunities of an individual is intrinsically good (without any assessment of the opportunity that is added). The idea that the size of the individual opportunity set as such is a fundamental value – the bigger, the better – is thus given normative status. But freedom of choice implies responsibility for one's choices, a claim that is essential for establishing Sugden's "opportunity criterion".

Consider an individual *i*. Assume that there exist $m > 1$ commodities in the economy and that *i* holds a bundle $\mathbf{x} = \{x_{i1}, ..., x_{im}\}$ of them. Let $\mathbf{e}_i$ be the initial endowment of *i*. The opportunities of that individual are then defined as *i*'s possibilities of trading the initial endowment for another bundle of commodities. More specifically, denote the opportunity set by $O_i \in \mathbb{R}_+^m$. It is then defined in such a way that $\mathbf{e}_i \in O_i$ and for all $\mathbf{x}_i \in O_i$ there exists a series of trades by which *i* can expect to get from $\mathbf{e}_i$ to $\mathbf{x}_i$. Furthermore, *i* is assumed to know the opportunity set. From the point of view of a social planner, Sugden argues, there exists a non-empty set of feasible commodity bundles $X_i$. It specifies the initial endowments in terms of resources that the planner is able to give to *i*. The elements in the set of different commodity bundles reflect exogenous limitations on resource allocations which the planner faces. The individual cannot choose a bundle outside $X_i$ due to restrictions which are not specified, but *i* can choose any $\mathbf{x}_i \in X_i$ as initial endowment. Hence, $X_i \subseteq O_i$. Now assume that after being given an initial endowment $\mathbf{e}_i$, *i* gets to $\mathbf{x}_i^* \in O_i$ through trade. The "opportunity criterion" is satisfied if for any other bundle $\mathbf{x}_i \neq \mathbf{x}_i^*$ either $\mathbf{x}_i \notin X_i$ (meaning that $\mathbf{x}_i$ is not feasible) or $\mathbf{x}_i \in O_i$ (meaning that $\mathbf{x}_i$ belongs to the opportunity set). So, if the individual complains to the planner because she has not obtained bundle $\mathbf{x}_i' \neq \mathbf{x}_i^*$, the opportunity criterion tells us: if $\mathbf{x}_i'$ does not belong to the feasible set, it is outside the planner's possibilities to make the bundlilable to *i*. If, on the other hand $\mathbf{x}_i'$ is in the feasible set and in the opportunity set of *i*, then it was the responsibility of *i* that has led her to have $\mathbf{x}_i^*$ and not $\mathbf{x}_i'$. *i* cannot blame anyone else for not having attained $\mathbf{x}_i'$.

The rationale of the Sugden's opportunity criterion is to separate the normative judgment on the size of the opportunity set (the bigger, the better) from an evaluation of the actual outcome of the choices. This is a possible way of accounting for the fact that innovations are likely to change individual preferences with the consequence of time-

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[6] This verdict is based on a conclusion Sugden draws from behavioral economics and its observation of distorted and context-dependent preferences. In his view, with preferences falling short of rational standards, preference satisfaction cannot claim normative weight as the basis for welfare assessments.

inconsistencies popping up in outcome assessments made at different points in time. The size of the opportunity set as the sole normative maximand is independent of whatever preference the individuals learn and what behavioral peculiarities and anomalies they may display in doing so. A different question is, of course, whether the size of opportunity set can indeed be argued to be a valid measuring rod, independent of how the individuals actually value it. Empirical research has shown that having a certain number of opportunities is indeed positively valued. However, with an increasing number of opportunities the evaluation is not linearly increasing. There are upper limits to the well-being which individuals derive from a growing opportunity set (e.g., Loewenstein, 1999; Schwartz, 2000). With an increasing number of choices, humans tend to develop increased regret aversion to the number of alternatives not chosen. This has been called the "multi-option treadmill": despite the fact that we face ever more options, well-being does not necessarily increase significantly (Binswanger, 2006).

With the size of the opportunity set, Sugden is eager to formulate a criterion for well-being that leaves open what precisely the choice options are and how they have become feasible. This effort protects his opportunity criterion from being accused of paternalistic inclination. However, by the same token his criterion is unable to discriminate between enlargements of the opportunity set which for many individuals may make a great difference with respect to their well-being. This is particularly difficult to align with normative intuitions in the context of innovativeness. Whether an innovative product or service becomes available or, for instance, an immoral offer or the opportunity to exploit someone else's quandary – for Sugden's criterion this does not matter. Both cases count as welfare increases while many people would reject this idea.

## 5. Hedonistic Concepts of Well-Being

A prominent class in the taxonomy of theories of well-being still to be discussed are hedonistic theories or mental state accounts of well-being. In this category fall *inter alia* the well-known subjective well-being theories (or synonymously: "happiness" theories). While there are theoretical contributions which distinguish between affective and cognitive layers of well-being, most of the empirical literature seems to be centered on a cognitive interpretation of subjective well-being. This is reflected in the notion of subjective well-being (or happiness) understood as life satisfaction: the interest lies in the cognitive aspect, making well-being a cognitive judgment-cum-endorsement, i.e. an attitude which one holds towards one's life (see, e.g., Frey and Stutzer, 2002).

At a practical level, one may well be critical of the validity of subjective well-being constructs and ask whether these really measure anything useful at all.[7] These doubts are alleviated by an impressive psychological literature that establishes the reliability and validity of such subjective well-being constructs (Diener et al., 1999), showing that there is a strong correlation between such well-being constructs and emotional expressions like smiling (Fernandez-Dols and Ruiz-Belda, 1995) and brain activity (Shizgal, 1999). Moreover, individuals tend to discontinue unsatisfactory behaviors (Kahneman et al., 1993; Shiv and Huber, 2000), thus also relating low satisfaction scores to choice behavior. Lastly, studies found that individuals are to a certain extent able to (ordinally) compare and assess other individuals' levels of satisfaction or happiness (Sandvik et al., 1993; Diener and Lucas, 1999). In consequence, a broad consensus emerged within the literature that the intended subjective well-being can quite reliably be measured in this way. Research here extends also to the intertemporal context: psychological research shows that well-being is partly stable and fixed over time since it is determined to some extent by genes (Lykken and Tellegen, 1996) and by quite stable psychological personality traits (Diener et al., 1999). But it is also variable to a certain extent, being influenced permanently by such life events as repeated unemployment, marriage or child birth (Headey, 2010).[8]

It seems, thus, that a good case can be made for conceiving of individual well-being as the continuous (automatic and often not fully conscious) evaluation of an organism's state in terms of hedonic experience, a concept of well-being that is very close to what individuals experience as rewarding. Since this continuous evaluation of reward is something which is linked to biological functioning and happens automatically and even without conscious attention, such a notion would be quite reliable and a (relatively) stable indicator of value *for an individual*. A further advantage is that hedonic experience is quite well researched in terms of the underlying brain processes, providing a hedonistic theory of welfare with a strong empirical basis (Binder, 2010, p. 103).

A hedonistic concept of well-being can avoid some problems that plague the standard preference satisfaction view.[9] Subjective well-being as measure of societal

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[7] At a philosophical level, hedonistic theories have often been attacked because of their subjective interpretation of well-being or happiness. It is criticized that one risks a solipsistic theory of welfare, if well-being is taken to be solely a mental state that is independent of the actual states of world (Nozick, 1974, pp. 42-5): there is obviously a difference between having a pleasurable state of mind and really doing something causing pleasurable feelings. At least in a consequentialist version, hedonism has difficulties in acknowledging a difference between pleasure arising from manipulation of the senses and pleasure triggered by "real world" action.

[8] It may also be noted that the test-retest reliability of subjective well-being constructs lies between 0.5 and 0.7 (over two weeks, both for cognitive and affective measures, see Krueger and Schkade, 2008), which is lower than some other economic variables' reliability, but nevertheless in a range that allows meaningful analysis.

[9] See Binder (2010) for an extensive discussion. The standard preference satisfaction approach can be criticized on the ground that it needs an underlying theory of the good to make sense of the intensity of preference satisfaction (Broome, 2008, but see Witt, 2012). Hedonistic theories are not susceptible to this

progress allows to disentangle the notion of social welfare from its traditional measure of income. The usual justification why policies often target income as a proxy for welfare becomes obsolete since subjective well-being research aims to assess welfare directly:

> "Money ... is a means to an end, and that end is well-being. But money is an inexact surrogate for well-being, and the more prosperous a society becomes, the more inexact a surrogate income becomes. The measurement of well-being has advanced sufficiently that it is time to grant a privileged place to people's well-being in policy debates, a place at least on a par with monetary concerns. After all, if economic and other policies are important because they will in the end increase well-being, why not assess well-being more directly?" (Diener and Seligman, 2004, p. 2)

Using relevant insights from psychology and the neurosciences furthers our understanding of the causes and correlates of subjective well-being. Subjective well-being measures then offer a much broader picture of human well-being than the traditional income-based measures can do. This is reflected in the many domains of life (beside income) that have a bearing on subjective well-being. Measures of subjective well-being here incorporate aspects of well-being that are only badly captured by monetary measures, such as health, the social domain etc (these domains are often only moderately correlated with income). Positive knowledge about these relationships also allows to more comprehensively assess the above-discussed technological externalities in the face of large-scale innovativeness.[10] Measures of individuals' subjective well-being elicited from citizens can be correlated in empirical happiness equations with known determinants of subjective well-being and other factors of the individuals' environment, by which it is possible to measure activities and institutional arrangements for which it is impossible to reveal preferences directly (e.g., preferences for democratic institutions, inequality, freedom, or inflation). This extends to the hedonic evaluation of public goods such as the level of pollution or environmental quality, crime, corruption and so on.[11]

Finally, the individual remains sovereign in applying its own definition of happiness when being asked open-ended subjective well-being questions (Graham, 2011, p. 24),

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critique as they directly specify the notion of the good. Furthermore the mere satisfaction of preferences is an important generic source of welfare but not necessarily constitutes the *nature* of welfare (Sumner, 1996, p. 137).

[10] The analysis of innovations and subjective well-being has only very recently come to the fore (see Binder 2012; Dolan and Metcalfe, 2012).

[11] Individual's stated preferences and the corresponding money equivalent tend to capture such effects in a distorted way. When accounting for the usual known influences on subjective well-being in happiness equations, adding variables for the above-mentioned factors allows to assess their effects on subjective well-being directly. Within a revealed preference framework it is exceedingly difficult for the individual to express a preference for things like an institutional regime. Here happiness research (with tools such as happiness-measures based cost-benefit-analysis) allows for better welfare estimates of a whole range of otherwise difficult to measure factors.

something that mirrors the commitment on individual valuations also present in the orthodox economic view of welfare as preference satisfaction. Retaining the individual as the final and sole judge of its own well-being does not raise objections of paternalism that objective theories of welfare (such as were discussed above) raise.

But hedonistic notions of well-being do also suffer from some perplexing implications regarding the assessment of welfare increases. From a hedonistic point of view, the satisfaction of a preference is only welfare-increasing to the extent that it does imply enjoyment. With the soaring per-capita income that large-scale innovativeness has made possible, it can be argued that the satisfaction of preferences increases. Yet, whether this also implies an increasing enjoyment of related pleasures is far from obvious. As the literature on subjective well-being has shown, there is considerable evidence that the individuals' overall capacity for enjoying pleasures is limited in absolute terms – the maximal enjoyment you can experience in 24 hours has an upper bound.

Further, and more momentous in the context of evaluating the consequences of innovativeness, there is an inherent tendency to adaptation in the experience of pleasures. Their enjoyment factually fades with continued experience (Frederick and Loewenstein, 1999). This phenomenon of "hedonic adaptation" is a feature of our sensory system. Its significance particularly for the long run effects of innovativeness are exemplified by the fact that avoiding pains like hunger, drudgery, or sickness meant huge welfare gains to our grandparents, while today in the developed world this has become a matter of course inducing little hedonic excitement. Hedonic adaptation is quite variable between domains. It is less strong, for instance, with regard to biologically fixed needs (Frederick and Loewenstein, 1999, p. 314). Adaptation in the experience of pleasures occurs among the poor (who learn to appreciate the small pleasures available to them) as among the rich (who learn to develop non-excited feelings about what once were great pleasures for them – and still may be great pleasures for less well-to-do). This "Paradox of Happy Peasants and Miserable Millionaires" (Graham, 2010), as well as the high domain-specificity of hedonic adaption pose a general problem for hedonistic theories of welfare (Binder, 2010, pp. 174-191). [12]

In the light of these phenomena, it can be expected that the endogeneity problem makes a re-appearance in different disguise also in hedonistic theories of well-being. Above it has been the dependence of preferences on the path of innovative change that hassled the attempt to construct an unchanging measuring rod for well-being. Now it is the dependence

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[12] It is unclear how to normatively deal with hedonic adaptation within the context of subjective well-being theories (see Binder and Broekel, 2012). A phenomenon related to, but different from, the adaptation effect, is the consistent finding in the subjective well-being literature that the self-assessed life satisfaction has relative features. It is often not the absolute level of pleasures we can enjoy that is relevant, but the relative status: relative to what others, whom we compare ourselves to, are able to enjoy (see, e.g., Clark et al., 2008).

of what the agents experience as pleasure and what level of reward is connected with any particular pleasurable activity. With innovative change in the economy it is most likely that, over time, new pleasures are being learned. But it also seems that the enjoyment of the newly learned pleasures substitutes (many of) the pleasures that were previously enjoyed – precisely because of the mentioned bounds on experiencing enjoyment in a given period of time and the adaptation effect. If so, the hedonistic measuring rod for well-being, the enjoyment of pleasures, would imply a quite peculiar message: It would tell us that welfare is much less obviously increasing with innovations and growth than it appears on first sight. A great leap forward in terms of enjoying relief from hunger, drudgery, illness, and other very basic, deprived needs perhaps creates significant increases in well-being if it removes suffering. But any innovations that create enjoyment have less lasting effects: due to hedonic adaptation their effect would only be temporary. If individuals get adapted to the pleasure from an innovation, other pleasures need to take over, but again only temporarily, often keeping up (rather than increasing) enjoyment and well-being. Ultimately, all increases in enjoyment and well-being would be bounded by our limited capacity to experience them – how much innovativeness and growth there may be.

## 6. Preference Relativism and the Welfare Effects of Large-scale Innovativeness

In the last century, the large-scale innovativeness of the developed economies has been driving the growth of per capita income and continues to do so. For Schumpeter the "rising living standard of the masses" improved the human lot in historically unprecedented ways (although in many individual cases a different picture may emerge because of negative externalities of innovations). The tacit presumption in much of the innovation literature that innovativeness is beneficial in nature seems to rest on a similar inference. However, an improvement is not that obvious if measured in terms of human welfare. As explained, the reason is that large-scale innovativeness not only drives income growth but also preferences change and the formation of new preferences. Large-scale innovativeness thus undermines the basis for consistent inter-temporal welfare comparisons.

The different notions of welfare discussed in the preceding sections provide no remedy for this effect. When they suggested to measure welfare in terms of the size of the individual opportunity sets, preferences changes would indeed not affect individual welfare. (Since the opportunity set grows on average as a result of rising per capita income, such a measure may be considered akin to Schumpeter's intuitions.) Consistent inter-temporal welfare comparisons would be feasible. However, they would be made on a basis that for many agents may not be a valid representation of their welfare, namely the mere number of choices they have. Instead, for many agents the proper measure is likely to be *what* choices they can make, i.e. how they value them. When, in contrast, the notions of welfare focus on the value which the individuals' opportunities have for them, either in objective terms of functionings and capabilities or in subjective terms of actual hedonic experiences, these

measures are affected by innovation-induced preference changes. The question then is whether the inter-temporal welfare assessment should be based on the present objective / subjective state of affairs when the innovations of the past have already affected the evaluation? Or should the basis be the past state when those innovations have not yet developed their effect on the evaluation?

The question is decisive as the outcome of the assessment depends on which basis is chosen. The reason is that preference learning and hedonic adaptation systematically transform the relevant preference relations over time as the following utility calculus shows. Assume that at time $t_1$ there exist $j = 1, ..., m$ goods and services from which an individual chooses a bundle $\boldsymbol{x}^* = \{x_1, ..., x_m\}$ that maximizes her utility under the given income constraint. If income would be raised by the amount $\Delta I$, the individual would choose a bundle $\boldsymbol{x}^+ \neq \boldsymbol{x}^*$ as optimal solution. Hence the relation

$$(1) \quad u_{t_1}(\boldsymbol{x}^+) \geq u_{t_1}(\boldsymbol{x}^*)$$

holds. Now suppose innovations are introduced which have two effects. (i) from time $t_1$ to $t_2$ the individual's income rises exactly by the amount $\Delta I$; (ii) as a result of new goods and services there exist n > m goods and services.

Assuming that the individual has developed a taste for the new goods and services, i.e. her preferences have changed in $t_2$, she now chooses an optimal bundle $\boldsymbol{x}^{*\prime} \neq \boldsymbol{x}^+$. Judged by her post-innovation preferences the order relation then is

$$(2) \quad u_{t_2}(\boldsymbol{x}^{*\prime}) \geq u_{t_2}(\boldsymbol{x}^+).$$

In case that the inequality holds, the new optimal bundle is strictly preferred to the bundle without the new goods and services that could be purchased with the same income. [13] Hence, the welfare of the individual would be reduced if those novelties would be removed from the choice set. However, judged by the pre-innovation preferences of time $t_1$ the order relation would be

$$(3) \quad u_{t_1}(\boldsymbol{x}^{*\prime}) \leq u_{t_1}(\boldsymbol{x}^+),$$

because the individual would at best be indifferent with respect to the new goods and services it has not yet learned to appreciate, if not rejecting them as align. This means that as long as no preference learning has taken place, no welfare loss would have to be incurred if one had to forego the not yet appreciated innovations. After preferences have adapted in $t_2$, in contrast, the idea of being set back to the bundle $\boldsymbol{x}^+$ would mean a welfare sacrifice.

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[13] If a complete hedonic adaptation to the new situation had occurred in $t_2$, this would imply that $u_{t_2}(\boldsymbol{x}^{*\prime}) = u_{t_1}(\boldsymbol{x}^*)$, a phenomenon that has been alluded to as hedonic treadmill effect, see, e.g., Binswanger (2006). By virtue of the order relation (2) it follows that $u_{t_2}(\boldsymbol{x}^+) \leq u_{t_1}(\boldsymbol{x}^*)$. If, after having learned a new preference and after hedonic adaption, one had to forego the new goods and services one may feel worse off than in the original situation, despite the command of a higher income, a paradox already described by Elster (1983).

However the question of whether to choose pre- or post-innovation preferences for inter-temporal welfare comparison is to be decided, the answer cannot be derived from any positive theory about human well-being and preferences. As a matter of fact, humans usually tend to assess their welfare on the basis of their present preferences, yet this is not to say that they could not equally well do otherwise. With respect to the question in the heading we thus find that the welfare effects of innovations cannot be assessed without making a normative value judgment in the first place – and that the this judgment preprograms which of the very different assessments one gets. A peculiar preference relativism turns up here and leaves its traces in the attempt to determine whether large-scale innovativeness not only drives economic growth but also improves economic welfare.

Innovations transform the opportunities for spending income. We have to learn to appreciate the changing ways of spending the growing income that large-scale innovativeness makes feasible. Once having gotten used to the new opportunities, we would no longer want to forego them. Had the new preferences not been learned, however, nothing would have been missed, if the new opportunities had been removed. When accounting for the likely hedonic adaptation effects, the implications of the diagnosed preference relativism are even stronger: large scale innovativeness may not even improve our welfare when we assess it in terms of our current preferences. In view of the costs of large-scale innovativeness in terms of its negative externalities mentioned in the introduction, the fact that its welfare effects cannot unambiguously be determined may disillusioning and invite the question of whether it is worth it.


## 7. Conclusion

In this paper we set out to discuss whether innovations that are the crucial drivers of economic growth can also be said to raise well-being, and if so in which sense. In the discussion many more questions have been raised, pointing to the fact that the original problem is at present not well understood. We have identified two major complications that make an assessment difficult. The first of them has been shown to be the inevitability of pecuniary and technological externalities of innovations. These external effects prevent a clear prediction about the changes in well-being as long as the extent of the social costs and their effects on the personal income distribution are unknown. The second complication has been shown to result from the difficulty of identifying a satisfactory measuring rod by which the impact of large-scale innovativeness on changes of well-being can be assessed. We have briefly reviewed several approaches that have been suggested in the literature just to find that the diagnosed lack of a measure is caused by the vexing difficulties that all of the approaches have with logical and time-dependent inconsistencies in how humans experience well-being.

The answer to the question in the heading which we have eventually derived has hedonic adaptation and preference learning – the two sides of the time-dependence of well-being – center stage. Both are intimately connected to the very effect of large-scale innovativeness on our preferences. And, as was explained, both together give rise to a peculiar welfare relativism. Put in perspective with the private and social costs of innovations this finding may challenge the tacit faith of innovation researchers in, and the widespread public excitement about, technical progress, innovations, and economic growth however well-being is measured.

**Acknowledgements**

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