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As Innovations Drive Economic Growth, Do They also Raise Well-Being?✧

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Abstract

While there is little doubt that innovations drive economic growth, their effects on well-being are less clear. One reason for this are ambivalent effects of innovations on well-being that result from pecuniary and technological externalities of innovations, argued to be inevitable. Another major reason lies in the fact that, as a result of innovations, preferences can change over time. Under such conditions, a time-consistent measuring rod for changes in well-being is hard to construct. Existing conceptions of well-being are shown not yet to solve the problem in a way that provides an unambiguous answer to the question in the title.

Key words: innovations, growth, welfare, well-being, preference change
JEL-classification: D63, I31, O00

1. Introduction

Over the past centuries, Western economies have seen an unprecedented growth of per-capita income. The driving force behind the spectacular economic growth has been technological progress based, in turn, on large scale innovativeness as the true "capitalist engine of growth" as Stan Metcalfe likes to call it. Large scale innovativeness set in with the emergence of the proto-industry right before the Industrial Revolution (Mokyr 1990) and continued all the way since (Rosenberg & Birdzell 1986, Dosi 1988, Nelson 1996, Aghion & Howitt 1998). In a long series of writings exploring the conditions under which industrial innovativeness can unfold, Stan Metcalfe has greatly enhanced our understanding of the relationships between innovations and economic growth (e.g. Metcalfe 1992, 1998, 2004). Among the still open questions, one to which Metcalfe (2001) has drawn attention seems particularly important: the question of how innovations affect well-being (well-being understood as how well an individual or society fares, i.e. as a synonym for individual or societal welfare). It is a tacit presumption in much of the innovation literature that innovations are all but a common good. But in terms of what variable

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can we provide hard evidence for such a claim? What is the scale on which the conjectured beneficial effect can conceptually and empirically be documented? It seems that, while the causal role of innovations for economic growth is quite well understood by now, their effect on well-being is much less obvious.

A first complication in the relationship between innovations and well-being is due to the fact that, although innovations foster economic growth and economic growth can be argued to raise well-being *on average*, this does not imply that *individual* well-being is thus enhanced in all cases, at least within agreeable time scales (Witt 1996). The observation that benefits and costs of innovations are quite unevenly distributed within the economy and over time has already been addressed in metaphorical language by Schumpeter (1942, p. 84), speaking of a "perennial gale of creative destruction", or by Stan Metcalfe's (2001) notion of the "restless nature of capitalism". As a matter of fact, it is known that successful innovations, which make many market participants better off, regularly produce also "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 but also imply an irreducible risk of turning out to cause negative *technological* externalities in the form of more or less severe damages to health or the environment. Examples of how innovations "bite back" are surprisingly frequent (see, e.g., Tenner 1996).

The second complication in the relationship between innovations and well-being arises from the fact that the measuring rod for well-being may itself be changing under the experience of innovations. 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 possibilities to act on which preferences may not have been formed as yet. This is quite obvious in the case of many radically new products for which consumers must first learn to appreciate them. In developing further one's preferences it is very likely, however, that also the preferences on all other action possibilities are revalued. 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. Time inconsistencies of individual preferences can have significant economic and political consequences and are therefore an important impetus for rethinking policy making from an evolutionary perspective as in Metcalfe (1994, 2007). At the theoretical front, a still unresolved task is to find a measuring rod for welfare that is able to cope with time inconsistencies of preferences (see Sugden, 2006a; Binder, 2010).

The present paper is devoted to discussing the two mentioned complications in the relationships between innovations and well-being in more detail. Given that the problems they pose are very different, it is useful to analyze each of them in isolation. This means that we will

discuss the first complication – the ambivalence of innovations with respect to individual well-being arising from their 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. Section 2 of the paper is devoted to this exercise.

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. There is not much consensus in the literature on what the desirable features of a welfare measure are in a static setting. When the preference-changing potential of innovations is taken into account – which, as we explain in Section 3, can hardly be avoided – difficulties increase by orders of magnitude. 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. The state of the art hardly allows more than pointing out strength and weaknesses in coping with innovation-induced preference change. Thus, in Section 4 we review what is called "objective list" notions of well-being which basically postulate a welfare measure that is independent of, though not necessarily in discord with, individual evaluations of well-being. Section 5 turns to recent pleas for taking the individuals' opportunity set and its change over time as a welfare measure. Section 6 reports on hedonistic notions of well-being and their plausibility. As a measure of well-being that can cope with innovation-induced preference change, none of these concepts will turn out to be satisfactory in all respects. In Section 7 we therefore conclude by calling for further research to fill the remarkable gap between the widely held belief in the beneficial nature of innovations and what can currently be proven to be their impact on well-being.

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 we are having, 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 tempting to extend the argument to imply that it is ultimately innovations that induce increased satisfaction of preferences and thus raise welfare. Instead of adopting a welfare-theoretic framework, Schumpeter (1942, p. 84) had suggested that, historically, the incessant innovativeness of capitalism raised the "standard of living of the masses". But a growing standard of living is obviously something beneficial in his mind so that the intuition is not much different from that of the preference satisfaction view. The underlying idea is in both cases that the productivity increases that innovations make possible eventually result in greater ability to pay for whatever one chooses to consume. Subscribing to such a causal relationship between innovativeness and expanding consumption, the question arises which institutional arrangements and policy choices should be advocated to foster innovativeness.

However, as already mentioned in the introduction, several complications prevent such conclusions to be drawn. Apart from the fact that even the inference from rising income to rising welfare is by no means as unproblematic as it may appear,[2] the effect of innovations on well-being in the economy (or, for that matter, the standard of living of the masses) is highly ambivalent even when invariable preferences are assumed. First, the increases in per-capita income that have been observed in the past as a result of large scale innovativeness are always averages for a whole economy. This means that some agents must have benefitted in terms of their income and welfare. Yet other agents – in extreme cases even the majority – may not have benefitted or may 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 off and forego expected income from human capital investments in other employments.

[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] Higher income can fail to increase welfare when well-being heavily depends on relative consumption, i.e. on positional concerns (Frank, 1999). Or welfare increases fail to be triggered because of rising aspirations or other psychological mechanisms such as adaptation to the status quo (Frederick and Loewenstein, 1999; Easterlin, 2003). Or individuals may simply lack information about how to make a welfare-enhancing use of additional income (Qizilbash, 2006).

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 we did observe in the past can also be expected to materialize in the future.[3]

In the case of the pecuniary externalities of innovations, the unknown changes of the personal income distribution are the major contingency logically preventing even for invariable preferences the conclusion that more innovations and income also mean greater welfare. The situation is even more uncertain in the case of negative technological externalities that cannot be excluded *ex ante* to emerge from innovations. 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.

Even though pecuniary and technological externalities of innovations are frequent and often substantial, it is likely that most people would agree with Schumpeter's intuition: the large scale innovativeness and the massive per-capita income increases that capitalism has generated have by historical standards improved the human lot considerably. This intuition seems to confirm the tacit presumption in much of the innovation literature that innovativeness is beneficial in nature, although in many individual cases at least in the short and medium run a different picture may emerge. The core of the intuition is, however, the more or less direct reliance of such judgments on income as a measuring rod which is obvious in the case of the standard of living of the masses or the preference satisfaction approach of standard welfare economics. The question that remains to be discussed then is to what extent the size of individual (disposable real) income can indeed be vindicated as a measuring rod for individual well-being

[3] The long term trend in the standard of living of the masses observed in the past cannot be claimed to necessarily extend into the future, unless it is explained why continued innovativeness and per-capita income growth should also in the future translate into the specific income distribution that enabled the past developments.

and what we understand by the term "well-being". As will turn out in the next sections, there is no easy answer to the question, because it is so difficult to determine what well-being means to us, particularly if we want to make comparisons at different points in time.

3. The Problem of Innovation-dependent Preferences

It is not difficult to imagine that, when asked, almost everyone would – at any given point in time – rate having a higher income better than having a lower one, simply because more of one's wants and needs can thus be served. This truism is presumably one of the reasons why the standard preference satisfaction approach (implying a strong positive correlation between income and well-being) is so popular. However, things are considerably less clear cut once the static framework is replaced by a dynamic one. Does a capacity to satisfy one's wants and needs that increases over time then always also imply increasing well-being? Is an innovation driven economic development as the "discovery and application of better ways of doing things to satisfy our wants" (Boulding 1958, p. 23) confined to a set of given wants? In a static world, we can make sense of an innovation that leads to cheaper bicycles because of a more efficient production process. It is, however, difficult to explain why individuals should adopt the consumption of a totally new and previously unknown product, if they had not acquired a preference for it after learning of its existence. Indeed, as has been argued elsewhere (Witt 2001), the emergence of hitherto unknown action possibilities that come into existence through innovations usually leads to the learning of new preferences and changes in old ones.

In this context, the very nature of innovativeness brings with it a vexing theoretical difficulty, concerning the traditional welfare economic measuring rod of preference satisfaction. While the Schumpeterian measure of the living standard of the masses might be defended on grounds of its being a crude indicator for social welfare, the inducement of new preferences by innovations (and the possible change of preferences more generally) leads to a theoretical inconsistency of the traditional preference satisfaction view. 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 major difficulty is that preferences tend to become endogenous to the process of innovative change in the economy: 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 the individual subjectively experiences satisfaction of her preference may no longer reflect the individual's objective situation.

An example of such preference endogeneity has been given by Elster (1983). He discusses how the Industrial Revolution can be imagined to have had impact on preferences. One can conceive of the Industrial Revolution as a process that has increased our opportunity sets and released the individuals in the economy from preferences that were adapted to the Pre-Industrial

state x in t_0. But this may have led to a cardinally decreased well-being in the Post-Industrial state y in t_1, because now our opportunity sets are so much larger and our wants so ambitious that we are frustrated despite the fact that we can realize many more opportunities. To put it in a slightly more precise way imagine that the Industrial Revolution has led to an increase in the number of wants that individuals have. Assume that the increase just offsets the increased satisfaction of existing wants that the Industrial Revolution has made feasible. Were this the case, one might well be led to conclude that society enjoyed higher levels of welfare (in terms of aggregated individual well-being) before, as compared to after, the Industrial Revolution.

Now imagine that the society would prefer the Pre-Industrial Revolution state ($x \succ y$) with preferences of Pre-Industrial Revolution (t_0), and the Industrial Revolution state ($y \succ x$) with preferences adapted to the Industrial Revolution (t_1). If one conceives of this situation in terms of a cardinal utility measure, the instance of adaptive preference formation leads the utilitarian to conclude that the Pre-Industrial Revolution state had a higher well-being associated with it, if $u_0(x) > u_0(y)$ and $u_1(y) > u_1(x)$ but also $u_0(x) > u_1(y)$ due to adaptive preferences.[4] As Elster summarizes, "We were happier before we got these fancy new things, but now we would be miserable without them." (Elster, 1983, p. 135) There may even be a point where a release from adaptive preferences can lead to the "enslavement to addictive preferences" (e.g., the treadmill of striving for ever more material comforts). The circularity involved in the preferences concerned prompts a dynamic analysis, i.e. of the formation and change of these preferences.

There are good reasons, thus, to assume that preferences are systematically affected by innovations or, to put it this way, that the current state of individual preferences is contingent on the series of innovations experienced in the past. The very same increase in income over time may therefore lead to different welfare assessments. We can accept this implication as a consequence of human nature and sacrifice the intuition that, by historical standards, rising income has improved the human lot. Alternatively, we can skip the idea of taking individual preferences as a measuring rod for individual well-being – and, hence, sacrifice the preference satisfaction approach – in favor of a different measuring rod that circumvents these problems.

4. Objective List Concepts of Well-Being

The problems that arise for assessing changes in well-being from the fact that preferences become endogenous to the process of innovative change in the economy discussed in the previous section can be avoided if a notion of well-being is adopted that is sufficiently "objective", i.e. independent of the individuals' subjective valuations. The result could be a list with "objective" constitutents for well-being 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

[4] With an ordinal standard, one cannot compare this instance of preference change at all.

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. 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 conatin "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 $c(\bullet)$ so that $\mathbf{c} = c(\mathbf{x}_i)$ denotes a characteristics vector of a given commodity vector $\mathbf{x}_i$. The characteristics of a commodity are the same for all individuals. What does vary, however, is the way individuals can benefit from the characteristics. Think of a person who possesses a loaf of bread. Someone suffering from a parasitic disease would benefit less from the characteristic "caloric content" than someone who is well-fed (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.[5] These conversion factors can be seen as non-monetary constraints. The functionings an individual can achieve are thus determined by the vector of commodities that are feasible for that individual and 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 *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 idiosyncratic preferences. In order to evaluate Q_i one can postulate a valuation function $v = v(\bullet)$ that assigns a numerical value to each $\mathbf{b}_i \in Q_i$. A straightforward rule would be to evaluate a vector according to the best element. Sen calls such a rule "elementary evaluation" and gives as a reason for it 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

[5] See Kuklys (2005, p. 11). Individual factors could be gender, intelligence, physical (dis)abilities, etc. Social influences are legal regulations, population density, etc. Examples for environmental factors include, *inter alia*, climate and environmental pollution.

thus the value of the best element of the set. One could alternatively evaluate the set according to its number of elements. The basic supposition here is that the larger a set, the more freedom an individual enjoys.

The fact that the capability approach assesses well-being in terms of opportunities rather than outcomes makes it radically different from traditional welfare economics. It is the capability to achieve a wide variety of functionings that matters to this approach.[6] 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 functioning 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 problem of the purportedly objective nature of welfare in Sen's theory. By assuming intrinsic value for the functionings independent of the individuals' own judgement they are given an objective status. However, Sugden (1993) and Nussbaum, (2003) rightly 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 should or should not be included, the question remains who makes this delicate normative decision. If Sen's account were really objective, there would have to be a definitive list of functionings, regardless of the purpose of the examination.[7]

Critics have also pointed out that any attempt to construct an objective list runs the risk of issuing paternalistic claims (Sugden, 2006b, p. 50). It is conceivable that a (partial) list of functionings that is chosen as an allegedly objective reflection of individual well-being corresponds in no way to what the affected individuals actually value. Such an objective list would then be disconnected from what people experience as rewarding.

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 "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. Since the capability approach offers no clear answer as to how to deal with different imaginable developments of our value standards, it does not seem to be overly attractive as a theory of welfare aiming to capture the effects of innovativeness. If innovations sufficiently alter an economy over time, different functionings might become valued or existing functionings might lose relevance. The largely *ad hoc* methodology that is exhibited in empirical applications of the approach can be interpreted as

[6] Since capabilities prove to be notoriously difficult to capture empirically, one often sees proponents approximating capability to function by measuring functioning achievement. One has to wonder what can be gained by departing from an outcome perspective to then measure opportunities by recourse to the outcomes eschewed before.

[7] 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 necessarily shared by everyone and, in that sense, objective.

evidence that such a framework might lead to arbitrary and possibly misleading assessments of welfare when it comes to assessing the effects of innovations. If, at the end of the day, the allegedly objective list of relevant functionings is variable over time, nothing is gained in comparison to the standard view: different functionings are valued at different times and as a function of the economic situation. This opens the door to the problem of preference endogeneity as idiosyncratic preferences now determine what societal consensus about a list of functionings exists. The *prima facie* objective list takes a "subjective turn" (Sumner 1996, p. 66). A way out of the predicament would lie in letting the theory converge to a simple maximization of opportunities argument: what is to be promoted is individuals' capability to function in general, but if one does not know the relevant functionings, one cannot say more than from a perspective that just wants to maximize opportunities.

5. 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, i.e. to avoid the endogeneity problem. Since the assumption of invariable preferences had above been rejected as counterfactual, an objective (invariable) list conception has been considered as a solution in the previous section. However, the arbitrariness inherent in determining what items should be on the list and for what reasons proved to be an obstacle for accepting the "objective" list as a suitable measure for changes in well-being.

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 our 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.[8]

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. From his perspective, any increase in the lifetime opportunities of an individual is intrinsically good (without any assessment of the opportunity

[8] The size of the opportunity set may appear attractive as a basis for welfare judgments for evolutionary economists when equating it to the extent of variety on which selection can operate. Since selection processes are assumed to lead to unknown, yet in any case desirable outcomes, a greater variety that boosts selection is also believed to generate more improvements. As Metcalfe (2002) has shown, however, there is little support for such a belief.

that is added).[9] The idea that the size of the individual opportunity set as such is a fundamental value – the bigger, the better – is thus given a normative status. The normative correlate of this measuring device is a kind of freedom-of-choice-implies responsibility-for-one's-choice principle that is formalized by Sugden's "opportunity criterion".

Consider an individual i. Assume that there exist $m > 1$ commodities in the economy and that i holds a bundle $\mathbf{x} = \{x_{i1}, \ldots, x_{im}\}$ 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 for which, due to time-inconsistencies and behavior anomalies, a stringent criterion may not be available. People are free to make their own mistakes and learn whatever preference they want to – the individual and collective consequences of these idiosyncrasies and peculiarities do not compromise the precision of the size of the opportunity set as a measuring rod for (potential) well-being. A different question is, of course, whether the variety of opportunities can indeed be argued to be good, independent of how the individuals actually value it, so that it can be made the sole normative maximand. Bearing on the empirical adequacy of the theory, research has shown that, while indeed a certain amount of opportunities are positively valued by the individual, this relationship is not linear and monotonically increasing. There seem to be upper limits to the increase in well-being individuals derive from increased opportunity sets (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

[9] Sugden's approach takes into account the findings of behavioral economics that preferences are subject to non-rational processes which distort and render them context-dependent so that they cannot claim normative weight. This argument serves Sugden as a justification to abandon preference satisfaction as the basis for welfare assessments.

the "multi-option treadmill": despite the fact that we face ever more options, well-being does not necessarily increase significantly (Binswanger, 2006).

While freedom of choice on one's opportunities is certainly a valuable criterion and far from being suspicious of paternalistic inclination, the idea that opportunity should be the only value that matters faces similar objections as they have already been raised before. Is an equal increase in the size of the individual opportunity set indeed implying an equal increase in individual well-being? Is the fact that the opportunity set of other individuals differs from mine really irrelevant for my well-being (and theirs) or does the relative size affect well-being? If one equates well-being with opportunity, there is no room for asking these questions, and the intuition that these questions are relevant for well-being is ignored. Moreover, in a historical perspective on innovativeness and economic growth, it is worth noting that Sugden's measure of well-being and the stylized equilibrium model by which its implications are explicated completely ignore how increases in the size of the opportunity set have come about. This is not easily compatible with normative intuitions when, for example, external effects are considered or instances of brute force. A growing opportunity set of some individual(s) could have come about through exploitation, fraud, or even slavery but would still satisfy Sugden's criterion for social well-being. Without a dynamic focus, Sugden's criterion glosses over all individual and collective mistakes of the past and amounts to a summary Panglossian acceptance of the status quo. Whether the decisions made to allow today's opportunities set foreclose a more favorable opportunity set tomorrow is left open in the static orientation of the theory. This proves to be unfortunate within the dynamic context of innovativeness.

6. Hedonistic Concepts of Well-Being

The last category in our typology of theories of well-being are hedonistic ones (mental state accounts of well-being). In this category fall *inter alia* the well-known "happiness" theories -- synonymously called: subjective well-being -- in the psychological literature. 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). Very similar to this tradition is research using the "satisfaction with life scale" (SWLS, Diener et al., 1985).[10]

Such hedonistic theories can come in an "internalist" or an "externalist" version. The internalist model of hedonism claims that pleasure is a sensation that has a homogeneous feeling tone. This means that all pleasures are qualitatively the same, whether it is the pleasure one derives from reading a book or from strolling through the park, or whether it is carnal pleasure. One of the most common criticisms leveled against hedonism concerns exactly this homogeneity

[10] A third distinction is made by Veenhoven (1991) who differentiates between affective and cognitive concepts of well-being, calling them "happiness" and "contentment", respectively.

of sensation. The critics doubt that the pleasures we derive from the above-mentioned activities really are of the same quality (see Sen 1981). The externalist version avoids this critique by arguing that pleasures are heterogeneous. What is homogeneous in the externalist account, however, is the reaction to experiencing these pleasures, for example in the form of having a favorable attitude towards them (Sumner, 1996, p. 90). While the externalist model may be more convincing regarding a potential incommensurability of pleasures, this comes at a certain cost: when having only one quality of pleasure, intrapersonal and, under certain conditions, also interpersonal comparisons of well-being seem possible. This is no longer the case with a model of multidimensional pleasures (Sen, 1981, p. 200).

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. To demonstrate this Nozick (1974, pp. 42-5) has proposed the following thought experiment. Suppose you are connected to a machine that constantly stimulates your brain. While your body is resting in a vat, you live in an illusionary world full of pleasant experiences. Would you tap in? Nozick and others say no and take this as an objection against hedonism because, they argue, there is something else besides pleasure that is important. 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.[11]

At a practical level, one may well be critical of the validity of subjective well-being constructs and ask whether happiness surveys really elicit anything useful at all. However, an impressive psychological literature exists 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). There are certainly difficulties related to the practical elicitation of subjective well-being measures. Nonetheless, a broad consensus emerged within the literature that the intended individual 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.,

[11] Another objection often raised against hedonism concerns the assumption that the value of a good life should consist only of pleasure, particularly a mindless seeking of "low" pleasures. It is suspected that other important higher values such as friendship, sympathy, or achievement are implicitly discounted. But there is no reason why hedonism should be confined to "low" pleasures. It could as well be argued to include the pleasures gained from achievement or from having friendships and the like.

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).[12]

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.

Arguably, an affective notion of enjoyment partly also underlies all of our cognitive judgments on how happy or how satisfied we are with our lives. Moreover, affect is an evolutionary primary whereas cognition is a recent feat of nature, available only to very few creatures (viz. only humans). In contrast, positive and negative affect seem to guide almost all higher animals. The affective process runs on a deeper biological level (it belongs to those brain processes that work automatically, without much cognitive interference). It also seems to be more stable and consistent than other notions of well-being and less biased by a multitude of cognitive influences On the other hand, it has to be admitted that it is not easy to elicit and measure empirically the stream of affective experience (but see Kahneman and Sugden, 2005).

A hedonistic concept of well-being can avoid some problems that plague the standard preference satisfaction view.[13] But it seems to trade them for 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. Furthermore, there is an inherent tendency to adaptation in the experience of pleasures so that their enjoyment factually fades with continued experience (Frederick and Loewenstein, 1999). This phenomenon of "hedonic adaptation" is a feature of our sensory system and it is economically significant as the welfare gains of avoiding pains like hunger, drudgery, or sickness

[12] 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.

[13] 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). Hedonistic theories are not susceptible to that critique as they directly specify the notion of the good. Furthermore stopping at the level of preferences is insufficient for the assessment of welfare and makes a theory vulnerable to the criticism of mistaking important generic sources of welfare (i.e., the satisfaction of preferences) for the *nature* of welfare (Sumner, 1996, p. 137).

show that still meant a lot to our grandparents, but whose high levels of experience accomplished today seem pretty much a matter of course to us. Hedonic adaptation is quite variable between domains, being for example less strong regarding 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 (see more extensively, Binder 2010, pp. 174-191). 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 relational features. It is 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).

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. Instead of the dependence of preference on the path of innovative change that hassles the attempt to construct an unchanging measuring rod for well-being, it is now the dependence 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. Since some pleasures are harder to adapt to than others, innovations will need to be evaluated also with respect to the intertemporal "pleasure profile" they are likely to generate. Relatedly, new pleasures from newly invented products and services can be evaluated in terms of their "happiness efficiency" (Binder and Broekel, 2011), i.e. the rate of pleasure per resources used. If resources are limited and ethical considerations prompt society to sustainably use their resource base, one might make a moral claim to favor these innovations that produce a similar amount of pleasure with lower costs to the environment and society. These considerations clearly point to the potentials of such a dynamic analysis feasible with this welfare concept, even if its implications seem somewhat perplexing. Nevertheless, much more research is called for along the lines sketched above.

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 even *ex post* as long as the effects on the personal income distribution are unknown and the extent of the social costs (including the question of who has to bear them). The second, and probably even more destructive, complication has been shown to result from the lack of 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 question we have posed in the heading thus needs further research before an unambiguous answer can be expected, if it can be expected at all. What seems already clear, however, is that the widespread excitement about technical progress, innovations, and economic growth in both economics and politics is not easy to justify in terms of how our well-being responds – however it is measured.

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