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Innovation Index Working Paper

Innovation and Well-being

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Executive summary

Background

The aims of this project were to: 1) review what is known about the relationship between innovation and well-being and, in particular, the causal relationship from innovation to well-being; and 2) consider whether data in the British Household Panel Survey (BHPS) could be used to shed light on this relationship.

For the purposes of this report, we focus on well-being as it is experienced by individuals in terms of their thoughts and feelings; that is, in terms of subjective well-being (SWB). We could find no direct evidence in the literature on the impact that innovation has on SWB.

Analysis of the British Household Panel Survey

Respondents in the BHPS have been asked about their life and job satisfaction, and also about their mental well-being using the General Health Questionnaire (GHQ).

There are three main research questions that we explored using the BHPS. First, is higher SWB conducive to creativity? Second, is working in an innovative environment (e.g. the R&D sector) conducive to higher SWB? Third, are certain innovations (e.g. consumer goods) conducive to higher SWB?

In one wave of the BHPS, respondents were asked whether they are original and can come up with new ideas, and whether they have an active imagination. There is a positive correlation between SWB and creativity but this could be due to response bias.

It appears that people working in the R&D sector report a higher level of job satisfaction than those in other sectors but, whilst we control for individual heterogeneity, there might selection effects since it is difficult to establish a good counterfactual.

In relation to the impact that consumer goods have on SWB, a number of waves of the BHPS ask about purchases of various consumables, such as digital TV (i.e. cable and satellite TV), computers, CD players, and mobile phones. It seems that owning a digital TV and a computer are positively correlated with SWB and owning a CD player is negatively correlated with SWB but we must again be careful about making inferences about causality.

For a mobile phone and a computer, there is a lead (or anticipation) effect of purchasing: SWB starts to rise a year before the purchase and SWB continues to rise years after the year of purchase, thus suggesting no adaptation to owning a mobile phone or computer up to three years in the panel. Owning a CD player, on the other hand, leads to a continuing fall in SWB.

The issue here is that individuals may self-select into buying these products, in a similar way that people self-select into R&D jobs. Therefore, those who would benefit most from these products (or jobs) are those who purchase them (or get those jobs). In addition, there might be omitted variables bias because of the identification problem inherent in this dataset.

Future studies

Notwithstanding some quite serious problems of making inferences about causality, it may also be possible to link the BHPS to other datasets, such as the Community Innovation Survey (CIS). Using the UK Innovation Survey 2005, we might be able to determine whether

there is a relationship between SWB by location and innovation in a location as defined by R&D expenditures, patent activities, and employees in creative industries.

While innovation is usually seen as being good if people are willing to pay for the product or service, there has been hardly any work to determine whether the benefits outweigh the costs. For instance, there are many labour-saving or time-saving goods or services which people have a preference for, such as the microwave or fast food, but in the long-run the costs might outweigh the benefits if the results are obesity, and less happy and shorter lives. Longitudinal data can help in addressing these issues.

What are really required to address issues of causality are randomised controlled trials (RCTs) and natural experiments. We are currently valuing a range of non-market goods using measures of SWB and the impacts of innovation and social innovation could be measured in similar ways.

Conclusion

There is little robust evidence on the causal relationships between SWB and innovation and future studies should seek to fill these important gaps.

Since the effects of innovation have to be experienced by someone, somewhere at some point, explicit consideration should be given to SWB in the innovation index, just as it is being considered in other areas of public policy (e.g. by Defra (2008) in its indicators of sustainable development).

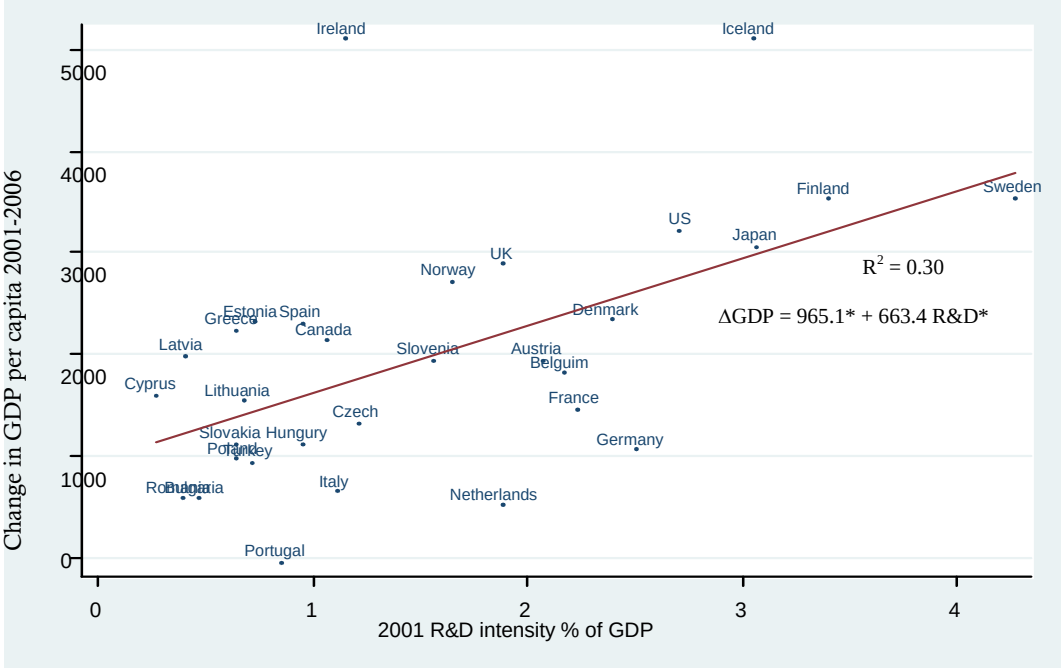
1. Introduction

1.1. The terms 'innovation' and 'well-being' are increasingly being used in academic and policy discussions but rarely are connections made between them. It is important to explore what these terms mean, how they relate to one another and, in particular, to consider whether and how the consequences of innovation could be measured and valued in terms of well-being. These are the aims of this mini project.

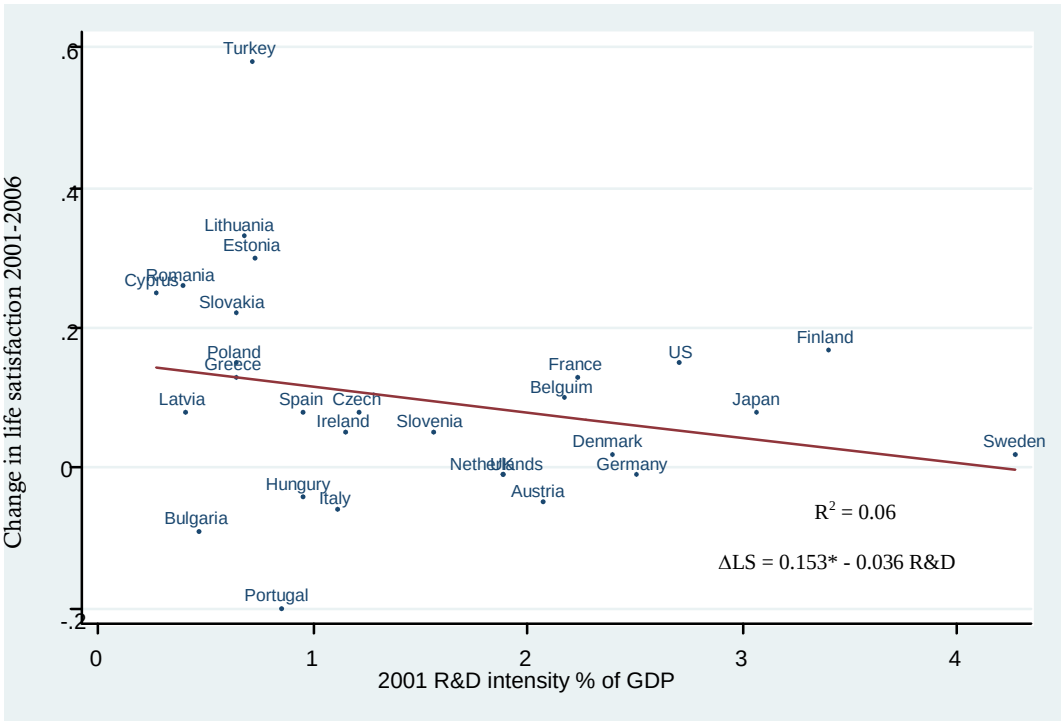
1.2. Much of the measurement of innovation focuses quite narrowly on the inputs to innovation. The Advisory Committee on Measuring Innovation in the 21st Century Economy (2008) recognises that "more work needs to be done to define appropriate outcome measures and analyze their utility and effectiveness" (p17).

1.3. The traditional measures of innovation have been expenditure inputs e.g. investment in R&D as a percentage of GNP. While this measurement of innovation has been heavily criticised for not demonstrating efficiency and the impact of the innovation process on outcomes (Coombs et al, 1996), the EU Lisbon Strategy has set a goal of 3% of GNP to be spent on R&D (European Commission, 2002).

1.4. When, as below, we plot R&D expenditure in European and North American countries as a percentage of GDP in 2001 (taken from Eurostat, 2005) against the change in real GDP per capita from 2001 to 2006 (in 2000 prices taken from the ERS International Macroeconomic Data Set) (*y*-axis), we find that higher R&D spending is correlated with higher GDP per capita. The relationship does not change once we control for conditional convergence (i.e. initial GDP per capita in 2001).



1.5. When, as below, we plot R&D expenditure in the same set of countries as a percentage of GDP in 2001 against the change in life satisfaction (LS) from 2001-2006 (taken from Ruut Veenhoven's World Database of Happiness), we find that higher R&D spending is correlated with lower LS.



1.6. We must treat these findings with great caution, given the small sample, short time frame, omitted variables bias, and issues of international comparability but they do suggest that the various relationships might be different and certainly far from straightforward.

1.7. Much of our own academic interest is in the public sector and social innovations of various kinds are sure to play a key role in tackling some of the key challenges that face policy-makers and that will affect well-being in the future (Office of Science and Technology, 2002). There are many recent example of innovation in the public sector (e.g. Learn Direct and NHS Direct) but the effectiveness of these innovations have rarely been evaluated in terms of their impact on well-being.

1.8. In section 2, we provide working definitions of innovation and well-being since different definitions could lead to different conclusions about the relationship between them. In section 3, we discuss what is already known about the impact that subjective well-being has on innovation and – what will be our primary focus in this report – the impact that innovation has on subjective well-being. As might be expected, remarkably little is known about causality.

1.9. In section 4, we discuss how existing data within the British Household Panel Survey could be used to address the issue of causality and provide some preliminary analyses of the data. We also briefly suggest how the BHPS might be related to other datasets that deal specifically with innovation, such as the Community Innovation Survey.

1.10. Existing data will only get us so far and we need new studies to better understand the relationships between innovation and SWB. In particular, we need to make better and innovative use of a range of methods, including natural experiments and randomised controlled trials. In section 5, we provide some examples of where experiments might prove helpful. We provide some concluding remarks in section 6.

2. Definitions of innovation and well-being

2.1 What is innovation?

2.1.1. The word ‘innovation’ comes from the Latin word ‘innovare’, meaning ‘to make something new’ (Amidon, 2003). The simplest definition of innovation is that of “the successful exploitation of new ideas” (DIUS, 2008) or “an idea, practice, or object that is perceived as new by an individual” (Rogers, 1995).

2.1.2. There is also a definition of successful innovation: “the creation and implementation of new processes, products, services and methods of delivery which result in significant improvements in outcomes efficiency, effectiveness or quality” (Mulgan and Albury, 2003). This definition incorporates social and organisational innovations.

2.1.3. Most definitions of innovation can be related to one or more of six dimensions: 1) newness; 2) innovation object; 3) stages in the innovation process; 4) systemic effect; 5) level of analysis; and 6) outcomes.

2.1.4. Newness, like most things, is relative: it could be new to the adopting unit or a proportion of key stakeholders but not entirely new (Osbourne, 1998). The innovation object can range from processes to products, from services to methods of delivery – from the Apple iPod to the Open University.

2.1.5. There are two main stages to innovation: generation (the creativity, problem-solving and decision-making involved in the development of an innovation) and adoption (the process of becoming aware of an innovation and implementing it within a market or organisation). Sometimes innovation refers only to the second stage, other times to both stages. Darzi (2008) has argued that the UK NHS is good at invention but lags behind in terms of take up.

2.1.6. The effect of the innovation on the system in can be incremental (minor changes to existing products, processes or services) or radical (a clear departure from existing practices). The level of analysis can be at the industry level (Scherer, 1984), the organisation level or at the level of the innovation itself.

2.1.7. One final dimension not incorporated by all theorists, but acknowledged by some such as Mulgan and Albury (2003), is that successful innovations must recognise the intended outcomes of the innovation. Outcomes can be in terms of efficiency, effectiveness, or quality, all of which can be applied and related to the SWB of individuals.

2.1.8. The actual definition of innovation adopted in relation to these six dimensions is dependent on the type of innovation research being undertaken (Gopalakrishnan and Damanpour, 1997). However, it is important to get a consistent definition since too many explicit measures can often obscure the key innovation drivers (Mulgan and Albury, 2003; Muller et al, 2005).

2.1.9. For this paper, the definition of innovation we adopt is the “*the successful exploitation of new ideas*” (NESTA, 2008), which is also in line with the DIUS (2008) definition. In essence, innovation can be anywhere in the various spectrums associated with the dimensions outlined here.

2.2. What is well-being?

2.2.1. According to Parfit (1984), there are three main accounts of well-being: objective lists, mental states and preference satisfaction.

2.2.2. "Objective list" accounts argue that well-being is highest when a person meets his material, social and psychological needs. Proposed needs include economic resources, health and political freedom. Objective lists are used to determine how many of these various needs have been met (Rawls, 1971; Sen, 1999; Nussbaum, 2001).

2.2.3. Subsets of psychological needs are discussed in the literature under the heading of 'psychological well-being' (PWB). Ryff and Keys (1995), for instance, have developed a model of six core psychological needs: autonomy, personal growth, self-acceptance, life purpose, mastery and positive relatedness.

2.2.4. Objective lists and PWB both draw on theoretical and intuitive accounts of what is of value – the 'good life'. However, most of the literature on measuring psychological needs is based on subjective self-reports e.g. whether the individual feels that that have purpose etc. In this sense, PWB is measured according to an account of well-being that is based on what is good for the individual and, in particular, on a mental state account of well-being.

2.2.5. In "mental state" accounts of well-being, an individual's life goes better if it is experienced more positively by the individual. This incorporates hedonistic accounts, which argue that pleasure is the only thing that is good for us, and pain is the only thing that is bad (Bentham, 1789), as well as broader evaluative accounts, which focus on an individual's cognitive assessment of his/her life.

2.2.6. Mental state accounts are often referred to as subjective well-being (SWB), which includes the thinking as well as the feeling self (Diener et al, 1999). Assessments of life satisfaction have become the most widely used measure of SWB, particularly in longitudinal datasets (Dolan et al, 2008). SWB measures have been validated against neurological evidence (Davidson, 2004), physiological evidence (Steptoe et al, 2005; Blanchflower and Oswald, 2008a), and a range of behaviours (Lyubomirsky et al, 2005), including suicide (Bray and Gunnell, 2006).

2.2.7. Until about 100 years ago, economists thought about 'utility' in terms of mental states but since then, and consistent with the behavioural revolution in the social sciences, they have considered utility in terms of "wantability" (Fisher, 1918) or "preference satisfaction". According to this account of well-being, an individual's life goes better if she gets more of what they want.

2.2.8. All else equal, if an individual's income increases, they are able to satisfy more of their preferences. It is not the income per se that makes them better off but, rather, the increase in choice that means they can satisfy more of their desires. Against this conceptual background, it is not surprising that many economists have come to see increases in income and GDP as almost synonymous with increases in well-being.

2.2.9. There would be little need for a discussion of accounts of well-being if they each produced similar results about who is doing well and who is doing badly – but unfortunately they do not (see Peasgood, 2008). The differences between the good life (objective lists) and what is good for the individual (mental states and preference satisfaction) are well documented in the writings of Sen and have been the source of much debate for two thousand years or more.

2.2.10. Of increasing interest to economists, psychologists and policy-makers is the accumulation of evidence to show that – contrary to an assumption that is implicit in many economic analyses – our preferences are frequently a very poor guide to our subsequent experiences. We are frequently guilty of "miswanting"; that is, of wanting things that will make us feel worse off and of not wanting things that would make us feel better off (Gilbert and Wilson, 2000).

2.2.11. There are many problems with preferences but one of the most pervasive relates to focussing effects. When we think about our preferences for market and non-market goods and services, we focus on those things differently to – and usually much more than – we actually focus on them in the experience of our lives. Just think about how often you actually think about your car once you have bought it. For more on this and other problems with preferences, see Dolan and Kahneman (2008).

2.2.12. As a separate consideration, there may also be psychological costs associated with having more choice (Schwartz, 2003), Indeed, the presence of more market choices can actually lead to fewer purchasing decisions being made (see, for example, the famous 'jam studies' where being able to sample more jams led to fewer purchases of jam; Iyengar and Lepper, 2000).

2.2.13. A fuller discussion of these issues is clearly beyond the scope of this report. We certainly recognise that each broad account of well-being has its place in informing policy decisions. Ultimately, though, the effects of policy – and of innovation – must be captured in someone's experiences, somewhere and at some point. Meeting needs and satisfying desires will often be very good proxies for future SWB but sometimes they may not be and so direct assessments of SWB are necessary. It is SWB that we focus on here.

3. The relationship between innovation and SWB

3.1. From SWB to innovation

3.1.1. The distinction between creativity and innovation is blurred since the definition of creativity used in the literature is "*coming up with fresh ideas for changing products, services, and processes so as to better achieve the organization's goals*" (Amabile et al, 2005) or "*the generation of new ideas – either new ways of looking at existing problems, or of seeing new opportunities, perhaps by exploiting emerging technologies or changes in markets*" (Cox, 2005).

3.1.2. A literature search of EconLit with the words "innovation" and "well-being" or "happiness" did not find any studies. Two relevant studies were found when we used the terms "creativity" and "positive affect". Frederickson (1998) suggests that positive affect increases the scope of attention and the scope of cognition. Isen (1999a) suggest that positive affect makes additional cognitive material available for processing and for increasing cognitive flexibility, which further increases the number of cognitive elements available.

3.1.3. When positive moods were induced by a stimuli (e.g. gift, music etc), individuals who had the stimuli had higher levels of creativity (Isen 1999a). Other experiments with students show similar results (e.g. Isen et al, 1987; Burroughs and Mick, 2004).

3.1.4. There has been one seminal field study by Amabile et al (2005) using a longitudinal study of 222 employees across seven companies each day over a 19-week period. They measured positive affect by using six self-report items from the pleasant part of the pleasantness-energy circumplex model (Russell, 1980) as well as measuring happiness and satisfaction with each day. They measured daily creativity by self-assessed creative thought and monthly creativity by peer assessment.

3.1.5. The results suggest a positive linear relationship between positive affect and creativity (but no opposite relationship with negative affect). Higher positive affect was also found to be a direct consequence of creativity. This study reinforces the idea that SWB precedes creativity from neurological studies that state that positive moods in conjunction with incubation periods (i.e. sleep) enforce memory and enhanced performance in tasks (Wagner et al, 2004).

3.1.6. As positive affect at work is highly related to overall job satisfaction (Judge and Ilies, 2004), it may be reasonable to assume that creative workplaces would be more pleasant places to work.

3.1.7. Anecdotal evidence from Vernon (1970) suggests that radical creative breakthroughs in mathematics (e.g. Henri Poincare) and music (e.g. Mozart) occurred during positive moods. In general, most research shows a positive relationship between positive affect and creativity (Barsade and Gibson, 2007).

3.1.8. It has also been found that people who report themselves as being time pressured in work also report themselves as being less creative (Amabile et al, 2002; Huhtala and Parzefall 2007). There are, of course, potential problems of response bias and acquiescence bias, which would create an erroneously significant correlation between the two measures.

3.1.9. However, negative affect may be good for creativity in some sectors. There is some support for a relationship between negative emotions and creativity from studies of affective illness in the artistic but not the science sector (Jamison, 1993; Feist, 1999). It would seem that this relationship exists when both recognition and rewards for creativity are high, since it is possible that psychosis interferes with memory and other processes that are essential for creativity (George and Zhou, 2002).

3.1.10. While affect might be important to creativity, the biological determinants of creativity are not so concrete. Jung-Beeman et al (2004) suggest creativity is an idiosyncratic nature in brain functioning and Simonton (2000) puts forward evidence to suggest that creativity and innovation are the result of purely random combinations of ideas.

3.1.11. However, Csikszentmihalyi (1996) and Hennessey and Amabile (1998) have shown that creativity and innovation may be the result of intrinsic motivation (enjoyment, meaningfulness and personal challenge) and less about extrinsic motivation (such as pay or promotion). It is entirely plausible that intrinsic motivation is important to the invention stage whereas extrinsic motivation is important to the innovation stage.

3.1.12. More recent work suggests that autonomy and flexibility can be beneficial for creativity only under certain conditions. For instance, Chua and Iyengar (2008) believe that giving people extensive freedom, flexibility, and autonomy in a task could be overwhelming, and that only people with high prior experience in the task domain and given explicit instructions to be creative would benefit from such factors.

3.1.13. It has been suggested for some time that spatial factors are important for the innovation process (Jacobs, 1970; Florida, 2002). In essence, the argument is that a

high population density of occupations with a creative component drives urban innovation. Whilst this argument is not fully supported by the evidence (Glaeser, 2000), it is possible that high SWB drives greater social interaction which in turn drives innovation.

3.1.14. Whilst there is a general suggestion that SWB can lead to innovation, at present, there is very little evidence to show causality.

3.2. From innovation to SWB

3.2.1. The obvious link from innovation to SWB comes in the form of economic growth. Endogenous growth theories stipulate that the interaction between technology and the structure of the economic system induces economic growth (Grossman and Helpman, 1991; Aghion and Howitt, 1998).

3.2.2. So, if innovation has direct effects on economic growth (see Galor and Tsiddon, 1997) and economic growth (or income) has direct effects on SWB (see Frijters et al, 2004; Stevenson and Wolfers, 2008), then innovation may well have causal consequences for SWB. This link relies on measuring the tangible inputs of innovation on economic growth and SWB.

3.2.3. There may also be important intangible inputs to innovation that affect economic growth and that also directly impact upon SWB. It is this direct link to SWB that we know very little about.

3.2.4. There have been some attempts to look at how innovation can enhance objective indicators of well-being, particularly in the medical sector. For example, Cutler and McClellan (2001) found that innovations in the treatment of heart attacks, low birth-weight infants, depression, cataracts, and breast cancer have led to increased longevity and less absenteeism from the workplace. These innovations are also likely to have improved SWB but no direct data were available.

3.2.5. Other studies suggest that more expenditure on medical innovations does not necessarily lead to improved outcomes, let alone represent an efficient use of resources (e.g. Berndt et al, 2003; Lichtenberg, 2004). The opportunity costs (in terms of any definition of well-being) of these innovations are also hard to determine.

3.2.6. Objective measures of well-being appear to be at the heart of most attempts to directly assess the well-being consequences of innovation. For instance, the effects of productivity and innovation of the quality of output in the NHS is measured by the change in the number of post-operation deaths (Office for National Statistics, 2002).

3.2.7. As an interest aside, there is some evidence to suggest that ‘innovators’ are getting older as more time is spent getting to the knowledge frontier (Jones, 2008). Jones (2007) provides evidence of longer doctorates and older Nobel laureates. Galenson (2004) and Weinberg (2006) suggest that older people often make set off innovations, while younger individuals are more involved throughout the whole innovation process. So, innovation might be U-shaped through the life-cycle, just as SWB is i.e. higher SWB at younger and older ages (Blanchflower and Oswald, 2008b).

3.2.8. It is striking how little else we know (or at least could find) about the impact of innovation on SWB. In a recent comprehensive review of the economics literature on the determinants of SWB, Dolan et al (2008) did not find anything on the causal relationship from innovation to SWB.

4. Using data from the British Household Panel Survey

4.1. It has already been argued that a better understanding of innovation requires greater use of secondary datasets (NESTA, 2008). In particular, NESTA (2008) argue that data should be analysed by industrial sector, geographic region and innovation system function.

4.2. Whilst fully accounting for the effects of hidden innovation on well-being will require new data (see Section 5), it is possible to begin using the British Household Panel Survey (BHPS) to determine how innovation affects SWB.

4.3. The BHPS is a nationally representative of British households, and has been running since 1991. Respondents are interviewed in successive waves and the sample remains broadly representative of the British population. The entire sample of the unbalanced panel contains 30,336 observations (17,206 individuals). Of those, 4,197 respondents have stayed in all waves from wave 6 onwards.

4.4. Since wave 6 (with the exception of wave 11), respondents have been asked a life satisfaction question with response options from 1 (not satisfied at all) to 7 (completely satisfied). In every wave, respondents have been asked questions about their job satisfaction on the same seven-point scale. In every wave respondents have also been asked the General Health Questionnaire (GHQ). The Caseness scale of GHQ-12 ranges from 0 (best mental well-being) to 12 (worst mental well-being).

4.5. There are three main research questions that can be explored using the BHPS. First, is higher SWB conducive to creativity? Second, is working in an innovative environment (e.g. the R&D sector) conducive to higher SWB? Third, are certain innovations (e.g. consumer goods) conducive to higher SWB?

4.6. In wave 15, respondents were asked whether they are original and can come up with new ideas, and whether they have an active imagination. The response options range from 1 (least able) to 7 (most able). So, we can run a regression with SWB as an explanatory variable for the responses to these questions to see whether happier people tend to be more creative.

4.7. The SWB coefficients are reported in Figures 1a and 1b, where we can see that see that people with low SWB are also significantly less likely to be original and creative, whereas people with higher SWB report themselves to be more original and more imaginative than others, on average.

4.8. These results are partial associations and not causations. Indeed, we might find a great deal of response bias for the ‘new ideas’ and ‘active imagination’ questions. Some respondents may also think that these attributes are important since the interviewer is asking about them and that they are therefore important attributes to have.

4.9. There may also be some sort of acquiescence bias, whereby some respondents give high ratings to all subjective assessments (Hurd, 1999), so that the SWB questions and the creativity questions are highly correlated. More causal research is needed on the relationship between self-reported, peer-assessed and objective levels of creativity and SWB levels.

4.10. In order to consider whether people who work in the R&D sector report higher levels of job satisfaction than others, we can look at the raw data of those who entered the

R&D sector at time, t, and remained there at t+1 (N=30). We can see from Figures 2 that there is a significant increase in the overall level of job satisfaction and satisfaction with pay, as well as satisfaction with the work itself after the individuals entered R&D.

4.11. We test this idea more systematically using regression analysis in Table 1. Looking at the random effects results in the first column, it appears that people working in the R&D sector, on average, report a higher level of job satisfaction than those in other sectors. The R&D coefficient is also positive though statistically insignificant in 'satisfaction with pay' and 'satisfaction with the work itself' regressions (see Columns 2 &3).

4.12. Table 1 also reports fixed effects results i.e. the effect of moving into the R&D sector on job satisfaction. A similar pattern emerges. A move into the R&D sector is associated with a significant improvement in the level of job satisfaction.

4.13. However, whilst we control for individual heterogeneity, it is important to note that there might selection effects here since it is difficult to establish a good counterfactual. For instance, it might be that moving into a new job (irrespective of whether it is a R&D job or not) provides the increase in job satisfaction that is found above.

4.14. A similar inference can also be made about the relationship between moving into the R&D sector and SWB but the correlations between R&D and SWB are statistically insignificant. We could further address issues of causality using propensity score matching but such analyses are beyond scope and resources of the current project.

4.15. In relation to the question about the impact that consumer goods have on SWB, a number of waves of the BHPS ask about purchases of various consumables, such as digital TV (i.e. cable and satellite TV), computers, CD players, and mobile phones.

4.16. Figures 3 report three of these raw correlations between owning the goods (computer, CD player, and digital TV) and measures of SWB. Respondents living in a household with a computer or a CD player report significantly lower mental well-being than those without one, but there is no effect on life satisfaction. Having a digital TV seems to correspond with higher levels of mental well-being and also higher levels of life satisfaction.

4.17. In order to control for other confounding influences of SWB, such as income and employment status, Table 2 estimates a number of SWB regression equations. Looking at the regression with only exogenous variables (gender, age, age-squared) as the other control variables in Column 1, it appears that mental distress is lower among those living in an accommodation with a digital TV and a computer. However, owning a CD player corresponds to lower mental well-being.

4.18. The signs, as well as magnitudes, of the estimated coefficients remain virtually the same when household income is included. This suggests that the correlations between durable goods and SWB are independent of the income effects. With the inclusion of full controls (Column 3) and individual fixed effects (Column 4), owning a digital TV and a computer continues to be positively correlated with mental well-being, whilst the coefficient on CD player suggests a negative correlation.

4.19. The results for life satisfaction are reported in Columns 5-8 and a similar pattern emerges. It seems that owning a digital TV and a computer are positively correlated

with life satisfaction and owning a CD player is negatively correlated with life satisfaction.

4.20. It is also possible to use the panel nature of the BHPS to study the leads and lags effects of owning a consumer durable on SWB. For example, we can estimate the SWB path up to three years before and three years after purchasing a mobile phone. The coefficients in these regressions represent the marginal effects of going on to own a mobile phone at t-3, t-2, t-1, as well as owning a mobile phone at t, t+1, t+2, and t+3 compared to those who do not own a mobile phone during these periods (for a further discussion of the model, see Clark et al, 2008).

4.21. The estimates of leads and lags SWB equations are reported in Table 3, and the results are illustrated in Figures 4. We can see that there is a lead (or anticipation) effect of purchasing a mobile phone: SWB starts to rise a year before the purchase of a mobile phone and SWB continues to rise years after the year of purchase, thus suggesting no adaptation to owning a mobile phone up to three years in the panel.

4.22. A similar analysis can also be carried out for owning a computer and a CD player. Figures 5 shows that there is a fall in mental well-being prior to the purchase of a computer at time t. Mental well-being rises at the year of purchasing a computer and continues to rise from t+1 to t+3. There is a one year anticipation effect of purchasing a computer at t-1 on life satisfaction, and life satisfaction continues to rise years after the year of purchase, suggesting that there is no adaptation in SWB to owning a computer. Owning a CD player, on the other hand, leads to a continuing fall in SWB.

4.23. The problem here is that individuals may self-select into buying these products, in a similar way that people self-select into R&D jobs. Therefore, those who would benefit most from these products (or jobs) are those who purchase them (or get those jobs). In addition, there might be omitted variables bias in our analysis because of the identification problem inherent in this dataset.

4.24. Notwithstanding some quite serious problems of making inferences about causality, it may also be possible to link the BHPS to other datasets, such as the Community Innovation Survey (CIS). The CIS is a survey conducted every 4 years by EU member states that allows innovation to be monitored. It measures innovation in products (including goods and services), process innovation in the way good and services are produced or provided, investment in innovation, such as R&D and capital goods, and wider innovation, such as strategic changes to the organisation of business.

4.25. The UK Innovation Survey 2005, covering the period 2002-2004, was the largest so far conducted: 28,000 UK enterprises with 10 or more employees were sampled and 58% responded. Therefore, we might be able to determine whether there is a relationship between SWB by location and innovation in a location as defined by R&D expenditures, patent activities, and employees in creative industries.

4.26. For this analysis, we would need a greater breakdown of the data from the BHPS and the CIS (i.e. neighbourhood level or local authority level data). This would allow us to determine whether a clustering of innovative firms in one area has positive spillovers to other people's SWB in that location. Using SWB might be an excellent way to examine positive (knowledge or non-knowledge) spillovers from innovation, which, so far, has been very elusive (see Krugman, 1991).

4.27. Conducting such analyses should also consider the effects of how inequalities at the city or local level can affect innovation. In conjunction with this, it might be that certain personality characteristics, such as resilience, which may be more

concentrated in some locations, are important catalysts to innovation, particularly in resource deprived areas.

4.28. It should also be possible to get address data of patents from the Patent website and consider the extent to which neighbourhood affects patenting and, in particular, whether dense communities are the innovative ones. This does not necessarily require the BHPS, as the National Census might provide enough information (in conjunction with other annual datasets) to provide information on such a relationship.

5. Future studies

5.1. There is certainly the potential to use the BHPS to a greater extent to examine the relationships between innovation and well-being e.g. by using propensity score matching to find individuals in the BHPS dataset who are closely matched to the 240 people moving to an R&D job. However, it is also necessary for us to think about how we could develop new studies and datasets to answer questions about those relationships and, crucially, about causality.

5.2. There are at least three important questions of causality: 1) does higher SWB make people more creative and innovative; 2) does working in an innovative environment increase SWB; and 3) does innovation increase SWB?

5.3. What are required to address each of these questions are randomised controlled trials (RCTs) and natural experiments. The use of RCTs in economics has increased dramatically over the past few years (Burtless, 1995) and are already being used to measure the effects of innovative technologies on education (Banjeree et al, 2007), although there are currently less widely used in the UK.

5.4. If we are to provide causal evidence on how higher SWB makes people more creative, we need to exogenously manipulate SWB across individuals and determine how this then affects innovation.

5.5. A simple study could be carried out across three firms or, better still, teams within a firm, whose jobs are to formulate new ideas. We would begin by eliciting SWB and creatively data on each group. We would then randomly assign the groups to one of three arms: an intervention that involves increasing positive affect, an intervention that takes the same amount of time but acts as a placebo, and no intervention at all. The same SWB and creativity data would then be elicited after a certain time to establish treatment effects.

5.6. It is preferable to randomise units as opposed to people because of interaction effects. If there are two people from the same unit where one is in the treatment group and the other is in the control group, it is possible that they may interact and the higher SWB employee (treatment) may make the control employee happier and therefore more creative. This would not allow us to identify causality because of what Manski (1993) calls the reflection problem.

5.7. Such future work on the effect of SWB on innovation and worker performance should complement the work by personnel economists in trying to analyse human resource management practices that motivate workers beyond simple incentive pay structures (Ichniowski and Shaw, 2003).

5.8. In addition, we could examine how working practices and SWB can have differential effects on motivation and creativity at the idea creation and idea diffusion stages. For instance, idea diffusion can be a difficult process (Darzi, 2008) but it might be that, under different mental states, individuals are more likely to adopt an innovation rather than reject it.

5.9. To provide causal evidence on whether working in an innovative environment increase SWB is problematic because people self-select into particular jobs and exogenous changes in employment are rare. However, the type of environment R&D or creative workers find themselves in could be subject to some exogenous factors.

5.10. For example, Imperial College has recently started an Innovation Incubator. The Incubator is specifically designed to support early stage companies in terms of modern laboratories and write-up suites, office space, meeting rooms and business centre cubicles. So, if the companies were randomised, we could start to determine whether working in a very innovative environment, as opposed to an isolated working environment, is better for employee/entrepreneur SWB.

5.11. Similarly, there has been increasing work on innovation cultures, but little work on the causal link from culture to SWB to innovation. One could envisage a tight field experiment where workers are randomly allocated to various different offices where the only thing that differs is the work or innovative culture. One could then examine the link between culture and innovation and how SWB might mediate such a relationship.

5.12. Whether innovation increases SWB can be addressed by considering a range of products and services and market and non-market goods. We also have a growing interest in behaviours relating to health and to the environment and could think of a number of studies that could isolate the effects of innovations in these areas.

5.13. For example, we could conduct RCT-type studies of whether attention-grabbing devices that show the number of calories burned during exercise (e.g. the Nike+ device) lead to greater leisure participation and SWB. Similarly, RCT-type studies could determine whether attention-grabbing devices about energy consumption promote lower energy use and increase or decrease SWB as a result.

5.14. While innovation is usually seen as being good if people are willing to pay for the product or service, there has been hardly any work to determine whether the benefits outweigh the costs. For instance, there are many labour-saving or time-saving goods or services which people have a preference for, such as the microwave or fast food, but in the long-run the costs might outweigh the benefits if the results are obesity, and less happy and shorter lives. Longitudinal data can help in addressing these issues.

5.15. There is also potential to analyse how products not only produce a direct effect on SWB, but also a spillover effect. For instance, it has been found that commuting is not an enjoyable experience during the day (Kahneman et al, 2004; Dolan and White, 2008). However, a product like the Apple iPod might make people feel better during their commute and make them more productive and sociable at work. They may also annoy other passengers and have negative spillovers, of course.

5.16. There are many social innovations that could be evaluated using natural experiments. We have shown how a very simple design can be used to assess the SWB consequences of urban regeneration (Dolan and Metcalfe, 2008) and the methodology can be applied to any social innovation.

5.17. We are also interested in determining the impact of social networking sites on SWB. The Royal College of Physicians (2008) has suggested that users of such sites might place less value on their real world identities, and might be more at risk in their real lives, perhaps more vulnerable to impulsive behaviour or even suicide. A RCT style experiment on not using such sites over a period of time might give some indication on the likely effects of using the sites.

5.18. The use of natural experiments and RCTs will inform various debates, including those around management science and the most appropriate ways to deliver education and targeted workplace initiatives for employers, in addition to how best to develop and refine policy and regulatory interventions.

5.19. Research studies should also seek to establish the effects of innovation on the distribution of SWB. We know that policy-makers and citizens have preferences for reducing inequalities, at least in the health domain, (see Dolan et al, 2006) and so innovations, particularly social ones, should be judged according to their effect on SWB and its distribution.

6. Concluding remarks

6.1. On the basis of our review, and as we all expected, there is very little evidence pertaining to the relationship between innovation and SWB, and hardly any evidence at all of the causal relationships between them. Secondary data has proved helpful in shedding some light on the relationship but it is limited because of a range of biases and selection issues.

6.2. What are required are more studies to address causality, and these are likely to be innovative randomised experiments, particularly in relation to social innovations. Amongst other things, this will enable us to consider whether innovation policies should be targeted at individuals, businesses, sectors or locations to have biggest hit on SWB.

6.3. Ultimately, the effects of innovation and particularly social innovation have to be experienced by someone, somewhere at some point, and explicit consideration should be given to SWB in the innovation index. It would be helpful if the measures of SWB used were consistent with those being used in the large datasets and now in government surveys e.g. as assessments of life satisfaction is part of Defra's (2008) indicators of sustainable development.

References

Aghion, P. and Howitt, P. (1998). *Endogenous Growth Theory*. Cambridge: MIT Press.

Amabile, T.M., Barsade, S.G., Mueller, J.S. and staw, B.M. (2005). Affect and creativity at work. *Administrative Science Quarterly*, 50: 367-403.

Amabile, T.M., Hadley, C.N. and Kramer, S.J. (2002). Creativity Under the Gun. *Harvard Business Review*, 80: 52-61.

Amidon, D. (2003). *The Innovation Highway*. Boston: Butterworth-Heinemann.

Banjeree, A.V., Cole, S., Duflo, E. and Linden, L. (2007). Remedying Education: Evidence from Two Randomized Experiments in India. *Quarterly Journal of Economics*, 122: 1235-1264.

Barsade, S.G. and Gibson, D.E. (2007). Why Does Affect Matter in Organizations? *Academy of Management Perspectives*, February: 36-59.

Bentham, J. (1789/1996). *An introduction to the principles of morals and legislation*. 1996 edition, edited by J.H. Burns and H.L.A. Hart. Oxford: Clarendon Press.

Berndt, E.R., Bir, A., Busch, S.H., Frank, R. and Normand, S.-T.T. (2002). The Medical Treatment of Depression, 1991–1996: Productive Inefficiency, Expected Outcome Variations, and Price Indexes. *Journal of Health Economics*, 21: 373–396.

Blanchflower, D.G. and Oswald, A.J. (2008a). Hypertension and Happiness across Nations. *Journal of Health Economics*, 27: 218-233.

Blanchflower, D.G. and Oswald, A.J. (2008b). Is Well-Being U-Shaped over the Life Cycle? *Social Science & Medicine*, 66: 1733-1749.

Bray, I. and Gunnell, D. (2006). Suicide rates, life satisfaction and happiness as markers for population mental health. *Social Psychiatry and Psychiatric Epidemiology*, 41: 333-337.

Burroughs, J.E. and Mick, D.G. (2004). Exploring Antecedents and Consequences of Consumer Creativity in a Problem-Solving Context. *Journal of Consumer Research*, 31: 402-411.

Burtless, G. (1995). The Case for Randomized Field Trials in Economic and Policy Research. *Journal of Economic Perspectives*, 9: 63-84.

Chua, R. and Iyengar, S.S. (2008). Creativity as a Matter of Choice: Prior Experience and Task Instruction as Boundary Conditions for the Positive Effect of Choice on Creativity. *Journal of Creative Behavior*, forthcoming.

Clark, A.E., Diener, E., Georgellis, Y. and Lucas, R.E. (2008). Lags and leads in life satisfaction: a test of the baseline hypothesis. *Economic Journal*, 118: F222-243.

Coombs, R., Narandren, P. and Richards, A. (1996). A literature-based innovation output indicator. *Research Policy*, 25: 403-413.

Cox, G. (2005). *The Cox Review of Creativity in Business: Building on the UK's Strengths*. London: H.M. Treasury

Csikszentmihalyi, M. (1996). *Creativity*. New York: HarperCollins.

Cutler, D.M. and McClellan, M. (2001). Is Technological Change In Medicine Worth It? *Health Affairs*, 20: 11-29.

Damanpour, F. and Euan, W.M. (1984). Organisational innovation and performance: the problem of organisational lag. *Administrative Sciences Quarterly*, 29: 392-409.

Darzi, A. (2008). NHS Next Stage Review: Final Report. London.

Davidson, R.J. (2004). Well-being and affective style: neural substrates and biobehavioural correlates. *Philosophical Transaction of the Royal Society*, 359: 1395-1411.

Defra (Department for Environment, Food and Rural Affairs) (2008). *Sustainable development indicators in your pocket 2008*. London: Defra.

Diener, E., Suh, E.M., Lucas, R.E. and Smith, H.L. (1999). Subjective well-being: three decades of progress. *Psychological Review*, 125: 276-302.

Dolan, P. and Kahneman, D. (2008). Interpretations of utility and their implications for the valuation of health. *Economic Journal*, 118: 215-234.

Dolan, P. and Metcalfe, R. (2008). Comparing willingness-to-pay and subjective well-being in the context of non-market goods. Mimeo, Tanaka Business School, Imperial College London.

Dolan, P., Peasgood, T. and White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology*, 29: 94-122.

Dolan, P., Shaw, R., Tsuchiya, A. and Williams, A. (2005). QALY maximisation and people's preferences: A methodological review of the literature. *Health Economics*: 14: 197-208.

Dolan, P. and White, M. (2008). Accounting for the richness of our daily experiences. Mimeo, Tanaka Business School, Imperial College London.

DIUS (Department for Innovation, Universities and Skills) (2008). *Innovation Nation*. London: HMSO.

European Commission (2002). *More Research for Europe, Towards 3% of GDP*. Brussels: European Commission.

EuroStat (2005). *R & D expenditure in the European Union*. European Commission.

Feist, G.J. (1999). The influence of personality on artistic and scientific creativity. In *Handbook of Creativity*. Sternberg, R. (Ed.) Cambridge: Cambridge University Press, pp. 273-296.

Fisher, I. (1918). Is "Utility" the Most Suitable Term for the Concept It is Used to Denote? *American Economic Review*, 8: 335-337.

Florida, R. (2002). *The Rise of the Creative Class*. New York: Basic Books.

Frederickson, B.L. (1998). What good are positive emotions? *Review of General Psychology*, 2: 300-319.

Frijters, P., Shields, M.A., and Haisken-DeNew, J.P. (2004). Money does matter! Evidence from increasing real incomes in East Germany following reunification. *American Economic Review*, 94: 730-741.

Galenson, D.W. (2004). A Portrait of the Artist as a Very Young or Very Old Innovator. *NBER Working Paper No. 10515*. Cambridge: NBER.

Galor, O. and Tsiddon, D. (1997). Technological Progress, Mobility and Economic Growth. *American Economic Review*, 87: 363–382.

George, J.M. and Zhou, J. (2002). Understanding when bad moods foster creativity and good ones don't: The role of context and clarity of feelings. *Journal of Applied Psychology*, 87: 687-697.

Gilbert, D.T. and Wilson, T.D. (2000). Miswanting: Some problems in the forecasting of future affective states. In Forgas, J. (Ed.), *Thinking and feeling: The role of affect in social cognition.* Cambridge: Cambridge University Press.

Glaeser, E. (2000). The Future of Urban Research: Nonmarket Interactions. *Brookings-Wharton Papers on Urban Affairs*, pp. 101-150.

Gopalakrishnan, S. and Damanpour, F. (1997). A review of Innovation Research in Economics, Sociology and Technology Management. *International Journal of Management Science*, 25: 15-28.

Grossman, G.M. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*. Cambridge: MIT Press.

Hennessey, B.A. and Amabile, T.M. (1998). Reward, Intrinsic Motivation, and Creativity. *American Psychologist*, 53: 674-675.

Huhtala, H. and Parzefall, M.-R. (2007). A review of Employee Well-Being and Innovativeness: An Opportunity for a Mutual Benefit. *Creativity and Innovation Management*, 16: 299-306.

Hurd, M.D. (1999). Anchoring and Acquiescence Bias in Measuring Assets in Household Surveys. *Journal of Risk and Uncertainty*, 19: 111-136.

Ichniowski, C. and Shaw, K. (2003). Beyond Incentive Pay: Insiders' Estimates of the Value of Complementary Human Resource Management Practices. *Journal of Economic Perspectives*, 17: 155-180.

Isen, A. (1999). On the relationship between affect and creative problem-solving. In *Affect, creative experience and psychological adjustment*. Russ, S.W. (Ed.) Philadelphia: Brunner, pp. 3-18.

Isen, A.M., Daubman, K.A. and Nowicki, G.P. (1987). Positive affect facilitates creative problem-solving. *Journal of Personality and Social Psychology*, 52: 1122-1131.

Iyengar, S.S. and Lepper, M. (2000). When Choice is Demotivating: Can One Desire Too Much of a Good Thing? *Journal of Personality and Social Psychology*, 79: 995-1006.

Jacobs, J. (1970). *The Economy of Cities.* New York: Random House.

Jamison, K.R. (1993). Touched with fire: Manic-depressive illness and the artistic temperament. New York: Free Press.

Jones, B.F. (2007). Age and Great Invention. *Review of Economics and Statistics*, forthcoming.

Jones, B.F. (2008). The Burden of Knowledge and the Death of the Renaissance Man: Is Innovation Getting Harder? *Review of Economic Studies,* forthcoming.

Judge, T.A. and Ilies, R. (2004). Affect and job satisfaction: A study of their relationship at work and home. *Journal of Applied Psychology*, 89: 661-673.

Jung-Beeman, M., Bowden, E.M., Haberman, J., Frymiare, J.L., Arambel-Lui, S., Greenblatt, R., Reber, P.J. and Kounios, J. (2004). Neural Activity When People Solve Verbal Problems with Insight. *PLoS Biology*, 2: 500-510.

Kahneman, D., Krueger, A.B., Schkade, D.A., Schwarz, N. and Stone, A.A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. *Science*, 306: 1776-1780.

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99: 483–499.

Lichtenberg, L. (2004). The Expanding Pharmaceutical Arsenal in the War on Cancer. *NBER Working Paper no. 10328*. Cambridge: NBER.

Lyubomirsky, S., King, L. and Diener, E. (2005). The Benefits of Frequent Positive affect: Does Happiness Lead to Success? *Psychological Bulletin*, 131: 803-855.

Manski, C.F. (1993). Identification of Endogenous Social Effects: the Reflection Problem. *Review of Economic Studies*, 60: 531-542.

Mulgan, G. and Albury, D. (2003). *Innovation in the Public Sector*. London: Cabinet Office.

Muller, A., Valikangas, L. and Merlyn, P. (2005). Metrics for innovation: guidelines for developing a customized suite of innovation metrics. *Strategy and Leadership*, 33: 27-45.

NESTA (National Endowment for Science, Technology and the Arts) (2008). *Measuring Innovation: Policy Briefing*. London: NESTA.

Nussbaum, M.C. (2001). *Women and Human Development: the Capabilities approach.* Cambridge: Cambridge University Press.

Office of Science and Technology (2002). *Chief Scientific Adviser Energy Research Review Group - Report of the group: Recommendations to inform the performance and innovation unit energy policy*. London: OST.

Office for National Statistics. (2002). Measuring productivity change in the provision of public services. *Economic Trends*, 582: 20-32.

Osbourne, S.P. (1998). Naming the beast: delivering and classifying service innovations in social policy. *Human Relations*, 51: 1133-1154.

Parfit, D. (1984). *Reasons and Persons*. Oxford: Oxford University Press.

Peasgood, T. (2008). *Measuring well-being for public policy*. Imperial College London Ph.D. thesis, London.

Rawls, J. (1971). *A Theory of Justice*. Cambridge: Harvard University Press.

Rogers, E. (1995). *Diffusions of innovation*. New York: Free Press.

Royal College of Physicians (2008). Royal College of Psychiatrists Annual Meeting, Imperial College, London, 1-4 July 2008.

Russell, J.A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39: 1161-1178.

Ryff, C.D. and Keyes, C.L.M. (1995). The structure of psychological well-being revisited. *Journal of Personality Social Psychology*, 69: 719-729

Scherer, F.M. (1984). Innovation and Growth. Schumpeterian Perspectives. Cambridge: MIT Press.

Schwartz, B. (2003). *The Paradox of Choice: Why More Is Less*. Ecco.

Sen, A. (1999). *Development as Freedom*. Oxford: Oxford University Press.

Simonton, D.K. (2000). Creativity: Cognitive, Personal, Developmental, and Societal Aspects. *American Psychologist*, 55: 151-158.

Steptoe, A., Wardle, J. and Marmot, M. (2005). Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. *Proceedings of the National Academy of Science of the United States*, 102: 6508-6512.

Stevenson, B. and Wolfers, J. (2008). Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox. Mimeo, Wharton Business School.

The Advisory Committee on Measuring Innovation in the 21st Century Economy (2008). *Innovation Measurement: Tracking the State of Innovation in the American Economy*. A Report to the Secretary of Commerce.

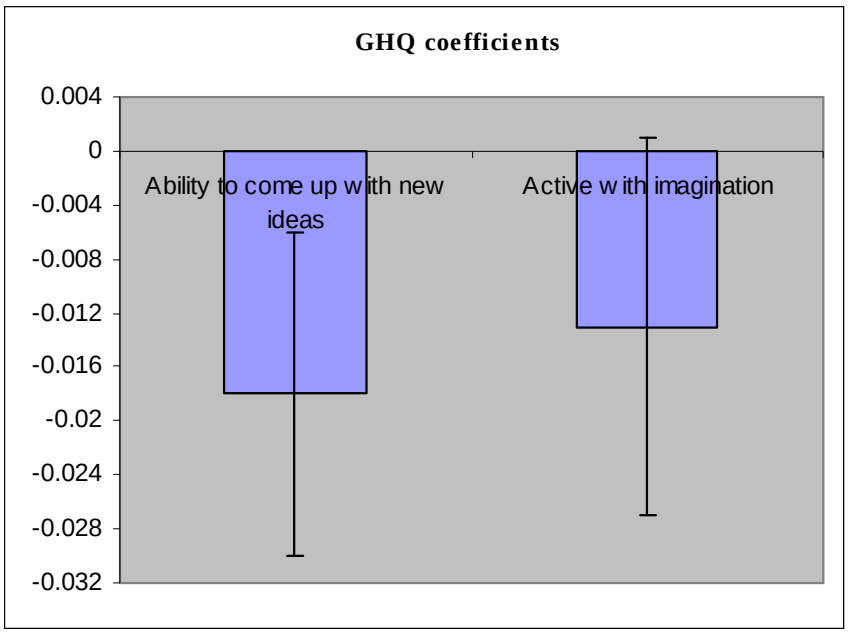
Veenhoven, R. (2008). World Database of Happiness, Erasmus University Rotterdam.

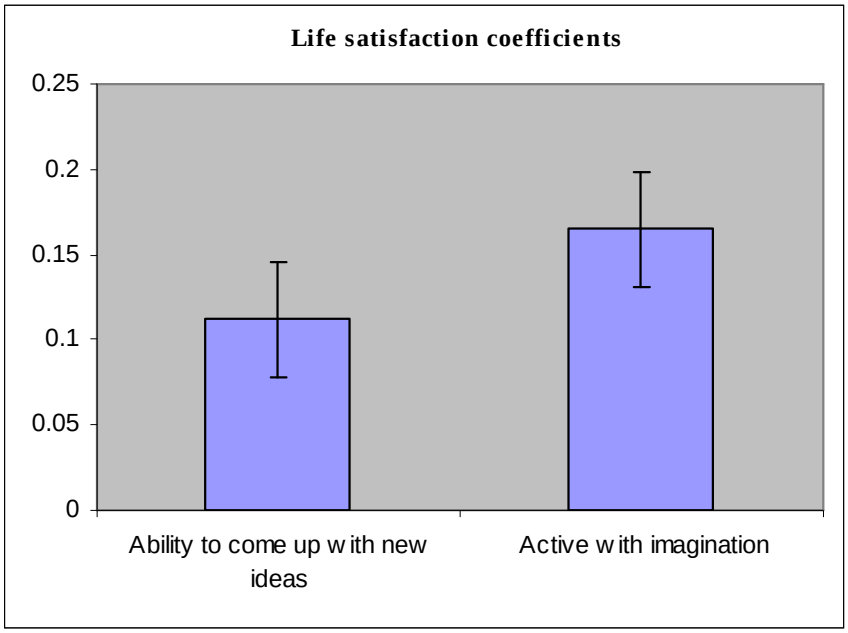
Vernon, P.E. (1970). *Creativity*. Middlesex: Penguin Books.

Wagner, U., Gais, S., Haider, H., Verleger, R. and Born, J. (2004). Sleep inspires insight. *Nature*, 427: 352-355.

Weinberg, B.A. (2006). Which Labor Economists Invested in Human Capital? Geography, Vintage, and Participation in Scientific Revolutions. Ohio State University Working Paper.

Figures 1a, 1b: Estimated correlations between SWB and ability to come up with original ideas, BHPS 2005





Note: 4-Standard-error-band (i.e. 95% confidence level). Both dependent variables (Ability to come up with new ideas & Active with imagination) are both on a 7-point scale and range from 1 (least able to) to 7 (most able to). All regressions control for gender, age, age-squared, employment status, marital status, education, subjective health status, number of children, and regional dummies. Standard errors are robust to cluster at the household level.

Figures 2a, 2b, 2c: The job satisfaction path of those who entered R&D sector at T and remained in there in T+1

Figure 2a: Job satisfaction overall

Figure 2b: Job satisfaction: satisfaction with pay

Figure 2c: Job satisfaction: satisfaction with work itself

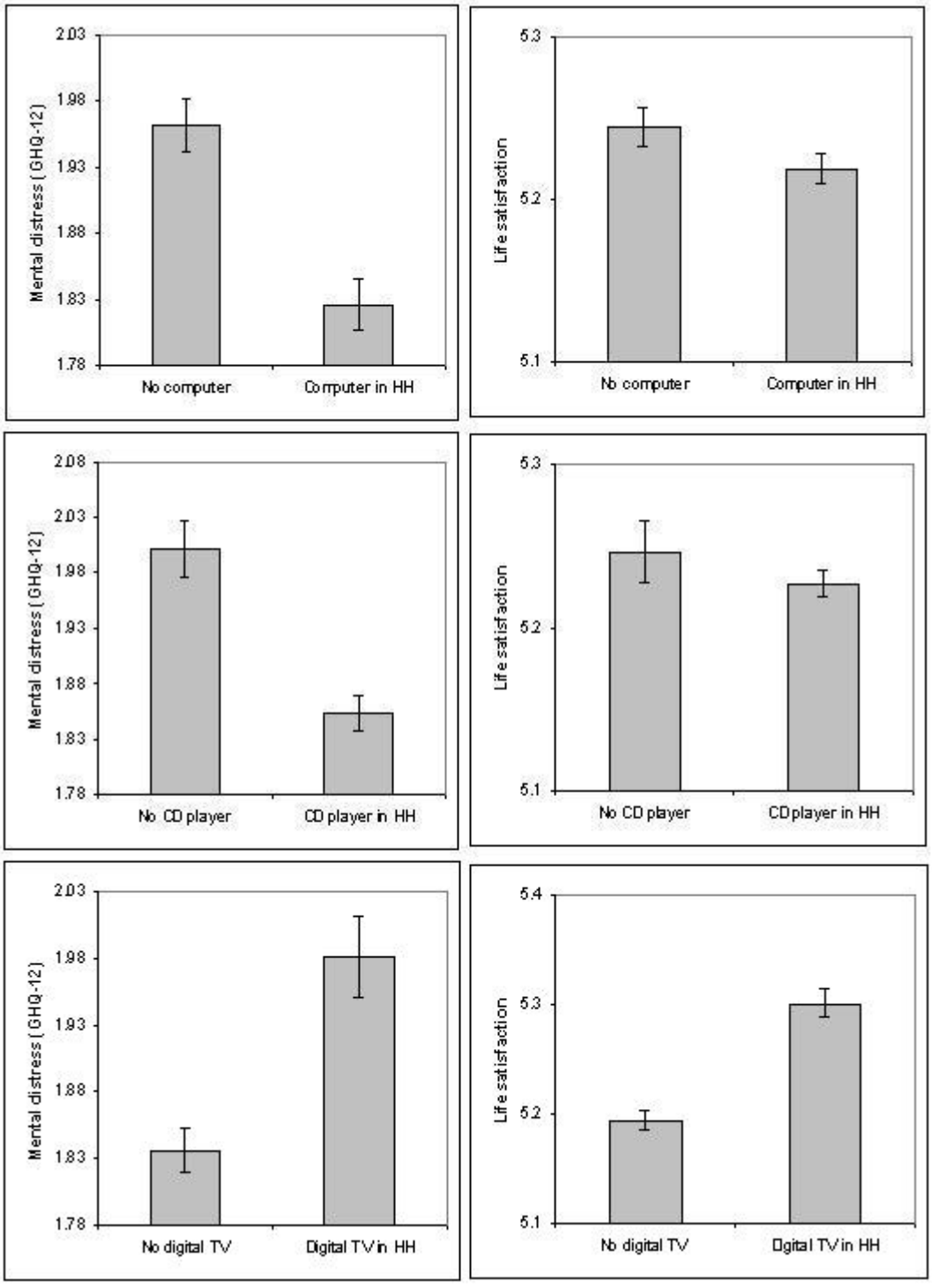
Note: 4-Standard-error-band (i.e. 95% confidence level). N = 30.

Table 1: Job satisfaction regression with working in the R&D sector, BHPS 1991-2005

	RE Job sat: overall	RE Job sat: pay	RE Job sat: work itself	FE Job sat: overall	FE Job sat: pay	FE Job sat: work itself
In R&D sector	0.193	0.137	0.172	0.212	0.107	0.205
	[0.090]*	[0.108]	[0.095]	[0.100]*	[0.118]	[0.105]*
Age	-0.060	-0.041	-0.034	-0.013	-0.027	0.021
	[0.004]**	[0.005]**	[0.005]**	[0.024]	[0.028]	[0.025]
Age-squared/100	0.078	0.058	0.049	0.072	0.027	0.029
	[0.005]**	[0.006]**	[0.006]**	[0.008]**	[0.010]**	[0.009]**
Cohabit with partner	-0.043	0.013	-0.439	-0.035	0.044	-0.534
	[0.020]*	[0.024]	[0.021]**	[0.023]	[0.027]	[0.024]**
Widowed	0.128	0.114	-0.004	-0.010	0.009	-0.201
	[0.066]	[0.081]	[0.069]	[0.089]	[0.105]	[0.094]*
Separated	0.020	-0.114	-0.098	0.027	-0.043	-0.160
	[0.034]	[0.041]**	[0.035]**	[0.042]	[0.049]	[0.044]**
Divorced	0.108	0.055	0.012	0.145	0.117	0.013
	[0.045]*	[0.053]	[0.047]	[0.049]**	[0.057]*	[0.052]
Never married	-0.164	-0.149	-0.346	-0.125	-0.107	-0.439
	[0.025]**	[0.030]**	[0.026]**	[0.032]**	[0.038]**	[0.034]**
Log of working hours	-0.176	-0.380	-0.211	-0.145	-0.323	-0.273
	[0.015]**	[0.017]**	[0.015]**	[0.017]**	[0.020]**	[0.018]**
Temporary job	-0.144	0.011	-0.118	-0.106	0.021	-0.068
	[0.021]**	[0.025]	[0.022]**	[0.023]**	[0.027]	[0.024]**
Self-employed	-0.124	-0.141	-0.175	-0.083	-0.136	-0.126
	[0.115]	[0.136]	[0.122]	[0.121]	[0.143]	[0.128]
Opportunity for promotion at work	0.000	-0.001	0.000	-0.001	-0.001	0.000
	[0.000]*	[0.000]**	[0.000]	[0.000]**	[0.000]**	[0.000]
Log of annual personal income	-0.011	0.126	0.023	0.030	0.110	0.041
	[0.009]	[0.010]**	[0.009]*	[0.010]**	[0.012]**	[0.011]**
Work size: 1-24	0.053	-0.126	0.302	0.002	-0.164	0.266
	[0.023]*	[0.028]**	[0.024]**	[0.026]	[0.031]**	[0.028]**
Work size: 25-199	-0.004	0.011	-0.032	-0.010	-0.006	-0.040
	[0.021]	[0.025]	[0.022]	[0.024]	[0.028]	[0.025]
Completed first degree	-0.167	-0.054	-0.129	0.078	0.032	0.200
	[0.030]**	[0.037]	[0.032]**	[0.053]	[0.062]	[0.056]**
Completed higher degree	-0.092	-0.053	-0.025	0.157	0.063	0.246
	[0.058]	[0.072]	[0.061]	[0.097]	[0.113]	[0.102]*
Health: poor	0.034	0.083	-0.074	0.042	0.067	-0.033
	[0.062]	[0.073]	[0.065]	[0.065]	[0.077]	[0.069]
Health: fair	0.178	0.074	-0.031	0.171	0.024	0.010
	[0.059]**	[0.070]	[0.062]	[0.063]**	[0.074]	[0.067]
Health: good	0.288	0.240	0.173	0.255	0.172	0.205
	[0.059]**	[0.070]**	[0.062]**	[0.063]**	[0.074]*	[0.067]**
Health: excellent	0.348	0.227	0.287	0.279	0.131	0.311
	[0.060]**	[0.071]**	[0.063]**	[0.064]**	[0.075]	[0.068]**
Constant	7.180	5.400	6.948	5.469	5.300	5.596
	[0.170]**	[0.203]**	[0.179]**	[0.716]**	[0.841]**	[0.756]**
Observations	61976	61932	61970	61976	61932	61970
Number of person	9071	9062	9069	9071	9062	9069
R-square (within)	0.0868	0.0895	0.1068	0.0898	0.0913	0.1096

Note: * < 5%; ** < 1%. Standard errors are in parentheses. RE = random effects. FE = fixed effects. Job satisfaction scale ranges from 1 (not at all satisfied) to 7 (completely satisfied). Number of observations in R&D sector = 240. Other controls include social class, wave, and regional dummies.

Figures 3a, 3b, 3c: Cross-tabulations between consumer durables and SWB, BHPS 1996-2005



Note: 4-Standard-error-band (i.e. 95% confidence level).

Table 2: Random effects well-being regressions with consumer durables at the household level, BHPS 1996-2005

	Mental distress (GHQ-12)				Life satisfaction			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Digital TV	-0.126	-0.105	-0.081	-0.060	0.239	0.234	0.134	0.139
	[0.021]**	[0.021]**	[0.021]**	[0.024]*	[0.009]**	[0.009]**	[0.009]**	[0.010]**
Computer	-0.433	-0.426	-0.288	-0.309	0.185	0.183	0.137	0.142
	[0.020]**	[0.020]**	[0.021]**	[0.022]**	[0.008]**	[0.008]**	[0.008]**	[0.009]**
CD player	0.202	0.205	0.203	0.201	-0.085	-0.089	-0.143	-0.166
	[0.024]**	[0.024]**	[0.024]**	[0.025]**	[0.010]**	[0.010]**	[0.010]**	[0.010]**
Control set	A	B	C	D	A	B	C	D
Observations	105265	105265	105265	105265	95572	95572	95572	95572
Number of person	10835	10835	10835	10835	10859	10859	10859	10859
R-square (within)	0.008	0.0081	0.1118	0.1143	0.0293	0.0292	0.1604	0.1625

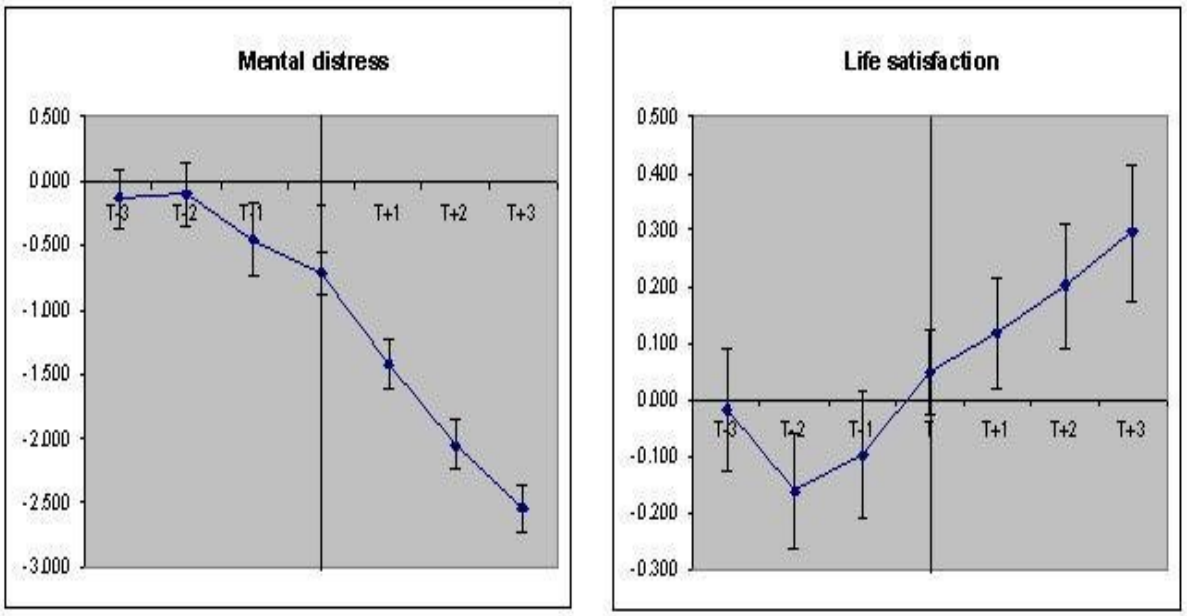
Note: * < 5%; ** < 1%. Standard errors are in parentheses. Mental distress (GHQ-12) scale ranges from 0 (best mental well-being) to 12 (worst mental well-being). Life satisfaction scale ranges from 1 (not at all satisfied) to 7 (completely satisfied). Control set A (exogenous variables only) = sex, age, age-squared; Control set B = Control set A + log of household income per capita; Control set C = Control set B + marital status, employment status, education, subjective health status, number of children, year dummies, and regional dummies; Control set D = Control set C + individual dummies (fixed effects). Wave 11 is missing in the life satisfaction regressions

Table 3: Fixed effects well-being regressions with leads and lags on the use of mobile phone, BHPS 2000-2005

	GHQ	GHQ	Life sat	Life sat
Three years before buying a mobile phone	-0.134		-0.016	
	[0.113]		[0.054]	
Two years before buying a mobile phone	-0.103		-0.160	
	[0.122]		[0.051]**	
One year before buying a mobile phone	-0.451		-0.096	
	[0.140]**		[0.057]	
Owning a mobile phone 0-1 year		-0.709		0.050
		[0.085]**		[0.037]
Owning a mobile phone 1-2 years		-1.420		0.119
		[0.095]**		[0.048]*
Owning a mobile phone 2-3 years		-2.042		0.202
		[0.094]**		[0.055]**
Owning a mobile phone 3-4 years		-2.542		0.296
		[0.091]**		[0.060]**
Observations	11844	32720	8436	30319
Number of person	3795	6572	3622	6578
R-square (within)	0.34	0.4	0.06	0.17

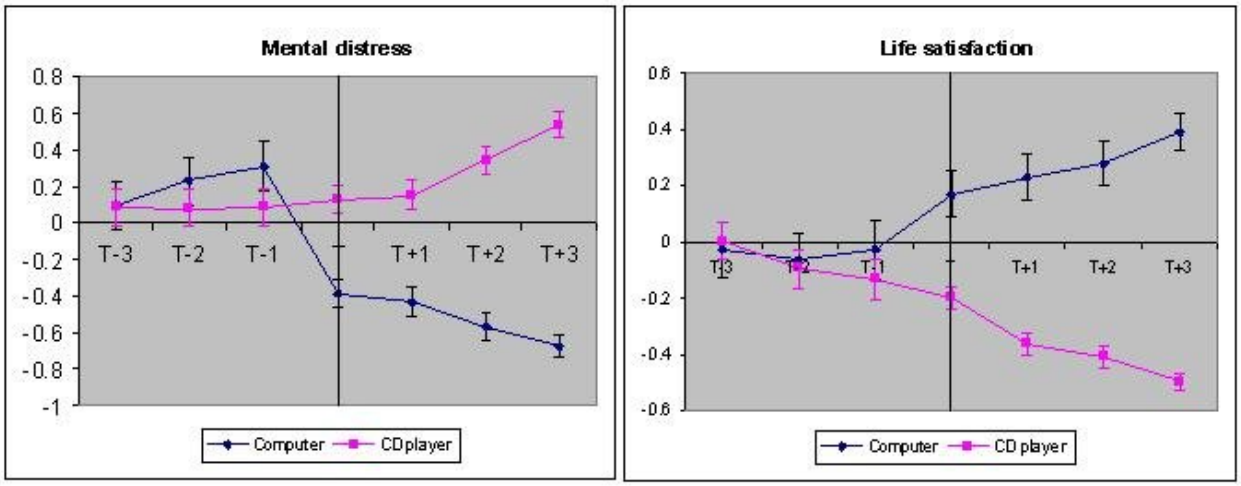
Note: * < 5%; ** < 1%. Standard errors are in parentheses. Mental distress (GHQ-12) scale ranges from 0 (best mental well-being) to 12 (worst mental well-being). Life satisfaction scale ranges from 1 (not at all satisfied) to 7 (completely satisfied). All regressions control for age, age-squared, marital status, employment status, education, subjective health status, number of children, year dummies, and regional dummies.

Figures 4a, 4b: the dynamic effects of buying a mobile phone on SWB



Note: 4-Standard-error-band (i.e. 95% confidence level). Year T is the year of mobile phone purchase

Figures 5a, 5b: the dynamic effects of buying a computer and a CD player on SWB



Note: 4-Standard-error-band (i.e. 95% confidence level). Year T is the year of computer and CD player purchase