

*Why is innovation important? Innovation is essentially, what has made us so well off. We can achieve more with less. Innovation is the fundamental driver of prosperity. But what are the fundamentals of innovation? It seems we know little of how to foster innovation. It is critical to understand this better. If it is possible to nurture more innovation we can achieve so much more.*

Innovation is important. Case and point! Everyone would agree. We hear it constantly, repeat it, use it. It has become an integral part of our vocabulary, conversation, and commentary. Just how important, though, and why, is often underappreciated or shrouded in myth. Innovation is the key to prosperity. It is not a convenient aspect of gadgetry, industrial competition, and academic vanities. In daily life, we encounter the wording in media, policy, casual conversation, as economic dogma. It has a familiar hollowness to it. Often we hold it as a highly abstract notion of continuous ‘progresses’. We take it for granted. We expect and anticipate the arrival of new, better, and cheaper things without knowing what and how. It is almost absurd. We embrace Moore’s law that computers double in speed ever so often,<sup>1</sup> new devices will be offered, products will become cheaper, and so on, thinking innovation is a given, a continuous stream. We defer purchases or even sometimes adopt legislation based on such innovation expectation, in full confidence that the necessary innovation will occur – a new iPad to arrive soon, the new generation of electric cars to be launched.<sup>2</sup> At the same time, in many cases we

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<sup>1</sup> This, of course, is only a popular proxy of Moore’s law actually stating that the number of circuits double every circa 2 years. The implication still holds. People expect the speed of computers to increase constantly without understanding the severe challenges and the need for cutting edge research and remarkable new ideas to make this possible. It is expected. It often drives consumer behaviour.

<sup>2</sup> For an example of such supply push legislation, see the California legislation on the energy efficiency of televisions, expecting to have a broad availability of more efficient television sets by 2013 (see California Energy Commission 2009). Other broader scale initiatives include Climate Change legislation and carbon trading schemes. Also see Norberg-Bohm (2000) and van den Ende and Dolfsma (2005).

hardly notice the profound innovations. It occurs at the backend, it seems often expected or incremental. Sometimes even a burden. A Blackberry, though offering some convenience is often perceived a restraint more than a glorious innovative leap and productivity gain. That it offers colour, becomes ever faster is expected. A touch-screen is a given. That prices fall is a must; that a new version will come soon an obvious fact. Still, sometimes we are interrupted and in awe of innovations, then quickly absorb them into daily life. The iPhone – shock and awe, now a standard. Other innovations, much more fundamental, often occur much less noticeable: the printing press, power loom, or less tangible ones such as matrix organizations and franchising, and so on. Its overall impact can hardly be overstated. At its inception, it often seemed marginal, expected, or unwelcome. Some innovations seem trivial, though with game changing impact (e.g. money, containerized shipping).<sup>3</sup> Other, more prominent achievements, but with less direct innovative impact at the time (e.g. the lunar landing, the compass) we praise as mankind's ingenuity, though do not necessarily connect it to personal affluence. Many things have changed and are constantly changing. We accept, even expect it. It is easy to attribute importance to innovation. But it is more than just a happenstance and matter of convenience. It is hard work with often extraordinary consequences.

That innovation exists is agreed. Its true impact is not. Think of innovation not as petty increments, but consider leaps, and the impact of such ingenuity becomes strikingly obvious. Increments add up. Look at it over a longer period. Pick two points in time. Spot the difference. Think of a world with no mobile telephony, without internet, without aviation, cars, etc. We have come a long way. We are moving forward with rapid pace. Tomorrow will not be the same as today. Who knows in 10 years? This is what science fiction tries to grasp – over, but often under-predicting the future prospects of yet unimaginable possibilities. Looking backward it is all too obvious – an astounding path of ingenuity. Innovation drives prosperity. It defines our limits; it defines what we can do and how we can live. It drives economic growth, it pushes the limits of what we can achieve – and it has, remarkably so.

To see this impressive account of human achievement, consider a long, a very long run perspective. Clearly, we have become richer, a lot richer and more affluent than anyone before. The conveniences of life have become more readily available, have become cheaper and have made a substantial impact on the quality of life. To better demonstrate this progress, this remarkable contribution of ideas, consider the light bulb. It epitomizes the sparking thought, the flash of genius, the brilliant idea. It symbolizes invention per se. The light bulb is now the ultimate cliché of a bright idea and invention. It is synonymous with invention. What better then to demonstrate the magnificent advances of human ingenuity that the light bulb, more general: lighting. We take it for granted. Who really thinks about the intriguing history and evolution of such common a thing as lighting when buying a light bulb or reading a book in the evening? We rather complain about the 'high' costs of lighting than relish this

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<sup>3</sup> For example see Bernhofen et al. (2013) on containerized shipping or Bughin et al. (2011) as well as Chen et al. (2013) on internet search.

impressive feat of human ingenuity that has made it possible in the first place. Just imagine you had to sit there with a torch, a candle, or an oil lamp. The manner in which we produce light has progressed significantly – without us really appreciating it. The first approaches of our early ancestors are sure to have been a controlled use of fire, such as simple sticks used as torches. Fairly simple oil lamps were used by the Babylonians and ancient Greeks and Romans. This was already a significant improvement. Further innovation made lighting continuously better and cheaper to obtain. In the Middle Ages tallow candles were used, later replaced by sophisticated oil (e.g. Argand oil lamp), later still with gas lamps. Edison's incandescent light bulb marked the start of the electrical lamps. They have steadily been improved. Fluorescent light bulbs are increasingly used, and promising results of modern light emitting diodes (LEDs) seem to point a way forward. From the use of fire to the use of electrical lamps has been an impressive evolution. It made the production of light several hundred times more efficient. To generate light for your nighttime read, what you can achieve with a simple light bulb today would have required a truckload of candles then. This from a technical perspective. It may not tell you much. A more interesting way of looking at it may be another: costs. How much would you have had to work to afford a certain amount of lighting? Prominent Yale economist William Nordhaus brought together this information demonstrating the power of such innovation (Fig. 2.1<sup>4</sup>).<sup>5</sup>

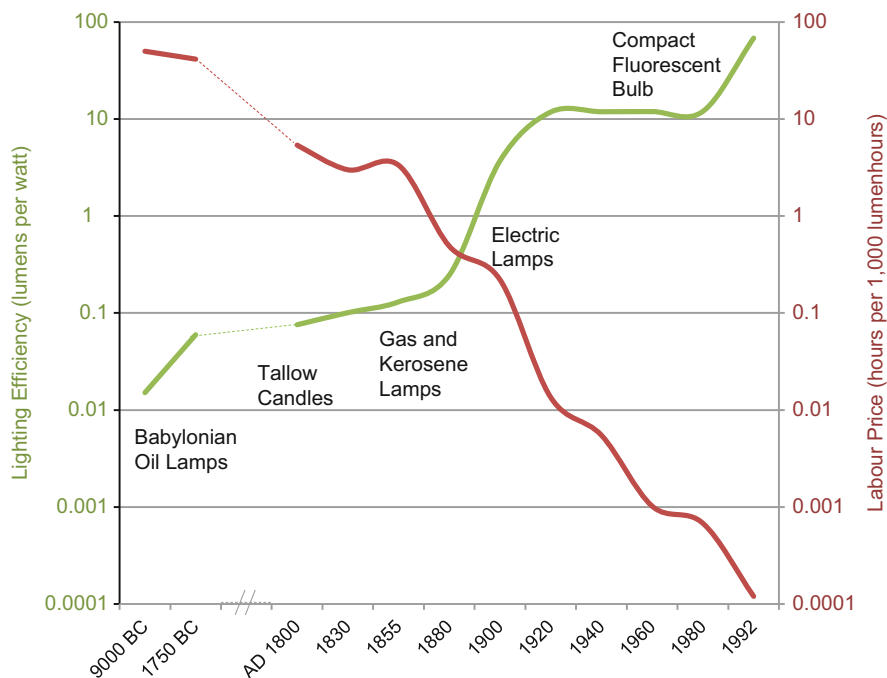
The price represents the amount of labour time that would be required to purchase a certain quantity of light (in hours worked to attain 1,000 lm-h. Note the logarithmic scale!). This is to say how long you would have to work to earn the money to afford an hour of light from a normal light bulb.<sup>6</sup> The hours of work required to earn this money fell only slowly until the mid-nineteenth century. Since then it has fallen drastically, by almost a factor of 10,000. Over an entire year, using a 100 W standard incandescent light bulb for 3 h each evening to read, today would cost you a total of a few dollars. In the early 1800s, generating this much light would have required 17,000 candles for which at the time “the average worker would have had to toil almost 1,000 h to earn the dollars to buy the candles.”<sup>7</sup> Or in another way: where the Babylonians still had to work 40 h to buy enough oil to generate an equivalent of an hour of light generated from a light bulb, Beethoven's contemporaries would have had to work about an hour, while today it will take you

<sup>4</sup> Based on calculation by Nordhaus (1996). Note the horizontal scale intervals. The intervals become shorter, thus shifting the data outwards, making it appear even less steep.

<sup>5</sup> See Nordhaus (1996, 1997). Actually, the papers have a different objective: the challenges and far-reaching implication of calculating adequate price indexes. The history of Lighting is used to demonstrate a potentially significant underestimation of economic progress. This, in the current context, would mean the achievements of innovation would be even greater with an even higher impact. For an equally impressive example demonstrating the power of invention, see Smil (1994).

<sup>6</sup> “1,000 lm-h are approximately the light cast by a modern 75-watt incandescent light bulb in one hour, or the light from burning a standard candle for about 60 h” Nordhaus (1997, p. 1552).

<sup>7</sup> Nordhaus (1996, p. 50). “The Age of Invention shows a dramatic improvement in lighting efficiency, with an increase of efficiency from 1800 to 1992 by a factor of 900, representing an annual rate of 3.6 % per year” Nordhaus (1997, p. 1553).



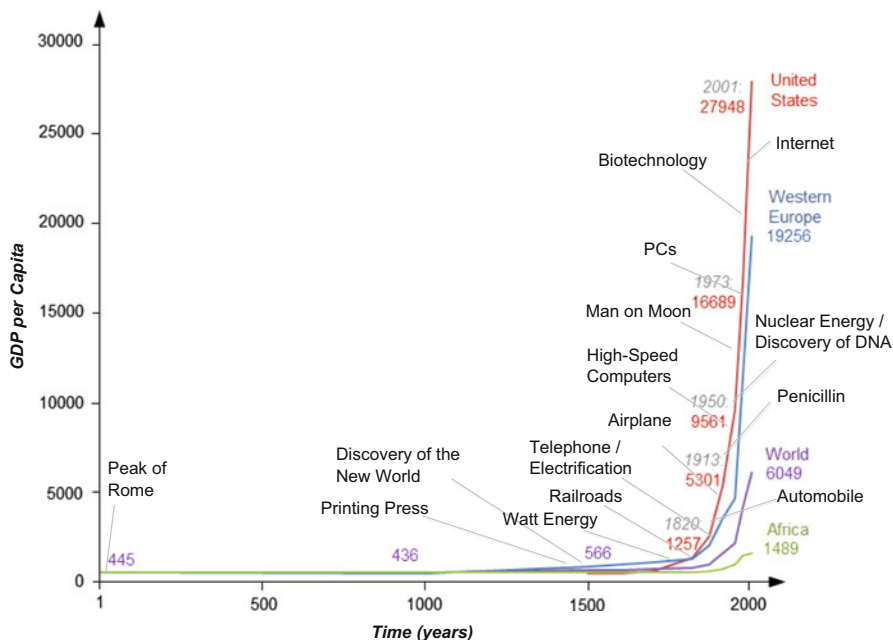
**Fig. 2.1** Innovation has made lighting cheaper and better

a few seconds the most. Of course, these are but estimates, using averages and standardized objectives, but you get the idea. Producing light has become ridiculously cheap compared to anytime in history. Innovation made this possible.<sup>8</sup>

Lighting is just one example. It hides a more important truth. We have not only progressed in the manner in which we produce light, but have progressed in many other areas as well. We can produce cheaper light because we have gotten better at building lamps, in generating electricity, producing the materials needed, and in general, have become better at many things.<sup>9</sup> We have become richer so that the relative portion we spend on lighting is getting ever lower as we get more and more productive in doing other things as well. Think of such prominent things as computers (they are constantly becoming faster and/or cheaper), music devices (from tapes, to CD, to mp3), or transportations (carriages, cars, hybrids). In almost all aspects of life, you can trace magnificent advances and progress. The growth in

<sup>8</sup> It probably could have been more impressive still if not for the Phoebus cartel, where its members – the major light bulb producers among others Phillips, Tungsram, Osram, General Electric – agreed to make light bulbs less long-lasting to increase replacement rates and thus turnover and profit (see *United States v. General Elec. Co.*, 82 F. Supp. 753, 890–91 (D.N.J. 1949)).

<sup>9</sup> For example, between 1880 and 1883 alone the price of producing an incandescent lamp fell from \$1.12 to 30 cents (see Millard 1990, p. 89).



**Fig. 2.2** Economic growth and innovation in the very long run

GDP may reflect this. It may at least be a good proxy. It provides for a similarly impressive account (see Fig. 2.2<sup>10</sup>). The tireless work of some clever economic historians has made possible to trace this progress.

We have prospered tremendously.<sup>11</sup> Population rose 22-fold. World GDP almost 300 times. The first 1,000 years almost so no progress. “From the year 1000–1820 the advance in per capita income was a slow crawl—the world average rose about 50 %. Most of the growth went to accommodate a fourfold increase in population. Since 1820, world development has been much more dynamic. Per capita income rose more than eightfold, population more than fivefold.”<sup>12</sup> Many factors contributed to these

<sup>10</sup> This is a mélange of the brilliant work by Robert Fogel (1999) and the magnificent efforts by Angus Maddison (2001). Two aspects should be noted: the invention is always assigned to the most prosperous GDP line. It is but indicative.

For a more extensive timeline of innovations, see, for example, [greatachievements.org](http://greatachievements.org) (02.03.2013), or [en.wikipedia.org/wiki/Timeline\\_of\\_historic\\_inventions](http://en.wikipedia.org/wiki/Timeline_of_historic_inventions) (02.03.2013). For a more detailed account of the more recent history, see Smil (2005, 2006). Similarly, even more ambitious data can be found also in Kremer (1993). Also see Maddison’s Historical Statistics dataset for disaggregated data ([ggdc.net/maddison/](http://ggdc.net/maddison/) 02.03.2013) and Maddison (2007).

<sup>11</sup> Such progress is very hard to measure. Different measures may reveal vastly different results. We possibly even prospered far more than the data reveals (see Nordhaus 1997, 1996).

<sup>12</sup> Maddison (2001, p. 17).

staggering dynamics.<sup>13</sup> “Advances in population and income over the past millennium have been sustained by three interactive processes: (a) Conquest or settlement of relatively empty areas which had fertile land, new biological resources, or a potential to accommodate transfers of population, crops and livestock; (b) international trade and capital movements; (c) technological and institutional innovation.”<sup>14</sup> The latter, innovation, seems the only sustainable over a longer term, even enabling and determining the former two to a large extent (though surely the reverse could also be said to some extent). At least for now, conquest and settlement seems to be reaching some geographic, economic and often environmental limitation. Gains from international trade are still incurred, but likely to be diminishing, as more and more such gains are being exploited in an increasingly globalized world. Future gains from trade are likely driven by innovation driven differentiation and specialization rather than the expansion of transport and capital movements alone. Essentially innovation drives economic growth. As the OECD put it: “Innovation is inextricably linked to past and future economic performance and to societal wellbeing. Most of the rise in material standards of living since the industrial revolution has been the consequence of innovation. New or improved products and services, and new and improved ways of producing them, have for a long time been the main motor of economic growth. This trend is expected to continue.”<sup>15</sup>

By any standard, this is an extraordinary account. Many countries have advanced and grown immensely rich compared to anyone before. We have become used to such progress; we have become used to an ever – advancing economy. To us such numbers, ½ %, 1 %, 2 % of economic growth, etc. may seem sometimes insignificant when we hear about China, Brazil, Botswana, and so on, with sometimes two-digit growth figures. But think about it using some simple numbers<sup>16</sup>: Imagine one of your forefathers 2,000 years ago had one dollar. He/she invested it for you. Its real value grew by 1 % a year. Today<sup>17</sup> it would be \$480 million! Had it grown by

<sup>13</sup> Decomposing growth, disentangling the different factors is far from easy. See, for example, Solow (1957) and Mankiw et al. (1992). Also Jorgenson and Griliches (1967), Aghion and Howitt (2007), Fernald and Neiman (2011). The question why then, and why in the places that it did, mainly Europe, still is subject of intense discussion. This will remain an on-going discussion that has produced many explanations. Whether it is institutions, the rise of intellectual property, enclosure movement, trade, colonial expansion, hereditary laws, climate, Protestant Ethics, a confluence of all, etc. (see, for example, North and Thomas 1973; Landes 1998; Bauer and Matis 1988; Rosen 2010; Weber 1950), or for a recent and highly intriguing perspective see, for example, McCloskey (2010). Many more exist.

<sup>14</sup> Maddison (2001, p. 18).

<sup>15</sup> OECD (2009b, p. 7).

<sup>16</sup> Following a similar illustrative example Barro and Sala-i-Martin (1995, p. 1) use to demonstrate the importance of growth. The calculations here are based on Maddison (see [ggdc.net/maddison/](http://ggdc.net/maddison/) 02.03.2013).

<sup>17</sup> For the sake of simplicity, the year 2000 is chosen. The original calculations go until then. Also it provides a better time horizon: 2000 years. This may be inexact, and the additional 10 years to 2010 do make a difference, but this is merely a thought experiment. The intuition still holds just the same.

**Table 2.1** The impact of growth in the very long run

	Annual growth rate (%)	Income per capita year 1 (USD <sup>a</sup> )	Income per capita in 2000 (USD <sup>b</sup> )
World			
Actual	0.13	450	6,029
Scenario 1: slightly higher growth	0.20	450	24,569
Scenario 2: higher growth	1.00	450	218,324,337,934
Scenario 3: same as USA after 1820	1.73	450	510,374,292,028,365,000

<sup>a</sup>1990 International Geary-Khamis dollars. Data from Maddison 2008

<sup>b</sup>Calculated as  $(450) \cdot e^{(2000 \cdot \text{interest rate})}$

only 0.5 % you would end up with ‘only’ \$22,000. At 1.5 % with \$10 trillion. In reality, compounded growth was far, far less than that. Crude estimates would put it at 0.13 %. You would end up with a little more than \$13. That’s it. If growth would have been slightly higher, unbelievably huge effects on prosperity would have resulted over such a long time (see Table 2.1). In year one anno domini, average world GDP per capita is estimated at \$450. With a compounded growth rate of 0.13 %, this has grown to an average of some \$6,029 per person today. Imagine it would have been a little bit higher. Instead of 0.13 % and 0.2 %. This small difference would have had a big impact. World GDP per capita would now be at \$24,569 instead of some \$6029. Would growth have been a ‘meagre’ 1 % over this time it would result in some \$218 billion per person. At 1.73 %, the rate the US grew since 1820, it would have resulted in \$510,374,292 billion per person. Per person! A noticeable difference. You would be quite a lot richer.<sup>18</sup>

What such flimsy ‘what-if’ numeric exercises show is that slight differences in growth can come a long, long way over time. And one, if not the most important determinant of growth is innovation. There are possibly good reasons why growth was ‘only’ at the rate it was. But try to grasp the impact if indeed it were possible to nurture growth, possible to nurture innovation, even only slightly, to continuously make better use of the innovation potential. Its economic impact would be enormous.<sup>19</sup>

<sup>18</sup> Similar would hold for the US economy. Take a shorter time horizon: ‘only’ 180 years (but an important 180 years of rapid industrialization and growth). Compounded it grew at 1.73 % annually. Imagine what a percentage more or less each year would have resulted in – in 2000 GDP per capita would have been at \$172,216; that is six times as much. Or even if it had grown only slightly faster, at a compounded annual rate of 1.91 % as Japan did over the past 180 years (though from a lower initial starting point), per capita income per person in the US would be significantly higher, at close to \$40,000, almost 50 % higher.

<sup>19</sup> In the short run, innovation may cause considerable adverse effects: structural unemployment, displacements, even conflicts (see, for example, Heertje 1973, or Vivarelli 1995) for an overview of the classical debate, including James Steuart, Ricardo, Marx, etc. Also, see other discussions, such as Neisser (1942), and most recently, the controversy surrounding Rifkin (1995). Also Freeman et al. (1982), Acemoglu (1997, 2002), Postel-Vinay (2002), Standing (1984), Vivarelli and Pianta (2000), Woirol (1996). This is an on-going debate. Empirically, no conclusive evidence has yet been found Pianta (2006, p. 577). Also, growth differs vastly across the globe. Catching up is hugely different

The history of economic growth is essentially a history of ideas. Ideas have been the single most defining element in determining and enabling prosperity. Surely not a linear one. At times we have diverged, faltered, regressed, we have at times forgotten ideas, gone wrong. The history of science is littered with marvellous advances, curious developments and embarrassing missteps.<sup>20</sup> Yet, all in all, we have progressed – and magnificently at that. Ideas made it possible. Such claim builds on two essential features of ideas: (i) ideas are – more or less – cumulative, and (ii) ideas prevail. We constantly add new insights to the stock of knowledge. It expands. We have the opportunity of standing on the shoulders of giants, making the giant grow by adding new knowledge. This provides us with a fascinating view of the world, an increasingly sophisticated understanding of the universes – and how to benefit from it.<sup>21</sup> New and exciting opportunities open up to improve our lives through ideas. This also stresses a second appealing feature of ideas. While structures decay, resources wane, capital depreciates, riches are squandered or destroyed, ideas remain. With knowledge, at least the potential to achieve prevails. We may not be able to live in a Roman villa or Viking hut, but the knowledge that was generated to build it remains and not only offers us the chance to easily repeat it, but has enabled us to build better and/or cheaper living quarters using our time and resources more effectively. Capital accumulation may determine the wealth of nations. Knowledge and ideas define its prosperity. In the long run ideas prevail and ideas dominate. They determine what we can achieve. They define prosperities envelop. As economist Paul Romer illustrated this intuition: “The raw materials that we use have not changed, but as a result of trial and error, experimentation, refinement, and scientific investigation, the instructions that we follow for combining raw materials have become vastly more sophisticated. One hundred years ago,

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than pushing the envelope (see, for example, Abramowitz 1986 or Mankiw et al. 1992). Many other factors determine growth, and many correlate with innovation. Incremental differs to radical innovation. Some are disruptive; others complements. Many act through externalities; others are not diffused. Some cluster, others are highly independent. Some occur in waves; others randomly. Sometimes they are forgotten; rediscovered or belatedly employed. Many are borne out of need; others come from affluence. And so on. These are all important aspects. The general claim though remains intact: over the long run innovation is the single most important contributor to economic growth and prosperity. As an indicative measure, its track record is sound.

<sup>20</sup> The most obvious setback, on a large scale, is surely the dark ages and the subsequent renaissance. Some more particular examples are the Harvey-Descartes Controversy (see Gorham 1994), the dispute between Huygens and Newton, or the “wounded dog theory” with the powder of sympathy to determine longitude (see Sobel 1995, Chap. 5). An entertaining example may also be the changing attitudes to hygiene over time (see The Economist 2009d). Such notions of non-linear progress in science have long been subject to extensive debate (most prominently the Popper-Kuhn-Feyerabend-Lakatos’ debate (e.g. Popper 1989; Kuhn 1970; Feyerabend 1975; Lakatos and Feyerabend 1974; also Blaug 1976).

<sup>21</sup> Despite the discouraging philosophical debate on truth, we often apply the pragmatic ‘no-miracles-argument’ – ‘according to which the success of science would be miraculous if scientific theories were not at least approximately true descriptions of the world’ (see Smart 1963 and Putnam 1975). However, it too faces severe constraints and methodological problems (e.g. Matheson 1998 or Ghins 2002).



all we could do to get visual stimulation from iron oxide was to use it as a pigment. Now we put it on plastic tape and use it to make videocassette recordings.”<sup>22</sup> In short: Ideas allow us to achieve more with less – not only repeating the same with more resources, but crafting new and better outcomes with the same or less inputs.<sup>23</sup> And, it is progressive. Building on what we know, adding ideas, we can achieve even more. Thus, utilizing the existing stock of knowledge, better yet expanding this envelop through new ideas can vastly improve lasting prosperity.

This provides a legitimate basis for the dull and numbing litany of the importance of ‘innovation’. It must seem trivial. In retrospect, it often looks so simple. Easy to put in some nonchalant metaphor: “economic growth springs from better recipes, not just from more cooking”.<sup>24</sup> Clearly, innovation is the main driver of prosperity. Thanks to the pioneering work of many luminaries, serendipitous circumstances and profound historic developments, we have fully embraced innovation as the fundamental driving force of prosperity. Technological progress, and more generally innovation, is now considered *the* most important driver of prosperity. Ideas are a key resource in a modern economy, “not just another resource alongside the traditional factors of production – labor, capital, and land – but the only meaningful resource today”.<sup>25</sup> This notion has found its way deep into public conscience. Media has popularized and romanticized innovation, has idealised inventors and entrepreneurs, stressed the gains of innovation for the individual and society. Innovation is now widely accepted as the source of prosperity. Innovation is mainstreamed. This is reflected also in policy. Political debates are shaped around this topic. It has spawned an edifice of innovation policy, and an exuberance of hope and belief in its power of salvation.<sup>26</sup> In Europe 2009 was declared the ‘European Year of Creativity and Innovation.’<sup>27</sup> India declared the entire next decade as the

<sup>22</sup> Romer (1990). Also see Romer (1992).

<sup>23</sup> This is a populist version of what the diligent denotative economist would consider an to produce the same with less or more with the same. Both are analytically and equally valid propositions. The resulting economic effects on growth and employment, however, depend on the assumptions being made, whether the inputs are held constant or the output. Clearly, if either one holds true, for any increment, however small, within such increment more with less is a valid statement – populist, agreed, true none the less. This captures an important point still: The choice of perspective yields different results. Either emphasizes too strongly or neglects entirely a possible negative effect innovation might have in the short run. The fear: the same with less – less has often been seen as less labour, hence unemployment, stirring reluctance, even luddite sentiment. This is a valid concern to be addressed in the text below. But it should be acknowledged, though not overstressed, nonetheless. Venturing into such debate is daunting given the dogmatic nature of it. This short reference to it here may suffice.

<sup>24</sup> Romer (2007).

<sup>25</sup> Nonaka and Takeuchi (1995, p. 6).

<sup>26</sup> “There is growing awareness among policymakers that innovative activity is the main driver of economic progress and well-being as well as a potential factor in meeting global challenges in domains such as the environment and health” OECD (2007, p. 3). Also see OECD (2005).

<sup>27</sup> [create2009.europa.eu](http://create2009.europa.eu) (02.03.2013).

Indian ‘Decade of Innovation’.<sup>28</sup> In the U.S. President Obama discovered “innovation is what America has always been about”<sup>29</sup> and the National Innovation Initiative proclaimed: “Innovation will be the single most important factor in determining America’s success through the twenty-first century.” with the affix: “Innovate or Abdicare”<sup>30</sup> The Chinese ‘Medium- to Long-Term Strategic Plan for the Development of Science and Technology’ envisions China by 2020 to be one of the world’s leading ‘innovation economies’: “By 2020, the progress of science and technology will contribute at least 60 % to the country’s development.”<sup>31</sup> The government envisions “to build China into a country of innovation.”<sup>32</sup> Similar could be found in most countries. This is typically backed by large funding volume, legislation, and large-scale initiatives. The EU for example earmarked some 60 billion Euros in research and innovation promotion funding; the US has the Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act (COMPETES); Germany is the ‘*land of ideas*’.<sup>33</sup>

In short: innovation matters gravely. We know that now. And with confidence, we can now proclaim: Ideas define prosperity. Innovation creates opportunities, creates affluence. The fundamental importance of innovation is well understood (if not fully appreciated). Policy is besotted with innovation. Grand claims are made. Many reports are written. Incredible amounts of money are spent on it. Innovation is fundamental!

But what are the fundamentals of innovation? It is suspiciously curious how little we really know about innovation – the inner working of what drives it, how it comes about. We just accept it. We have identified its importance, but not how it comes about. Indeed, “windy talk about innovation is mind-numbingly abundant.”<sup>34</sup> Despite all the research, despite all theorizing we are still a long way from a practical approach. Many disciplines seem to experience a recent revival in search of the principle and practices of innovation, as our understanding is unmasked as rudimentary at best, guesswork if you will, theorizing on the surface, with little depth and fundamental insights. It still seems an ‘intellectual onion’: ‘You peel it back layer by

<sup>28</sup> Pratibha Devisingh Patil, President of India (Patil 2009).

<sup>29</sup> President Obama (2012).

<sup>30</sup> Council on Competitiveness (2004, p. 7 and p. 9). Also see President Obama (2009).

<sup>31</sup> [english.gov.cn/2006-02/09/content\\_183426.htm](http://english.gov.cn/2006-02/09/content_183426.htm) (02.03.2013) Also OECD (2007).

<sup>32</sup> China’s Peaceful Development: [What China Aims to Achieve by Pursuing Peaceful Development](http://www.english.gov.cn/official/2011-09/06/content_1941354.htm), September 2011, Information Office of the State Council, Beijing, [english.gov.cn/official/2011-09/06/content\\_1941354.htm](http://english.gov.cn/official/2011-09/06/content_1941354.htm) (02.03.2013).

<sup>33</sup> (i) Combining FP7 ([cordis.europa.eu/fp7/](http://cordis.europa.eu/fp7/) 02.03.2013) and CIP ([ec.europa.eu/cip/](http://ec.europa.eu/cip/) 02.03.2013), both running from 2007 until 2013. In addition, substantial amounts within the Structural Funds ([ec.europa.eu/regional\\_policy/thefunds/index\\_en.cfm](http://ec.europa.eu/regional_policy/thefunds/index_en.cfm) 02.03.2013) aim at this too; (ii) [thomas.loc.gov/cgi-bin/query/z?c110:H.R.2272](http://thomas.loc.gov/cgi-bin/query/z?c110:H.R.2272): (02.03.2013); (iii) [land-der-ideen.de](http://land-der-ideen.de) (02.03.2013).

<sup>34</sup> The Economist (2010d). See especially the feisty article in the Wall Street Journal May 23 2012 quoting the Securities and Exchange Commission figure that, in 2011, the word innovation was used 33,428 times in quarterly and annual reports.

layer and when you get to the centre, there is nothing there, but you are crying.’<sup>35</sup> Devoid of a clear view, the most sophisticated approach still, it seems, is to lavishly throw money at it. In principle, this can be a good idea as innovation is in essence often a question of resources, risk and incentive. But how? Current practices seem a shameful example of how not to proceed. Many are not eligible or neglected by dotting politicians attempting to pick winners in information and communication technology (ICT), biotechnology and high and green technology sectors. Ideas can pop up anywhere, and often stem from less vogueish endeavours. The second popular approach: institutional provisions for entrepreneurship, whatever that may mean to most (e.g. ‘Doing Business’, Intellectual Property, liability laws, access to finance, etc.). Grander approaches still: Dwell on the notion of education, culture, incentives per se. Alas, despite its prominence, innovation remains elusive. No wonder then innovation is often mused as the ‘secret sauce’ of business success, or a ‘mysterious process’, and ‘magic formula’.<sup>36</sup> It seems hard to grasp, even harder to nurture. Attempts to foster, increase innovation are often platitudinal interpolations, are best guesses.<sup>37</sup> Some work, some do not. Most only work in particular circumstances. No one seems sure how to truly bring about innovation. To be fair, such harsh appraisal should be placed into a more elaborate context. In principle, these are all good points it seems. Many valuable insights do indeed exist. But, on the one hand, are they typically very vague, fragmented and often incoherent, and in practice fail to be effective as the conceptual linkages are poorly understood. On the other hand, and this is more intriguing, underlying all this is typically already a very distinct concept of innovation, characterizing our perception of innovation processes, clichés of how ideas are realised, ought to be realised. This determines the existing approaches – and often their failure.

How do you think innovation comes about? A flash of genius? Hard work? And the process? Large corporations and high-tech, gadget-laden laboratories? Some tinkerer in a shabby garage? A clever entrepreneur making his way in the world? Serendipitous circumstances where the stars align? Innovation has many facets, has surely many possibilities and stories to it. But when it comes to the question of what to do, how to foster it, how to nurture innovation, a more general understanding is needed to address the challenges head-on. We all have some preconceptions, some notion of how innovation manifests. These determine how we approach innovation, how we perceive our chances of success, our possibilities and prospects in participating in the innovation process, in shaping policy. Taking a step back, allowing for an unspoiled perspective can help to better identify such underlying concepts, can help connect some of the dots, to provide for a more comprehensive

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<sup>35</sup> To paraphrase the delightful image used by Stevenson (2004). Admittedly, Stevenson, a Harvard Business School Professor for entrepreneurship, portrays a more positive picture of entrepreneurship in this article. This remains to be argued.

<sup>36</sup> See Dyer et al. (2009), Hargadon and Sutton (2000), The Economist (2009b), Burnham (2009), Berkun (2007); etc.

<sup>37</sup> See, for example, OECD (2009b).

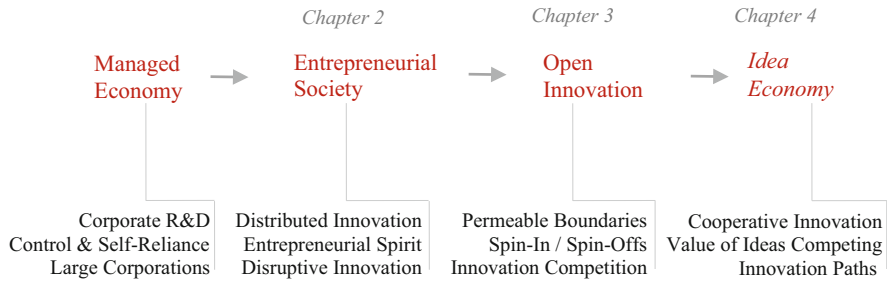
or at least more dynamic picture of innovation processes. It can provide new perspectives, new insights, and help to keep an open mind to appreciate the things to come. It can help identify challenges and obstacles to overcome. Imagine the prospects if only it were possible to nurture innovation, allow easy and more successful participation in the innovation process.

Such an approach needs to be broad enough to be inclusive, granular enough to be applied, and pragmatic enough to work. Thus the plan: First, capture innovation as an evolving concept in a larger socioeconomic framework (in the following, Part I). This can help identify more profound developments, a more dynamic perspective, not just, where we are but also expose the trends of where we are heading, and why. Then, as a next step, understand how, what obstacles, practical challenges, and possible pragmatic solutions exist to foster innovation in such a setting (Part II).

To capture innovation, broad strokes can help provide an organizing framework. Stereotypes can help crystallize important evolutionary steps. This is crude, but necessary. Such stereotypes may help paraphrase characteristics of an era, of a process, of socio-economic conditions. They expose our implicit preconceptions of innovation, what we mean by and how we handle it. Certainly, there are always many aspects that may not be fully captured, and any categorization falls short of the complexity it represents. But it is helpful. It helps conceptualise it, to think of it in terms of trends. None is exclusive, and they often apply overlapping or simultaneously. But they describe some major indicative characteristic of the socio-economic environment. We do it all the time, assigning prototypical traits to people, institutions, nations, etc. such as talking about ‘The Germans’, ‘The Investment Bankers’, ‘The Youth Today’, and so on. Surely not all Germans are orderly, surely not all investment bankers are overpaid neurotics, obsessed with business card quality as in the movie *American Psycho*,<sup>38</sup> and most certainly not all youth is Wii-crazed, uses strange lingo and is drunk. Yet they are often pictured and defamed in such terms, are stereotyped. Though often helpful, they bear a risk. We act on them. Such stereotypes often determine our actions, our policies and approaches, the manner we engage. They should not be thrown around lightly. Two things follow: first, stereotypes are helpful. For them to stick they need to be catchy, short, and precise. More importantly the second: they need to be sound. Anecdotes and tales of vague conjecture are not useful (e.g. broken society and youth). They need to be argued, rationalized, and supported by sound underpinnings. Thus better examples include characteristics that hold more closely and can be supported much better. Surely, we are moving increasingly from primary agricultural production to secondary manufacturing to a more tertiary, a ‘service economy’. Data supports that. We surely not all work in services, but it may still well describe the overall current economic composition and its impact. We live in an era where we have to take and are exposed to more and more manmade risks – a ‘Risk Society’. Logical

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<sup>38</sup> Harron (2000).



**Fig. 2.3** Evolution of innovation (From the Managed to the Idea Economy)

argument supports that. The world is getting smaller – not literally – but globalized. With ease we travel, trade, communicated globally. We live in a ‘globalized world’. Daily experience supports that. These are stereotypical descriptions of a situation, an economy, a society. Surely they do not affect all in the same way, overstress certain aspects, and clearly cannot be seen the only aspect. Often they coexist depending on the context. But, they may capture important developments, trends, changes and complex concepts; they may convey important developments, and illustrate important features. They are helpful. We indeed do the same when describing innovation. More granularity is needed. What kind of innovation? How does it manifest? What are the conditions, the enabling environment? What are the underlying dynamics? In discussing this, stereotypes can help. Exposing different facets of innovation in terms of stereotypes can help better understand them; crafting new ones may help provide perspective and vision. Such vision, such broader picture is useful. It can be assessed and discussed, and it can help prepare for it, even foster its arrival. To ruin the suspense: the innovation framework has progressed from the ‘managed economy’ to an ‘entrepreneurial society’ and will, via ‘open innovation’, move towards an ‘*Idea Economy*’ (see Fig. 2.3).

The managed economy, where innovation was largely a function of corporate R&D and implementation by the incumbent firm, has been replaced with the entrepreneurial society. Today entrepreneurship exemplifies innovation, and with it defines our attitudes and policy approaches towards innovation. The arrival of the entrepreneurial society has in turn set in motion other developments. ‘Open innovation’ is gaining ground – as corporate response to the entrepreneurial threat. Corporations are increasingly pressured, their markets contested by start-ups realizing better ideas. Firms are adjusting, opening up to gain access to such ideas in order to compete and not to be left behind. Together this dynamic will culminate in yet another socio-economic stereotype: the *Idea Economy*. Ideas will be traded; a division of labour between invention and implementation will drive innovation. With its arrival, much will change. New opportunities will open up. Understanding the evolution towards it, the implications and challenges may help to better prepare, may help to accelerate it and may help to bring it about. It may help to foster innovation, and with it, enhance growth and prosperity.

## References

- Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *The Journal of Economic History*, 46(2), 385–406.
- Acemoglu, D. (1997). Technology, unemployment and efficiency. *European Economic Review*, 41(3), 525–533.
- Acemoglu, D. (2002). Technical change, inequality, and the labor market. *Journal of Economic Literature*, 40(1), 7–72.
- Aghion, P., & Howitt, P. (2007). Capital, innovation, and growth accounting. *Oxford Review of Economic Policy*, 23(1), 79–93.
- Barro, R., & Sala-i-Martin, X. (1995). *Economic growth*. New York: McGraw-Hill.
- Bauer, L., & Matis, H. (1988). *Geburt der Neuzeit: Vom Feudalsystem zur Marktgesellschaft*. Munich: DTV Deutscher Taschenbuch.
- Berkun, S. (2007). *The myths of innovation*. Sebastopol: O'Reilly.
- Bernhofen, D. M., El-Sahli, Z., & Kneller, R. (2013). *Estimating the effects of the container revolution on world trade*. CESifo working paper series no. 4136. [http://www.cesifo-group.de/DocDL/cesifo1\\_wp4133.pdf](http://www.cesifo-group.de/DocDL/cesifo1_wp4133.pdf). Accessed 31 March 2013.
- Blaug, M. (1976). Kuhn versus Lakatos or Paradigms versus research programmes in the history of economics. Reprinted In Hausman, D. M. (1994). *The philosophy of economics – an anthology* (2nd ed., pp. 348–375). Cambridge: Cambridge University Press.
- Bughin, J. et al. (2011). *The impact of internet technologies: Search*. McKinsey & Company. [http://ssl.gstatic.com/think/docs/the-impact-of-internet-technologies-search\\_research-studies.pdf](http://ssl.gstatic.com/think/docs/the-impact-of-internet-technologies-search_research-studies.pdf). Accessed 31 March 2013.
- Burnham, J. B. (2009). Economic growth, entrepreneurship, and the deployment of technology. In N. Aydogan (Ed.), *Innovation policies, business creation and economic development* (pp. 13–35). New York: Springer.
- California Energy Commission (2009). Appliance efficiency regulations. Docket Number 09-AAER-1C, California Code of Regulators, Sections pp.1601–1608.
- Chen, Y., Jeon, G. Y., & Kim, Y. M. (2013). *A day without a search engine: An experimental study of online and offline searches*. [http://yanchen.people.si.umich.edu/papers/VOS\\_2013\\_03.pdf](http://yanchen.people.si.umich.edu/papers/VOS_2013_03.pdf). Accessed 31 March 2013.
- Council on Competitiveness (2004). *Innovate America: National innovation initiative summit and report*. Council on competitiveness, Washington, DC. [www.compete.org/images/uploads/File/PDF%20Files/NII\\_Innovate\\_America.pdf](http://www.compete.org/images/uploads/File/PDF%20Files/NII_Innovate_America.pdf). Accessed 02 March 2013.
- Dyer, J. H., Gregersen, H. B., & Christensen, C. M. (2009). The innovator's DNA. *Harvard Business Review*, 87(12), 61–67.
- Fernald, J. G., & Neiman, B. (2011). Growth accounting with misallocation: Or, doing less with more in Singapore. *American Economic Journal Macroeconomics*, 3(2), 29–74.
- Feyerabend, P. K. (1975). *Against method*. London: New Left Book.
- Fogel, R. W. (1999). Catching up with the economy. *The American Economic Review*, 89(1), 1–21.
- Freeman, C., Clark, J., & Soete, L. (1982). *Unemployment and technical innovation: A study of long waves and economic development*. Westport: Greenwood Press.
- Ghins, M. (2002). Putnam's no-miracle argument: A critique. In S. Clarke & T. D. Lyons (Eds.), *Recent themes in the philosophy of science: Scientific realism and commonsense* (pp. 121–137). Dordrecht: Kluwer Academic.
- Gorham, G. (1994). Mind-body dualism and the Harvey-Descartes controversy. *Journal of the History of Ideas*, 55(2), 211–234.
- Hargadon, A., & Sutton, R. I. (2000). Building an innovation factory. *Harvard Business Review*, 78(3), 157–166.
- Harron, M. (2000). *American psycho*. [Movie] Directed by Harron, M., screenplay by M Harron and G Turner, based on a novel by BE Ellis, Lions Gate Films.
- Heertje, A. (1973). *Economics and technical change*. London: Wiley.

- Jorgenson, D. W., & Griliches, Z. (1967). The explanation of productivity change. *The Review of Economic Studies*, 34(3), 249–283.
- Kremer, M. (1993). Population growth and technological change: One million B.C. to 1990. *Quarterly Journal of Economics*, 108(3), 681–716.
- Kuhn, T. S. (1970). *The structure of scientific revolutions*. Chicago: University of Chicago Press.
- Lakatos, I., & Feyerabend, P. K. (1974). *Kritik und Erkenntnisfortschritt*. Braunschweig: Vieweg.
- Landes, D. L. (1998). *The wealth and poverty of nations: Why some are so rich and others so poor*. New York: Norton.
- Maddison, A. (2001). *The world economy: A millennial perspective*. Paris: OECD Development Centre. doi:10.1787/9789264189980-en.
- Maddison, A. (2007). *Contours of the world economy 1–2030 AD: Essays in macro-economic history*. Oxford: Oxford University Press.
- Maddison, A. (2008). Statistics on world population, GDP and per capita GDP, 1–2006 AD. <http://www.ggdc.net/maddison/Maddison.htm>. Accessed 6 July 2009.
- Mankiw, N., Romer, D., & Weil, D. (1992). A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107(2), 407–438.
- Matheson, C. (1998). Why the no miracles argument fails. *International Studies in the Philosophy of Science*, 12(3), 263–279.
- McCloskey, D. (2010). *Bourgeois dignity: Why economics can't explain the modern world*. Chicago: University of Chicago Press.
- Millard, A. J. (1990). *Edison and the business of innovation*. Baltimore: Johns Hopkins University Press.
- Neisser, H. P. (1942). “Permanent” technological unemployment: “Demand for commodities is not demand for labor”. *The American Economic Review*, 32(1), 50–71.
- Nonaka, I., & Takeuchi, T. H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York: Oxford University Press.
- Norberg-Bohm, V. (2000). Creating incentives for environmentally enhancing technological change: Lessons from 30 years of U.S. energy technology policy. *Technological Forecasting and Social Change*, 65(2), 125–148.
- Nordhaus, W. D. (1996). *Do real output and real wage measures capture reality? The history of lighting suggests not*. Cowles foundation working paper no 957, <http://cowles.econ.yale.edu/P/cp/p09b/p0957.pdf>. Accessed 02 March 2013.
- Nordhaus, W. D. (1997). Traditional productivity estimates are asleep at the (technological) switch. *The Economic Journal*, 107(444), 1548–1559.
- North, D. C., & Thomas, R. P. (1973). *The rise of the western world: A new economic history*. Cambridge: Cambridge University Press.
- Obama, B. (2009). *Remarks by the president: On a new beginning*, Cairo University, Cairo, Egypt, June 4, The white house, office of the press secretary. [www.whitehouse.gov/the-press-office/2009/06/04/remarks-president-cairo-university-6-04-09](http://www.whitehouse.gov/the-press-office/2009/06/04/remarks-president-cairo-university-6-04-09). Accessed 02 March 2013.
- Obama, B. (2012). *State of the Union 2012*. Remarks by the president in State of the union address, United States Capitol, Washington, DC, 24 Jan, The White House, Office of the Press Secretary. [www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address](http://www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address). Accessed 02 March 2013.
- OECD. (2005). *Oslo manual* (3rd ed.). Paris: OECD. doi:10.1787/9789264013100-en.
- OECD. (2007). *OECD Reviews of innovation policy China*. Paris: OECD. doi:10.1787/9789264039643-en.
- Patil, P. D. (2009) *President of India, Smt. Pratibha Devisingh Patil's address to the joint session of 15th Lok Sabha in New Delhi*. 4th June, AKT/AD/HS/LV (Release ID :49043). <http://pib.nic.in/newsite/erelease.aspx?relid=49043>. Accessed 02 March 2013.
- Pianta, M. (2006). Innovation and employment. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 568–598). Oxford: Oxford University Press.
- Popper, K. R. (1989). *Logik der Forschung* (9th ed.). Tübingen: Mohr.



- Postel-Vinay, F. (2002). The dynamics of technological unemployment. *International Economic Review*, 43(3), 737–760.
- Putnam, H. (1975). *Mathematics, matter and method (Philosophical papers I)*. London: Cambridge University Press.
- Rifkin, J. (1995). *The end of work: The decline of the global labor force and the dawn of the post-market era*. New York: Putnam.
- Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5), 71–102.
- Romer, P. M. (1992). Two strategies for economic development: Using ideas and producing ideas. *Proceedings of the World Bank Annual Conference on Development Economics, 1992*, 63–115.
- Romer, P. M. (2007). Economic growth. In: D. R. Henderson (Ed.), *The concise encyclopedia of economics* (2nd ed.). Indianapolis: Liberty Fund. [www.econlib.org/library/Enc/EconomicGrowth.html](http://www.econlib.org/library/Enc/EconomicGrowth.html). Accessed 02 March 2013.
- Rosen, W. (2010). *The most powerful idea in the world: A story of steam, industry, and invention*. New York: Random House.
- Smart, J. J. C. (1963). *Philosophy and scientific realism*. New York: Humanities Press.
- Smil, V. (1994). *Energy in world history*. Boulder: Westview Press.
- Smil, V. (2005). *Creating the twentieth century: Technical innovations of 1867–1914 and their lasting impact (Technical revolutions and their lasting impact)*. New York: Oxford University Press.
- Smil, V. (2006). *Transforming the twentieth century: Technical innovations and their consequences*. New York: Oxford University Press.
- Sobel, D. (1995). *Longitude: The true story of a lone genius who solved the greatest scientific problem of His time*. New York: Walker and Company.
- Solow, R. M. (1957). Technical change and the aggregate production function. *The Review of Economics and Statistics*, 39(3), 312–320.
- Standing, G. (1984). The notion of technological unemployment. *International Labour Review*, 123(2), 127–147.
- Stevenson, H. H. (2004). Intellectual foundations of entrepreneurship. In H. P. Welsch (Ed.), *Entrepreneurship: The way ahead* (pp. 3–1). New York: Routledge.
- The Economist (2009b). *Special report on entrepreneurship: Magic formula. The secrets of entrepreneurial success*. 12 March 2009.
- The Economist (2009d). *Filth. The joy of dirt: Why cleanliness may be going out of fashion*. 17 Dec 2009.
- The Economist (2010d). *Promoting innovation. Growth on the cheap: The OECD tells governments how to unleash business's creative potential*. 27 May 2010.
- van den Ende, J., & Dolfisma, W. (2005). Technology-push, demand-pull and the shaping of technological paradigms: Patterns in the development of computing technology. *Journal of Evolutionary Economics*, 15(1), 83–99.
- Vivarelli, M. (1995). *The economics of technology and employment: Theory and empirical evidence*. Cheltenham: Elgar.
- Vivarelli, M., & Pianta, M. (Eds.). (2000). *The employment impact of innovation: Evidence and policy*. London: Routledge.
- Weber, M. (1950). *The protestant ethic and the spirit of capitalism*. (trans: Talcott, P.). London: Scribner. <http://ia700306.us.archive.org/5/items/protestantethics00webe/protestantethics00webe.pdf>. Accessed 02 March 2013.
- Woirol, G. R. (1996). *The technological unemployment and structural unemployment debates*. Westport: Greenwood Press.



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