# sustainable Innovation

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Cátedra ISC

Universidad Rey Juan Carlos

RED DE INNOVACIÓN

# Credits

## > Sustainable innovation

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**About Forética:**
Forética is Spain´s leading organization in the fields of CSR and sustainability. Its mission is to promote the culture of corporate responsibility and business ethics, providing organizations with knowledge and tools to integrate CSR within the business as a driver of competitiveness and sustainable business models.

OBSERVATORIO zeltia

**About Observatorio Zeltia:**
The Zeltia Group launched Observatorio Zeltia with the goal of creating innovation processes for scientific and technical education, the dissemination of training programs and, as mean to increase competitiveness within society. This observatory is one of Zeltia´s main corporate citizenship commitments.

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# Introduction

> “Innovation is the specific instrument of entrepreneurship. The act that endows resources with a new capacity to create wealth.”
> Peter Drucker.

Innovation is an adaptive response to the needs of the environment. It is the result of producing something new or different with a practical application. As long as there exists a gap in addressing those needs –or they can be created- there will be innovation. But which are the elements that make an innovation to be regarded as more responsible than other solutions? Is being responsible a process or a result, if not both? What is the role of sustainability in the innovation process when developing new products and services? Has CSR added value to operations and business models? What can companies learn from social innovation? These are the questions to be addressed in this piece of research.


# Defining innovation

Innovation is a value-adding-oriented activity through which new or existing needs and requirements in the marketplace can be addressed. It is the use of a novel or at least different approach to existing solutions. Innovation is regarded as the quintessence of prosperity, enabling the increase in productivity of resources, the creation of new markets, or both. One of the defining elements of innovation is its transactional nature by which its result is meant to be subject to commercialization. This commercial approach –not being mutually exclusive- places innovation closer to economics than science.

# The “S” curves, from radical to incremental

Innovation can be materialized into a continuous refinement and improvement of existing technologies, or it can emerge abruptly –creating a gap between Legacy and new technologies– as a game changer both for users and producers.

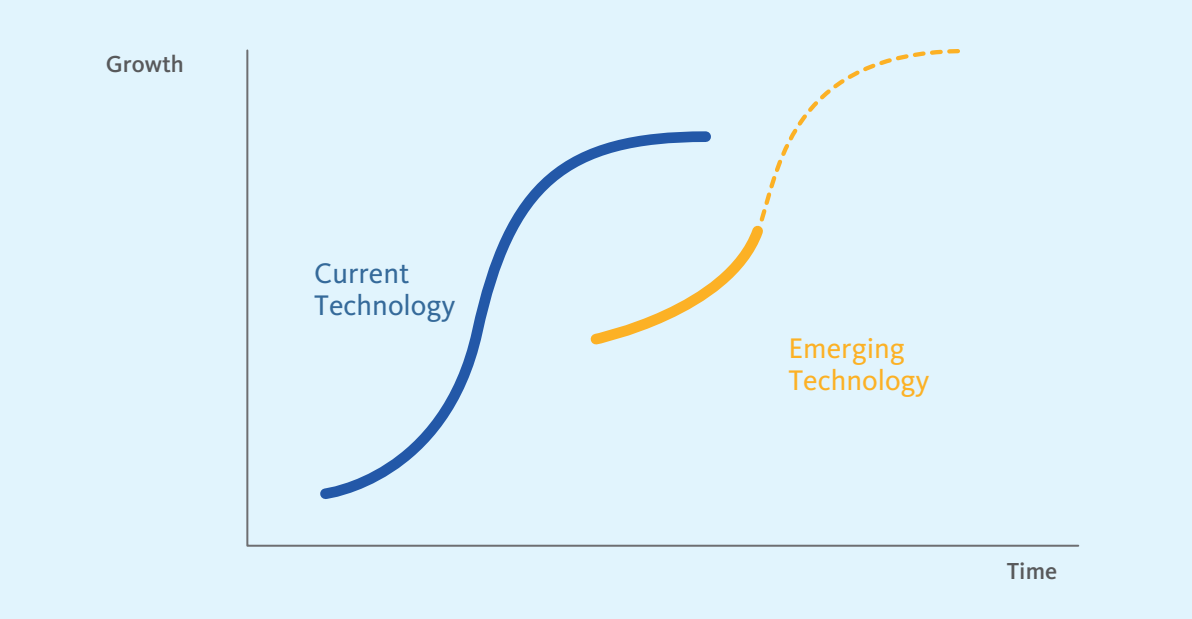
The innovation life cycle can be graphed through the so called “S” curves, where revenue growth or productivity gains from innovation are plotted against a time scale.

## > Radical innovation: Gutenberg versus Olivetti

In 1440 Johannes Gutenberg invented the printing press, which meant a radical innovation that enabled massive and mechanic printing processes. The production of books grew 25-fold within a century, from less than 10 million manuscripts in 15th century to over 200 million books a hundred years later. This was a tremendous disruption. Culture became accessible to large portions of the population, while copyists and amanuensis went out of business. The invention of the type writer, on the other hand, improved efficiency in text processing but both the invention and its impact were incremental. ■

In a first stage, the adoption rate of the technology is slow, showing a rather flat slope. However, a growing number of users in a second stage increases competition, accelerating the improvement in performance of the invention and increasing the steepness of the curve. In a third stage, the pace of incremental innovation slows and so the curve will flatten. As a logic consequence, these are symptoms of a new “S” curve forming down below.

**Figure 1**
The "S" curve.




**Source:** Forética.

# What is sustainable innovation

The concept of sustainable or responsible innovation can be rather controversial. For some, an innovation will always be responsible since it is its purpose to address a market need, and below that need, there will always be human beings. On the other hand, others would argue that not all human needs are legitimate or ethical. Moreover, beyond the boundaries of ethics and philosophy, lies ever more complexity in the concept brought by the economist Joseph Schumpeter of Creative Destruction. According to this line of thinking, restless innovation breaks the status quo among industries, creating violent dynamics by which added value is seized or given in by economic players in sudden and unpredictable waves, destroying wealth in existing sectors and imposing changes in the factors of production.

We could consider a responsible innovation that which creates a net positive contribution to the *function of sustainability*. This is to say that any innovation creating a posi-

> **Creative destruction: Smartphones and their killer applications**

The smartphone revolution is a good example of destructive creation. On top of being micro-computers, let alone cellular phones, smartphones with the right applications are currently replacing a whole range of devices such as scanners, fax machines, modems, TV remote controls, GPS navigators, multi-media players, low intensity torches, music amplifiers for guitars, multi-track recorders, video game consoles, books, cameras, webcams, TV sets, or astronomic compasses. Every manufacturer of the previous devices and their business partners have a reason to be worried as their products are being devaluated by this smart telephone terminals. ■

1. The concept of creative destruction was formulated by Schumpeter who was inspired, according to the author himself, by Karl Marx. This idea has been argued as the main virtue or vice of capitalism both by supporters or detractors respectively.

**Foretica's sustainability function**

$$f(e,s,a) = \frac{e_1}{e_0} + \frac{s_1}{s_0} + \frac{a_1}{a_0} > 0$$

$e_1$, $s_1$, $en_1$ = Innovation contribution
$e_0$, $s_0$, $en_0$ = Innovation's contribution

tive result to the combination of a three-factored function –economic, social and environmental- could be categorized as responsible.

This model is a simplification of reality. Economic, social and environmental factors do not and should not weigh the same when evaluating a nuclear plant or weekend-out-leisure activities. But it is a powerful way to illustrate the complexity and the delicate interdependence between all three factors, thus making it hard to assess the degree of sustainability without being to some extent arbitrary. As an example, a new solution to detecting and upstreaming oil would have net positive economic contribution (ROI), a positive effect on society– considering an increase of oil supply leading to cheaper energy prices, generating a consumer surplus and increasing tax revenues- while having a negative environmental impact –cheaper oil leading to higher consumption and thus increasing CO2 emissions–. On the other hand, research on rare diseases has an uncertain return on investment –potentially high research expenditures and a small number of patient- but a remarkable contribution to society´s welfare –patients, family and physicians- and a neutral environmental impact. Finally, the use of crops for the production of biofuel has a positive economic contribution– crop yields rising for farmers while potentially lowering energy prices as more substitutes to oil are available- along with a net environmental impact –reducing reliance on fossil fuels curving the greenhouse gases emissions- but a negative social contribution – higher demand for agricultural commodities reducing food supply, increasing prices, putting pressure on stocks and eating out a higher portion of lower income earners' wealth, increasing disparities between rich and poor.

## > Another inconvenient truth: The Jevons paradox

The Jevons paradox is a reminder that sometimes increasing the efficiency of resources is not good enough, and rather than reducing consumption it expands it. This empirical observation was described in 1865 by Williams S. Jevons who realized that, defying conventional wisdom, some technological improvements that boosted the efficiency of coal created an increase in demand from this source of energy. This will happen when demand is elastic enough (sensitive to price changes) when factoring in what that resource can achieve in terms of output. When reducing consumption for a given industrial application some excess supply emerges in the market and prices fall. An elastic demand for that particular good would respond absorbing more of it. The total consumption at the end of this feedback loop will be higher when the so called rebound effect is higher than 100%. A more up to date example can be found in the United States´ shale gas revolution where a technological improvement has reduced extraction costs dramatically, expanding the supply of gas, plummeting prices, decoupling them from oil´s and boosting consumption. ■

# Chronos, the implacable judge

Another dimension can yet change the sign of the economic, social and environmental contribution of an innovation. That is time. This is intimately related to Schumpeter´s concept of creative destruction. Disruption often created by innovation can create divergent consequences depending on the time span that is being evaluated. For example, a big restructuring process for a company or a country dramatically reduces output and increases unemployment in the short term, while allowing to update factors of production and to re-allocate resources leading to higher long term growth potential. This makes evaluating responsible innovation even harder because the longer the time span the more uncertain future benefits become. A similar phenomenon occurs with natural catastrophes. Devastation from natural shocks paralyze a territory and bring casualties in the short run. However, several research analysis argue that these phenomena also increase future growth rates[2].

In an extremely competitive innovation market, product´s life cycle tend to shorten, compressing the length of "S" curves generating costs as well as benefits. Some innovations are rejected before gaining critical mass, while incremental improvements are ever faster.

2. Skidmore and Troya 2002. Chul Kyu Kim 2012

# Space, the importance of an innovation fabric

Innovation can be pinpointed in a when and a where. The geographic factor of innovation is empirical evidence derived from the fact that innovation tends to concentrate around clusters. This is neither a response to a pleasant weather in a certain location, nor necessarily to a privileged access to key natural resources. There are three critical factors that explain this pattern: a high degree of specialization, the existence of compelling incentives to innovation and a sound socio-political governance.

The specialization within a region –through technology or as a specific industry cluster- creates a feedback loop by which the players in a particular activity subject to innovation settle in the place best suited[3] for accessing ideas, talent, capital and key suppliers. As a consequence hyper-competitive environments accelerate the innovation process.

On the other hand, the economic incentives for innovation are another determinant factor that makes a specific location more attractive than others. Talent intensive activities must be properly funded and financed. A country´s economic policy plays an important role for that to happen. Thus, the dominant model in the United States relies on innovation ecosystems where renowned academic institutions on technical and scientific fields of expertise, companies and venture capitalists create top innovation hubs. A particular characteristic is the high degree of integration between universities and the private sector. In the Boston area, for instance, Harvard and MIT create and attract research labs, companies and over 164 venture capital outfits. In the San Francisco area, Stanford and Berkeley create clusters that nurture 270 venture capital companies focused on information technology and other sciences.

3. The idea of geography based competition is a contribution made by Michael E. Porter in “The Competitive Advantage of Nations”.

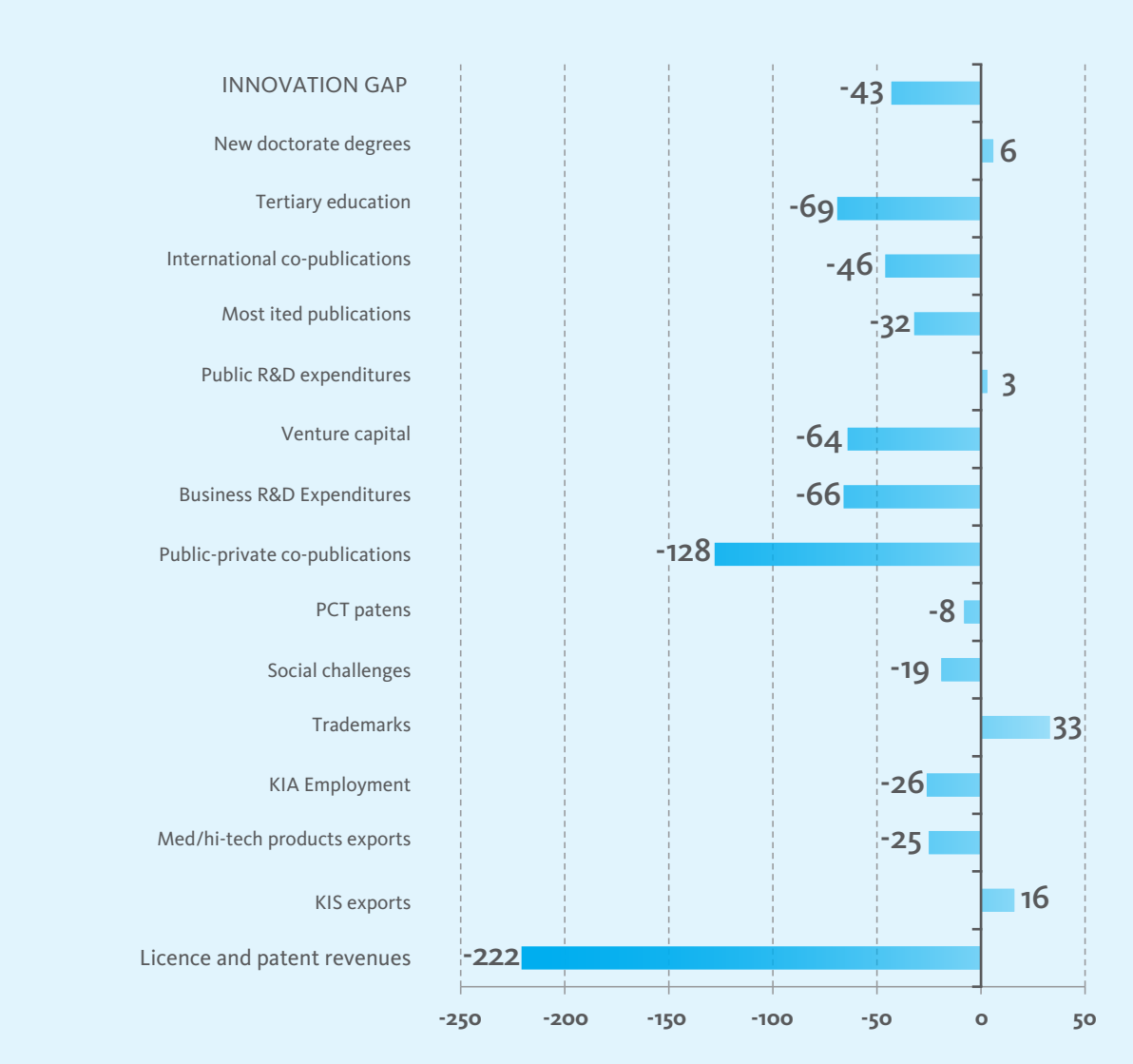
In Europe, the European Commission has launched the Innovation Union within its Europe 2020 strategy. This Union aims to promote innovation as a mean to tackle the great challenges that social issues, climate change, resource scarcity or health and active ageing pose to society. One of the goals of this initiative is to bridge the existing gaps between the USA and Japan in terms of innovation effort and results, and it states that the EU should invest at least 3% of its GDP on R&D. According to the EC´s estimates this would imply the creation of 3.7 million jobs and increasing the value of GDP by 800€ billion by 2025[4]. The idea of sustainable innovation is embraced within the pillars of this strategy. The priorities of this Union are the following:

- *Smart cities.*
- *Efficient water management.*
- *Sustainable supply of non-energy related commodities.*
- *Smart mobility for citizens and businesses throughout the EU*
- *Agricultural productivity and sustainability.*

Consistently with the idea of the regional component of innovation, Europe presents an uneven development of its regions. According to the Innovation Union Scoreboard 2013, at the forefront of innovation the Innovation Leaders are visible in central Europe (Germany, Belgium and Austria), Scandinavia (Sweden and Denmark) and South of United Kingdom. A second category, Innovation Followers, dominate most parts of Western Europe except for the peripheral countries. As an exception to this trend, Ireland, and the main industrial parts of Spain (Aragón, Cataluña, Madrid, Navarra and the Basque Country), Italy (northern Italy) and Portugal (the central region) are regarded as second-tier innovators. The rest of the European map falls in one of the two lower categories as *Moderate and Modest Innovators*.

4. *Innovation Union Communication Brochure. EU.*

**Figure 2**
Performance gap with US




**Source:** European Commission. *Innovation Scoreboard* 2013. Forética.

The third element for success, as mentioned earlier, is sound governance. As the World Economic Forum´s yearly ranking for international competitiveness illustrates, one of the twelve dimensions under consideration is based on the quality of a country´s institutions (both public and private). In a previous piece of research by Forética[5], we stated that the five best performing countries in terms of the quality of their institutions –namely Singapore, Sweeden, New Zealand, Finland and Denmark- were poised to outgrow developed economies by 12% per annum in the period 2012-2017. In this line of thinking, one of the most correlated results in the afore mentioned Innovation Union Scoreboard 2013 is the quality of governance and the degree of innovation within regions. High rated countries in terms of governance tend to be Innovation Leaders in the scoreboard and the main drivers cited in the benchmark are: *the rule of law, government effectiveness, control of corruption*, and *voice and accountability*.

5. The value of transparency. RSEARCH nº 5. Forética.
http://www.foretica.org/biblioteca/rsearch/doc_details/585-rsearch-nd5?lang=en

# At the edge of responsible innovation

The challenges of sustainable development reflect potential constrains to the availability of resources. This makes sustainable innovation one of the main catalysts for growth for any sector or industry. Below are briefly explained some of the mentioned challenges that could have a significant impact on innovation processes across the board.

Adapting to an urban planet: The speed at which the social landscape is evolving globally is transforming the planet, from a predominantly rural world to an urban one. According to McKinsey & Co. estimates[6], China alone is ready to build 2.5 times the city of Chicago every year. Adding India into the calculation would give 3.5 Chicagos per annum.

Demographics and the welfare state crisis: Some of the most emblematic entitlements made by developed economies in the last century will show unsustainable as the effects of demographic changes take center stage. From an economic point of view a greying population means a slower economy, a big impact on fiscal revenue as well as an increase in social spending. Worker´s intellectual and physical capabilities tend to be slowly and progressively reduced from an early age (20 years old), and tend to curve productivity of labour on their fifties[7].

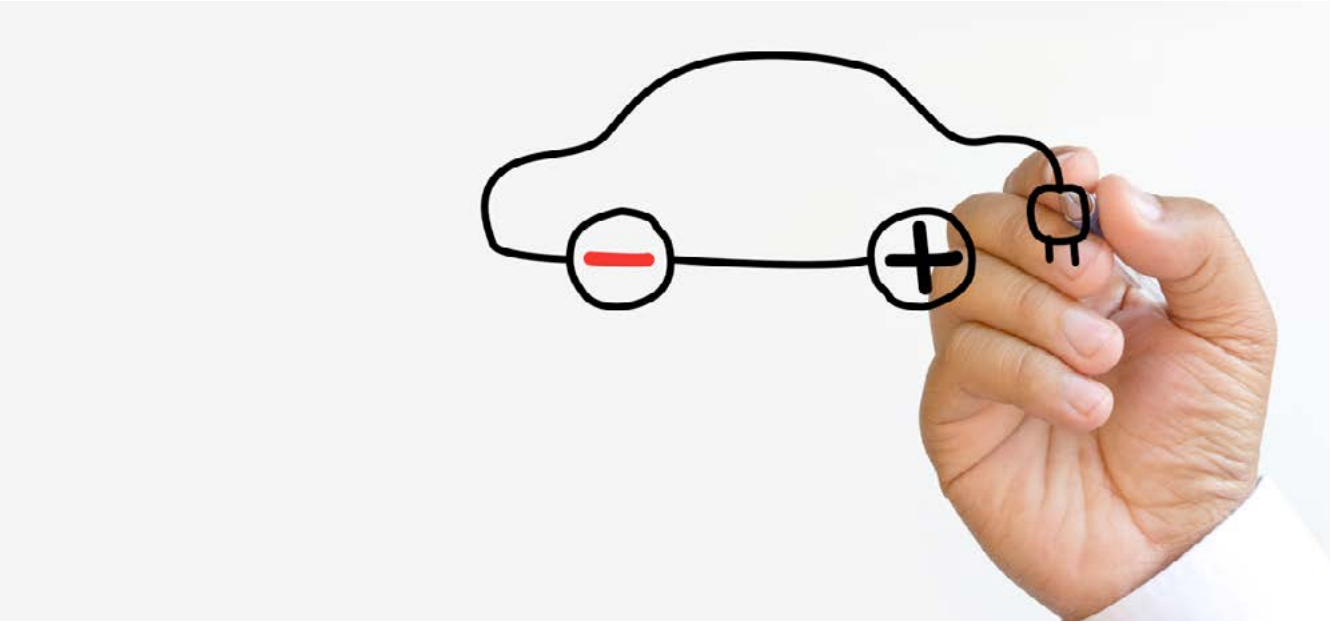
Unlimited demand for a rigid supply of resources: Economic convergence of emerging and developing economies will add 3 billion new people to the world´s middle class in the next 20 years, from the current 1.8 bil-

6. *The Resource Revolution. Mckinsey 2011.*
7. *Psycology and Aging 199. Age and individual productivity: a literature survey, Vegard Skirbekk, Max Planck Institute for Demographic Research, 2003.*

lion. This means 2.6 times more power for consumption, shifting the demand curve even further away, since the marginal propensity to consume is higher for lower incomes than it is for already high income earners. This transition into the world middle class will expand demand for resources such as energy, food, land, water and metals. The already relatively rigid supply for those goods requires a radical expansion in productivity to meet the expected demand.

The raise of chronic diseases and other pandemics: Life expectancy and quality of life records have been systematically improved in the last century in most parts of the planet. This has created a solid base for prosperity and economic development, which importance has not been sufficiently acknowledged all too often. However, serious warnings threaten to reduce this impressive performance in global health that, if materialized, imply enormous social and economic costs. The progressive development of chronic diseases, the growing number of antibiotics-resistant bacteria and the existence of new potential pandemics require a continuous innovation in scientific research, as well as a greater coordination by national and supranational healthcare organizations in the monitoring and containment of potentially global outbreaks.

Climate change, water and volatility: Climate Change may generate a number of unwelcome consequences that affect life on earth, from natural catastrophes to major biodiversity losses, let alone volatility in weather patterns. All of these bring in important economic costs and drops in the quality of life of vast portions of population. Decreasing reserves of fresh water and lower weather predictability will affect agricultural productivity that, on the other hand, should serve a growing global population.



# Segmenting responsible innovation

We have argued previously that a responsible innovation is such that generates a net positive contribution to our sustainability function. We are now going to discuss how responsible innovation takes shape.

| | |
|---|---|
| **Product**<br>Examples | Innovation materializes in a specific product.<br>*LED lightning, hybrid cars, fair trade products, microfinances, smartphones and tablets, reverse mortgages, smart grids.* |
| **Services**<br>Examples | Innovation is delivered as a service.<br>*Car sharing, peer to peer renting (homes, cars etc.), online banking, location based services.* |
| **Process**<br>Examples | Innovation is channelled through a process or scheme.<br>*Co2 trading platforms, open-innovation, clean development mechanisms, returnships.* |
| **Business model**<br>Examples | The Innovation lies within the business model.<br>*Bottom of the pyramid, TED, Purpose.com, Patagonia* |
| **Social structure**<br>Examples | Innovations in the allocation of social-intensive resources.<br>*Social impact bonds, Creative Commons, free education.* |

Innovation can take shape in a product, a service, a process, a business model or a new way of organizing and allocating social-intensive resources. How responsible an innovation is from the sustainability standpoint is not a univocal reading for any beholder or, as mentioned earlier, necessarily consistent through time. Sometimes an innovative product is considered as positive to society until it is proved otherwise. This is something relatively frequent in healthcare or food and beverages sectors. It is not the goal of this paper to assess or rank the contribution of different innovation from a sustainability perspective but to suggest a method to do so.

This could ultimately help to orient public policies for stimulating sustainable innovation, which on the other hand would yield a double dividend for a state or a region. For starters, fostering innovation could potentially boost productivity and wealth in the economy. Moreover, sustainable innovation can solve or mitigate some of the greater challenges and constrains at the economic, social and environmental levels.

Companies could also benefit from this approach in order to channel their innovation efforts. An innovation that could dwarf some of the aforementioned conundrums can indeed be a great business or- at least- a catalyst for reputation and good understanding with governments and regulators.

## Pondering sustainable innovation

In this section we would like to illustrate how our sustainability function would work in practice when assessing innovation. It is not our aim to do an exhaustive analysis of the economic, social and environmental impact of the examples bellow, but to show the interrelation of the different dimensions that play out in a particular innovation.

## Table 1
Sustainable innovation examples

PRODUCTS

### ELECTRIC CARS

Vehicle run on one or more electric engines.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| The cost of ownership is reduced. Cheaper access to energy and maintenance on a less number of components. | Noise is significantly reduced. Preserves the quality of air. Positive effects on health in the cities. | It eliminates fossil fuel as a primary energy source and its dependence on carbon is tied to the energy mix of the local power grid. Electric engines are considered three times more efficient than internal combustion ones when it comes to transformation rates. |

### REVERSE MORTGAGE

A reverse mortgage is a financial solution for people over 65 in which a financial institution commits to a fixed monthly payment to the asset owner temporary act as an annuity.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| It is a mean to monetize on illiquid assets financing retirement. | It allows to offset the income reduction during retirement, improving quality of life. | It has no environmental impact. |

### SMART GRID

Smart grids improve the performance of energy infrastructure, from power generation to its transportation, distribution and consumption. An automated system manages energy demanding resources, optimizing energy supply, reducing waste and providing consumers and producers with real time data on prices and consumption.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Reduces energy cost by optimizing supply and increasing competition among sources of production. | Cheaper energy and increased affordability | A more efficient model reduces waste and allow a cleaner energy mix. |

SERVICES

### CAR SHARING

Car Sharing is a model of car rental where people rent cars for short periods of time, often by the hour.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| A payment system based on miles driven and hours of disposal is an economic alternative to the purchase of the vehicle. Ownership of a car implies the down payment of the total value of the car as opposed to paying for usage. | Efficiently improves mobility reducing traffic congestion and connecting points not covered by public transport. | High occupation rates can replace between 4 to 8 private cars, reducing emission and other environmental impacts. |

### PEER TO PEER RENTAL

Underutilized goods and services are rented to other individuals creating an additional income for the non-professional asset owner.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Boosts personal income and creates new markets for more affordable products and services. | Consumers have an alternative source to goods and services increasing choice and reducing costs. | There is no significant environmental impact attached. |

### LOCATION BASED MARKETING

The use of technology to provide offerings and advertisement based on the location of the user through tracking devices such as smartphones and tablets.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| It is a cheap technology enabling targeting consumers that are close to the selling point. | Improves consumer interaction by providing relevant information at a convenient timing. Peer reviews and directions increase the value of the information. | Supply and demand are matched reducing opportunity as well as environmental costs. |

## Table 2
Sustainable innovation examples

PROCESSES

### CO2 CAP AND TRADE MECHANISMS

Carbon markets allow industry participants to trade their extra emission to more pollutant producers.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Creates an economic incentive for reduction of carbon emissions since cleaner producers can monetize their improvements while less carbon efficient players internalize an additional cost. | Society benefits from a reduction in pollution and the mitigation of potential consequences of climate change. | Lower green house gas emissions. |

### OPEN INNOVATION

An open innovation model combines internal research and development resources with knowledge outside of the organization. This collaboration can improve in-house R&D by adding external experts and new lines of work in a collaborative way.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Time and costs are reduced by accessing to other people and institution´s ideas and R&D. | Society at large plays a more active role in innovation processes. | There is not a significant environmental impact associated to open innovation. |

### RETURNSHIP

Returnships are the equivalent for an internship in which the employee is a person returning to the labor market after some years of absence.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| New and flexible models of participation in the labor market increase economic output by adding people to the workforce that would be out of the market otherwise. | Creates more opportunity for senior people that abandoned the labor market for personal factors such as family needs, health problems or other elements. | There is not a significant environmental impact associated to returnships. |

SOCIAL ORGANIZATION

### SOCIAL IMPACT BONDS

SIBs are financing structures set up to fund social and environmental projects. Governments would only pay upon performance as the venture reaches pre-approved targets.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Investors get a potential financial return as they back a social project altogether. Governments free up funds that will only create an obligation in case of achieving the expected results. | Neglected society´s needs are addressed. Tighter cooperation between governments, NGOs and the private sector. | There is not a significant environmental impact associated to returnships. |

### CROWD FUNDING

Alternative way of financing projects through the collective effort of individuals who pool their money.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Broadens financing base allow more innovative and socially beneficial projects. | Individuals engage in projects addressing society´s needs. | There is not a significant environmental impact associated to crowdfunding. |

### CREATIVE COMMONS

A creative commons license is a public copyright license that enable the free distribution of an otherwise copyrighted work. People can freely use and build on the work under the creative commons license without copyright infringement.

| Economic Impact | Social Impact | Environmental impact |
|---|---|---|
| Easier and cheaper dissemination of ideas. It reduces costs for users. | Society benefits from free access to value added content | There is not a significant environmental impact associated to crowdfunding. |

# Sustainable innovation's challenges

The challenges at the heart of sustainable innovation are, in many cases, identical to its (less sustainable) peers. Here we would like to highlight those that are especially relevant for sustainable innovation.

The front end back end dilemma: The innovation process typically has two phases. The front end has to do with the ideas origination, the quest for alternatives for solving a particular problem. The back end, on the other hand, is the phase of testing and implementing the idea. Despite the fact that human ingenuity is scarce enough, the back end is the main bottleneck since the development phase is way more expensive and resource intensive than the prior one. As a natural consequence, many great ideas are set aside for lack of resources for prototyping and testing at large scales.

Innovation and SMEs. Size matters? In line with the previous idea, large companies have more resources for financing the back end of innovation. Does this imply that innovation only occurs at big firms? Large companies tend to optimize their resources by focusing on the process of innovation itself, by managing a diversified portfolio of innovations. This approach refines the allocation of resources giving priority to those innovation with a higher probability of commercialization in the marketplace. This process is rather similar to financial investing where an asset manager would allocate his capital in a diversified collection of investments, maximizing the expected return with the least overall risk profile. SMEs on the other hand, concentrate their innovation activities in a small number of products if not just a single one.

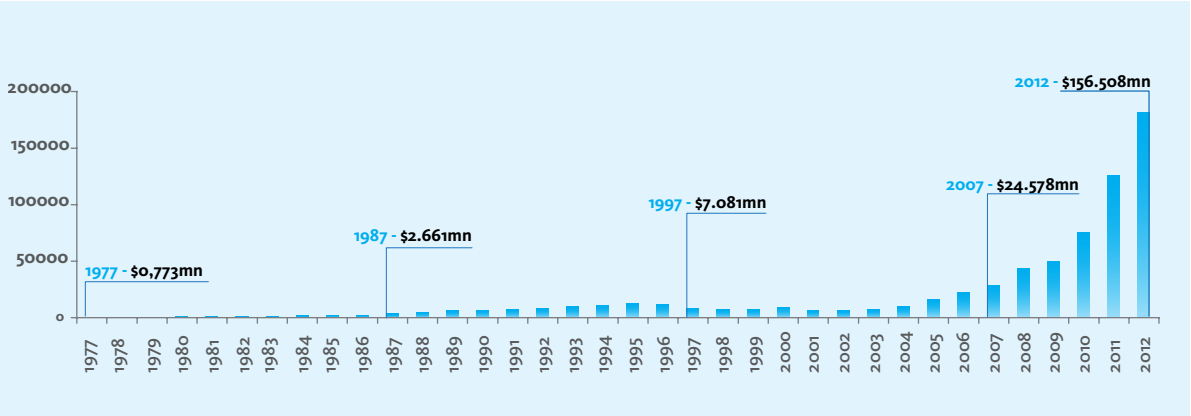
Several research studies have tried to weigh the impact of size of an organization with its innovation productivity, but the results are mixed and not clear cut.

The main explanation why some large companies were small once and grew their way out of their SME category is because innovation provide superior products, services, processes and business models. The speed at which in-

novation transforms organizations and the different catalyst make it hard to label a company as large, medium or small. Take Apple Inc. as an example. This iconic firm in the field of innovation started up with two employees, with a turn over falling short of 800 thousand dollars back in 1977. That is a very small firm. Only ten years later, revenue rose to 2.7 billion dollars. That is big enough indeed. In 2012 its income statement showed 156 billion dollars in revenue, about 200,000 greater than its first year of operation (see chart) and became the world´s largest company by market value.

Another important factor is the fact that innovation can be originated within the company or to be bought out somewhere else.

**Figure 3**
Annual revenue for Apple Inc.




**Source:** Reuters. Forética.

This is a very common pattern for large corporations where one of their main innovation drivers is through acquisition of start-ups or small and medium innovative firms.

Going forward, small and medium sized firms are poised to play a critical role in future innovation cycles, creating some sort of symbiosis between large and comparatively small companies. The front end of innovation will orbit around small and medium sized firms where there is a greater degree of flexibility, faster adaptation capabilities and are (more) independent.

The back end will be driven by large companies deeper pockets to finance the development process and better access to distribution channels.

Innovation and the tragedy of the commons: One of the greatest dilemmas in sustainability is that, all too often, the benefits of responsible innovation may slip away downstream in the value chain. Sometimes these benefits are spread into such an ample number of stakeholders that it is virtually impossible to monetize the innovation.

8. SMEs are in general more fluid as coordination costs are a fraction of larger firms. Decission making in a SMEs goes through less formal structures such as commitees and approval procedures. They are not subject to the preassure of financial markets, they can restructure fast, and they can work smoothly with dynamic budgets.

## Great idea! Thank you for your kind contribution.

Imagine a company –Benefactor Materials- that manufactures construction materials. Its latest invention consists in a magic formula that when applied to components in walls and glass is able to keep a constant room temperature of 22°C (71.6°F). This would eliminate the need for heating and air conditioning thus saving energy, money and improving environmental impacts as well as life quality. The question is, can this innovation boost the company´s income? The answer lies to a great extent in the bargaining power of the firm within the value chain. But let's just say that the company will probably face some headwinds. All too often the bulks of innovation benefits are captured at the end of the value chain. In our example, Benefactor Materials would sell its formula to Appropriator Construction Company –interested in lowering construction costs and hence improving its margins-, would then face Speculator Real Estate –a realtor selling a product that consumes a great part of their costumers' income and therefore sensitive to price changes - and Mr. Ego Jones –an end-consumer interested both in buying as cheap as possible and in reducing his energy bills-. In such scenario, innovation will be successful, but Benefactor Materials will likely profit from its innovation less than expected. The biggest beneficiaries would the environment, Mr. Ego Jones and probably Speculator Real Estate who might absorb some of the implicit energy savings through a little Premium Price. ■

Alignment of partners vested interests: The afore mentioned example shows that improvements in social and environmental factors are prone to be diluted in a myriad of stakeholders. This can be a hurdle for the return on responsible innovation investments. For this particular reason, public-private partnerships are the structure of choice for many areas of responsible innovation where companies, investors – private equity and business angels- government agencies, academia and non profits can coexist. The agendas of these partners can converge and diverge easily. Time frames and decision making processes can also be hard to agree upon. Therefore the political and economic dimension along with the collision of interests add complexity to this form of responsible innovation.

## Financial innovation at the rescue

The last greatest financial innovation orbits at great distance from the credit derivatives realm. Social Impact Bonds (SIBs) are an ingenuity that provide financial means for social projects creating a contractual structure through which investors and philanthropists can back a community project and –if social performance targets are met- cash in some return on the investment. SIBs are a multi-stakeholder partnership where different agents co-exist:

**Non-profit service providers:** Non-profit organizations are specialized in some particular social service for which they have built-in expertise. These identify problems, propose and design a specific solution and have the know-how and competences to deliver the service. However, they lack of financial resources.

**Governments:** Governments intend to solve problems in a community but lack financing

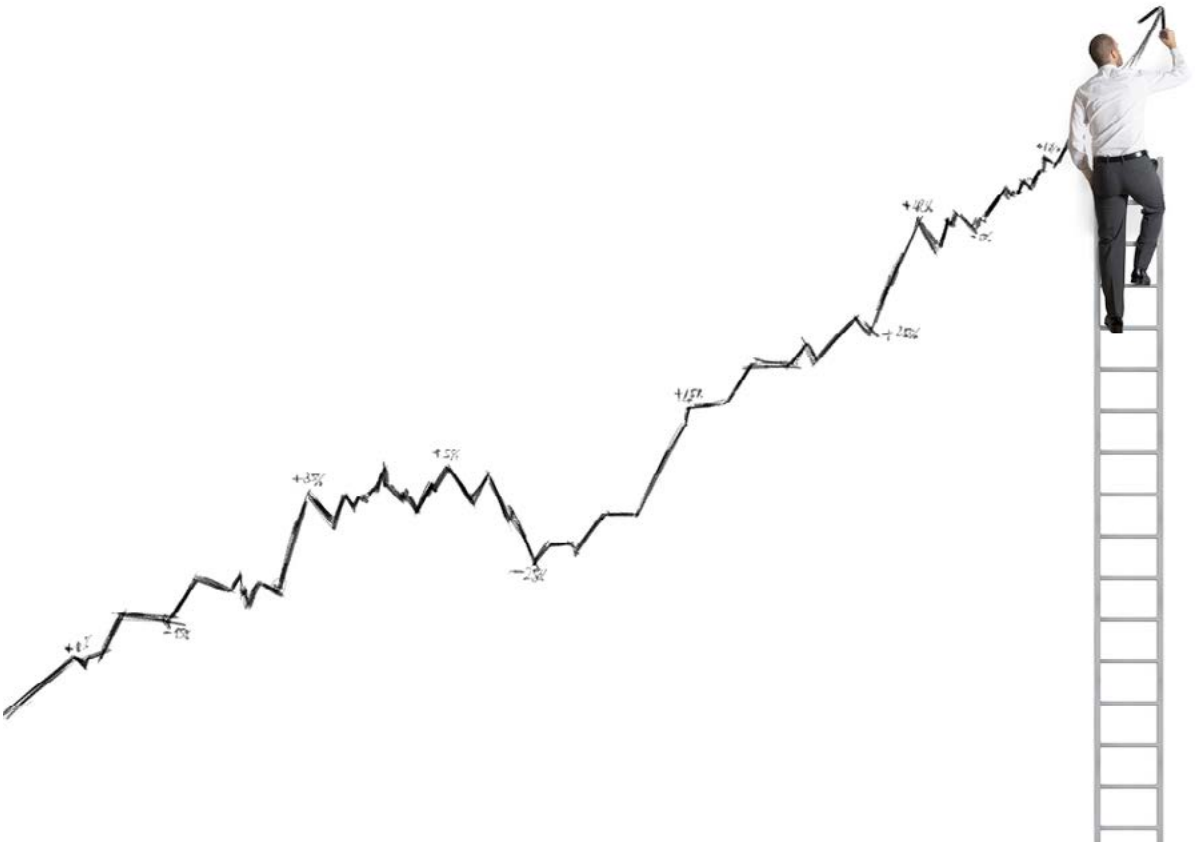
or experience or just cannot deviate resources already ear-marked for other initiatives. Governments tend to be willing to support certain extra-initiatives if their financial risk can be reduced and it only pays for actual performance.

**Financial intermediaries:** Between government and NGO, a financial intermediary with experience in social projects and financial competences structures the scheme, designing the bond and underwriting it among impact investors (both investors and philanthropists). The capital raised is distributed throughout the life of the bond between the non-profit service providers.

**Impact investors:** Impact investors are those who buy the bond and bear the financial risk of the operation.

**Independent assessors:** As a further assurance of the project, independent assessors operate between non-profit service providers and financial intermediaries. At the end of the project a third party evaluation is performed.

First generation SIBs are high risk financial structures. The debut of such a mechanism was in the UK and its risk-return profile is close to some sophisticated path-dependent derivatives. For example, the Peterborough SIB, created with the goal of reducing reconviction rates at the local prison, has a return between -100% at one end and somewhere between 0% and 93% at the other. ■



# Responsible innovation in Spain

Responsible innovation is the reflection of one country innovation´s animal spirits. Spain´s innovation profile is heterogeneous. According to European Commission's data, one third of Spain is a second tier innovator (Innovation Follower), other third falls in the Moderate Innovator category, and the final third is considered as Modest Innovator.

***Regional innovation in Spain. Innovation Union Scoreboard 2013****

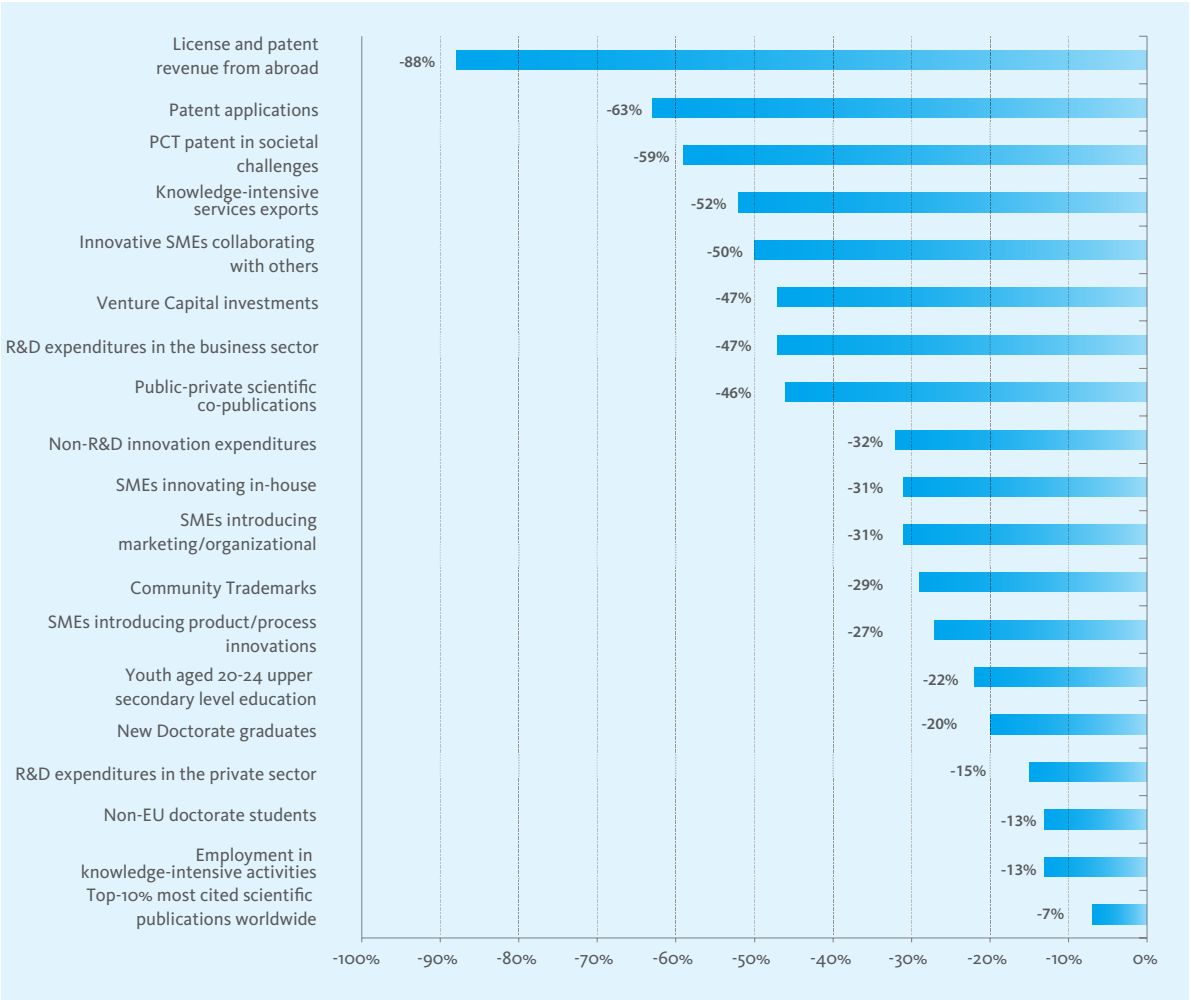

* The scorecard does not assess Ceuta and Melilla

There are three strengths in Spain´s innovation profile. The percentage of population aged between 30 and 34 with higher education (17% above EU average), The co-publication of international scientific papers (99% above), the creation of community brands (16%), sales of new-to-market products (32%). Some clusters are also significant such as aerospace, automobiles, IT, health related technology, Biopharma and chemicals.

However some major challenges remain. The most acute are related to marketing innovation and the productivity of R&D measured as new patent applications. Other factors include the inefficient allocation of economic resources, especially human capital. Public and private return on R&D investment is limited by labor market´s lack of dynamism. The unemployment rate among the young ended 2012 at 55,12%. Moreover, 28% of people with higher education is working in activities not related with their academic background (versus 13% for the EU average).

Nevertheless, Spain counts with a sound base and potential for innovation. Part of that potential is reflected in the success stories of responsible innovation out of which we would like to highlight the following:

**Figure 4**
Spain´s innovation challenges versus EU.




**Source:** European Commission. Innovation Scorecard 2013. Forética

■ ADIF and its FERROLINERAS: project: This initiative led by ADIF (Spain´s railway infrastructure company) provides charging for electric cars with energy extracted from the braking of trains. This improves the efficiency in the railway´s electric system while improving the overall mobility environmental impact.

■ INDRA and CONSIGNOS initiative: This pilot projects tackles social inclusion of hearing impaired people. Through cutting edge technology, information is translated in real time into Spanish Sign Language (LSE). The features of Consignos include voice and language recognition, automatic translation, and sign language communication through an animated character.

■ EADS and its Biofuels production and use for aviation: This Project is focused on the development of a cradle to grave value chain for sustainable bio-kerosene as a renewable power source extracted from camellia oil.

■ Fruits de Ponent´s DOSAFRUT DOSAFRUT is a system for dosing the amount of chemicals and fertilizers matching the specific field characteristics such as height, length, width and leafiness of the harvest.

■ A&B LABORATORIOS DE BIOTECNOLOGÍA and its product DD 456: The all-in-one enzymatic D 456 is a cleaning product with an organic degrading activity combined with degreasing and cleaning features. This is a more efficient product than traditional alternatives. The design and development of the product takes into account life-cycle environmental impacts.

■ ZELTIA and its project OBSERVATORIO ZELTIA: Initiative to promote innovation, dissemination and analysis of biotechnological information applied to health. It is focused on three main areas of performance in the field of biotechnology applied to health: Innovation, Dissemination and Analysis. It counts on the participation of excellent collaborators like the Superior Studies Center of Pharmaceutical Industry (CESIF), Rey Juan Carlos University and Forética.

# Conclusions

Throughout this paper we have outlined the importance of responsible innovation. This is a complex task since it requires discussing innovation and innovation dynamics on the one hand, and then putting it into the context of sustainability. Both Innovation and Sustainability are hot topics for governments, companies and stakeholders alike, but are far from maturity. We would like to draw the main conclusion of our research:

**1. Establishing a sound framework for assessing sustainable innovation.** We have argued that sustainable innovation is such that makes a net positive impact in our sustainability function. As we saw, the sustainability function has three factors (economic, social and environmental), which make it simpler. However, every factor has a different weigh for any given observer and for any given project which might increase in detail and complexity. Analysing how these factors perform in any innovation process might help in optimizing the impact of innovation from a societal perspective. In the end it might inspire public as well as private policies for R&D.

**2. Time and elasticity of demand might affect the impact of sustainable innovations.** Estimating an innovation´s contribution might be a hard and difficult task since a new technology can produce unexpected results. In this research paper we have outlined two phenomena that challenge conventional wisdom. One is the Jevon´s paradox, in which some improvements in the efficiency of one resource increases its consumption instead of reducing it. That might happen when demand for a product is too sensitive to its price to performance ratio. In this same line of thinking, there are other behavioural responses that might reduce the innovation´s social or environmental net positive impacts. For instance, a person might end up consuming more paper than before just because it is recycled paper and therefore, more environmentally friendly.

On the other hand, as in most investment projects, time might change the sign of the contribution of the innovation as it unfolds. This might be the case in many disruptive innovations which might have a negative impact in the short run but can add tremendous value in the long haul and vice versa.

**3. Innovation´s locus: industry, incentives and transparency.** Productivity of innovation have a local component. Elements such as specialization, an accommodative incentives scheme, access to capital and socio-political governance of a region have a critical impact and might generate positive dynamics for innovation. This last aspect can be slippery but is on of the main building blocks of highly innovative ecosystems. The rule of law, the lack of corruption, the mitigation of conflicts of interests, transparency in public affairs, all create conditions for competitive innovation to prosper.

**4. Sustainability at the edge of innovation.** Sustainability challenges will be at the heart of the next high impact innovations. The incredible speed of social and economic transformation, demography and its impact on social welfare and economic productivity, the rigidity in the supply of natural resources when trying to meet an ever increasing demand, health related shocks, water scarcity and climate change, represent serious threats for social, economic and environmental development. The impact of those threats depends on the degree of our innovation.

**5. The role of the government in sustainable innovation.** We have pointed out the importance of innovation for a countries competitiveness, and that sustainable innovation for society´s welfare. We have seen several market failures that limit financial incentives for the innovator when applied to sustainability challenges (see *Innovation and the tragedy of the commons*). This would argue in favor of public policies that promoted sustainable innovation. The adoption of models such as our sustainability function could improve the effectiveness of sustainable innovation from a macro perspective within a country or a region.

**6. Innovation in Spain. A margin for improvement.** Spain -as seen in several pieces of research discussed in this paper- needs to review its approach towards promoting innovation form a public policy perspective. A more focused emphasis on competitiveness, bridging the gap between business and universities and enabling the economic viability of its innovation fabric could be explicit goals for policy making.

**7. Sustainable innovation in Spain can be a source for inspiration.** Spain has state of the art sectors and best practices related to corporate responsibility and innovation. A further support for sustainable innovation can help in the development and long term impact of its innovation fabric, attracting talent and investment.

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