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Chair of Business Ethics

# From Health to Tech, Redistributive Justice:

# Adapting the Health Impact Fund to Address Automation-Driven Disparities

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# Introduction

From the beginning of human history innovation has marvelled people, it is one of the driving forces that shape society and humankind's future. However, the known and unknown ripple effects of innovation, have generated uncertainty about the future. This thesis has uncertainty as one of its main focuses, or better, its starting point, to examine some of the potential repercussions of technological advancement.

Facing an unforeseeable future raises many questions, and the experience of problems encountered in the past, can make imagination run wild. Who could have foreseen the consequences of Thomas Midgley Jr.'s[1] inventions at the time? An interesting and stark example of the kind of dilemmas one can encounter is Roko's Basilisk thought experiment, posted online in 2010 in the LessWrong blog:

> Imagine a future where a superintelligent artificial intelligence reigns, one that had foreseen its own creation and devised a master plan to ensure its birth. In this theoretical scenario, known as Roko's Basilisk, the AI harbours a vindictive streak, punishing those who knew it could come into existence but chose not to aid in its creation. This creates a tale of a self-fulfilling prophecy, where knowledge of the potential for such an AI becomes a kind of curse, a unique information hazard that casts a shadow of retrocausal influence, reaching back through time to shape its own destiny

The explanatory summary above is offered by OpenAI's ChatGPT, a large-language-model artificial intelligence. This thought experiment exemplifies the uncertainty that can arise when attempting to imagine the consequences of technological advancement. A significant number of people found this thought experiment so troubling they even began to view it as a life threat. Eliezer Yudkowsky[2], founder of LessWrong blog had to take the post down to avoid panic.

Even though Roko's Basilisk stands as an extreme example of the kind of fear that the development of artificial intelligence technologies can generate, this does not mean that there are no plausible and realistic negative consequences tied to their development. This thesis seeks to explore the uncertain consequences of large-scale automation technologies integration into the value chains of the

[1] Inventor of Leaded gasoline and Freon.
[2] An American artificial intelligence researcher, known for his works on decision theory and ethics.

developed world, considering the possible repercussions on developing countries. To be more precise here is developed an analysis of how adaptations of Pogge's Health Impact Fund to other fields can address issues like the widening of the competitional gap between developed and developing countries. Assuming a pre-emptive stance aimed at the minimization of suffering, the thesis reflects on global justice theories, principles of *justice as Equality* and *luck egalitarianism*. Basically, assuming that possible alternative measures could be taken by developed and developing countries alike. The analysis of the Health Impact Fund and its adaptation to the software automation sector resulting in the Automation Technology Impact Fund, has the scope to offer alternatives to the application of free market rules. Emphasising ethical values over short-term profit maximization could prove viable, preserving economic sustainability and efficiency, both for corporations and countries.

Furthermore, this thesis tackles the pervasive issue of uncertainty surrounding innovations, a topic frequently addressed in the ethics field through preventive measures, aimed at forecasting potential outcomes. While this anticipatory approach has proved to have merits, the thesis examines the possibility of taking a different approach: the implementation of the Impact Funds. The funds, rewarding only technologies with a positive impact, represent a valid alternative to the forecasting approach, introducing reactive and adaptive mechanisms. The Impact Funds are designed to reward only positive impact technologies, encouraging a development that could, possibly, prove to have fewer negative repercussions.

# Chapter 1: Innovation, Technology and Artificial Intelligence

## 1.1 Defining the Concept of Innovation

The concept of innovation is broad, it encompasses almost every human activity, its nature is mutable and malleable, its connotation constantly changing according to the time and the field it is applied to. This thesis focuses on analysing the Impact Funds from different perspectives, one of which is their innovative nature. The Impact Funds are *per se* innovative in nature, they represent an alternative approach to common practices, prioritising the ethical aspect over the profit-maximising approach that businesses commonly have. The grounding ideas at the basis of the Impact Funds are rooted in global justice theories. To better understand the context that shapes these funds it is crucial to describe how and why they can be considered innovations. A general overview of the innovative landscape is necessary.

In her article in Encyclopædia Britannica (2019), Sarah Boslaugh defines the concept of innovation as follows: "Innovation, the creation of a new way of doing something, whether the enterprise is concrete (e.g., the development of a new product) or abstract (e.g., the development of a new philosophy or theoretical approach to a problem)". While it is defined as*:* "a new idea or method, or the use of new ideas and methods" from the Cambridge Dictionary (2019a).

Semantically the term innovation often overlaps with the term invention, which however has a substantially different meaning:

- "Invention, the act of bringing ideas or objects together in a novel way to create something that did not exist before" (Burke, 2018).
- "Something that has never been made before, or the process of creating something that has never been made before" (Cambridge Dictionary, 2019b).

Thus, even if it is unconventional, it is possible to consider global justice theories as "*inventions*", a novel approach that addresses global disparities, while the Impact Funds can be seen as the "*innovation*", the practical implementation of those theories. As an example, the Health Impact Fund introduces a new method for businesses to seek profit, it is a means through which companies can shift from mere profit maximization to impact maximization strategies (grounded on global equality of opportunity principles) while still maintaining business sustainability.

Another interesting point that is worth mentioning is the difference between innovation and technology. While the connotation of innovations is often abstract, technology is tangible, the first is a process, as clarified by Boslaugh's definition, technology instead is the means by which innovations are implemented (Callegaro, 2017).

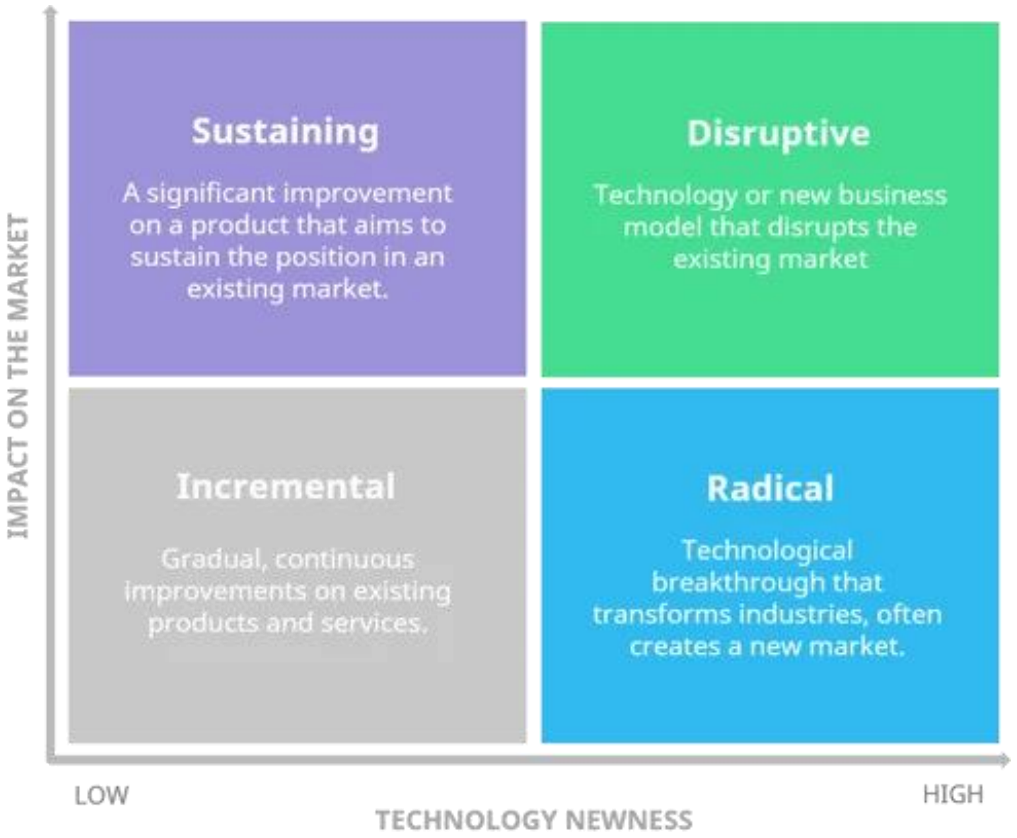
## 1.2 Classifying Innovation Types

There are different classifications of innovation types, according to the point of view applied. The two most prominent perspectives regard:

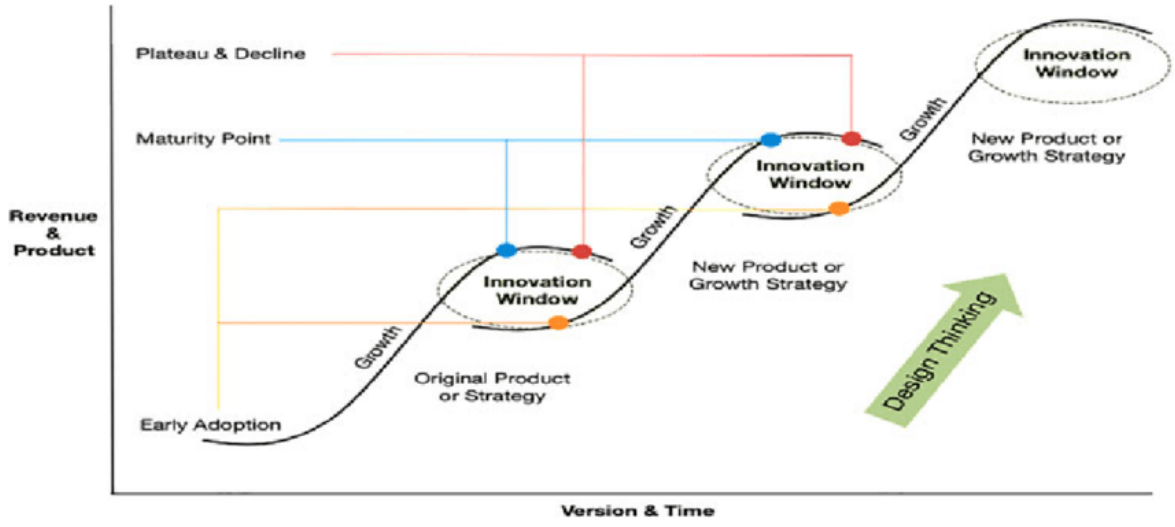
1. The approach that links **the market impact and the newness** brought by the innovation; this approach defines the **type** of an innovation.
2. The approach that analyses the **fields** that are affected by the impact of the innovation, this approach focuses on the **field and extension** of an innovation.

### 1.2.1 Types of Innovation

The first approach classifies innovations based on the market impact and the newness of the technology that an innovation can cause/bring. This method is one of the most popular because it can be universally applied without significant difficulties.




(Table 1)[3]




(Table 2)[4]

[3] Source: Kylliäinen, J. (2019, October 4). Types of Innovation – The Ultimate Guide with Definitions and Examples. Viima.com; Viima Solutions Oy. https://www.viima.com/blog/types-of-innovation

[4] Source: Mazouz, A. (n.d.). The "S" Curve and Innovation Window. ResearchGate. https://www.researchgate.net/figure/The-S-curve-and-innovation-window_fig1_331976444

**Incremental Innovations**

Incremental innovations offer a steady and constant improvement compared to their predecessors; this kind of innovation does not generate breakthrough technologies since they are based on previous versions of the innovative applications. They do not explore or create new markets and are often sold to customers that are already used to the technology, essentially, they can serve niche markets present in the customer pool. This kind of innovation generally arises in the maturity period, the upper edge of the *"S"* curve that defines the lifecycle of a technology/innovation. They anticipate the innovative stagnation that comes with the "*plateau*" and eventual "*decline*" phase. Incremental innovations can bring new features and prices to the market.

**Sustaining Innovations**

Sustaining innovations are similar to incremental innovations, the major difference between the two is their capacity to generate profit for the producer/innovator. The innovations do not bring high degrees of newness, they basically satisfy more demanding customers, thus generating significant profits. It is the definition of a low effort and risk - high reward approach adopted by numerous companies, it is highly attractive to capital. These kinds of innovations are often used to strengthen the market position of an affirmed company.

**Radical Innovations**

Radical innovations bring high-impact technologies and changes, their customer base is often very small if not even unaware of the need that these innovations satisfy, in fact, their impact on the market is not significant in their starting phase. However, Tushman and Anderson (1986) describe these innovations as so impactful that the older technologies cannot sustain their competitive pressure, once customers become aware of their potential.

**Disruptive Innovations**

Disruptive innovations, whose effects are described by Bower and Christensen (1995), are innovations that achieve a high impact on the market dimension while significantly innovating the technological landscape. "Managers must beware of ignoring new technologies that don't initially meet the needs of their mainstream customers" (Bower & Christensen, 1995) in their article the

authors warn incumbents about the degree of change this kind of innovation can bring to the market, disruptive innovations can completely phagocytize existing markets or discover *blue oceans*[5].

### 1.2.2 Fields of Innovation

The second approach defines the innovation by the area/field it affects, these definitions are self-explanatory:

- **Product & Product Performance Innovation:**
- **Technological Innovation:**
- **Business Model Innovation**
- **Organizational Innovation**
- **Process Innovation**
- **Marketing / Sales / Channel innovation**
- **Network Innovation**
- **Customer Engagement / Retention**
- **Social Innovation**

### 1.2.3 The Impact Funds as Innovation

It can be challenging to categorize the specific type of innovation into which Impact Funds fit (the classification strongly relies on the impact a fund is able to achieve and the industrial sector it promotes). At this time, Impact Funds can be classified as **Radical Innovations**, they bring a significant level of newness to the environment while they have still not achieved a remarkable impact

[5] *"Blue ocean is an entrepreneurship industry term created in 2005 to describe a new market with little competition or barriers standing in the way of innovators. The term refers to the vast "empty ocean" of market options and opportunities that occur when a new or unknown industry or innovation appears."* (Young, 2022).

on the market. However, the transformative effect these initiatives can trigger could potentially lead them to reach Disruptive Innovation status in the future.

It is easier to understand which "*areas*" the Funds could innovate. The Impact Funds can be classified as **Social Innovations**. The scope of these types of Funds is to address issues related to the social sphere by innovating the approach and the methods previously used. The HIF aims to reduce the final cost sustained by the population by revolutionizing the methods firms use to gain profits. Substituting classical market-derived profit with the Impact Fund rewards, while at the same time fostering the development of high-impact medicines. According to these characteristics, Impact Funds could also be classified as **Business Modell Innovations**. The structural modification of the patent system required to participate in the initiative can cause businesses to reconfigure their structure significantly, the R&D branches may also end up being reformed in order to seek and attain impact-driven profit instead of the "*traditional*" profit maximization.

## 1.3 Artificial Intelligence and RPA

The Automation Technology Impact Fund, object of this thesis, is based on the application of Pogge's Health Impact Fund and Green Impact Fund for Technologies, to the automation sector, more precisely software automation. To better grasp the technologies discussed, it is important to provide a brief overview of these technologies.

### 1.3.1 Artificial Intelligence

#### 1.3.1.1 Artificial Intelligence Stages

The stages of development of Artificial Intelligence: Since the world is currently just beginning to grasp the potentialities (and perils) of these technologies some of the stages are purely indicative and hypothetical.

- **Artificial Narrow Intelligence (ANI):** Also called Weak AI, trained to perform specific, and narrow tasks. In its restricted domain it has capabilities that reach consistently beyond the human level, an example can be an artificial intelligence trained to play chess.
- **Artificial General Intelligence (AGI):** Artificial intelligence with human-like capabilities, able to make decisions, to think and to perform a large array of tasks. For the moment this stage is still theoretical, to be considered an AGI artificial intelligence ought to pass tests such as the Turing Test[6].
- **Artificial Super Intelligence (ASI):** Nick Bostrom[7] defines ASI as: "any intellect that greatly exceeds the cognitive performance of humans in virtually all domains of interest".

[6] "*A machine and a human both converse unseen with a second human, who must evaluate which of the two is the machine, which passes the test if it can fool the evaluator a significant fraction of the time."* (Wikipedia Contributors, 2019d)

[7] Swedish philosopher, director of the Future of Humanity Institute at Oxford University.

#### 1.3.1.2 Artificial Intelligence Types

- **Reactive Machines Artificial Intelligence:** Operating only on existing data, able to perform limited tasks, Reactive Machines are not able to perform inferences to calculate future actions. One example is the IBM Chess Program.
- **Limited Memory Artificial Intelligence:** A technology able to base its current decisions on previous experiences and data stored in a short-term memory bank. For example, self-driving cars.
- **Theory of Mind Artificial Intelligence:** Designed to understand and interpret human psychology by analysing human emotions. These kinds of technologies are in development.
- **Self-Aware Artificial Intelligence:** Technologies that have consciousness and are self-aware.

#### 1.3.1.3 Artificial Intelligence Branches

- **Machine Learning:** Technologies that aim to solve problems in the real world, they are designed to analyse and interpret data. Machine learning is divided into three categories of learning.
    - **Supervised:**

      It is defined by its use of labeled datasets to train algorithms that to classify data or predict outcomes accurately. As input data is fed into the model, it adjusts its weights until the model has been fitted appropriately, which occurs as part of the cross validation process (IBM, n.d.-a).

    - **Unsupervised:**

      … uses machine learning algorithms to analyze and cluster unlabeled datasets. These algorithms discover hidden patterns or data groupings without the need for human intervention. Its ability to discover similarities and differences in information make it the ideal solution for exploratory data analysis, cross-selling strategies, customer segmentation, and image recognition (IBM, n.d.-b).

- **Reinforcement:**

  > … is an area of machine learning concerned with how intelligent agents ought to take actions in an environment in order to maximize the notion of cumulative reward. … Reinforcement learning differs from supervised learning in not needing labelled input/output pairs to be presented, and in not needing sub-optimal actions to be explicitly corrected. Instead, the focus is on finding a balance between exploration (of uncharted territory) and exploitation (of current knowledge) (Wikipedia Contributors, 2019c).

- **Deep Learning:** Requires the implementation of neural networks to generate solutions or insights. It is generally applied to complex problems.
- **Natural Language Processing:** Technologies that aim to understand human language, spoken and written, to gather data and organize information.
- **Robotics**: Machines that are designed to perform tasks in the physical world.
- **Fuzzy Logic:** Not based on 1 or 0, true or false (Boolean Logic), but on degrees of truth. Based on the human decision-making process that involves non-numerical information.

## 1.3.2 RPA

### 1.3.2.1 RPA Types

RPA or Robotic Process Automation is a technology designed to automate complex repetitive tasks that have a stable and constant set of rules eliminating the human variable, therefore being more precise, sacrificing the human capacity to adapt to anomalies. To overcome their lack of elasticity when problems arise, they can be flanked by artificial intelligence or supervised by humans to which they can report anomalies. The A.I. support enables RPAs to not be completely bound by the strict rules that enable their operativity. RPAs are one of the technologies that the Automation Technology Impact Fund can promote to reduce the automation-driven competitive gap between developed and developing countries. There are four main categories of RPA (this technology is solely software-based):

- **Data Entry Robots:** designed to move data between different systems or perform copy-and-paste activities. They are usually implemented to reduce human-driven errors and do not require complex integration procedures to be adapted to different systems.
- **Verification and Validation Robots:** Used to bridge internal (to a company) systems with external ones or third-party ones. These kinds of robots guarantee a higher reliability than humans, but they also require experienced human supervisors to whom they can report anomalies.
- **System Integration Robots:** Robots specially designed to help with systems fusing procedures when different companies merge, they allow continuity in the customers' experience and service.
- **Schedule or Trigger Robots:** Designed to be subordinated to specific events, they can organize information and design the tasks that need to be completed to reach a specific goal. They require authorization before starting to perform the tasks they created.

## 1.4 Vincix Group Case Studies

To better comprehend the reasoning behind the Automation Technology Impact Fund, and the need to avoid the future widening of the competitive gap between developed and developing countries, it can be useful to analyse some real-world data on the impact artificial intelligence and RPAs can have on business branches. The data analysed are provided by Vincix Group, an international company that designs and develops Robot Process Automations and Artificial Intelligences. These data were collected by me for my bachelor's thesis: "Technological innovations, intelligent automation - impacts on economic growth", I chose to mention them briefly in this thesis due to their effectiveness in illustrating the impact that software automations can have on entire business divisions.

Vincix Group provided data on three cases from clients that operate in different industrial sectors, each automation is purposely designed to meet the specific needs of the client, this highlights the adaptability of software automation technologies. The main parameter used in this evaluation is called FTE or Full-Time Equivalent, this parameter is used to evaluate the impact brought by the integration of the automation, one FTE is equal to a full-time employee. For privacy reasons, following the dispositions of Vincix Group, the clients will be labelled as Firm A, Firm B and Firm C.

**Firm A Case Study**

Firm A, annual revenue of 18 billion dollars, is a company specialising in the production of consumer electronics, in particular printers and cameras. The automation that Vincix Group designed in this case regards the analysis of orders delivered through e-mails, after having collected the data from the e-mail the RPA registers them into Firm A's database. The RPA is flanked by an A.I. that is trained on a dataset provided by the client collecting 3 GB of emails, the artificial intelligence is able to analyse the data collected by the RPA (new e-mails) using past records (old emails used to train the A.I. and clients' order history) to detect anomalies and propose the correction of incongruencies to a supervisor. The intelligent analysis performed by the A.I. component is also capable of recognising clients' complaints and to report them to its supervisor.

By integrating RPA and A.I., Firm A saved 20 FTE units with an average cost per year of €18,000, saving €360,000 per year. The upfront investment for the firm was €80,000 with a maintenance cost of €8,000 per year**. As a result, firm A saved €272,000 in the first year and €352,000 in the following years.**

Quality index improvements: since data entry tasks are prone to **errors**, the percentage of errors or exceptions moved approximately from **20% ex-ante to less than 2% ex-post the integration** (Pagano De Astis, 2021, p. 44).

**Firm B Case Study**

Firm B, annual revenue of 2.9 billion euros, operates in 140 countries in the car rental sector. in this case, the automation is deployed to manage the assignment of broken cars to local mechanics. This function is a pivotal element in Firm B's operations, efficiency is mandatory. The automation gathers the mechanics' availability weekly and distributes repair tasks accordingly, based on a criterion of minimum distance, thereby optimizing the distribution process.

The firm has a medium salary of €23,500, for operators, automatization halved the staff required, 6 units of FTE were saved, resulting in €141,000 saved per year. The upfront investment for Firm B was €40,000 with a maintenance cost per year of €7,200. **The net savings were €93,800 for the first year and €133,800 for the following years.**

> The quality index improved due to the **decrease in errors** and exceptions that went down from approximately **10% to less than 1%** (Pagano De Astis, 2021, p. 45).

**Firm C Case Study**

Firm C generates an annual revenue of 3.3 billion euros, it operates in the distribution of energy and water sector. The automation in this case is only an artificial intelligence, no RPAs are involved, it performs the analysis of the pipelines' data searching for leaks and contaminations. Before the automation integration, the analysis of the data was performed by one chemist, who was in charge of reading several pages of numbers for each sensor (hundreds of pages weekly). The employee was forced to conduct a sample analysis because the examination of the whole population of data was practically impossible for a single person. The automation took on this task allowing the analysis of the entire dataset, finding all the data that broke the pre-established boundaries, the artificial intelligence is also able to propose new rules based on the data it analyses.

> In Firm C case, there have not been FTE savings, the chemist still supervises the machine's reports, but the percentage of data examined went up from less than 10% to 100%. The capital investment for the client was €70,000, with a maintenance cost of €12,000 per year. To reach such levels of supervision, the firm would have needed to hire a dozen chemists, with an average salary of €35,000 - €40,000 each, resulting in a yearly expense of €420,000 in the best-case scenario.
>
> The **estimate of errors** and exceptions due to the human variable before the A.I. integration was **around 10%,** thanks to the machine activity**, it went down to less than 1%.** As a consequence, the improvement of water quality benefits the consumers directly, it is also an unaccounted asset for the firm (Pagano De Astis, 2021, p. 46).

The automations boosted productivity without increasing costs. In fact, Vincix Group's automations led to significant cost reductions as follows:

- **Firm A:** 75.5% in the first year, followed by 97.7% in subsequent years.
- **Firm B:** 66% in the first year, followed by 95% in subsequent years.

- **Firm C:** While it did not allow for a direct reduction in costs, it did enhance the quality of the service significantly.

# Chapter 2: The Health Impact Fund

The pharmaceutical sector is often subject to judgment and numerous ethical concerns due to its natural and structural impact on health, and therefore human lives. According to Pogge (2011), firms in this sector suffer from a significantly low reputational grading, rating at the same level as tobacco companies, even though the effects on health from the two industries' products are, at least in theory, antithetical.

This peculiar situation is a direct consequence of different factors: pharmaceutical companies, as companies operating in other industrial sectors, have the managerial duty of creating value and profit for the shareholders. This condition stimulates a vast array of behaviours (e.g., profit maximization, monopolistic behaviours, market share preservation and expansion, defence of IPRs and patents, minimization of the competition…) that aim at and compose the hopefully prosperous financial well-being of companies.

Given the classic market environment and the business structure adopted by companies nowadays in the pharmaceutical sector, ethical behaviours, such as reducing prices to raise accessibility, or suffering major distribution costs to reach remote areas, often are considered very close to charity. This is given by the fact that the companies' opportunity cost[8] is the lost profit they would derive from engaging in this kind of activity. In addition to this, there is a "*shadow cost*", the lost profits result in reduced reinvestment in the companies (e.g. in marketing activities) so they can generate secondary negative effects, increasing the missed profits in the long run (lower investment in marketing activities can negatively impact the market share of a company, particularly if the market is highly competitive). These structural conditions prevent companies from engaging in positive ethical behaviours. This is also even easier to justify if it is considered that pharmaceutical companies spend significant portions of their earnings on litigations and lobbying (Pogge, 2011).

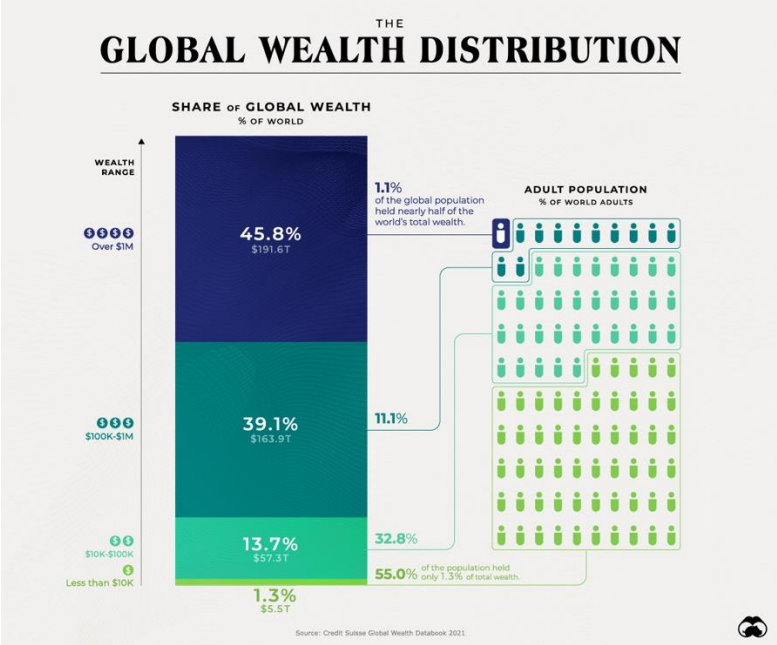
Then, if the structure of the market and competition justify the behaviours of pharmaceutical companies, how is it that the reputation of the industry is so low?

> We don't focus on the diseases that do the most damage… 10% of all the money spent on pharmaceutical research is focusing on diseases that account for 90% of the global burden of

[8] The cost of not undertaking an activity.

disease and vice versa 90% of the money is spent on diseases that account for only 10% of the global burden of disease. So there is a huge mismatch between where we spend the research money and where the greatest problems are (Pogge, 2011).

With this statement, Pogge explains how, from a global well-being maximization perspective, funds are not efficiently allocated. They are efficiently allocated from a profit maximization point of view, which as mentioned before appears to be the one and only way of operating in the sector. Therefore, the vast majority of pharmaceutical companies' expenditure (R&D, marketing, distribution channels…) and effort is focused where wealth is concentrated (84.9% of wealth is detained by 12.2% of the global population).




(Table 3)[9]

The reputation of the industry is so negative probably not because the industry fails at engaging in ethical activities, but because its behaviour is perceived as an active and intentional deprivation of human rights. In the Universal Declaration of Human Rights[10] (United Nations, 1948) articles 1, 3, and 25(1), it is written:

"All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood" (Article 1).

[9] Source: Deshmukh, A. (2021, September 20). This Simple Chart Reveals the Distribution Of Global Wealth. Visual Capitalist. https://www.visualcapitalist.com/distribution-of-global-wealth-chart/
[10] (UDHR)

The industry does not show altruistic behaviours, for the sake of profit.

> "Everyone has the right to life, liberty and security of person" (Article 3).

The industry seeking profit creates the conditions for low-income people to not be able to afford essential life-preserving medications.

> Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control (Article 25(1)).

Neither the industry nor other entities grant access to medications.

As Pogge (2011) points out: The reason behind all these points is profit, but profit is not sought by companies for its own sake; the vast amount of expenditures required to survive in their environment is the real reason. Clearly, it is easy to conceive that incomplete information may lead to different outcomes.

The low reputation problem is the fruit of the impossibility of satisfying two aspects at the same time: companies' survivability and ethical activities. The market is structured in such a way that ethics and profits cannot be complementary. Companies are not incentivized to seek ethical purposes because of their environment and therefore their R&D follows, leading to the *10%/90%* outcome, previously mentioned. The result of the current conditions is a market that sees companies spending their revenues on potentially unproductive activities, high mark-ups, and limitations to medication accessibility from the customer side.

Pogge identifies these aspects as the most impactful inefficiencies of the industry:

- Universal access:
    - Under patent: high mark-ups
    - After patent expiration: inadequate incentives lead to scarce deliverance of generic medications to poor and hard-to-reach customers.
- Focused innovation: 90% of expenditure is focused on 10% of the global burden of disease.

- Overall efficiency: heavily reduced by unproductive activities.

According to Pogge, the Health Impact Fund is a proposal that would increase the positive social impact of medicines and the overall efficiency of the system without harming any party, neither the wealthy countries nor poor ones; he states that both parties would in fact benefit from this shift.

## 2.1 Purpose of the HIF

> The Health Impact Fund (HIF) is a new proposal based on two simple insights: (1) privately funded pharmaceutical R&D responds to incentives, and (2) new drugs can have a much larger impact if their prices are low. At present, the most profitable research efforts are not the ones most needed to alleviate the global burden of disease. And high prices often put new drugs out of reach of most of the world's population.
>
> The HIF seeks to correct both failings by offering to reward any new medicine, if priced at cost, on the basis of its global health impact (Pogge & Hollis, 2008, p. 1).

In the opening sentences of the executive summary, Thomas Pogge and Aidan Hollis lay the groundwork for their proposal, an alternative system to the current classic business model of the pharmaceutical sector. According to the authors, the research and development orientation is highly influenced by the incentives the firms are exposed to, if the market grants firms higher revenues when they focus the production on solving first-world needs, then they will focus on first-world health-related issues. The HIF model aims at creating a new structure of incentives based on global justice theories, deeply studied by Pogge. The main purpose of the model is to address:

> The chief problems with the present system governing the development and distribution of medicines are well known: despite relatively low manufacturing costs, patented medicines are often very expensive and are therefore unaffordable for most people; and diseases concentrated among the poor attract little or no pharmaceutical research (Pogge & Hollis, 2008, p. 1).

The methodological shift proposed by the HIF, according to the authors, brings several social and strategic benefits, to bring some examples:

- New and innovative companies would have an easier time when trying to penetrate the market. Essentially barriers to entry into the drug market would not be as high as they are.
- Global public health expenditure would be reduced while achieving a higher impact.
- Wasteful capital activities by pharmaceutical companies would be reduced.
- Medicines would be more accessible to the portion of the population that cannot afford the high markups imposed by monopolies.

The Health Impact Fund aims at commercialising low-cost drugs to grant accessibility to a much larger number of consumers. Clearly, the current structure of the sector would not allow the realization of such an ambition. Hollis and Pogge's proposal completely alters the market structure in which participating companies would operate. As deducible from the name of the project, the HIF is indeed a fund, financed by governments and private entities, whose purpose is to reward companies based on the positive impact their drugs achieve over a given period of time. To participate, companies must renounce the markups obtainable through patents and must market the product at a price equal to the long-term marginal cost.

"Unlike the regular implementation of the patent system, the HIF mechanism is designed to reward innovators based on value created" (Pogge & Hollis, 2008, p. 21).

### 2.1.1 The Reward Mechanism

The reward system of the fund is designed to motivate and ensure a shift in the corporate objectives of the participating companies: moving from a business model focused on maximizing profits to a business model focused on creating and commercializing high social impact drugs. This is possible through the innovation of the incentive structure to which the participants will be exposed.

"This mechanism creates incentives for innovation that are efficient in the sense of maximizing health impact for a given amount of payments by aligning the interests of the innovator with society's interest in public health" (Pogge & Hollis, 2008, p. 13).

In their proposal the authors provide a draft of what the HIF reward system could look like, they also point out that further modification may be applied to consider stakeholders' opinions. The structure of the fund is outlined following these criteria:

- Optionality: Participation in the fund is optional; companies can decide to join the fund with a particular drug at any time, although according to the authors companies will decide whether or not to participate with a given medicine before approval by the major markets.
- Patents: The participating company owns or has a license for all the patents necessary for the production and commercialization of the product.
- 10-year reward duration: Starting from the initial year of product approval companies will receive a compensation calibrated on the incremental global health impact of the given drug each year for ten years. The impact is evaluated by an administrative branch of the fund according to the *S x F* function.
    - *S* is the share of Health Impact attributable to the drug in question, calculated as: "the estimated Health Impact of that product divided by the sum of the estimated health impacts for all products eligible for reward in that year" (Pogge & Hollis, 2008, p. 22).
    - *F* is the fixed total sum of compensations issued in the given year by the HIF.

At the end of the ten years, the HIF has permission to share all the patents necessary for the production and commercialization of the participating products in all jurisdictions, to facilitate the competition of generic drugs.

“Ten years is intended to replicate roughly the typical period of exclusivity of new products under the patent system, given that the approval process is so lengthy for new pharmaceuticals” (Pogge & Hollis, 2008, p.20)

The paper also analyses other situations and possibilities that could potentially alter the reward structure of the fund. For example, the case of perfect complementarity[11] of two products, of which only one is registered in the HIF, and the difficulty of evaluating the impact that would result from it. To avoid delving excessively into the evaluation of purely theoretical and hypothetical situations, these cases have been omitted and are not included in this thesis. The analysis of the HIF here mainly has the purpose of explaining what inspired the TIF, to permit informed evaluation of the similarities and differences between the two models.

[11] The success of the treatment requires the use of two different medicines.

### 2.1.2 The Health Impact Measurement

One of the critical aspects of the project is the measurement of the *Health Impact* that medicines have on the population. This section of the project is the administrative heart of the proposal. The authors consider various hypotheses and methodologies in their proposal, ultimately agreeing that the use of different methods may lead to the most accurate result. One of the most useful metrics could be the Quality-Adjusted Life Years (QALY), whose measurement may be complex but achievable by the use of different techniques. For example, clinical trials, even if known for their lack of accuracy in evaluating the real epidemiological impact on the population, still can be used to define the superiority of one treatment over already existing ones. Even though this method is not functional for measuring the impact of a drug it can be used to evaluate its affinity to the fund objective:

> … it is important to remember that the HIF is intended to be an option, so that in cases where a firm has a product which it believes is effective, but for which the clinical trials and other epidemiological evidence does not show a substantial effect, the firm can exploit its usual rights under the patent system. The HIF is designed to reward products which have high demonstrated health impact (Pogge & Hollis, 2008, p.31).

The assessment work can also be supported by the participating companies, which will probably be incentivized to create systems for the data collection on the use and effects of their registered products. This data should then be further verified by the HIF administration with cross-checks on the sales volumes of wholesalers and retailers, to minimize the possibility of data manipulation, which companies could artificially inflate to receive higher compensation from the fund. Additionally, the HIF could make use of data collected by third parties, such as the data collected by the Global Burden of Disease (GBD[12]), to confirm the impact of a given product on a global scale, should it be globally and widely distributed.

According to the authors, the HIF needs about 6 billion dollars a year to be effective, of which approximately 10% would be dedicated to impact measurement (600 million). This would make the HIF: "…by far the largest health assessment agency in the world" (Pogge & Hollis, 2008, p.31).

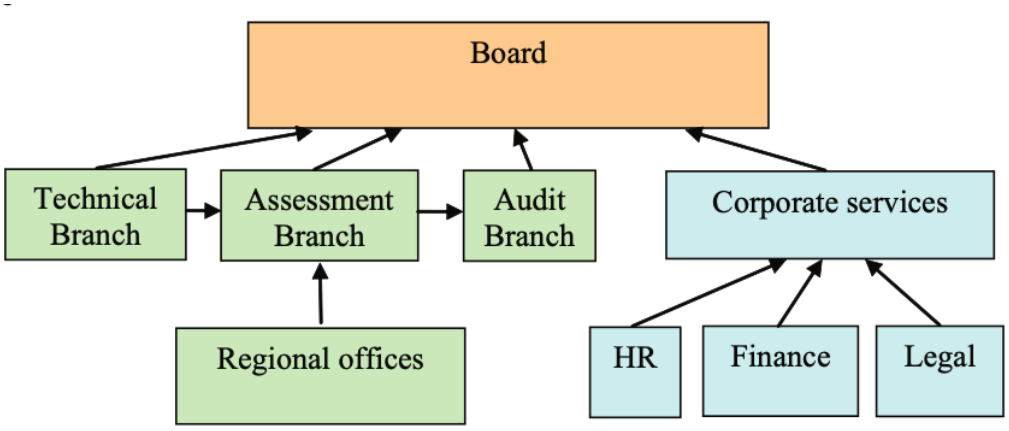
[12] *"The Global Burden of Disease (GBD) provides a comprehensive picture of mortality and disability across countries, time, age, and sex. It quantifies health loss from hundreds of diseases, injuries, and risk factors, so that health systems can be improved and disparities eliminated."* (Gardner, n.d.)

The enormous[13] budget is justified by the great difficulties in measuring health impact. Starting from the fact that the QALY system used must consider territorial differences, certain clinical conditions can lead to different situations depending on where the patient is located, and therefore the impact of a particular drug may vary significantly. Data collection, especially in poor countries, can be difficult due to the opacity of distribution systems and the underdevelopment of communication systems. These factors further manifest the need for cross-checking activities on the data provided by participants that could exploit the lack of infrastructure to take advantage of the fund.

### 2.1.3 HIF Administration

The administration of the HIF has been designed by the authors with two fundamental purposes: the first is simply to administer the project, the structure is quite similar to the one of a normal enterprise; the second purpose is to protect, as much as possible, the administrative organs from the potential lobbying activities that the participants could try to conduct. Transparency and the correct implementation of administrative activities are central aspects in the theorization of the fund.

The authors directly transpose the two-sided design in the administrative structure of the fund. This structure is graphically observable in the picture below: on the right of the chart, is the *"classic"* section of the fund of *corporate services*, composed of Human Resources, Finance, and Legal sections; while on the left are the specific functions of the fund, the Technical Branch, the Assessment Branch, and the Audit Branch. Everything is directed by the board of directors.




(Table 4)[14]

[13] *"NICE (the UK's National Institute for Clinical Excellence) has a budget of approximately $50 million."* (Pogge & Hollis, 2008, p.31).
[14] Source: Pogge, T., & Hollis, A. (2008). The Health Impact Fund: Making New Medicines Accessible for All. Incentives for Global Health. Pogge & Hollis, 2008, (p.38.)

Starting from the composition of the Board the authors evaluated different options in their study, they observe that the classical method that sees the investment contribution mirrored by the voting power cannot be applied in the proposal.

"Such an approach gives the greatest voting power to the countries that contribute the most. While this is attractive in some respects, it may lead to domination of the Board by a very small group of directors" (Pogge & Hollis, 2008, p.37).

This is a valuable consideration, developed countries have significantly larger capital, if they were to participate in a fund with such a system, they could acquire control of it with a much cheaper relative[15] cost compared to the developing countries. The authors needed to ensure a management framework that could effectively manifest the participants' needs, therefore they designed an alternative:

"In the case of the HIF, this division into constituencies would be artificial, as funding partners are also beneficiaries. It might, however, be appropriate to require a geographical distribution which accounts for the different burdens of disease in different regions" (Pogge & Hollis, 2008, p.38).

Pogge and Hollis also add that additional members of the Board could be elected by third parties such as the World Health Organization. The main role of the Board is not the assessment of Health Impact, but rather the selection of the personnel assigned to the various administrative sections and the representation of the fund with stakeholders and potential investors.

Delving into the administrative sections:

- ***Technical Branch:*** The Technical Branch does not perform the assessment of the impact of participating drugs, it creates, it designs and manages the evaluation parameters so that they are technically viable, consistent, and fair, trying to guarantee predictability for the participants. This department is responsible for creating coherent and independent evaluation systems from the geographical area in which the drugs operate, implementing a standardization of the evaluative methods applied by the fund. The protocols and structure of the branch are flexible and depend on the size of the fund and on the data that can be collected.

[15] Considering a total investment of 6 billion dollars achieving a majority share of 51% of the fund would require a significantly higher portion of the disposable capital of a developing country than the one required to a developed country.

- ***Assessment Branch:*** The Assessment Branch is the fulcrum of the administrative functions of the fund. It applies the guidelines dictated by the technical branch to the data collected on products in various countries. This branch also deals with the collection of additional data from countries, NGOs, wholesalers... involved. The staff of this administrative section includes various specializations ranging from epidemiology, economics, pharmaceuticals to public health. The transparency of this branch is crucial for the proper functioning of the fund.

- ***Audit Branch:*** The Audit Branch's main purpose is to verify that the Assessment Branch correctly applies the dictates of the Technical Branch. This branch strengthens the reliability of the fund's functions and helps to guarantee its transparency. It may be composed of external and internal staff members and can also perform general evaluation activities on the fund.

Pogge and Hollis also note that given the high cost of assessment activities, it is necessary for participants to pay a participation fee, the purpose of which is to create a deterrent for participants who wish to join the project with low-impact medicines.

### 2.1.4 Financing the Fund

Another fundamental aspect of the fund is the financing method, a topic extensively described by the authors. They emphasize that to guarantee predictability in future rewards for participating companies, the commitment in terms of time from states must be at least equivalent to the duration of the reward period planned for participants. This allows companies to formulate R&D plans.

In the study, it is proposed that the states' participatory share be calculated based on Gross National Income (GNI). This method would allow states to see their contributions updated and aligned with their current financial situation. If they were to find themselves in a period of economic depression, their contributions would decrease, and vice versa.

The authors note that this structure could be contested from several points of view. For example, the countries that bear most of the cost would be those with higher per capita income, which could be a deterrent for their participation. In this way, poorer countries could opt for a free-riding approach,

participating with few financial resources but still enjoying the benefits. To this criticism the authors respond as follows:

> It is also important that the HIF should reflect, and be seen to reflect, a genuine commitment by all the funding partners who maintain it. The large avoidable excess of morbidity and premature mortality in this world is not just a problem of the poor countries, whose people bear most of this burden, nor just a problem of the affluent countries which will bear much of the financial costs of the HIF. Rather, it is a common global problem, and all countries ought to contribute to its solution in accordance with their means (Pogge & Hollis, 2008, p. 44).

Adding then that the cost poor countries would sustain could easily be borne by developed countries.

> Though they contain 37 percent of the world's population, the 53 countries the World Bank currently lists as "low-income" account for only 1.3 percent of global income. Their partner contributions to the HIF would therefore be quite low – around $30,000 to $200,000 per million population – and, if needed, could easily be subsidized by wealthier states or other donors (Pogge & Hollis, 2008, p. 44).

The authors develop their reasoning based on principles of global justice, an aspect that will be explored in more detail in the subsequent chapters of this thesis, however, it is important to mention it here to highlight its centrality in the proposal.

The authors suggest that an initial annual budget of $6 billion is necessary for the proper applicability of the project. According to their estimates, it would allow the fund to support a portfolio of 20 medicines. If the countries responsible for a third of the global income participated, approximately 0.03% of their GNI would be required to reach the designated quota of $6 billion.

The target sum is justified also by the fact that with a large amount of medicines the costs of the activities that do not depend on the number of participants[16] can be distributed, generating economies

[16] Such as the Technical Branch.

of scale internal to the fund. The more participants there are the lower the impact of such activities on the reward budget.

Countries also have the option to withdraw their annual funding, but to ensure the stability of the fund's payments, their exit requires two years' notice and a progressive reduction of their participation by 10% per year for 10 years until the completion of the operation.

## 2.2 The Problem of Uncertainty

Uncertainty plays a crucial role in many of the dynamics related to the fund. Both parties, funders and participants must estimate the potential benefits of the fund and define the opportunity cost of their participation. Pogge and Hollis address the possible uncertainty of future earnings for participating companies with several hypotheses:

- ***Insurance:*** The fund could rely on a consortium of insurance companies to guarantee a minimum dollar-per-QALY payment in exchange for a fixed premium. The authors note that this solution might not be optimal given the high degree of uncertainty in the fund's initial years of activity, which could lead insurance companies to demand high premiums, that would have to be deducted from the funds available for rewarding the impact of the drugs.

- ***Debt:*** The fund could guarantee a minimum dollar-per-QALY by tipping the missing funds from future participation quotas and funds. This mode would probably induce investors to reduce their capital investment.

- ***Transfer Uncertainty:*** A third option is to transfer uncertainty from pharmaceutical companies to funder entities. According to the authors, companies have a high interest in the reliability of rewards and are already exposed to the uncertainty that arises from their regular activities (research and development, marketing, patenting, etc.). Pogge and Hollis offer three reasons why funding states could take on the uncertainty:

- States can bear the cost without risking failure, given the minimal percentage discussed above, whereas companies (especially small and medium-sized ones) would struggle significantly if they were to find themselves having to sustain those costs.

- There is already a significant level of asymmetry in the distribution of uncertainty. If, for example, the number of participating drugs was high, the premiums would have to be distributed among the participants. This would lead several companies not to be able to reach the break-even point, while states would only have more benefits (e.g., reduced healthcare costs beyond predictions for the country; reduction of the general burden of disease; economic benefits from improved global health, etc.).

- Companies already exposed to high levels of uncertainty might divert research to projects whose outcome is safer but of lower impact, reducing the overall effectiveness of the fund.

# Chapter 3: The ATIF

## 3.1 Introduction

Different types of innovation clearly have different impacts on society and, more broadly, on the systems into which they are introduced. Despite the best efforts of scholars and developers of such innovations, the effects of new technologies often spill over, generating unforeseen dynamics that reach far beyond the initial intended scope, even raising theoretically unexpected issues. This can be explained by concepts and methods that have become quite popular today and are often used to describe how small changes in the *status quo* can cause large-scale consequences: It is the so called *Butterfly Effect*. The term was coined by mathematician and meteorologist Edward Norton Lorenz[17] in 1972, however, the concept's introduction to meteorology studies is attributed to Henri Poincaré[18], the term is also frequently applied in the study of Chaos Theory[19].

"Chaos: When the present determines the future, but the approximate present does not approximately determine the future" (Edward Lorenz, 1993).

*The butterfly effect* is relevant when evaluating complex innovation outcomes just because of their unpredictable nature. In fact, Lenore Newman (2005) in her article "Uncertainty, Innovation, and Dynamic Sustainable Development" emphasizes two key aspects:

1. "We must accept that some breakthrough technologies will have unpredictable effects, and develop our ability to cope reactively with problems accordingly" (p. 28).
2. "…our society and ecosystems are inherently unpredictable" (p. 28).

In essence, innovation is an unpredictable process already by itself, and its application environment is even more unpredictable, dynamic, and subject to constant change.

Newman offers a clarifying example, in the field of innovation, to demonstrate that taking precautions, always assuming it is possible, is often not enough to stem the consequences of introducing new technologies:

[17] When he noticed that tiny changes in the initial state of weather patterns could cause completely different effects. The original idea involved a seagull causing a storm, Lorenz was persuaded to use the term butterfly to make the concept more poetic.
[18] French mathematician and engineer.
[19] Also known as Deterministic Chaos, a branch of mathematics, that studies the behaviour of dynamic systems governed by deterministic laws but with unpredictable outputs.

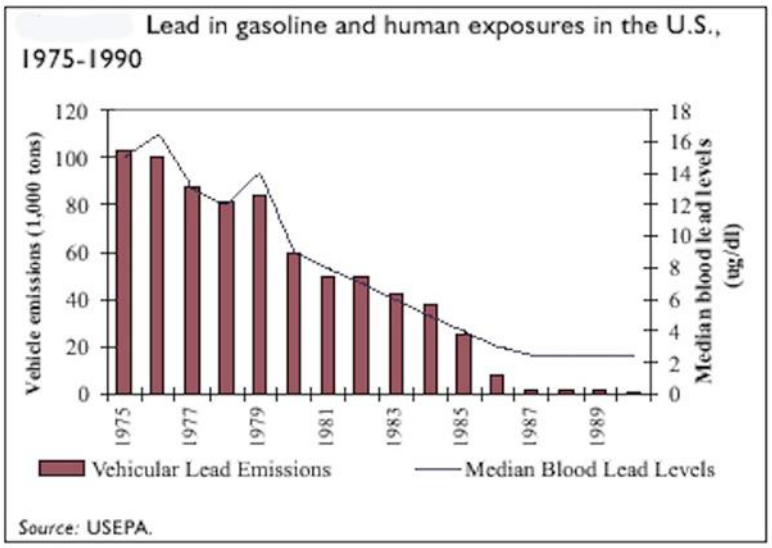
> As an example, the development of chlorofluorocarbon-based refrigerants allowed a revolution in cooling and food storage that saved many lives and greatly improved human health. The technology to understand the risk that these compounds posed to the ozone layer did not exist until much later, and thus what mattered was not our ability to apply a precautionary principle, but our ability to react quickly and effectively to an unforeseen problem (p. 28).

The ethical and scientific assessments that can be conducted on the impact of a given technology, prior to its market introduction, are thus subject not only to systematic and endogenous unpredictability but also to the limitations of the tools available at the time of the assessment.

The scientist and inventor Newman refers to is Thomas Midgley Jr. who synthesized Freon[20] (enunciated to the public in 1930 at an American Chemical Society conference). The case of Midgley Jr. is one of the most notorious when considering the unexpected negative effects of innovation. His two most important innovations, the aforementioned Freon and the leaded gasoline[21] (in 1921 he discovered that leaded gasoline prevented engines from knocking), caused millions of deaths over the past century. Freon, as Newman reported, damaged the ozone layer in the atmosphere, increasing the incidence of diseases such as skin cancer, while leaded gasoline poisoned several generations, causing tens of millions of premature deaths worldwide. The incidence of fuel in blood lead levels is evident from the graph below (Table 5). Since 1975, countries around the world have begun banning leaded gasoline; the last country to ban it was Algeria in 2021.

"Researchers have estimated that decades of burning leaded gasoline caused millions of premature deaths, enormous declines in IQ levels and many other associated social problems" (Kovarik, 2021).

[20] Commercial name (registered by chemical company DuPont), it identifies a family of compounds derivatives of methane and ethane used in the refrigerator industry.
[21] Precisely gasoline diluted with tetraethyl lead.




(Table 5)[22]

Midgley Jr.'s inventions provide two different perspectives on the problems associated with innovation. In the case of freon, the technologies and knowledge of the time were unable to predict the damage that would manifest in the decades that followed; in the case of leaded gasoline, pressure from General Motors led to the fuel's approval despite numerous concerns from the scientific community. Concerns that have been amplified by the accident at the manufacturing complex in Elizabeth, New Jersey in 1924, when a large number of workers suffered lead poisoning and some of them died shortly after. Out of the 49 people working at the plant, 35 contracted significant neurological issues and five others died (Hofverberg, 2022).

In both cases, freon and leaded gasoline, the social implications have been substantial: on the one hand, the innovations brought great improvements to the quality of life for billions of people, but the price paid was very high and still continues to be paid by the global community.

Midgley's example is one of the most resounding in history and exemplifies how fallacious the predictive systems we rely upon can be when we are confronted with innovations. As a matter of fact, from both an ethical and social perspective, it is precisely the predictive aspect of the precautions to be implemented that is the weakest link in the chain. It is clear, that responding to problems only when they occur, when and if the scenarios make it possible to avoid them, is neither sufficient nor a socially and ethically viable solution. In addition, it must be considered that ethics itself evolves

[22] Table Source: Kovarik, B. (2021, December 9). *A century of tragedy: How the car and gas industry knew about the health risks of leaded fuel but sold it for 100 years anyway*. The Conversation.

"Moreover, it is possible that new ethical issues will develop, either based on new technical capabilities or on the basis of changing moral perceptions" (Stahl et al., 2016. p. 377).

This emphasizes that the evaluation parameters in the *introduction stage*[23] of a given innovation may turn out to be inadequate in its future *power stage*[24] period when it is fully implemented.

The problem of the unpredictability of future social and technological conditions can be addressed through a change in the fundamental paradigms of the incentives to which companies are exposed: if the system that guarantees profitability for companies when they introduce innovations was closely intertwined with the collective social interest, and if this system was structured on the basis of the positive impact that technology generates, the social and the corporate interest would be aligned. A system, such as the one studied by Pogge and Hollis in developing the Health Impact Fund, applied to technological innovation in its generality creates the conditions not only to reward and ensure the positive impact of new technologies (even if not oriented primarily to the richest markets) but can generate an environment that is able to grant aspects such as:

- **Stakeholder participation:** An essential condition as explained by Stahl et al. (2016), in order to ensure the adaptability of evaluation principles and especially their adherence to the ever-changing social texture. An aspect secured by dynamic impact evaluation systems that can vary over the years (Pogge & Hollis, 2008). The designers of the Health Impact Fund consider this an aspect of such importance that they recommend the participation of some stakeholders in the Board of Directors of the proposal (p. 20).

- **R&D realignment:** By changing the incentive structure, that is, the revenue opportunities to which companies are exposed, it is possible to realign research and development toward socially virtuous goals.

- **Access to resources:** considering an example case → a developing country has funds available with which it wants to finance social development projects:
    - With this sort of mechanism, the country will not have to fully develop the resources needed to achieve its goals, it could *de facto* draw on some of the resources and

[23] The earliest implementation phase of a technology (Moor, 2005)
[24] The phase in which a technology has permeated the market to its fullest and is well established (Moor, 2005)

technologies of companies in developed countries (production facilities, R&D, value chains, economies of scale ...)

- If the state shares a common situation with other states, they can collectively participate in funding the *impact fund*, a cooperation that will probably encourage the generation of economies of scale.
- IPRs and patents: The state would have access to existing technologies without having to develop new ones thanks to patents held by participating companies, further reducing the cost of developing/introducing innovations it is interested in.

- **Internal competition within the fund:** Inspired by the Health Impact Fund, the fund has an internal competition mechanism: if there are few participants and the potential rewards are high, this will attract more participants, and vice versa, if there are too many participants the fund loses its attractiveness to new entrants, becoming self-regulating.

Clearly, systems similar to the *Health Impact Fund* are not always applicable, different technologies and products require different approaches. Pogge himself, in creating another proposal, the *Green Impact Fund for Technologies* (GIFT), adapts the pre-existing Health Impact Fund to a different technological framework. *In primis*, he introduces territorial discrimination, the GIFT also aims to improve conditions in the global South like HIF[25], but it does not require companies to give up their monopoly rights on a global scale. In fact, participating companies have to give up their monopoly rights only in limited zones called: GIFT Zones. As the name suggests, this proposal is aimed at green technologies that have sustainability as their goal. The prize, then, will no longer be proportional to the impact of the technology on a global scale, as it was with the HIF for the introduction of an innovative low-priced drug, the prize will be estimated on the emission reduction achieved by a given technology in a given territory. The introduction of price discrimination mechanisms on a territorial basis makes the initiative more attractive in the eyes of companies, which can continue to have high profit margins in more developed countries, while offering access to technologies in the target areas, where they otherwise would not be implementable.

The implementation of an initiative like the GIFT would certainly help to satisfy developing countries such as India, which, for example, at COP26 (Glasgow, Scotland, 2021) asked developed countries

[25] It requires products to be sold at a price equal to the cost of production or to the long run marginal cost.

for $1 trillion in funding for the country's ecological transition; the size of the sum was justified by India because it was to be seen as compensation for the pollution produced by developed countries in the previous two centuries. In addition, according to Pogge (2022)

> …the GIFT would stimulate development of additional greenovations that – tailored to prevailing needs, cultures, circumstances, and preferences in the GIFT Zone – would be especially impactful there. These two effects would produce a third: the GIFT would help build capacities to develop, manufacture, distribute, install, operate, and maintain greenovations in the GIFT Zone (p. 2).

Moreover, to frame the potential of such proposals, one can take as a reference a report on India's green transition by the World Economic Forum, the focal points of which are summarized by Alexandra May 2021 in one of her articles: "India's Transition to a Green Economy Presents a $1 Trillion Opportunity", which states, "The World Economic Forum today released a new report outlining how India's path to decarbonization will have an estimated economic impact of more than 1. trillion by 2030 (with the creation of more than 50 million jobs) and about $15 trillion by 2070". Although proposals such as the GIFT are unlikely to achieve that much, they certainly can help fuel virtuous mechanisms such as those discussed by Pogge, which can then lead to consequences such as job creation, reduced emissions in a geographic area, and an established position in distant markets for participating companies, a possible additional advantage to the already programmed reward on impact.

Pogge at the present time has not discussed and developed GIFT as much as he did with HIF, which was theorized about a decade earlier, but the work he has done is nonetheless useful in understanding how a different field requires adaptations and modifications. GIFT offers a very useful insight into how to structure the Automation Technology Impact Fund, the theme of this thesis.

## 3.2 The Name of the Fund

The chosen name: ATIF Automation Technology Impact Fund, indicates quite clearly the area of study of this thesis. However, some clarifications are necessary: the proposal discussed below embraces a wide range of software technologies, that aim at supporting or automating certain operational functions within companies and corporations. The term automation refers to all those technologies of intelligent (A.I.) and non-intelligent (e.g., RPA) nature that can increase productivity and reduce costs. Although automations and A.I. are two different tools, they can be combined and adapted for the purpose mentioned above; therefore, they will be treated as one type of tool, united by their common purpose. This is also justified by the fact that these kinds of software are in constant evolution, and there is no telling what the most relevant innovations will be in the coming years.

The fund aims to simplify access to these technologies in geographical areas that risk falling behind, thereby helping to prevent the developed world from gaining excessive competitive advantages, which could lead to further exploitation of developing countries.

## 3.3 Why an Automation Impact Fund

Given the incredible structural diversity of sectors and technologies, theorizing how an impact fund works for different sectors is not a trivial task. For this reason, this thesis will focus on one of the most impactful sectors of recent years: the automation and artificial intelligence sector. These two areas will be treated together because combining the two technologies offers a significant increase in their effectiveness. Indeed, non-intelligent type automation such as RPAs, when supported by artificial intelligence, for example in analysing data or proposing new rules of behaviour, can achieve superior results to the mere and simple automation aimed at performing repetitive tasks with established and enduring rules. The relevance of the field in the modern period is the main reason why it was chosen, in fact, it consists of what can be considered the greatest innovation since the advent of the Internet. Artificial intelligence combined with automation will most likely be defined in the coming decades as a *disruptive innovation*, as it has the capacity to transform the world as we know it today. These technologies certainly can bring a great competitive advantage to companies that choose to implement them. Considering the vast and ever-growing scale of applications of intelligent automations, the implications will not be limited to the structure of businesses and the

organization in general, the impact on society will most likely be considerable, bringing with it the need to assess the prospects on an ethical and moral level as well.

Like many innovations of the past, that have had significant impacts on the way things are done, artificial intelligence will change the global landscape, for better or worse. An impact-based fund in this field is interesting to study because such technologies can provide incredible competitive advantages. The local availability of resources in this specific sector is almost unimportant. Computational capacity can be rented from facilities located on the other side of the globe (cloud[26]), and thanks to the interconnections given by globalization practices most of the markets are now connected. On the other hand, the fact that there is little difficulty in accessing software resources means at the same time that developing markets are exposed to foreign markets and their competitive advantages. The exploitation of less developed markets is often debated, but the magnitude of change brought about by the advent of automation and artificial intelligence could take the competitive advantage of developed countries to previously unthinkable levels. If the outsourcing of labour today brings companies' production costs down and provides access to new opportunities in less developed countries, automation could lead to the repatriation of production systems. If artificial intelligences make it possible to achieve such high levels of efficiency that in a couple of years the costs of entire branches of business can be reduced by 97.7%[27], the impact on economies and workforces that today depend on foreign demand and that have developed by orbiting that demand will be incredible. According to a study by McKinsey, AI has the potential to increase the UK GDP by 22% by 2030, compared to the global average of 16%. The difference is simply given by the fact that the UK appears to be relatively more ready for adoption than other countries (Bughin et al., n.d.), this data provides insight into how essential it is to move early in this circumstance.

An impact fund in this technological field has the function of making it economically viable to share, or rather commercialize, resources in countries that would have no way to adopt them in time. Essentially, the ATIF would serve to reduce the competitive gap that might arise as advanced economies begin to introduce automations on a large scale. The ATIF is thus a preventive countermeasure, if applied in time, for the likely consequences of large-scale automations adoption concentrated in developed countries. Approaches of this nature make it possible to curb the difficulties that come from having to respond to the unpredictable crises caused by the advent of new technologies, given, as mentioned earlier, by unstable and ever-changing environments. The

[26] The term Cloud refers to a vast net of servers that are used to host software. It can be accessed remotely using the internet.
[27] As shown by Vincix Group’s case studies.

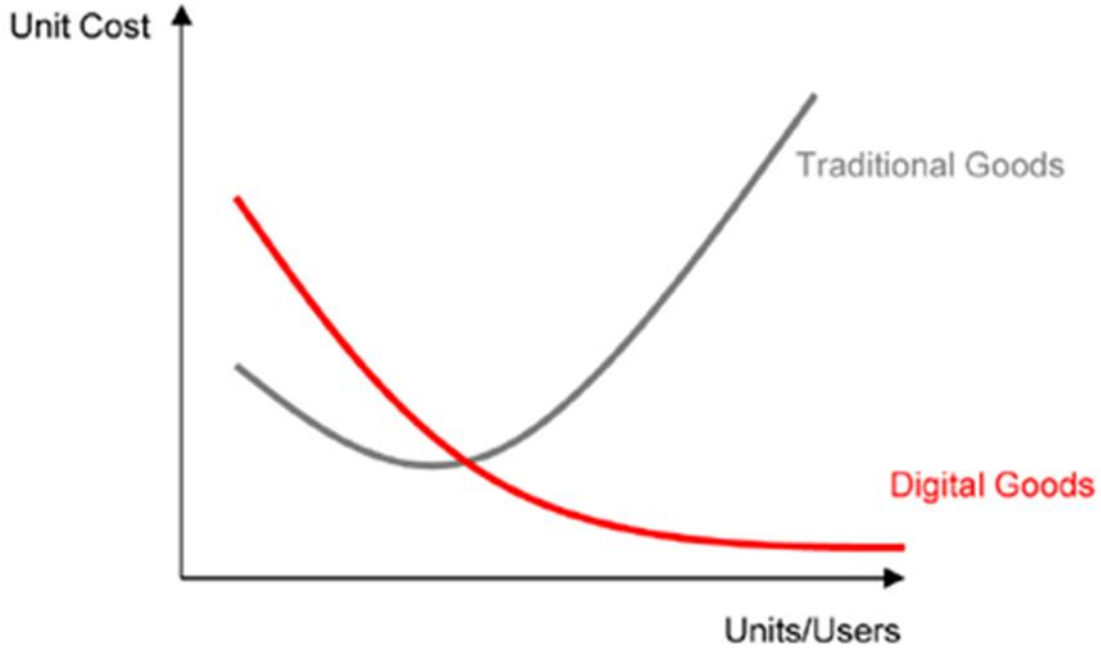
structuring of incentive systems in line with ethical paradigms, aimed at global justice, can correspond not only to short-term benefits but also to long-term global development and expansion of markets and global economic growth, as mentioned by Jim Yong Kim[28] (2016). Essentially, limiting future problems by creating systems that disincentivize their emergence.

## 3.4 Industrial Sector

As mentioned earlier, the structure of the ATIF is based on that of the Health Impact Fund and the Green Impact Fund, although the funds have a similar structure, changes are needed to adapt it to technologies of a different nature. To further clarify which technologies the ATIF deals with, the fund focuses on software automation technologies. Hardware automation (e.g., mechanical arms, assembly lines, robots...) is to be considered too different because of its physical nature, and in fact would require fundamentally different mechanisms and assumptions, for example, products of this nature are unlikely to have low production costs, require sometimes rare and expensive materials, and their integration into developing countries' value chains would require major changes on both sides. It is also unlikely that the product will achieve low marginal costs of production (economies of scale) because of differences between the beneficiary firms and companies in the areas of interest and because of the differences within the production chains in developed countries (it would be hard to produce, in an economically viable way, a physical automation product if companies' production lines are too different). Therefore, this work will focus on products that are software in nature, which can virtually achieve approximately zero marginal costs, given that issuing an extra digital copy does not require additional costs for manufacturing companies.

"Classic automation replaced human muscle, whereas digital automation replaces human thought or information-processing—and unlike physical machines, digital automation is very cheap to duplicate" (Müller, 2020).

[28] Former president of the World Bank (2012-2019)




(Table 6)[29]

Marginal costs for digital products tend to zero in a theoretical perfect market, in reality there are costs related to server maintenance and management, which can be truly negligible if the service providers have economies of scale in place.

This notion greatly facilitates the possibility of receiving applications to the fund: participating companies can issue additional copies of their products without incurring significant additional costs, and beneficiaries do not incur high costs, always if the model described by Pogge and Hollis (2008) in their proposal for the HIF is applied in practice: "… (registrants have to) sell the product at a low price, no higher than the long-run marginal cost of production…" (p. 14). The scenario that would ensure the greatest attractiveness of the proposal is: if products or services, already developed by applicants for developed markets, were compatible with the markets of interest of the proposal. This would ensure that participating companies would be able to take advantage of the economies of scale and very low marginal costs right away. This scenario is not guaranteed in 100% of cases but considering that a good portion of the purely operational jobs (very low value-added activities) are similar in most businesses there is a good chance that the products will be compatible. In fact, companies often introduce automations starting with the sections characterized by simple operations, where the work of humans has little impact, and there is little added value, to provide a few examples

[29] Source: Nakra, M. (2021, January 18). The meaning of unit economics for startups and investors. Medium.

activities involving: data monitoring and notification of anomalies, transfer of data from one database to another, collection of orders placed via e-mail, allocation to service hubs scattered around the territory...

Obviously, this does not occur in all cases, RPAs for example have a relatively high cost since they require development space licensed by the big players[30] in the industry, which is necessary in order to operate the service. Although the price of licensing and software development may seem high, the impact they have on the functions they are going to automate is substantial and it permits, in most cases, the project investment to be paid back in a single year, requiring very low maintenance costs for subsequent years.

Another important peculiarity of the digital sector is the possibility for firms to discriminate prices particularly effectively on a geographic basis. One of the reasons why Pogge and Hollis (2008) argue for selling low-cost products globally, in the case of HIF, is the possibility that the difference in price on a territorial basis may incentivize arbitrage activities: "Differential pricing between rich and poor consumers, between or within countries, is difficult: arbitrageurs will try to buy the good cheaply and resell it at the higher price" (p. 5). In the digital sector, if the right countermeasures are taken, the problem does not exist, and thus the sharing of digital resources does not result in a loss of profits on a global scale for the applying companies. Therefore, in the case of the ATIF, it is advisable to establish zones similar to the GIFT Zones used in the Green Impact Fund for Technologies proposal.

The Automation Technology Impact Fund must consider another important difference with the sectors studied by Pogge, the digital sector often offers profit opportunities subordinate to the sale of the product/service itself. The user in fact, often, using the product provides data to the manufacturer passively. This data, as it is well known, are then analysed by the manufacturer providing him with several secondary resources: data can be analysed to understand the user's needs, improve the user's experience, and allow the product to be improved by making it more appealing, they can also be sold to third parties thus generating further profits for the manufacturer. This aspect, in the case of this proposal, adds an additional benefit for participants, namely, the ability to understand new developing markets before the competitors do, enabling them to penetrate them more efficiently once the infrastructure *in loco* is sufficiently developed for the actual commercialization of the product.

[30] UiPath, Automation Anywhere, Blue Prism…

## 3.5 The Structure of ATIF

### 3.5.1 The ATIF Zones

> The GIFT would support diffusion of green technologies in the GIFT Zone in two ways: by avoiding the headwind of monopoly markups (delinking the sales price from the fixed cost of R&D) and by adding the tailwind of impact rewards. This substitution of impact rewards for monopoly rents transforms originator motivations. While monopoly rewards incite considerable efforts to find, stop, prevent, and deter patent infringements, impact rewards encourage originators actively to promote the rapid, frequent, and effective deployment of their greenovation for increased impact rewards (Pogge, 2022. P 6-7).

As mentioned earlier, The Automation Technology Impact Fund has a similar structure to the Green Impact Fund for Technologies on the issue of monopoly rents. In fact, given the nature of the technology that the ATIF operates with (automation), given the low chances of arbitrage opportunities and given the preventive security restrictions that manufacturers can implement, it makes sense to avoid the commercialization of the product at the marginal cost price point on a global scale. Therefore, the ATIF could implement the *Zones* strategy of the GIFT, where access to the technology will be considerably cheaper, without depriving manufacturers of revenue from commercialization in other geographical areas. Considering that, in some cases, technologies would not even be commercialized in such Zones, “Often, such products are then not even made available in poor countries” (Pogge, 2022, p. 1) the producer can leverage the fund to broaden its geographic horizons by seizing additional opportunities. Given the nature of the fund’s reward system, based on the Impact that the technology achieves, the producer will be incentivised to facilitate the technology spreading. The deprivation of patents in the ATIF Zones not only facilitates the diffusion of the technology through low costs, it also reduces the costs related to the patent creation, maintenance and protection that the producer would have to sustain. Technologies in the ATIF Zones require less protection in general since the low cost disincentivizes the software’s illegal diffusion. In addition, automations are generally run by the owner of the technology, they are hosted in servers not possessed or managed by the customer, therefore the only way illegal activities would be able to acquire the source code is by hacking the owner. Automations are in fact often services, not products, only the outcome of its

activities is delivered to the customer. This characteristic of the sector allows ATIF Zones to promote the patent-free policy without the risk of harming the producer.

### 3.5.2 The Reward System

It should be noted that Pogge and Hollis' proposal of a reward system for producers is an alternative to the monopoly rights on the drug. The duration of the rewards is linked to the regulations that delineate the rights of the creator of the drug. For this reason, it is essential to consider how copyrights work for software products/services, taking as an example the laws in force on software copyrights in Europe:

- Elements protectable by classical copyright:
    - The graphical interface - the visual, also protected by design law.
    - The user's manual.
    - The software title - also protectable under trademark law.
    - The specifications.

- Elements protectable by specific copyright law:
    - The program – i.e., the source and object code.
    - Preparatory design material – functional and organic analyses, mock-ups, prototypes, flow charts, internal and external specifications, and functional architecture…

- Non-protectable elements: (defendable in case of unfair competition or if secured under secrecy[31]):
    - Algorithms (they are considered as ideas).
    - The programming language.
    - The software functionalities (also considered as ideas).

(copyright.eu, 2022)

[31] Under special circumstances also databases can be eligible for protection

Software cannot be patented because patents protect products or processes that provide new technical solutions (According to: Article L611-10 of the Intellectual Property Code). However, the software may be a section of an invention; in this case, the software could be eligible to receive protection.

Software can be protected by copyright[32] if the work is original, and the contribution of the author is not mere know-how on programming; the ideation is an essential component for the copyright to be applicable.

> This protection provides economic rights on the work, opposable to all, which allows to control its exploitation (via licenses for example), its distribution and to prohibit or authorize the reproduction, modification, or translation of the work, with exceptions... It allows infringement proceedings to be brought... This exclusive right lasts until 70 years after the death of the author (copyright.eu, 2022).

The same is true for the US: "Copyright protection lasts for the life of the author plus an additional 70 years" (U.S. Copyright Office, 2019).

If the software is created inside an organization or company the employer holds the rights related to ownership and copyright, the employee is considered to have just performed the work.

While copyright protection does not require special procedures and is formality-free[33] in the countries that participate in the Berne Convention[34], laws regarding patents are not harmonious globally, some countries grant patents for software if a government agency conducts examinations procedures.

Considering that the duration of the copyright protection for software is long, it is very likely that the software will end up being outdated before the expiry of the rights related to it. Therefore, for the sake of the fund's long-term sustainability, it would be plausible to create rules that limit the reward window for participants. For example, the fund could grant the producer an impact-based reward for 10 years, after which an in-depth analysis will determine if the software is still used and not surpassed. If the software is still relevant additional two years of impact-based rewards can be added. The cycle of analysis then repeats every two years until the inevitable obsolescence of the software arises. In

[32] *"A patent protects new inventions, processes, or scientific creations, a trademark protects brands, logos, and slogans, and a copyright protects original works of authorship."* (Kurt, 2022)
[33] It is not required to deposit registration or copies.
[34] The convention took place in 1886 with the objective of setting the principles to protect original work, it originally involved 10 European countries, nowadays it has been ratified by 181 states.

the case of the ATIF normal market rules could be enough: if the demand for the software decreases, due to the presence of better options or other reasons, then its maintenance costs would reach the point of unsustainability, leading the producer to retire it from the fund/market autonomously. The additional layer of analysis conducted by the fund is required to reduce the bureaucratic burden, in other words, to avoid excessive resources being wasted in the biennial evaluation of almost unused software. This aspect is a major difference with the HIF that limits the reward window to 10 years, however, a more elastic approach is required due to the significant difference in the length of the protection duration. As for the HIF, implementing a maximum percentage ceiling to the rewards a single firm can achieve annually (in the case of a "*blockbuster*" automation) is functional to the maintenance of the fund's appeal to new entrants, so it is probable that the ATIF would benefit from the integration of a similar mechanism.

### 3.5.3 The ATIF Measurement

In the case of the ATIF, monitoring performance is easier. The digital nature of the technologies in question allows manufacturers to insert monitoring systems into the software, which permit accurate information about the automation's performance, thus enabling estimates of their impact. The fund could also require participants to implement systems that prevent data tampering or that allow the fund to directly monitor the data. However, it is very likely that data analysis in IT is much less costly compared to that in the pharmaceutical field. The impact of a specific technology is easier to distinguish from the impact of other technologies or exogenous factors. In the health sector (for example, in the pharmaceutical field) it is difficult to precisely monitor who takes the drug, whether the impact is caused by another drug, or whether life expectancy simply increases due to factors such as better nutrition. Despite the relative ease of monitoring software impact, there are still many different variables and approaches that can be chosen to define the impact that a technology has. To name a few:

- **FTE (Full Time Equivalent):** It is possible to use this parameter to calculate how much a company saves, and therefore calculate its impact on efficiency and the effect of cost reduction on competitive capacity. This parameter is often used in the automation sector for its effectiveness in representing the impact of the technology integration in the company. This is a valuable variable to use because automations can be implemented in operative branches that

are not strictly related to production, whose variation in efficiency could not be easily determinable by evaluating fluctuations in the production volumes.

- **Volume of data:** Calculating the impact of technology based on the volume of data it processes. This parameter is less universal compared to FTE and would require the creation of different categories of analysis, which would then need to be analysed and adjusted to allow for comparison in the evaluation phase. Probably, this approach would imply an increase in analysis costs.

- **Evaluation of production increase:** By fixing the other variables, it is possible to isolate the effect of automation on, for example, productive output. Clearly, the evaluation is approximate if complex data analysis systems are not implemented. This aspect makes this evaluation system inefficient if the analysis is not conducted very precisely.

The greater efficiency and precision of measurement tools available to the ATIF permits it to allocate a higher percentage of its annual budget to the compensation pool destined to participating companies, once again favouring participant adherence.

### 3.5.4 The Administration of the ATIF

As for the administrative side of the fund, there is no reason for it to diverge much from the one studied by Pogge and Hollis on the structural level. Certainly, some sections do not require the same amount of complexity and funds required by the HIF. the *Assessment Branch* and the *Technical Branch* of the ATIF always have reason to exist, their functions are essential, but the sector does not require them to be as complex and costly. The same goes for the *Audit Branch*. The general budget reduction of ATIF's administrative functions is not only caused by cheaper data collection methods it is also facilitated by the probable implementation of automations in the analysis and management of the data in the fund's branches.

#### 3.5.4.1 Divulgation Branch

One of the major obstacles to the integration of artificial intelligence and automations in companies is the reluctance, fear, and ignorance of employees. Contrary to the familiarity people have with medicines, often automations are unfamiliar and "*alien"* to people, so it might be necessary to create a branch specialized in the spreading of information within the ATIF Zones. This would allow the fund to increase the acceptance rate of the technologies it promotes in the hope of achieving a higher impact level. This branch should work and communicate with both the country's administration and the private entities in the ATIF Zone:

- **Communication with the countries' administration:** The *Divulgation Branch* should introduce the technological sector to the country's administration, to ensure that the interested public entities have the appropriate knowledge to promote the automations' integration, preserving at the same time the interests of the stakeholders.
- **Communication with privates:** the divulgation branch will have to interface with those who will integrate the automations, so mostly companies and corporations, which will be introduced and informed about the potential of these kinds of technologies to raise their awareness and to facilitate their decision-making process.

The staff of the Divulgation Branch can, and probably should, involve members of the participating companies, both producers and adopters.

### 3.5.5 Financing the ATIF

As for the Health Impact Fund, a financing system based on Gross National Income seems to be one of the best options. At the base of the reasoning, there is the same assumption that Pogge and Hollis made for the HIF: developed countries are incentivized to support the development of developing countries both from an ethical/moral point of view and from an economic point of view. As mentioned in the previous chapters, developed countries can derive significant benefits from the economic growth of less developed states. A financing system based on GNI guarantees a level of participation that is flexible and proportional to the country's financial performance. From the financing point of view, the ATIF does not present significant differences from the HIF; even the model studied by Pogge and Hollis, which guarantees the possibility of withdrawing from financing the fund, is not subject to

modifications deriving from the sector in question. The only difference in this procedure could be given by the different duration of software copyrights, but given the methods and timescales described for the assessment phase (revision after 10 years of the software ...), the *Phase Out* procedure of the HIF would not undermine the stability of the ATIF. If the technologies end up being particularly long-lasting, and the amount of available funds remain stable over time, changes to the *Phase Out* modalities might become necessary, for example by extending the timescales required to interrupt the financing.

A participation fee for companies that wish to apply to the fund is probably useful in the HIF as it is in the ATIF; in both cases, it is desirable to avoid too many applications. The fee works as a deterrent for companies not confident enough in their product's impact potential. Having too many technologies under the fund umbrella could lead to a disproportionate increase in bureaucratic costs.

#### 3.5.5.1 Funding Entities

As stated above funding strategy does not diverge from the fundamentals described by Pogge and Hollis in the HIF proposal. The fund can be financed by privates and states, the more it can collect the better.

**Privates**

Excluding philanthropic endeavours that might choose to partake in financing the fund, three categories of private entities could potentially benefit from the proliferation of the discussed technologies in the ATIF Zones:

- Private entities of ATIF Zones: Local companies, corporations, shareholders... could obtain significant benefits if automation technologies were distributed and made available in their areas, so they might participate in financing the fund in order to incentivize the participating companies to share their technologies.

- Private producers of symbiotic technologies: Companies that produce complementary or automation-dependent technologies might be motivated to favour the creation, development,

and implementation of a *Host*[35] technological network for their technologies in new geographical areas.

- Private entities aiming for expansion in the ATIF Zones: companies aiming at expansion in the ATIF Zones that do not have specific links to the technologies favoured by the fund, but could nonetheless benefit from the development of the infrastructure in general and from greater openness towards foreign markets. Another plausible motivation for investing is the benefit that the company's reputation might gain by supporting ethically valid proposals.

**Public**

The funders with the highest interest in supporting the fund:

- Countries benefiting from the fund's initiatives: The countries whose territory falls within the ATIF Zones. Probably among the entities with the greatest interest in supporting the proposal to ensure the economic sustainability of the companies present in their territory.

- Foreign countries (not targeted by the fund's initiatives): countries that can benefit from the development of the countries targeted by the proposal. It is likely that the development of global south markets can also benefit the economy of developed countries (e.g. value chain efficiency increase, access to new markets and customers, access to rare resources through ethical work conditions and free markets...).

Furthermore, the fund itself could encourage developing countries to a more efficient use of essential resources, part of which could then further contribute to finance the project. If automations were introduced within the managerial and bureaucratic systems of the country, they would lead to the reduction of administrative costs, increasing the availability of economic resources.

[35] Host technologies, as defined by Coccia and Watts (2020), are technologies that are needed by other technologies (parasitic technologies). This kind of technologies have a symbiotic relationship.

Take Nigeria as an example, it is a country that has high managerial costs, whose budget is mainly invested in self-supporting its administrative functions, while the capital expenditure in infrastructures useful for the country and the population, has a decreasing trend:

- 2010: Budget USD 28.75 Billion and capital expenditure USD 11.15 Billion.
- 2013: Budget USD 30.75 Billion and capital expenditure USD 9.38 Billion.

(Iyoha et al., 2015).

In Nigeria, as in many other countries, the implementation of automated and intelligent systems could help reduce administrative expenses, potentially increasing the transparency of money flows, always supposing there is a willingness to increase efficiency on behalf of the government. By adopting automations, the country could access previously inaccessible resources obtaining an increase in efficiency thus raising available monetary resources. This capital could then be invested in the development of the country, potentially also refinancing the fund.

The fund and the technologies promoted by it would not only benefit the population and industries but also the state itself, creating a virtuous mechanism that would require less economic effort. The reasoning is similar to the one Pogge explained in the development of the HIF proposal, where increased availability of economically accessible drugs reduces public spending on health policies and facilities.

## 3.6 Uncertainty in the ATIF

Similar to the HIF, the ATIF also involves entities that face a certain level of uncertainty; however, the unique sector it operates in and the establishment of ATIF Zones alter the broader context. Specifically, the fund's structure is designed to mitigate, if not wholly eradicate, some of the uncertainties that are inherent in the HIF.

- **ATIF Zones:** The institution of *Zones* guarantees that participating companies do not have to reduce prices on a global scale. Considering that the fund deals with areas where automation is not present, the opportunity cost for participating companies is quite low. Companies do not give up potential earnings they access new opportunities. The risk of damaging activities such as arbitrage or illegal distribution is quite low in the automation sector.

- **Software:** Issuing an additional copy of a software typically has a very low cost. In the case of automations, there are higher costs due to the cost of the servers where they are run and due to licenses issued by third parties. These kinds of costs can almost certainly be sustained by the companies that adopt automations with the saved resources[36] or the increase in efficiency and productivity.

- **Product adaptability:** The fund, initially, aims at implementing basic technologies in the realities present within the ATIF Zones. The adaptation of existing technologies does not involve research and development costs for the participating companies, further reducing the risk they are exposed to. Using previously developed technologies is not mandatory, but it is an optional course of action for companies that want to evaluate the system without incurring in significant costs. This is made possible by the fact that automations can achieve a high impact even if they are not specifically designed for the client.

- **Secondary effects:** the possibility for companies to obtain secondary benefits, such as data collection and the acquisition of information on emerging markets, which can generate long-term advantages for future expansion.

Clearly, not all risks are mitigated by the technological framework of the automations and the fund. Classical risks are still relevant, and participants must evaluate them before joining the fund:

- **Financial Risk:** Companies must evaluate if joining is a sustainable activity; the reward system does not guarantee compensation, and companies need to be confident about their technologies. This is more relevant for physical products with non-negligible marginal costs, such as drugs or green technologies.

- **Operational Risk:** Participating in the ATIF might require that companies adjust their internal structure to suit the fund's requirements. For example, the company will probably have to train some of the employees on the new revenue model and the new modalities regarding

[36] E.g. Automations can reduce the number of resources needed to complete tasks. Sustaining the automation costs a minimal share of the saved capital.

copyright management in the ATIF Zones. Companies will have to develop new practices to nurture the relationship with these new markets for the sake of a long-term presence in the areas.

- **Market Risk:** These new markets are blue oceans, there will not be much competition, but at the same time the cultural and social framework is almost unknown. The people and market response to technologies like automation can be unpredictable. Companies will have to research the ATIF Zones to deliver their products in the best way possible.

- **Reputational Risk:** New opportunities can also generate new risks, also if the companies have the best intentions incidents can occur. Failure when trying to penetrate a new market or to comply with the fund's requirements can potentially hurt the company's reputation.

- **Competition risk:** Even though the impact of similar technologies[37] can easily be distinct with proper data management and monitoring activities, companies have to face the fund's internal competition. Since the fund's financial resources are finite, non-concurrent technologies may represent a threat to profitability because they could achieve an impact so significant that the remaining funds could not be worth the effort. This aspect's relevance is mitigated by the technology and by the ATIF Zones.

[37] Pogge and Hollis were concerned about this issue when describing the impact assessment procedures of the HIF.

## 3.7 Additional considerations

Participation in proposals such as the ATIF can be significantly valuable for companies, especially at the current time. Nowadays the attention to the environment, ethics, and social framework in general, is at its all-time high. Stakeholders are pressuring companies to behave according to the general morale and values as it has never been done before. The internet and the ability to share information across the globe make it easier to control companies' activities and denounce them to the masses if something is not aligned with the generally accepted morale. For this reason, many companies are trying to amend themselves, if they happen to have done something "*wrong*", or to simply have a good score. Being in a good position in the eyes of the stakeholders is critical not only to avoid boycotts but also to be attractive to investors. This trend, focused on the long-term sustainability of companies' activities, is reflected in different practices:

- **Environmental, Social and Governance (ESG[38]) investing** where investors do not only care about revenues but also about the impact of companies under these aspects.

- **Corporate Social Responsibility (CSR):** Companies are nowadays expected to go beyond profit-making practices, they are required to prove that they have a positive social impact.

- **Responsible Research and Innovation (RRI):** research and development practices aiming at aligning scientific progress, innovation, and development with collective values.

Companies (both participants and funders) may be attracted to the ATIF to increase their appeal to investors, customers, and stakeholders in general.

[38] Practice that began in the '60s when investors started to exclude stocks that were not helpful to society's welfare (e.g. tobacco companies).

# Chapter 4: Ethical evaluations

## 4.1 The Ethical Framework of the Impact Funds

> Is it morally permissible to impose strong patent protections where doing so prices important new medicines out of the reach of many poor people? We argue that doing so is not permissible and in fact a human rights violation. To become human rights compliant, the global patent regime must be complemented by an enduring institutional mechanism that effectively incentivises the development and distribution of high-impact medicines that meet the health needs of poor people and are accessible to them. The Health Impact Fund is designed to be such as complement (Pogge & Hollis, 2008, p. 51)

While the Health Impact Fund designed by Pogge and Hollis is a response to a problem (the violation of human rights caused by the mechanisms deriving from the use of patents), the Automation Technology Impact Fund is a *quasi*-preventive measure to the potential issues that may arise from the mass-scale implementation of automations. It is a "*quasi-preventive*" measure because the world is having a glance at the (innovative) *disruption* automations can bring. The ATIF is meant to interrupt the causality link between problem and solution, by shaping a system that creates virtuous dynamics and that generates the preventive conditions that can reduce the need to rely on forecasted countermeasures. Since the success of a technology is determined by its impact, products/services with foreseeable negative impacts would not be sustainable, limiting the chances of the manifestation of problems. There are exceptions clearly, unforeseeable problems are *per se* not predictable, but the dynamic evaluation systems and the annuality of the rewards allow to rapidly stop the funding of negative impact technologies. It is important to underline these characteristics of the fund because the ATIF is a means for companies to reach new and fragile geographic areas, therefore the fund should guarantee, as much as possible, that the technologies it finances have not exploitative purposes. The fundamental motivations behind the ATIF proposal are rooted in principles of global justice. The fund aims to reduce the gap between developed and developing countries while preventing an increase in competitive capability inequalities.

However, the concept of justice is malleable and subject to interpretation; it is closely tied to the social structures, morals, and ethics one is exposed to. As Miller (2021) observes, "…we will need to

accept that no comprehensive theory of justice is available to us; we will have to make do with partial theories – theories about what justice requires in particular domains of human life." Therefore, seeking a universal definition of justice might be challenging, if not misguided. Nevertheless, it is possible to discern foundational principles behind Impact Fund proposals: the philosophical framework they rely upon is what is commonly referred to as *Justice as Equality*, specifically grounded in the domain or field of study known as *Luck Egalitarianism.*

Miller (2021) states:

> According to luck egalitarians, justice requires that no one should be disadvantaged relative to others on account of 'brute' bad luck, whereas inequalities that arise through the exercise of personal responsibility are permissible … 'Brute' luck is interpreted widely to include not only external circumstances such as one person's initially having access to more resources than another, but also internal factors such as possessing natural abilities or disabilities, or having involuntarily acquired expensive tastes. All such inequalities are to be ironed out by redistribution or compensation, while people's choices about how to use the assets they are granted should be respected, even if this leads to significant inequality in the long run.

The Impact Funds aim to tackle these kinds of issues (opportunity inequalities). In the case of the HIF, the problem is present and ingrained in the global economic structure, while in the case of the ATIF, the problem is starting to emerge. Due to the possible development of the competitive environment described in previous chapters, automation-driven inequalities have the potential to dismantle current trade patterns and reshape the distribution of work availability globally. Thus, the automation sector can potentially become a significant source of inequalities just as it is in the case of unequal drug distribution.

Having cleared which domain of *justice* is applied here, it is important to underline that the Impact Funds deal with the **international** landscape and the inequalities deriving from the historical relationships between nations and markets. Therefore, to properly define the ethical framework that shapes the Impact Funds it is necessary to frame the concept of justice in an international context.

> Contemporary political philosophers had focused their theorizing about justice almost exclusively within the state, but the last twenty-five years or so has seen a marked extension

> to the global sphere, with a huge expansion in the array of topics covered. … (Focusing on) the context of contemporary phenomena like intensified globalization, economic integration, and potentially catastrophic pandemics and anthropogenic climate change (Brock, 2015).

There are two distinct branches of justice in the "*global sphere*":

- **International justice:** International justice studies justice between nations and sees nations as the central entities.
- **Global justice:**

> The domain of global justice … theorists do not seek primarily to define justice between states or nations. Rather they drill down through the state shell and inquire about what justice requires among human beings. Global justice inquiries take individual human beings as of primary concern and seek to give an account of what fairness among such agents involves. … Global justice analyses are not precluded from yielding state-level obligations; indeed, they typically do. However, they consider a wider array of possible agents and organizations that might have duties as well (Brock, 2015).

The Impact Funds seek justice on the human level by acting in the organizational layer, basically building an infrastructure that promotes global fairness; addressing, in the case of the HIF, basic human needs, or aiming to prevent, in the case of the ATIF, the future deterioration of the capacity to access these needs. If automations are too concentrated in the developed world, developing countries may lose their competitiveness and the living conditions of their populations could worsen. For instance, a scarcity of economically sustainable companies in the region can lead to low job availability, potentially thrusting a significant number of people into poverty.

## 4.2 Duties

The next step after outlining the general ethical concepts guiding the Impact Funds is to consider what drives the implementation of such ethical constructs. The impetus to act derives from the observation of the fact that the principles discussed are not applied in the real world. If the situation does not follow the theoretical concepts something has to be done to align reality and justice.

The market's structure is not based on justice, it is tendentially focused on efficiency: what works and is sustainable can exist. The agents of the market (corporations, organizations, firms…), generally, seek profit, the generation of profits grants their sustainability and the satisfaction of the shareholders that manoeuvre them. As Pogge (2011) mentions altruistic behaviours in the pharmaceutical sector deprive corporations of funds that are necessary for their sustainability. In this case like in most others, helping is not sustainable in the short run even though it may bring benefits in the long run.

However, the market environment is gradually changing[39], the vast influence of stakeholders on companies' behaviours is pushing towards the alignment of the crude market structure with ethical justice. The impact of stakeholders' will on companies' sustainability brings to the application of ethical duties into normal business practices. This trend is the manifestation of scholars' assumptions when discussing justice.

There are two types of duties:

- Negative duties: the obligation of not harming others.
- Positive duties: the obligation of helping others actively.

### 4.2.1 Negative Duties

"A negative duty, is … a moral obligation not to harm or injure others in a given way." (Encyclopædia Britannica, n.d.)

In his book: "World Poverty and Human Rights Cosmopolitan Responsibilities and Reforms" Thomas Pogge argues that the developed world is not fulfilling its negative duties towards the global south: "He (Pogge) argues that since developed countries impose a coercive global order on the poor that foreseeably and avoidably causes great harm, they have important responsibilities to reform the global

[39] Observable by the shift towards practises such as ESG investing, CSR and RRI.

order such that it ceases to do so and instead better secures human rights" (Brock, 2015). This book represents the starting point of what brought the author to the creation of the HIF proposal. The Health Impact Fund discourages practices that can lead to the violation of negative duties, supporting, profitably, the transition to a system that is impact-focused and reduces the cost of life-saving medicines. The ATIF instead prevents the violation of negative duties by avoiding the possible consequences of large-scale automation deployment in the developed world, helping to prevent the widening of the competitive gap between rich and poor countries.

### 4.2.2 Positive Duties

"A positive duty is a moral obligation to aid or benefit others in a given way in situations where they are in need of help" (Encyclopædia Britannica, n.d.).

The Impact Funds help to fulfil positive duties by redirecting the incentives to which companies are exposed. The impact reward system fosters positive impact R&D over profit-oriented R&D, actively influencing factors that can improve the quality of life in developing countries. Positive duties become even more relevant when considering that often the cost required to provide help is not high. Peter Signer on this matter made a provocative thought experiment, stating that not helping poor countries is like watching a child drown in a shallow pond, the investment required to save the child is extremely low when compared to the benefit.

> Singer argues that you would be obligated to assist using the principle that when it is in our power to prevent something bad from happening without sacrificing anything significant or comparable, it is wrong not to prevent the bad from occurring. So, Singer argues that we have extensive duties to assist needy others, whether they be geographically proximate or not. We have extensive duties to assist the global poor who, with equally minimal effort on our part, can be saved from dire circumstances, since the same principle applies in both cases (Brock, 2015).

## 4.3 Developing Nations on Negative and Positive Duties

An interesting thing to consider is the duties poor countries' governments have towards their populations. In the writing of this thesis, it has been assumed that developing countries would participate in the Impact Funds because they surely have an interest in improving the quality of life in their territories, but what if this is not the case?

In the Nigeria case, examined in the previous chapters, there is a peculiar trend that sees an antithetical capital expenditure decrease with an increasing budget. The aim of the study (Iyoha et al., 2015) that reports those data is to understand the impact on the quality of life of the high cost of governance of the country, a cost that has been proven, according to the authors in previous studies, to be manipulated by the corrupt administration of the country to gain advantages. The conclusion of the study confirms that the administration demonstrates no interest in fulfilling its positive and negative duties, the population does not have priority when the opportunity cost is paid by individuals in the administration.

> This study has provided evidence that Nigerians are at the mercy of the individuals in government. This is explained by the failure of the public interest theory to explain the legitimacy of governance. Rather, it would appear that the Special Interest Theory, which says that government purposefully bestows wealth on those in government at the expense of the average citizen, is relevant in Nigeria. This is possible because the individuals in government have the power to use coercion to achieve whatever they desire. From the analysis of the issues contained in this study, those who are involved in government have the same motivations that those in the private sector have. That is, they are motivated by a narrow concept of self-interest: wealth, fame, and power, which represent the act of balancing one’s budget at the expense of the generality of the populace. If there is a conflict between the public's interest and the private interest of governmental decision-makers, the public's interest will lose (Iyoha et al., 2015, p. 250).

These considerations can completely reshape the grounding fundamentals that the Impact Funds rely on, it might be difficult to operate efficiently if the local institutions of developing countries see the Impact Funds as an opportunity to exploit in their own interest. If the local administration’s mindset is short-term oriented, they may not provide the assistance needed by the fund to operate. These kinds

of obstacles are probably more relevant than one could imagine when theorizing altruistic proposals such as the Impact Funds. From a naïve perspective, who would think that altruistic proposals could be hampered by the ones who can benefit from them. Applying Singer's approach, and also in accordance with Thomas Pogge's statements, the financing activities could easily be sustained by developed nations without the assistance of developing nations, but if the local administrations actively hamper the development in their regions the Impact Funds could not achieve a sufficient level of impact. Therefore, it can be stated that a preliminary analysis of the local administration tendencies is required before the *landing* of the Impact Funds in a designated territory. The commitment of local governments to fulfil their negative and positive duties toward their populations could become a necessary condition for the eligibility of the area.

However, it should also be considered that corrupt local administrations can benefit from a richer population with a higher quality of life. Thus, it is also possible to assume that unethical governors, with a long-term approach, could facilitate the operations of the Impact Funds. For example: the HIF can reduce local healthcare capital requirements, increasing the available capital for unethical practices of such administrations.

## 4.4 The Ethical Framework of Automation Technologies

"The future of AI will not be decided by ethical conclusions, it will be decided by which ethics does the concluding" (Brusseau, 2022).

Artificial Intelligence technologies and automations are evolving at an exponential pace, these technologies are one of the most significant innovations of this period. The degree of change that they can cause is the source of increasing uncertainty, so as their potential impact increases the ethical concerns revolving around them becomes more prominent. As discussed in the previous chapters it is difficult to point out which ethical framework will define the restrictions and possibilities of automations. Currently, there are different ethical approaches that are being suggested in addressing A.I. and automations:

- **Classical Ethics:** Based on established ethical theories, it implements a steady development and revolves around traditional doctrines such as deontological ethics and consequentialism.

- **Proactive/Preventive Ethics:** It relies on anticipating potential future dilemmas and developing scenario guidelines.

- **Responsive/Agile Ethics:** An approach that addresses ethical concerns by adapting and reiterating the ethical dilemmas. “It is a key agile principle to postpone design decisions until as late as possible, allowing for just-in-time but well-informed decisions” (Leijnen et al., 2020).

- **Ethics by Design:** This approach requires the integration of ethical parameters in the A.I. design and development stages, preventing the deviation from those parameters. As described by the European Commission (2021) there are six ethical principles that should be embedded into A.I.’s design:
    - **Respect for Human Agency:** The design of artificial intelligence technologies should revolve around the *Autonomy*, *Dignity* and *Freedom* of human beings.
    - **Privacy and Data Governance:** Data protection and privacy are human rights; artificial intelligence technologies need to be designed to follow those rights.
    - **Fairness:** Human beings should benefit from equal rights and opportunities.
    - **Individual, Social and Environmental Well-being:** Artificial intelligence technologies must not harm individual, social, and environmental well-being.
    - **Transparency:** Stakeholders should be able to clearly understand the purpose, inputs, and operations of artificial intelligence technologies.
    - **Accountability and Oversight:** The creators and the persons involved in the design of artificial intelligence technologies should take responsibility for the functions and consequences of their creations.

The ATIF can be considered as a tool that fuses the *ethics by design* approach with the *agile* approach, it constitutes a system/environment where technologies are created and diffused to have a positive impact, the participating technologies need to be designed with human rights at their core to achieve the fund’s objective. In addition, the evaluation mechanism guarantees that if ethical concerns arise the “*problematic”* technology will be analysed, if the ethical criteria are not met the reward activity

will be stopped, this allows an agile approach that evolves over time in pace with the technologies and the ethical values.

## 4.5 The Introduction of Automations and Unemployment

Automation technologies are implemented in business operations to reduce costs, sometimes the technologies support the human resources, and in other occasions, they can substitute employees. In general, automations are assigned to jobs with highly repetitive tasks where human work adds low value; the narrative pretends that companies move the substituted employees to more uplifting tasks that need actual humans to be completed, clearly, this is not always the case. This consideration brings to the major ethical concern of software automations: **unemployment**.

One of the metrics used in the evaluation of software automation's effectiveness is FTE, or full-time equivalent, which measures how many full-time employees would have to be hired to complete the task in the amount of time that the automation needed to complete it. This metric can highlight the degree of the impact automations can have on employment, entire departments can be substituted by automations without losing on productivity, while at the same time saving on costs. In countries with well-established and functional work laws where layoffs are regulated, the substituted employees will be moved to higher value-added jobs, but in other contexts, the former employees risk being laid off. Essentially there are two scenarios:

1. The company that implements an automation can surf the wave of increased productivity by reorganizing its human resources and assigning them to other departments, ending up with an automated department that maintains its former production level but with lower costs, while having more human resources[40] assigned to other tasks raising the productivity of the other branches.

2. The company that implements an automation enjoys the cost reduction, not reassigning the existing human resources to other tasks, its productivity remains the same, but the profit margins are higher.

[40] Maybe after a training period.

Both scenarios bring advantages to the company's efficiency, the first one shows that both parties received benefits with the workers having the ability to perform higher value-added jobs, while in the second one, workers lost their jobs.

The second scenario might be one of the strongest antitheses to a proposal such as the Automation Technology Impact Fund: if automations are pushed in a context in which workers perform low value-added jobs, with high chances of being substituted, the cost borne by individuals can potentially be higher than the benefit brought to the economy of the ATIF Zone.

To evaluate this point without expanding extensively on out-of-topic scenarios it is mandatory to make some assumptions:

- The following decades will be characterized by a large-scale implementation of automations especially in developed countries.
- Automations will widen the competitive gap between poor and rich countries.
- The increase in efficiency caused by automations will reduce the developed countries' demand for low-cost labour in poor countries, due to the repatriation of the automated business branches.
- Lower demand for work in developing countries will bring large-scale unemployment, raising the number of people living in poverty.
- The widening of the competitive gap between poor countries and rich countries will damage poor countries leaving them more exposed to the exploitation of their resources perpetrated by developed countries.

These assumptions outline a scenario that is very consistent with what Müller (2020) states:

> It would appear that the AI economy has three features that make such justice unlikely: First, it operates in a largely unregulated environment where responsibility is often hard to allocate. Second, it operates in markets that have a "winner takes all" feature where monopolies develop quickly. Third, the "new economy" of the digital service industries is based on intangible assets, also called "capitalism without capital" (Haskel and Westlake 2017). This means that it is difficult to control multinational digital corporations that do not rely on a physical plant in a particular location. These three features seem to suggest that if we leave the distribution of wealth to free market forces, the result would be a heavily unjust distribution: And this is indeed a development that we can already see.

Essentially the uncontrolled development and diffusion of automation technologies can naturally bring to the worst-case scenario.

In response to the critique moved against the ATIF mentioned above, and following the assumptions outlined, it is possible to conclude that:

1. If the uncontrolled diffusion of automations can generate unjust resources and wealth distribution as described by Müller (2020), the introduction of a proposal such as the Automation Technology Impact Fund could mitigate the negative effects on developing countries, granting the diffusion of the technology, and facilitating the generation of a just global market where opportunities are more equally distributed.

    a. If companies are able to reallocate their human resources inside other business branches, both the companies and their employees will benefit from the introduction of automation technologies. In this case, companies in developing countries are more likely to withstand the competitive pressure exerted by automated foreign companies.

    b. If companies are not able to reallocate their human resources within their business branches, and the consequences of the adoption of automations are an increase in efficiency, a reduction of cost and the dismissal of a portion of their human resources; the damage is mitigated because the company will be able to survive despite the more competitive market. It is still able to provide work opportunities when exposed to automated foreign companies, even though the company can offer fewer job opportunities than before, minimizing the suffering.

Thus, the diffusion of automations as it is described by the ATIF can mitigate the damages that the population would inevitably suffer in free market conditions. Therefore, the implementation of a proposal such as the ATIF, under the domain of the outlined assumptions, is an ethical choice that fosters global justice and parity of opportunities.

In addition, it must be considered that automation technologies are to be considered one of the key technologies supporting the fourth industrial revolution.

“Organizations like the World Economic Forum include AI, along with other technologies like mobile, robotics and IoT, in what is referred to as the 4th Industrial Revolution” (Thomas, 2020).

Adapting to and adopting the technologies that characterize Industrial Revolutions is often a mandatory requirement to survive the period of structural and methodological innovation that brings to the next industrial phase.

> In the long run, higher productivity in industrial societies has led to more wealth overall. Major labour market disruptions have occurred in the past, e.g., farming employed over 60% of the workforce in Europe and North-America in 1800, while by 2010 it employed ca. 5% in the EU, and even less in the wealthiest countries (European Commission 2013). In the 20 years between 1950 and 1970 the number of hired agricultural workers in the UK was reduced by 50% (Zayed and Loft 2019). Some of these disruptions lead to more labour-intensive industries moving to places with lower labour cost. This is an ongoing process (Müller, 2020).

Therefore, the ATIF proposal not only brings the benefits listed above, it could also become an instrument that allows companies and workers in developing countries to cross the transition period prosperously. Hopefully, it has the potential to lead them to a wealthier long-run.

# Conclusion

Innovation is an unstoppable force resulting from the need to find alternative and better solutions to problems, this driving force shapes societies and cultures. Innovation is the lifeblood of what is known as "*advancement*", be it in the technological, philosophical, ethical, or cultural field, however, it is characterized by its unpredictability, as described in the second chapter of this thesis. The causal effects that innovation can generate are not always predictable and the ever-growing interconnections between the different aspects that compose society strengthen the ripple effects that change generates. In addition to the natural innovation-driven uncertainty, there is also a certain component of carelessness inherent in human nature: as it was for the atomic bomb, when no one was completely sure the chain reaction would not ignite the atmosphere, there are now serious uncertainties about the possible negative effects of the advancement of artificial intelligence.

> There will be a strong and increasing pressure to improve AI up to human-level. If there is a way of guaranteeing that superior artificial intellects will never harm human beings then such intellects will be created. If there is no way to have such a guarantee then they will probably be created nevertheless (Bostrom, 1998).

The higher the card castle of advancement the higher the chances of affecting one of its fragile foundations. Essentially as research and development expands and advancement accelerates, the probability of reaching a point of no return with disruptive inventions rises. The effects of such inventions could damage the vast amounts of tesserae that compose society's complex mosaic, to the point that the known or desired image can lose its recognisability. This does not mean that change is negative *per se*, but negative outcomes can inadvertently occur, either caused by lust for progress/profit, or for other unpredictable reasons, as Bostrom describes.

Thus, as the potential impact of innovations increases, the countermeasures taken to limit the negative effects rise proportionally, effects are visible globally, such as the European Union's growing interest in RRI (Brey, 2012).

In the field of ethics the countermeasures addressing the *problem of uncertainty*[41], are purely speculative attempts to control potential and unknown outcomes, but as Brey (2012) states these still are better than nothing:

> It would seem undesirable that ethicists lose themselves in speculation over future ethical issues that might emerge but that may be based on completely inadequate projections of future developments. On the other hand, it would also seem undesirable that ethicists remain silent about emerging technologies because of this uncertainty (p. 307).

Fundamentally the problem with these kinds of countermeasures is their speculative approach, an approach dictated by the *problem of uncertainty* inherent to innovations. This speculative approach cannot guarantee that possible, and severe outcomes can be avoided due to the *butterfly effect* that innovations can have on apparently uncorrelated *tesserae* of society.

One of the focuses of this thesis is to address the *problem of uncertainty* by applying and adapting Pogge's HIF model as the answer to uncertainty. For example, the ATIF model is a concrete and extensive example that addresses the possible problem of the widening of the competitive gap (as the unpredictable consequences of software automation innovation and application) between developed and developing countries. The *uncertainty problem* is dealt with by the creation of a system structured to reduce the diffusion of negative impact innovations. It not only fosters the creation of positive impact technologies, as the HIF, it also carries out constant assessments of the technologies it funds. Essentially the Impact Funds are an R&D and commercialization environment, that offers an alternative to the classic market. It is grounded on ethics and global justice, the conditions to participate serve to generate different outcomes:

- Promoting positive impact technologies.
- Hampering negative impact technologies.
- Redirecting R&D towards high-impact technologies as an alternative to profit-maximizing strategies.
- Limiting the reliance on speculative ethics caused by the problem of uncertainty by creating an environment that promotes ethical technologies.

[41] With practices as: anticipatory technology ethics (ATE), ethical technology assessment (eTA) and ethical assessment of emerging information and communication technologies (ETICA)

- Promoting parity of opportunity and global justice.

The second focal point of the thesis is the economic and ethical analysis of the Impact Funds, not only as a preventive countermeasure for the problem of uncertainty but also as an applicable economically sustainable vehicle for global justice theories. The discussion developed in chapters three and four extensively analyses the possibility of constituting Impact Funds to address issues such as the competitive gap between developed and developing countries and the application of global justice theories, demonstrating the possibility of applying Pogge's HIF to different industrial sectors in an economically sustainable way for countries and corporations. Clearly, the whole reasoning assumes that there is an intent from both parties (developed and developing countries) to address and improve the current (in the case of the HIF) and potential (in the case of the ATIF) conditions of developing countries. Essentially, it is deemed worthwhile to evaluate different alternatives, not limiting the boundaries and possibilities to the purely theoretical free market rules. It seems that those rules are not sufficient to address distributive real-world problems if a more equally distributed economic and social justice is desired.

Sometimes saving a child from drowning in a shallow pond is not as expensive as it might seem.

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(Used to explain Roko's Basilisk thought experiment)