

# Towards an XBRL-enabled Sustainability Taxonomy – A behavioral accounting approach

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*“Ecological problems will be the main issue in the coming decades and if we do not act responsibly, we will make this planet uninhabitable due to the environmental damage that we can already foresee. And of course, we all have a responsibility in this regard.” Alfred Herrhausen, 1989 in Kipper (2017)\**

**ABSTRACT:** Globalization has led to an unprecedented correlation of massive global systems causing systemic risk to increase exponentially (Centeno et al., 2013). 10 years after the global financial crisis, what are the lessons learned, what was improved and what still needs to be accomplished? The crucial question remains: has the global financial system and with that the world become less susceptible for a reoccurrence of a financial crisis? What are the factors to achieve a sustainable finance architecture with stable economic markets? In the aftermath of the 2008/09 world financial downturn the interest in understanding non-financial factors and interplay to financial markets increased. A system can only be sustainable if inequality, governance and environmental sustainability is surmounted. According to Beyer et al., significant progress was made in the modelling, as the Global Financial Crisis revealed shortcomings in the model strategy (Beyer et al., 2017). The question arises if also progress is made on social responsibility investing in the securities, selected for social environmental ethical and institutional aspects? Based on the EU led High-Level Expert Group on Sustainability (Cullen, 2018) the EU examines how to integrate sustainability consideration into its financial policy framework. The EU plans to develop a classification system (‘taxonomy’) on what can be considered an environmentally sustainable economic activity. To overcome the climate change challenge, a consensus has a pivotal role to enable to invest in climate friendly investments, which do not turn out to be a false labelling. The global architecture of climate finance is important part of a sustainable finance architecture. Additionally, disclosure regulation is planned that institutional investors integrate ESG (environmental, social and governance) factors into their investment-decision making process. In the absence of a globally integrated financial and non-financial framework, this paper tries to put emphasis back on decision-usefulness of the investor and a Sustainability Taxonomy considering the transparency technology Extensible Reporting Mark-up language (XBRL). This working paper tries to bridge early statements about environment and the responsibility for future generations in the financial service sector (Kipper, 2017).

**KEYWORDS:** Sustainability Taxonomy, Sustainable Reporting, Finance Architecture, Behavioural Economics, Decision-usefulness and XBRL, Climate Change

## Introduction

In the last 10 years since the break out of the financial crisis 2008/09 a lot was accomplished for the development of models, which can better predict future losses. However, the best model cannot predict long forecast horizons. Based on the experience with IFRS 9 typically forecast horizon comprise of less than five years. This is since longer forecast time horizons can not be reliably estimated. This is also very often mentioned in the academic literature. One of the most prominent economic theory, which encompass the uncertainty of the prediction of future events is the random walk theory (Taylor, 1982). In addition to that, people under a behavioral approach do not behave rational. Considering behavioral economics encompassing a wide range of psychological, economic and sociological laboratory and field

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\* This working paper is dedicated to Alfred Herrhausen, who was a real visionary of corporate social responsibility and sustainability.

experiments human proved beings deviating from rational choices. Standard neo-classical profit maximization axioms often failed to explain how human behave (Puaschunder, forthcoming). Human beings rather use heuristics in their day-to-day decision making. These mental shortcuts enable to cope with a complex world yet also often leave individuals biased and falling astray to decision making failures (Puaschunder, forthcoming). Research in Political Science about voting decision from people shows that they are strongly influenced by rather unreflective first impressions and those decisions are not the outcome of rational reflection and deliberation (Todorov, 2005).

Behavioral Economics identify anomalies and shortfalls in neo-classical economics. Ample evidence showed that human beings disregard rational choices standard neo-classical profit maximization axioms would predict but rather use heuristics in their everyday decision making (Puaschunder 2018b). Due to mental deficiencies, humans are unable to cope with a complex world and fall prey to complexity. Contrary to standard neo-classical assumptions, individuals try to reduce complexity, whenever it is possible (Puaschunder, 2018b). Reducing complexity also implies decreasing cognitive drain on our limited mental resources. For many day-to-day problems, humans developed certain heuristics, which represent mental shortcuts or rule of thumbs, which are very successfully applied (Gigerenzer, 1999). Contrary to neo-classical assumptions, pareto optimality for society over time deviates from the aggregated individual generations' preferences. As the sum of individual generations' preferences will not lead to societally favorable outcomes over time (Puaschunder, 2017). What makes it so crucial for financial stability is that once societally not favorable outcome of climate change becomes a defining issue "it may already be too late" (Carney, 2015) as expressed by Mark Carney Governor of the Bank of England and Chairman of the G20's Financial Stability Board. "Climate change is a tragedy of the horizon which imposes a cost on future generations that the current one has no direct incentive to fix" (Carney, 2015). Climate change will be once it causes a real tangible impact exceed traditional horizons of most actors including businesses and central banks. Once climate change therefore becomes a real threat to financial stability the point of no return could already be reached (Carney, 2016). Carney names besides this time horizon tragedy a second main paradox associated with climate change that success implies failure, if too fast and too successful a low-carbon economy is achieved a material damage to financial stability could be caused. "A wholesale reassessment of prospects, as climate-related risks are re-evaluated, could destabilise markets, spark a pro-cyclical crystallization of losses and lead to a persistent tightening of financial conditions: a climate Minsky moment" (Carney, 2016).

Climate change represents therefore one of the most pressing problems in the age of globalization as for exacerbating more risks than ever before in terms of water crises, food shortages, constrained economic growth, weaker social cohesion and increased security risk. The implementation of climate stability accounts for the most challenging contemporary global governance predicament that seems to pit today's generation against future world inhabitants and is also represent the greatest threat to long-term sustainable financial stability (Puaschunder, 2017). To better cluster risks associated with climate change and to be able to develop a reporting taxonomy the following three climate risk channels are introduced (Carney, 2016).

- Physical risks
- Liability risks
- Transition risks

Physical risks imply the danger on the value of financial and non-financial assets which are caused by the damages from climate change and weather-related events. Heat stress, extreme weather scenarios, sea level rise, drought and extreme wind situations.

Liability risks result from incurred losses from climate change, which will be forced to be compensated via litigation (Herweijer et al., 2009).

Transition risks are associated with the adjustments toward's a lower-carbon economy, as conversion could cause sudden changes in policy, consumer preferences, technology and physical risks. The sustainability taxonomy will need to address physical and transitional risks (Labatt and White, 2011). Before further elaborating the taxonomy, the authors will provide a historical overview on Sustainability Reporting.

### **History of Sustainability Reporting**

Sustainability reporting is the main communication platform for sustainable performance and impacts. There is no exact agreement on what constitutes exactly "Sustainability Reporting", which is why many of the previous research deals with the challenge to develop standards for defining and reporting sustainability (Aras and Crowther, 2009). The following section applies an inductive approach to sustainability by focusing on the de-facto reporting practice by companies. Sustainability reporting occurs when organizations consider their impacts on a wide range of sustainability issues mainly based on transparent risk and opportunity analyses. A sustainability report publishes a corporations' economic, environmental and social impacts alongside the organization's values and governance model. Reports link strategy to commitment to a sustainable global economy. Sustainability reporting helps organizations to measure, understand and communicate economic, environmental, social and governance performance. Setting goals in the reporting helps to manage change. Concrete sustainability reporting comprises of non-financial reporting, triple bottom line reporting, Corporate Social Responsibility and integrated reporting, which combines financial with non-financial performance.

In the wake of sustainability reporting, organizations consider their impacts on people, planet and profits in the realm of sustainability. Sustainability reporting enables corporations to be transparent about risks and opportunities. Communicating to stakeholders, sustainability reporting allows to identify and communicate risks and opportunities for the organization. Transparency thereby leads to better decisions, which helps build and maintain trust in businesses.

Sustainability reporting is guided by the GRI Sustainability Reporting Standards, the Organization for Economic Co-operation and Development (OECD), the United Nations Global Compact and the International Organization for Standardization (ISO), which offers an international standard for social responsibility.

Corporate sustainability reporting has a history going back to environmental reporting. The first environmental reports were published in the late 1980s by companies in the chemical industry, which had serious image problems and were forced to make working conditions and environmental impacts transparent. The other group of early reporters was a group of committed small and medium-sized businesses with very advanced environmental management systems. Additionally, the tobacco industry adopted such reporting much earlier than the rest of the corporate world, in an attempt to attract new investors at a time when ethical investing was becoming increasingly popular.

Non-financial reporting, such as sustainability and CSR reporting, is a recent trend which has expanded over the last decades. Many companies now produce an annual sustainability report and there are a wide array of ratings and standards around intended to be a "vessels of transparency and accountability." Often, they also intended to improve internal processes, engage stakeholders and persuade investors.

Historically, sustainability reporting stems from the field of ecological economics and related topics in environmental economics and political economies. From the consumer perspective, marketing and transparency in the digital social media age played a role in propelling sustainability reporting. It covers basic approaches to the relationships between ecological and economic systems, both traditional and alternative economic theories and worldviews. Most recently after the World Financial Recession of 2008 but also after the Paris Agreement, the role

of economics in understanding and valuing environmental concern has increased. The relation of the economy and current environmental issues, such as climate change, biodiversity loss, land degradation, ocean acidification and freshwater use are introduced through this outlet. In total, the reports feature multiple approaches and analytical frameworks developed historically and by unconventional economists to frame and interpret these issues. Scientifically, the reporting is trace of the application of ecological economic principles to environmental problem-solving in different industries around the globe. The reports give an overview of economics with an application in the public domain define the relationship between the economy and the environment, the role of economic analysis in understanding and valuing the environment, and examine problems of social and economic development, environmental and related policies.

Considering the rising climate change awareness and demand for an economically efficient transitioning into renewable energy, the UN-led Earth League most recently inceptioned the Climate Risk and the Finance Sector working group in partnership with United Nations Environment Programme Finance Initiative (UNEP FI), the World Resources Institute (WRI), and the Global Challenges Foundation. The UNEP FI is a global partnership between the UNEP and the financial sector. Over 200 institutions, including banks, insurers and fund managers, work together with UNEP to capture the mutual impacts of environmental and social considerations on financial performance (Puaschunder, 2016b).

At the 3rd Conference on Financing for Development in July 2015 in Addis Ababa, and at the global summit on the Sustainable Development Goals in New York City in September 2015, external financing for development was proven as key driver of developing economies. In the wake of the 2015 inception of the UN Sustainable Development Goals, a report was published by UNEP FI in cooperation with the PRI, UNEP Inquire and the UNGC that aims at elucidating debates surrounding environmental, social and governance issues in the light of fiduciary duty. The report is meant to foster investors' understanding and consideration of environmental, social and governance (ESG) issues in their investment decision making. The research stresses the point that a failure to consider long-term investment value drivers including ESG issues in investment practices is a failure of fiduciary duty. The report also touches on the implementation of sustainable finance and impact investment in order to propose practical action for institutional investors, financial professionals and policy-makers to embrace sustainable development (Puaschunder, 2016).

One of the most novel trends is the acknowledgement of role of political divestiture for sustainable development (Puaschunder, 2016). With political divestiture having increasingly become an element of fiduciary duty, particularly for investors with long-term horizons that oversee international portfolios, this Financial Social Responsibility means has also come closer to serving sustainable development. Sustainable investment is needed in global economic growth and development, especially in light of financing SDGs and developing countries being highly dependent on corporate contributions. There are massive worldwide financing needs for sustainable development and FDI plays a crucial role in bridging the investment gap, especially in developing countries. Due to stability and diverse development impact compared with other sources of finance, FDI is the most important component of external development finance to fragile economies. Over the past decade, FDI stock tripled in least developed countries and small-island developing economies and quadrupled in landlocked developing countries. At the same time, inward FDI to the developing economics reached their highest level at USD 681 billion with a 2 percent rise in 2015 (Puaschunder, 2016; World Investment Report, 2015). According to the World Investment Report 2015, investment community trends will still be geared towards investment liberalization, promotion and facilitation in the future. Global FDI flows are expected to reach \$1.4 trillion in 2015, implying a 11 percent increase. Capital flows are expected to increase further to \$1.5 trillion and \$1.7 trillion in 2016 and 2017 (Trade and Development, 2015). With a concerted effort by the international investment development community, FDI in

weak economics could quadruple by 2030. In the future, economic diversification should target at fostering greater sustainability in these most vulnerable countries (Puaschunder, 2016b; World Investment Report, 2015). For the future the world's leading Stock Exchange Commissions seek to further support the PRI and consider innovative ways how to partner with the UNGC. Sustainable development impact reporting can thereby highlight sustainable development criteria such as environment and social standards. For instance, the United States' Overseas Private Investment Corporation (OPIC) uses about 30 development indicators to evaluate job creation and human capacity-building, sustainability effects as well as impacts on environmental and community benefits (World Investment Report, 2015). In addition, specific sustainable development outcomes could be screened if being in line with industrial development strategies and regional economic cooperation. Future monitoring could comprise of an ombudsperson and facilitator to help ensure a vital sustainability climate.

Sustainability Reports offer information on the efficiency and unknown potentials as well as possible downturns of SRI. In a cost and benefit analysis, SRI implies short-term expenditures, but grants long-term sustainable investment streams. In the short run, screened funds have a higher expense ratio in comparison to unscreened ones – that is social responsibility imposes an instantaneous 'ethical penalty' of decreased immediate shareholder revenue (Tippet, 2001, Mohr and Webb, 2005). In addition, for investors the search for information and learning about CSR is associated with cognitive costs. Screening requires an extra analytical step in decision making, whereby positive screens are believed to be more cognitively intensive than negative ones (Little, 2008). Screening out financial options lowers the degrees of freedom of a full-choice market spectrum and risk diversification possibilities (Biller, 2007).

On the long run, SRI options offer higher stability, lower turnover and failure rates compared to general assets. Being based on more elaborate decision making processes, once investors have made their socially responsible decision, they are more likely to stay with their choice (Little, 2008). As a matter of fact, SRI options are less volatile and more robust during cyclical changes (Bollen, 2007). SRI measurement deficiencies stem from intangible and time-inconsistent pay-offs as well as measurement errors. SRI studies are methodologically limited as for small sample sizes due to the relative novelty of Financial Social Responsibility, inconsistencies in the short time frames under scrutiny and differing modelling techniques used to estimate investment returns (Jones et al., 2008). Most SRI studies do not take externalities on the wider constituency group into consideration, which lowers the external validity of the results and calls for a more whole-rounded examination of SRI with a global perspective.

### **Behavioural approach to Sustainability**

Contemporary theories and studies of economics have turned behavioral. Behavioral Economics revolutionized mainstream neo-classical economics in the past two decades. Laboratory experiments have captured heuristics as mental short-cuts easing choices of mentally constrained human in a complex world. At the same time, heuristics were examined as a source of downfalls on rational and socially-wise choices given future uncertainty. Behavioral economists have recently started to nudge – and most recently wink – people into favorable decision outcomes, offering promising avenues to steer social responsibility in public affairs. Since then two Nobel Prizes in Economics have crowned this growing field as a wide range of psychological, economic and sociological laboratory and field experiments proved human beings deviating from rational choices and standard neo-classical profit maximization axioms often failed to explain how human actually behave. Human beings rather use heuristics in their day-to-day decision making. These mental short cuts enable to cope with a complex world yet also often leave individuals biased and falling astray to decision making failures. What followed was the powerful extension of behavioral insights for public policy making and international

development. Behavioral economists proposed to nudge and wink citizens to make better choices for them and the community around the globe. Many different applications of rational coordination followed ranging from improved organ donations, health, wealth and time management, to name a few. Starting with the beginning of the entrance of behavioral aspects in economic analyses and intercultural differences in behavioral understandings, these days sustainability accounting and reporting as a powerful application in a truly interdisciplinary fashion. Reporting innovatively apply behavioral economics in the professional domain. The application of behavioral economics to corporate sector economic analysis is a cutting-edge approach to capture the power of real-world relevant economics. Drawing from a line of research on bounded rationality, reporting can improve corporate success based on economic analysis tools. Delineating the potential of behavioral economics to implement market value portrays economics as a real-world relevant means to maximize value in a constantly transitioning world economy.

As one of the newest trends in Behavioral Economics, governments and institutions around the world nowadays apply behavioral economic models (Sunstein 2013) for choice architecture on regulation. In the next section it will be further analysed how that choice architecture offers opportunities to nudge institutional and private investors into the preferred solution investments considering common sustainable criteria's and standards.

### **Taxonomy development with XBRL**

Behaviorally informed tools for disclosure and transparency are selected by governments (Sunstein 2013). To use a technical standard for the exchange of information, regulators or independent institutions introduce taxonomies using flexible "transparency technology XBRL (eXtensible Business Reporting Language)" (Sunstein, 2013). It is part of the choice architecture on regulation by governments (Sunstein 2013), which applies nudging for influencing towards a preferred option. XBRL represents an open free of charge technical standard for electronic reporting and the exchange of data (Cohen, Schiavina and Servais 2005; Mirsch, Lehrer and Jung 2017; Sunstein 2013; Weinmann, Schneider and vom Brocke 2016) and should democratise the information access between institutional and private investors. XBRL inevitably requires the usage of an adequate taxonomy (Kurt and David 2003).

The taxonomy development in the context of XBRL considering the academic literature follows the following aims:

- Offer transparent corporate information to investors, which is structured so that it becomes possible to process the information by software without the requirements to manually map or human intervention and comparable information based on country-by-country or sector analysis (Arnold et al., 2012).
- Enable the preparers to fulfill compliance requirements set by regulators, in terms of disclosing information in accordance with local and international rules (Piechocki, 2009).
- Improve the financial and non-financial communication by enabling adoption of specific branch requirements of industry (banks, insurance etc.) and of business variations (Swanson et al., 2007).

However, XBRL requires a taxonomy (Piechocki and Felden, 2007), as the main advantage of being able to compare can only be reached by a common used taxonomy (Debreceeny et al., 2009). This is also relevant for sustainability, as without a holistic standardized approach it can not be achieved to reach sustainable goals, as institutional and private investors would follow completely different metrics. Therefore, the aim of such a sustainability taxonomy is to provide a framework for classifying all potential assets or activities against a comprehensive set of sustainability goals – from climate change to broader environmental and social goals, including

the Sustainable Development Goals (Cullen, 2018). The starting point for the definition of sustainability goals are the three associated risks: physical, transition and liability risk.

Different types of finance are 1) used to finance different stages of a project or asset development (e.g. acquisition/ development, operation, refinancing) and 2) used to match varying levels of inherent risks in any investment, as this can affect ability to access different types of finance.

According to Roe and Thomas (2013), there exists no standard way to build up a taxonomy. Taxonomies can be developed for several reasons (Thietart, 2001) and different approaches exist from software, knowledge and ontology development for XBRL engineering (Debreceeny et al., 2009). There is a best practice release by XBRL International, the “Financial Reporting Taxonomy Architecture (FRAT)” (Hamscher et al., 2006), which defines modelling rules for XBRL taxonomy development (Debreceeny 2009). However, this model focuses on technical aspects of how business rules are implemented in a specific XBRL taxonomy, and aspects of software engineering are integrated within this model. From a holistic point of view, the taxonomy development process encompasses reporting elements, technical XBRL specification and testing.

Existing approaches for the methodology of the development and engineering of a taxonomy in the academic literature share a focus on the technical aspects of the taxonomy development process via engineering models (Piechocki and Felden, 2007). The following overview follows the objective to combine business-rule development and taxonomy development.

- In the preparatory phase, reporting elements need to be defined and the associated meta-data, including specifications of the taxonomy and its intended use.
- A building phase follows, which focus on technical considerations, application rules on the base taxonomy and the management of extensions.
- Finally, there is a maintenance and evolution phase for the management and development of the taxonomy on a continued basis.

### **Principles-versus rule-based Sustainability Taxonomy**

The development of a sustainability taxonomy should also consider existing best-practice taxonomies for corporate reporting. Historically, either an inductive or deductive methodology to develop a taxonomy can also be referenced to the principles-based vs. rule-based debate in the academic literature about accounting taxonomies (Benston et al., 2006). The principles-based vs. rule-based debate in the U.S. was rediscussed after the Enron and WorldCom accounting scandal 2002 (Nobes, 2005). An intense discussion whether US GAAP should become more principles-based, as rules-based standards might give rise to “cook-book accounting”, without considering a substance-over-form approach (Parfet, 2000). So, if there is no discretion to the chef, the taste will always be the same. US GAAP tends to be mechanical and inflexible. Clear-cut rules have some advantages, but the risk is that this approach motivates financial engineering designed specifically to circumvent these knife-edge rules, as is very often given proof in the tax literature (Healy and Palepu, 2003). According to Nelson (2003) a standard should not be seen as only principles or rule-based but should rather be regarded as more or less rule-based. According to a behavioral analysis, Nelson concludes that rules can improve the accuracy of the communication of the standard setter and reduce imprecision associated with aggressive reporting due to unawareness of existing rules (Nelson 2003). Nelson does not consider that rules increase imprecision but also enable companies to structure transactions to meet the accounting rule without following the true economic substance of the transaction. This is one of the main arguments by supporter of principles or concepts-based accounting (Maines et al., 2003). They point to the challenge when moving from a rule-based to a concepts-based standard setting, as informed professional judgement and expertise for the implementation is increasingly required.

## Overview of existing Sustainability Taxonomies

The Global Reporting Initiative (GRI) issued after a long development period a taxonomy covering sustainability reporting. Sustainability reporting consists of the “practice of measuring, disclosing, and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainable development” (Global Reporting Initiative, 2013). “Sustainability reporting” is followed as a general term which consists of reporting on economic, environmental, and social impacts (Kolk, 2008).

This taxonomy (Anonymous, 2007) was developed by the Global Reporting Initiative (GRI), a worldwide non-profit organization that founded a sustainability reporting framework that has been commonly used and applied on a worldwide basis since the 1990s (Hedberg and von Malmborg, 2003). The taxonomy consists of both quantitative and qualitative factors. The following main recommendations for external reporting elements are part of the so called “GRI Framework” (Global Reporting Initiative, 2013;(Beerbaum, 2015)) :

- Organizations should identify their stakeholders and provide disclosures explaining what actions have been taken to meet the stakeholders’ expectations and interests.
- Organizations should provide an executive summary of main impacts, challenges and opportunities.
- The report should disclose the performance of the corporation in a broader framework of sustainability.
- The report should comply with the requirements that:
- Transactions that have a significant economic, environmental and social impact are to be disclosed;
- Aspects which might influence decisions of stakeholders are to be externally reported;
- The report should include disclosures that incorporate indicators of the organizations’ performance to enable an informed evaluation of the corporation’s overall performance.
- The organization should assess, prepare and report information on a consistent basis.
- The reported information should be disclosed in a way that provides stakeholders with the possibility to assess whether the organization’s performance may become volatile over time and enables them to perform peer analysis.
- The reported information should comply with the criteria of sufficient accuracy and completeness, enabling stakeholders to assess the organization’s performance.
- The organization should submit information continuously so that stakeholders can rely on the constant availability of information to make informed decisions.
- The organization should follow a communication strategy that considers that stakeholders have access to and are able to follow the information using the report.
- The organization should collect, store, prepare, analyse and present information related to the preparation of a report in a manner that allows it to undergo examination and establishes validation, control and materiality of the information.
- Specified standard disclosures
  - Disclosures on management approach
  - Topics by category:
    - Economic - economic business drivers, market shares, business strategy, procurement approach;
    - Environmental - emissions, pollution, supplier environment assessment, environmental grievance mechanisms;



- Social – employment satisfaction and commitment practices, corporate volunteering;
- Sector-specific commonly practiced disclosures.

The GRI-Taxonomy 2013 is available on the website of the Global Reporting initiative organization (Global Reporting Initiative, 2013); the taxonomy consists of seven main categories:

- Strategy and profile disclosures
- Economic category
- Environmental and labour category
- Human rights category
- Society category
- Product responsibility category
- CG-related matters are allocated under the category “Strategy and Profile disclosures”. The following are the governance-related disclosures based on the elements in the GRI-taxonomy (Global Reporting Initiative, 2013):
- Disclosure about governance structure including committees, responsibilities, description of the mandate and composition;
- Disclosure about the highest body of governance related to the chair’s entitlement, remuneration in relation to the organizational performance;
- Processes and procedure of the highest body of governance to monitor the financial, environmental and social success of the organization and its compliance with the company’s policies, national regulations and international codes and standards;
- Procedures for identification and remediation for conflicts of interests;
- One-tier boards have to disclose their number of independent members;
- Disclosure of the nomination and selection process for the members of the most senior body of governance;
- Procedures in place to evaluate the performance of the highest body of governance.

### **Development of a “Sustainability Taxonomy”**

The concept follows the idea of the development of a uniform classification system for environmentally sustainable economic activities (“Sustainability taxonomy”). With that classification the growth of sustainable investments and financing can be fostered, and a transparent and trusted framework can be created. Institutional and private investors are helped into a preferred option, which is in favor for the whole global society or *res publica*, for which we all have a responsibility (Kipper, 2017). Developing such a taxonomy will also help the whole financial market as investment advice or portfolio management will have a common and reliable sustainable taxonomy come into effect, in order to avoid fragmentation of the market.

To come up with a “sustainability taxonomy” an inductive approach was applied by using the existing publications from issuers as basis, the GRI taxonomy and existing Corporate Governance taxonomy (Beerbaum, 2015).

Table 1: Overview of sample (as January 10,2017)

Table 2: Break-down of sample into country and sectors

It is essential for market participants that a common understanding of sustainable standards, labels, assets and financial products exist. In a next step market, a participant will be able to build

trust by providing full transparency and precise information applying these developed sustainable standards. This understanding needs to be derived from legally approved, clear, consistent, comprehensible and neutral definitions that should take into consideration existing international and regional standards, which are already applied by market participants. The application of the sustainability taxonomy will also enable to provide transparency on potential chances as well as risks associated with Environmental Social and Governance-related factors.

Sustainability reporting helps organizations to measure, understand and communicate economic, environmental, social and governance performance. Setting goals in the reporting helps to manage change. Concrete sustainability reporting comprises of non-financial reporting, triple bottom line reporting, Corporate Social Responsibility and integrated reporting, which combines financial with non-financial performance.

Based on Diffenbaugh et al. physical climate change has already started to impact globally (Diffenbaugh et al., 2017). The authors give evidence that extreme climate events have increased in many regions. Based on four applied attribution metrics to four climate variables at each available point on a global grid Diffenbaugh et al. find out that historical global warming has increased the severity and probability of the hottest monthly and daily events at more than 80% of the observed area and has increased the probability of the driest and wettest events at approximately half of the observed area.

Taken into account transitional risk over time based on World bank data, Governments NDCs cover 58% of emissions to carbon pricing however current prices are less than USD 10/t, however to meet Paris climate agreement objectives prices of USD 40-80tCO<sub>2</sub> would be needed by 2020 (Coalition, 2017).

Based on the analysis of the corporate reporting's of the sample of 40 companies the following sustainability taxonomy is developed.

Figure 1: Sustainability Taxonomy – Governance- Social and Climate Change (GSC)

Below are described the reporting elements and the required meta data to form a taxonomy complying with XBRL requirements.

Figure 2: Sustainability Taxonomy – Financial Climate Change Reporting elements – Transition and Liability Risk

The following reporting elements define the first channel on transition risk (Trucost, 2009)

Transition risk indicators can be summarized to:

- Carbon risk
  - Carbon emissions for one year divided by the company total revenue in tCO<sub>2</sub>/ USD m.
  - Carbon emissions from the company Tier 1 suppliers
  - Trend of carbon emissions over a time horizon of five years
  - Revenues impacted by carbon emissions avoidance
- Energy Transition Risk
  - Carbon emissions for one year for the company's fossil reserves divided by the company total revenue in tCO<sub>2</sub>/ USD m.

- Percentage of revenues which come from green products
- Trend of revenues which come from green products over a time horizon of five years
- Water Risk
  - Water consumption (water abstracted) per year divided by the total company's revenue in that year in tCO<sub>2</sub>/ USD
  - Trend of water abstracted over a time horizon of five years

Liability risk consist of litigation risk caused by climate risk.

Figure 3: Figure 3: Sustainability Taxonomy – Financial Climate Change Reporting elements – Physical Risk

The following reporting elements define the second channel on physical risk (Trucost, 2009)

- Physical Risk
  - Supply Chain Risk
    - Sales impact due supply chain risk impacted by climate risk leading to distribution delays, supply shortage and high price sensitivity
    - Resource demand of dependency of natural resources leading to supply shortage and high input cost
  - Operational Risk
    - Heat: increase in number of warm days, which lead increasing energy costs, growing risk of power outages and stress on human health and labor force
    - Wildfires: increasing droughted and longer wildfire seasons leading to interruption of business activities, damages to property plants and equipment's and workforce displacements
    - Water Stress: Changes in water supply and seasonal variations leading to reduced water supply, increasing costs for water and water restrictions
    - Sea level Rise: Augmented sea level rise leading to permanent loss of property and damages and relocation costs
    - Hurricanes & typhoons: Increased frequency of hurricanes & typhoons leading to property and building damages and business interruptions
    - Socio-economic: Migration and economic disruption leading to business interruptions, political instability and social license to operate
  - Market Risk
    - Sales impacted by climate risk leading to interruptions at point of sale, migration conflict and risk of political disruption
    - Weather sensitivity leading to volatility in sales and revenues and changing consumer preferences

## Conclusions

Globalization led to an intricate set of interactive relationships between individuals, organizations and states and to an unprecedented correlation of massive global systems causing systemic risk to increase exponential. Unprecedented global interaction possibilities have made communication more complex than ever before in history as the whole has different properties than the sum of its increasing diversified parts.

This paper in the absence of a globally integrated financial and non-financial framework tries to put emphasis back on decision-usefulness of the investor and develops a Sustainability Taxonomy considering the transparency technology Extensible Reporting Mark-up language (XBRL). The linkage to financial stability is provided by three channels of risk capturing: physical, transition and liability risk for climate change. However, considering content analysis of existing corporate reports on integrated reporting and sustainability provide evidence that companies not only report on climate change risks, but also governance and social factors. This also reflect the expectation of many market participants to include also “social” and “good governance” factors (Centeno et al., 2013).

Alongside of providing an overview of behavioral sciences with an application in the corporate domain; future research should also take a critical approach to the economic analysis of the corporation. By drawing from the historical foundations of political economy, a critical stance on behavioral sciences’ use for guiding on corporate concerns could also be adopted as a heterodox spin. Behavioral Economics insights should be used for improving economic analyses to improve the accuracy and efficiency of corporate sustainability reporting. The analysis could thereby also take a heterodox economics stance in order to search for interdisciplinary improvement recommendations of the use of economics for the corporate world.

Climate risk is an increasing risk to investors due to the possible value destruction of assets. High carbon emissions incur lower risks compared to physical risks like sea-level rise, extreme weather and water shortage, which we observed in the recent summer world particularly in Europe.

Investigations should feature a broad variety of research methods and tools to conduct independent projects in a truly multi-methodological approach. Overall, all these endeavors will help gain invaluable information about the interaction of economic markets with the real-world economy with direct implications for corporate decision makers.

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## Appendix

Table 1: Overview of Sample (as January 10, 2017)

Company	Country	Sector	MarketCap EUR
British American Tobacco	UK	Tobacco	108.00
Inditex	Spain	Apparel	98.00
BASF	Germany	Chemicals	80.00
Vodafone Group	UK	Telecommunications	71.30
Diageo	UK	Beverages	69.50
Novo Nordisk	Denmark	Pharmaceutical	70.00
UBS	Switzerland	Financial Services	59.50
Eni	Italy	Oil & Gas	57.00
ING Groep	Netherlands	Financial Services	53.00
Telefonica	Spain	Telecommunications	46.30
Iberdrola	Spain	Electric Utilities	39.00
Orange	France	Telecommunications	39.00
Atlas Copco	Sweden	Industrial Equipment	35.00
GDF Suez (Engie)	France	Electric Utilities	29.60
Koninklijke Philips	Netherlands	Electronics	26.00
Vivendi	France	Media	23.50
Assicurazioni Generali	Italy	Insurance Companies	22.50
ArcelorMittal	Luxembourg	Steel	22.00
Caixabank	Spain	Financial Services	20.00
KGHM	Poland	Mining	19.00
Atlantia	Italy	Transportation Services	18.00
Gas Natural	Spain	Electric Utilities	17.70
UniCredit	Italy	Financial Services	16.80
SGS	Switzerland	Quality Services	16.40
AkzoNobel	Netherlands	Chemicals	15.00
Ferrovial	Spain	Construction	13.00
KPN	Netherlands	Telecommunications	12.00
Aegon	Netherlands	Insurance Companies	11.00
NN Group	Netherlands	Insurance Companies	10.90
Royal DSM Group	Netherlands	Chemicals	10.60
Atos	France	IT	10.00
Randstad Holding	Netherlands	Personnel Services	9.90
Terna	Italy	Electric Utilities	8.60
Grupa LOTOS	Poland	Oil & Gas	7.20
Coca-Cola Hellenic Bottling	Switzerland	Beverages	6.50
J Sainsbury	UK	Retailing	6.50
ABN AMRO	Netherlands	Financial Services	6.25
Enagas	Spain	Electric Utilities	5.70
EnBW	Germany	Electric Utilities	5.60
Marks & Spencer	UK	Retailing	5.50

Table 2: Break-down of sample into country and sectors

Company	Country	Sector	MarketCap EUR
UniCredit	Italy	Financial Services	16.80
ING Groep	Netherlands	Financial Services	53.00
ABN AMRO	Netherlands	Financial Services	6.25
UBS	Switzerland	Financial Services	59.50
Caixabank	Spain	Financial Services	20.00
BASF	Germany	Chemicals	80.00
AkzoNobel	Netherlands	Chemicals	15.00
Royal DSM Group	Netherlands	Chemicals	10.60
EnBW	Germany	Electric Utilities	5.60
GDF Suez (Engie)	France	Electric Utilities	29.60
Terna	Italy	Electric Utilities	8.60
Iberdrola	Spain	Electric Utilities	39.00
Gas Natural	Spain	Electric Utilities	17.70
Enagas	Spain	Electric Utilities	5.70
Vodafone Group	UK	Telecommunications	71.30
Orange	France	Telecommunications	39.00
KPN	Netherlands	Telecommunications	12.00
Telefonica	Spain	Telecommunications	46.30
Assicurazioni Generali	Italy	Insurance companies	22.50
Aegon	Netherlands	Insurance companies	11.00
NN Group	Netherlands	Insurance companies	10.90

Figure 1: Sustainability Taxonomy – Governance- Social and Climate Change (GSC)\*

		XBRL Specification/ Meta Data			
		Reporting Elements $\Sigma$	Disclosure Format	Reference	Classification
Non-Financial	Internal/External Governance/ Board Organization	20	Text	ISAR	Mandatory
	Environmental/ Social Policy	10	Text	ISAR	Mandatory
Financial	Transition Risk	10	Table	S&P Trucost	Mandatory
	Physical Risk	10	Table	S&P Trucost	Mandatory
	Liability Risk	2	Table	ISAR	Mandatory

- The Non-financial categories are derived from a previous study on Corporate Governance Reporting Taxonomy (Beerbaum, 2015)



Figure 2: Sustainability Taxonomy – Financial Climate Change Reporting elements – Transition and Liability Risk

		XBRL Specification/ Meta Data			
		Reporting Elements	Disclosure Format	Reference	Classification
Financial	Transition Risk	Carbon Risk	<ul style="list-style-type: none"> <li>• Share of intensity</li> <li>• 5Y Trend</li> <li>• Revenue</li> <li>• Tier 1</li> </ul>	S&P Trucost	Mandatory
		Water Risk	<ul style="list-style-type: none"> <li>• Share of intensity</li> <li>• 5Y Trend</li> <li>• Revenue</li> </ul>	S&P Trucost	Mandatory
		Energy Transition Risk	<ul style="list-style-type: none"> <li>• Share of intensity</li> <li>• 5Y Trend</li> <li>• Revenue</li> </ul>	S&P Trucost	Mandatory
	Liability Risk	Litigation	<ul style="list-style-type: none"> <li>• Number of cases</li> <li>• Amount</li> </ul>	ISAR	Mandatory

Figure 3: Sustainability Taxonomy – Financial Climate Change Reporting elements – Physical Risk

		XBRL Specification/ Meta Data			
		Reporting Elements	Disclosure Format	Reference	Classification
Financial	Physical Risk	Market Risk	<ul style="list-style-type: none"> <li>• Sales impact</li> <li>• Weather dependence</li> </ul>	S&P Trucost	Mandatory
		Supply Chain Risk	<ul style="list-style-type: none"> <li>• Sales impact</li> <li>• Raw material demand</li> </ul>	S&P Trucost	Mandatory
		Operational Risk	<ul style="list-style-type: none"> <li>• Heat</li> <li>• Wildfires</li> <li>• Water Stress</li> <li>• Sea level Rise</li> <li>• Hurricanes &amp; typhoons</li> <li>• Socio-economic</li> </ul>	S&P Trucost	Mandatory