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Erasmus Platform for Sustainable Value Creation

Working paper

Valuing companies in transition

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Abstract

Transition management and corporate finance are separate disciplines. This article connects the two disciplines by developing a model of expected transition losses. It appears that adaptation to transition is a key determinant of a company's long-term value. Companies that are early in the game can reap the first mover benefits. Companies that adapt later experience higher adaptation costs and may even not survive. The transition model helps companies to sharpen their strategy and cope with major sustainability transitions that are currently happening.

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1. Introduction

Society faces multiple sustainability challenges. On the environmental front, climate change, biodiversity loss, freshwater shortages and depletion of natural resources are destabilising eco-systems. On the social side, many people are afflicted by poverty, lack of education and lack of healthcare. The United Nations' Sustainable Development Goals are a guide for the transition towards a sustainable and inclusive economy (UN, 2015). Sustainability transitions are uncertain and happen shock-wise (Loorbach, Frantzeskaki and Avelino, 2017).

Companies play an important role in that transition to a sustainable economy, because social and environmental externalities are generated primarily in the corporate sector (Hart and Zingales, 2017). Only companies that can adapt to these transitions by changing their business model will survive (Kurznack, Schoenmaker and Schramade, 2021). Sustainability transitions can thus have a major impact on company valuation.

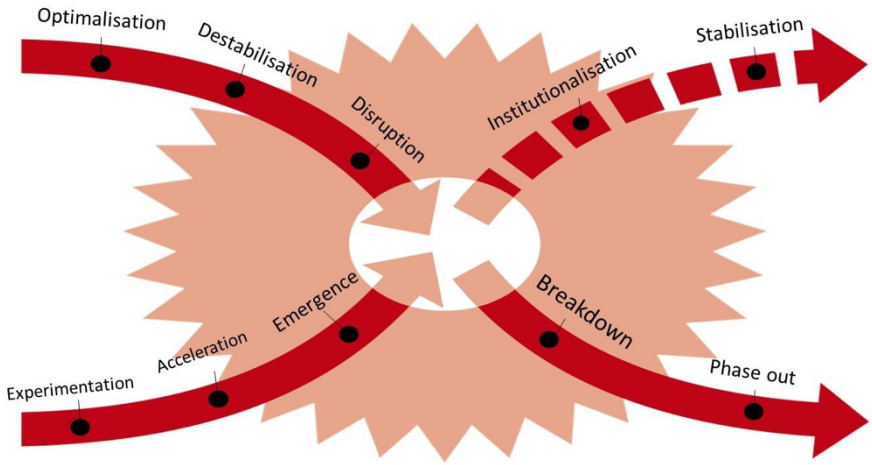
Nevertheless, transition management (e.g. Loorbach *et al.* 2017) and corporate finance (e.g. Berk and DeMarzo, 2017) are separate disciplines. The aim of this short article is to connect the two fields. The missing link is the modelling of expected transition losses. By estimating the expected losses from (lack of) transition, we can derive the impact of transition on company value. We design a simple transition model for these losses and apply it to company valuation. Adaptability to transition is a key determinant of company value. In a dynamic version of our transition model, we show how companies can strategically invest in adaptation.

The article is organised as follows. Section 2 sets out the sustainability transitions. Next, section 3 models the transition losses and section 4 derives the impact on company valuation. The final section concludes.

2. Transition

Transition is about transformational change rather than incremental change. Figure 1 depicts the dynamics of socio-technical transitions as iterative processes of build-up and breakdown over a period of time (Loorbach, Frantzeskaki and Avelino, 2017). In a changing societal context, incumbent regimes develop path-dependently through optimisation, while change agents start to experiment with alternative ideas, technologies and practices. Over time pressures build on regimes to transform, leading to destabilisation as alternatives start to accelerate and emerge. The actual transition is then chaotic and disruptive and new combinations of emerging alternatives and transformative regime elements grow into a new regime. In this process elements of an old regime that do not transform are broken down and phased out. This is an example of creative destruction, a process in which new technologies and business models replace the old ones (Schumpeter, 1942).

Figure 1: The x-curve of transition dynamics



Source: Loorbach, Frantzeskaki and Avelino (2017).

To guide the transition towards a sustainable and inclusive economy, the United Nations has developed the 2030 Agenda for Sustainable Development (UN, 2015). The 17 UN Sustainable Development Goals (SDGs) stimulate action over the 2015-2030 period in areas of critical importance for humanity and the planet. Within the larger SDG agenda, we identify four clusters of large transitions that are important for business (Schoenmaker and Schramade, 2019):

1. **Climate - energy transition**: Moving from the use of fossil fuels to renewable energy. This has not only an impact on energy companies -oil and gas companies and electricity utilities-, but also on other carbon-intensive sectors, like manufacturing and mobility.
2. **Raw materials - circular economy**: Redesign and recycle products leading to less use of raw materials and less carbon emissions (e.g. recycling aluminium saves on carbon emissions in the production of aluminium).
3. **Biodiversity – healthy food and regenerative agri- and aquaculture**: Trend towards healthy food production with respect for land and water. This implies moving from intensive to organic farming to preserve the quality of the land without use of fertilizer and pesticides. In addition to preserving biodiversity, land restoration and reforestation provide watershed function and carbon absorption. Protecting biodiversity also implies no overfishing and preserving ocean health.
4. **Labour practices - social transition**: Trend towards decent labour practices across the value chain of production. Decent labour implies paying a living wage, ensuring safe working conditions and respecting human rights.

Transitions are not constrained to the move to a sustainable economy. Other examples of major transitions in society are digitalisation and ageing. The scope of this paper is mostly on sustainability transitions.

3. Transition losses

3.1 Expected transition losses

Transitions have a major impact on the viability of companies. Only companies that can adapt to these transitions by changing their business model will survive (Kurznack, Schoenmaker and Schramade, 2021). Building on the widely-used model for expected credit losses (Hull, 2018), we can formalise the expected transition losses ETL_{ij} for company i in sector j as follows:

$$ETL_{ij} = EAT_{ij} \cdot PT_j \cdot LGT_{ij} \tag{1}$$

where EAT_{ij} represents the exposure at transition. It measures which part b_j of company i's long-term value potential LTV_{ij} is exposed to transition: $EAT_{ij} = b_j \cdot LTV_{ij}$. The long-term value potential is the value a company can obtain by meeting societal trends in its main markets (combining operational performance with adaptability to transition, as explained below). Figure 2 shows the extreme case of $b_j = 1$, where the full sector j is in transition from conventional to sustainable products. Transition exposure ranges from no transition to full transition: $b_j \in [0, 1]$. We assume that sectoral transition b_j is representative for all companies i in that sector. Sectors that are characterised by large negative externalities and the availability of substitutes (that address the externalities) tend to have a high b_j.

The second variable PT_j represents the probability of transition for sector j. The size and timing of transition are uncertain. Scenarios analysis can be used to estimate the probability distribution for transition (De Ruiter, 2014). This analysis contains different scenarios for the degree of transition and the timing of transition. It should be noted that transitions happen shock-wise along a dynamic time-path (Loorbach, Frantzeskaki and Avelino, 2017).

The final variable LGT_{ij} is the loss given transition. In credit risk models, the recovery rate γ indicates how much can be recovered from the company in the case of default (Hull, 2018). The loss given default LGD is then: $LGD = (1 - \gamma)$. In a similar way, we introduce the company i's adaptability a_{ij} to transition, whereby $LGT_{ij} = (1 - a_{ij})$. A company can recover or retain its value by adapting to transition.

A company can anticipate societal trends in its markets by building capabilities to learn about and serve these new societal needs, as part of its strategy. a_{ij} is non-negative with the following range: $a_{ij} \in [0, 1]$. $a_{ij} = 1$ denotes the case where a company is fully adapted to the new world, allowing it to reach its long-term value potential. As can be seen from equation (2), the expected transaction losses are then zero: $ETL_{ij} = b_j \cdot V_{ij} \cdot PT_j \cdot (1 - 1) = 0$. a_{ij} depends on management quality (see Section 4.2 below). Those companies that incorporate sustainability in their strategy are the early adopters, that can capture first-mover advantages (e.g. higher margins with a price skimming strategy and a strong brand name capturing consumer surplus) or at a minimum avoid missing out on the new market standard. These early adopters thus minimise expected transition losses. It should be noted that early adapters face technological uncertainty,

and possibly high R&D investments, but they are also more likely to execute a successful price differentiation strategy that allows them to generate higher profit margins. Nevertheless, we are not seeking to establish an optimal entry point of transition. Instead, we argue that companies should be early in building the capabilities that give them the option to enter the market with new technologies and business models. The focus of our model is on companies' competitive position in navigating transitions.

We can now rewrite equation (1) as follows:

$$ETL_{ij} = b_j \cdot LTV_{ij} \cdot PT_j \cdot \left(1 - a_{ij}\right) \quad (2)$$

Equation (2) provides the expanded formula for calculating expected transition losses. In the next sub-section, we apply our model to past and current transitions.

3.2 Case-studies

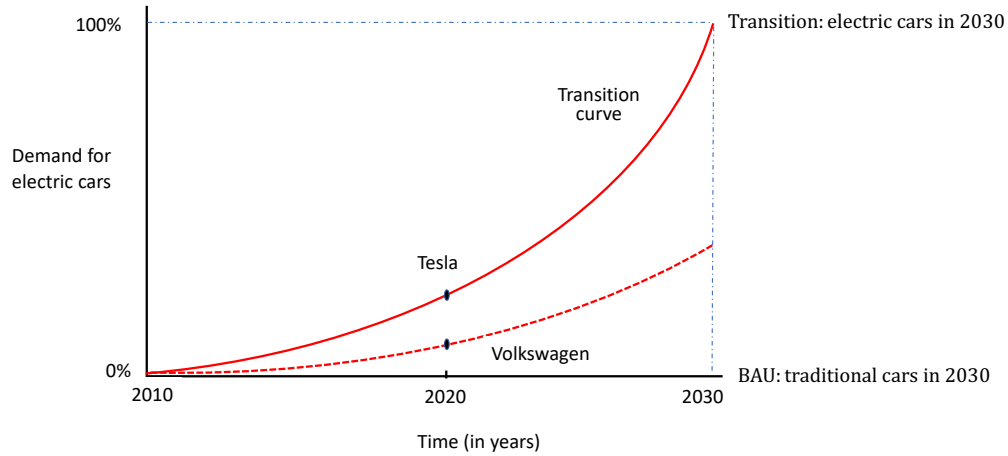
We illustrate our transition model with case studies. The first case-study concerns the car industry, which is currently undergoing a transition from internal combustion engines towards electric driving (as part of the wider energy transition). Tesla, the US electric carmaker, is ahead in its capabilities and can quickly scale up its production capacity to serve increased demand. Traditional German carmakers are behind and lose market share. Some traditional carmakers, like Volkswagen, are catching up at high cost.

The difference in capabilities is summarised in the Bloomberg article titled *VW's Boss Warns the Troops: We Don't Want to End Up Like Nokia*:

> "Volkswagen is at a critical juncture. It has electric cars rolling out but is well behind Tesla. And it has massive manufacturing scale but desperately needs to rethink its vehicles as rolling software devices. It is this last issue that CEO Herbert drives home with VW's more than 635,000 employees. The transition in competencies from industrial might to software prowess will be an immense challenge for automakers that are vast, deliberate and some say ripe for disruption. Car companies that get it wrong risk ending up like Nokia – failed hardware makers doomed by more nimble and technologically adept upstarts." (Rauwald, Patel and Thomas, 2020).

Figure 2 depicts the transition curve from 2010 to 2030. Over this 20-year period, the car industry is transitioning fully from traditional combust engine cars to electric cars. In terms of equation (2), $b_j = 1$ and $PT_j = 1$. Tesla is fully prepared for the electric vehicle market with $a_{Tesla} = 1$, while VW is only partly prepared. Kurznack *et al.* (2021) estimate Volkswagen adaptability at 40%: $a_{VW} = 0.4$. So, transition losses may mount to 60% of VW's long-term value: $ETL_{ij} = b_j \cdot LTV_{ij} \cdot PT_j \cdot \left(1 - a_{ij}\right) = 1 \cdot LTV_{VW} \cdot 1 \cdot (1 - 0.4) = 0.6 \cdot LTV_{VW}$.

Figure 2: Transition to electric driving



Source: Kurznack, Schoenmaker and Schramade (2021).

The second case-study refers to the transition to digital photography. The Eastman Kodak Company was established by George Eastman in 1881. It was a leading company in photography in the twentieth century. However, Kodak kept its print-based photos (business-as-usual) and failed to see the transition to digital photography. Kodak's adaptability was thus zero: $a_{Kodak} = 0$. Kodak lost its full value and filed for bankruptcy in 2012. In terms of equation (2): $ETL_{ij} = 1 \cdot LTV_{Kodak} \cdot 1 \cdot (1 - 0) = 1 \cdot LTV_{Kodak}$.

4. Company value

4.1 Impact on company value

Companies have a behavioural bias to extrapolate current cash flows into the future in a business-as-usual scenario (Graham, Harvey and Puri, 2013). This business-as-usual scenario implicitly assumes that circumstances do not change and the company can retain its value. Dyllick and Muff (2016) argue that the current economic paradigm is based on a purely economic view of the company and business processes, whereby companies retain access to cheap resources under a business-as-usual scenario.

By contrast, the transition paradigm argues that sustainability transitions affect companies' business models, whereby some companies can adapt and survive and others collapse. Transitions have thus an impact on company value. Companies can invest in adaptation I_{ij}, which we define below in equation (4). Expected transition losses and adaptation investment reduce a company's value V_{ij} as follows:

$$V_{ij} = LTV_{ij} - ETL_{ij} - I_{ij} = \left(1 - b_j \cdot PT_j \cdot \left(1 - a_{ij}\right)\right) \cdot LTV_{ij} - I_{ij} \qquad (3)$$

Equation (3) indicates that a lack of adaptability ($a_{ij} < 1$) hinders a company to reach its long-term value potential ($V_{ij} < LTV_{ij}$). Transition analysis is thus important for company valuation. Our model suggests a four-step process to estimate the impact of transition on company value. This process starts at sector level.

The first step is to identify which part of a sector is affected by societal trends (parameter b_j). There are several science-based approaches to constructing transition pathways, in particular for transition scenarios that are compatible with 2^0 Celsius global warming. An example is the Transition Pathway Initiative (TPI) of the LSE Grantham Institute, which develops transition pathways for several sectors, such as energy, transportation, materials, manufacturing and consumer goods (TPI, 2021).

The second step is to estimate the probability of transition (parameter PT_j) over a given time period. Scenario analysis can help to estimate this probability, by assigning probabilities to the business-as-usual (no transition), early transition or late transition scenarios. The probability of transition is then the weighted average of these possible scenarios, with the probabilities as weights.

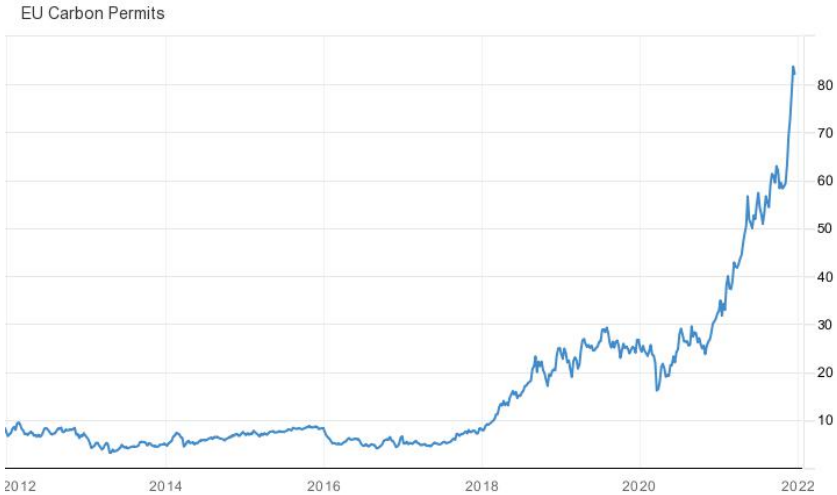
It is important to note that the probability of transition can change over time. Back in 2016, the dominant scenario was a late and sudden transition (ASC, 2016). This scenario was based on the then low carbon price of about €8 per tonne CO_2-equivalent (see Figure 3 below). The recent rise of the carbon price to over €80 suggests that the likelihood of the energy transition is increasing. A related example is the transition to electric driving. While this was a 'possible' scenario a decade ago, electric driving is now the dominant scenario for the car industry. The mass under the probability distribution has shifted to the right, culminating in a probability of transition close to 1 (see section 3.2).

A good indicator for the size b_j and probability PT_j of the energy transition in a given time period is the carbon price. The higher the carbon price the larger and faster the energy transition. Figure 3 shows that the European price for carbon permits (as part of the EU Emissions Trading System) has increased from below €10 per tonne CO_2-equivalent until 2018 to around €30 in 2019/20 and further to around €80 end-2021. The EU Green Deal with ambitious climate targets - reduction of carbon emissions with 55% by 2030 and net zero by 2050 - is thus gathering pace.

The third step is to estimate a company's capabilities to adapt its business model in a timely fashion (parameter a_{ij}). Companies need to design their strategy and adapt their business model to realise the long-term value potential. After designing transition pathways for a sector, TPI (2021) estimates the distance of individual companies in that sector to this transition pathway. This approach allows TPI to assess companies' preparedness for the transition to a low carbon economy.

The fourth and final step is investing in adaptability (parameter I_{ij}), which is analysed in the next sub-section

Figure 3. EU carbon price (2012-2022)



Source: Tradingeconomics.com

4.2 Investing in adaptability

Companies can make (extra) investments in adaptation to unlock long-term value. In credit risk terms, this is called credit risk mitigation, for example by taking collateral or reducing exposure to possible negative outcomes (Hull, 2018). In our case, a company can invest in adaptation to mitigate transition risk.

Doda *et al.* (2016) find that carbon management practices may not be sufficiently impact-oriented. Adaptation, or transition preparedness, does thus not only depend on current performance, but also on management quality (Dietz *et al.,* 2019). We model investment in adaptation a_{ij} as follows:

$$a_{ij} = c_{ij} \cdot \left({I_{ij}}/{\bar{\bar{I}}_{ij}} - d_{ij} \cdot \left({I_{ij}}/{\bar{\bar{I}}_{ij}} \right)^2 \right) \tag{4}$$

The first term c_{ij} reflects a company's capability, which in turn depends on its management quality ranging from low to high $c_{ij} \in [0.5,1]$. Dietz *et al.* (2019) assess a company's management quality with regard to climate change through the following five levels:

1. Unaware of (or not acknowledging) climate change as a business issue;
2. Acknowledging climate change as a business issue: the company adopts a climate change policy;
3. Building capacity: the company develops its basic capacity, its management systems and processes, and starts to report on carbon performance;
4. Integrating into operational decision-making: the company improves its operational practices, assigns board responsibility and provides comprehensive disclosures on its carbon performance;

5. Strategic assessment: the company develops a more strategic and holistic understanding of risks and opportunities related to the low-carbon transition and integrates this into its business strategy and capital expenditure decisions.

A company can only capture the full benefit of adaptation investment ($c_{ij} = 1$), when management incorporates sustainability in the company's strategy (level 5). At lower levels of management quality, a company realises just a partly return on adaptation investment ($c_{ij} < 1$).

The second term I_{ij} is the investment in adaptation, which is scaled by total adaptation investment $\bar{\bar{I}}_{ij}$ (reflecting investment for full adaptation). The adaptation function is concave reflecting decreasing marginal benefits from investment for late adapters. The first company $i = 1$ captures the full benefit of adaptation investment: $d_{ij} \in \langle 0, 0.5]$, whereby $d_{1j} < d_{2j} < \cdots < d_{nj}$. The economic rationale is that timely adapters can capture higher margins in the new market and face minimal write-down costs of old production capacity (either because they are new-comers or the second-hand value of their old facilities is still high at the start of the transition). By contrast, laggards get an increasingly large deduction ($d_{ij} \gg 0$) in equation (4), because of reduced margins in the new market, which becomes more competitive with new entrance, and low or negative margins in the old market due to overcapacity in the fading market. The old production facilities may turn into 'stranded assets' as the laggards move jointly to the exit (Caldecott, Tilbury and Carey, 2014).

We can now rewrite equation (2) with the expected transition losses and add investment:

$$ETL_{ij} = b_j \cdot LTV_{ij} \cdot PT_j \cdot \left(1 - a_{ij}\right) + I_{ij} \tag{5}$$

In this setting, a company can determine its optimal level of adaptation investment in order to minimise expected transition losses and preserve its long-term value potential. By taking the first derivative of equation (5) with respect to investment, we can derive the optimal level of adaptation investment. Solving and rearranging the first derivative gives the following expression:

$$I_{ij}^{*} = \frac{\bar{\bar{I}}_{ij}}{2 \cdot d_{ij}} \cdot \left(1 - \frac{\bar{\bar{I}}_{ij}}{b_j \cdot LTV_{ij} \cdot PT_j \cdot c_{ij}}\right) \tag{6}$$

The optimal level of adaptation investment I_{ij}^{*} is thus positively related to management quality c_{ij} and negatively to its 'lateness' d_{ij}. Companies, that have weak management and are late adapters, find it thus increasingly difficult to catch up in the transition and may fail. Again, this is the process of creative destruction (Schumpeter, 1942). It can also be optimal to close down the company before it fails. This is the case if the company's liquidation value (through asset sales) exceeds V_{ij} after absorption of expected transition losses ETL_{ij} and possible adaption investments I_{ij}, as given by equation (3).

In sum, a company can invest to improve its adaptability and thus reduce expected transition losses. But a company's management quality and stage of adaptation determine the effectiveness of such adaptation investment.

5. Concluding remarks

Transition management is a well-developed discipline. However, it is not yet used in economic and financial models. This article applies transition management to corporate finance. It appears that a company's transition preparedness, also called adaptation to transition, is a key determinant of its long-term value. Companies that are early in the game can reap the first mover benefits. Companies that adapt later experience higher adaptation costs, as the value of their current (unsustainable) assets is declining rapidly. These assets can turn into 'stranded assets' (Caldecott, Tilbury and Carey, 2014) in the process of creative destruction (Schumpeter, 1942).

The interdisciplinary approach taken in this article provides new insights, which can also be applied by investors and policy-makers. Investors can engage with companies on the quality of management (by appointing more sustainability-oriented managers) and their adaptability (by stimulating adaptation investment) to unlock long-term value potential. But when companies are too much behind in management quality and/or adaptability, investors may divest from these companies. Policy-makers can follow a similar strategy in their sustainability policies. Our transition model indicates that subsidies can accelerate companies that have strong management and are early adopters in the transition. By contrast, subsidies for laggards are not very effective.

We encourage economics and business researchers and practitioners to apply transition thinking more widely. This may in turn speed up the sustainability transition.

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