

Scrutinizing the Sustainability of Business Models: System Dynamics for Robust Strategies

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Abstract

The success or failure of a business hinges in the first place on the model that forms the basis of its commercial activities. Business models are needed in all kinds of enterprises. Often these models are not scrutinized with the necessary depth. In situations of high planning uncertainty, e.g., when starting a new business, the lack of data tools to assess the sustainability of business models tends to mislead investors and managers to superficial appraisals. The purpose of this contribution is to demonstrate how such an assessment can be organized, even when data are very scarce, in a way that it leads to crucial insights for strategists. We demonstrate how dynamic modeling and simulation can foster understanding, enabling decision-makers to select between sustainable versus flawed conceptions, and opening them clues for better ways of selecting and developing new strategic fields of business activity. For this aim, we have chosen a case study from e-commerce, within a family of business models which is novel and sufficiently complex as an exemplar. Additionally we have tested our findings on another business within the same sector. We show that with the help of System Dynamics modeling and simulation the test of a business model's sustainability can deliver high value to investors and managers, helping avoid fatal mistakes, and taking new opportunities.

Keywords

Business Model; Assessment; Modeling; Simulation; Strategic Decisions; Diagnosis; Business Design; Robustness of Strategies

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I. Setting the Stage

This contribution aims to shed light on the role of business models for the sustainability of organizations. Many definitions of ‘business model’ have been proposed, covering different aspects of the concept, - business model as a statement, a representation, a structural pattern, a template, a conceptual tool, etc. (Zott, Amit and Massa 2011). Striving for an operational definition, which incorporates all of these five aspects, we conceive of a business model as the rationale of how an organization creates, delivers, and captures value (Osterwalder & Pigneur 2010). A business model is furthermore a tool to express the business logic of a company by which it generates profitable and sustainable revenue streams (Osterwalder et al. 2005). The formulation of business models has emerged with the growing importance of the start-up and venture capital industry as they are especially helpful in conceiving of new business ideas. Every business model consists on the one hand of a value proposition, which represents the sum of the novel and unique value generated by the project. On the other hand, this value must then be priced in a way that a sustainable evolution of the business can be achieved.

Current literature that concentrates on the design of business models emphasizes the importance of consistency, but it hardly pays any attention to the testing of business designs. An exception is Osterwalder (2004); in his dissertation he developed a qualitative method for the assessment of the viability of business designs. On that basis a well-known framework, called lean canvas, emerged, which helps entrepreneurs elaborate their business models. Even so, that framework is static and lacks a concept for rigorous testing of the quantitative implications of qualitative designs.

For the analysis, assessment and optimization of business designs, dynamic modeling and simulation methods are of high value, because they provide additional insights, by adding the time dimension. This approach will most likely become ever more important. Pertinent case studies have already been published (e.g., Köpp et al. 2012, 2014; Grösser & Bürgi 2014).

Business models define structures and as structure “determines” behavior, the effects of ill-designed business models can be disastrous (Bruno & Leidecker 1988; Osterwalder 2012). The challenge then is trying to avoid defective designs and foster the casting and implementation of better ones.

The purpose of our study emanates from this background. *We intend to demonstrate how business models can be scrutinized and analyzed in more effective ways, in order to assess the likely sustainability of the respective businesses.* A test of a business model should lead to important insights for strategists, by which, in a very early phase, business failures can be anticipated and avoided, and business success promoted. Both flawed designs and promising conceptions could be sorted out, and alternatives for the better could be developed. Hence, our derived aim is to introduce modeling and simulation as an opportunity for the dynamic optimization, calibration and redesign of business models to make the respective businesses viable, already at very early stages of the life cycle.

With this vision in mind we have decided not to elaborate a general heuristic for the assessment of business designs. Given the relative novelty of our topic we opt for presenting an exemplar by which the virtues and shortcomings of a simulation approach for the assessment of business models can be made tangible. For this aim, we have chosen a case study, which is sufficiently complex as an exemplar. The company under study is a young venture in e-commerce. It is in the business of fixed-offer group-buying schemes. The complexity of the respective business model results from an intricate web of three

kinds of decision-making agents (company-in-focus, customers, merchants), and three decision criteria (price, discount, fee), which interact dynamically. See Figure 1.

We show that, with the help of dynamic modeling and simulation, the test of a business model's sustainability can deliver high value to managers, helping to avoid fatal mistakes, and to take new opportunities. Our perspective is on the long term.

This leads us to our following research questions:

- What are the key feedback loops driving the sustainability of the Group Buying Schemes (GBS) business model?
- Which dynamic pattern unfolds when these feedback loops are simulated and what can we learn from this?
- Could the sustainability of the business model be enhanced, based on the dynamic simulation approach, and to what extent?

We are going to conduct a model-based inquiry, building a dynamic model by means of the System Dynamics (SD) methodology. System Dynamics is a discipline of modeling, simulation and steering. It stems from Prof. Jay Forrester at the Massachusetts Institute of Technology (MIT); see for example Forrester 1961, Sterman 2000, Schwaninger & Grösser 2008. SD is an ideal vehicle for modelling complex, dynamic issues such as the case under study. System Dynamics also provides a mature set of procedures for the validation of dynamic models (Forrester and Senge 1980, Barlas 1996, Schwaninger & Grösser 2009).

Methodologically we have chosen a single case design about fixed-offer group buying schemes (FOGBS), in order to insert a rich and insightful example. This is in line with Yin (2009) who recommends using this kind of design for revelatory instances, such as the one at hand. In the tradition of System Dynamics research single case study designs, at the level of specific organizations, have been used extensively, for gaining insights into complex phenomena (e.g., Hall 1973; Lane 1993; Barabba et al., 2002; Santos et al. 2008; Ambroz 2009; Perlowa & Repenning 2009).

As the business model under study has not been applied by any company publicly reporting its financial data until recently, access to precise relevant data was limited.

This paper can be seen as a contribution to business model design and recent entrepreneurial research. Empirical data were gained from archival sources, extended online research and an interview with the founder and CEO of a Swiss group buying scheme.

We will now give an overview of the limited scientific literature in the field of fixed-offer group buying schemes, which are the object of the case study (Section II). The next section analyzes the logic behind the assessment of business models regarding their long-term sustainability. Additionally, a dynamic hypothesis is formulated that will be tested in the study (Section III). Then, the logic of the fixed-offer group buying scheme business model is made transparent through in-depth analysis of the revenue streams and underlying incentives. On that basis, a system dynamics model is built to analyze the sustainability of the business under study (Section IV). The model is used to develop policies, with the help of an adaption algorithm, in search of a sustainable solution (Section V). Additional policy tests, such as an optimization combined with sensitivity analysis, are performed to test potential solutions to the problem of non-sustainability (Section VI). In the next section, validation tests carried out to enhance the quality of the system dynamics model are documented (Section VII). The ensuing discussion summarizes the substantive

lessons from the case (Section VIII) and tries to crystallize the relevant aspects. We finalize the paper with a synthesis of the methodological insights gained (Section IX).

II. Literature Review about Group-Buying-Schemes

For our case, we have chosen fixed-offer group buying schemes, to which we will refer by the abbreviation *Group Buying Schemes* (GBS). We try to be very precise with this definition since in contrast to the online voucher or coupon-based GBS (*Group Buying Scheme*), which we will study here, the traditional economic view of online group buying schemes underlies variable prices induced by variable group size and therefore demand (“flexible-offer”). Anand and Aaron (2003) define this as a case of second-order price discrimination. In the case we are going to study prices, minimal demand and often a total number of available coupons within a deal, which are fixed (“fixed offer”).

These fixed-offer group buying schemes represent a business model that has emerged over the last few years. That business has been pioneered by GROUPON, one of the glorious internet start-ups in the first decade of the new millennium. Founded in 2008, that enterprise pursues the idea of exploiting the phenomenon of group buying, attracting potential customers through massive marketing efforts. GROUPON is making use of the first-mover advantage in combination with a loss-leader approach¹; being the first and the quickest player in the market, exploiting as much rent as possible and building a strong brand name with high brand awareness. The underlying rationale is that merchants can expand their customer bases, while customers thrive on bargains offered by the merchants, the trigger for the demand being discount prices linked to a system of coupons provided by GROUPON through its online platform, that give access to these perks.

Since the internet start-up GROUPON was founded, it has gained massive attention. This swift take-off derived first from eager shoppers in search of the next great bargain and soon thereafter from the business world due to the firm’s reports of enormous revenue growth. This beginning encouraged the emergence of numerous GB copycats in different countries, such as a company called DEINDEAL, in Switzerland. Takeover bids from prominent internet companies such as Yahoo (Arrington 2010) and Google in late 2010 followed (James 2010, Ingram 2010, Madslien 2011), with offers of three billion dollars and \$5.3 billion dollars respectively. GROUPON, however, rejected both bids and aggressively pushed forward its IPO. On November 4, 2011, GROUPON went public, offering 5% of its shares and raising 700mio dollars in return. GROUPON’s valuation at that point was estimated at around \$13bn (Barr & Baldwin 2011). But also doubts about GROUPON’s fundamentals and the viability of its business model have arisen and persisted despite all efforts GROUPON made, to prove the contrary.²

Online discount vouchers or fixed-offer group buying schemes more specifically have not seen much academic attention so far. Predominantly empirical and descriptive studies have been performed regarding the economic viability of this business model³. A sum-

¹ Loss-leader approach comes originally from retail sector, where big super market chains are baiting customers into their stores with products sold at or below procurement costs to drive out competitors from the market.

² See for example articles from Sherman 2011a and 2011b, or footnote 6. The journals cited regarding the loss leader approach also deal with the question of sustainability of GROUPON’s business model.

³ For insights on experiences companies made offering coupons from GROUPON see Dholakia 2011a or Dholakia & Tsabar 2011.

mary of important indicators for a stagnation of GROUPON's spectacular growth path was presented by De La Merced before GROUPON became public. De La Merced claims that the revenue per newsletter subscriber, the conversion rate of customers into subscribers, revenue per customer, coupons sold per customer and revenue per coupon were all decreasing (De La Merced 2011). This calls for an assessment of GROUPON's business model.

According to Anand and Aaron a classical group buying mechanism is a pricing scheme where discounts are raised leading to an increase in aggregated group demand. These authors compare the pricing scheme of variable pricing to the approach of posted prices⁴. In a survey of merchants participating in group-buying promotions, Dholakia finds that only little more than half of these merchants made money out of the coupon promotion. A fourth of them lost money and about a fifth broke even. Finally less than half of the merchants under study answered they would try another coupon promotion (Dholakia 2011b). Byers et al. have studied GROUPON's operational strategy regarding optimizing deal size, deal prices, market timing and soft incentives to purchases (Byers 2011). Lang et al. look at the effect of group size in group buying schemes and find that group size does not raise profits among group members, but rather slows down group coordination (Lang et al. 2012). Agrawal presents on his blog some financial indicators one should definitely consult before investing in GROUPON (Agrawal 2011). Arabshahi discusses GROUPON's business model through an economic perspective defining different price discrimination schemes between GROUPON and other agents (Arabshahi 2010). Edelman et al. take up this idea and define a model of price discrimination and advertising within the GROUPON online discount voucher framework (Edelman et al. 2011). They show how online distribution of vouchers promising discounts can be used for price discrimination between a population with a lower reservation price having access, and a population with a higher reservation price not having access to such vouchers.

According to economic theory vouchers have to cover marginal costs. From experience⁵ and from simple benchmarking with average margins over different sectors, we know that many merchants are offering their discounted products in GROUPON deals at such a low price that they are incurring losses in the first place⁶. To see this in practice a short stop at GROUPON's website immediately reveals discount rates of up to 80% on the original sales price. From an economic perspective making a marginal loss is the definition of an unviable business. The more you sell the more you lose. In such a situa-

⁴ Many GBS are using some kind of a mixture between posted prices and the group-buying-mechanism, where deals can have a minimum and a maximum number of coupons, and have a fixed discount or posted price. This led to the creation of the term fixed-offer group buying scheme. For further information on this difference see Anand & Aaron 2003.

⁵ See for example experience from a small drink shop in Sherr 2010 or Dholakia 2011a who finds mixed results regarding satisfaction of merchants with the overall profitability of the GBS promotion. Regarding customer complaints see Sturzenegger 2012 on GBS's inability of providing sufficient capacity with his merchants to allow customers to cash-in their coupons within the expiration date of one year and the unclear legal liability which arises from this.

⁶ GROUPON is persecuting a loss leader approach by offering high discounts compared to its competitors. Merchants' P&L considerations suggest that if GROUPON is subsidizing, they might incur losses. E.g., see Agrawal 2011, Forensic Accounting, Investigation and Expert Services 2011, Ovide 2011, Raice 2011, Magee 2011 or Kincaid 2011.

tion a merchant can only hope for a big number of no-shows,⁷ or he offers only a small amount of such coupons that have the character of a first come first served policy⁸. Therefore merchants must hope for a certain retention rate of customers who buy at the original price to cover these losses (cross-subsidization). GROUPON on its advertisement videos claims that the merchants cover losses from sales via the coupon through extra sales⁹. In practice this would mean customers get a drink for 20% and then buy some food at full price. This way, cross-subsidization takes places within a sale. There is little evidence that either of this works in practice, for several reasons¹⁰. People who buy vouchers are price sensitive and therefore compare prices. They are not willing to spend the entire bargain from the voucher on overpriced food or spend the fivefold amount of money for the service¹¹. Many of such bargain seekers buy several vouchers, only to profit from the reduced price; they make their bargain and avoid spending any extra money. There are many customers reporting that due to the pressure on prices stemming from the high discounts demanded from the GBS in a coupon promotion, merchants lower service quality. Customers claim to be called GBS customers given lower priority and sometimes facing serious issues of redeeming their coupons before the expiry date¹². Depending on the nature of the service offered by the merchant, extra sales are nearly impossible, but customer loyalty is not. Furthermore extra sales are given exogenously whereas customer loyalty is defined endogenously through the service or product and can therefore be modelled.

From a theoretical economic perspective cross subsidization, either across single sales or inter-temporally (customer loyalty), is the essential argument which determines the long-term success of the GBS business model.

However except all of these very recent and rather theoretical contributions, which are raising doubts about the sustainability of fixed-offer group-buying schemes, we have not found any forward looking approach that investigates the sustainability of such schemes through simulation. We have neither found any contribution testing options through scenario analysis nor any concepts deducing strategic management recommendations based on a qualitative and quantitative assessment. This is the research gap we are addressing.

⁷ Meant are customers who are not going to cash in their coupons. Dholakia, 2011b finds that this percentage is about 20%. We call such people defectors.

⁸ First come, first served policy is one explanation for the common maximum capacity in GBS deals, which means that a limited number of coupons is sold per deal. In other words one uses a special form of inverse price discrimination through imperfect information among buyers, giving only a limited number of customers (bargain hunters) the exclusive possibility to buy the product at a discounted price.

⁹ Compare Beefeater Restaurant Microworld by Kim Warren on www.strategydynamics.com.

¹⁰ Dholakia, 2011b finds that only 35.9% of the customers cashing-in vouchers spend money beyond the deal value.

¹¹ If you assume a discount of 80% then paying the full price means $5 * 20\% = 100\%$, therefore fivefold.

¹² For the issue of unredeemable coupons within expiry date see Sturzenegger 2012.

III. Assessing the Sustainability of Business Models

To define ex ante the magnitude of the value proposition of a start-up business idea is equivalent to fortune telling. The daily business of venture capital funds' investment boards and seed-financing business angels consists to a large extent in screening and evaluating such value propositions. The assessment of business models is often considered an art. But the scientific component should not be forgotten. To define a value proposition theoretically is constructing theory about something that is not reality yet. A robust theory for a sustainable business needs both, qualitative estimates and quantitative assessment.

Especially in e-commerce start-up situations, where there are high ex ante investment costs for programming and setting up the start-up, but afterwards very small variable costs or even decreasing variable costs to scale for maintenance and operations, estimating consumers' willingness to pay for a specific value proposition is indispensable when deciding to undertake the investment¹³.

When assessing new ventures and their value propositions we therefore first and foremost must study how a start-up business is planning to generate revenue. This has been especially true when looking at former start-ups like for example Google. Google had created a brand new business model by offering a free online search engine service whose sole purpose is to attract consumers' attention. This way, value is created for advertisers and marketers who are finally paying for the advertisement services and the matching of their ads to consumers' search results offered by Google.

Finding other parties (marketers and advertisers) to pay for your (consumer) service has changed and revolutionized e-business. Google's example shows that e-business companies' revenue streams get sometimes quite intransparent. Therefore a clean assessment of an e-commerce business model mainly consists in analyzing and defining its revenue streams. Success and failure dynamics will then show whether prices are too high, too low or within a bandwidth that is sustainable for the business as a whole. Therefore not only consumers' willingness to pay is of relevance but also distributors' and partners', or influencers' willingness to pay may matter greatly.

Willingness to pay in general is induced by the proposed value proposition and constitutes a money-based expression of the underlying valuation.

Theoretically three situations are possible:

1. Willingness to pay¹⁴ is high enough to cover up-front investment and variable costs over the life-time of the product or service

¹³ Throughout the whole paper we are assuming fixed costs to be set to zero, since they are expected to be very small in the case of GBS and all costs which are occurring can be tied to the size of the business. Therefore fixed costs matter less with increasing size of a business.

¹⁴ To obtain a potential turnover, we need to multiply the number of people willing to pay a hypothetically acceptable price (or more) with a price which reflects that level.

2. Willingness to pay is high enough to cover only variable costs in the future
3. Willingness to pay is not high enough to cover any costs

Willingness to pay for a product decreases with a loss of uniqueness. For example, Day's arguments that a product's lifecycle is highly influenced by the up-rising of competitors (Day 1981). Harvard's Michael Porter used the term "threat of new market entrants" to stress the importance of the number of competitors in a specific market as it is defining the intensity of competition (Porter 1979). The more profitable a market seems to be and the lower the entry barriers to entering a new market, the higher is the probability that new competitors will appear. At first when a product in a growing market is still unique, there can be charged prices which are high enough to justify investments into a new business idea since they promise to pay back the investments over a short time. In other words the business model is sustainable. The more intense competition about a product gets, the more is willingness to pay for a specific product reduced and so are prices. In other words it is easy to substitute the product by a similar one from an uprising competitor. Therefore investments into developing this product or service are reduced, but eventually the prices will not cover the investments any more. The business model becomes unsustainable.

It is the dynamic behavior of a system and the underlying structures shaping that behavior, that define, for a given value proposition, how fast a product or service switches from situation one (profit) to situation two (positive cash-flow with little or no profit) or three (loss). In the special case of a start-up company such as Groupon, with a unique product at the beginning, which is easy to copy (low market-entry barriers), at the same time (non-protectable intellectual property rights), minimal time to market is crucial for creating market power from the first-mover advantage. Controversially enough for Groupon to publicly draw attention to its profitability would boost competition in the market, and therewith impair its strategic advantage.

Dynamic Hypothesis

At the end of our study we should be in a position to assess the outcomes of the simulations. Therefore, we formulate the following dynamic hypothesis about the likely simulation outcome:

In the current Group Buying Schemes that we are studying, the customers' willingness to pay for the services offered does not match the value proposition of the vendor; this way the up-front investments cannot be covered; both sales and profit will show an overshoot and collapse pattern.

We expect that this business model, aligned with the current policy inputs, cannot be sustainable in the long-run since value added by the GBS is highly overpriced. First, an aggressive fee policy together with great expectations of merchants for positive returns (Locher, 2012) can potentially cause substantial inflation of both the customer and merchant bases. This initial inflation stemming from lagged realization is followed by a sudden collapse of both bases, once merchants' expectations are suddenly reduced, i.e.

adjusted to the reality, whereupon the existing merchants stop their involvement in coupon promotions.

Therefore our dynamic hypothesis is that the business volume of any GBS, if the company pursues this business model, will show an overshoot and collapse pattern. The reasons for this lie in the revenue streams of the merchant which are the main earmark in determining the total profitability of a coupon promotion. As long as extra-sales per coupon deal plus the revenue per loyal customer multiplied with the amount of loyal customers per merchant (total of measurable cross-subsidization) are not covering all the costs incurring to merchants, for offering their services or products, they will face marginal losses and therefore not profit, but lose from any sold coupon (they face a negative surplus from coupon promotions). Therefore they will not be inclined to pay the GBS for promoting their service at all. In case of a flexible adaption of the cost drivers towards static equilibrium values, the business model might turn sustainable at lower levels though.

IV. Modeling the GBS Business

We pursue a model that sheds light on the evolution of the company in its market. We explicitly take on a GBS owner position. We will analyze the GBS Business Model starting with the revenue streams, then explain the importance of loyal customers using a Causal Loop Diagram and then simulate the base behavior.

Business Model – Revenue Streams

Fixed-offer group buying starts when contracting with local businesses and arranging for the sale of its discounted products or services through the GBS's website. For consumers, this sale takes the form of a coupon – a heavily discounted offer of a good or service. This deal is executed only if a certain minimal number of people buy it and is in most of the cases also limited to a maximum number of coupons available¹⁵. If this minimal number of buyers for a certain deal is not reached within a defined timespan, the purchasers get back their money and the coupons become useless, which means incurring losses¹⁶. On the other hand the merchant can define a maximum number of coupons to be sold, and newly also per capita. In this way, local businesses get the chance to promote themselves directly while ensuring cost-efficient scale. The consumer, on the other hand, gets a chance to save money with the discount. The GBS receives the payment and then transfers it to the business, deducting a certain fee, which is agreed upon in the contract with the local business.

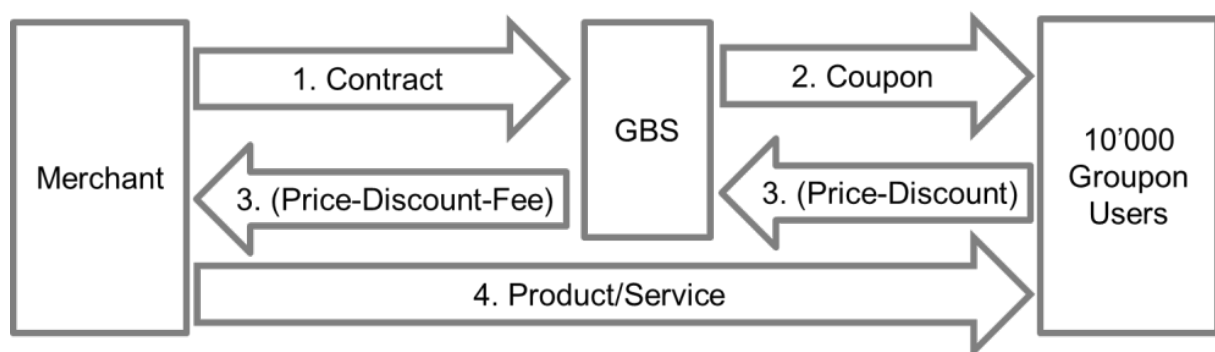


Fig. 1: Group Buying Scheme overview over the revenue streams taken from GROUPON

Key-Suppliers' Revenue Streams

At this point we need to address the merchants' revenue streams.¹⁷ These are always linked to a coupon promotion, since merchants, as B2B clients, are the GBS's key suppliers. Current GBS business models will cease to exist if they cannot find merchants, who want to try a coupon promotion anymore, since these merchants through their

¹⁵ This can be seen as an indication for merchants supposedly incurring losses and therefore are not willing to provide unlimited amounts of their coupons

¹⁶ Potential losses from non-executed GBS deals are not taken into consideration and would even more support our findings

¹⁷ According to Timmers 1998 a business model also contains a description of the sources of revenue. Compare fig. 2 - the loyal customers - to understand why merchants' profitability is also critical for GROUPON's business model.

fields of business activity define the GBS's offers in the first place. The possible revenue streams a merchant gets from a coupon promotion are:

1. Revenue from the coupon¹⁸
2. Induced extra sales (intra-temporal or inter-product cross-subsidization)¹⁹
3. Customer loyalty (inter-temporal cross-subsidization)
4. Extra new customers by gains of marketing attention²⁰

We build the simulation model starting with a qualitative mapping of the issues under study. For that purpose we use a CLD – Causal Loop Diagram. Based on this qualitative feedback structure, we proceed at formulating a quantitative System Dynamics model: The CLD is transformed into a stock-and-flow diagram, the variables of that diagram are quantified, and equations are formulated that represent the connections between the variables. A simulation model results (Sterman 2000).

The Basic Causal Loop Diagram

The most basic feedback loop represents the mutually reinforcing causal relationship between the number of merchants working with the GBS and the number of customers buying coupons²¹. The economic explanation is that the more merchants offer coupons, the more people, whose needs they can cater to, participate. The more people join such a system, the more eager are merchants to participate, as they can expect greater interest from potential loyal customers.

The Loyal Customers

The loyal customer in general, due to the necessary cross-subsidization, is the major entity of inspection. We have therefore set up the following CLD representing all different types of loyalties between customers, group-buying-schemes, merchants and the GBS. The complete Stock-and-Flow Diagram of the simulation model is in Appendix A.

¹⁸ This is the original price minus the discount, and this remainder is split up between GROUPON and the merchant according to GROUPON's fee. Relevant for calculating direct returns from a GBS promotion are potential no-shows, but these lead not quite to the intended results, since the customer does not redeem his coupon and therefore also cannot consume the merchant's service. No-shows are therefore not considered to play an important role, since that would imply, at the same time, that a GBS promotion is actually useless.

¹⁹ For the reasons mentioned in the introductory chapter this type of extra revenue generation is not considered in our model.

²⁰ For additional information regarding the value of attention see for example the classical AIDA model (Attention – Interest – Desire – Action).

²¹ All coupons offered are assumed to be sold (market clearing). In the model the number of coupons sold depends proportionally on the discount level.

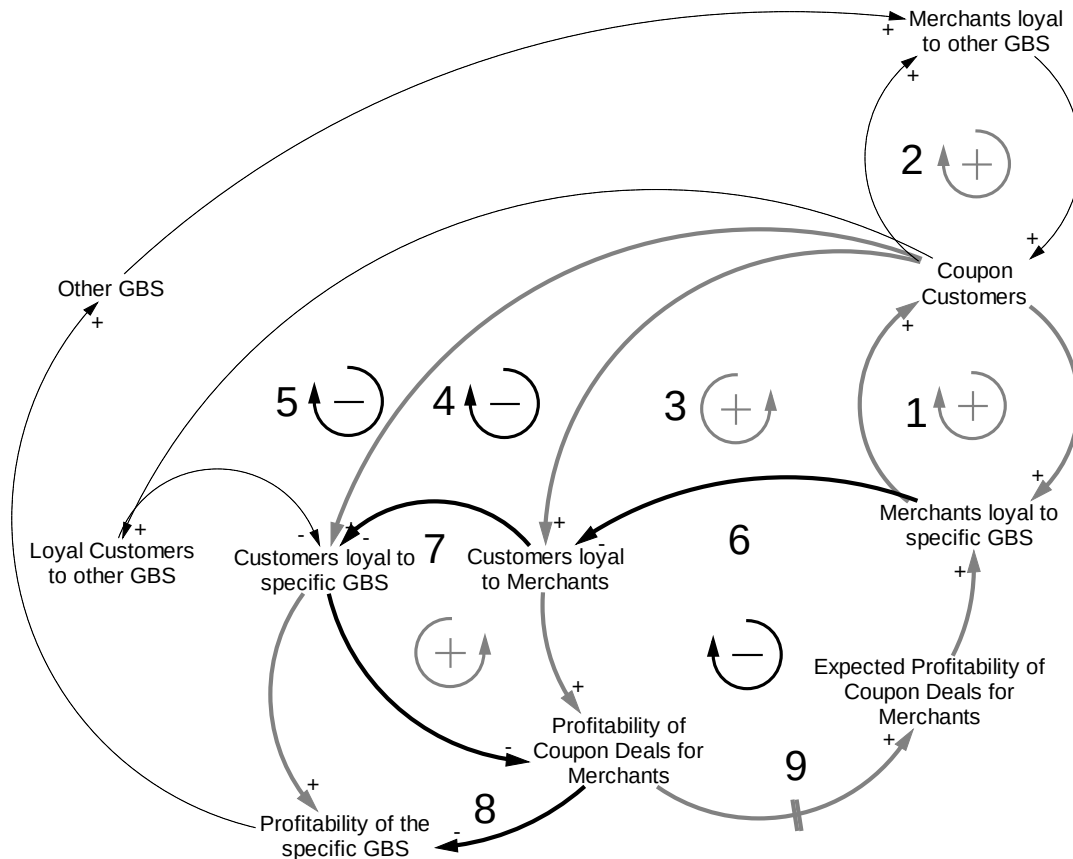


Fig. 2: CLD - The Loyal Customers

--- = indirectly included in the model
 — = positive relationship
 - = negative relationship

Loop (1) is of the self-reinforcing type. This loop describes the basic notion that more participating merchants lead to more coupons sold, as mentioned in the last section. At the same time this also creates more merchants being loyal to voucher platforms other than the specific GBS under study, since the business model is easy to be copied (Loop 2)²². More customers hopefully mean more loyal customers to the participating merchants (3) who, again in a reinforcing loop, foster entry of new merchants by raising the coupon's profitability. The incentive trade-off gets visible when looking at loop (4). Raising the amount of customers loyal to the specific GBS, by selling more coupons, cogently reduces the profitability of a coupon promotion. A customer is either fond of a merchant (customer loyal to the merchant), fond of a specific GBS²³, fond of a competing GBS (5),

²² For an insightful article on worldwide copycat websites and a global mapping see Underwood 2010. Dholakia 2011b finds that more than 70% of merchants would be indifferent about which one of the many extant deal promotion platforms to choose.

²³ Theoretically customers could be loyal towards several merchants who offer different services and products, being disloyal only for a few sectors in which these merchants operate, and at the same time be loyal to GROUPON. Since we assume merchants to be of one single sector this possibility is not included in our model.

or s/he is not participating or stops participating at all. From this effect results the negative correlation of the GBS' profitability with the merchants' profitability (8). The balancing (self-attenuating) loop (6) represents the market cannibalization effect²⁴ of several merchants offering the same service²⁵ (competition among merchants). More customers loyal to the merchant have a negative effect on customers loyal to GROUPON which in the end turns into a reinforcing circle (7)²⁶. Since the profitability expected by merchants from coupon deals, can only be updated after realizing a deal with expiration of a year, there is a delay between the expected profitability²⁷ and the realized profitability. This is going to be the major force creating the overshoot and collapse pattern we discussed in the dynamic hypotheses.

Hence, theoretically loyalty can be targeted towards one or more of the following groups:

- Customers to any GBS (Full Free-riders)
- Customers to a specific GBS [Customers Loyal to GBS²⁸]
- Customers to Merchant [Customer Loyal to Merchant]
- Merchants to a specific GBS [Merchants]
- Merchants to any GBS other than the specific GBS²⁹

To enable quantitative simulation, we elaborated a System Dynamics model based on the CLD outlined above. The model was implemented by means of the VENSIM software³⁰. For the overall stock-and-flow diagram, see Appendix A. The equations are documented in Appendix F. Several more detailed stock-and-flow diagrams can be found in Köpp et al. 2012.

Profitability and Merchants' Behavior

For the following, see Figure 3 and the complete stock-and-flow diagram in Appendix A. The GBS's Earnings are only positive when the GBS is selling enough coupons to cover for the costs incurred by their employed labor force. The number of coupons sold depends on the number of participating merchants offering coupons. To raise this number a GBS must raise the number of participating merchants. This happens when coupon deals are profitable, i.e., when the sum of all potential sources of revenue (extra-sales per customer, income generated from loyal customers plus income from sold coupons) over-compensates the costs the [Merchant] pays for the promotion, which results in a positive [Surplus Income] generated by merchants through the sale of coupons. These costs are defined by two variables: the [Discount] rate of the service

²⁴ One could incept even more forms of market cannibalization, e.g., customers between GBS platforms, customers between geographic regions, etc.

²⁵ A similar phenomenon observed is the empirical fact that people tend to buy more than one coupon each, which is perfectly rational as long as the discount is so high that the price is below marginal costs. This leads automatically to serious problems and is not taken into effect in this model. For an example see Sherr 2010.

²⁶ In our model, for the sake of abstraction, we are only looking at one specific service, even though losing a customer for one specific service to a merchant in reality does not mean that GROUPON loses this customer for all different sectors and services it is offering.

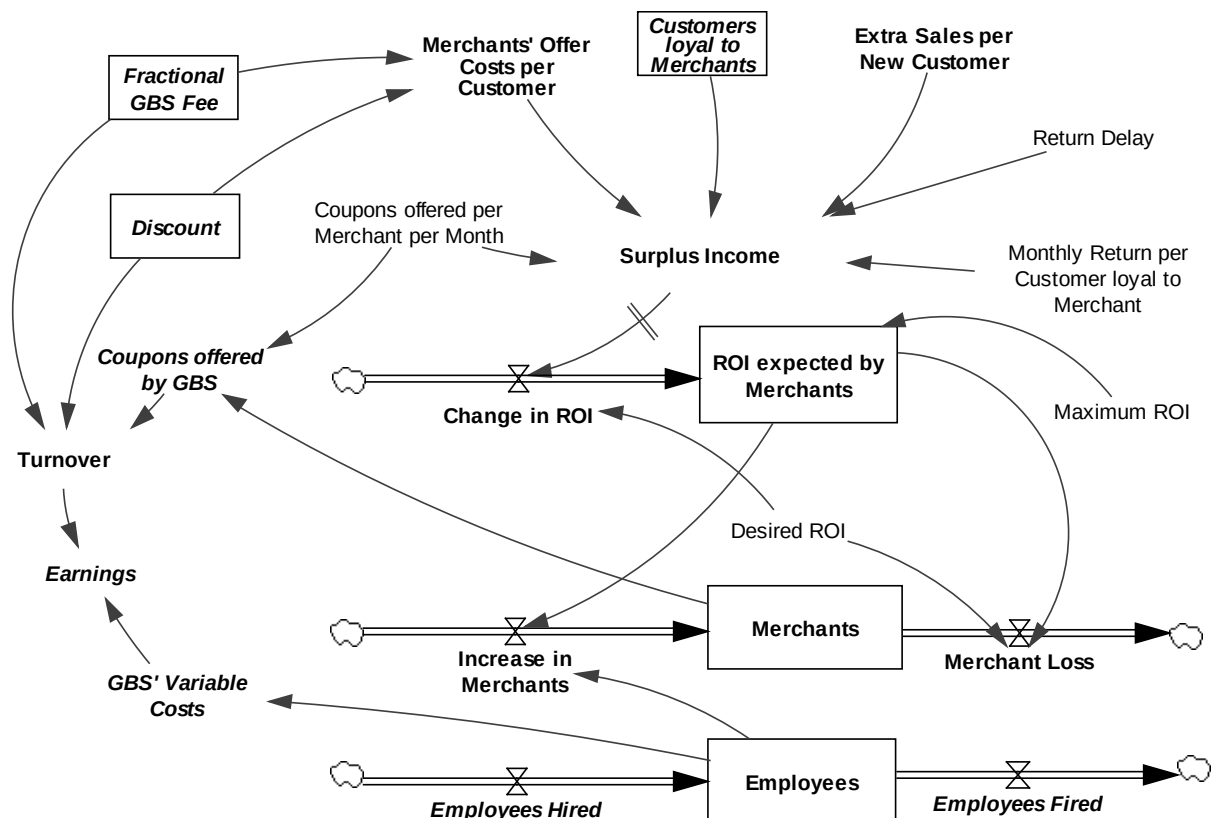
²⁷ We measure profitability as return on investment (ROI).

²⁸ Variables directly taken from the model are written in brackets - [...].

²⁹ This group of customers is not explicitly included, but addressed via the decreasing propensity to acquisition which is reduced when additional copy-cat websites pop up, or the discount is reduced.

³⁰ Available from www.vensim.com.

offered to the final customer and the fee the GBS charges for providing the distribution platform ([Fractional GBS Fee]). These two variables reduce the [Surplus Income] generated by merchants through sale of coupons; the higher the [Discount] rate and the [GBS Fee], the lower the actual ROI, which, with a delay, affects the [ROI expected by the Merchants] through the flow variable [Change in ROI expected by the Merchants]. As long as the [Surplus Income] generated by the merchants through sale of coupons is greater than their [Desired ROI], their [Expected ROI] increases up to a maximum value which is itself increasing the rate of increase of newly participating merchants. In all the other cases it decreases.

Fig. 3: Merchants' Dependence on ROI and Accounting GBS Earning³¹

Employees

From the GBS' perspective, the number of merchants also depends on the number of the GBS' [Employees]. Only if the GBS has the capacity in terms of employees to deal with the interested merchants will it be able to transform a potential merchant into an actual merchant. For the mentioned cannibalization effects and the GBS growth strategy, expansion in the number of employees and regions is key, if the percentage of [First Time Customers] should stay as high as it is³².

³¹ For a more detailed diagram, see Appendix A

³² According to Dholakia 2011b, 80% of overall online voucher customers on platforms like GROUPON, LivingSocial, OpenTable, Travelzoo and BuyWithMe Promotions were new customers to a merchant (business).

Simulating the Base Case

The most important measure for evaluating the sustainability of a GBS's business model is its [Earnings] (monthly and accumulated).

Considering the high starting discount rates and service fees and starting with high expectations among the merchants, an overshoot and collapse pattern will slash the [Earnings] due to the fact that merchants will no longer engage in GBS promotions, since they expect that this sort of promotion can neither generate profit nor earnings for the merchant in the long-term. Therefore, the GBS will not be able to offer any more coupons. Thus the variables [Earnings] and [Merchants] as well as all customer variables will show an overshoot and collapse pattern.

To test our dynamic hypothesis, we ran a simulation over a period of 240 months, with constant values for discount and fee, to see whether our model was reproducing an overshoot and collapse pattern as anticipated in our dynamic hypothesis.

Our simulation delivers the following outputs (Fig. 4):

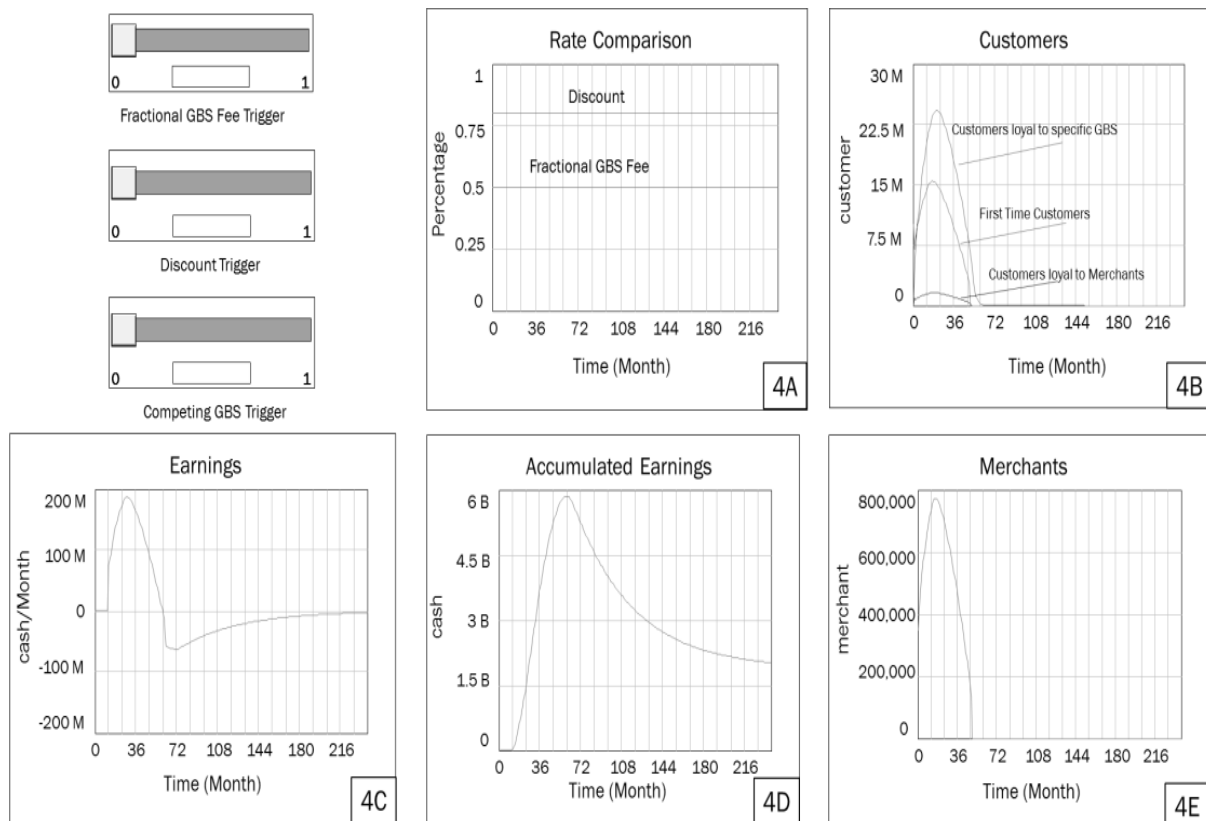


Fig. 4: Simulation outputs (Discount and Fee are fixed rates)

The graphs in Fig. 4 show an overshoot and collapse pattern in the simulation for all major stocks that let the model function. As the key exogenous variables remain constant (Fig. 4A), at rates of 0.8 for the [Discount] and 0.5 for the [Fractional GBS Fee], [Earnings] (4B) and [Accumulated Earnings] (4C) initially boom and then collapse. The cause for this collapse is the fall in participating merchants (4D), which brings down the number of [Customers loyal to GBS] and [First Time Customers] to a halt (4E) – because there are not enough coupons to circulate. The number of [Customers Loyal to Mer-

chants] (4E) follows the same pattern, but, as we can observe, their number never really matches that of [Customers loyal to GBS] – one of the reasons why [Merchants] become less enthusiastic in the first place.

Summing up the previous paragraphs, we conclude: The System Dynamics model, which we designed according to the commonly accepted perception of the economic causal relationships that make up the group-buying business model, indicates a robust pattern of behavior. High expectations of participating merchants coupled with aggressive discount and fractional fee policy inevitably lead to an overshoot and collapse pattern in [Earnings] for our given set of parameters.

Summing up the reasons for the overshoot and collapse behavior:

1. There is a time delay which allows for overrated growth dynamics and delayed adjustment of market expectations of the actors involved
2. Prices (merchants' costs) charged by the GBS under study are too high
3. The GBS business model is not capable of generating enough recurrent sales through fostering customer loyalty, neither to a specific merchant nor to the GBS. This is the ultimate criterion of failure: the business model is not sustainable.
4. Extra-Sales generated through coupon sales are not high enough to cover the current merchants' costs – this business model seems to mainly attract bargain hunters who have a low willingness to pay.

The main result that follows from our simulation analysis is clear and straightforward: Groupon's business model (and the same is true for DeindDeal, see Appendix E) in its current shape is not going to be sustainable in the long run. Consequently, the GBSs cannot maintain their current business models unchanged if they want to survive the next five years or more successfully.

V. Searching for a Sustainable Business Model

As the previous section has explained, the business model appears to be unsustainable in the long run. In this section we will try to discover if there are ways of attaining a dynamic path of economic sustainability. For this aim, the current parameters of the business model must be altered. The [Fractional GBS Fee] represents somewhat a price since it represents the fraction which the GBS charges for its services. Indirectly also [Discount] which is an inverse price, defines GBS revenue in absolute terms, as the Fractional GBS Fee is charged on the remainder when deducting the discount from the original price of the merchant's service or product³³. Therefore the bigger the discount, the smaller this remainder will be which means an inverse relation.

In the original model these two variables are exogenous parameters. An examination of possible policy choices available to the GBS of how to endogenously have these two variables determined by the system, may yield a resolution to the problem of long-term non-sustainability. Such a policy choice would target the lagged excess expectation ([ROI expected by the Merchants]) to keep earnings at a higher level. Meaning that GBS should make sure that the merchants' expected return on investment from a coupon promotion should be met. In other words a GBS should hold its promises.

One of the important factors affecting the merchants' ROI is their participation cost which is constituted by the [Fractional GBS Fee] and the [Discount]. Lowering these costs(e.g., [Discount]) could remove the overshoot and collapse pattern completely and turn the business model into one of continuous and sustainable growth, given there exist values for which this business model can generate positive returns to the [Merchants] and at the same time high enough returns for the GBS.

Meanwhile such a reduction of the discount also reduces a coupon promotion's attractiveness which results in a reduction of the inflow rate of new GBS customers. From the point of view of the GBS reducing the discount means *ceteris paribus* an increase in revenue since the same [Fractional GBS Fee] is charged on an increased remainder.³⁴

The GBS's value proposition loses value while reducing merchants' costs which is why relative GBS fees must be lowered as well to keep costs and the value proposition in an adequate relationship. Otherwise Customers will buy from other GBS which raises their attractiveness instead and the original GBS loses even further attractiveness.

If there exists a certain combination of discount and fee that is high enough to fulfill the conditions of situation one - willingness to pay is high enough to cover up-front investment and variable costs over the life-time of the product or service, competition will rise, because profitability has been proved to be achievable³⁵. The reason for this seems quite simple. As long as these conditions are fulfilled it is profitable to run a GBS. Therefore someone will start to copy existing GBS and start-up a new business. This will reduce the profitability though for all actors in the market (GBS) and finally lead to a race

³³ For a detailed explanation of this mechanism please see Köpp et al. 2012.

³⁴ The reason is that fees are applied to the remaining revenue, regular price minus discount. If discount is lowered, this remainder increases. A constant fee means increasing returns to the GBS as long as discounts go down.

³⁵ Often this is called „proof of concept“.

to the bottom. This race will only stop when no actor any longer will lower prices and by this reveals the market's "true" willingness to pay or the market's valuation of the value proposition. Therefore the big question remaining is if this "true" willingness to pay is high enough and will allow for a GBS up-front investment to be paid back over an adequate period of time³⁶.

For practical implementation to endogenize both variables [Discount] and [Fractional GBS Fee] we need an algorithm to determine when and by which magnitude the [Discount] and the [Fractional GBS Fee] should be reduced. Then we can check what implication this has for the expected earnings and [Accumulated Earnings] of the GBS in the long term.

Algorithm to reduce Merchants' Costs and keep revenue growing

Our GBS reaction algorithm relies on lowering the [Fractional GBS Fee] and the [Discount] at an equal relative rate each time the GBS shows negative [Accumulated Earnings] or the merchants observe a surplus income generated by merchants through a sale of coupons which is smaller than the ROI they desire ([Surplus Income generated by merchants through the Sale of Coupons] < [Desired ROI]). If one of these two conditions is satisfied [Fractional GBS Fee] and the [Discount] are reduced by a fixed relative adaption rate which is set to 5%. Below we examine, by simulation, the effects of such a policy on the long-term sustainability and economic viability of a GBS' business model. Capturing this set of statements in a mathematical expression with Boolean operators, using the VENSIM notation, we get:

(1)

$$Z_{t+1}^i = \text{IF THEN ELSE} ([\text{Fractional GBS Fee Trigger}] = 1, \\ \text{IF THEN ELSE} ([\text{Accumulated Earnings}] < 0: \text{OR:} \\ [\text{Surplus Income}] < [\text{Desired ROI}], [\text{monthly adaption rate}] * Z_t^i, 0), \\ 0)$$

s.t.

(2)

$$Z_t^i = [\text{Fractional Groupon Fee}]:\text{OR}:[\text{Discount}]$$

If we will find a solution with this algorithm, we can assume that reducing the costs to the ascertained discount and fee levels will be sufficient for the business to stay sustainable. To find an optimal solution we will then perform an optimization maximizing the [Accumulated Earnings] using the monthly adaption rate as the decision variable, and [Discount] and [Fee] as the varied parameters. This means that we let the GBS optimize its adaption rate over time to see what maximum [Accumulated Earnings] can be

³⁶ This includes of course that the willingness to pay must cover also the variable costs.

reached over a period of 20 years. The result will be used as an approximation for the GBS valuation.

Applying this Algorithm on the GBS' fee alone, keeping the [Discount] constant, does not turn the business model sustainable yet³⁷. On the contrary, this even worsens its performance, as [Earnings] become negative after four years already: A large reduction of [Earnings] would have no substantial impact on the [ROI expected by Merchants]³⁸. [Earnings] approach a value of about \$ -50mio per month, but with no operational room left, because all merchants have opted out. The final customer and merchant stocks show an overshoot and collapse pattern, and the GROUPON fee goes down to zero. One gets a similarly unsustainable pattern for the contrary setup, by endogenizing the [Discount] only and keeping the [Fractional GBS Fee] fixed³⁹ (for graphs see Appendix B).

Endogenizing both variables through application of the algorithm equally⁴⁰ results in a different pattern. [Earnings] overshoot, collapse and then rise again, leveling off at around \$50mio. [Accumulated Earnings] therefore are approaching linear growth passing \$10bn (Fig. 5). As with [Earnings], the same is true for all customer stocks including [Merchants]. The remaining boom and bust bump at the beginning comes from the 12-month delay: even though we endogenize [Discount] and [Fractional GBS Fee] simultaneously, these variables are still kept fixed for the first 12 months, since due to that delay merchants expectations are not adapted earlier.

³⁷ Endogenization here means that optimal values for Discount and/or Fractional GROUPON Fee are determined inherently by the model. This is implemented through two triggers, each of which is set to 0 if the respective value stays constant at its starting value, or is diminished according to the condition, in case Increase in Merchants is smaller than Merchant Loss.

³⁸ Since in each period the fee is lowered, GROUPON earnings go down directly. But lowering GROUPON's fee alone has not enough leverage to turn coupon promotions profitable for merchants, since original price minus discount stays higher, so that end-price results smaller than marginal costs, even if the fee is at zero. For an extensive discussion of the effects of discount and fee on GROUPON revenues please see Köpp et al. 2012.

³⁹ The explanation for this pattern is easy. A fixed fee percentage lowering the discount reduces attractiveness of GROUPON deals from the customers' perspective. At the same time, since the remaining revenue (original price minus discount) gets bigger in absolute terms, the absolute revenue of GROUPON rises. This makes the deal less attractive to a merchant and therefore s/he will quit.

⁴⁰ One could imagine to apply different adaption rates to the two variables, or let the adaption rate itself change during the simulation. Finding an optimal control through an optimal solution was not the goal of this study.

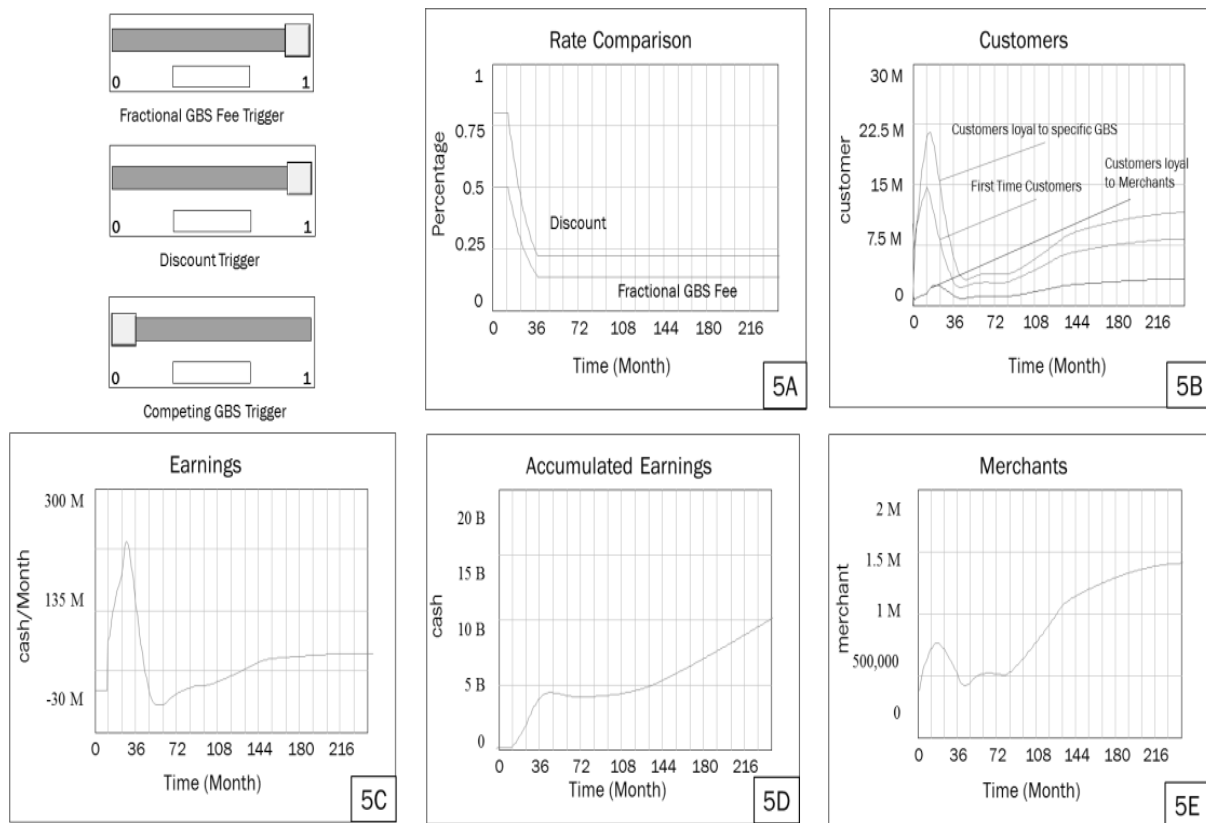


Fig. 5: Simulation outputs (Discount and Fee are endogenized)

As mentioned above, results show that GROUPON expects to hit the 10bn [Accumulated Earnings] frontier about 20 years from now. Therefore GROUPON's valuation in these simulations, with a time horizon of 240 months (20 years), appears to be extremely far-looking, as the time horizon used in the valuation of companies usually is in the range of 5-10 years. It also shows that a valuation above \$10bn does not seem sensible.

For the [Discount] and the [Fractional GBS Fee], when both are regulated according to our policy⁴¹, the fee approaches 14% and the discount becomes sustainable at 22% (Fig. 5a). These values result as the remaining parameters, e.g., [Desired ROI] or [Average Return per Customer for merchant], are set at empirical values (Köpp et al., 2012)⁴².

The Effects of Growing Competition

There is a limitation to our model: We are assuming an infinite pool of merchants available to become GBS partners in supplying services. Slowing down the acquisition rate by a propensity of 1% per month through the assumption of a natural exhaustion of first time merchants through increasing competition caused by an S-shaped diffusion of GBS competitors worldwide, our results change once more as shown in Fig. 6.

⁴¹ [Discount] and [Fee] are continuously reduced, in parallel, until they stabilize at a certain value.

⁴² As you can see earlier in the paper the adaption mechanism is not following an optimization logic, but rather a randomly chosen fixed percentage iteration procedure.

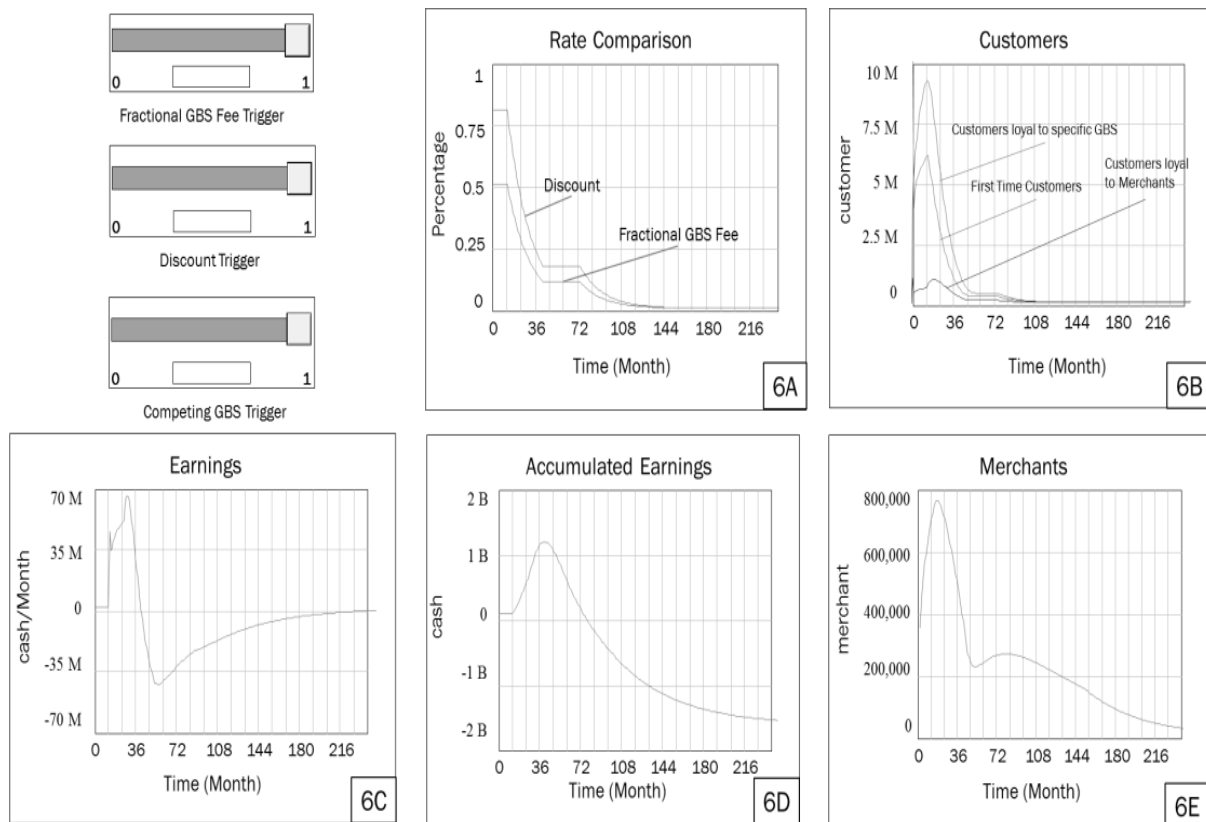


Fig. 6: Simulation outputs - Discount and Fee are endogenized and there is competition for merchants between the GBS

Therefore we not only find that the current business model is not sustainable, but it is also highly vulnerable showing low robustness. Even a low level of competition changes model behavior tremendously. After the first bump caused by our initial 12 month delay, GROUPON never manages to make any surplus again, and even the total [Accumulated Earnings] become negative. As soon as, due to competition, it becomes slightly harder to attract new merchants, than it was when GROUPON was the first and only player in the market, all profits are driven out.

VI. Testing Alternative Valuations

Assuming a reasonable degree of validity of our simulation model⁴³ we could now test any ex ante valuation of GROUPON's strategy and development. We have chosen to test the valuation by Bloomberg. Many different valuations have been disclosed, preceding GROUPON's IPO. The most reliable valuation though is the one finally used when defining the amount of shares and their respective denomination at the initial public offering (IPO) (compare MacMillan & Spears 2011 or Shearman 2011). In connection with GROUPON's partial IPO, a stake of 5.5% of the company's share was sold for a total amount of \$700mio (35mio shares at \$20 each). Bloomberg concluded that 100% of the shares would be worth roughly \$13bn (\$12.7bn at the IPO on 4th November 2011).

Optimization

To accomplish that test, we performed an optimization to maximize the GBS's [Accumulated Earnings] over a time period of 20 years to see whether the optimal value is somewhere close to an estimated valuation of \$13bn⁴⁴. The rationale behind this optimization is to give GROUPON the chance to optimally adapt and see what implications this would have for the viability of the business. The valuation of \$13bn is the extrapolation of the valuation by the face value of \$20 share price, since GROUPON only sold 5.5% of its stock through the IPO, raising \$700mio in exchange. On the other hand we would like to see at what levels the discount and the GBS fee will remain as a result from an optimal solution.

We will maximize the following objective function using [monthly adaption rate] as single decision variable:

Objective Function (2)

$$[\text{Accumulated Earnings}]_{\max} = \max_x \int_{t=0}^{240} [\text{Earnings}(\text{Fractional GBS Fee}_t, \text{Discount}_t)] d_t$$

s.t.

Decision Variable (3)

$$x = [\text{monthly adaption rate}]$$

Range of the Decision Variable (4)

$$0 > x > -150\%$$

Algorithm applied on [Fractional GBS Fee] (5)

⁴³ Validity tests are documented in Chapter VII.

⁴⁴ Bloomberg wrote Groupon even discussed a valuation of \$25bn with banks before the IPO, see Bloomberg online article from March 17, 2011 by Douglas MacMillan.

$$\begin{aligned}
& \text{[Fractional GBS Fee]}_{t+1} \\
& = \text{IF THEN ELSE}(\text{[Accumulated Earnings]}_t < 0: \text{OR: [Surplus Income]}_t \\
& < \text{[Desired ROI]}, \quad x * \text{[Fractional GBS Fee]}_t, \quad 0)
\end{aligned}$$

Algorithm applied on [Discount] (6)

$$\begin{aligned}
& \text{[Discount]}_{t+1} = \text{IF THEN ELSE}(\text{[Accumulated Earnings]}_t < 0: \text{OR: [Surplus Income]}_t \\
& < \text{[Desired ROI]}, \quad x * \text{[Discount]}_t, \quad 0)
\end{aligned}$$

Starting Value Condition (7)

$$\text{[Fractional GBS Fee]}_{t=0} = 50\%$$

Zero-Lower-Bound-Condition (8)

$$\text{[Fractional GBS Fee]}_t \geq 0$$

Starting Value Condition (9)

$$\text{[Discount]}_{t=0} = 80\%$$

Zero-Lower-Bound-Condition (10)

$$\text{[Discount]}_t \geq 0$$

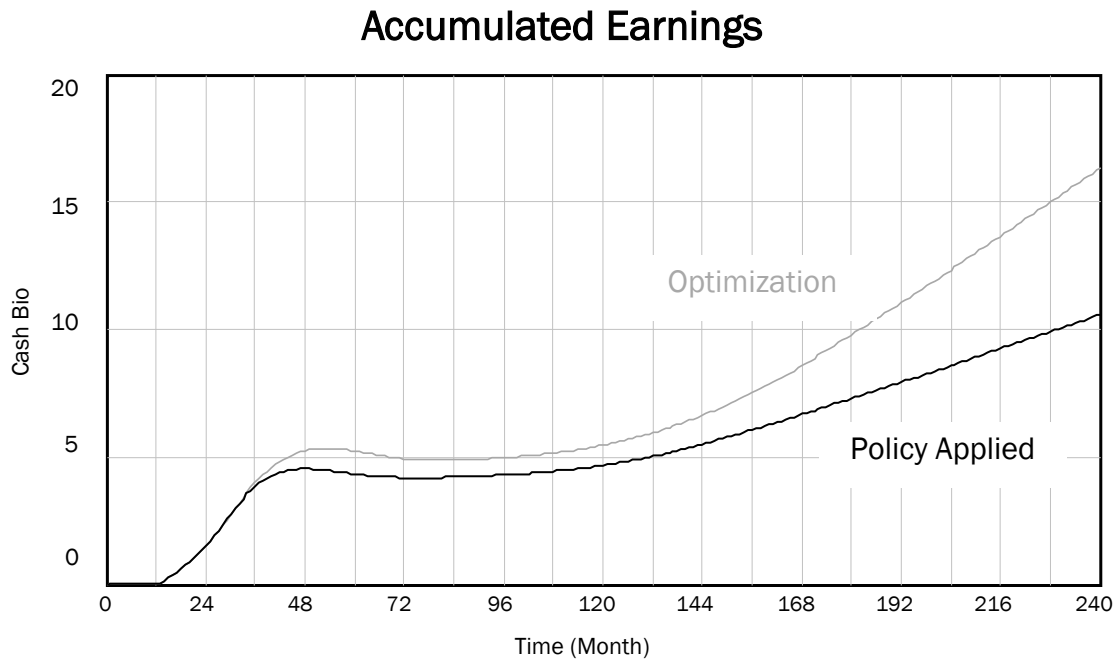


Fig. 7 Accumulated Earnings for policy applied versus optimization

We take the [Monthly adaption rate] as the only decision variable in the optimization. This rate defines the percentage by which the discount and fee are reduced per month, if one of the conditions in the algorithm mentioned above is fulfilled. For the optimization we let the decision variable be in a range– between -150% and 0% of monthly adaption. We do not allow for any positive recovery of neither [Discount] nor [Fee] over time, given the irreversibility of this specific kind of market process (product life cycle). Discount and fee are adapted by a common fixed percentage which is a limitation of our model⁴⁵. Using the Powell optimization algorithm in the VENSIM software, we find an optimal monthly adaption rate of -3.4%.

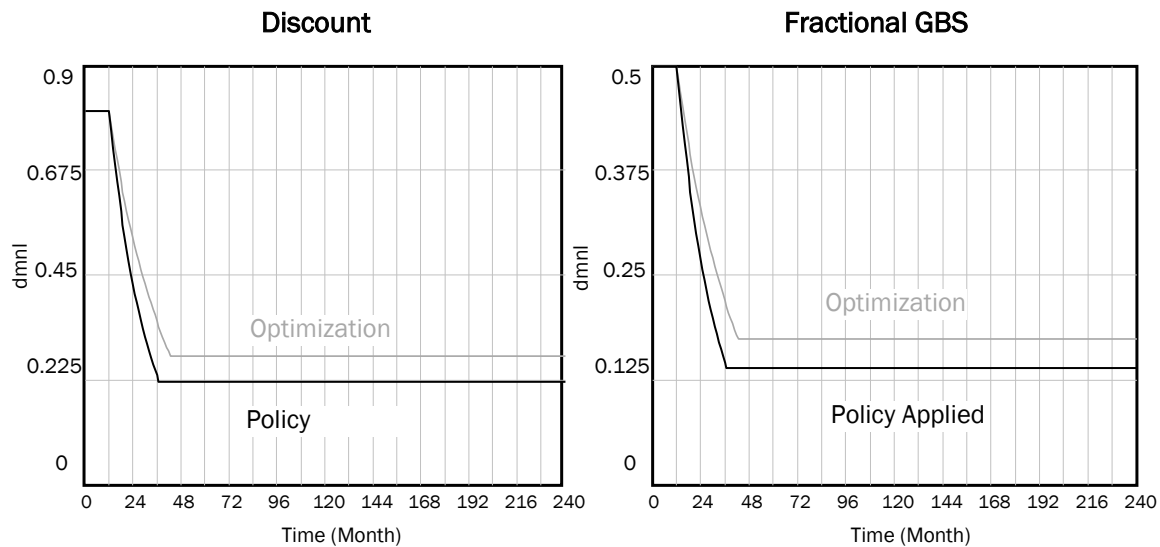


Fig. 8: Discount and Fee levels for Policy Applied versus Optimization

In this optimal situation we see that the accumulated earnings over 20 years reach nearly \$16bn. In such an optimal situation the GBS can also maintain the [Discount] and [Fractional GBS Fee] levels on higher values, 27.7% for the [Discount] and 17.3% for the [Fractional GBS Fee]. These results on the one hand back the valuation made by the analysts (Shearer 2011), on the other hand they also suggest a much longer than usually requested pay-back time⁴⁶ and presume optimal decisions.

Sensitivity Analysis

To assess the reliability of this maximal valuation we perform a sensitivity analysis where we let the following variables vary and use the optimal monthly adaption rate of -3.4%.

Variable Name	Distribution	Minimum	Maximum
Average Coupon Value	Random Uniform	80	300
Desired ROI	Random Uniform	0%	60%

⁴⁵ Defining the adaption rate as a function would allow for a dynamic change of the adaption rate, which is neither implemented in our model as well as other possible ways in searching for an optimal control.

⁴⁶ In the venture capital sector, the assumed pay-back time is usually 5 to 7 years.

Monthly adaption rate	Random Uniform	-150%	0%
Monthly Return per customer loyal to Merchant	Random Uniform	50%	150%

We performed 200 simulations and got the following result:

Accumulated Earnings

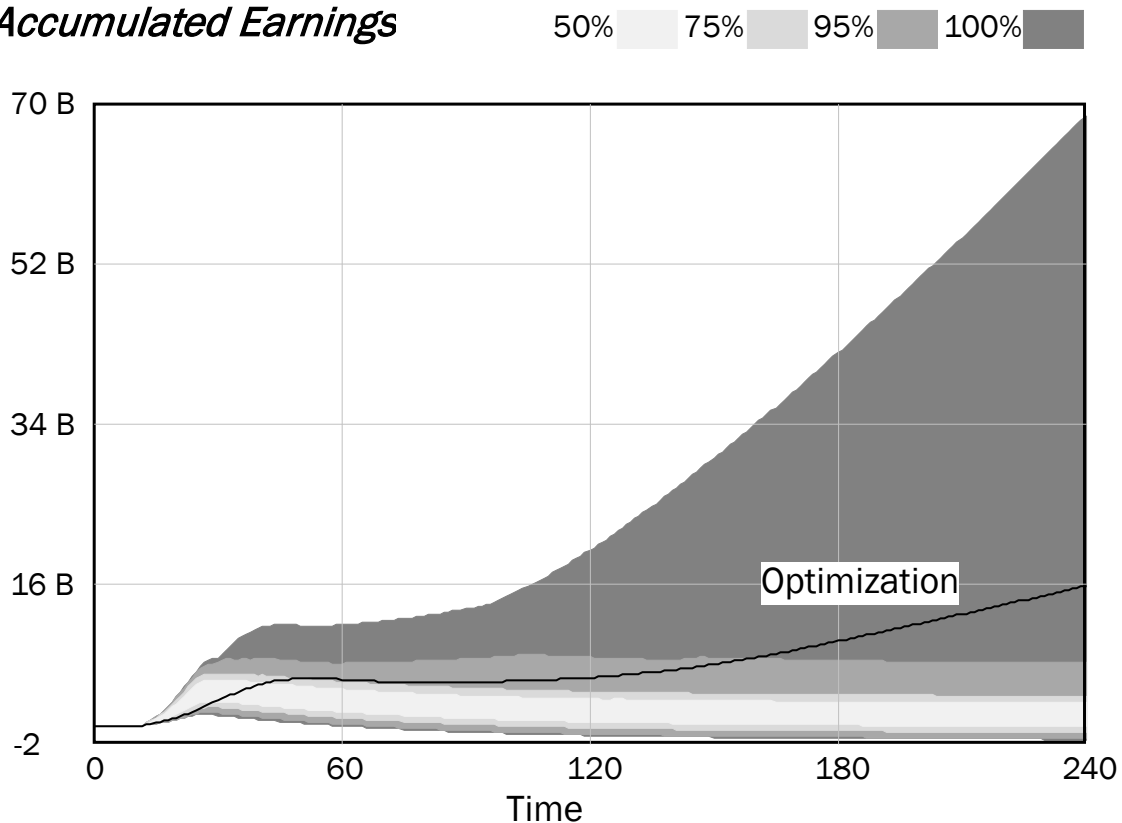


Fig. 9: Sensitivity Chart for Accumulated Earnings with confidence levels and the optimal result

Figure 9 shows that the optimal solution leaves the 95 percentile range after roughly 13 years and reaches its temporary maximal value after 20 years. The maximal possible accumulated earnings defined by the border of the 100% percentile range would suggest a valuation of nearly \$70bn, but there are much more likely scenarios that include even possible negative valuations. The minimal value in the sensitivity analysis is \$-1,57bn. We can see that having a 5 year investment and valuation focus in mind (see [Accumulated Earnings] after 60 months) valuations of above \$13bn are completely out of reach. Another interesting number is the median of these sensitivities, which is around \$1,36bn. This seems to be a much more reasonable valuation, since this reflects more or less the sum of venture capital investments made into GROUPON throughout its lifetime plus the \$700mio stemming from the IPO.

Statistical Inference

Our test is concluded with the following statistical inference. Taking the sensitivity runs (n=241) into consideration for a one-sided t-test, our null hypothesis H_0 would be that GROUPON's valuation amounts to \$13bn or more and our alternative hypothesis H_1 suggests that the true valuation is lower than \$13bn.

$$H_0: \mu \geq \mu_0 \quad vs. \quad H_1: \mu < \mu_0,$$

μ being the true valuation and μ_0 the value against which we are testing (\$13bn).

Formula1: Hypotheses for Student's t-test

Calculating the t-statistic based on n-5 degrees of freedom we get the following results:

$$t = \frac{\bar{X} - \mu_0}{\sigma / \sqrt{n - 5}},$$

where $\bar{X}$ is the sample mean.

$$\bar{X}$$

Formula 2: One-sided t-statistic for

μ_0 13 000 000 000

Min	Max	Variance	Standard Deviation
-1 565 250 000	68 603 800 000	38 980 381 425 358 500 000	6 243 427 058
Median	$\bar{X}$ (Mean)	T-Statistic (one-sided)	Probability (P-Value)
1 364 970 000	2 151 119 795	27,0314632	0,0000085%

From these results follows that the probability for the null hypothesis (true valuation is \$13bn or bigger) being true amounts to 0.0000085%, which makes the t-test become highly significant and leads to a rejection of our null hypothesis. This is equivalent to saying that with an inverse probability of $1 - 0.0000085\% = 99.99999153\%$ our alternative hypothesis, which postulates that GROUPON's valuation is below \$13bn, is more appropriate.

In sum, we can assume that the valuation by Bloomberg was too high.

VII. Validation of the Simulation Model

Model validation is the process by which the validity of a model is enhanced systematically. It consists in gradually building confidence in the usefulness of a model by applying validation tests (Schwaninger and Groesser 2009). Our validation efforts pervaded all phases of the modeling process, and, in addition, reached into the phases of model use. The tests we carried out were crucial to the quality of our model.

We have reverted to the canon of validation tests as used in the System Dynamics Community (Forrester and Senge 1980; Barlas 1996; Sterman 2000; Schwaninger and Groesser 2009). The following standard tests were accomplished:

1. Direct Structure Tests
 - 1.1 Structure and Parameter Examination Tests
 - 1.2 Direct Extreme Condition Tests
 - 1.3 Dimensional Consistency Test (Units Check)
2. Indirect Structure Tests
 - 2.1 Indirect Extreme Condition Tests
 - 2.2 Behavior Sensitivity Tests
 - 2.3 Integration Error Tests
3. Tests of Model Behavior

These tests helped in building the final model presented in this paper. All of them were passed and have been documented in a predecessor of this paper (Köpp et al 2012: 41ff.). In the same document we examined the model in the light of further quality criteria, mainly:

- A. Refutability of Theory
- B. Importance
- C. Precision and Clarity
- D. Parsimony and Simplicity
- E. Comprehensiveness
- F. Operationality
- H. Reliability
- I. Fruitfulness
- J. Practicality

Here, we will apply an additional test that is of high importance for the external validity of our simulation model, - the family members test. The question it asks is: "Does this model also hold for other cases of the same class?"

As mentioned above we did not have access to relevant original data series from any group-buying scheme worldwide, so we decided to construct another different case of a group-buying scheme, based on DEINDEAL. DEINDEAL differs from GROUPON in several respects: Firstly, DeinDeal has a much higher cost per employee due to the much higher price level in Switzerland compared to the United States of America. Secondly, DeinDeal differs much in size from GROUPON. That is reflected, for example, by the assumed starting values of the stocks of employees or the stocks of existing merchants. For a complete comparison between DeinDeal and GROUPON used in this model see Appendix C. For the DEINDEAL case we ran the same scenario simulations as for our GROUPON case and saw that our model still produced the same pattern. For the policy applied scenario the DEINDEAL scenario produced the following results. The slightly less aggressive policy let DEINDEAL have their fee remain at 19% and the discount at a 23% level (see Appendix E). For a comparison of GROUPON and DEINDEAL see Appendix C: To measure the similarity in outcomes between the two different cases we decided to apply statistical measures of fit.

The most important measure in this context was Pearson's correlation coefficient, ρ , which we also have calculated for a larger set of variables since this measure does not need transformation. The average of 0.895 overall correlation shows that the curves for the two cases – GROUPON and DEINDEAL - in all five scenarios are indeed very similar in shape (See table in Appendix D). Therefore we can conclude that our model works not only for one single case, but rather brings up similar results for a whole family of GBS schemes even when stemming from different preconditions (See also the graphics in Appendix E).

These results let us assume that even if we had access to real-world data from GROUPON, the results might be more precise, but the basic pattern would remain the same. *The difference between the real-case outcome and the simulation study would be one of degree but not of kind. This leads us to the assumption that indeed our results are valid for a whole family, - the class of fixed-offer GBS in general.*

VIII. Lessons from the Case Study and Implications

Our results suggest four major findings:

1. A GBS's business model can be turned sustainable, even though this highly depends on the competition the GBS is facing. Sustainability depends on an adequate pricing of the value added by the GBS.
2. [Fractional GBS Fee] and [Discount Rate] cannot be treated as individual levers, but must be viewed and handled as a pricing package, which is defined by this specific group-buying business model under study. Changing one of them alone does not lead to the intended changes, as the two parameters affect earnings in opposite directions. An exogenous change in one parameter implies adapting the other one to keep the package sustainable.
3. [Fractional GBS Fee] and [Discount] are too high and must be lowered to become sustainable in the long run. According to this result, values of no more than about a third of the starting rates of the pricing package lead to a sustainable business model. This result is inherent to this type of a system and generally true. The used SD approach is based on endogenous causation rather than exogenous and therefore promises broad validity.
4. The long-term success of a GBS depends on the profitability a merchant can expect from a coupon promotion. Levels of the main income factors such as fractional rate of extra sales per coupon customer, number of loyal customers and willingness to pay or reservation price respectively from such a customer determine whether a merchant will turn loyal towards the specific GBS and merchants' loyalty towards a GBS is crucial to sustain a high coupon supply to cover fix costs. At the same time the GBS's supply determines the attraction it gets and therefore the amount of supplied coupons sold, a perfect closed feedback loop which will only work as long as there is enough supply. Growth in supply on the other hand comes mainly from the novelty bias and must transform over time into a sustainably equalized price-value based attraction.

Our competition analysis indicates that, for this type of growth-focused business model, it is size that matters. Getting leverage and growing as fast as possible are the main two goals of an e-commerce loss-leader approach. Market power is key and speed is essential for the survival of the fastest. There exist such tremendous economies of scale comparing the relatively low up-front investment to the extremely high potential revenue and to future fixed costs which are rising less than proportional with size that make such venture capital investments seem incredibly attractive. A look at the naked numbers should bring a reasonable investor down to earth, future profitability being the basis for a serious investment decision.

To answer our dynamic hypothesis, we built a relatively complex System Dynamics model. Our initial dynamic hypothesis was that a boom and collapse pattern would occur in the generic coupon business model with its aggressive discount and fee policies, which is what our simulations revealed. At the end of the day every actor has to make profits,

otherwise s/he will retreat from the promotion⁴⁷. Therefore a loss-leader approach must always be limited to a certain time period, otherwise the business won't survive.

Our search for a sustainable solution with its adaption to the model employs less restrictive assumptions, - that [Discount] and [Fractional GBS Fee] are flexible downward rather than fixed. This reveals a solution to the sustainability problem in that if there is no competition. However, in reality competition and resource limits will likely undermine it, because as Groupon's business model can be copied so easily that competition is very likely to increase.

Our results are also in line with Dholakia's conclusion that shares in revenues will go down and that it will be harder for specific voucher platforms to find merchants interested in starting an online voucher promotion in the future (Dholakia 2011). This effect will most probably lower the fees such platforms can charge from merchants.

In closing we would like to add that since we built our model (Mid 2012) the GBS market has proven to be highly dynamic. GBS have started to offer their own services such as marketing related consulting targeting the merchants and teaching them how to conceptualize their coupon promotion and place such a promotion within a merchant's portfolio of marketing measures. GBS have also started to sell products directly through their platforms at discounted prices as another source of revenue. GBS schemes are furthermore shifting their revenue source towards the end customer instead of the merchants to raise merchants' profitability. At the same time some GBS have started to charge the customer their fee for offering the coupon through their platform directly and granting the customer the right to claim the service underlying the coupon at a discounted price directly at the merchant. This way the upfront payment equals the GBS total revenue. The discounted service is paid directly at the merchant after having obtained the service. Such a business model creates a different incentive structure⁴⁸ and could be the focus of further research⁴⁹.

Which are the implications of our findings? On a more general level this study reveals that entrepreneurs, who commit substantial resources to business models that are not sustainable, do in fact exist and there are indeed spectacular exemplars of that kind. If a feasibility study assessing the business model ex ante, would have been supported by a good dynamic model, the economic viability would certainly not have been assumed

⁴⁷ Attracting a high amount of people by selling them products or services under face value may also have some advantages. However, from a long-term perspective one will never find any merchant who, in such a situation, would pay for a service to increase the number of customers and therewith exacerbate his loss.

⁴⁸ The main difference in such uprising business models is the switch in liability. In our case the GBS is liable to a certain extent for granting the customer the possibility of claiming successfully his service or product acquired through a coupon from the GBS platform. This is why the GBS in our case is also collecting the whole turnover from the customer (price minus discount) and then keeps its fee, and forwards the rest to the merchant. New platforms only sell the coupon itself. Therefore a customer buys only the right to claim a discount on a defined service or product from a given merchant, which corresponds to what we call the [Fractional GBS Fee]. The customer pays the discounted price directly to the merchant. In such a system the GBS platform gets money from the merchant for selling his coupons and from the customer for buying them. In such constellations it could have been proven already that resulting GBS fees are much lower than 50% (see, e.g., the following footnote).

⁴⁹ See for example snapdeal.com in India. There the online upfront payment is 99 Rupees. The remaining rest of 500 Rupees for the service is directly paid to the merchant, in this case a Spa in Hyderabad, when cashing in the coupon. 99 Rupees are about 16 ½ % for the fractional GBS fee which is in line with our findings. <http://www.snapdeal.com/deal-hyderabad-tarash-spa-salon?pos=2:159>

on the spur of the moment. Engaging in a fundamentally unsustainable venture would be incompatible with a sound business logic. Necessary adjustments and mistakes in business model design can be anticipated accurately, with the help of a reasonable simulation model. As we described above, GROUPON did what seemed to be “the way” out of an incipient disaster. Even given the proposed adjustments, in the long term, GROUPON’s business model remains unsustainable. The corroboration of this claim will be just a matter of time. There is only one way out, - a proper redesign of the business model. The corporate transformation that GROUPON is undergoing currently seems to point in that direction. The fact that GROUPON’s shares are floating around \$6 to \$7 for the first trimester 2014 backs the claim that GROUPON is not too successful in this yet.

IX. Methodological Insights

Our initial claim was that business models should and can be scrutinized in more effective ways than common practice suggests. By means of modeling and simulation, the long-term viability of a business, as defined by specific model, can be assessed.

It has been worthwhile conducting a detailed case study, as it has been revelatory: Our inquiry demonstrates that there are start-up companies that rest on flawed business models, which have not been uncovered as being unsustainable, by their protagonists, be it on purpose or not.

We have been able not only to show that the business model of the firm under study is not viable, but also to explain how and why this is so. The simulation model we built and outlined here was run on the data of two companies that differ significantly in various dimensions. The similarity of the results shows that our conclusions apply to more than a single case, i.e., to a family of companies – in principle, any fixed-offer group buying scheme.

Explanations of this kind are normally based on an exogenous logic, which assumes that results are caused from outside. In contrast, we have given an explanation along a logic of endogenous causation, stemming from a defective business design.

The lessons learned from this inquiry reach beyond the insights into the specific structure and behavior of one firm's operations. The following points summarize our conclusions of a more general nature that transcend the bounds of a single case. These markers do neither amount to a theory, nor are they unknown or even new to seasoned system dynamicists. However, they are of an indicative value, and therefore worth highlighting:

Understanding: The case study demonstrates the power of the System Dynamics methodology to reconstruct a business model. As the focus is not on data but relationships, the analysis (and synthesis) concentrates on the conceptualization of structure and patterns of behavior exhibited by the system under study. The design of a business model is a highly creative process leading to most diverse conceptual architectures. Both qualitative and quantitative modeling with System Dynamics can be applied to any such architecture, subject to the condition that the researcher possesses the necessary experience with the use of this methodology. The modeling process enhances mental penetration and understanding of the logic inherent in the business model, better than approaches, which focus on data and detailed point estimations. In principle, such depth cannot be accomplished by using a standard model. We reckon that normally the models need to be more or less customized.

Dynamic approach: In situations of complex dynamic systems that feature high uncertainty, long timeframes of inspection, data shortfall or even a combination of them, dynamic modeling and simulation is definitely superior to other assessment procedures, e.g., static calculations or econometric models. In comparison, the dynamic approach helps fleshing out patterns of behavior and underlying structures, enabling differentiated causal ex-

planation. The purpose of system dynamics is not in making point estimations but in understanding the workings of a system made up of causal relations and temporal delays. To understand the mechanisms of how such systems work and how to manipulate them towards a desired outcome means understanding the incentive structure inherent to a system. This way, the space of potential system behaviors and the necessary responses can be ascertained. Related to our topic, the understanding gained is about the fundamental logic of business models. The apprehension of the respective system as a whole, in its context, conveys a new perspective which opens possibilities that reach beyond those attained by segmental, e.g., functional or sectorial views.

Usability: The concept of dynamic modeling and simulation makes possible gauging the evolution of an organization, even if data are scarce, as in our case. For example during a due diligence situation where an investor is trying to estimate a start-up company's future potential, dynamic modeling can deliver very important insights or uncover potential pitfalls. In contrast, alternative quantitative methods require by far more data. For example, in econometrics, 500 to 1000 observations are needed to deduce a reliable trend. As has been shown, data sets including time series of inputs or cross-sectional data are not needed to understand the system under study. This makes system dynamics also a potentially highly valuable methodology for the assessment of a business from outside, as accomplished in our case study.

Evaluation- versus Design-orientation: The approach demonstrated here is not limited to the realm of scrutinization or assessment. Scenarios and possible modifications of a model can give clues about possible designs or redesigns of business systems, and their consequences. They are also apt to show where such redesign cannot lead to sustainability. And ultimately they can also help reframe a business model in order to make it viable.

Rigor: The quality standard applied to the validation of models is particularly high in the system dynamics community. Only models tested rigorously are accepted. The canon of tests, which has been developed over the years, is comprehensive. Even in a small exercise as is our case study, model validation has played an essential role.

Relevance: The case study demonstrates the power of dynamic modeling and simulation in representing and assessing complex business models. These appraisals are at the core of any sophisticated business management. They are crucial for the long-term success or failure of organizations. Therefore, scrutinizing the viability of the business model is of utmost importance in any enterprise. Non-simulation-based assessments are in great need for support by good simulation models. The simulation results delivered in our study corroborate our initial assertion that testing the sustainability of a business in advance can deliver high value to investors and managers: It can help avoiding fatal mistakes and taking new opportunities.

In this sense, we trust having opened a path towards a promising new field for the application of System Dynamics: the assessment of business models' sustainability.

Appendix A

Complete Stock-and-Flow Diagram
Stocks are represented by boxes, flows by valves

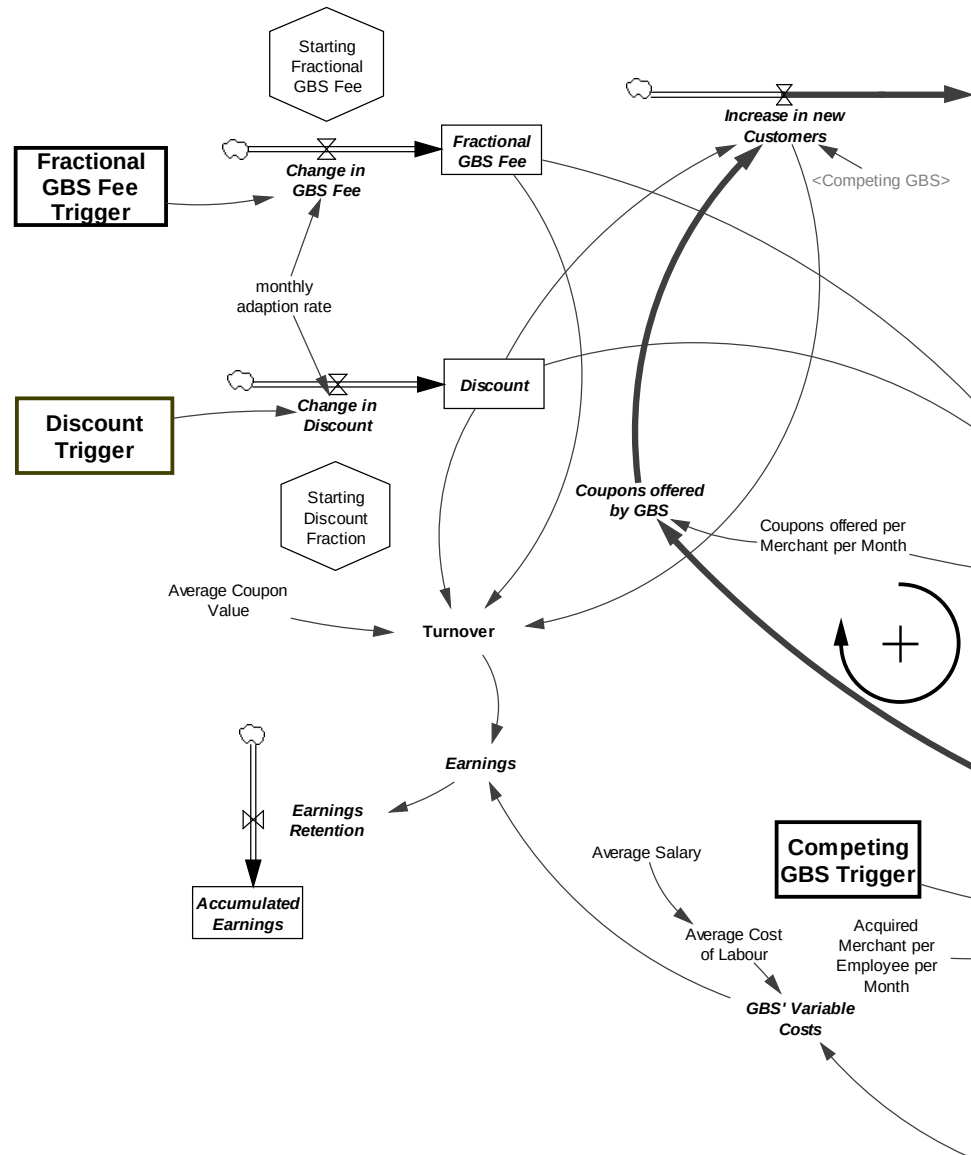


Fig. 6: Full VENSIM Model

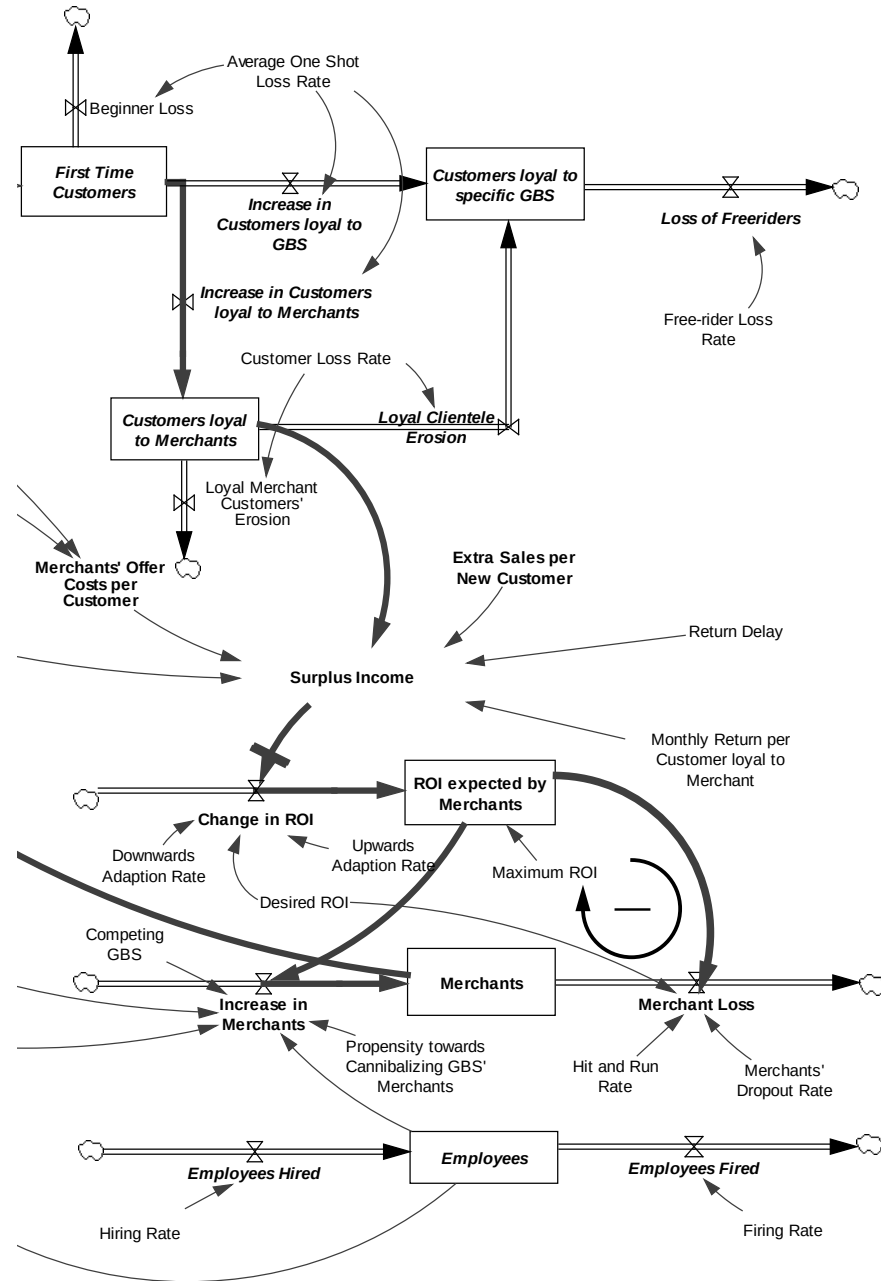
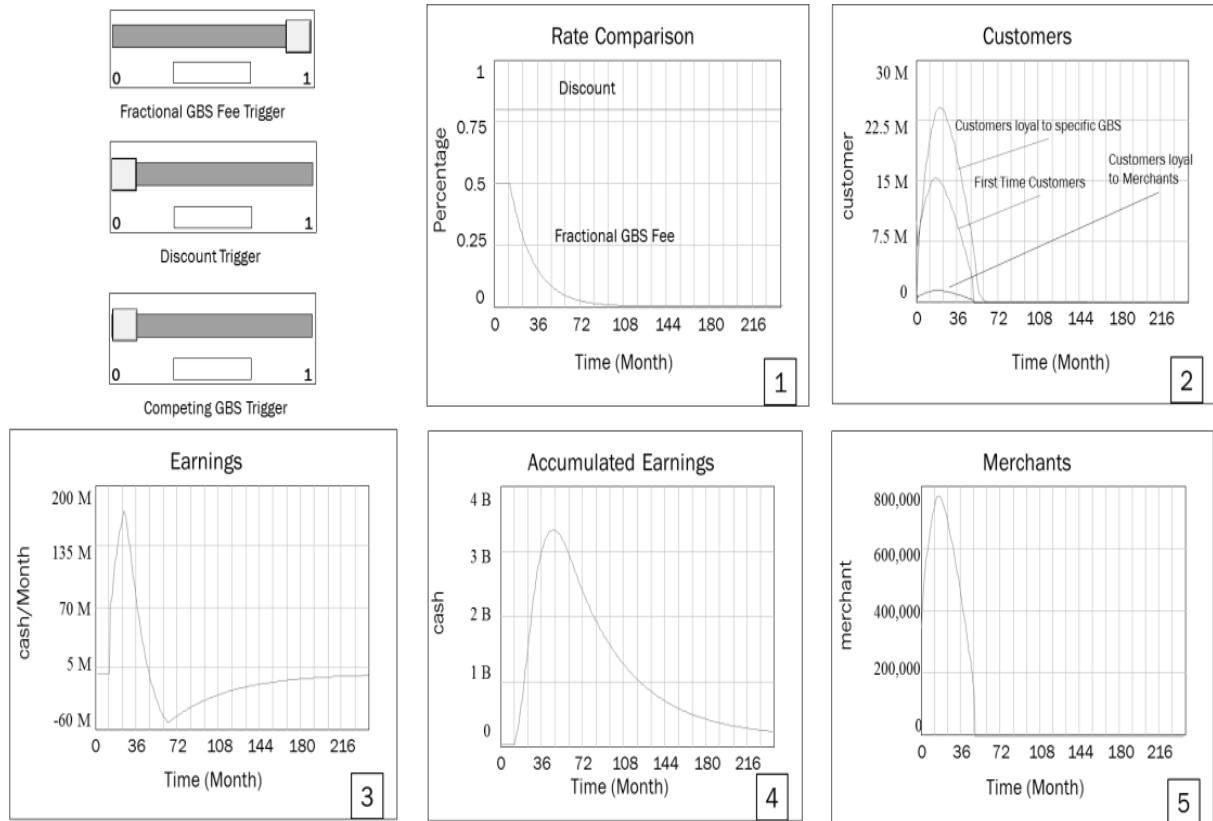


Fig. 6: Full VENSIM Model (continued)

Appendix B

Endogenizing GROUPON's Fee only



Endogenizing GROUPON's Discount only



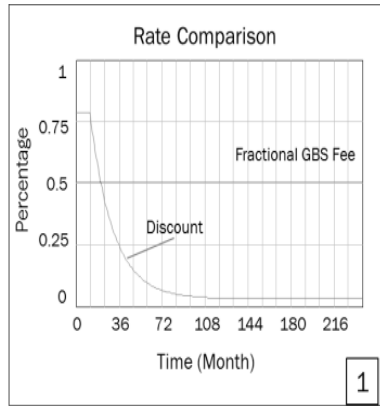
Fractional GBS Fee Trigger



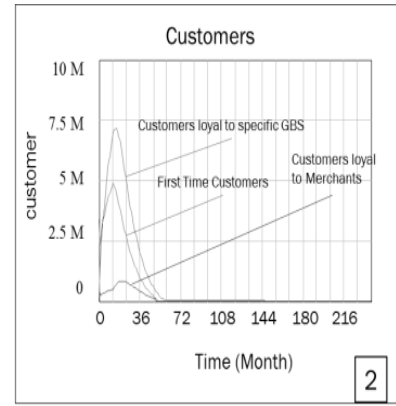
Discount Trigger



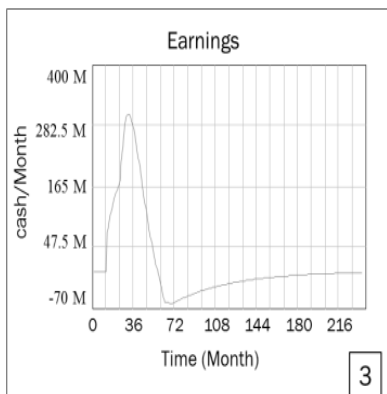
Competing GBS Trigger



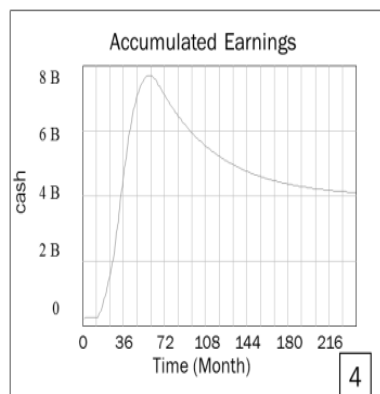
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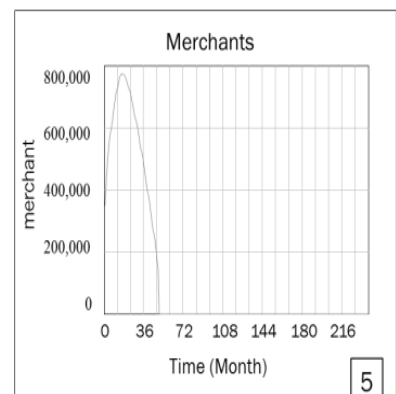
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Appendix C

Comparison of the Initial Values of selected Stocks between GROUPON and DEINDEAL

Variable	GROUPON	DEINDEAL	Explanation
Acquired Merchants per Employee per Month	16	12	GROUPON's employees are more productive in acquiring merchants, since GROUPON is not focusing on keeping their merchants, but on acquiring them. Therefore the Merchants' Dropout Rate is 20% in GROUPON's case and only 10% in DEINDEAL's case. Additionally GROUPON profits from a first mover advantage being among the first companies to have come up with this fixed-offer group buying scheme business model.
Average Coupon Value	100	100	DEINDEAL and GROUPON are selling congruent services and therefore use equivalent numbers for their average coupon values.
Average Salary	3500	10000	Including exchange rate, price level, tax/subsidies differences for startups and differences in social cost of labor; a big difference in labor cost, as for example between Switzerland and USA, is assumed.
Desired ROI	0	-0.4	GROUPON is promising merchants more than DEINDEAL. GROUPON claims a coupon promotion to be an efficient way to promote one's business and such a promotion should pay back. DEINDEAL is much more conservative in its communication with the merchant, lowering expectations right away, by telling him that he must expect such a promotion to entail certain costs.
Discount *	80%	60%	Since GROUPON is more aggressive their discount level starts at a higher value.
Employees *	10000	120	GROUPON is much bigger than DEINDEAL, DEINDEAL is a copycat of GROUPON.
First Time Customers *	10000000	50000	Size is reflected in first time customer stocks.
Fractional GBS Fee *	50%	50%	Relatively both GBS charge an equal rate, but in absolute terms GROUPON is cheaper from the point of view of a merchant since the remainder of 80% is 20% and half of 20% is only 10% while DEINDEAL is charging 20% of the original price (100%-60%*0.5).
Merchants *	350000	5000	According to the First Time Customers the number of merchants is similarly different.
Merchants' Dropout Rate	20%	10%	DEINDEAL is more focused on building a long-term relationship with the merchant and trying to sell his service, than GROUPON, where sales not merchants are "everything".
Monthly Return per Customer loyal to Merchant	100%	100%	This means that every customer loyal to the merchant is willing to pay the full price of the service in a resale situation without coupon.

* = Initial Value of the Stock

Appendix D

Comparison of Five Scenarios showing the correlations between results for GROUPON and DeinDeal

Scenarios	1	2	3	4	5		
Variables	Base Case	END=FGBSF	END=DIS	Policy Applied	PA & CGBS	μ	GM
ACCUMULATED_EARNINGS	0,961	0,992	0,811	0,960	0,967	0,938	0,936
COUPONS_OFFERED_BY_GBS	0,953	0,952	0,953	0,943	0,913	0,943	0,943
CUSTOMERS_LOYAL_TO_MERCH	0,943	0,942	0,979	0,912	0,952	0,946	0,945
CUSTOMERS_LOYAL_TO_SPECI	0,947	0,946	0,980	0,422	0,963	0,851	0,814
EARNINGS	0,937	0,986	0,973	0,785	0,891	0,914	0,911
TURNOVER	0,990	1,000	0,998	0,572	0,994	0,911	0,891
EMPLOYEES	0,953	0,942	0,974	0,446	0,916	0,846	0,814
FIRST_TIME_CUSTOMERS	0,989	1,000	0,998	0,816	0,994	0,959	0,957
GBS__VARIABLE_COSTS	1,000	0,995	1,000	0,937	0,968	0,980	0,980
INCREASE_IN_MERCHANTS	0,953	0,952	0,988	0,473	0,986	0,870	0,840
INCREASE_IN_NEW_CUSTOMER	0,953	0,952	0,953	0,943	0,913	0,943	0,943
MERCHANTS	1,000	0,381	1,000	0,916	0,951	0,850	0,802
ROI_EXPECTED_BY_MERCHANT	0,667	0,028	0,734	0,968	0,978	0,675	0,420
SURPLUS_INCOME_GENERATED	0,952	0,986	0,982	0,599	0,978	0,899	0,884
Arithmetic Mean (μ)	0,943	0,861	0,952	0,764	0,955	0,895	
Geometric Mean (GM)	0,939	0,705	0,948	0,732	0,954	0,848	

Scenarios:

1. Base Case (Overshoot-and-Collapse pattern)
2. GBS fee endogenized, and therewith flexible
3. GBS discount endogenized
4. Optimization of accumulated earnings with flexible discount and fee
5. Discount and fee flexible plus growth in number of competitors

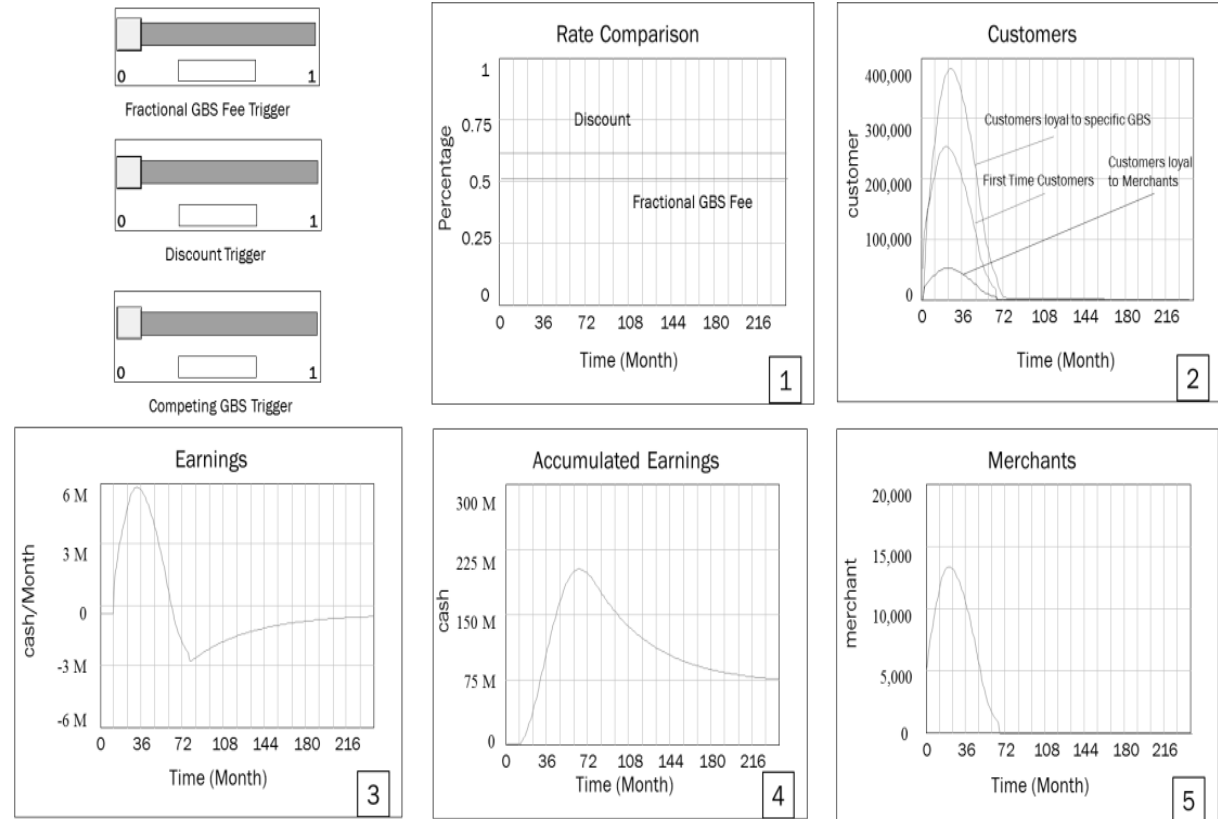
Code:

μ	Arithmetic mean of all scenarios
GM	Geometric mean of all scenarios
END	Endogenized
FGBSF	Flexible Group Buying Scheme Fee
DIS	Discount
PA	Policy Applied
CGBS	Competition among Group Buying Schemes

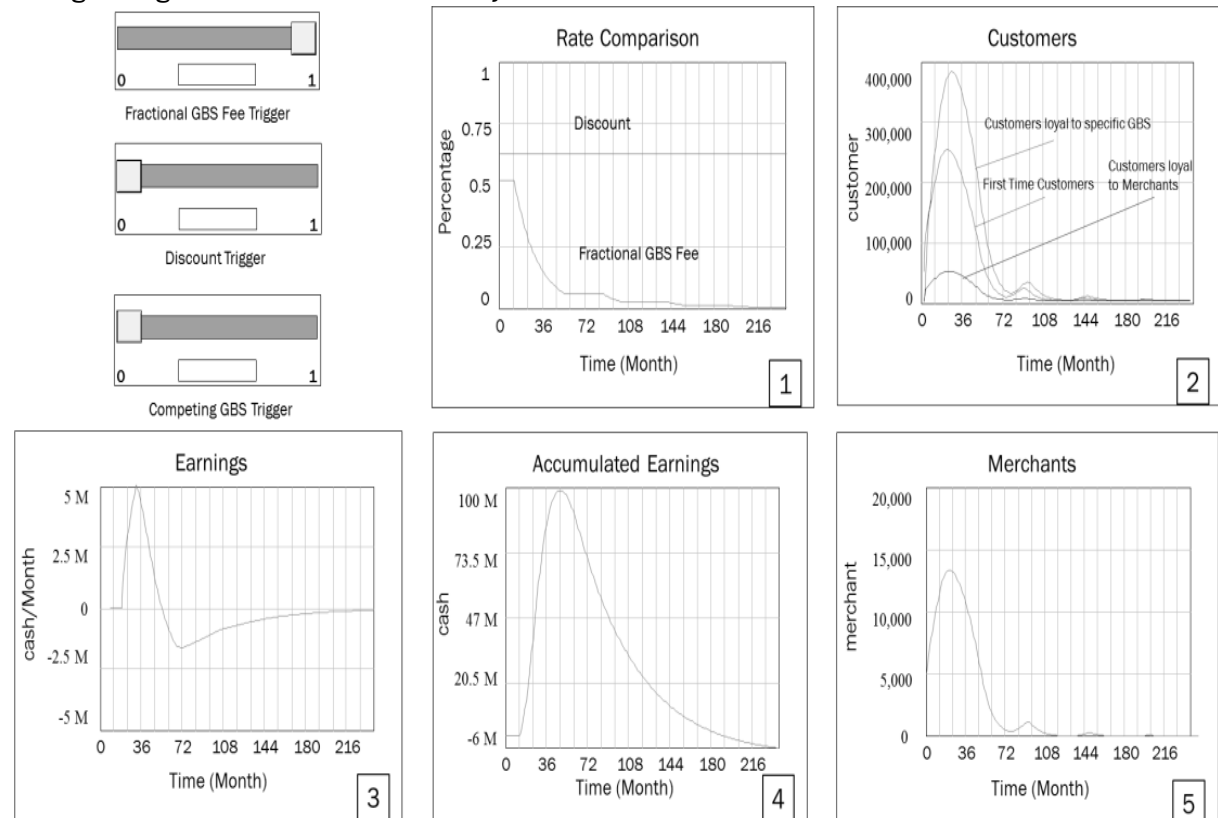
Appendix E

All five Scenarios for the data from DEINDEAL

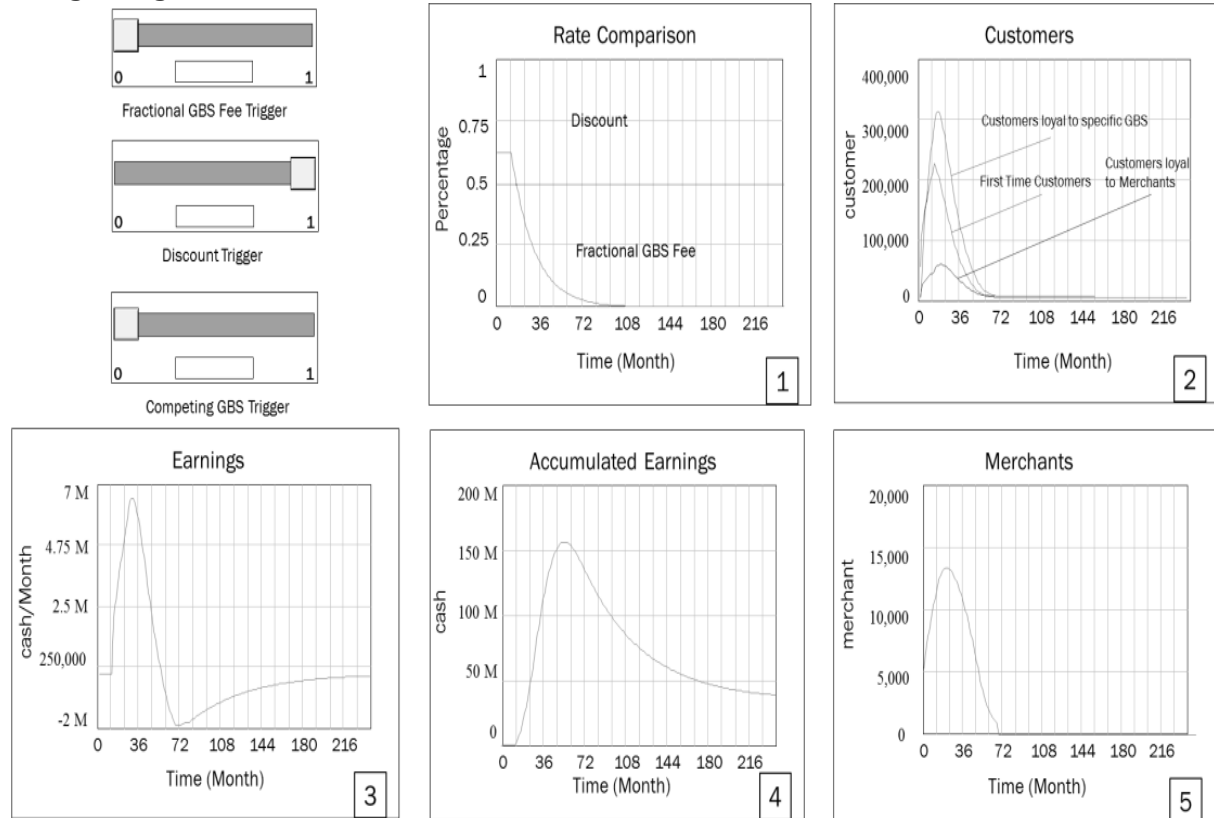
Base Case



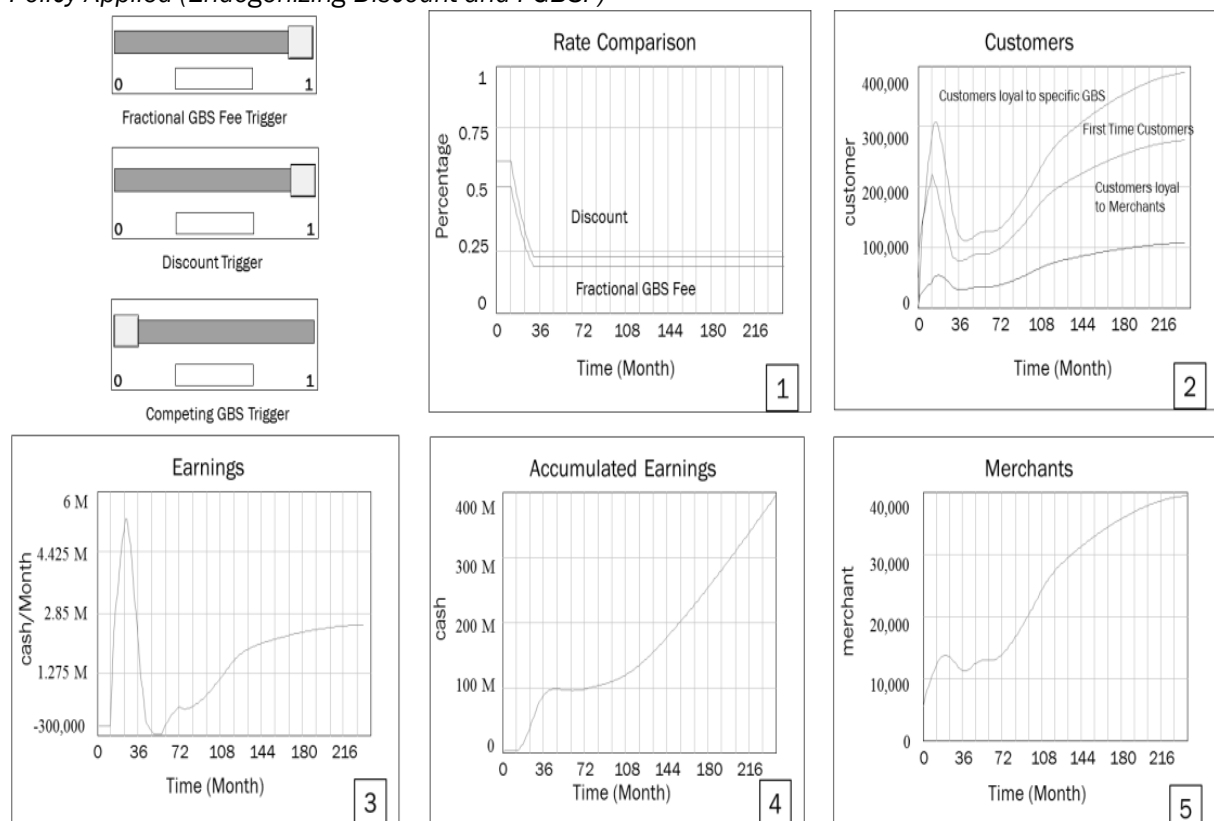
Endogenizing the Fractional GBS Fee only



Endogenizing the Discount only



Policy Applied (Endogenizing Discount and FGBSF)



Policy Applied & Competing GBS



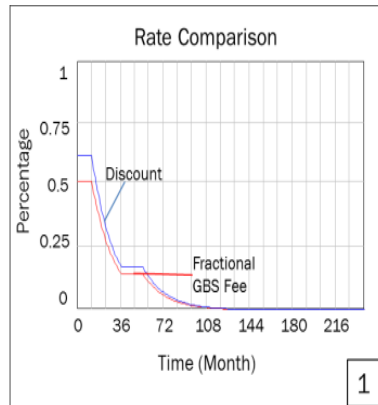
Fractional GBS Fee Trigger



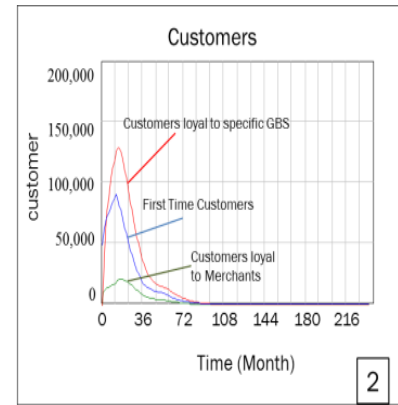
Discount Trigger



Competing GBS Trigger



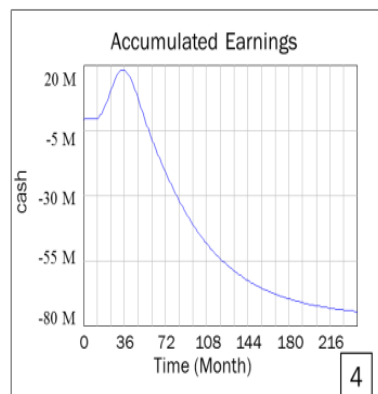
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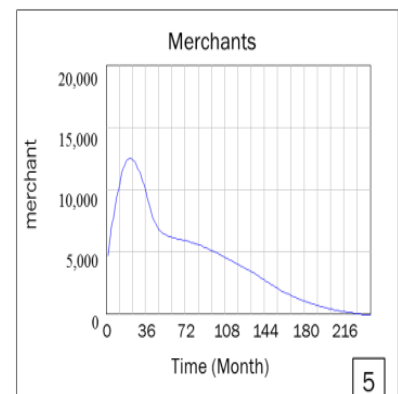
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Appendix F

Model Equations

Accumulated Earnings= INTEG (Earnings Retention,0)

Units: cash

The sum of the GBS' earnings over the whole period of 240 months.

Acquired Merchant per Employee per Month= 16

Units: merchant*merchant/employee/Month

This figures represents how many merchants are contracted by every employee each month.

Average Cost of Labor=Average Salary*(800+Time)/800

Units: cash/employee/Month

Average cost of a GBS employee, including the social costs, which are increasing over the period of 20 years by 30%, as a compensation for future inflation (Time=240 ==> 1040/800=1.3).

Average Coupon Value=100

Units: cash/customer

The original price of the service offered without discounts.

Average One Shot Loss Rate= 0.5

Units: 1/Month [-2,2]

Average rate of customers who only make one purchase from the GBS not become loyal to a merchant.

Average Salary= 3500

Units: cash/employee/Month/Month

The average salary per employee the GBS is paying, including social costs.

Beginner Loss= First Time Customers*Average One Shot Loss Rate

Units: customer/Month

The number of people who will not purchase from a GBS anymore, nor become loyal to a merchant.

Change in Discount= IF THEN ELSE(Discount Trigger=1, IF THEN ELSE(Accumulated Earnings<0:OR:Surplus Income<Desired ROI, monthly adaption rate*Discount, 0), 0)

Units: dmnl/Month

The monthly change of the discount rate.

Change in GBS Fee= IF THEN ELSE(Fractional GBS Fee Trigger=1, IF THEN ELSE(Accumulated Earnings<0:OR:Surplus Income<Desired ROI,monthly adaption rate*Fractional GBS Fee, 0), 0)

Units: dmnl/Month

*The change in the amount of money the GBS charges for every sold coupon. The fee is a fraction of the price which GBS customers have to pay. This means: (original sales price - discount)*relative GBS fee = absolute fee paid.*

Change in ROI= IF THEN ELSE(Surplus Income<Desired ROI,Downwards Adaption Rate,Upwards Adaption Rate)

Units: dmnl/merchant/Month

The expected ROI is not fixed over time. It can be changed as the expected ROI is positively/negatively affected by the real income generated by merchants through the sale of coupons. Whereas the expectation adaption is faster downwards (-2.5%) and slower upwards (1%).

Competing GBS ((0,0)-(245,200)), (0.733945,4.29825), (7.70642,7.36842),
(18.7156,10.4386), (40.4587,17.5439), (59.9388,29.8246),
(74.8624,47.2807), (84.4037,74.2982), (93.945,101.93),
(103.486,116.053), (113.761,122.193), (118.899,125.877),
(143.853,136.842), (172.324,140), (204.771,140), (227.523,140),
(235.596,140), (244.404,140))

Units: dmnl

Raising number of competing group buying schemes (GBS) entering the worldwide market, different from our specific GBS under study.

Competing GBS Trigger= 0

Units: dmnl [0,1,1]

This trigger is used to turn on/off the competition effect of the model.

Coupons offered by GBS= Coupons offered per Merchant per Month*Merchants

Units: customer/Month

The number of coupons offered by the GBS to the customers. It is simply the number of merchants multiplied by the number of coupons the merchants are offering per month.

Coupons offered per Merchant per Month=20

Units: customer/merchant/Month

Average number of Coupons offered per Merchant per month.

Customer= 1

Units: customer

Unit check variable since the cost per customer are calculated only from percentages (dmnl) - discount and fee - therefore to include the costs per customer which is the same as per coupon we need to introduce a variable customer to divide by.

Customer Loss Rate=0.2

Units: dmnl/Month

The fractional rate at which customers to merchants decide both to leave their merchant and look for another one on the specific GBS or look for on another GBS different from the one under study.

Customers loyal to Merchants

= INTEG (Increase in Customers loyal to Merchants-Loyal Clientele Erosion-Loyal Merchant Customers' Erosion,0)

Units: customer

Group of customers who are satisfied with a specific service provided by a specific merchant.

Customers loyal to specific GBS

= INTEG (Increase in Customers loyal to GBS+Loyal Clientele Erosion-Loss of Freeriders,0)

Units: customer

The stock of regular GBS customers buying coupons regularly.

Desired ROI=0

Units: dmnl/merchant/Month

The return which the merchant expects out of the partnership / from a coupon promotion with the GBS. Therefore the variable is not only cash/month, but cash/month/merchant

Discount= INTEG (Change in Discount, Starting Discount Fraction)

Units: dmnl

The discount the customer gets. If a product usually costs 100\$, but through a GBS he can buy it for 45\$, the absolute discount rate is 55; consequently the discount fraction is 55%.

Discount Trigger=1

Units: dmnl [0,1,1]

Trigger: If turned off the discount stays constant at the initial level. If turned on the discount rate becomes part of the model and adapts accordingly (see change in discount).

Downwards Adaption Rate=-0.025

Units: dmnl/merchant/Month

Monthly rate at which the expected ROI adapts downwards.

Earnings= DELAY FIXED (Turnover-GBS' Variable Costs, 12, 1)

Units: cash/Month

GBS' earnings which are defined as turnover minus variable costs.

Earnings Retention=Earnings

Units: cash/Month

This represents the monthly GBS profit.

Employees= INTEG (Employees Hired-Employees Fired,10000)

Units: employee

Number of Employees working for the GBS. The biggest part of employees are working in the acquisition of new merchants.

Employees Fired=Employees*Firing Rate

Units: employee/Month

The number of employees who are leaving the GBS.

Employees Hired=IF THEN ELSE(Earnings<0, 0, Employees*Hiring Rate)

Units: employee/Month

The number of employees the GBS is hiring monthly. If the GBS is making losses no new employees are employed.

Extra Sales per New Customer=0.4

Units: dmnl/customer [-1,4,0.1]

This is the relative fraction of extra sales a merchant can generate when a customer is redeeming his coupon through selling him extra stuff (intra-temporal cross-subsidization).

Firing Rate=0.02

Units: 1/Month

Constant firing rate of employees per month (high fluctuation).

First Time Customers= INTEG (Increase in new Customers-Increase in Customers loyal to GBS-Increase in Customers loyal to Merchants- Beginner Loss,1e+007)

Units: customer

Group of customers which for the first time in their lives buy a coupon from a specific GBS.

Fractional GBS Fee= INTEG (Change in GBS Fee,Starting Fractional GBS Fee)

Units: dmnl

*The amount of money the GBS charges for every sold coupon. The fee is a fraction of the price which GBS customers have to pay. This means: (original sales price - discount)*fractional GBS fee = absolute fee paid.*

Fractional GBS Fee Trigger=1

Units: dmnl [0,1,1]

Trigger: If turned off the GBS fee stays constant. If turned on the GBS fee becomes part of the model and adapts accordingly (see change in fractional GBS fee).

"Free-rider Loss Rate"=0.3

Units: dmnl/Month

The standard proportion of freeriders, who stop acquiring coupons on the specific GBS online platform.

GBS' Variable Costs=Average Cost of Labor*Employees

Units: cash/Month

Simplified formula: Employees are the biggest cost fraction. So the GBS' variable costs can be roughly calculated by the number of employees and an average salary. These costs are expected to raise over the time period of 20 years by 30%.

Hiring Rate=(720-Time)/24000/Month/Month

Units: 1/Month

The constant monthly fractional hiring rate which the GBS is pushing for its expansion. This rate is decreasing with advances in the GBS' expansion and approaching the same value as the firing rate over 20 years (=stable number of employees).

Hit and Run Rate=1

Units: dmnl/Month

This constant rate equals a merchants' dropout rate of 100%, which is applied when the ROI gets smaller than the desired ROI.

Increase in Customers loyal to GBS $= (1 - \text{Average One Shot Loss Rate}) * \text{First Time Customers} * \text{Discount}$

Units: customer/Month

The rate of increase in customers buying regularly coupons from a specific GBS.

Increase in Customers loyal to Merchants $= (1 - \text{Average One Shot Loss Rate}) * \text{First Time Customers} * (1 - \text{Discount})$

Units: customer/Month

This is the number of first time customers who decide not to go for another GBS promotion at all, but to become loyal to a specific merchant.

Increase in Merchants $= \text{IF THEN ELSE}(\text{Competing GBS Trigger}=1, \text{MAX}(\text{ZIDZ}(\text{Acquired Merchant per Employee per Month} * \text{Employees} * \text{ROI expected by Merchants, Competing GBS}(\text{Time})^{\text{Propensity towards Cannibalizing GBS' Merchants}}, 0), \text{MAX}(\text{Acquired Merchant per Employee per Month} * \text{Employees} * \text{ROI expected by Merchants}, 0))$

Units: merchant/Month

Increase in merchants is the inflow into the stock Merchants. It is defined as the monthly number of merchants who are becoming new partners of a specific GBS. It is depending on two different factors: Firstly the attractiveness of the GBS, which is defined by the ROI of a coupon promotion and secondly by the capacity of the GBS to acquire new merchants, depending on the number of employees and the respective acquisition rate per employee.

Increase in new Customers $= \text{IF THEN ELSE}(\text{Competing GBS Trigger}=1, \text{ZIDZ}(\text{Coupons offered by GBS} * \text{Discount, Starting Discount Fraction} * \text{Competing GBS}(\text{Time})^{0.4}), \text{ZIDZ}(\text{Coupons offered by GBS} * \text{Discount, Starting Discount Fraction}))$

Units: customer/Month

This is the number of new customers generated through the sales of coupons.

Loss of Freeriders $= \text{"Free-rider Loss Rate"} * \text{Customers loyal to specific GBS}$

Units: customer/Month

Dropout rate of customers which either decide to buy coupons from a different provider (e.g. Citydeal, DeinDeal, LivingSocial) or who were disappointed by the service, which made them decide not to buy any further coupon from the GBS in the future.

Loyal Clientele Erosion $= (1 - \text{Customer Loss Rate}) * \text{Customers loyal to Merchants}$

Units: customer/Month

The rate of customers switching from their preferred merchant back to the GBS.

Loyal Merchant Customers' Erosion $= \text{Customers loyal to Merchants} * \text{Customer Loss Rate}$

Units: customer/Month

The number of customers who are not satisfied either with the GBS or with the merchant anymore. This outflow represents an additional loss in potential customers for the specific GBS. At the same time a certain percentage of such customers might become loyal to another GBS in the market.

Maximum ROI $= 1.2$

Units: dmnl/merchant

The rational maximum value which merchants can expect as a ROI on a coupon investment.

Merchant Loss $= \text{IF THEN ELSE}(\text{ROI expected by Merchants}/\text{Month} < \text{Desired ROI, Merchants} * \text{Hit and Run Rate, Merchants} * \text{Merchants' Dropout Rate})$

Units: merchant/Month

Merchant loss is the outflow of the stock Merchants. It is defined as the number of merchants who stop their partnership with a specific GBS. The outflow is defined in terms of merchants per month. It is depending on two different factors: Firstly the attractiveness of the GBS towards the merchant is defined by the ROI on a coupon promotion, secondly by genuine dropout rate. The "if-then-else" function deals with the fact, that if the expected ROI is smaller than the desired ROI, merchants drop-out at the hit and run rate (at the maximum all merchants leave the GBS partnership the same month). If the ROI is bigger than the desired ROI, only a genuine fraction represented in a merchants' dropout rate stop their cooperation with the GBS.

Merchants= INTEG (Increase in Merchants-Merchant Loss,350000)

Units: merchant

Merchants are companies who sell their offers with coupons via a specific GBS. The GBS is consequently only the mediator between the merchant and the actual coupon customer. Merchants is a stock and can decrease or increase depending on the attractiveness and sustainability of the GBS' offers and fees.

Merchants' Dropout Rate= 0.2

Units: dmnl/Month

The relative amount of merchants that decide not to post any more GBS promotions with this specific GBS based on their bad experience.

Merchants' Offer Costs per Customer

$$=((1-\text{Discount}) * \text{Fractional GBS Fee} + \text{Discount}) / \text{customer}$$

Units: dmnl/customer

This represents the costs which are incurring to the merchant depending on the discount, the fractional GBS fee, extra sales a merchant is making when a customer is redeeming his coupon and the average value of a coupon.

Month=1

Units: Month

Month is an auxiliary constant variable at the value 1 used for equalizing the units.

Monthly Adaption Rate=-0.034

Units: dmnl/Month [-1,1]

The monthly downwards adaption rate applying equally to the discount and the fractional GBS fee.

Monthly Return per Customer loyal to Merchant=1

Units: dmnl/Month/customer [0,10,0.1]

Merchant's return generated from loyal customers.

Propensity towards Cannibalizing GBS' Merchants=0.01

Units: dmnl

This is the propensity to cannibalize coupon merchants (& customers indirectly). The logic is that every new GBS also gains new customers and new merchants, but wins some of them from other GBS. With an increasing number of GBS the pool of potential merchants and customers is reduced.

Return Delay=12

Units: Month [0,60,1]

The time which passes until the merchant realizes his effective surplus income throughout one coupon offering with the GBS.

ROI expected by Merchants

$$= \text{INTEG} (\text{IF THEN ELSE}(\text{ROI expected by Merchants} > \text{Maximum ROI}, 0, \text{Change in ROI}), 0.8)$$

Units: dmnl/merchant

The long-term expected return on investment by the merchant from a coupon promotion with the specific GBS.

Starting Discount Fraction=0.8

Units: dmnl

This is the initial discount fraction.

Starting Fractional GBS Fee= 0.5

Units: dmnl

This variable represents the initial fractional GBS fee which merchants have to pay per coupon sold.

Surplus Income = $\text{DELAY FIXED (ZIDZ(Monthly Return per Customer loyal to Merchant} \times \text{Customers loyal to Merchants, Merchants)-Merchants' Offer Costs per Customer} \times \text{Coupons offered per Merchant per Month} + \text{Extra Sales per New Customer} \times \text{Coupons offered per Merchant per Month, Return Delay, 1})$

Units: dmnl/merchant/Month

The surplus income generated by merchants through sale of coupons and either extra-sales (intra-temporal cross-subsidization) or recurring sales through customers becoming loyal (inter-temporal cross-subsidization). This must be calculated per merchant and take into consideration how much money a recurring customer (customer loyal to the merchant) is spending when coming back (return per customer loyal to merchant), since for the high discount he was given, his reservation price might lay below a level below 100% of the original price.

Turnover = $\text{Average Coupon Value} \times (\text{Increase in new Customers} + \text{Increase in Customers loyal to GBS} + \text{Loyal Clientele Erosion}) \times (1 - \text{Discount}) \times \text{Fractional GBS Fee}$

Units: cash/Month

GBS' turnover (not revenue, nor profit): turnover - variable costs = earnings.

Upwards Adaption Rate=0.01

Units: dmnl/merchant/Month

Monthly rate at which the expected ROI adapts upwards.

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