The establishment of container-deposit on single-use beverage packaging in Germany

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Abstract

In 2003, the German government introduced a deposit on disposable single-use beverage containers in addition to the already existing deposit on reusable beverage containers. Politicians meant to enhance and stabilize the use of reusable beverage containers by lowering the attractiveness of beverages in single-use containers through a high deposit. After the new law was introduced, the usage of reusable beverage containers increased, but after a while it started to decrease again. The aim of this paper is to analyze the assumed feedback mechanisms behind this unexpected behavior. Our analysis shows, that the establishment of the container deposit in Germany is a prime example of policy resistance, which is a common problem in policy making. We argue that the unexpected behavior can be explained by the fact that unclaimed deposit counts as profit for retail and production companies. In that way, the container deposit made beverages in single-use containers less attractive for the consumers but, in turn, increased the profit per unit for the retailers. That led to a higher supply of beverages in single-use containers and a massive shortfall of beverages in reusable containers. Consumers substituted their demand by available beverages in single-use containers and that results in higher sales for the retailers. The sales, in turn, are an incentive to provide an even higher supply of beverages in single-use containers as it otherwise would have been.

Keywords: policy resistance, policy analysis, system dynamics

Introduction

In 1991, the first regulation on the prevention and recycling of packaging waste, called "Verpackungsverordnung" (packaging ordinance) was approved by the German parliament. The bill stated that the reusable container quota for beverage packaging – the percentage of beverages sold in reusable containers compared to the total amount of beverages sold – should be at least at a level of 72% (Deutscher Bundestag 1991). However, due to the continual failure to reach this percentage, a container deposit on single-use beverage containers was to be introduced according to the packaging ordinance.

On 01.01.2003, the container deposit of 25 Euro cents on single-use beverage containers was established (Hartlep and Souren 2011). Advocates of the deposit assumed it would increase the reusable container quota. In 2003, in the year of the establishment of the deposit, Jürgen Trittin, who was the German minister for the environment stated: “The expansion of the container deposit to include cans [and other single-use packaging] marks a turn in the beverage market. It will stabilize the use of reusable containers and lessens that of single-use packaging” (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 2003). This statement represents the expectations and confidence in the effect of the deposit. Contrary to the belief of the advocates, the reusable container quota continued to decline after a short raise in the years following the establishment.

The determination, establishment and evaluation of the container deposit spanned over 15 years. In this time, several contradictory political and scientific opinions in regard to the effect of the container deposit had been vocalized. With respect to this discussion and the continuously declining reusable container quota, it becomes apparent that the debate about the reason of the decrease of the quota and the effect of the container deposit is still current.

The aim of this paper is to, firstly, present the opposing arguments and, secondly, to analyze the assumed feedback mechanisms behind this unexpected behavior of the reusable container quota. It will further be shown that the establishment of the container deposit in Germany is a prime example of policy resistance, which is a common problem in policy making (Ghaffarzadegan, Lyneis and Richardson 2011).

The paper is structured as follows. In the first part, the different arguments about the container deposit are presented. Then, in the second part, the different container deposit systems in Germany are explained and presented in a stock and flow structure. In the third part, the simulation model is presented, including the reference mode and the decision rules. In the last part, it will be shown that the model adequately simulates the reference mode. The weaknesses of the model will be discussed and concluded that the policy itself created the unfavorable behavior of the reusable container quota.

The debate surrounding single use container deposits

Over the years there have been varying political, economic, and scientific arguments for and against the mandatory container deposit. In the field of political arguments, for instance, the Free State of Bavaria's official political stance is in favor of the already existent reusable container deposit of 8 to 15 Euro cents. Within the process of the elaboration of the packaging ordinance and its legal determination of the container deposit Deutscher Bundestag (1991), the Free State of Bavaria was requesting a ban of cans (Bundesrat 1991). This ban is to be seen as a support for regional breweries, which profit from the returnable system (Hoffmann 2011). This was clearly revealed as the motivation for the ban by the national association of private beer brewers, which stated that a single-use container deposit helped address the competitive disadvantages of smaller and medium sized breweries (Hoffmann 2011).

At German federal level, the oppositional factions of the social-democratic and Green party sought to strengthen the existing returnable system by instating an immediate mandatory container deposit (Deutscher Bundestag 1995). The then-government turned down this proposition (Hoffmann 2011) and, later on, criticized the container deposit on throw away beverage packaging because of resulting investment cost for vendors and retailers (Deutscher Bundestag 2000). This argument is still made by critics of the single use container deposit today. Opponents argue that the threat of a possible mandatory deposit serves as a incentive for the industry to strive and meet the reusable container quota (Wacker-Theodorakopoulos 2000). The establishment of the single use container deposit would in turn suppress this incentive and therefore increase the use of reusable containers.

In addition, critics question repeatedly the defined dominance of reuse in comparison to recycling, reutilization and disposal (European Union 2008). In 1994, for instance, the German government ordered a study on the environmental impact of single use packaging (Bundesrat 1994). The results of this and other more recent studies (Prognos and IFEU 1999) are found in the amendments of the packaging ordinance, where certain single use beverage packaging like beverage carton and polyethylene tubular bags are defined as "ecologically advantageous" (Deutscher Bundestag 1998). This commendation means consequently a relief of mandatory container deposit for such packaging. However, these environmental performance evaluation studies have sparked major discussion. Environmental activists claimed that the results were

based on false assumptions (Bund für Umwelt und Naturschutz Deutschland 2000). Experts stated that the studies included only very simplistic models of the complex multi-cycle container deposit system. And these simplistic representations were used as comparison reference for the environmental performance evaluation studies and its environmental solutions (Groth 2005). Nevertheless, the number of supporters of the container deposit rose as associations were in favor of the decision to grant the commendation "ecological advantageous" to some packaging (Fachverband Kartonverpackungen für flüssige Nahrungsmittel 2000).

In the years following the establishment of the container deposit and its official evaluation (Cantner et al. 2010), the reuse container deposit and additional possible steps to increase the reusable container quota were subject of further discussion. The argument was made that an official commitment of the industry to strengthen the reusable container quota may have been more effective (Cansier 2001). Further, it was argued that the container deposit falsely suggests that the use of throw away containers with deposit is ecologically friendly since customers return the containers to the retailers (Wacker-Theodorakopoulos 2008). In addition, it was claimed that, in order to enhance the reusable container quota, a campaign to clarify the difference between throw away and reusable containers was needed (Cantner et al. 2010; Fischer 2012). Moreover, scientists reasoned that the mandatory container deposit lead to "ugly" and opportunistic behavior since it creates the incentive to mislabel containers in order to gain a profit from the deposit difference (Thießen 2011). Another demand in an attempt to raise the reusable container quota was the introduction of a garbage tax on throw away beverage packaging. In such a way, the price of beverages in single use containers would increase and the money flew from the consumer to the state. It therefore creates a change in buying behavior and not only the incentive to return empty containers (Fischer 2012). Additionally, the role of the supermarkets and retailers were criticized. It was stated that one of the main reasons the reusable container quota even sunk after the instatement of the container deposit was due to the fact that the retailers offer more single use containers than reusable ones (Cantner et al. 2010; Fischer 2012).

The Container Deposit System

I. The Reusable Container Deposit System

The reuse of drink containers began in the 18th century. Its motivation was to minimize the amount of packaging the drink supplier had to produce (Deutsche Umwelthilfe 2008).

Accordingly the container deposit serves as an incentive to return the bottles. This deposit is paid on all levels of the supply chain.

The basic function of the returnable deposit system is described in several publications with only slight variations (Albrecht et al. 2011; Hartlep and Souren 2011; Arbeitskreis Mehrweg 2010). In the following, a simplified model, depicted in figure 1, is described. The respective variable names are given in the brackets.

The empty bottles are cleaned and filled by the producer ("*Cleaning and Filling MC*") and sold to the retailer ("*Buying Beverages MC*"). The abbreviation "MC" stands for multi-cycle. The retailer pays the deposit to the producer ("*Deposit prepayment MC*"). The consumer then buys the beverage ("*Selling MC*") and pays the deposit to the retailer ("*Paying deposit MC*"). After having consumed the beverages ("*Consuming beverages MC*"), the customer returns the empty container to a retailer (""*Return bottles MC*") and receives the deposit back ("*Regain deposit MC*"). The retailer then transports the empty containers to producer ("*Retransport bottles MC*") which, in turn, pays the deposit back ("*Deposit repayment MC*"). Therefrom, the flow of money is always connected to the transfer of containers, which is shown in the co-flow structure in figure 1. The circle closes when the containers are cleaned and refilled by the producer. As mentioned above, this is a simplified model of the reusable container deposit system. It was assumed that the producer is able to clean and fill the containers. In some cases these activities could be carried out by separate companies. Further, the wholesaler is omitted. Nevertheless, the most important steps within the reusable container deposit system are explained.

Additionally it is important to mention that a fraction of bottles is not returned by the consumer ("*Wasting MC*"). This is often due to loss of the functionality of the container (Hartlep and Souren 2011). Furthermore the bottles are worn down ("*Scrapping MC*"), after approximately 40 cycles there is a reduction in their functionality and they are removed from circulation (Cantner et al. 2010). The losses are matched through the purchase of new reusable bottles ("*Buying new bottles MC*").

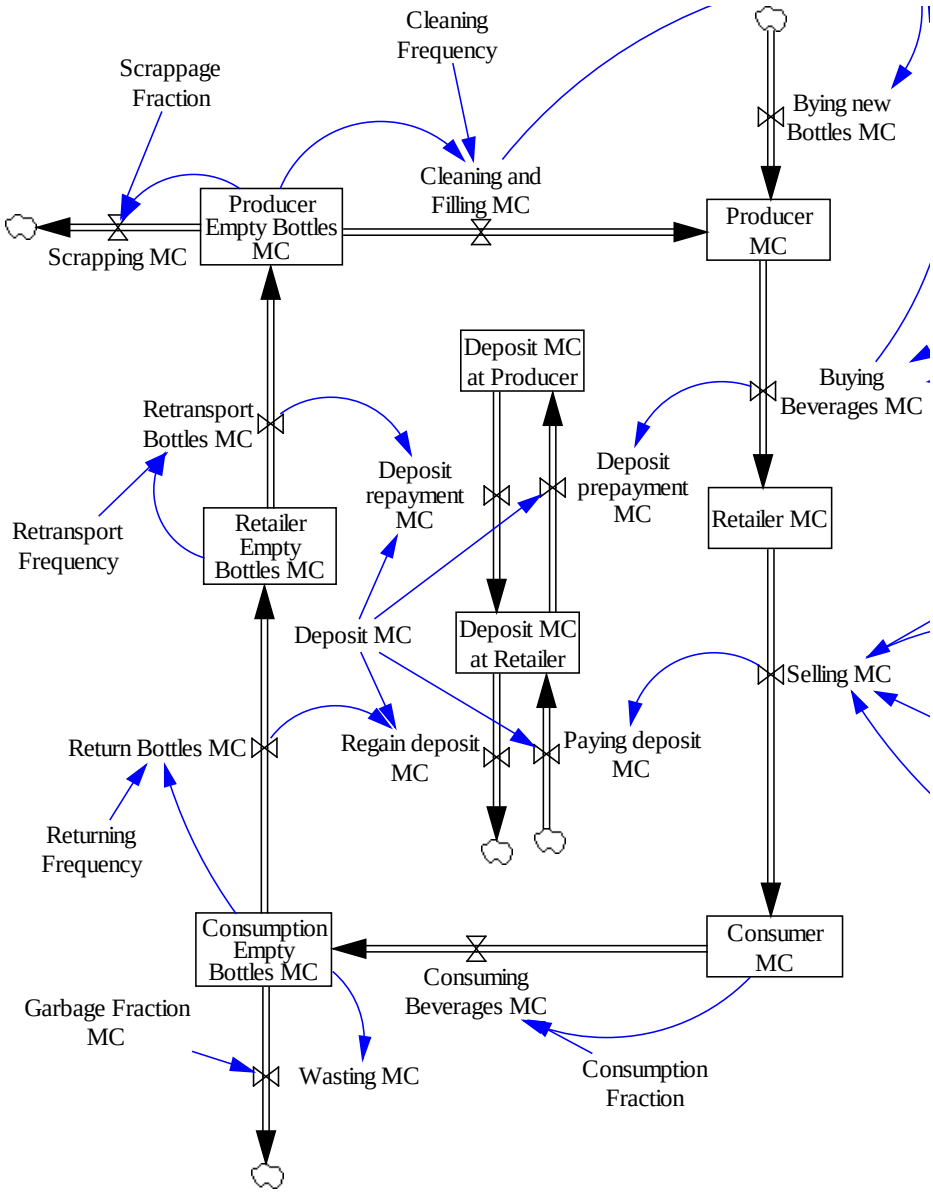

Figure 1. The Reusable Container Deposit System

The cost for the transport and the original purchase prices of the beverages and new empty bottles are not considered in the model. Figure 1 shows that only returned bottles are reimbursed. It further shows that in case of no reimbursement of the consumer due to "*wasting MC*", the unclaimed deposit is retained and counts as additional income (ten Hompel and Heidenblut 2011)[1]. In the reusable container deposit system, the producer profits from unclaimed deposits.

[1] In Germany, this income was a further subject to discussion and that important that a special term was created to refer to. The income from unclaimed deposit is called "Pfandschlupf"

II. Single Use Container Deposit System

In comparison to the reusable container deposit system, the idea of single use containers deposit system is relatively new. As described above, it was legally set in 1991 with the packaging ordinance, which calls for single use container deposit if the reusable falls under 72% (Deutscher Bundestag 1991). In 1997 this legally determined reusable container quota was not met and even continued to decrease in the subsequent years. Nonetheless it took until 2002 that the officially calculated reusable container quota was published, which was the requirement to eventually initiate the deposit on throw away containers in 2003 (Hartlep and Souren 2011).

Unlike in the reusable container deposit system, the returned single use containers are disposed in the single use container system. This leads consequently to structural differences between the two systems. Figure 2 shows the general structure of the functioning of the single use deposit system in a stock and flow diagram. In the following, the general dynamics based on several different sources (e.g. Brauindustrie 2006) are explained.

In the single use container deposit system, the producer fills the bottle ("*Production OW*") and then supplies it to the retailer ("*Buying Beverages OW*"). The abbreviation "OW" stands in this case for one-way. Similar to the reusable container deposit system, the transfer of beverage containers is connected to deposit payments. However, in the initial phase of the single use container deposit system the deposit payment was only made between the retailer and the consumer (Hoffmann 2011). Therefore, the deposit payment corresponding to the trade between producer and retailer ("*Deposit prepayment OW*") is given in a co-flow structure but is set to be zero with a switch variable ("*Switch 2*") until the period of its introduction in November 2003.

The structure between the retailer and the consumer is similar in both systems: The retailer receives deposit payments from the consumer ("*Paying deposit OW*") at the time of purchase ("*Selling OW*"). After the beverage has been consumed ("*Consuming beverages OW*") the consumer returns the empty container to the retailer ("*Return bottles OW*") and thereupon the deposit is returned ("*Regain deposit OW*"). The switch variable ("*Switch 1*") introduces the deposit in 2003. Here, it is important to note that until May 2006 the ''Island solution'' was allowed, which meant that single use containers had to be returned to the store where they were

purchased (Hoffmann 2011). This complicated the process of returning single use containers for the consumer increasing the amount of not returned containers ("*Wasting OW*").

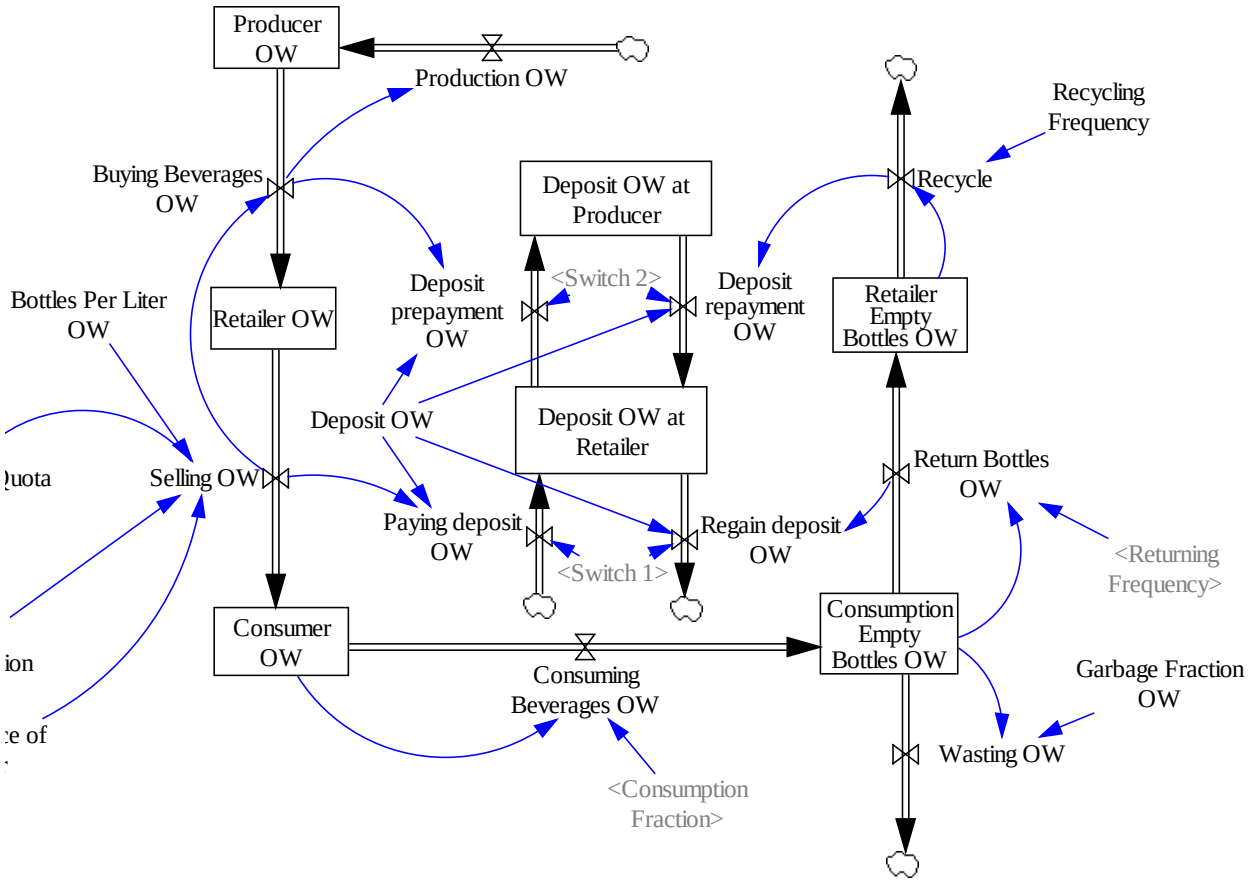

Figure 2. Single Use Container Deposit System

The biggest difference between the two systems lies in the return of the empty used single use bottles, i.e. the disposal. After the consumer has returned the used empty containers to the retailer, single use containers are then sold ("*Recycle*") to a buyback recycling center (Hartlep and Souren 2011). The containers are not returned to the producer. The return of the deposit by the producer to the retailer ("*Deposit repayment OW*") is only digital and not associated with an exchange of the product.

Model

I. Dynamic Problem

The subject of the analysis is the reusable container quota. An interesting fact of the reusable container quota is that it has never been defined by law (Groth 2005). However, the most

common definition is using the amount of beverages in reusable containers in comparison to the total amount of beverages consumed in liters (Heinisch 2009; Albrecht et al. 2011):

$$\frac{\textit{Beverages sold in reusable containers [in l]}}{\textit{Beverages sold in reusable and single-use containers [in l]}}$$

Figure 3 depicts the reusable container quota from 1991 to 2010. In the initial years the percentage was relatively stable at a level over 72%. In 1997, the quota dropped under the legally required level and continued to decrease. By 2002 it had sunk to 55%. In 2003, the year of the establishment of the deposit on throw away beverage packaging, the reusable container quota began to rise again reaching 63%, but immediately after that year the quota diminished again and by 2009 it had sunk to under 45%. The reusable container quota serves as reference mode of our analysis.

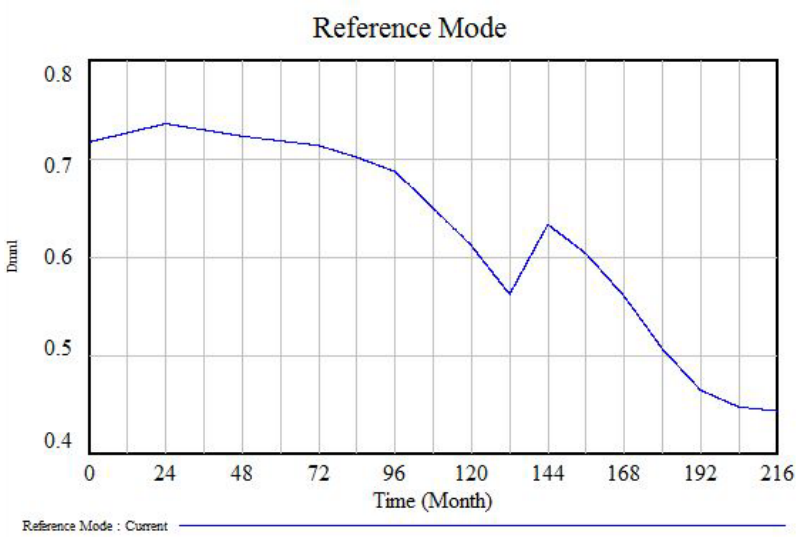

Figure 3. The reusable container quota of beverage packaging in the period of 1991-2009 (Source: Cantner, et al. (2010), Albrecht, et al. (2011) und Hartlep and Souren (2011))

This graph suggests that the policy of establishing a deposit on disposable beverage packaging failed at fulfilling the initial goal in increasing the reusable container quota. This unexpected development could be a sign of counteracting feedback mechanisms in the underlying system which create a policy resistance. Such kind of counterintuitive behavior is often found in association with the introduction of a law (Ghaffarzadegan, Lyneis, Richardson 2011).

II. Dynamic Model Hypothesis

This chapter looks at the previously described systems in figure 1 and 2. It adds the decision rules of the actors. Those decision rules will regulate the flows of the model and therefore influence the behavior of the stocks as well as the reusable container quota which is calculated by the number of liters of beverages sold in reusable containers divided by the total number of liters of beverages.

With regard to the decision rules, we differentiate between consumer behavior and retailer behavior. The behavior of the consumer is based on two decision facts, firstly the decision about of buying beverages in reusable containers (preference) and additionally the decision return of the empty container. The return of the empty container depends on the ease of the return and the amount of the deposit. A deposit of 25 cents for single use containers and 11.5 cents for reusable containers was assumed[2]. The retailer makes decisions associated with investments in the supply capacity of beverages, i.e. either in beverages in reusable or single-use containers. The model does not differentiate between the different actors of the supply chain. We simplified the model and assumed that wholesaler, retailer, producer and other actors can be summarized.

In the following, the assumed causalities and mechanisms are explained in more detail. Figure 4 summarizes them in a causal loop diagram on basis of single-use containers. The model differentiates between single-use and reusable containers. In both cases the structure is the same. Showing the whole causal structure would undoubtedly provide more information but lowers also the readability of the model. Therefore, we decided to argue on basis of single-use containers. Figure 4 focuses as well on the single-use segment. However, we want to remind the reader that the same mechanisms hold true for reusable containers. In the right box of figure 4, the assumed mechanisms before the introduction of the deposit are shown. The left hand side shows the structural addition due to the introduction of the deposit.

The retailer's decisions are represented in solid lines. As described above, the retailer decides about investments in supply capacity. In the case of excess demand, the retailer loses

[2] As mentioned earlier, the deposit on reusable beverage packaging varies according to the shape and use of the bottles. Some bottles entail 8 Euro cents and some 15 Euro cents. With regard to the model, it was assumed that the mean is an appropriate value to aggregate the difference.

potential sales, and therefore a pressure piles up in order to invest in new supply capacity. More supply capacity, in turn, decreases the excess demand to a lower level as it otherwise would have been. This negative mechanism is a balancing feedback loop. It can be found in the lower right part of figure 4 captured “Pressure to invest”. Further, the retailer invests in supply capacity because of profit. A higher supply capacity leads to higher sales, leads to higher profit. Profit, in turn, enables the retailer to invest in more supply capacity, which leads to a higher supply capacity as it otherwise would have been. This positive feedback is called “Capacity Expansion” loop in figure 4.

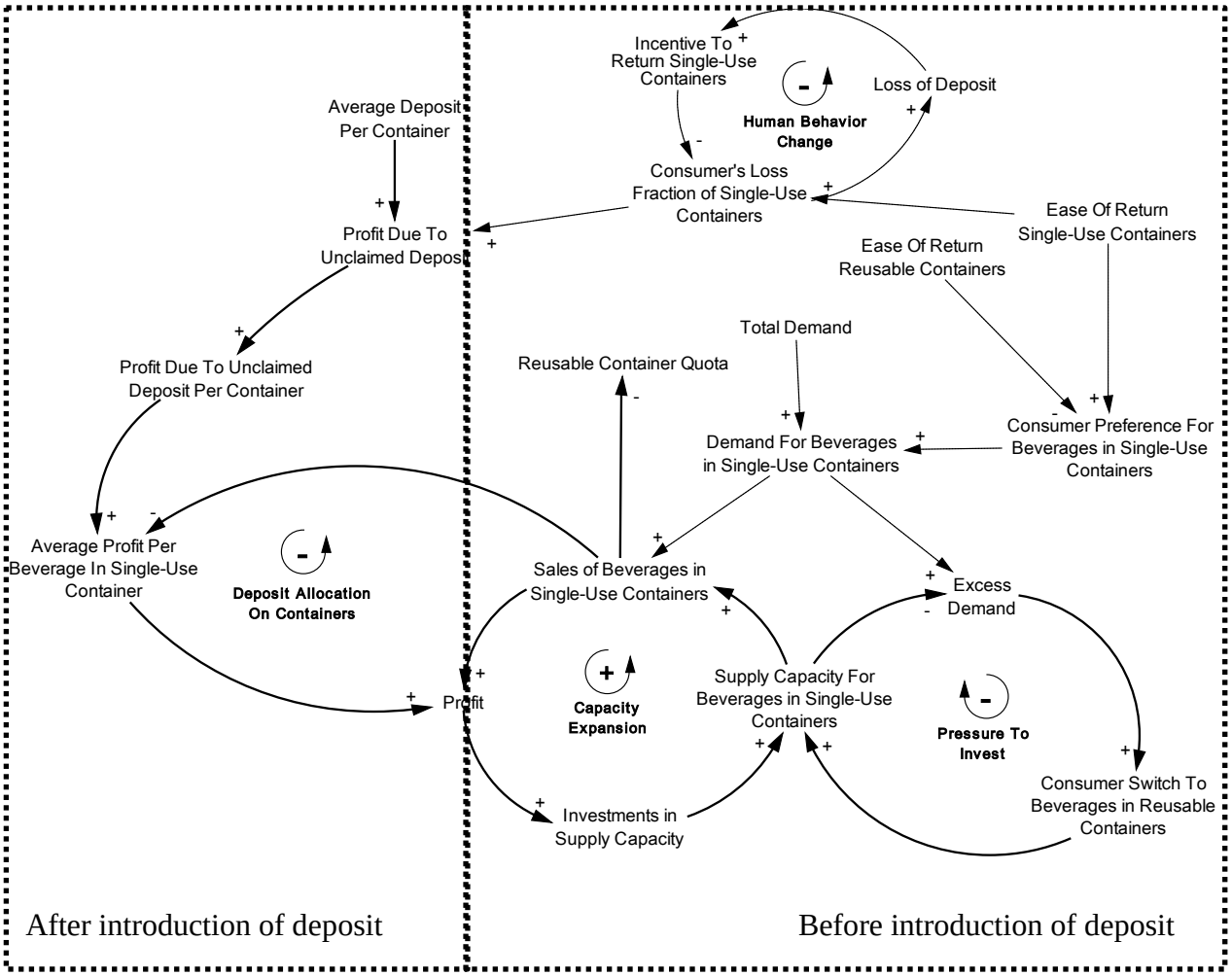

Figure 4. Causal loop diagram about the container deposit

The behavior of the consumer is represented by dashed lines. In the center of figure 4 is the constant “Total Demand”. The demand divides into demand for beverages in single-use containers and reusable containers. These subsets depend on the consumer preference for the

respective demand. Figure 4 shows only the "Consumer Preference For Beverages in Single-Use Containers". The preference, in turn, depends solely on the ease of the return of the given container. Before introduction of deposit on single-use containers, the ease was at 100%, since there was no effort to bring back the containers. The ease of return of reusable containers was, on contrary, was below 100% because there was the need to return them in order to claim the deposit back. Therefore, before introduction of the deposit on single-use containers, the consumer preference moved towards single-use packaging.

An important mechanism in the model is the "Human Behavior Change" loop. It is a balancing feedback and regulates the consumer's loss fraction of containers. The ease of return in both – reusable and single-use containers – segments leads to a loss fraction. However, when there is a deposit on containers, consumers have an incentive to return the containers. If not they lose the deposit they paid up front. This money loss is therefore an incentive to change their behavior and bring back the containers they paid deposit for. That lowers the loss fraction.

The introduction of the deposit on single-use beverage containers caused structural changes. Those changes can be seen in the left box of figure 4. The main changes due to the introduction are the preference change and the investment boom. The preference change can be explained solely with the existing structure (figure 4, right box). Due to an introduction of deposit on single-use containers, the ease of return for empty single-use containers decreased because people needed to return the bottles and, in addition, there were a lot of logistical issues related to the process of returning bottles[3]. That led to a drop in the preference by the consumers, which in turn led to a declining demand for beverages in single-use containers. This effect is a change in the preference and explains the sudden increase of the reusable container quota in 2003. However, there is a second effect, which we call the investment boom. Since unclaimed deposit can be declared as profit for the retailer, the introduction of the deposit created a causal link between the consumer's loss fraction and the retailer's profit. People change their behavior slowly and the high loss fraction in the single-use segment (the loss fraction was 100% since there was no need to return single-use containers) decreased bit by bit. That led to additional

[3] In the first months after the introduction, consumer had to return the single-use containers to the shop of purchase showing the receipt. Afterwards supermarket chain specific deposit systems were established. Only in 2006, a nationwide deposit system for single-use beverage containers was launched.

profit per bottle for the retailer, who could invest more money in the supply capacity of beverages in single-use containers.

This added structure is the reason why the reusable container quota decreased after the short increase in 2003. The reusable bottle quota stabilizes eventually because of the balancing feedback in the “Human Behavior Change” loop. The high amounts of lost money serves as an incentive to return all single-use containers. When the consumers return all single-use containers, there is virtually no unclaimed deposit, and therefore no additional profit for the retailer, which in turn means lower investments in the supply capacity.

Simulations result and discussion

The simulation results are shown in figure 5. As it can be seen, the model at hand is able to simulate the general pattern of the reusable container quota. Although based on several assumptions, the model depicts the general development of the short raise and decrease of the historic data shown in figure 3. This graph is included again in figure 5 (see the red line) to serve as reference mode to compare with the simulated data. The initial decrease of the reusable container quota is due to the preference of the consumer. Consumers ask for beverages in single-use containers because of its high ease of return. That demand leads to higher investments and eventually to a higher supply capacity, which explains the slow but fundamental decrease before the introduction of deposit on single-use containers. The model is then shocked by a step function. The ease of return in the single-use segment shrinks below the level of the reusable segment. The reusable container quota rises due to the changed preference. The ease of return leads to higher demand of beverages in reusable containers. However, the loss fraction of single-use containers is very high. That leads to high amounts of unclaimed deposit which is by definition profit for the retailers. Retailers have therefore the incentive to invest in more supply capacity of beverages in single-use containers. Consequently, there is a shortfall of beverages in reusable containers. Consumer switch to available beverages and the reusable container quota decreases tremendously. The described pattern matches approximately the historic data. The slight variations of the model to the actual data are discussed in the following paragraphs.

Firstly, the simulation reaches the temporary peak later and sinks faster, than the historical reference data. Furthermore, before the mandatory deposit is enacted, the reusable container

quota of the model is in equilibrium. This is not the case in the real historical example. The mandatory deposit was only instated because the reusable container quota continually fell under the desired value, 72%, and was not stable. This leads to the assumption that the reference example was additionally affected by another factor or relationship which was not regarded in the model. The stronger decline in the simulated slope than in the reference could possibly signalize that a factor is weighted too strongly in the model, or that a negative feedback loop was not considered.

The question also arises if the deposit really was a factor in the preference of the consumer. In the model it comes to an increase of the consumer's preference for reusable containers. Though, as can be seen by the simulation this plays an unclear role as the willingness to substitute is considered. This should be critically questioned with respect to the type of beverage. Simply put, the willingness to substitute could be different in the case of beer or water and should be considered individually.

Furthermore, the model does not display the cost, environmental footprints or the profit margins of the beverages. The consideration of the retailer's purchase strategy in the model is very simplistic and assumes that the choices are based entirely on the additional income derived from unclaimed deposit. For future analysis the purchase strategy should be evaluated in more detail.

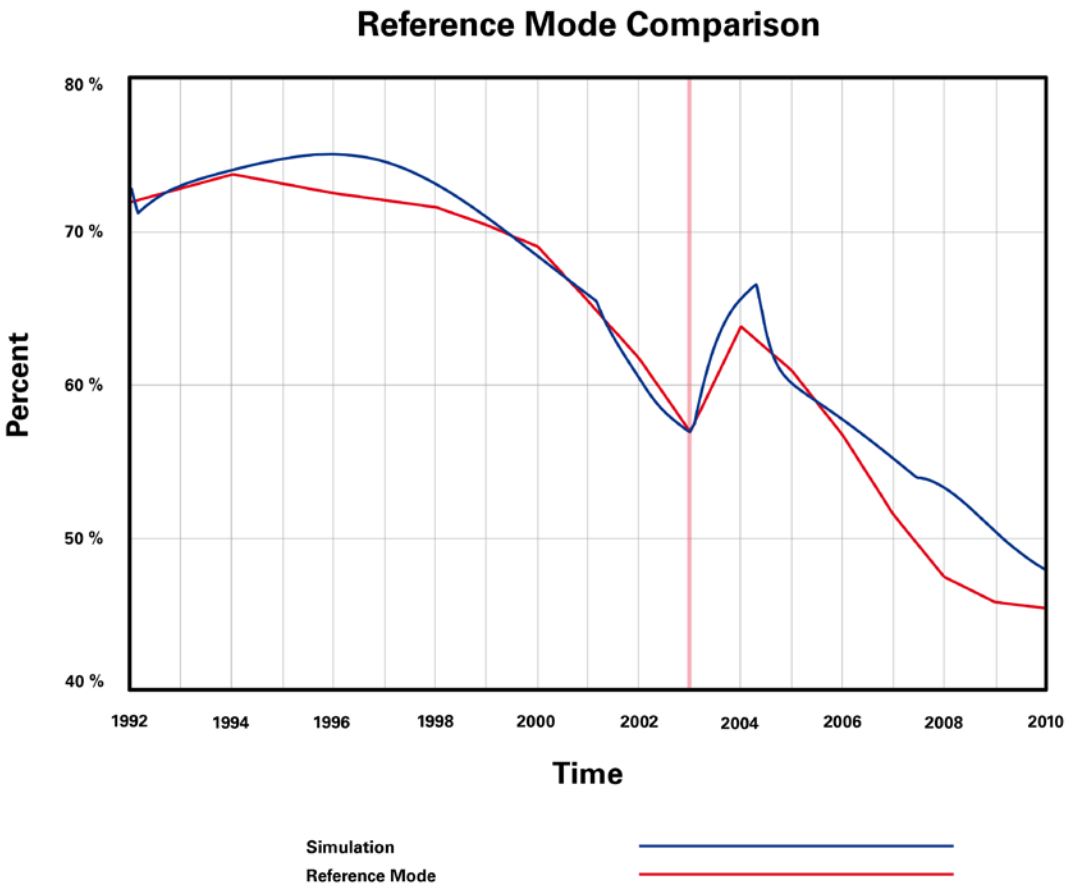

Figure 5. Reference mode comparison

Despite these weaknesses, the model correctly depicts the general tendencies, and is a helpful tool in the discussion about policy resistance in the case of the mandatory deposit in Germany. From this model, it can be concluded that the introduction of the mandatory container deposit on single-use containers is the reason for both the rise and the fall of the reusable container quota. This can be seen in the causal loop diagram in figure 4. As a result of the profit derived from unclaimed deposit, the retailers have an incentive to use increasingly more single-use containers. Thus, the establishment of the deposit ordinance made non-returned single-use container lucrative for retailers.

This knowledge about the revealed causal relations makes the actions of the industry and the positions of the debate before the establishment of the deposit appear illogical. It seems possible that it was not clear what the effects of the deposit would be. It is also inexplicable why the number of cans in circulation has lessened since the instatement of the single use container deposit. This point should be critically evaluated in the further validation of the model. In

contrast, based on the model, it can be argued that the can may again become more frequent as a single use container. This can be corrobated based on data from the beer industry where cans increase from von 1% to 10% from 2003 to 2009 (Albrecht et al. 2011).

In summary it becomes clear that this model is the first step towards identifying and analyzing the underlying feedback structure of the two container deposit systems in Germany as well as to explaining policy resistance in the case of the container deposit legislation in Germany. The model at hand identified the reason for the policy resistance. The immediate increase of reusable container quota is due to the change in consumer preference which was caused by the massive complication of returning single-use beverage containers. However, the complication led also to higher unclaimed deposit which is simultaneously a profit for the retailers. Retailers had therefore an incentive to focus their supply on beverages in single-use beverage containers. This fact explains the decrease of the reusable quota in the years after the establishment of the deposit.

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