Negative prices are a fundamentally new phenomenon. The buyer of a product, not the seller, is the one who gets paid. The most striking examples come from electric utilities and from banking. The two most common conditions which cause negative prices are negligible marginal costs and an imbalance between supply and demand. These in turn are influenced by new modes of manufacturing and the ability to conduct business online. In other cases, extenuating circumstances unrelated to production or purchase cycles can make negative prices not only possible, but optimal. Finally, the optimal combination of marketing instruments depends on the relative effects of promotions and negative prices. In some cases, it can be optimal to devote more marketing budget to negative prices than to promotions. Hermann Simon is founder and chairman of the global management consulting firm Simon-Kucher & Partners Strategy & Marketing Consultants. He can be reached at Hermann.Simon@Simon-Kucher.com.

Negative Prices – A New Phenomenon

Negative prices are a fundamentally new phenomenon. The buyer of a product, not the seller, is the one who gets paid. The most striking examples come from electric utilities and from banking. The two most common conditions which cause negative prices are negligible margin costs and an imbalance between supply and demand. These in turn are influenced by new modes of manufacturing and the ability to conduct business online. In other cases, extenuating circumstances unrelated to production or purchase cycles can make negative prices not only possible, but optimal. Finally, the optimal combination of marketing instruments depends on the relative effects of promotions and negative prices. In some cases, it can be optimal to devote more marketing budget to negative prices than to promotions. Hermann Simon is founder and chairman of the global management consulting firm Simon–Kucher & Partners Strategy & Marketing Consultants. He can be reached at Hermann.Simon@Simon-Kucher.com.

In normal business transactions, a customer pays a seller a positive price and receives a product or service in return. The customer is prepared to pay something as long as the positive utility from the acquired goods or services outweighs the negative utility of making the payment. From the sellers’ perspective, the short-term price floor is defined by marginal cost. In other words, they will sell when they can achieve a positive contribution to profit. In the traditional business world, marginal costs are usually greater than zero, so that a price of zero is rare and a price below zero practically never occurs.

The Internet, along with other new technologies, has ushered in a fundamental change in this paradigm. As Jeremy Rifkin described bluntly and in great detail in his bestseller The Zero Marginal Cost Society, the marginal cost of making an incremental unit of a product or a service is falling to zero – or near zero – in more and more industries (Rifkin 2014). This development has far-reaching consequences. For solar energy, the marginal cost of electricity generation is not only zero; the generated electricity must be consumed. In an increasing number of cases, the power company can only achieve that by incentivizing the consumer/buyer with a supplemental payment in addition to the provision of electricity. Such negative prices mean that the sellers pay the buyers to take the product off their hands, rather than vice versa.

Table 1: Number of days with negative electricity prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>35</td>
</tr>
<tr>
<td>2010</td>
<td>18</td>
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</tr>
<tr>
<td>2014</td>
<td>28</td>
</tr>
<tr>
<td>2015</td>
<td>25</td>
</tr>
</tbody>
</table>

Negative electricity prices

An article with the headline “Negative Prices are not a theoretical concept. Buyers really are receiving electricity and money from sellers” has appeared on the homepage of the European Energy Exchange (EEX 2016). Negative prices seem to be a new and growing phenomenon, judging from the frequency with which they are happening. Starting in 2008, negative prices have occurred occasionally on the Leipzig Electricity Exchange and later on the European Power Exchange (EPEX), sometimes with considerable frequency. Table 1 shows the number of days in each year from 2009 to 2015 on which negative prices occurred.

On these days, power customers paid electricity producers a negative price per megawatt hour. The buyer received electricity and also money. How can we explain this? Apparently one prerequisite is that at a price of zero, supply still outstrips demand. In other words, even a price of zero does not create an equilibrium between supply and demand. There is still an oversupply. Under such circumstances, the power companies would normally shut down generation. That is not possible, however, for some forms of electricity generation, such as solar panels. Even traditional power plants have only limited flexibility to shut down and restart in response to imbalances in supply and demand. The electrical power they produce must get taken up by someone. And on some days that happens only when the producer pays the buyer a negative price. One could speak of a “time-based byproduct” in this case. In order to produce and earn a profit on days with positive prices, the producers need to subsidize production and consumption on days with negative prices. As Table 1 shows, negative electricity prices are not a temporary phenomenon. The opposite appears to be the case. It is no wonder that Germany’s Wind Energy Association (Bundesverband Windenergie) warned in 2014 that “the current market structure means we have the threat of negative prices becoming more frequent.” Even though the number of days with negative prices was slightly lower in 2015 than in 2014, the number of hours with negative prices in 2015 actually doubled from the previous year.

Negative prices also occur in other markets and other places. The Financial Times reported on July 19, 2015 that “propane in Edmonton, Canada is trading at a negative price.”
similar to the situation with solar energy, namely, that a price of zero failed to clear the market. There was still an oversupply, and when the tanks are full, the producers need to get rid of the excess propane.

**Negative interest rates**
An unusual example for negative prices, historically speaking, resulted from how interest rates were managed during the financial crisis in 2008-2009. Interest rates are nothing more than the price banks or other parties charge for lending money. One author describes the traditional point of view as follows: “The concept of negative interest rates was so outlandish it wasn’t even mentioned in economics courses.” Negative interest rates were first observed in Denmark in 2012. Four years later they have become a widespread and frequently debated phenomenon. The arguments sometimes take on philosophical tones. Thomas Jordan, the president of Switzerland’s central bank, said that “negative interest goes against human nature.” Countries such as Denmark, Switzerland, Germany, Finland, and Austria raised money in 2015 by offering negative interest rates. Germany’s government-backed development bank KfW also enjoyed negative interest rates in financing. On April 21, 2015 “the money market interest rate Euribor was calculated with a negative yield for the first time.” At that time, the European Central Bank charged bank customers who held deposits there a negative interest rate of 0.2 percent. In August 2015 the German federal government sold a two-year bond at an interest rate of -0.25 percent. The Swiss central bank charged an interest rate of -0.75 percent from its depositor banks. As of the end of January 2016, there were more than €6 trillion worth of sovereign debt outstanding which had a negative interest rate. On a two-year bond, Switzerland “pays” interest of -1.14 percent, in Denmark the rate is -0.71 percent and in -0.29 percent in Germany. But not only states with good ratings can borrow money at negative rates, even companies achieve this unlikely result. In September 2016 Henkel of Germany, a large manufacturer of fast moving consumer goods, and Sanofi of France, a leading pharmaceutical company, were the first corporates to be paid to borrow money. For 2- and 3.5-year notes respectively they get -0.75 percent. You borrow money and get paid for it. That’s a totally new world.

The German health fund, which invests health insurance contributions for the short term, needed to pay €1.8 million in negative interest in 2015. In March 2016, the first ever mortgage-backed bond with an AAA rating and a negative interest rate (-0.162 percent) hit the market. That €500-million bond issue from Berlin Hyp was three-times oversubscribed, meaning that buyers will pay an additional €2.43 million annually for the €1.5 billion Euros in bonds they bought.

Even private customers have not escaped the spread of negative interest rates. In October 2015 the “Alternative Bank Schweiz” (Alternative Bank of Switzerland, or ABS) became the first bank to introduce negative interest rates for private customers. For a deposit of 100,000 Swiss francs, the depositor was charged -0.125 percent as interest, and -0.75 percent for larger deposits. Larger deposits had already seen negative interest rates, sometimes under the guise of an asset surcharge. At the end of January 2016, the Japanese central bank also introduced negative interest rates. In November 2016 a German cooperative bank introduced negative interest rates even for smaller. For savings of 10,000 Euros interest of -0.59 per year is due.

As with electricity, these developments appear to be trends, not aberrations. Germany’s Frankfurter Allgemeine Zeitung (FAZ) ran a story under the headline “The negative interest rate as something permanent.” The economist Carl-Christian von Weizsäcker speaks of “natural negative interest” as in no way temporary, but rather as a lasting phenomenon. He sees the cause in the “structural oversupply of the private willingness to save vs. the private willingness to invest.” With negative interest rates, the borrower not only pays no interest, but receives interest from the lender, which is unthinkable under traditional banking circumstances. In Denmark, Sweden, and Spain, customers have received loans for home building with negative interest rates.

There was apparently an oversupply of money in the market which could not be invested, even with an interest rate of zero. For a bank, it can make more sense to lend the surplus money at an interest rate of -0.1 percent than to deposit it at the central bank at a negative interest rate of -0.2 percent, or even -0.75 percent in Switzerland. When depositors are willing to make money available to banks at a negative interest rate, it can then lend this money at a negative interest rate and still earn a positive profit contribution.

**Figure 1: Revenue and profit at positive and negative prices.**
When interest rates are negative, consumers and banks could of course simply keep their money in cash. But this alternative also imposes costs. It is logistically complicated and risky. Furthermore, it is almost a practical impossibility to hold very large amounts of money as actual cash.

**Negative prices and profits**

What happens to revenue and profit when prices are negative? Figure 1 illustrates what happens. We assume that the price-response function is $q = 100 - 10p$, where $q$ is the unit volume and $p$ is the price.

At negative prices, revenue must be negative, because we are multiplying a positive number (volume) with a negative one (price). As we enter the realm of negative prices, the revenue curve falls off at an increasingly steeper rate. Because volume rises as the price declines, both factors in the equation are increasing in absolute terms. This means that the absolute value of the product of those terms rises very rapidly. This is what happened when electricity prices went negative.

And what happens with profits? First we will look at a situation in which we have positive variable unit costs ($c = 2$). For simplicity's sake we will assume that there are no fixed costs. Profit is zero when the unit price is 2, and the profit curve falls off in a similarly sharp fashion as the revenue curve did when prices are negative. A price of zero yields a loss of €200, and a price of -2 results in a loss of €480. The second, higher dotted profit curve shows how profit changes when we have variable unit costs of -2 instead of 2. That corresponds to the situation when banks receive money from depositors at a negative interest rate of -2 percent or when electricity resellers buy their power at negative prices. In such cases, the profit is greater than the revenue.

The profit maximum is still in the area with positive prices, in this case at a price of 4. Volume at that price is 60 units. This results in a unit contribution of €6, with €4 coming from the customer and €2 from depositors who pay negative prices. This is a two-sided price model, i.e. the returns come from two sources. The profit is €360. The firm can still earn a profit with prices between 0 and -2. The rate of decline of the profit curve is similar to those of the other profit curves when prices are negative; only the level of the curve is higher. It is theoretically possible for the profit-maximizing price to be negative. If variable unit costs were -12 in our example, the profit-optimal price would be -1 and the profit would be €1,210.

But fundamentally speaking, if someone buys at a negative price and the marginal costs are also negative, then the short-term price floor is also below zero. In such situations, it can be optimal for a firm to sell at negative prices. This actually happened in April 2016, when negative prices appeared for the first time in sales financing. The furniture dealer Who's Perfect offered “negative interest financing” for 24 months. The loan had an interest rate of zero percent (not uncommon in durable goods financing), but the buyer received 1 percent of the financed amount back. The financing had a negative price, albeit a slight one. That is also how Mercedes is marketing its A-Class 160 model with an effective annual interest rate of -1.26 percent.

**Negative prices due to transfer effects**

There are special situations – across time, product, and personal circumstances – in which negative prices come into question. When a company introduces a new product (for instance, for a pharmaceutical product or a consumer product), free samples are very common. These, of course, have a price of zero. This behavior in the introductory phrase breaks the rule that the price of a product should not be lower than its marginal costs. This tactic can make sense if the price of zero stimulates unit sales in subsequent periods when the price is no longer zero, meaning that the customers who were won over with the free samples continue to buy in the future. But this raises an interesting question: why does zero need to be the price floor in this situation? If you step back and think about it for a moment, zero appears to be a completely arbitrary floor. Perhaps the acceptance of a new, previously unknown or unfamiliar product could be accelerated if the seller pays the initial buyers (i.e. charge a negative price) instead if distributing the product at a price of “only” zero. If marginal costs are zero, as is often the case on the internet, this option becomes much more relevant than it would be for products with high marginal costs, which are more typical under classical economics.

We actually observe such negative prices in the real world. Germany’s Commerzbank is giving new customers €50, which means it is paying a negative price. This is similar to the coupon of the same amount which the club retailer METRO Cash & Carry gives to new customers. In its start-up phase, PayPal offered negative prices. Every new customer received $20.

We can use an analogous line of argument for other effects. If Product A promotes unit sales of highly profitable Product B, it can make sense to offer Product A at a negative price. This chain of effects lends itself to a freemium structure, for example. The typical freemium model has a basic version with a price of zero. Once again, we ask the question why the price floor needs to be at this arbitrary level of zero. If the experience with the basic version really does drive conversion to the premium model, it can make sense to pay initial users or early adopters for a limited time to use the product, i.e. to offer a negative price rather than a price of zero. Many telecom companies offer customers a free...
phone, or charge a symbolic price of €1, when those customers agree to a fixed-term service contract. Here we ask the same question: why couldn’t they pay the customers to take the phone rather than stop artificially at a price of zero?

The answer depends on the price effects or more precisely on the price response. Prospect theory and mental accounting lead one to suspect that a negative price could be a more effective customer acquisition tool than a rebate, a price of zero, or a symbolically low price. A seller of telecommunications services, which declines to be named, told me that they have had good results from offering negative prices for cell phones. The negative price was paid out in cash, which probably enhanced the effect.

The widespread practice of offering “cash back” in the United States can be understood in this context. With this method, a consumer buys a car for $30,000 and gets $2,000 in cash back. One could interpret this $2,000 as a negative price. Why does that make sense? Why not simply charge $28,000 instead? Prospect theory provides the answer. The payment of $30,000 creates a so-called negative utility, because the consumer needs to sacrifice that amount. The positive utility of the automobile offsets the negative utility of payment. Then we introduce a third utility component, namely the positive one resulting from the negative price of $2,000, which usually gets applied to the down payment on the car. Apparently many car buyers feel they derive a higher net utility from this price structure than when they simply pay $28,000 for the car with no additional negative-price component from the cash back.

Finally there is the question of the role negative prices play in decisions about marketing and promotions. When is one approach superior to the others? Product introductions are usually accompanied by large promotional budgets. The money flows into instruments such as advertising, displays, promotional actions, and rebates. Until now, negative prices have been a rare exception to this standard list. But depending on the relative magnitude of the price and the promotional elasticities, a negative price can be more effective than advertising or similar measures, without needing to set aside larger budgets. With marginal costs at or near zero, conditions under which negative price make sense will become more common.

Marginal costs of zero and negative prices
Rifkin has forecast the increasing spread of valid zero-marginal-cost paradigms for many economic sectors. One is education through so-called MOOCs, or Massive Open Online Courses. Others are the energy sector (wind, solar) and the sharing economy. In the sharing economy, available capacity such as private rooms or cars are marketed and put to good economic use instead of sitting empty or idle. There is no doubt that these phenomena – which aren’t necessarily new but which have spread like wildfire thanks to the Internet – will have significant effects on business models and price models. Some of these effects have already become reality, but the majority of them remain in the future.

Marginal costs of zero mean that the short-term price floor also sinks to zero. This may cause a massive intensification of price competition. It is to be expected that some suppliers will break the price threshold of zero and offer negative prices for their products and services. Today it is not uncommon for products to be sold below their marginal costs, in line with the classic idea of a “loss leader.” So it should be no surprise when we start to see an increase in the usage of extremely low or even negative prices, on a spot basis or selective basis.

Conclusion
In theory, the short-term price floor is equal to marginal cost. When marginal costs are zero, it means that the price floor is also zero. But more and more, we are observing negative prices, which means the seller pays the buyer. Production and cost factors can create situations in which the price floor of zero is no longer the absolute bottom. Sometimes the cause of negative prices is an oversupply amid ongoing production (such as with electricity), even when the market cannot absorb all that supply at a positive price or even at a price of zero. The cause could also be factors or circumstances across time and product line. Finally, the growing prevalence of low or zero marginal costs will render negative prices more frequent. To find the optimal solution, a company needs to quantify the effects of promotions and negative prices. In the Internet age, we can expect that investments into negative prices will pay off more frequently.