

To Repel or to Kill the Pest?

- an attempt to apply the Coase theorem with the example of biotechnologically modified potatoes

When Italian navigator serving the Spanish Queen and King Christopher Columbus in 1492 landed at the coast of newly discovered continent he brought horses to the local inhabitants. "Everybody, also this one, who has never been in wilderness, can understand what a horse in inland means." - Czech traveller Alberto Fric who at the beginning of the last century travelled over the considerable part of the American continent wrote in his book *The Indians of South America*.¹ On the other hand, in Europe Columbus brought tobacco and reportedly potatoes, too. But they were so called sweet potatoes - ipomoea batatas. The right potatoes were brought by the Spanish conquistadors at some point not until around 1570.

The discovery of the New World at the end of the 15th century meant opening the way for the later globalization² by breaking the rigid frontiers of the world known so far which until then had been seen as a closed and immutable circle of countries.³ Only by the discovery of the overseas countries the solid foundations of international trade were laid. It led to the changeover from the craft to the manufacturing and specialization. This was the starting point for the modern large scale industry and for the creation of one large globalized market.

If we define globalization as a transaction of culture⁴ from one country to another, or even from one continent to another continent and the culture everything that is in contrary to the nature the result of human activity, so including the intervention to the bioculture,⁵ than there can be said that the globalization is not a concomitant of the modern era, but it had already begun with the arrival of modern times, i.e. in the turn of the 15th and 16th century when by the human intervention horses appeared on the American continent and potatoes were imported to Europe where they begun to be grown und successively they became domesticated here completely. Except the initial advantages the globalization latter brought also disadvantages. While for the ordinary American the horses today have probably no great significance, the Europeans would hardly imagine their diet without potatoes. Not speaking of the popularity of the tobacco use ...

There in Middle Europe potatoes have been known approximately for three hundred years. After their introduction to Europe they were first cultivated only in botanical gardens as a rarity and were admired as an overseas curiosity. The distrust and also inexperience hampered a greater measurement extension. The first growers consumed in fact the violet and mildly poisonous berries instead of the underground tubers. Even at the beginning of the 18th century, potatoes were a rare delicacy on the tables of the nobility. Plain people fattened pigs with them and the servants refused to eat this unusual food. Later, however, potatoes have become a staple food for countless poorest European. They influenced the history of nations.

¹ Alberto Vojtech Fric: *Indiani Jizni Ameriky (The Indians of South America)*. Mlada fronta, Praha (Prague) 1957, pp. 212 (p. 196)

² The term "gobalization" first came into existence in 1944; in 1981 it started to become commonly used and after the Theodor Levitt's article *The Globalization of Markets* (Harvard Business Review, May-June 1983, pp. 92-102) was published the term was widely used in the business mainstream.

On the other hand "today's globalization is probably less acute than it was more than a century ago when 60 million emigrants left Europe." Klaus Macharzina: *Fragmentation in Globalization*. Management International Review, vol. 41, 2001/4 (p. 329)

³ The French Physiocrats two centuries later as the first began to perceive the economy as a repetitive circular flow of goods and money; not completely closed cycle that maintains balance itself.

⁴ or (if we understand globalization as) the inception and spread of mass culture, one begins to speak about in context with the industrial revolution in the turn of the 18th and 19th century

⁵ In Latin originally the word *cultura* meant *cultivating the land*. (cf. also *agriculture*)

At the time, there were good conditions for growing potatoes in Europe – not only climatic (they remained unchanged to the present), but also because their significant pest, i.e. the Colorado potato beetle – originally coming from North America,⁶ occurred in Europe for the first time not before 1874. In Middle Europe the presence of the Colorado potato beetle was found out not until after World War II. Unfortunately not only potatoes but also the Colorado potato beetle found here favourable conditions. The Colorado beetle doesn't occur only in areas higher than 1800 m above sea level where the larvae don't develop as they dry out because of the thin air. In addition too high temperature obstructs the development of the Colorado beetle eggs. When the air temperature is above 38 °C the eggs dry up.⁷

Although there in climatic conditions of Middle Europe the weather isn't a natural enemy of the Colorado potato beetle, this beetle has some natural enemies also here. Many eggs fall victim to the plant bug *Lygus pratensis*. Also the seven-spotted ladybug, which, however, comes on potato fields for aphids, destroys the eggs. The enemies of the larvae are also *Calosomas* and *Carabuses*. Another enemy, but not natural as the previous ones, is the true bug *Perillus bioculatus* that were deployed in fight against the Colorado potato beetle by people. But even these natural enemies can hardly cop with all, and so different chemical sprays are used against the Colorado beetle, unfortunately they kill also the beneficial insects, e.g. the seven-spotted ladybug. In addition to the economic costs and sometimes questionable effectiveness of chemical sprays they have also another disadvantage, i.e. environmental impact of their use.

The Czech traveller, ethnographer, botanist Alberto Vojtech Fric (1882 - 1944) came up with an interesting solution as he supposedly cultivated a hybrid of potatoes that had for the Colorado potato beetle poisonous ham and edible to human health harmless tubers.⁸ During his life the Colorado beetle wasn't an acute problem because (although it had occurred in Europe that time) it has arrived in Middle Europe sometime about 1950, a few years after Fric's death. But even before the World War II the Colorado potato beetle committed great potato crop damages in France and then during the war it arrived in Germany.

Fric thought in advance and was ahead of his time not only with his prediction of the occurrence of this problem, but also with the fact that already in 1939, after one of the world's largest collections of cacti froze him (for lack of coal for heating) in Prague, he began to carry out biotechnological experiments with utility plants.⁹ He worked on the simple presumption namely, that the cacti have stings as the protection against being eaten by the local fauna. Plants without the protective stings, which have survived all the pitfalls of nature, stayed only because their juices have either a strong unpleasant smell, taste disgusting parts or contain toxic drugs. Therefore Fric examined especially the chemical composition of the plants without stings on their travels mainly on the South American continent. Information about the biotechnological experiments of Alberto Vojtech Fric is little known to this day.

If the modern biotechnology would continue in these Fric's experiments, but for fear of the toxicity of the ham, which (like the slightly poisonous berries dissuaded first European consumers several centuries ago) could dissuade some consumers today (especially those opposing biotechnology), the ham and leaves would be not poisonous but only inedible for

⁶ The Colorado potato beetle was introduced not only to Europe but also to Asia.

⁷ From this point of view the areas with such climatic conditions have for growing potatoes so-called comparative advantage.

⁸ Karel Crkal: *Lovec kaktusu (Cactus Hunter)*. Academia, Praha (Prague) 1983, 430 pp. (p. 353)

Fric is also said to have grown a hybrid that produced tomatoes above the ground and potatoes below the ground. Such a multiplication of the yield of one plant certainly would be significant economic effect.

⁹ The foundations of biotechnology actually were laid by Johann Gregor Mendel (1822 - 1884) as he revealed the fundamental laws of genetics. His scientific contribution, however, wasn't recognized by Fric who claimed that "Mendel is wrong."

the beetle (which, of course, wouldn't have any influence on the taste and health harmlessness of the tubers), there would be obviously a problem. The Colorado beetle would change the fields of those potato growers who try this innovation for the fields of the other potato growers and the greater number of beetles would destroy the crops of these potato growers more quickly and more intensively causing them losses.

Moreover, if the Colorado potato beetle stops to taste the potato ham probably it would throw on the leaves of tomato ham and maybe also on the cabbage (or on tobacco leaves) and would commit damages elsewhere, i.e. on other economic plants. The negative externality would occur in this way – the originator doesn't bear all the costs of his activity but he transfers a part of them to others thus causing them losses.¹⁰ Some economists consider externalities a form of market failure although the negative externality is theoretically resolved through the known example of economics textbooks where the power plant polluting the surrounding forest raises the price of the sold electrical energy in order to compensate financially the ecological damage where the higher price decrease both the demand for electrical energy and also for its production at the same time. It means a reduction of the coal consumption and of the amount of impurities discharged by the plant to the atmosphere, too.

If a part of the potato growers would plant the biotechnologically modified potatoes with leaves which would be poisonous to Colorado potato beetle while tubers were for human health totally harmless and tasty, the Colorado beetle would eat these poisonous leaves and it would die. (Assume the effect of the poison only when ingested a large number of leaf and with a certain time delay.)

So the Colorado beetle would cause damage to the modified potatoes growers because due to eaten ham large tubers wouldn't grow to them while unmodified potato growers would have higher yields because the beetle which died after having eaten the biotechnologically modified ham wouldn't fly any longer to their field to eat the ham here. And this would allow greater yields to these farmers. So there would occur positive externality - the originator doesn't enjoy all the benefits of his activity and a part of them is transferred for free (without costs) to others.

On this theoretical model of two variants of biotechnological combat with the Colorado beetle, where in both externalities occur (in one case negative, in the second one positive) Coase theorem is applicable, according to which the problem associated with the emergence of externalities can be resolved by agreement between the parties. First, all the potato growers should agree whether they plant biotechnologically modified potatoes with the haulm and leaves that are poisonous or just inedible for the Colorado beetle. In the first case, at the expense of eradication of Colorado potato beetle there would be low crop of potatoes one year, or rather comparable with the current state when biologically modified potatoes aren't grown. In the second case the potato crop would be big but at the expense of the low crop of tomatoes, cabbage and other vegetable the Colorado beetle would be look as a substitute for the inedible potato leaves. In the first case consumers would pay higher prices for potatoes, in the second case for tomatoes and cabbage.

The second solution wouldn't sustainable in long term. It would mean a higher crop of potato every year at the expense of lower crop tomatoes, cabbage etc. It would involve also a lot of multilateral negotiations (between the grower of potatoes, tomatoes, cabbage, etc.) probably high transaction costs. Only the potato growers could agree among themselves in which ration

¹⁰ A negative externality causes a discrepancy between private and social costs. If a manufacturer transfers some of his costs on others, he can produce (at lower costs) more than he would produce has he had to bear all his costs.

they plant the potato with poisonous and inedible leaves,¹¹ in order to achieve both higher crop of potato and the gradual liquidation of unwanted pests. The growers of potatoes with inedible leaves, which would have a higher crop, based on previous agreements would compensate the growers of modified potatoes with poisonous leaves, which would have a lower crop. Weren't such an agreement found an illegal cartel agreement?

The greater the number of participants, the lower the probability of such a cartel agreement¹² and at the same time, the higher the probability that someone finally will violate this cartel agreement. Because the fact that one who violates an agreement wins in the short term - at the expense of this one who keeps it - is valid also by the cartel agreements.

Abstract

Biotechnologically modified plants are a big chance for the world, especially for the third one. Their introduction can meet with opposition not only by the consumers, but also by the growers although the biotechnologically modified plants promise them higher yields. Who will not be convinced by this elementary economic argument, may be convinced by the knowledge described by the so called Coase theorem according to which a problem associated with externalities can be resolved by agreement among involved parties. The growers who remain outside the agreement could have, by unchanged way of growing, lower yields than before. On the other hand, agreements among competitors can be found illegal cartel agreements.

¹¹ However, we should also take into consideration the conservative potato growers refusing biotechnologically modified crops, which would still plant the conventional potatoes (without an effect of repelling or killing pests) and probably would be worse off.

¹² Ludwig Mises: Human Action. San Francisco, Fox & Wilkes 1996 (4th revise edition), 906 pp. (p. 362)