


Revisiting Pesticide Taxation Schemes

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Revisiting pesticide taxation schemes

Abstract

The risks caused by pesticide use for human health and nature are one of the major challenges for agricultural policies. Despite their high potential to contribute to better policies, economic instruments such as pesticide taxes are rarely used in the current policy mix. In this essay, we combine current discussion on pesticide policies in European countries with new insights from recent economic research to provide an outline for better pesticide policies to policy makers and stakeholders. We show that differentiated taxation schemes have a high potential to reduce risks caused by pesticide use and that the targeted re-distribution of tax revenues in the agricultural sector is crucial to create leverage effects on pesticide use and to increase the acceptability of pesticide taxes.

Keywords: pesticide, tax, incentive, environment, regulation

JEL Codes: Q12, Q52, H23

Introduction

Plant protection is essential for the provision of high quality food in adequate quantities (e.g. Oerke, 2006). However, especially the use of pesticides often induces possible negative effects for the environment and human health (e.g. Gilden et al., 2010; Pimentel, 2009; Traversi und Nijkamp, 2008,). The risks for human health and nature caused by pesticide use are one of the major challenges for agricultural policies and have caught large attention in recent public debates, such as on the potential ban of glyphosate in Europe. In response to these challenges, various European countries have introduced National Action Plans on pesticide use (e.g. due to the Directive 2009/128/EC). Economic instruments such as pesticide taxes can be efficient components of an optimal pesticide policy (Skevas et al., 2013). Yet, these instruments are rarely used. For example, pesticide taxation schemes are established only in four European countries, i.e. in France, Sweden, Denmark and Norway - an introduction, however, is discussed in various other countries (e.g. Belgium, Switzerland, the Netherlands and Germany) (see Böcker and Finger, 2016, for an overview)¹. Despite the higher allocative efficiency than other policy instruments that are frequently used, such as bans or regulation, little progress has been made to overcome stakeholders' preconceptions and concerns with respect to pesticide taxes (e.g. Zilberman and Millock, 1997). In a similar vein, current policies and policy proposals are often not aligned with the current state of research. This essay aims to contribute to bridge new insights from recent economic research and from current discussions on pesticide taxation in different European countries to provide an outline for better pesticide policies to policy makers and stakeholders.

Goals and Effectiveness of Policies

Definition of goals of a pesticide tax

In order evaluate pesticide policy measures, crucial criteria are i) the effectiveness and efficiency of the measures, ii) the polluter pays principle and iii) the acceptability of the measure among

¹ Moreover, a quota system has been introduced in France in 2016 (Bellassen 2015). See Möckel et al. (2015) and Finger et al. (2016a) for recent discussions in Germany and Switzerland.

stakeholders including the effects of policy measures on farmers' income (see e.g. Falconer 1998). We will use these criteria as guiding principles to combine recent policy discussion and scientific evidence.

Important for the evaluation of the effectiveness and efficiency of measures such as a pesticide tax is the specification of policy targets, which varies substantially across countries. Reductions of physical quantities of pesticides used dominate public and policy debates, especially because these are easy to communicate and easy to measure. For example, the French policy defines a 50% reduction target for the total quantity of pesticides used from 2015 to 2025 (MAAF and MEDDE, 2015). However, such policy targets not necessarily internalize external effects. Pesticides differ strongly with regard to their properties, i.e. average quantities applied, intensity of application, risks of applied products for human health and the environment. A reduction of applied pesticide quantities could for example be easily achieved by the substitution of oils, normally used in great quantities but with low risks for human health and the environment, through smaller quantities of pesticides with potentially high risks (e.g. Böcker and Finger, 2016). Thus, risk-based indicators (e.g. based on H-phrases or R-phrases or impact assessment systems) should preferably be used to formulate policy targets as these better reflect external effects. For example, the Danish government planned to achieve a risk reduction of 40% between 2013 and 2015 (MIM and FVM, 2013), and the current proposal for a national action plan on pesticides in Switzerland postulates a reduction of risks caused by pesticide use by 50% (FOA, 2016).

The definition of risk-based policy targets has implications for the optimal design of pesticide taxes, which should internalize external costs of pesticide use to contribute to welfare increases. In order to reflect social marginal costs, taxes should not be uniform across pesticides in terms of ad-valorem or per unit taxes. In contrast, the potential mismatch between quantities of pesticide used and associated risks outlined above motivates differentiated pesticide taxes, so that more risky pesticides are taxed at higher rates. This creates incentives to substitute towards less toxic pesticides and non-chemical plant protection strategies. Along these lines, evidence from European taxation schemes shows that despite the fact that taxes have not reduced total quantities of pesticide use, they have led to the targeted reductions of risks caused by pesticide use (Böcker and Finger, 2016). In contrast, non-differentiated taxation schemes might create unintended consequences. For instance, quantity reductions can be caused by the substitution towards more toxic products resulting in higher risks for humans and the environment. Moreover, taxing only specific products at high levels keeps the average tax burden for pesticides low. If the high taxation of specific products, however, causes plant protection gaps, a dynamic fiscal scheme, as proposed by Martin (2014), should be adopted.

The effectiveness of pesticide taxes.

An important requirement for effectiveness and efficiency of pesticide taxes is that the demand for pesticides is price sensitive. The inelastic demand structure for pesticides was claimed in policy debates as a major reason for not introducing a pesticide tax (e.g. Hof et al., 2013, for the Netherlands). It is also used as a key argument in the policy debate such as by the German farmers' union in response to a recent proposal for a pesticide tax to be introduced in Germany (DBV, 2015). A recent meta-analysis shows that the median of pesticide demand elasticities reported in studies in North America and Europe is -0.28 (Böcker and Finger, 2017). Thus, there is – on average – a significant change in pesticide use due to the introduction of a tax to be expected. However, this response is inelastic. Elasticity levels reported by individual studies differ remarkably. Skevas et al. (2012), for instance, report elasticities between -0.03 and -0.0003 for pesticides in Dutch crop production. In contrast, Chen et al. (1994) report elasticities of -2.42 for mixed farms in Alabama (USA). The specific structure of demand

elasticities has important implications for pesticide taxation schemes. In that respect, three observations from the study by Böcker and Finger (2017) are especially important. First, elasticities differ largely across agricultural systems. For example, special crops show less elastic demand structures. Thus, also pesticide use reductions and tax burdens will differ across agricultural systems. Second, the demand for pesticides is in the short-run substantially less elastic than in the long-run. In the long-run, crop rotations and production technologies can be adjusted. Thus, pesticide taxes should be evaluated only in the longer run. This is further emphasized by the observation that before the introduction or increase of a pesticide tax, hoarding activities were observed regularly in Sweden, France, Denmark and Norway (Böcker and Finger, 2016). Thus, a clear communication of the non-short term time horizon of targeted effects is indispensable. Third, elasticities differ across types of pesticides. More specifically, herbicides are found to be more elastic, also because mechanical alternatives are available. Thus, lower tax rates are required to reduce herbicide use.

Pesticide taxes as part of a coherent set of policies

The use of tax revenues is crucial.

Increasing pesticide prices due to a tax could, especially in the short run, result in lower farm incomes. However, some recent studies suggest that income reduction due to reduced pesticide applications could be small. For example, Pedersen et al. (2012) show for a sample of 1164 Danish farms that one third of these farms is not operating cost-oriented but rather apply pesticides to maximize yields. In a similar vein, Nielsen (2005) argues that massive reductions in pesticide use have been achieved in Denmark without observing losses in aggregate agricultural incomes or production levels. For Dutch arable farms, Skevas et al. (2014) show that – if comparing with profit maximizing levels – 100% of the farms overuse herbicides, 86% overuse fungicides and 67% overuse insecticides. Jacquet et al. (2011) show that a 30% reduction of pesticide use would be possible without income losses for French arable farming systems.

However, potential income reductions for farmers and use of the tax revenues remain an important aspect of policy debates (see e.g. Bahrs and Back, 2016, for Germany). In addition, revenues of the pesticide tax in Sweden and Norway are not specifically used for agricultural or related purposes. In France, part of the tax revenues is used to internalize external effects of pesticide use, i.e. is used to clean water from pesticide residues (Art. L213-10-8 Code de l'environnement). The remaining revenues are allocated to the general budget. Earlier research has argued to support research activities with proceeds of pesticide taxes (e.g. Zilberman and Millock, 1997). Despite the fact that these solutions fulfil the polluter pays principle, the income reduction in the agricultural sector caused by a tax is one of the key hurdles for acceptance of such measure. Moreover, by not re-distributing tax revenues opportunities to create leverage effects are missed. We argue that a complete re-distribution of tax revenues to the sector shall be envisaged. Transaction costs of existing taxation schemes are very small, so that large parts of tax revenues are available for such re-distribution. For instance, in the Norwegian system transaction costs represent only about 1% of the tax revenues, with only about 10% of these costs incurring at the public administration level (Vatn et al., 2002). Tax revenues should be used to finance measures that create leverage effects with respect to reductions of risks caused by pesticide use. Those might comprise measures such as i) support of extensification (switch to organic or low pesticide production techniques), ii) support of new spraying material and new equipment related to pesticide use, iii) support of independent extension and advisory services, iv) support of biological plant protection strategies.

First, subsidizing organic production can lead to overall decreases in pesticide use. However, reduced production increases concerns of effectiveness if measuring environmental effects per unit of output and reduced domestic production causes problems of leakage. Other alternatives are subsidies to production systems that explicitly exclude specific pesticides from the production. For example, in Switzerland the production of cereals, rapeseed, sunflowers and beans not using all types of pesticides but herbicides and seed treatment is supported with an ecological direct payment (Finger and El Benni, 2013). Similar programs also exist in other countries (e.g. Baylis et al., 2008). Despite the higher intensity of these systems if compared to organic agriculture, smaller output levels are observed compared to intensive agricultural systems. Second, improved equipment and spraying technology can reduce emissions from pesticide use. For example, Aubert and Enjolras (2014) show in an analysis for French wine producer that the age of the equipment is significantly increasing the likelihood of over-application of pesticides. Investment in better technologies remains an important policy measure even in developed countries. Precision agriculture and the development of smart farming systems will offer new potentials in this field for the future. Support of these measures can compensate for tax burdens and does not lead to negative production effects. Third, independent management advice and extension service with particular focus on plant protection can contribute to the reduction of risks caused by pesticide use. Wiebers et al. (2002) show that support by advisors resulted in a higher pesticide use of farmers, which they argue stems from the profit maximization rationale of advisors who also sell pesticides to farmers. Thus, better and independent advisory and extension services might reduce pesticide use and increase farmers' income. Fourth, the support of biological prevention and control strategies contributes to reduce pesticide use and to maintain production levels (Cullen et al., 2008). These measures may comprise the creation of habitats for natural enemies or the use of biological crop protection agents.

Providing and supporting a wide set of targeted measures and strategies to reduce the risk caused by pesticide use is necessary to account for the large diversity of agricultural systems, environmental and human health impacts of pesticide use and finally also the large diversity of farm and farmers' characteristics. The revenues of a pesticide taxation scheme can provide the financial means required to realize these measures. More general, pesticide taxes are not efficient if used as stand-alone measure, but should be used in a coherent set of policies and measures aiming to reduce risks of pesticide use.

Aligning agricultural policies.

Pesticide policies and pesticide taxes need to be aligned with other policy instruments. Four aspects are highlighted here that are overlooked in current policy designs. First, land use (i.e. extensive margin) effects of agricultural policies are potentially more relevant than policies at the intensive margin. The quantity of pesticide use as well as the resulting risks for the environment and humans differs substantially across crops. For instance, German promotion of biogas has created land use effects towards higher acreage under maize (Britz and Delzeit, 2013). Thus, a coherent framework is required that accounts also for extensive margin effects of pesticide taxes and other policies. Second, policies on fertilizer and pesticide use have to be assessed jointly. Empirical studies highlight the important interaction of fertilizer application and pesticide use. More specifically, higher levels of nitrogen fertilizer use have been reported to increase herbicide, insecticide and fungicide use, caused by positive effects on, for instance, weed growth, aphids and mildew (e.g. Bürger et al., 2012). In addition, the value of the marginal product of pesticides increases for fields with high yield potentials due to high fertilization levels. Thus, regulating nitrogen fertilizer use also affects pesticide use. However, such

regulation via fertilizers cannot account for the risks for humans and the environment by specific pesticides. Third, pesticide policies and taxes can have important spill-over effects towards other policy goals. The above presented finding of the demand for herbicides being more elastic, implies that a pesticide tax may also affect tillage intensities, potentially diminishing benefits from minimal soil disturbance (Hobbs et al., 2008). The relevance of this interdependence between policy goals to restrict pesticide use and increase soil conservation has been highlighted in Europe's debate on the ban of glyphosate. Fourth, effects of pesticides on income risks and farmers' risk preferences can be crucial for policy design. For instance, recent shifts in agricultural policies towards the provision of better risk management instruments and subsidizing insurances (e.g. El Benni et al., 2016) may affect pesticide use and the effects of a taxation scheme. If pesticides are risk reducing, risk averse farmers would use larger than profit maximizing quantities of pesticides. However, pesticides have often been found to even have risk increasing effects (e.g. Horowitz and Lichtenberg, 1994). This is one of the reasons why yield and revenue insurances do not necessarily substitute for pesticide use. In contrast, empirical studies show that insurance uptake often leads to higher farm-level pesticide use (e.g. Finger et al., 2016b). Especially the effects of insurance on land use decisions, i.e. extensive margin effects, matter (e.g. Wu, 1999). Insurance solutions are often more attractive for intensive-input crops. Providing better insurance opportunities might thus lead to a land allocation towards these crops and increase total pesticide use at the extensive margin. Based on this background, insurance mechanisms should be developed that are specifically targeted for reductions of pesticide use (e.g. targeted index solutions, or insurances supporting low-pesticide production systems, e.g. Norton et al., 2016; Serra et al., 2008) and avoid land allocation effects.

Conclusions

Based on the above findings, we conclude the following for the design of pesticide policies and pesticide taxation schemes:

1. Differentiated pesticides taxes can effectively reduce risks for human health and the environment, induced by pesticides use. Substitution to less risky pesticides and non-chemical plant protection strategies can be incentivized when pesticides are taxed according to their potential riskiness and thus linking taxation more closely to external effects than an ad-valorem or per unit tax. Such a system keeps the average tax burden for pesticides low and can be adjusted to country specific policy goals.
2. Pesticide policies, including pesticide taxes have potentially large interdependencies with other policy targets and instruments with respect to risk management, fertilizer use and conservation agriculture that need to be accounted for in policy design.
3. The small but significant price elasticity of demand for pesticides implies that tax rates for highly toxic pesticides have to be large to generate a relevant decrease in their demand.
4. Low transaction costs for pesticide taxation allow re-distribution of tax revenues.
5. A reimbursement of tax revenues to the agricultural sector helps preventing income effects. Leverage effects on pesticide use can be created if this reimbursement is made via instruments which further reduce risks of pesticide use. The introduction of a tax scheme on pesticides should only be part of a portfolio of coherent accompanying policy measures, focusing on measures that do not imply reductions of production levels (e.g. better application technologies and better non-chemical plant protection) in order to avoid leakage problems. This especially applies for the case of production systems with small price elasticities of demand for pesticides.

6. Pesticide taxes do not have considerable short-run effects on pesticide use, because the elasticity of demand is small in the short-run and strong hoarding activities are induced. Pesticide taxes, however, incentivize the long-run reduction of the risks caused by pesticide use for human health and nature.

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