SHADOW PRICES OF SELECTED AGRICULTURAL COMMODITIES – THE CZECH CASE

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Abstract

The main objective of the paper is to contribute to practical applicability of the CBA in the agricultural sector by exploring the chances to estimate Czech social values of selected agricultural commodities using available statistical data. More specifically, we try to analyse for which commodities secondary data sets are available from which we may deduce the estimates of shadow price ratios, then to estimate SPRs for selected agricultural commodities and to analyse and discuss the applicability of such estimates in practical appraisal with respect to theoretically ideal measures and resulting available measures as well as with respect to the situation in which the CBA analyst typically is. We selected the following commodities: poultry, pigs, bulls, milk, rapeseed, maize, barley and wheat as items more suitable for SPR estimates mostly because of the data availability and the internal homogeneity of the items, which was closer to the theoretically required values than for other commodities. Under additional simplifying assumptions, we estimated SPR proxies for the particular commodities and finally summarized the pros and cons for application of SPR alternatives.

Keywords: shadow prices, shadow price ratio, accounting price ratio, conversion factor, border prices, cost-benefit analysis, willingness to pay, social value, project appraisal, agricultural projects, agricultural policy, agricultural commodities

JEL Classification: D60, D61, Q0, H0

Introduction

In general, the agricultural sector is one of the branches where the influence of public activity and public interventions on the economic decisions of particular stakeholders is sensible and regular. Public subsidies or any other form of interventions are used significantly by the vast majority of governments of European countries. We may highlight European Union members where Common Agricultural Policy and Common Commercial Policy instruments and various national supports (notified by the European Commission) are commonly used. The Czech Republic is no exception from this perspective.

Interventions assume the form of regulatory policies, subsidy programmes or direct project support. To make a decision about acceptance or rejection of such a kind of intervention brings the need for ex ante evaluation – appraisal. As the decision makers

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are public agents, they should evaluate an intervention from the society-wide perspective – most typically the national perspective.

Social cost-benefit analysis (cost-benefit analysis, CBA) is the most internally consistent and theoretically comprehensive method developed on the fundamentals of welfare economics. Although the history of the method use is longer, its regular and widespread international application started in the 1970s thanks to methodological progress triggered by the UNIDO and World Bank activities. Even though not all the barriers to successful practice have been overcome, the UNIDO approach [UNIDO, 1972] and the LMST approach [Little & Mirrlees, 1974; Squire & van der Tak, 1975] made the theoretical concept much more applicable than it had been before.

CBA is a method consisting of planning the intervention (project), forecasting "all" consequences (effects) in natural units and valuing individual effects in monetary units reflecting their social values, and final aggregation of all these monetized costs and benefits in time (reflecting the social time preferences). Ignoring some remaining theoretical and methodological problems for a while, we may state that the success of evaluation depends mainly on our ability to foresee the future alternative development of variables affected by our decision with and without the project under the condition of uncertainty and also on our ability to estimate social values of particular effects. Obviously, this is a very demanding task, which will never produce an indubitable and certain solution, but there could exist solutions closer and farther from the conceptual ideal. Such a result is limited by knowledge attainable to the intervention planner and evaluator.

In principle, all evaluators in any country or international institution willing to try to rationalize a public choice using CBA face these problems. However, not all the evaluators and decision makers face the same availability of underlying empirical estimates and studies with the same costs. From this perspective, the scope of the data availability problem varies from country to country and from sector to sector. The Czech Republic is not a country with a long application tradition of the method such as the USA, Canada and the UK, which are examples of countries where the use is most deeply rooted; not even as long as, for example, Germany, Sweden, Italy and France; moreover, the research resources spent on this field have traditionally been limited. As a result, fewer and less reliable estimates of social values of goods coherent with the CBA theory are available in general in the Czech Republic than in the countries mentioned. However, some estimates of particular non-market and market goods have come into existence in the last two decades. The situation in the Czech agricultural sector is not better than in the other sectors and worse than, for example, in transport from this perspective. It may seem surprising if we take into consideration the importance of the public interventions. Surely the state of the field does not help applicants in their attempts.

The main objective of the paper is to contribute to practical applicability of CBA in the agricultural sector by exploring the chances to estimate Czech social values of selected agricultural commodities from available statistical data.

The paper consists of three chapters. The first chapter briefly describes the theoretical definition of social value of goods as well as the methodological approximation of the valuation based on the shadow pricing concept. The second chapter contains a description of available data sets relevant to the estimate and a brief explanation of the particular methodological choices as well as choices of selected goods in our focus. The third chapter brings available estimates of shadow prices of commodities themselves. The paper

concludes with a discussion focused mainly on the problems embedded in the estimates and on how these problems may affect the reliability of the estimates in practical use.

1. Theoretical foundation of shadow prices and basic estimate approach

1.1 Welfare economics framework

Within the welfare economics framework, value of good is determined by the change in utility caused by consumption of a good. As the utility functions are not directly observable and measurable, theory offers two basic measures for evaluation linked to traditional demand and supply schedules. Two alternative concepts are defined for valuation of goods affecting the utility – output valuation: willingness to pay and willingness to accept. The inputs are then valuated using the social opportunity costs concept. A full description of the relationships between the terms mentioned above and all the related theoretical problems is beyond the scope of the paper and can be found in any textbook on welfare economics [Johansson, 1991; Boadway & Niel, 1984] or theoretical background of social cost benefit analysis [Mishan & Quah, 2007; Boardman, Greenberg et al., 2002]. We would only like to summarise the basic valuation concepts very briefly.

- Willingness to pay (WTP) – the maximum amount of money that an individual is willing to pay for a positive effect (compensating variation) or for the avoidance of a negative effect (equivalent variation).

- Willingness to accept (WTA) – the minimum amount of money that an individual is willing to accept to feel compensated for a negative effect (compensating variation) or to be willing to sacrifice a positive effect (equivalent variation).

- Social opportunity costs (SOC) – the lost value of effects that society cannot benefit from, because the resource was used for the activity in question and not for the second best use.

In principle, these concepts can be used for monetization of any effect – marketed or non-marketed goods (produced private goods and services, resources, externalities and public goods). One way of the effect valuation is to estimate social surplus changes (difference between social WTP and SOC of the change on a given market) in case there exists a market and an estimate of demand and supply schedule is available. If there is no market for the affected good or service and hence there is no possibility to observe S and D schedules and to deduce social surplus changes resulting from the project, then indirect market methods (methods based on observation – revealed preferences methods) or methods based on stated preferences (methods based on questioning) can be used to elicit information about the social value of the effect.

In spite of the availability and relevance of the methods mentioned above, analysts face resource, competence and time constrains and cannot afford such demanding research into each particular homogeneous good affected by a project. This is more obvious if we take into consideration the fact that hundreds of such items or even more

than that scale could be affected. To make the cost-benefit analysis and the decision-making process worthwhile – efficient, the analyst is generally forced to use "plug-in values" approximating social values that would be as appropriate as possible to the context of the specific project. This analytical practice is most widespread in the case of non-marketed goods, where the need for approximation is absolutely clear as there are no directly observable prices of the goods.

The situation is a little different in the case of marketed goods, because there is the possibility to observe market prices of the goods and hence to use them as social values with very acceptable costs of observing and not too high research competences required. This is an especially acceptable approach under the condition that the project does not have too significant impacts on the market and the market works in reality under conditions very close to those determining market efficiency. Unfortunately, this is not generally the case. Situations where there are significant reasons to doubt the appropriateness of use of market prices as proxies for social values due to market failures or government intervention, or both, are rather usual in practice than rare. If we are not willing to accept market prices as a sufficiently appropriate measure of welfare changes resulting from additional product offer or input consumption, additional correction is needed. The purely theoretical way would be to conduct a set of studies analysing all the particular affected markets and to elicit all the net social benefits (or losses) using the social surplus and net government revenue concepts. However, then the analyst is in the same trap of unbearable analysis costs and timeframe as mentioned above. The approach that deals with the problem, among others, consist in the use of shadow prices.

1.2 Shadow pricing methodology

The methodology of shadow prices was developed in the 1970s primarily for evaluation of projects in developing countries, where the market conditions were visibly far away from efficiency and a correction of market prices was unavoidably needed. As there were institutions such as the UNIDO and the World Bank, active in financing of plenty of projects in many developing countries around the world, the demand for methodological progress in CBA application came into being and the shadow price methodology was worked out as a reaction on the demand. The basics were defined in the UNIDO guide [UNIDO, 1972]; a later contribution consisting in use of border prices as proxies for shadow prices was added by Little and Mirrlees [1974], and the methodology was completed by Squire and van der Tak [1976] by adding social weighting and other than efficiency goals to the analysis. The methodology developed made cost-benefit analysis more feasible and highlighted the principle based on opportunity costs of the society from international trade. The fact that the approach was created for developing countries does not mean that it would not be appropriate in developed countries. Quite the opposite is true; it became a widely accepted standard as it makes the CBA method more applicable, feasible and efficient. From the Czech perspective, the most important factor is the acceptance of the method principles by the EC because the official guidelines are obligatory for major Structural Fund projects and recommended for the others [EC, 2014b; EC, 2008 for previous periods]. However, irrespective of European procedures, demand for the evaluation method has come into existence naturally, driven by decision-making needs in the public sector.

Following the methodology mentioned above, shadow prices for internationally traded goods are generally deduced from border prices of the items. The reason is not the fact that international markets would be less distorted than domestic markets, even though they usually are, but because they represent opportunity costs of the society from foreign exchange.

Particular items can emerge in the domestic economy projects or intervention plans as inputs or outputs and they can be imported, exported, produced by the domestic economy or consumed in the domestic economy.

The shadow price of an imported input would be equal to its CIF[1] price plus shadow prices of costs necessarily added within domestic economic activities to offer the product for its market price on the domestic market. All the pure social transfers included in the financial costs have a shadow price equal to zero as taxes, duty or extra economic profits of the domestic stakeholders because they do not reflect real resource consumption. Hence, only a part of the difference between the market price and the CIF price can be expected as relevant. Under such extreme conditions where real social resources necessary to offer the item on the domestic market are negligible, the CIF itself can be used as a shadow price of the item.

The same shadow price estimate should be used for the item under the condition that the item would be an output of the project in question. Even though the output is produced by domestic projects, the logic behind the idea is that if the output is not produced, it would had to be imported. So the value that society attains by the project production is appropriate to the shadow price of an equivalent imported item.

In the case of project output that is exported, the base for the estimate of the shadow price is FOB[2]. In this case, FOB represents what the society (the relevant society members) "really receives at the border" for its production and hence the FOB represents the shadow price of the item. FOB could theoretically be greater due to export taxes (which is not in reality the case with Czech exports) but the export taxes are transfers from foreign entities to domestic government and so a shadow price equals the nominal value and not zero as it would be a net gain from the domestic economy's perspective. The shadow price could theoretically be lowered by the costs necessarily spent by the domestic providers to switch the item from domestic use to the delivery to the border, which otherwise would not be spent. But this is appropriate only under the condition that these costs are not already counted as a specific input consumption of the project. If we took into consideration these input items on the CBA cost side explicitly, then reducing the output shadow price for them would lead to double counting.

The last case an analyst may face is to identify the shadow price for a domestically produced input into the project in question. Since the item is internationally tradable, we assume that if the good is not used as a project input, it would be exported, so the proper base for the shadow pricing of the item is the net social loss from the unrealised export; hence, the base for the shadow price is FOB too. In this case in principle, the shadow price equals to FOB lowered by the shadow price of domestic services necessary to deliver the item to the border, plus the shadow price of the services required to deliver the item to the domestic market distribution place. Contrary to the previous case, we may expect that in the CBA procedure, these distribution costs are usually not explicitly reflected on the

1 Cost, Insurance and Freight, see Incoterms.

2 Free on Board, see Incoterms.

project cost side as they are typically included in the domestic market price and hence should be reflected in the shadow price of the item being counted.[3]

The shadow price ratio required in CBA for multiplying flows originally estimated in actual (market) prices to get "economic flows from the society perspective" instead of "financial flows from the investor or project provider perspective" would then be the rate between the shadow price of the item and its appropriate market price.

$$SPR_i = \frac{SP_i}{MP_i}, \tag{1}$$

where SPR is the shadow price ratio of the good *i,*
SP – shadow price of the good *i*,
MP – market price of the good *i*.

With respect to the methodological insight summarized above, the original objective of the paper could now be rewritten more specifically as to contribute to practical applicability of CBA in the agricultural sector by exploring the chance to estimate the SPR for selected agricultural commodities following the ideal framework and by discussing the pros and cons of the estimate applicability.

2. Data source options and dataset selection

This paper has focused on an assessment of primary agricultural commodities. We tried to set the shadow price ratios for main crop and animal commodities produced in the Czech Republic.

According to the diagram mentioned above, the calculation of the shadow price ratio requires identification of the costs of transportation, costs of distribution, and sometimes export duties (no export duties are used in the EU). It is almost impossible to obtain these data without field research, so an alternative, simplified, solution has been chosen, and available data were used.

However, we need FOB and CIF prices to assess outputs of primary agricultural production which can be exported instead of being sold on the domestic market, as well as to assess the same production as inputs which can be, for processing, purchased from abroad instead of domestically. These prices are not available; thus, prices of external trade were used (calculated from the Czech External Trade Database), whose character is closer to them.

Hence, the formulas used for shadow price ratio (SPR) estimates are:

$$SPR_i^E = \frac{EP_i}{PP_i}, \tag{2}$$

where SPR^E_i is the shadow price ratio of the good *i* estimate based on export prices,
EP_i – export price of the good *i*,
PP_i – producer price of the good *i*.

3 For example, Powers [1990] provides a useful summary of shadow pricing based on the original guidelines by Little-Mirrlees and Squire-van der Tak focused on an explanation of how to properly deal with border prices.

And

$$SPR_i^I = \frac{IP_i}{PP_i}, \tag{3}$$

where SPR^I_i is the shadow price ratio of the good i estimate based on import prices,
IP_i – import price of the good i,
PP_i – producer price of the good i.

Instead of farm gate prices, producer prices are commonly used. Producer prices do not include value added tax. We used two types of producer prices which are official and regularly published. The first is producer prices of agricultural commodities surveyed by the Czech Statistical Office (CZSO) among a sample of producers. These producer prices are usually contractual prices of commodities sold by producers on both domestic and foreign markets without transportation costs to purchasers.

For some commodities, there are also other sources: departmental statistics of the Ministry of Agriculture (MoA) for milk, and the State Agricultural Intervention Fund (SAIF) for live animals (beef cattle and pigs, or their meat). In these cases, producer prices are calculated from dairy and slaughterhouse reports, so they do not contain the part which is exported. Milk producer prices are surveyed by the MoA among all the domestic processors. The SAIF survey of live animal producer prices is not complete; it covers approximately 45 % of domestic production of pork, and 35 % of domestic production of beef (in 2012–2014). Producer prices of live animals are converted from prices of carcass weight with official coefficients set by the Ministry of Agriculture.[4]

Export and import prices could serve as shadow prices, but it is important to consider their suitability for each commodity item. Export and import prices are calculated as unit prices, i.e., they are defined as average export/import values divided by average export/import volumes. The external trade database of the Czech Statistical Office is the national source of these data. An export price is the statistical value of exported goods based on the invoiced price. It only includes those direct trade costs (freight and insurance premium in particular) that are incidental to the transport within the Czech Republic, whether paid by the buyer or the seller. It does not include banking fees or banking compensations linked to the export of the goods or export-related taxes and levies. Statistical value in exports is the value free to border of the Czech Republic. An import price is the statistical value of imported goods based on the invoiced price. It only includes those direct trade costs that are incidental to the transport outside the Czech Republic, whether paid by the buyer or the seller. It does not include banking compensations linked to the import of the goods or import-related taxes and levies.

Shadow price ratio estimates were calculated for wheat, barley, maize, rapeseed, milk, bulls, pigs and poultry. Exports of all these commodities are substantial and definitions of items and their real contents are close to each other. Nevertheless, it is not possible to take into consideration their possible differences between breeds, varieties and qualities.

Some commodities were not included in the analysis because no data about their prices were available. Other commodities were excluded from our analysis mostly because of too serious problems with insufficient traded volumes, or irregular frequency of importation/

4 Methodological notes available at: https://www.czso.cz/documents/10180/32803968/27012716m_en.pdf/d597a5ba-9847-473a-94d5-5d5c787b7c12?version=1.0.

exportation, as their export/import prices could be biased. Other reasons for exclusion of a commodity were too high a share of re-exports included in export data in combination with too high seasonal price fluctuations (as was the case with fruits and vegetables) or simply too heavy incomparability of the substance of the commodity exported/imported and domestically produced (the items were significantly and systematically different from the qualitative perspective). The problems are further mentioned in the final discussion in chapter five.

Table 3 | Particular producer prices and export prices – detailed description

Commodity	Export prices for	Producer price items for
Wheat	CN 1001 90 99 (until 2011) and CN 1001 99 00 (since 2012) – Wheat, not durum, not seeds. Marginal meslin is theoretically included.	Prices for milling soft wheat and fodder wheat are available.
Barley	CN 1003 00 90 – Barley (of all kinds), not seeds (until 2011) and CN 1003 90 00 (since 2012)	Prices for malting barley and fodder barley are available. Price of food barley is not published in all months, but production of this sort is insignificant.
Maize	CN 1005 90 00 – Maize (of all kinds), not seeds	Fodder maize. Production of food maize is minor in the CR.
Rapeseed	1205 10 90 – Low erucic acid rape or colza seeds, not seeds	Rapeseeds
Milk	CN 0401 20 99 – Milk, of a fat content > 3 % and ≤ 6 %, in packages > 2 l	Cow milk, 0 & 1st class quality
Bulls	CN 0102 90 71 (until 2011) and CN 0102 29 91 (since 2012) – Bulls (and steer) > 300 kg, for slaughtering, i.e., slaughtering bulls predominantly	Slaughtering bulls SEUR*), in live weight
Pigs	CN 0103 92 19 Pigs > 50 kg (domestic species), not sows having farrowed at least once, of a weight of not less than 160 kg, i.e., pigs for slaughtering predominantly	Slaughtering pigs SEU*), in live weight
Poultry	CN 0105 94 00 – Poultry *Gallus domesticus* > 185 g, i.e., roughly slaughtering poultry	Slaughtering poultry, 1st class quality

Note: CN – Combined Nomenclature of the EU – nomenclature used for customs purposes. SEUROP is the EU system of carcass classification ("S" is the best, "R" is the worst).

Source: Customs nomenclature, sheets of producer prices (CZSO, MoA, SAIF), experts' findings

3. SPR estimate for selected agricultural commodities

The calculation of shadow price ratios was made for the period of the last six years (2010–2015) because of year-to-year fluctuations, which are distinctive for agricultural commodity prices. Averages, variation ranges and coefficients of variation have been added as statistic descriptions of the given series.

The results of the calculations are average SPR^Es and SPR^Is for the monitored period, see Tables 4–11. All the calculated prices are applicable. Their variability in the given time series is mostly low. In all the cases except the SPR^E of rapeseed, shadow price ratios are slightly higher than 1. The SPR^E and SPR^I of rapeseed are equal to "1" (rounded). This commodity also has a substantial non-food use and its market is influenced (indirectly supported) by energy policy.

SPR^E higher than "1" mirrors the situation where producers prefer selling their products abroad. In some cases, exports are not surpluses which cannot be placed on the domestic market; some commodities are export-oriented, because producers, or traders, get better prices on foreign markets (EU single market included). However, the analysis of producers' export motivations is not a topic of this paper.

The calculated SPR^I do not differ from SPR^E much (by less than 10 %, in both directions). Exceptions are maize ($SPR^I > SPR^E$ by 40 %) and barley ($SPR^I > SPR^e$ by 14 %). The resulting SPR^I are mostly greater than SPR^E except those for wheat and bulls. The probable explanation is that their exports and imports are of various quality.

Table 4 | Wheat (prices in CZK/tonne)

Wheat	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	3153	4652	4665	5365	4283	4091	4368	2212	0.15
Export price	3565	5067	5242	5415	4877	4699	4811	1850	0.13
SPR^E	**1.13**	**1.09**	**1.12**	**1.01**	**1.14**	**1.15**	**1.11**	**0.14**	**0.04**
Import price	4155	4767	5636	4917	4065	3997	4590	1639	0.13
SPR^I	**1.32**	**1.02**	**1.21**	**0.92**	**0.95**	**0.98**	**1.07**	**0.40**	**0.14**

Note: Producer prices have been calculated according to production areas for milling and fodder wheat in the CR.
p: data for 2015 are preliminary estimates.
Source: Export prices and producer prices – CZSO, authors' calculation

Table 5 | Barley (prices in CZK/tonne)

Barley	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	3024	4423	4786	5182	4562	4256	4372	2158	0.15
Export price	3315	4981	5488	5309	5149	4522	4794	2173	0.15
SPR^E	**1.10**	**1.13**	**1.15**	**1.02**	**1.13**	**1.06**	**1.10**	**0.12**	**0.04**
Import price	4884	5771	5889	5885	4864	4795	5348	1094	0.09
SPR^I	**1.62**	**1.30**	**1.23**	**1.14**	**1.07**	**1.13**	**1.25**	**0.55**	**0.15**

Note: Producer prices have been calculated according to production areas for malting and fodder barley in the CR.
p: data for 2015 are preliminary estimates.
Source: Export prices and producer prices – CZSO, authors' calculation

Table 6 | Maize (prices in CZK/tonne)

Maize	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	3282	4707	4567	5362	4253	3781	4325	2080	0.15
Export price	3488	4801	4779	5247	4022	3714	4342	1759	0.15
SPR^{E}	1.06	1.02	1.05	0.98	0.95	0.98	1.01	0.12	0.04
Import price	8064	6357	5789	5628	4872	4505	5869	3559	0.20
SPR^{I}	2.46	1.35	1.27	1.05	1.15	1.19	1.41	1.41	0.34

Note: Food maize can theoretically be included in the export prices, but its production is minor in the CR.
p: data for 2015 are preliminary estimates.

Source: Export prices and producer prices – CZSO, authors' calculation

Table 7 | Rapeseed (prices in CZK/tonne)

Rapeseed	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	7545	11,381	11,843	10,949	9724	9860	10,217	4298	0.14
Export price	7603	10,730	11,935	9632	8447	10,014	9727	4332	0.15
SPR^{E}	**1.01**	**0.94**	**1.01**	**0.88**	**0.87**	**1.02**	**0.95**	**0.15**	**0.06**
Import price	8427	11,837	12,508	10,816	9270	10,279	10,523	4081	0.13
SPR^{I}	**1.12**	**1.04**	**1.06**	**0.99**	**0.95**	**1.04**	**1.03**	**0.16**	**0.05**

Note: Minor high erucic rapeseed is not included in the export prices as its customs item contains seeds.
p: data for 2015 are preliminary estimates.

Source: Export prices and producer prices – CZSO, authors' calculation

Table 8 | Milk (prices in CZK/litre)

Milk	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	7.43	8.26	7.68	8.51	9.37	7.66	8.15	1.94	0.08
Export price	8.11	8.86	8.45	9.54	10.29	8.49	8.96	2.18	0.08
SPR^{E}	**1.09**	**1.07**	**1.10**	**1.12**	**1.10**	**1.11**	**1.10**	**0.05**	**0.01**
Import price	8.37	8.57	9.10	10.43	10.65	10.06	9.53	2.28	0.09
SPR^{I}	**1.13**	**1.04**	**1.18**	**1.23**	**1.14**	**1.31**	**1.17**	**0.28**	**0.07**

Note: Raw milk is not defined separately by the customs nomenclature; nevertheless, it forms the major part of the stated item in the Czech milk exports.
p: data for 2015 are preliminary estimates.

Source: Export prices – CZSO, producer prices – MoA, authors' calculation

Table 9 | Bulls (prices in CZK/kilogram)

Bulls	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	39.96	42.97	47.25	45.99	47.54	48.66	45.40	8.70	0.07
Export price	46.90	49.15	56.08	48.05	49.84	50.49	50.08	9.18	0.06
SPR^{E}	**1.17**	**1.14**	**1.19**	**1.04**	**1.05**	**1.04**	**1.11**	**0.15**	**0.06**
Import price	40.12	56.06	62.64	41.06	46.47	47.13	48.92	22.53	0.16
SPR^{I}	**1.00**	**1.30**	**1.33**	**0.89**	**0.98**	**0.97**	**1.08**	**0.43**	**0.16**

Note: Minor buffalos included in export prices until 2012.
p: data for 2015 are preliminary estimates.

Source: Export prices – CZSO, producer prices – SAIF, authors' calculation

Table 10 | Pigs (prices in CZK/kilogram)

Pigs	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	27.48	29.46	33.99	34.43	33.50	29.56	31.40	6.95	0.09
Export price	28.29	30.86	35.52	36.63	33.02	29.69	32.34	8.33	0.09
SPR^{E}	**1.03**	**1.05**	**1.05**	**1.06**	**0.99**	**1.00**	**1.03**	**0.08**	**0.03**
Import price	32.35	34.90	39.14	37.26	34.24	30.79	34.78	8.35	0.08
SPR^{I}	**1.18**	**1.18**	**1.15**	**1.08**	**1.02**	**1.04**	**1.11**	**0.16**	**0.06**

p: data for 2015 are preliminary estimates.

Source: Export prices – CZSO, producer prices – SAIF, authors' calculation

Table 11 | Poultry (prices in CZK/kilogram)

Poultry	2010	2011	2012	2013	2014	2015p	Average	Variation range	Coeff. of variation
Producer price	20.375	22.111	23.084	24.742	23.859	23.733	22.984	4.37	0.06
Export price	21.670	21.885	24.301	26.697	25.755	23.352	23.943	5.03	0.08
SPR^{E}	**1.06**	**0.99**	**1.05**	**1.08**	**1.08**	**0.98**	**1.04**	**0.10**	**0.04**
Import price	20.703	24.948	27.257	23.969	24.281	26.835	24.666	6.55	0.09
SPR^{i}	**1.02**	**1.13**	**1.18**	**0.97**	**1.02**	**1.13**	**1.07**	**0.21**	**0.07**

p: data for 2015 are preliminary estimates.

Source: Export prices – CZSO, producer prices – CZSO, authors' calculation

Discussion

In this last section of our paper, we would like to highlight final recommendations for SPR use in analytical practice as well as pitfalls of the estimates.

We do anticipate that the analyst making a cost-benefit analysis of any project, where commodities can be included on either the side of costs or benefits (as either an input or an output), shall use the estimates as a factor of conversion from market prices to shadow prices. He or she can multiply particular sales or cost predictions originally based on producer price forecasts by the appropriate SPR to get proxies of monetarily expressed social values of the project commodity production or project commodity consumption from the Czech perspective. Such an approach is common practice in most relevant methodologies such as that of the World Bank and the EC [e.g., EC, 2008].

Following the original logic of section 1.2 and reflecting the fact that we have no data available about the costs of distribution to borders or to domestic markets, we may recommend the use of SPR^E in case the particular commodity occurs in the CBA study as a domestically produced input. Conversely, we may generally recommend the use of SPR^I estimates in case the commodity occurs in the study as a domestically marketed output. In case the particular commodity occurs in the study as an exported output or imported input, it would be very likely that the items are naturally planned in the financial plan and valued in export prices or import prices and do not need to be adjusted. The only thing that should be analysed separately project by project is the effects of distribution costs and costs of switching the item form domestic markets to borders (see section 1.2). This recommendation would be appropriate if we do not reflect the differences in reliability of estimates presented among particular commodities.

There were several problems in the process of shadow price estimation beyond data unavailability. There must be a sufficient homogeneity in the process of commodity identification in the customs nomenclature and in items for which producer prices are set. In the case of long-term analyses, there must be a sufficient stability in these specifications (nomenclatures are sometimes modified). Moreover, price volatility is distinctive among agricultural commodities; annual shadow price estimates can vary substantially year-to-year (using averages is a possibility). Besides, it is important to calculate a shadow price ratio as a quotient of the export price and producer price or the import price and producer price only for commodities which are traded in sufficient volumes.

Application of this method is not appropriate for commodities which are not exported/imported commonly, as their export/import prices may not be representative. Besides, the use of the calculation is not convenient, for example, in the case of fruits and vegetables, which are largely imported under this country's conditions (and their prices are totally different off season), and there are high shares of re-exports in their exports.

Differences between export and import prices of some commodities can be caused by quality differences of goods on the export and import sides. In some cases, there can be a time discrepancy of export and import flows within the monitored period (a year in this paper). Furthermore, the prices can be influenced (distorted relative to a current market price) by contractual settings (prices designed in advance, long-term partnerships, a need to keep a business partner). Last but not least, the countries which commodities are exported to and imported from are different, and they can be characterised by various price levels.

There can be a little distortion in the SPR of the analysed cereals, rapeseed and poultry; their SPRs may be greater in reality because producer prices are also influenced by exports with their higher prices. It depends on how many exporting producers are included in the sample for producer price surveys and what is the share of exports in their sales.

Regarding the problem of the time stability of the SPR, the more stable the SPRs are in time, the more we may believe that the SPR could be used for the prediction. From this perspective, there is a question whether the differences are rather given by impreciseness of our measurements due to the problems mentioned above, or due to real changes on the foreign or domestic markets. In the first case, it would be better to use averaged SPR over periods where part of the time shifts problems and inconsistencies could be averaged out. In the second case, it would be better to use the latest estimates. We do publish both, but we personally believe that more often it would be better to use averages. Under this condition, another question comes into existence: whether it is meaningful to let the average be influenced by outliers. This is mainly the case of maize and barley, where the average SPR^Is are significantly affected by the untypical year 2010. All the averages presented in the tables above are affected by all the annual values for methodological consistency.

Then there is the problem whether the conceptual better appropriateness of SPR^I in comparison of SPR^E and vice versa is less or more important than robustness of the estimates, which does not have to be the same for both ratios. Generally, the estimates of SPR^E are significantly more robust that SPR^I, as there is a much greater sample of cases in the statistics.

Reflecting all these problems, we do recommend the use of SPR^E rather that SPR^I regardless whether the commodity emerges as an input or output as there is a greater homogeneity of the items in export price measurements and producer price measurements as well as a greater quantity of transactions.

For the appropriate application, the analyst should reflect the fact that the data used for our SPR calculations did not include the shadow prices of distribution to the borders and their adjustment, as we theoretically recommend in chapter 1.2, and this adjustment should be considered during the particular project CBA studies being processed.

In conclusion, we would like to briefly summarize the main objective of the availability of SPR plug-in values. Availability of SPR estimates for given commodities should be viewed as one of many steps that should jointly lead towards wider and more accurate application of the CBA method in evaluation of projects and interventions in general. It should lead to more accurate application of CBA in existing use as well as wider use of the method in the process of agriculture policy formation. Namely, it allows the analyst to take into consideration differences between internal market prices of selected agricultural commodities that may be affected by the potential project or policy in question, which is appropriate in studies conducted from a societal perspective instead of a private investor's perspective. The practical technique based on adjustment of such forecasted effects using "plug-in" SPR estimates makes the calculation of net social benefits of options more accurate in comparison with the status quo and it does not simultaneously increase additional analytical costs. Thanks to systematic use of SPR, particular economic analyses weighting pros and cons of individual options in the agricultural sector should be less systematically biased. The method allows reflection of

more relevant factors in a way more corresponding to real social preferences. As a result, it should partially weaken one of the existing barriers to rationalizing public choices and somewhat diminish the likelihood of public failure.

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