Chapter 4.

ESTIMATING POLICY TRANSFERS: PRICE TRANSFERS

81. Once policies have been identified for inclusion in the measurement of support and appropriately classified, the next step is to estimate the value of transfers created by these policies. Policy transfers are divided into the following broad groups: *price transfers*, and *other transfers* (i.e. budgetary transfers and revenue foregone). This chapter shows how to estimate price transfers, while Chapter 5 discusses the estimation of other transfers.

82. The chapter begins with a theoretical discussion regarding transfers that arise from policies that affect domestic market prices. Policies that increase and decrease domestic market prices are differentiated for both importing and exporting situations. The following two sections explain how price transfers to producers and consumers are estimated. The fourth section discusses the estimation of the Market Price Differential, an integral component of price transfers.

4.1. Price transfers arising from policy measures: a graphical analysis

- Policy measures which affect the domestic price of a commodity result in a Market Price Differential (*MPD*).
- Policies which increase domestic market prices (a positive *MPD*) create transfers to producers from consumers. When the commodity is exported, producers also receive transfers from taxpayers. When the commodity is imported, additional transfers go from consumers to others, including central government, in the form of tariff revenue.
- Policies which decrease domestic market prices (a negative *MPD*) create transfers from producers to consumers. When the commodity is imported, consumers also receive transfers from taxpayers. When the commodity is exported, additional transfers go from producers to others, including central government.

83. The key theoretical assumption underlying the estimation of support is that agricultural markets are competitive. The characteristics of competitive markets, such as perfect information, homogeneity of products traded and free entry and exit, imply price arbitrage. Market agents exploit and gain from price differences across markets. Theoretically, price arbitrage works to dissipate price wedges between domestic and world market, so that there is a stable tendency of domestic prices to align with external prices when expressed in a common currency unit.[1] In this context, a persistent price differential between the domestic and external markets is the result of government interventions. As such, this price differential becomes a key parameter for estimating transfers arising from government's price policies.

84. A variety of government policy measures may affect the domestic market price of a commodity, including measures imposed at the border, such as tariffs and export subsidisation, as well as quotas on imports or exports. Domestic market interventions may include direct price administration and public

1. This influence of arbitrage on prices of identical commodities exchanged in two or more markets is often referred to as the "law of one price". This law states that in an efficient market there must be, in effect, only one price for identical commodities regardless of where and how they are traded (although in nominal terms prices in different locations and along the value chain differ according to transaction and processing costs).

stockholding. All these policy interventions alter the domestic market price of a commodity compared to its border price.

85. This policy-induced price difference is denoted as the Market Price Differential (*MPD*):

$$MPD = DP - BP \qquad [4.1]$$

where: MPD – Market Price Differential

DP – domestic market price

BP – border price

86. *MPD* is positive when the policy induces a higher domestic market price, thereby supporting commodity production. It is negative when the policy induces a lower domestic market price, thereby discouraging commodity production.[2] In the latter case, policies place a tax on producers, and price transfers are accounted for in estimated support with a negative sign. Policies which alter the domestic market price affect both producers and consumers of a commodity; but they can also involve transfers to or from the government budget and therefore have implications for taxpayers.

87. Using a partial equilibrium framework, Figures 4.1 and 4.2 illustrate the price transfers associated with policies that increase or decrease the domestic market price of a commodity respectively. In both cases, a distinction is made according to whether the commodity is imported or exported. Domestic supply and demand curves are denoted by *SS* and *DD* respectively. The various price transfers are distinguished according to three economic groups – producers, consumers and others (including taxpayers) – receiving and financing these transfers.

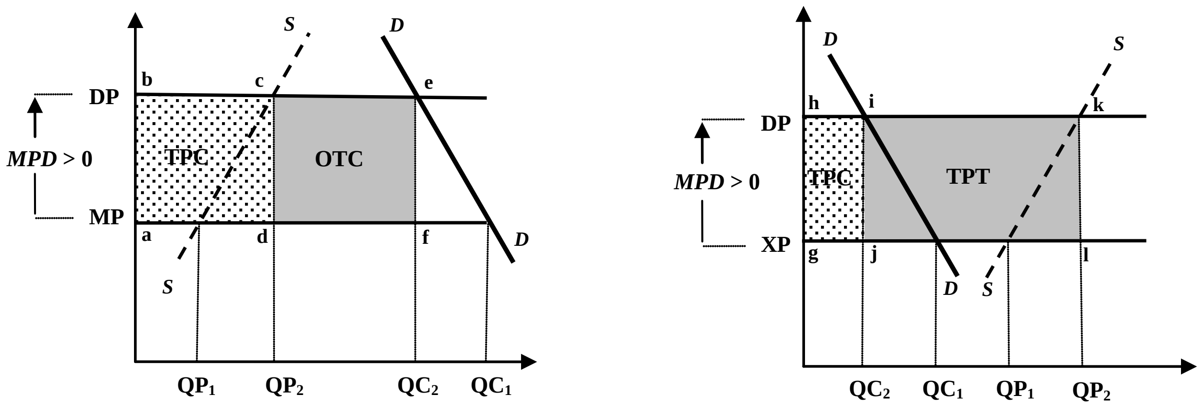
88. Panel A of Figure 4.1 presents the case where policies that increase the domestic market price are introduced on an imported commodity. In the absence of these policies, equilibrium will be reached in the domestic market when the domestic price is equal to the import price (MP), with domestic production equal to QP_1 and domestic consumption equal to QC_1. The difference between demand and supply, $QC_1 – QP_1$, is met by imports.

89. Policies that increase the domestic market price are now introduced, e.g. a tariff. Producers benefit from a higher price, encouraging them to produce more; on the other hand, consumers reduce consumption. A new domestic market equilibrium is reached at price *DP*, resulting in a positive *MPD*; with production rising to QP_2, consumption falling to QC_2, and the volume of imports falling to $QC_2 – QP_2$.

2. In this discussion, and in the calculation of the indicators in general, positive and negative price gaps and the concept of support, are described from the perspective of the producer. The perspective of the consumer is the reverse. Policies which raise market prices discourage consumption; policies which lower market prices support consumption.

Figure 4.1. Price transfers associated with policies that increase the domestic market price

A. Imported commodity **B. Exported commodity**



90. In the *import situation*, policies which increase domestic market price create the following price transfers:

- *Transfers to Producers from Consumers* (*TPC*), with the value corresponding to rectangle *abcd*:

$$TPC_i = MPD_i \times QP_i \qquad [4.2]$$

- *Other Transfers from Consumers* (*OTC*), with the value corresponding to rectangle *dcef*. These transfers are due to the fact that consumers pay the higher price *DP* for all consumption, whether the commodity is produced domestically or imported:

$$OTC_i = MPD_i \times (QC_i - QP_i) \qquad [4.3]$$

91. When there is only a tariff in place, the area *dcef* measures transfers from consumers to the budget in the form of tariff receipts. However, when other policy measures are used, e.g. tariff quotas, who receives this transfer from consumers depends on what measures are in place and how they are implemented. For example, if tariff quota imports are controlled through licences and distributed on a first-come-first-served basis, part or all of the transfer (termed "quota rents") may be obtained by those who receive the licences, whether domestic importers or foreign exporters. But no matter who receives the transfers (in the form of tariff revenue or quota rents), they have been paid by consumers.

92. Panel B in Figure 4.1 presents the case where policies that increase the domestic market price are introduced on an exported commodity. In the absence of policies, equilibrium will be reached in the domestic market when the domestic price is equal to the export price (*XP*). At this price, production is equal to QP_1 and consumption equal to QC_1. In this case, the difference between supply and demand, $QP_1 - QC_1$, is exported.

93. Policies that increase domestic market prices are now introduced. Consequently, the domestic price (*DP*) increases above the export price, creating a positive *MPD*. Producers benefit from a higher price, which encourages them to increase production to QP_2; consumers now pay a higher price, which results in a reduction in consumption to QC_2; and the quantity exported increases to $QP_2 - QC_2$.

94. In the *export situation*, policies which raise domestic market prices create the following price transfers:

- *Transfers to Producers from Consumers* (*TPC*), with the value corresponding to rectangle *ghij*:

$$TPC_i = MPD_i \times QC_i \qquad [4.4]$$

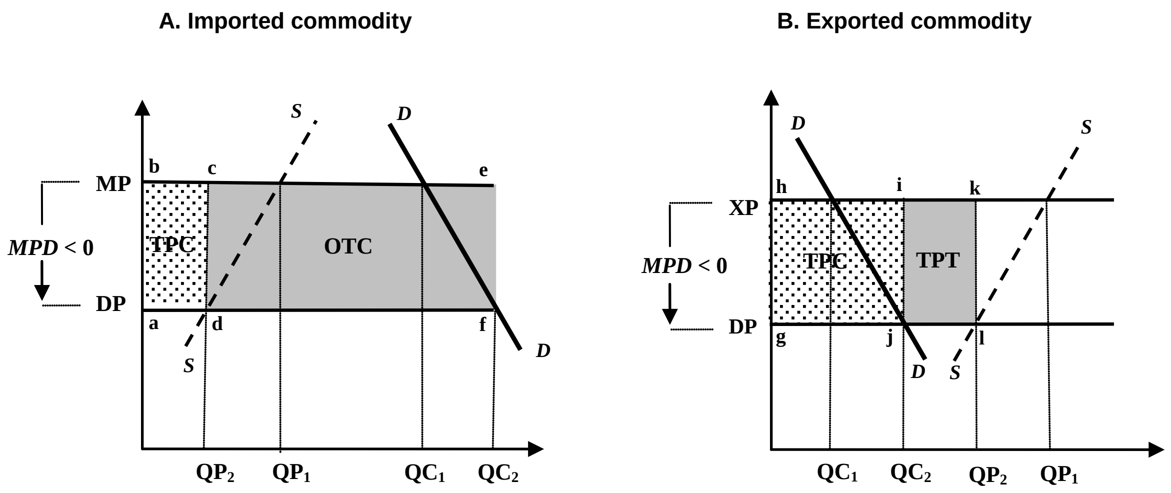
- *Transfers to Producers from Taxpayers* (*TPT*), with the value corresponding to rectangle *jikl*. These transfers represent the part of producer price support borne by taxpayers in the form of budgetary outlays on export subsidisation, food aid or public stockholding:

$$TPT_i = MPD_i \times \left(QP_i - QC_i\right) \qquad [4.5]$$

95. An important distinction between the import and export situations is that in the former only part of total price transfers created (*abef*) is received by producers (*TPC*), and this part is entirely financed by consumers. In the export case, all transfers (*ghkl*) are received by producers, and their cost is shared between consumers and taxpayers.

96. A similar analysis can be done for the situation where policies that induce a lower domestic market price are introduced, i.e. when a negative *MPD* is observed (Figure 4.2). Panel A shows the outcome when such policies are introduced on an imported commodity. In the absence of policies, equilibrium will be reached in the domestic market when the domestic price is equal to the import price (*MP*). At this price, production is equal to QP_1; consumption equal to QC_1; and the difference between demand and supply, $QC_1 - QP_1$, is imported.

Figure 4.2. Price transfers associated with policies that decrease the domestic market price



97. Policies that decrease the domestic market price are now introduced. For example, the government wishes to lower food prices by setting administrative limits on domestic prices and subsidising imported product. Consequently, the domestic price (*DP*) falls below the import price, creating a negative *MPD*. Production falls to QP_2 and consumption rises to QC_2. In this case, in contrast to Panel A, Figure 4.1, there is an increase in the volume of imports, $QC_2 - QP_2$. In the import situation, policies that decrease domestic prices create price transfers to consumers (*abef*) from producers (*TPC*) and taxpayers (*OTC*).

98. Panel B of Figure 4.2 presents the case for an exported commodity. In the absence of policies, equilibrium will be reached in the domestic market when the domestic price is equal to the export price

(*XP*). At this price, production is equal to QP_1 and consumption is equal to QC_1. In this case, the difference between supply and demand, $QP_1 – QC_1$, is exported.

99. Policies that decrease the domestic market price are now introduced. For example, the government may regard agriculture as a source of budgetary revenue and impose a tax on agricultural exports. Such a policy of low food prices may also be in accordance with the government's social objectives. Consequently, the domestic price (*DP*) decreases, creating a negative *MPD*. Production falls to QP_2, and consumption rises to QC_2, leading to a decrease in the volume of exports, $QP_2 – QC_2$. In the export situation, policies that reduce the domestic market price of a commodity create transfers to consumers (*TPC*) from agricultural producers, who also finance transfers to the budget (*TPT*) in the form of export taxes, resulting in overall transfers from producers represented by the area *ghkl*.

4.2. Price transfers to producers

- The Market Price Support (*MPS*) for a commodity is estimated by adding together transfers to producers from consumers and taxpayers, alternatively found by multiplying the quantity of production by the *MPD*.
- Adjustments for Price Levies and Excess Feed Cost net out the contribution that producers make to *MPS*.

100. In calculating the indicators, price transfers to producers are called ***Market Price Support (MPS)*** and are defined as: *the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policy measures that support agriculture by creating a gap between domestic market prices and border prices of specific agricultural commodities.*

101. Before presenting a general formula for estimating *MPS*, two new items need to be explained.

102. The first are Price Levies (*LV*), sometimes termed production taxes, which can be imposed on producers as part of market price support policy. An example of such a tax is the levy imposed on EU milk producers when they exceed their production quotas. Another example would be levies charged on producers to finance some of the cost of export subsidisation. *LV* is an observed value, which is obtained from the information on budgetary expenditures.

103. The second item is the Excess Feed Cost (*EFC*), a component accounting for the price transfers that go from livestock producers to feed producers as a result of policies which alter the domestic market price for feed crops, an important input for the former group.

104. The Price Levies and Excess Feed Cost are accounted for in the MPS in order to exclude from the value of price transfers to producers contributions that producers make to the transfers.

105. Based on the analysis in the previous section, a general formula for the calculation of MPS for commodity *i* is expressed as:

$$MPS_i = TPC_i + TPT_i - LV_i - EFC_i^{LV} \qquad [4.6]$$

where: TPC_i – Transfers to Producers from Consumers of commodity *i*

TPT_i – Transfers to Producers from Taxpayers of commodity *i*

LV_i – Price Levies for commodity *i*

EFC_i^{LV} – Excess Feed Cost for livestock commodity *i*

106. *EFC is included in the estimation of MPS for livestock commodities only* and calculated as (also illustrated in Box 4.1):

$$EFC_i^{LV} = \sum_j (MPD_j \times QC_j^i) \quad [4.7]$$

where: EFC_i^{LV} – Excess Feed Cost for livestock commodity *i*

MPD_j – Market Price Differential for feed crop j

QC_j^i – Quantity of crop *j* used as an input into the production of livestock commodity *i*

107. Note that the quantity of crops used should include *only domestically produced feed,* so that the total quantity of each feed crop, summed up across all types of livestock ($\sum_i QC_j^i$) satisfies the following condition: $\sum_i QC_j^i \leq QP_j$, where QP_j is the total domestic production of crop *j*. This condition is important in the situation when consumption of a feed crop is partly covered by imports. In this case it is the quantity of domestic production (QP_j) of that crop that is used for calculation of the *EFC*, and not the total quantity consumed for feed. This condition is necessary to ensure that *the EFC component of the MPS is calculated on the basis of domestic production*, consistent with all other *MPS* components.

108. The *EFC* adjustment may increase or reduce the value of MPS for livestock depending on particular mix of price affecting policies in place. For example, in a situation where both livestock production and feed crop production are supported by policies, resulting in positive *MPDs*, the *EFC* adjustment would reduce the *MPS* value for livestock. This occurs because livestock producers pay higher prices for feed crops as a result of price support for these commodities. The opposite would be true if policies are in place to decrease the price of feed, resulting in a negative *MPS* for feed crops. In this case, livestock producers receive additional price support because they can purchase feed at lower prices.

109. Substituting from equations 4.2, 4.4 and 4.5 into 4.6 yields equations 4.8a and 4.8b which distinguish the import and export situations. Both equations reduce to the same expression of transfers to producers. However, the transfers to producers from consumers (*TPC*) and from taxpayers (*TPT*) are identified separately, and may then be used to calculate other indicators and to analyse the composition of support.

Import Situation

$$MPS_i = (MPD_i \times QP_i) - LV_i - EFC_i^{LV} \quad [4.8a]$$

In the import situation, *TPT* is zero.

Export Situation

$$\begin{aligned} MPS_i &= (MPD_i \times QC_i) + (MPD_i \times (QP_i - QC_i)) - LV_i - EFC_i^{LV} \\ &= (MPD_i \times QP_i) - LV_i - EFC_i^{LV} \quad [4.8b] \end{aligned}$$

110. In calculating the indicators, MPS is first estimated for individual commodities. These estimates are used to calculate a national (aggregate) MPS, which is a major building block for the calculation of the PSE. The procedure for selecting individual commodities for which to calculate MPS, and the method for estimating the national MPS, are provided in section 6.1, along with empirical examples.

Box 4.1. Illustration of Excess Feed Cost adjustment in price transfers

The distinction in the calculation of the Excess Feed Cost (EFC) adjustment in price transfers for producers and for consumers is illustrated in Table 4.1.

Price Transfers to Producers (MPS): the EFC adjustment is made only for livestock products and is denoted in Table 4.1 as EFC^{LV}. This adjustment is calculated for each individual livestock product accordingly, yielding results presented in the last column of the table, i.e. EFC^{LF}_1, EFC^{LF}_2, to EFC^{LF}_m.

Price Transfers from Consumers (PTC): the EFC adjustment is made only for crop products *used for feed* in the country concerned and is denoted in Table 4.1 as EFC^{CR}. This adjustment is calculated for each individual crop product, yielding results presented in the last row of the table, from EFC^{CR}_1, EFC^{CR}_2, to EFC^{CR}_n.

Table 4.1. Schema for the calculation of Excess Feed Cost in price transfers for producers and consumers

		Feed crop products				**Excess Feed Cost in price transfers to producers (MPS)**
		Feed crop 1	Feed crop 2	…	Feed crop n	Sum across all crop products
Livestock products	Livestock product 1	$MPD_1 \times QC_1^1$	$MPD_2 \times QC_2^1$	…	$MPD_n \times QC_n^1$	$\mathbf{EFC^{LV}_1}$
	Livestock product 2	$MPD_1 \times QC_1^2$	$MPD_2 \times QC_2^2$	…	$MPD_n \times QC_n^2$	$\mathbf{EFC^{LV}_2}$
	…	…	…	…	…	**…**
	Livestock product m	$MPD_1 \times QC_1^m$	$MPD_2 \times QC_2^m$	…	$MPD_n \times QC_n^m$	$\mathbf{EFC^{LV}_m}$
Excess Feed Cost in price transfers from consumers (PTC)	Sum across all livestock products	$\mathbf{EFC^{CR}_1}$	$\mathbf{EFC^{CR}_2}$	**…**	$\mathbf{EFC^{CR}_n}$	$\mathbf{EFC_C}$

EFC^{LV} and EFC^{CR} *for an individual product* represent, respectively, the sums across rows and columns of Table 4.1 where each individual element is the product of quantity of feed crop j used for livestock product i (QC_j^i) and the Market Price Differential for the feed crop j (MPD_j), following formulas 4.7 and 4.10.

Summing up *across all individual products* – the EFC^{LV} for livestock products and the EFC^{CR} for crop products – yields an equal value. This value corresponds to an aggregate Excess Feed Cost Adjustment at the country level, or EFC_C in the bottom right-hand cell of Table 4.1. The aggregate EFC_C is included in the calculation of price transfers when deriving national (aggregate) level indicators.

4.3. Price transfers from consumers

- Price Transfers from Consumers (*PTC*) for a commodity are estimated by adding together transfers from consumers to producers and transfers from consumers to other recipients. Alternatively, this can be found by multiplying the quantity of consumption by the *MPD*.
- An Excess Feed Cost adjustment nets out the contribution that comes from other agricultural producers rather than from consumers.

111. Price Transfers from Consumers (*PTC*) are defined as: *the annual monetary value of gross transfers from (to) consumers of agricultural products, measured at the farm gate level, arising from policy measures that support agriculture by creating a gap between domestic market prices and border prices of specific agricultural commodities.*

112. Again, based on the analysis in section 4.1, a general formula for the calculation of ***price transfers from consumers*** resulting from policies which affect market price for commodity *i* can be expressed as:

$$PTC_i = -(TPC_i + OTC_i) + EFC_i^{CR} \qquad [4.9]$$

where: TPC_i – Transfers to Producers from Consumers of commodity *i*

OTC_i – Other Transfers from Consumers of commodity *i*

EFC_i^{CR} – Excess Feed Cost for crop commodity i

113. In this case, *TPC* and *OTC* are given a negative sign because these transfers represent an implicit tax on consumers. Excess Feed Cost (*EFC*) in the PTC is a component introduced to remove from the estimation of PTC the value of transfers that come from agricultural producers rather than from consumers. This contribution is due to the fact that part of the agricultural output – the crops used in animal feed – is purchased by livestock producers, and not by (non-agricultural) consumers. *The EFC adjustment is made only in the calculation of PTC for crop commodities*. The EFC adjustment may affect the PTC value in different ways depending on the particular mix of price policies applied. EFC for crops is calculated as follows (also illustrated in Box 4.1):

$$EFC_j^{CR} = MPD_j \times \sum_i QC_j^i \qquad [4.10]$$

where: EFC_j – Excess Feed Cost for crop *j*

MPD_j – Market Price Differential for feed crop j

QC_j^i – quantity of crop *j* consumed as feed by livestock i

114. Substituting from equations 4.2 to 4.5 yields separate calculations for both the import and export situation (4.11a and 4.11b). Both equations reduce to the same expression for calculating price transfers from consumers. Again, the practice is to estimate separate values for the recipient of the transfers from consumers to producers and others, which are then used for calculating other indicators and for analysing the composition of support.

Import Situation

$$PTC_i = -((MPD_i \times QP_i) + (MPD_i \times (QC_i - QP_i))) + EFC_i^{CR} = -(MPD_i \times QC_i) + EFC_i^{CR} \quad [4.11a]$$

Export Situation

$$PTC_i = -(MPD_i \times QC_i) + EFC_i^{CR} \quad [4.11b]$$

In the export situation, OTC is zero.

115. As in the case of *MPS*, *PTC* is estimated for a number of individual commodities. These estimates are then used to calculate various commodity-specific indicators of support to consumers, as well as to obtain a country's aggregate consumer Single Commodity Transfers, which is also the major building block for calculation of the Consumer Support Estimate. These topics are covered extensively in Chapter 7, including numerical examples.

4.4. Market Price Differential (MPD)

- The *MPD* measures the extent to which a set of agricultural policies affects the market price of a commodity.
- Normal practice is to calculate the *MPD* using a price gap which measures the difference between the domestic price and the border price of a commodity.
- As an alternative to the price gap method, *MPD* can be derived from the value of export subsidies or based on applied MFN tariff rate.

116. As demonstrated in the preceding sections, a key component in estimating the value of price transfers is the *MPD* which measures the extent to which policies affect the market price of a commodity. *An MPD is calculated for a commodity when one or more policies are applied that change the market price received by producers of that commodity. When there are no such policies in place, an MPD is not calculated and is assumed to be zero.*

117. Policies that change the market price for a commodity include, but are not limited to, the following list:

- Import measures – e.g. tariffs, levies, import quotas, tariff quotas and licensing requirements.
- Export measures – (a) enhancing exports, e.g. export subsidies, export credits and foreign food aid; (b) limiting exports, e.g. quantitative restrictions, licensing, export bans and export taxes.
- Domestic price support measures – e.g. production quotas, administered prices and intervention purchases, including for domestic food aid, public stockholding and market withdrawals.

118. The benefit of calculating the value of price support transfers through an *MPD* is that it captures in a single measure the combined impact on market prices of a potentially complete set of price policies. Policies which raise the price received by producers for a commodity without changing the market price (i.e. without raising consumer prices) are included elsewhere within the PSE under category *A.2 Payments based on output*.

119. Most commonly, policies affecting market prices are implemented by governments in order to increase the price received by producers of a commodity. *Ceteris paribus,* such policies will lead to a positive *MPD*. The *MPD* is interpreted as a static measure of the additional price received by producers resulting from agricultural policies in a given year. It is the extra cost paid by consumers and in some cases also by taxpayers, resulting from policies that provide market price support to agricultural production.

Alternatively, as analysed in section 4.1, some countries may implement policies that lower market price for a commodity. *Ceteris paribus*, such policies will lead to a negative *MPD*.

120. The common approach to calculate the *MPD* for a commodity is to measure the difference between two prices, i.e. a domestic market price in the presence of the policies and a border price, whether an import or export price, representing the opportunity price (cost) for domestic market participants.

121. The graphical analysis presented in section 4.1simplified the domestic market down to a single level at which transactions take place. In reality, there are a number of different levels at which prices can be measured within a domestic market: farm gate prices (i.e. prices received by producers), wholesale prices, retail prices, prices at the border, etc.; these reflect, among other things, various stages of processing. Section 4.5 discusses how to select and adjust domestic market prices and border prices to calculate the *MPD* at the farm gate level. Section 4.6 details two alternative procedures, sometimes used to derive an *MPD*, which do not rely on the price gap method.

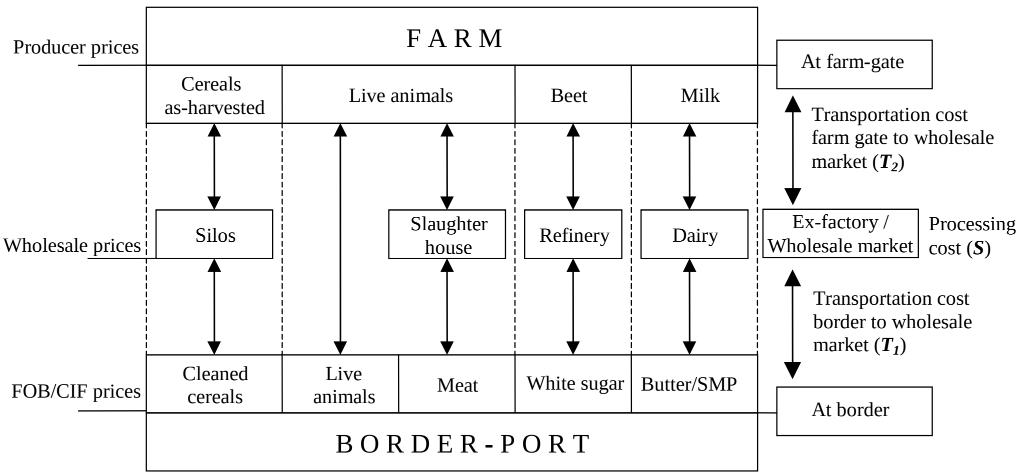
4.5. Calculating an MPD based on the price gap method

- The underlying principle is to compare "like with like" prices, at the farm gate or another level. To do so, adjustments may be needed for both marketing margins (representing the costs of processing, transportation and handling) and weight conversion (e.g. in crop processing, of livestock slaughter), and similar product quality must be ensured.
- Various formulas are used depending on whether a commodity is imported or exported.

4.5.1 General approach

122. The underlying principle is that support is measured at the farm gate level. Consequently, the task is to obtain an estimate of the price gap at the farm gate level. The challenge in doing this is that an agricultural commodity that is sold by a producer at the farm gate may be very different from the products derived from that commodity which pass over the border. This is particularly so for livestock commodities and commodities such as sugar, wine grapes and oranges, which may have a significant degree of processing involved before being traded at the border, e.g. juices made from fruit). In addition, border prices include transportation, handling and other costs incurred in bringing the product to the point of trade (Figure 4.3).

Figure 4.3. Schematic presentation of value added chain



Price gap calculation using farm gate prices

123. One method to deal with this challenge of comparing "like with like" is to compare a producer price, i.e. a price which is received at the farm gate level, with a border price that has been adjusted to make it comparable with the farm gate producer price. This involves netting (out, i.e. excluding from) the border price of marketing margins that may be applicable. It also involves weight adjustment, so that prices are comparable on a quantity basis, and adjustments for quality differences if relevant. As a result of these adjustments, *a border price measured at the farm gate level is obtained; this is further referred to as the reference price***.** The *MPD* for a commodity estimated through this method is expressed as:[3]

$$MPD_i = PP_i - RP_i \quad [4.12]$$

and :

$$RP_i = (BP_i \times QA_i - MM_i) \times WA_i \quad [4.13]$$

where: PP_i – producer price for commodity *i*

RP_i – reference price of commodity *i* (border price at farm gate)

BP_i – border price of commodity *i* or products derived from commodity *i*

QA_i – quality adjustment co-efficient for commodity *i*

MM_i – marketing margin adjustment for commodity *i*

WA_i – weight adjustment co-efficient for commodity *i*

124. The producer price can be the annual average price received by all producers of a given commodity, or a representative producer price, perhaps of an average product quality grade. The choice relates to what suits the best for observing the "like with like" principle in comparing with the border price chosen. It is not necessarily appropriate to compare an average domestic producer price for a commodity with a border price for one specific product derived from that commodity.

125. It should also be noted that, depending on the character of the price data used: (a) border price adjustments in equation 4.13 may not necessarily be expressed in this particular algebraic form; (b) neither adjustment (for marketing margin, weight or quality) may be necessary; and that (c) making one adjustment does not necessarily require the other.

Price gap calculation using wholesale prices

126. In some cases, an approach is adopted to estimate the price gap at a higher level in the value added chain, e.g. at the wholesale level, by using wholesale prices instead of farm gate prices for comparison with border prices. In this case, the *MPD* can be expressed as:

$$MPD_i = PP_i - RP_i = WP_i - BP_i \quad [4.14]$$

where: WP_i – wholesale price of commodity *i*

127. This approach assumes that the *absolute price gap* measured at a higher level of the processing chain, $WP_i - BP_i$, is the same as occurs at the farm gate level, $PP_i - RP_i$. In some cases, it may be more

3. Note that the *MPD* expression in equation 4.12 is in principle similar to that in equation 4.1; however, in the latter, adjustments of border price to the farm gate were omitted for simplification.

reasonable to assume the equality of the price gap in relative terms, $\frac{WP_i - BP_i}{WP_i}$, i.e. that it is the *rate of protection* that is the same at the wholesale and farm gate levels. The latter implies that a proportion of the absolute price gap measured at the wholesale level is captured at that level, and that only a part of the measured price gap is passed back to the farm gate. In this case, the *MPD* is expressed as:

$$MPD_i = PP_i \times \frac{WP_i - BP_i}{WP_i} \qquad [4.15]$$

128. It is a matter of judgment as to which of the two "equality assumptions" should be used. In principle, the more competitive the food chain, the more reason there is to assume the equality of absolute price gaps. However, if the structural characteristics of the food chain are such that it is more appropriate to assume that part of the protection is captured at higher levels of the food chain, it would be preferable to use the assumption of the equality of relative price gaps.

129. Theoretically, the method to calculate the *MPD* using the farm gate prices is superior to the one based on wholesale prices, because the latter involves rather simple assumptions on the transmission of protection across the food chain. However, in practical terms, the choice is usually determined by the nature and availability of the price and marketing margin data, and in some cases it may be more appropriate to measure the price gap at a higher level of the value chain. First, this will avoid most (or all) of the adjustments of border price to the farm gate. Both wholesale and border prices, properly selected, represent products at the same value added level. Wholesale markets may be located near the border, and hence the transportation differential between the two markets can then be ignored; a considerable advantage when information on marketing margins is scattered and difficult to obtain. Therefore, it may be more accurate in some cases to use wholesale prices to estimate the *MPD* than to adjust the border price to the farm gate when there is imperfect marketing margin data. Second, the data on farm gate prices is not always available or representative. This is the case, for example, of highly integrated industries, such as the poultry or sugar industries, where considerable quantities of primary production are directed down the food chain within one firm and without passing through the market.

Box 4.2. Setting a negative price gap to zero

In some cases, an *MPD* with the sign opposite to what would be expected based on the policies in place may be calculated. This is the case, for example, when for an exported commodity the domestic price is below the border price but no policies – export duties, export restrictions, or administrative barriers to inter-regional movement of goods – are applied that would explain the negative price gap. Similarly, when for an imported commodity it may be found that the domestic price is less than the border price, but policies which should increase the domestic price are in place, such as a tariff. In such cases, the *MPD* is set to zero, i.e. *PP = RP*, on the assumption that the observed price gap is due to factors not related to agricultural policies. While setting the negative *MPDs* to zero may improve the accuracy of the estimation, it may also reduce consistency over time and between countries, since positive *MPDs* may also capture the impact of non-policy factors, while negative MPDs, when set to zero, do not.

130. The following sub-sections further develop the calculation of price gap. Sub-section 4.5.2 discusses the selection of a border price, while the last three sub-sections focus on the key elements of adjusting the border price to the farm gate: sub-sections 4.5.3 and 4.5.4 discuss, respectively, the marketing margin and weight adjustments, while sub-section 4.5.5 addresses the need for quality adjustments.

4.5.2 Selecting a border price

131. A variety of border prices and alternative methods are used to calculate MPDs for OECD and selected non-OECD countries (Table 4.2). The choice of a border price for a given commodity in any country is determined by factors such as market structures, specifically the net trade position of the commodity concerned, and data availability. The net trade situation is defined by comparing total domestic

consumption and production of the commodity. When there is no trade because the commodity, tradable in principle, is highly protected, the country is treated as a net importer.

Border price for an exported commodity

132. If the country is a net exporter of the commodity, the most appropriate border price is an *FOB* unit value.[4] Very simply:

$$BP_i = FOB_i \qquad [4.16]$$

133. The *FOB* value may be either an annual average of a specific *FOB* quotation price or the annual average unit value of exports of the commodity (*i.e*. total value of exports divided by total quantity). An *FOB* value may correspond to different levels of tariff aggregations. If so, care needs to be taken to ensure that prices and quantities relate to a common unit for calculating an average unit value. It is preferable to choose the tariff lines for the least transformed products. If trade in these products is small, then more traded tariff lines may be used.

134. As shown in Table 4.2, *FOB* prices are the main source from which reference prices are derived for the European Union, Turkey, Brazil, Chile and Ukraine. For the EU, both export unit values (e.g. for pigmeat and poultry) and specific *FOB* quotation prices (e.g. the London daily price for white sugar from EU ports) are used.

135. In the case of a large exporter of a commodity, if exports account for a significant share of domestic production and no export subsidy or other export-enhancing measures are applied, the *MPD* is assumed to be zero. This assumption is made for the majority of commodities produced in Australia and New Zealand, and for apples, (table) grapes and oranges in South Africa.

4. *FOB* stands for Free on Board. It is the cost of an export good at the exit point in the exporting country, when it is loaded in the ship or other means of transport in which it will be carried to the importing country. See next footnote for *CIF*.

Table 4.2. Border prices and alternative methods used to derive the *MPD* by country

Country	Border Prices						Alternative Methods		Set equal to PP (MPD is zero)
	Net Exporter	Net Importer					Net Exporter	Net Importer	
	Country's own		Other country						
	Traded price				Other price				
	Export price (FOB)	Import price (CIF)	Import price (CIF)	Export price (FOB)	Wholesale price	Producer price	Export Subsidy (per tonne)	Import tariff	
OECD countries									
Australia	MK							RI	BA, BF, CT, EG, OA, PK, PT, RP, RS, SB, SF, SH, SO, WL, WT
Canada		MK			BF	EG, PT		MA	BA, OA, PK, RS, SB, WT, FX, PO, LN, BN. PE
Chile		WT, MA, RS, BF, MK							AP, GR, TM, PK, PT
EU-27	BA, EG, MK, OA, PK, PT, RS, WT	MA, RI, SH, TO[1]				BF	WI	FL, PO	RP, SF, SB
Iceland			SH	BF, EG, MK, PK, PT		WL			
Israel	CT	WT, AP	BS	MK, PT, EG		BF		SH	PN, TM, PB, PO, OR, GP, GR, AV
Japan		BA, CC[2], CU[2], GR[2], MK, MN[2], PR[2], RI, RS, SP[2], SW[2], WO[2], WT			PK			AP[2], BF, EG, PT	SB
Korea		BA, BF, GA, MK, PP, SB		RI	PK	EG, PT		CC	
Mexico	TM	MK		BA, MA, RI, SB, RS, SO, WT	BF, BN, CF	EG, PK, PT			
New Zealand				EG		PT			BA, BF, MA, MK, OA, PK, SH, WL, WT
Norway			SH	BA, BF, EG, MK, OA, PK, PT, WT					WL
Switzerland		BA, MA, MK3, RS, WT	SH	BF, EG, PK, PT		RP			
Turkey	AP, CT, GR, PO, SH, TB, TM	MK, WT	MA, SF	BA, BF, EG, PT, RS					
United States	MK			RS	BF		BA, EG, PK, PT, RI, WT[4]	SH, WL	MA, SB, SO
Non-OECD countries									
Brazil[5]	CF[6], PK, PT, RS,	RI, CT[7], MK		MA, WT					SB, BF
China[8]	MA	WT, CT, MK, RP, RS, SB		RI[9]				BF, SH, PT, PK	AP, PN, EG
Indonesia		MA, RS, MK, BF	PT, EG	RI			PL	SB	CO, CV, BS, RB, CF, PK
Kazakhstan	WT, BA, MA, CT	MK, PT, EG		RI, SF, PK		BF, SH, PO			
Russia[10]	WT, MA, BA, SF	RS, BF, MK, PT, PO		EG, OA, PK, RY					
South Africa[11]	MA, PN, RS	MK	BF, PK, PT, SF, SH, WT						AP, EG, GR, OR
Ukraine	BA, BF SF, MA, MK, OA, PT, SF, WT		PO	EG, PK, RS					

Notes to Table 4.2

1. Whether a *CIF* or *FOB* price is used to derive a reference price is calculated on a monthly basis depending on the net trade situation. See Box 4.3 for the treatment of seasonal markets.
2. The lower of the average annual *CIF* value or the producer price plus tariff.
3. While Swiss import prices are used for butter and SMP, the EU *FOB* export price is used for four types of cheese.
4. EEP subsidies were last provided in 1998 for BA, 1996 for *EG*, 1994 for *PK*, 2001 for *PT*, and 1995 for *RI* and *WT*.
5. For exported commodities *BF*, *CF*, *PK*, *PT*, *RS* and *SB*, negative price gaps are calculated based on actual prices but *MPD* is set at zero. For imported commodities *MA*, *RI* and *WT* applied in years for which negative price gaps are calculated, *MPD* is also set at zero (Box 4.2).
6. Weighted average of Brazilian *FOB* export prices for Arabica and Robusta coffee.
7. Brazilian import data are officially reported on an *FOB* basis.
8. For exported commodities *AP*, *BF*, *EG*, *PK*, *PN* and *PT*, negative price gaps are calculated based on actual prices, and *MPD* is set at zero.
9. Weighted average of Thai export price (*FOB*) for Indica rice and US export prices (*FAS* – Free Alongside Vessel) for Japonica-type rice.
10. For imported commodity *EG*, negative price gaps are calculated based on actual prices and *MPD* is set at zero.
11. For exported commodities *MA* and *PN*, negative price gaps are calculated based on actual prices and *MPD* is set at zero.

Commodity acronyms:

AP – Apples	FL – Plants and flowers	PE – Dry Peas	SB – Soybean
AV - Avocados	FV – Other fruit and vegetables	PR – Pears	SF – Sunflower
BA – Barley	FX - Flaxseed	PK - Pigmeat	SH – Sheep meat
BF – Beef and veal	GA – Garlic	PL – Palm oil	SO – Sorghum
BN – Dry beans	GP - Grapefruit	PN – Peanuts	SP – Spinach
BS - Bananas	GR – Grapes	PO – Potatoes	SW – Strawberries
CC – Chinese cabbage	LN - Lentils	PP – Red pepper	TB – Tobacco
CF – Coffee	MA – Maize	PT – Poultry	TM – Tomatoes
CO – Cocoa beans	MK – Milk	RB – Rubber	WI – Wine
CT – Cotton	MN – Mandarins	RI – Rice	WL – Wool
CU – Cucumbers	OA – Oats	RP – Rapeseed	WM - Watermelons
CV – Cassava	OR – Oranges	RS – Raw sugar	WO – Welsh onion
EG – Eggs	PB - Pepper	RY – Rye	WT – Wheat

Source: OECD indicator database.

Border price for an imported commodity

136. If the country is a net importer of the commodity, and if imports are regular and of a reasonable quantity, then the most appropriate border price is a *CIF* value for imports into that country.[5]

$$BP_i = CIF_i \qquad [4.17]$$

137. This can be either the annual average *CIF* unit value for imports of the commodity or products derived from the commodity, or an annual average of a specific *CIF* quotation price. *CIF* prices are used for the majority of commodities in Japan and Korea, and for some commodities in China, the EU and Switzerland.

138. As in the export case, it is preferable to choose the tariff lines for the least transformed products and, if trade in these products is small, more traded tariff lines are to be used. However, if imports are irregular and/or insignificant in quantity, other sources for prices need to be investigated. Similarly, if imports vary in quality from one year to the other, or are very different from those produced in the country, the unit value of imports should be avoided.

139. First, consider if there are other border prices that might be relevant. It may be appropriate to use a *CIF* price in another country, particularly if it is located close by and imports significant quantities of the same product.

$$BP_i = CIF_{other} \qquad [4.18]$$

where: CIF_{other} – annual average CIF unit value for imports in another country

140. As an example of this method, the EU CIF price for sheepmeat is used as a proxy for border price for Iceland, Norway and Switzerland.

141. Alternatively, if a nearby country is a major exporter of the commodity, then an *FOB* price from that source may provide a satisfactory proxy for border price. In this case, the insurance and freight to the country concerned may be added if considered significant.

$$BP_i = FOB_{other} + IF_i \qquad [4.19]$$

where: FOB_{other} – an annual average *FOB* unit value for exports from another country

IF_i – insurance and freight cost of transporting the product to country concerned

142. For example, EU *FOB* prices are used to derive border prices for livestock commodities for Iceland, Norway, Switzerland and Turkey. US *FOB* export prices are used as the basis for calculating reference prices for a number of commodities for Mexico. Sugar border prices for Mexico and the US are derived from the *FOB* price of sugar from Barbados.

143. If actual border prices are not available or relevant, it may be possible to construct a border price based on a wholesale price in another country. For example, border prices for beef in the three North

5. *CIF* stands for Cost, Insurance and Freight. It is the landed cost of an import good on the dock or other entry point in the receiving country. It includes the cost of international freight and insurance and usually also the cost of unloading onto the dock. It excludes any charge after the import touches the dock, such as port charges, handling and storage and agents' fees. It also excludes any domestic tariffs and other taxes or fees, duties or subsidies imposed by a country-importer.

American countries of Canada, Mexico and the US are derived from an Australian wholesale cattle price. A US wholesale price for pigs is used to derive a border price for pigmeat in Japan and Korea. A similar equation to 4.19 is used in this case.

144. Finally, there are certain situations where it is appropriate to derive a border price for a commodity from a producer price for the same commodity in another country:

$$BP_i = FG_{other} + IF_i \qquad [4.20]$$

where: FG_{other} – farm gate price from commodity *i* in another country

145. It can be appropriate to use this method when there is significant transformation of the commodity from that produced by the farmer to the product traded internationally. For example, border prices for wool for Norway and Iceland are derived from the New Zealand producer price for wool. This method was also used prior to 2005 to calculate the *MPD* for milk for all countries monitored. It can also be the appropriate method when the volume of international trade in the product is severely limited by sanitary and phytosanitary requirements, as in the case of poultry meat.

146. The most appropriate border price may change for a commodity within a country over time. There are primarily three reasons for this: (a) data becomes available (or unavailable), e.g. import flows become regular and significant, resulting perhaps from policy reform lowering border protection; (b) the net trade position of the commodity changes; or (c) there is a significant change in the policy measures affecting the market price of a commodity. The net trade position is reassessed every year: *if a country has been a net importer in two of the previous three years, it is considered as a net importer, and vice versa for the net exporting situation*.

Box 4.3. Calculating MPD for a commodity with seasonal markets

Some crops (e.g. fruits and vegetables) are highly perishable and seasonal. In principle, each month could be considered as a separate market given that supply is specific and cannot be transferred to the following month without bearing high storage costs and deterioration of the goods. Policy interventions, in particular import tariffs, often vary according to the month or season. At harvest time, higher import tariffs are usually applied to protect domestic production, while lower tariffs are applied in off-season periods. These are often referred to as seasonal tariffs. At the same time, market withdrawals may occur during the harvesting period.

In these cases, the annual average *MPD* is estimated by weighting seasonal *MPD*s, i.e. the difference between producer and reference prices for each season (or month) within a year, by the seasonal (monthly) quantity of marketed production. When the data are not available, the existing pattern of domestic marketed production or consumption may be estimated. Statistics on international trade are currently available on a monthly basis. Consequently, if the seasonal pattern of domestic marketed production can be estimated with a sufficient degree of reliability, domestic availability for use can be estimated (or *vice versa* if the pattern of domestic consumption is easier to estimate). When no estimation of seasonal production and consumption is possible, an annual *MPD* may be calculated by weighting seasonal *MPD*s by the number of days each tariff remains in force.

This method is used to calculate the *MPD* for tomatoes in the European Union. A *MPD* is estimated for each month as the difference between the unit value of intra-EU trade (the domestic price) and the unit value of extra-EU trade (the border price). Monthly *MPD*s are then averaged using the seasonal pattern of production, i.e. the share of monthly production in total annual production.

4.5.3 Marketing margin adjustment

147. To be correctly compared with the farm gate price, the border price must be made equivalent to the farm gate price, i.e. it must be adjusted for marketing margins, which include the costs of processing, transportation and handling of a product incurred between the farm gate and the border.

148. *Processing costs* relate to the physical transformation of primary farm products into marketable ones. Agricultural products often undergo a certain degree of transformation before they are traded: grains

are cleaned, dried, or husked; sugar beet is processed into sugar; and animals are slaughtered, cut and packed. The costs of these operations should be netted from the border price.

149. *Transportation and handling costs* relate to the spatial movement of products and represent another source of value added beyond the farm gate. The way in which the border price is adjusted for transportation costs depends on whether the product is imported or exported (Figure 4.3). In the case of *imports*, the first step is to add to the CIF price the costs of transporting the product from the border to the internal wholesale market (T_1). This is necessary in order to account for the full cost of an import at the domestic market level. The second step is to subtract from this price the cost of transporting the product from the wholesale market to the farm gate (T_2). This is necessary to express the price of an import in farm gate equivalent terms. The marketing margin adjustment to the CIF price, which also takes into account processing costs, is thus expressed as:

150. $$CIF_i^* = CIF_i + T_1 - T_2 - S \qquad [4.21]$$

where CIF_i^* – CIF price of imported product *i* adjusted to the farm gate (reference price)

T_1 – handling and transportation costs between border and domestic wholesale market

T_2 – handling and transportation costs between wholesale market and the farm gate

S – costs of processing farm product into imported product *i*

151. In the case of *exports*, an *FOB* price is adjusted *only* downwards to the farm gate so as to exclude all internal costs incurred between the farm gate and the border. The marketing margin adjustment in the case of an export is expressed as follows:

152. $$FOB_i^* = FOB_i - T_1 - T_2 - S \qquad [4.22]$$

where FOB_i^* – *FOB* price of exported product *i* adjusted to the farm gate (reference price)

T_1 – handling and transportation costs between border and domestic wholesale market

T_2 – handling and transportation costs between wholesale market and the farm gate

S – costs of processing of farm product into exported product *i*

153. All cost elements of the margin adjustment should be those of the country concerned (whether an importer or exporter) and not the costs reflecting the market structures of another country.

154. There can be difficulties in obtaining reliable or regular data on marketing costs, and these difficulties may justify some simplifications. A standard simplification relates to adjustments of the *CIF* price for imported commodities. As can be seen from equation 4.21, one element of the transportation costs (T_1) increases the reference price, while another (T_2) reduces it. This allows for the assumption that these costs offset each other, a simplification which is actually applied in the majority of cases where *CIF* prices are used. Adjustment for processing costs can be minimised (or omitted) by selecting external prices for products that are minimally transformed.

4.5.4 Weight adjustment

155. As farm products undergo physical treatment before they are traded, more than one unit of weight of a farm gate product is typically required to obtain one unit of weight of a traded product. For example, one tonne of boneless beef requires the processing of approximately 1.9 tonnes of live animal, or *vice versa*, one tonne of live animal yields only 0.53 tonnes of boneless beef. Hence, border and farm gate prices may not be directly comparable, in the sense that they reflect different quantities of a farm gate product (or alternatively, they reflect different quantities of a traded product). For comparisons to be accurate, the two prices need to be expressed on the same weight basis, i.e. in terms of either the farm gate commodity or the traded product. This is achieved by adjusting for weight either the producer price or the border price. Both methods yield the same price gap result. Using equation 4.13 (where other adjustment are omitted for simplicity), the alternative for the weight adjustment is as follows:

Option 1: Expressing producer price in boneless beef weight equivalent*:*

$$PP_{bb} = \frac{PP_{bl}}{WA_{bb}} \qquad [4.23]$$

Option 2: Expressing reference price in live animal weight equivalent:

$$RP_{bl} = (BP_{bb} - MM_{bb}) \times WA_{bb} \qquad [4.24]$$

where: PP_{bb} – producer price for beef in boneless beef weight equivalent

PP_{bl} – producer price for beef in live animal weight equivalent

WA_{bb} – weight adjustment co-efficient (tonnes of boneless beef obtained from one tonne of live animal)

BP_{bb} – border price of boneless beef

RP_{bl} – reference price of boneless beef in live animal weight equivalent

MM_{bb} – marketing margin adjustment to border price of boneless beef

156. The algebraic procedure of the weight adjustment may not always be such as written in equations 4.23 and 4.24. It is determined by how the weight adjustment coefficient (*WA*) is expressed. For example if *WA* is expressed in tonnes of live animal required to obtain one tonne of boneless beef (1.9 tonnes), i.e. if it represents a reciprocal of WA_{bb} as defined above, the procedure would be to multiply the producer price by *WA* in equation 4.23 and to divide the border price (with margin adjustment) by *WA* in equation 4.24.

157. It is also *important to ensure that all quantity variables used in calculations* (e.g. quantities of production and consumption) *are expressed in the same weight equivalent* as that applied for prices.

4.5.5. Quality adjustment

158. The domestic market and border prices used to estimate the *MPD* should represent commodities/products of similar quality. Quality relates to such product attributes as size, colour, moisture level, protein, fat or oil content, degree of impurities, bacterial pollution, etc. Among other factors, these determine commodity prices and cause price differentials, which may emerge independently of price

policies. The measured *MPD* should be free from the “noise” due to quality differences, so that the border price is comparable with the domestic price in terms of product quality.

159. A quality differential should not be confused with price differences that reflect the degree of processing that the commodity has undergone. For example, prices for meat can be expressed in terms of carcass meat, meat with bone, or boneless meat. Each of the three prices represents three different stages of processing, and the corresponding price differentials are due to the value added at each stage and to the physical transformation of product, although each price may represent meat obtained from the same animal and therefore reflecting the same product quality.

160. For the majority of *MPD* estimates, no quality adjustment is made, indicating that it is generally assumed that the quality composition of domestic and traded commodities/products is reasonably comparable. However, there are a few cases (summarised in Table 4.3) when specific adjustments to the border price are made to bring it closer to the domestic producer price in terms of some specific quality characteristic. The way in which the adjustment is carried out largely depends on the type of quality characteristics affecting the price levels and data availability.

161. *Example 1: MPD based on weighted average for different market segments*. An *MPD* is estimated for the various market segments; an average *MPD* is calculated by weighting each segment *MPD* by the share of that segment in domestic production. This method can only be used when both domestic and border prices can be identified for products of different segments.

162. This method, for example, is used to estimate the *MPD* for beef and veal in Switzerland where veal represents about 40% of the total value of beef and veal production. The *MPD* for beef and veal is the weighted average of the *MPD*s estimated individually for veal and beef:

$$MPD_{BF} = MPD_V \times \frac{VP_V}{VP_{BF}} + MPD_B \times \frac{VP_B}{VP_{BF}} \qquad [4.25]$$

where MPD_{BF} – weighted average *MPD* for beef and veal

MPD_V – *MPD* based on prices for veal

MPD_B – *MPD* based on prices for beef (cows, bulls, steers and heifers)

VP_V – value of veal production

VP_B – value of beef production (cows, bulls, steers and heifers)

VP_{BF} – total value of beef and veal production

163. When the average quality of commodities produced domestically is very different from the quality of commodities available at the border, there are two possible options to compare like with like.

164. *Example 2: applying a quality adjustment coefficient to the border price* to bring it to a comparable level of quality with the domestic price. This method is used to estimate the *MPD* of wheat for Ukraine, which is a net exporter of wheat. The *MPD* is estimated based on a differential between the Ukrainian average domestic and export prices of wheat. Feed wheat typically accounts for the majority share of Ukrainian exports, while domestic production is relatively evenly distributed between milling and feed quality wheat. In order to eliminate the impact of such quality asymmetry on the levels of average domestic and export prices and therefore on the measured *MPD*, the reference price is adjusted as follows:

$$BP_{WT}^{*} = BP_{WT} \times QA \qquad [4.26]$$

and $$QA = \frac{BP_{WT}^{*}}{BP_{WT}} \qquad [4.27]$$

where BP_{WT}^{*} – border price with quality adjustment

BP_{WT} – border price before quality adjustment

QA – quality adjustment coefficient

165. The quality adjustment coefficient (QA) in equation 4.27 can be derived as follows:

(i) express the domestic producer price of wheat (PP_{WT}) as a weighted average of domestic producer prices for feed (PP_{feed}) and milling (PP_{mill}) wheat with weights – *a* and *b* respectively – being the quantity shares of each wheat type in total domestic production:

$$PP_{WT} = a \times PP_{feed} + b \times PP_{mill} \qquad [4.28a]$$

(ii) express the border price of wheat (BP_{WT}) as a weighted average of border prices for feed (BP_{feed}) and milling (BP_{mill}) wheat, with weights – *c* and *d* respectively – being the quantity shares of each wheat type in country's total exports:

$$BP_{WT} = c \times BP_{feed} + d \times BP_{mill} \qquad [4.28b]$$

(iii) express BP_{mill} through BP_{feed}, assuming ΔP to be a quality price differential between the two prices:

$$BP_{mill} = (1 + \Delta P) \times BP_{feed} \qquad [4.28c]$$

(iv) express BP_{WT} through BP_{feed} using [4.28c]:

$$BP_{WT} = c \times BP_{feed} + d \times (1 + \Delta P) \times BP_{feed} = BP_{feed} \times (c + d \times (1 + \Delta P)) \qquad [4.28d]$$

(v) assume the adjusted border price of wheat (BP_{WT}^{*}) to be a weighted average of border prices for feed (BP_{feed}) and milling (BP_{mill}), with weights being shares of feed and milling wheat in domestic production – *a* and *b* – and express BP_{WT}^{*} in terms of border price of feed wheat using [4.28d]:

$$BP_{WT}^{*} = a \times BP_{feed} + b \times (1 + \Delta P) \times BP_{feed} = BP_{feed} \times (a + b \times (1 + \Delta P)) \qquad [4.28e]$$

(vi) obtain *QA* using [4.27], [4.28d] and [4.28e]

$$QA = \frac{BP_{WT}^{*}}{BP_{WT}} = \frac{a + b \times (1 + \Delta P)}{c + d \times (1 + \Delta P)} \qquad [4.28f]$$

166. As is seen from equation 4.28e, the key assumption used for this method is that the adjusted border price is a weighted average of border prices for feed and milling wheat with weights corresponding to quantity shares of these two types of wheat *in domestic production*. Another assumption is that the quality premium for milling wheat (ΔP) is the same for both domestically marketed and exported grain. Calculation of the quality adjustment coefficient requires information on the composition of domestic

production and exports in terms of quantities of feed and milling wheat (coefficients *a*, *b*, *c*, and *d*) and the quality price differential between milling and feed wheat (ΔP). It is possible to apply this method to any other commodity and to adapt the formula to include any number of quality grades, if relevant.

167. *Example 3: using weighted average of border prices for specific quality grades*. Brazil is a net exporter of coffee. A higher-priced Arabica coffee accounts for around 90% of Brazilian exports and a lower-priced Robusta coffee for the remaining 10%. The shares of these two groups in domestic production are around 75% and 25% respectively. The difference in the quality composition of domestic production and exports is tackled by constructing a weighted average reference price, as follows:

$$BP_{CF} = FOB_A \times \frac{QP_A}{QP_{CF}} + FOB_R \times \frac{QP_R}{QP_{CF}} \qquad [4.29]$$

where: BP_{CF} – weighted average border price of coffee

FOB_A – export price of Arabica coffee

FOB_R – export price of Robusta coffee

QP_A – quantity of Arabica coffee produced

QP_R – quantity of Robusta coffee produced

QP_{CF} – total quantity of coffee produced

168. The border price in equation 4.29 represents a weighted average of the Robusta and Arabica export prices, with weights corresponding to the shares of these two groups in domestic production. As in the previous example, this is a key assumption for harmonizing quality composition of border and domestic prices. This method is also used to derive China's import price for rice, which represents a weighted average of Japonica and Indica-type rice. This method, therefore, can be used both for exported and imported products, but requires the existence of international trade prices for products of specific quality grades.

Table 4.3. Methods used for adjusting prices for quality difference

Country	Weighted average MPD for different market segments	Adjusted border price	
		With quality adjustment co-efficient	Weighted average of border prices for specific quality grades
Canada	BF	-	-
US	BF	-	-
Norway	-	PT	-
Switzerland	BF	-	-
Brazil	-	-	CF
China	-	-	RI, WT
Ukraine	-	BA, WT, MA	-

4.6. Alternative methods for calculating an MPD

- Instead of using a price gap to calculate a *MPD*, export subsidy or import tariff rates may be used, after adjustment and/or weighting to ensure comparability.

169. Two methods alternative to comparing domestic and border prices, are sometimes used to estimate an MPD for a commodity.

170. In a ***net export*** situation, if the country has significant levels of exports of a commodity and uses export subsidies to bridge the gap between domestic and world prices, the level of export subsidy per tonne of exports is assumed to represent the MPD. In this case, the *MPD* can be expressed as:

$$MPD_i = \frac{XS_i}{QX_i} \qquad [4.30]$$

where: XS_i – value of export subsidies for commodity *i* or products derived from *i*

QX_i – level of exports of the commodity *i* for the annual period

171. This method is used to calculate the *MPD* of several commodities (barley, eggs, pigmeat, poultry, rice and wheat) for the United States, where the value of export subsidies is derived from expenditures by commodity on the Export Enhancement Programme (EEP). The same approach is also applied in the case of wine for the European Union.

172. Compared to the general method of estimating a price gap, the approach that involves using a unit export subsidy may lead to some underestimation if additional export competition instruments such as export credits are used. The effects may also fail to be picked up in cases where they constitute the only intervention, if no price gap measurement is undertaken or possible.

173. The alternative method in the case of a ***net import*** situation is to derive the *MPD* directly from tariffs. This method is not a preferred option if other *MPS* policies such as tariff quotas, licensing or state-trading enterprises be in place, because it does not capture the extent to which these policies change domestic market prices. However, it can be used even when other policies exist if price data is unavailable or unreliable and it is believed that deriving an *MPD* by this method results in a more accurate estimate of *MPS* for the commodity. The *MPD* can be expressed as either:

$$MPD_i = PP_i \times \frac{tr_i}{1 + tr_i} \qquad [4.31]$$

where: tr_i – average *ad valorem* tariff applying to commodity *i*

or

$$MPD_i = TR_i \qquad [4.32]$$

where: TR_i – average specific tariff applying to commodity *i*

174. The most appropriate tariffs to use are the *statutory applied MFN tariffs* that would pertain to imports: *statutory* rather than collected tariff revenue, since the latter ignores prohibitive tariffs that do not yield any revenues; *applied* rather than WTO bound tariffs, since they are the tariffs effectively protecting the market and can be significantly different from bound levels; and *MFN* rather than preferential tariffs, since they represent the protection level imposed on marginal imports.

175. Commodities are traded at various degrees of processing and packaging that correspond to different tariff lines which may have significantly different tariff rates. In addition, for some commodities that have a limited shelf life, tariffs can vary by season (Box 4.3). Consequently, there are two major steps that must be carried out in order to calculate an average tariff for a commodity.

176. The first step is to ensure that the tariffs applying to imports of the commodity are expressed in the same form. Statutory tariff rates can be *ad valorem* or specific. Sometimes they are a mixture of both. To average several tariff lines, all tariffs have to be converted to either an *ad valorem* equivalent or a specific equivalent. The appropriate border prices to use for tariff conversion should be those corresponding to the specific tariff lines. But if the information is not available, e.g. if no trade occurs because the tariff is prohibitive, an alternative price has to be used, for example, another indicator of the world price of the same product, the border price of a close tariff line or the border price of the commodity itself converted to the appropriate processing equivalent.

177. The final step is to apply an appropriate weighting to the tariffs. If significant flows of trade occur for all tariff lines, tariffs can be weighted by import volumes, ensuring that volumes have been converted to the same product weight. If there are no imports for some tariff lines, for example because of prohibitive tariffs, another weighting system has to be used, usually a simple average.

4.7. Work examples

178. As the preceding sections of this chapter show, the calculation of a MPD is an essential task in the estimation of market price support transfers. It requires a thorough understanding of how the policy works, knowledge of the relevant agricultural commodity markets, including trade flows, access to sources of domestic and trade data, and great care to ensure that the correct price comparisons and the required adjustments are made. The following tables provide illustrative examples of how a *MPD* is calculated, based on the methods outlined in section 4.5. The examples relate to key agricultural commodities, such as grains (wheat), sugar, and meat (beef), while Annex 4.1 deals specifically with the calculation of the implicit reference price and the *MPD* for milk.

179. It should be emphasised that, *while the arithmetic process for calculating a MPD varies between the examples, the underlying principle is always the same*, i.e. *to ensure the comparison of "like with like"*.

180. Table 4.4 provides an example of how a *MPD* may be calculated for wheat based upon specific policy interventions, market characteristics and data availability. In this example, only milling wheat is produced in the country. This could be the case, for example, due to certain cultivation traditions and/or government policies where protection is provided to milling wheat through an import tariff, while feed wheat enters the domestic market duty-free. Consequently, the difference between production and consumption of food wheat is zero. While the country is a net importer, importing some 20 000 tonnes of feed wheat, it would not be correct to base the reference price on these imports because of the difference in quality between the two types of wheat.

181. As there are no imports of milling wheat into the country, an appropriate border price needs to be found from information other than the country's own trade. In this example, a close neighbour country is a major importer of milling wheat. The average *CIF* price of wheat imports for milling in the neighbour provides a suitable proxy for a border price of wheat in the example country (equation 4.18). Domestic processing costs are then subtracted from the border price to obtain a reference price that is comparable to the producer price (equation 4.13). Given the geographic characteristics of the country's market, an assumption is made that the handling and transportation costs between wholesale market and border (T_1) and internal handling and transportation costs between farm gate and wholesale market (T_2) offset each other. These costs are therefore not explicitly considered in the estimation of the marketing margin. The reference price is then subtracted from the producer price to obtain a *MPD* (equation 4.12).

Table 4.4. WHEAT: Calculation of a MPD for a net importer

Reference price based on other country's import price and marketing margin adjustment

Symbol	Description	Units	Value	Source / equation
QP	Production	000 T	100	Data
	of which for feed	000 T	0	Data
VP	Value of production	LC million	35	Data
PP	Producer Price	LC/T	350	Data or (VP / QP) * 1000
QC	Consumption	000 T	120	Data
	Consumption for feed	000 T	20	
BP	Border Price	LC/T	300	CIF_{other}
CIF_{other}	CIF price at neighbour	LC/T	300	Data
MM	Marketing Margin	LC/T	20	S, with $T_1 = T_2$
S	Processing costs (cleaning and drying)	LC/T	20	Data
RP	Reference Price	LC/T	280	BP - MM
MPD	Market Price Differential	LC/T	70	PP - RP

182. Table 4.5 provides an example of how a reference price could be calculated when wheat is produced for both milling and feed uses within a country. In this example, wheat production is split 50/50 between milling and feed wheat, with tariff protection and export subsidies used to support wheat producers. The country is a net exporter of wheat, exporting one half of its total wheat production, and 80% of exports comprise wheat for feed use.

183. In this case, the average export price of wheat is not comparable to the average producer price because the product composition (in terms of milling and feed wheat) varies significantly. A quality adjustment to the border price is therefore required. The available information allows a quality adjustment as expressed in equations 4.26 and 4.27 to be made. From the adjusted border price (*BP*QA*), a marketing margin is deducted, including processing costs and all internal handling and transportation costs (between farm and wholesale market and between wholesale market and border). In the example shown, this results in a reference price that is higher and a *MPD* that is lower than with the average border price without quality adjustment. However, if milling wheat dominated exports, the opposite would be the case.

184. In the case of wheat, a considerable amount of trade takes place in product that has undergone only minor processing, so that no weight adjustment is needed. For other products, such as sugar and beef, trade mainly occurs in more highly processed forms. In these cases, the calculation of a *MPD* requires not only a marketing margin adjustment but also an appropriate weight adjustment between the farm and traded products.

185. Table 4.6 provides an example of how a *MPD* could be calculated for sugar under specific policy and market characteristics, and data availability. In the example, farmers produce 2 million tonnes of raw sugar cane, which is transformed into 300 000 tonnes of refined sugar. In order to determine whether the country is a net importer or exporter, the country's total production and consumption of sugar are compared. The quantity consumed should account for all forms of sugar consumption (including in processed foods, such as confectionery). This information is typically obtained from the country's production, supply and utilisation balance sheet for sugar: this aggregates consumption of sugar in all forms and expresses these quantities in common physical terms, e.g. in refined sugar equivalent.

186. Calculation begins by expressing domestic production of sugar cane in refined sugar equivalent. This is done by multiplying the quantity of sugar cane produced by the extraction rate of refined sugar from sugar cane (0.15). Domestic production of sugar cane can now be compared with total consumption, also

expressed in refined sugar equivalent. As can be seen from Table 4.6, the country's sugar consumption exceeds domestic production, with imports representing 33% of domestic consumption.

187. The average *CIF* value of refined sugar imports is the appropriate border price, from which processing costs are deducted (assuming again in this case of a net importer that the two transport components from wholesale to border and farm to wholesale offset each other). However, this price is a refined sugar price, while the producer price is in raw cane terms. Producer price may be expressed in refined sugar equivalent in two ways, and depending on the data available. If the price available is for raw cane sugar (PP_{cane}), it can be divided by the extraction rate of refined sugar from sugar cane (*WA*) (equation 4.23). In the example the *WA* corresponds to the units of refined sugar obtained from one unit of raw sugar cane (i.e. a ratio of 0.15 indicates that one tonne of raw sugar cane yields 0.15 tonnes of refined sugar). If only the total value of sugar cane production is available (*VP*), it can be divided by the quantity of sugar cane expressed in refined sugar equivalent ($QP_{refined}$). As can be seen from Table 4.6, both options yield the same producer price in refined sugar equivalent. This price is comparable to the reference price, and is used to calculate the *MPD*.

188. The previous examples have all been based on calculations that involve adjusting a border price into farm gate values, requiring in particular a marketing margin adjustment (equation 4.13). Because of commercial sensitivity or lack of consistent and systematic estimates, this information is not always readily available. Table 4.7 provides an example of a price gap calculation based on wholesale prices, which does not rely on marketing margin information (equations 4.14 and 4.15).

189. In the following example, 1.5 million tonnes of sugar beet are transformed into 150 000 tonnes of refined sugar. Almost all domestic consumption of refined sugar is derived from domestic production, with very little imports. It is therefore more appropriate to derive a border price from an alternative source. The example uses an average *FOB* export price from a major exporter as a starting point, with adjustments made for the cost of insurance and freight from the exporting country to the country in question (equation 4.19). This is essentially a derived *CIF* price, which is then subtracted from the domestic wholesale price for refined sugar to obtain a *MPD* at the wholesale level.

190. There are two ways in which this price gap can be translated back to the farm gate level. The first assumes that the *absolute* price gap at the wholesale level is the same as at the farm gate level (Option 1), which results in a *MPD* of LC 125.

191. The second assumes that the price gap between the wholesale and farm gate level is the same in *relative* terms (Option 2). In the example, this results in a *MPD* of LC 63. It also results in a *MPD* that is lower than the first calculation, as it always will do. The difference between the *MPD*s derived from the two options increases as the relative price gap between the wholesale price and the border price increases. The choice between the two options should be made in terms of which one best reflects the market structure of the value chain in the country and therefore requires some knowledge of the situation.

192. In comparison with the previous examples, this method does not require marketing margin data but it does require wholesale price information. Weight and quality adjustments may also be required depending on the commodity being examined.

193. Table 4.8 provides another example of deriving a farm gate level *MPD* from a wholesale price gap, in this case for beef. The country is a net importer of beef, with total beef imports representing one-quarter (25%) of consumption. This allows the use of average import values as the basis for calculating a border price. However, an important characteristic of this market is that domestic production is made up entirely of grain-fed beef, while imports consist of both grain-fed and grass-fed beef. The latter is considered as of lower quality than grain-fed beef and is being available at a lower price.

Table 4.5. WHEAT: Calculation of a MPD for a net exporter

Reference price based on country's own export price, quality and marketing margin adjustments

Symbol	Description	Units	Milling wheat (mill)	Feed wheat (feed)	Total Wheat (WT)	Source / equation
QP	Production	000 T	100	100	200	Data, where $QP_{WT} = QP_{mill} + QP_{feed}$
VP	Value of production	LC million	35	30	65	Data, where $VP_{WT} = VP_{mill} + VP_{feed}$
PP	Producer Price	LC/T	350	300	325	Data or (VP / QP) * 1000
QC	Consumption	000 T	80	20	100	Data, where $QC_{WT} = QC_{mill} + QC_{feed}$
BP	Border Price	LC/T	327	280	289	Data or (VX / QX) * 1000
VX	Value of exports	LC million	7	22	29	Data, where $VX_{WT} = VX_{mill} + VX_{feed}$
QX	Quantity of exports	000 T	20	80	100	Data, where $QX_{WT} = QX_{mill} + QX_{feed}$
QA	Quality adjustment	ratio	-	-	1.05	$(a + b * (1 + \Delta P)) / (c + d * (1 + \Delta P))$
a	share of feed wheat in total production	ratio	-	-	0.50	Data
b	share of milling wheat in total production	ratio	-	-	0.50	Data
c	share of feed wheat in total wheat exports	ratio	-	-	0.80	Data
d	share of milling wheat in total wheat exports	ratio	-	-	0.20	Data
ΔP	quality price differential between milling and feed wheat	ratio	-	-	0.17	Data
MM	Marketing Margin	LC/T	-	-	24	$T_1 + T_2 + S$
S	Processing costs (cleaning and drying)	LC/T	-	-	10	Data
T_1	Handling and transportation wholesale/border	LC/T	-	-	12	Data
T_2	Handling and transportation farm/wholesale	LC/T	-	-	2	Data
RP	Reference Price	LC/T	-	-	279	(BP * QA) - MM
MPD	Market Price Differential	LC/T	-	-	46	PP - RP
Comparison: RP based on average wheat export price						
RP	Reference Price	LC/T	-	-	265	BP - MM
MPD	Market Price Differential	LC/T	-	-	60	PP - RP

Table 4.6. SUGAR: Calculation of a MPD for a net importer

Reference price based on country's own import price, weight and marketing margin adjustments

Symbol	Description	Units	Value	Source / equation
QP_{cane}	Production (raw cane)	000 T	2000	Data
WA	Weight Adjustment (refined sugar extraction rate)	ratio	0.15	Data, where WA = $QP_{refined}$ / QP_{cane}
$QP_{refined}$	Production (refined sugar equivalent)	000 T	300	QP_{cane} * WA
PP_{cane}	Producer Price (raw cane)	LC/T	75	Data
VP	Value of sugar cane production	LC million	150	Data
$PP_{refined}$ (1)	Producer Price (refined sugar equivalent): option 1	LC/T	500	PP_{cane} / WA or
$PP_{refined}$ (2)	Producer Price (refined sugar equivalent): option 2	LC/T	500	(VP / $QP_{refined}$) * 1000
$QC_{refined}$	Consumption (refined sugar equivalent)	000 T	450	Data
$BP_{refined}$	Border Price (refined sugar)	LC/T	400	($VM_{refined}$ / $QM_{refined}$) * 1000
$VM_{refined}$	Value of imports (refined sugar)	LC million	60	Data
$QM_{refined}$	Quantity of imports (refined sugar)	000 T	150	Data
$MM_{refined}$	Marketing Margins (refined sugar)	LC/T	200	S, with $T_1 = T_2$
$S_{refined}$	Processing costs (refined sugar)	LC/T	200	Data
$RP_{refined}$	Reference Price (refined sugar equivalent)	LC/T	200	$BP_{refined}$ - MM
$MPD_{refined}$	Market Price Differential (refined sugar equivalent)	LC/T	300	$PP_{refined}$ - $RP_{refined}$

Table 4.7. SUGAR: Calculation of a MPD for a net importer

Reference price based on other country's export price (a derived import price)
and price gap based on wholesale price

Symbol	Description	Units	Value	Source/equation
QP_{beet}	Production of beet (raw beet)	000 T	1500	Data
WA	Weight Adjustment (refined sugar extraction rate from beet)	ratio	0.10	Data, where WA = $QP_{refined}$ / $QP_{raw\ beet}$
$QP_{refined}$	Production of beet (refined sugar equivalent)	000 T	150	QP_{beet} * WA
PP_{beet}	Producer price (raw beet)	LC/T	15	Data
VP	Value of sugar beet production	LC million	23	Data
$PP_{refined}$ (1)	Producer Price (refined sugar equivalent): option 1	LC/T	150	PP_{beet} / WA or
$PP_{refined}$ (2)	Producer Price (refined sugar equivalent): option 2	LC/T	150	(VP / $QP_{refined}$) * 1000
$QC_{refined}$	Consumption (refined sugar equivalent)	000 T	152	Data
$QM_{refined}$	Quantity of imports (refined sugar)	000 T	2	$QC_{refined}$ - $QP_{refined}$
$WP_{refined}$	Wholesale Price (refined sugar)	LC/T	300	Data
$BP_{refined}$	Border Price (refined sugar)	LC/T	175	FOB_{other} + IF
FOB_{other}	Export price of major exporter (refined sugar)	LC/T	150	Data
IF	Freight from exporting country	LC/T	25	Data
Option 1: Assuming a constant absolute price gap				
$MPD_{refined}$	Market Price Differential (refined sugar equivalent)	LC/T	125	$WP_{refined}$ - $BP_{refined}$
Option 2: Assuming a constant relative price gap				
$MPD_{refined}$	Market Price Differential (refined sugar equivalent)	LC/T	63	$PP_{refined}$ * (1 - $BP_{refined}$ / $WP_{refined}$)

Table 4.8. BEEF: Calculation of a MPD for a net importer

Reference price based on country's own import price, weight and quality adjustments and price gap based on wholesale price

Symbol	Description	Units	Value	Source / equation
QP_{lw}	Production (live weight)	000 T	100	Data
	Production of beef	000 T	98	Data
	Production of veal	000 T	2	Data
WA	Weight Adjustment (ratio of carcass to live weight)	ratio	0,60	Data, where $WA = QP_{cw} / QP_{lw}$
QP_{cw}	Production (carcass weight)	000 T	60	Data or $QP_{lw} * WA$
PP_{lw}	Producer Price (live weight)	LC/T	2400	Data
VP	Value of production	LC million	400	Data
PP_{cw} (1)	Producer Price (carcass weight): option 1	LC/T	4000	Data or $(VP / QP_{cw}) * 1000$
PP_{cw} (2)	Producer Price (carcass weight): option 2	LC/T	4000	Data or PP_{lw} / WA
QC_{cw}	Consumption (carcass weight)	000 T	80	Data
QM_{cw}	Quantity of imports (carcass weight)	000 T	20	$QC_{cw} - QP_{cw}$
WP_{cw}	Wholesale Price (carcass weight)	LC/T	5000	Data
Comparison: Calculation of a MPD based on border price for grain fed beef only				
BP_{cw}	Border price (carcass weight)	LC/T	4667	$(VM_{cw} / QM_{cw}) * 1000$
VM_{cw}	Value of imports (carcass weight)	LC million	70	Data
QM_{cw}	Quantity of imports (carcass weight)	000 T	15	Data
	Option 1: Assuming a constant absolute price gap			
MPD	Market Price Differential	LC/T	333	$WP_{cw} - BP_{cw}$
	Option 2: Assuming a constant relative price gap			
MPD	Market Price Differential	LC/T	267	$PP_{cw} * (1 - BP_{cw} / WP_{cw})$
Comparison: Calculation of a MPD based on border price of all beef imports				
BP_{cw}	Border price (carcass weight)	LC/T	3500	$(VM_{cw} / QM_{cw}) * 1000$
VM_{cw}	Value of imports (carcass weight)	LC million	70	Data
QM_{cw}	Quantity of imports (carcass weight)	000 T	20	Data
	Option 1: Assuming a constant absolute price gap			
MPD	Market Price Differential	LC/T	1500	$WP_{cw} - BP_{cw}$
	Option 2: Assuming a constant relative price gap			
MPD	Market Price Differential	LC/T	1200	$PP_{cw} * (1 - BP_{cw} / WP_{cw})$

194. The table shows the results of using the wholesale price gaps to estimate the farm gate price gaps under absolute and relative price gap assumptions. These two options are in turn considered using the reference price based on total beef imports and that based on grain-fed beef imports only. Grain-fed imports may be identified in terms of specific tariff lines, or in terms of geographic origin of imports. The example again demonstrates that the assumption of a constant relative price gap results in a lower *MPD* than the assumption of a constant absolute price gap. It also shows that the *MPD* is lower when only grain-fed imports are used, reflecting the higher price of this product in comparison to grain-fed beef. In this sense, a quality adjustment occurs not in terms of a particular formula but in terms of data selection.

195. A final example is provided in Table 4.9, demonstrating all the possible adjustments that can be made in terms of marketing margins, weight and quality. In comparison to the previous example, an important characteristic of the beef market in this example is the relatively significant contribution of veal to total beef and veal production.

196. The country is a net exporter of beef, so that an average *FOB* price can be used to calculate a border price. However, there is a significant difference between the product composition of exports (dominated by veal) and the composition of farm production (dominated by beef), similar to that considered in the first example for wheat (Table 4.4). Consequently, the average export price is not comparable with the domestic producer price.

197. Data regarding processing and transportation costs are needed to allow the marketing margins to be calculated. Along with the weight adjustment, they also indicate further differences between beef and veal production that could be recognised in the calculation of a *MPD.*

198. It is appropriate to calculate separate reference prices for beef and veal by subtracting their own marketing margins from their respective average export prices and applying their respective weight adjustments, following equation 4.13. A reference price for beef and veal is then obtained by weighting the separate reference prices for beef and veal by the shares of production. In the example, this amounts to a reference price of 2 640 in local currency units and a *MPD* of 2 410 in local currency units.

199. For comparison, Table 4.9 also shows the result of using the simple total beef and veal averages to derive a reference price and *MPD* that do not account for the differences between export and production composition. The result is a *MPD* that is lower than that with the quality-adjusted reference price, reflecting the greater proportion of the higher-priced veal in exports than in production.

Table 4.9. BEEF: Calculation of a *MPD* for a net exporter

Reference price based on country's own export price, weight, quality and marketing margin adjustments

Symbol	Description	Units	Beef (B)	Veal (V)	Beef & veal (BF)	Source / equation
QP_{lw}	Production (live weight)	000 T	60	40	100	Data, where $QP_{lw(BF)} = QP_{lw(B)} + QP_{lw(V)}$
WA	Weight Adjustment (ratio of carcass to liveweight)	ratio	0.65	0.55	0.61	Data, where $WA = QP_{cw} / QP_{lw}$
QP_{cw}	Production (carcass weight)	000 T	39	22	61	$QP_{lw} * WA$
PP_{lw}	Producer Price (live weight)	LC/T	3000	3200	3080	Data
VP_{BF}	Value of production	LC million	180	128	308	Data, where $VP_{BF} = VP_B + VP_V$
PP_{cw} (1)	Producer Price (carcass weight): option 1	LC/T	4615	5818	5049	Data or $(VP / QP_{cw}) * 1000$
PP_{cw} (2)	Producer Price (carcass weight): option 2	LC/T	4615	5818	5049	Data or PP_{lw} / WA
QC_{cw}	Consumption (carcass weight)	000 T	20	10	30	Data, where $QC_{cw(BF)} = QC_{cw(B)} + QC_{cw(V)}$
BP_{cw}	Border Price (carcass weight)	LC/T	3975	4753	4276	Data or $VX_{cw} / QX_{cw} * 1000$
VX_{cw}	Value of exports (carcass weight)	LC million	76	57	133	Data, where $VX_{cw(BF)} = VX_{cw(B)} + VX_{cw(V)}$
QX_{cw}	Quantity of exports (carcass weight)	000 T	19	12	31	Data, where $QX_{cw(BF)} = QX_{cw(B)} + QX_{cw(V)}$
MM_{cw}	Marketing Margins (carcass weight)	LC/T	1477	1862	1616	$T_{1(cw)} + T_{2(cw)} + S_{cw}$
S_{cw}	Processing costs	LC/T	785	989	858	Data
$T_{1(cw)}$	Handling and transportation wholesale/border	LC/T	462	582	505	Data
$T_{2(cw)}$	Handling and transportation farm/wholesale	LC/T	231	291	252	Data
$RP_{cw\ (B,V)}$	Reference Price (Beef and veal)	LC/T	2498	2891	-	$BP_{cw} - MM_{cw}$
RP_{cw}	Reference Price (weighted average)	LC/T	-	-	2640	$[RP_{cw(B)} * QP_{cw(B)}/QP_{cw(BF)}] + [RP_{cw(V)} * QP_{cw(V)}/QP_{cw(BF)}]$
MPD	Market Price Differential	LC/T	-	-	2410	$PP_{cw} - RP_{cw}$
Comparison: RP based on beef and veal simple average export price						
RP_{cw}	Reference Price (simple average)	LC/T	-	-	2660	$BP_{cw} - MM_{cw}$
MPD	Market Price Differential	LC/T	-	-	2389	$PP_{cw} - RP_{cw}$

Annex 4.1

Methodology for calculating the border price for milk

Introduction

200. Since fluid milk is not normally a tradable commodity, a border price is not directly observable. Consequently, from the early 1980s through to 2004 the annual reference price for milk in each country was derived from a New Zealand farm gate milk price, adjusted for country differences in milkfat content and transportation costs. In 2005 a new methodology was introduced and has been used to recalculate annual indicators back to 1986.

201. The key idea of the new method is to derive a reference price from border prices of representative, tradable dairy products. This method is based on two assumptions. First, world markets for tradable dairy commodities are competitive. This allows the formation of a single price for each of the solid components (milkfat, protein, lactose, etc.) of raw milk. Second, each type of dairy product contains unique and fixed amounts of each of these solid components of milk.

202. The issue is which tradable dairy products are to be selected. To have a meaningful comparison between domestic and border prices, selected dairy products should be common, tradable products in global dairy markets. From this criterion, butter and skim milk powder (*SMP*) were selected. Reference prices for most countries are calculated using these two products. As a variation of the method, cheese was selected in addition to the above two dairy products if the policy, trade or other factors in particular countries were such that adding additional products would increase the accuracy of the calculation. The reference price for milk in the European Union and Switzerland is calculated using this variation.

Implicit border price of raw milk

Two dairy products case (butter and SMP)

203. Two solid components in dairy products – milkfat and non-fat-solids – are considered. First, the implicit prices of the two components are calculated from the border prices of butter and SMP, and the percentage of fat and non-fat-solids in these two products. The appropriate border prices to use for butter and *SMP* follow the general procedure for selecting a border price for any other commodity, i.e. depending on whether the country is a net exporter or importer of the product (as to whether an *FOB* or *CIF* price is used) and the regularity and quantity of product traded (as to whether the country's own or another country's *CIF* or *FOB* prices are used).

204. The implicit prices of milkfat and non-fat-solids are calculated by solving the following equations.

$$\begin{cases} aX + cY = BP_b \\ bX + dY = BP_s \end{cases} \qquad \text{[A4.1]}$$

where X and Y are the implicit prices of milkfat and non-fat-solids respectively, a and b are the percentage of milk fat in one tonne of butter and *SMP* respectively, c and d are the percentage of non-fat-solids in one tonne of butter and *SMP* respectively, BP_b and BP_s are butter and *SMP* prices at the border of the country in question respectively.

205. Solving the above equations results in:

$$X = \frac{dBP_b - cBP_s}{ad - bc} \qquad [A4.2]$$

and

$$Y = \frac{aBP_s - bBP_b}{ad - bc} \qquad [A4.3]$$

206. The implicit border price of raw milk can be written as:

$$BP_m = eX + fY \qquad [A4.4]$$

where *e* and *f* are the percentage of milkfat and non-fat-solids in one tonne of raw milk respectively.

207. Using results of *X* and *Y*, BP_m can also be written as:

$$BP_m = \alpha BP_b + \beta BP_s \qquad [A4.5]$$

where $\alpha = \dfrac{de - bf}{ad - bc}$ and $\beta = \dfrac{af - ce}{ad - bc}$ [A4.6]

Three dairy products case (butter, SMP and cheese)

208. Where three dairy products are used, three main solid components are considered: milkfat, protein and lactose. From the border prices of the three dairy products and their percentage of milkfat, protein and lactose, the implicit prices of three solid components are calculated. The implicit border price of raw milk can be calculated from these three implicit prices and the percentage of the three solid components in raw milk.

209. In equation form, the implicit raw milk price can be written as:

$$\widehat{BP}_m = eX + nZ + oW \qquad [A4.7]$$

where *X*, *Z* and *W* are implicit prices of milkfat, protein and lactose respectively, at the border, and *e*, *n* and *o* are the tonnes of milkfat, protein and lactose contained in one tonne of raw milk respectively.

210. From the information about the composition of the three dairy products, the implicit prices of the three components can be estimated as the solution of the following equations.

$$\begin{cases} aX + hZ + kW = BP_b \\ bX + iZ + lW = BP_s \\ gX + jZ + mW = BP_c \end{cases} \qquad [A4.8]$$

where a, *b* and *g* are the percentage of milkfat in one tonne of butter, SMP and cheese respectively; h, i, and j are the percentage of protein in one tonne of butter, SMP and cheese respectively; *k*, *l*, and *m* are the percentage of lactose in one tonne of butter, SMP and cheese respectively; BP_c is the cheese price at the border.

211. Solving the equations leads to:

$$\begin{cases} X = \dfrac{BP_b(im - jl) + BP_s(jk - hm) + BP_c(hl - ik)}{aim + ghl + bjk - ajl - bhm - gik} \\ Z = \dfrac{BP_b(gl - bm) + BP_s(am - gk) + BP_c(bk - al)}{aim + ghl + bjk - ajl - bhm - gik} \\ W = \dfrac{BP_b(bj - gi) + BP_s(gh - aj) + BP_c(ai - bh)}{aim + ghl + bjk - ajl - bhm - gik} \end{cases} \quad \text{[A4.9]}$$

Using the above results, $\widehat{BP}_m$ can be rewritten as:

$$\widehat{BP}_m = \gamma BP_b + \delta BP_s + \varepsilon BP_c \quad \text{[A4.10]}$$

where γ, δ and ε are defined as:

$$\begin{cases} \gamma = \dfrac{e(im - jl) + n(gl - bm) + o(bj - gi)}{a(im - jl) + h(gl - bm) + k(bj - gi)} \\ \delta = \dfrac{e(jk - hm) + n(am - gk) + o(gh - aj)}{b(jk - hm) + i(am - gk) + l(gh - aj)} \\ \varepsilon = \dfrac{e(hl - ik) + n(bk - al) + o(ai - bh)}{g(hl - ik) + j(bk - al) + m(ai - bh)} \end{cases} \quad \text{[A4.11]}$$

Marketing (Processing)[14] margin

212. The above implicit border price includes marketing margins, since it is derived from processed dairy products. Therefore, the margin must be subtracted from the implicit border price in order to obtain the reference price. However, in most countries data on marketing margins is not available from official statistical sources. As a practical alternative, the implicit wholesale price of raw milk is calculated from the wholesale prices of butter and SMP in the same way as the implicit border price of milk was calculated from the border prices of butter and SMP. The processing margin is obtained by subtracting the producer price for manufacturing quality milk from the implicit wholesale price of raw milk. In equation form, processing margin *MM* can be written as:

$$MM = (\alpha WP_b + \beta WP_s) - PP_m \quad \text{[A4.12]}$$

$$\text{where } \alpha = \frac{de - bf}{ad - bc} \text{ and } \beta = \frac{af - ce}{ad - bc} \quad \text{[A4.13]}$$

14. Marketing margin is understood here to include processing margin only and therefore the two terms are used interchangeably.

where WP_b and WP_s are, respectively, butter and SMP prices in the domestic wholesale market and PP_m is the domestic producer price for manufacturing milk.

Implicit reference price for milk

213. The reference price for milk is obtained by subtracting the marketing margin from the implicit border prices of raw milk. Milk reference prices for countries other than the four major exporting countries can be written as:

$$RP_m = (\alpha BP_b + \beta BP_s) - MM \text{ for the case of two dairy products} \quad [A4.14]$$

and

$$\widehat{RP}_m = (\gamma BP_b + \delta BP_s + \varepsilon BP_c) - MM \text{ for the case of three dairy products} \quad [A4.15]$$

214. For the major dairy products exporting countries, such as Australia, the European Union, New Zealand and the United States their own processing margins, as defined in equation A4.11, are used to calculate RP_m or $\widehat{RP}_m$. For the majority of other countries the simple average of the marketing margins for Australia, the European Union, New Zealand and the United States is used to calculate milk reference price, while for several non-EU European countries the EU marketing margins are used. This approach is mainly explained by data limitations, however it seems reasonable, since these four countries are the world’s major producers and exporters of dairy products and their marketing margins represent a reasonable approximation for other countries.

Work example

215. Table A4.1 provides an example of how the reference price for milk is calculated on the basis of two dairy products, butter and SMP. Using the data on border prices and on content of milkfat and non-fat solids in these two products, implicit border prices for milkfat (X) and non-fat solids (Y) are derived (equations A4.2 and A4.3). An implicit border price of raw milk is then calculated, as a weighted average of X and Y, with weights being the percentages of milkfat (e) and non-fat solids (f) in raw milk (equation A4.4).

216. An alternative way to derive the implicit border price of milk would be to first compute coefficients α and β (shares of border prices of butter and SMP in the milk price) from the percentages of milkfat and non-fat solids content in butter, SMP and raw milk (equation A4.6). The implicit border price of milk is then calculated as a weighted average of the border prices of butter and *SMP* (BP_b and BP_s), with weights being coefficients α and β (equation A4.5). As is shown in Table A4.1, this leads to the same result in terms of the implicit border price of milk.

217. The next step is to calculate the marketing margin. As noted above, for the four major exporters this is done by using the information on domestic (wholesale and producer) prices of milk, butter and SPM and coefficients α and β. For the majority of other OECD countries an average of the marketing margins of the four exporters is applied, and for several non-EU European countries the marketing margins are assumed to be the same as those of the European Union.

218. Finally, an implicit milk reference price is derived by subtracting the calculated marketing margin (MM) from the implicit milk border price BP_M and the MPD is calculated as the difference between the domestic producer price and the implicit milk reference price (RP_m).

Table A4.1. MILK: Calculation of an implicit Reference Price and MPD

Symbol	Description	Units	Value	Source / equation
PP_m	Producer Price of raw milk	LC/T	400	Data
BP_b	Border Price - Butter	LC/T	3000	Data
BP_s	Border Price - SMP	LC/T	2500	Data
a	Milkfat content in butter	%	81	Data
c	Non-fat solids content in butter	%	1	Data
b	Milkfat content in SMP	%	1	Data
d	Non-fat solids content in SMP	%	86	Data
e	Milkfat content in raw milk	%	4	Data
f	Non-fat solids content in raw milk	%	8	Data
BP_m	Implicit Border Price of raw milk: ***option 1***	LC/T	376	(eX+fY)/100
X	Implicit Border Price of miklfat	LC/T	3668	$(dBP_b\text{-}cBP_s)/(ad\text{-}bc)*100$
Y	Implicit Border Price of non-fat solids	LC/T	2864	$(aBP_s\text{-}bBP_b)/(ad\text{-}bc)*100$
BP_m	Implicit Border Price of raw milk: ***option 2***	LC/T	376	$\alpha BP_b + \beta BP_s$
α	Share of butter price in milk price	Ratio	0.05	(de-bf)/(ad-bc)
β	Share of SMP price in milk price	Ratio	0.09	(af-ce)/(ad-bc)
MM	Marketing Margin	LC/T	60	$(\alpha WP_b + \beta WP_s) - PP_m$
RP_m	Reference Price of raw milk	LC/T	316	BP_m - MM
MPD	Market Price Differential	LC/T	24	$PP_m - RP_m$

219. When three dairy products are involved (butter, SMP, and cheese) the calculation follows the same steps. In this case prices for these three dairy products and their content in terms of fat, protein and lactose are considered. Equations related to the three-product case are applied (A4.7 – A4.11 and A4.15).