

## Annex A. Methodological notes

### A.1. Construction of the GTRIC for the counterfeit market in Sweden

#### *Construction of GTRIC-p*

GTRIC-p is constructed in three steps:

1. For each product category, the seizure percentages for sensitive goods are formed.
2. From these, a counterfeit source factor is established for each industry, based on the industries' weight in terms of Swedish imports.
3. Based on these factors, the GTRIC-p is formed.

#### *Step 1: Measuring product seizure frequencies*

$v_p$  and  $m_p$  are, respectively, the seizure and import values of product type  $p$  (as registered according to the HS on the two-digit level) sold in Sweden from *any* provenance economy in a given year. The relative seizure frequencies (seizure percentages) of good  $p$ , denoted below by  $\gamma_p$ , is then defined by:

$$\gamma_p = \frac{v_p}{\sum_p v_p}, \text{ such that } \sum_p \gamma_p = 1$$

#### *Step 2: Measuring industry-specific counterfeiting factors*

$M = \sum_p m_p$  is defined as the total registered imports of all sensitive goods into Sweden.

The share of good  $p$  in Swedish imports, denoted by  $s_p$ , is therefore given by:

$$s_p = \frac{m_p}{M}, \text{ such that } \sum_p s_p = 1$$

The counterfeiting factor of product category  $p$ , denoted by  $C_p$ , is then determined as the following.

$$C_p = \frac{\gamma_p}{s_p}$$

The counterfeiting factor reflects the sensitivity of product infringements occurring in a particular product category, relative to its share in Swedish imports. These constitute the foundation for forming GTRIC-p.

#### *Step 3: Establishing GTRIC-p*

GTRIC-p is constructed from a transformation of the counterfeiting factor; it measures the relative likelihood of different types of product categories being subject to counterfeiting and piracy in Swedish imports. The transformation of the counterfeiting factor is based on two main assumptions:

1. The first (A1) is that the counterfeiting factor of a particular product category is positively correlated with the actual degree of trade in counterfeit and pirated goods covered by that chapter. The counterfeiting factors must thus reflect the real intensity of actual counterfeit trade in the given product categories.
2. The second (A2) acknowledges that the assumption A1 may not be entirely correct. For instance, the fact that infringing goods are detected more frequently in certain categories could imply differences in counterfeiting factors across products merely reflect that some goods are easier to detect than others, or that some goods, for one reason or another, have been specially targeted for inspection. The counterfeiting factors of product categories with lower counterfeiting factors could, therefore, underestimate actual counterfeiting and piracy intensities in these cases.

In accordance with assumption A1 (positive correlation between counterfeiting factors and actual infringement activities) and assumption A2 (lower counterfeiting factors may underestimate actual activities), GTRIC-p is established by applying a positive monotonic transformation of the counterfeiting factor index using natural logarithms. This standard technique of linearisation of a non-linear relationship (in the case of this study, between counterfeiting factors and actual infringement activities) allows the index to be flattened and gives a higher relative weight to lower counterfeiting factors (Verbeek, 2008).

In order to address the possibility of outliers at both ends of the counterfeiting factor index – i.e. some categories may be measured as particularly susceptible to infringement even though they are not, whereas others may be measured as unsusceptible although they are – it is assumed that GTRIC-p follows a left-truncated normal distribution, with GTRIC-p only taking values of zero or above.

The transformed counterfeiting factor is defined as:

$$c_p = \ln(C_p + 1)$$

Assuming the transformed counterfeiting factor can be described by a left-truncated normal distribution with  $c_p \geq 0$ ; then, following Hald (1952), the density function of GTRIC-p is given by:

$$f_{LTN}(c_p) = \begin{cases} 0 & \text{if } c_p \leq 0 \\ \frac{f(c_p)}{\int_0^{\infty} f(c_p) dc_p} & \text{if } c_p \geq 0 \end{cases}$$

where  $f(c_p)$  is the non-truncated normal distribution for  $c_p$ , specified as:

$$f(c_p) = \frac{1}{\sqrt{2\pi\sigma_p^2}} \exp\left(-\frac{1}{2}\left(\frac{c_p - \mu_p}{\sigma_p}\right)^2\right)$$

The mean and variance of the normal distribution, here denoted by  $\mu_p$  and  $\sigma_p^2$ , are estimated over the transformed counterfeiting factor index,  $c_p$ , and given by  $\hat{\mu}_p$  and  $\hat{\sigma}_p^2$ . This enables the calculation of the counterfeit import proneness index (GTRIC-p) across product categories, corresponding to the cumulative distribution function of  $c_p$ .

### *Construction of GTRIC-e*

GTRIC-e is also constructed in three steps:

1. For each provenance economy, the seizure percentages are calculated.
2. From these, each provenance economy's counterfeit source factor is established, based on the provenance economies' weight in terms of Swedish total imports.
3. Based on these factors, the GTRIC-e is formed.

#### *Step 1: Measuring seizure intensities from each provenance economy*

$v_e$  is Sweden's registered seizures of all types of infringing goods (i.e. all  $p$ ) originating from economy  $e$  during a given year in terms of their value.

$\gamma_e$  is Sweden's relative seizure frequency (seizure percentage) of all infringing items that originate from economy  $e$  in a given year:

$$\gamma_e = \frac{v_e}{\sum_e v_e}, \text{ such that } \sum_e \gamma_e = 1$$

#### *Step 2: Measuring economy-specific counterfeiting factors*

$m_e$  is defined as the total registered Swedish imports of all sensitive products from  $e$  and  $M = \sum_e m_e$  is the total Swedish import of sensitive goods from all provenance economies.

The share of imports from provenance economy  $e$  in total Swedish imports of sensitive goods, denoted by  $s_e$ , is then given by:

$$s_e = \frac{m_e}{M}, \text{ such that } \sum_e s_e = 1$$

From this, the economy-specific counterfeiting factor is established by dividing the general seizure frequency for economy  $e$  with the share of total imports of sensitive goods from  $e$ .

$$C_e = \frac{\gamma_e}{s_e}$$

#### *Step 3: Establishing GTRIC-e*

Gauging the magnitude of counterfeiting and piracy from a provenance economy perspective can be undertaken in a fashion similar to that for sensitive goods. Hence, a general trade-related index of counterfeiting for economies (GTRIC-e) is established along similar lines and assumptions:

1. The first assumption (A3) is that the frequency with which any counterfeit or pirated article from a particular economy is detected and seized by customs is positively correlated with the actual amount of counterfeit and pirate articles imported from that location.
2. The second assumption (A4) acknowledges that assumption A3 may not be entirely correct. For instance, a high seizure intensity of counterfeit or pirated articles from a particular provenance economy could be an indication that the provenance economy is part of a customs profiling scheme or that it is specially targeted for investigation by customs. The role that provenance economies with low seizure intensities play regarding actual counterfeiting and piracy activity could, therefore, be underrepresented by the index and lead to an underestimation of the scale of counterfeiting and piracy.

As with the product-specific index, GTRIC-e is established by applying a positive monotonic transformation of the counterfeiting factor index for provenance economies using natural logarithms. This follows from assumption A3 (positive correlation between seizure intensities and actual infringement activities) and assumption A4 (lower intensities tend to underestimate actual activities). Considering the possibilities of outliers at both ends of the GTRIC-e distribution – i.e. some economies may be wrongly measured as being particularly susceptible sources of counterfeit and pirated imports, and vice versa – GTRIC-e is approximated by a left-truncated normal distribution as it does not take values below zero.

The transformed general counterfeiting factor across provenance economies on which GTRIC-e is based is therefore given by applying logarithms onto economy-specific general counterfeit factors (Verbeek, 2008):

$$c_e = \ln(C_e + 1)$$

In addition, following GTRIC-p, it is assumed that GTRIC-e follows a truncated normal distribution with  $c_e \geq 0$  for all  $e$ . Following Hald (1952), the density function of the left-truncated normal distribution for  $c_e$  is given by

$$g_{LTN}(c_p) = \begin{cases} 0 & \text{if } cf_e \leq 0 \\ \frac{g(e)}{\int_0^\infty g(c_e) dc_e} & \text{if } cf_e \geq 0 \end{cases}$$

where  $g(c_e)$  is the non-truncated normal distribution for  $c_e$ , specified as:

$$g(c_e) = \frac{1}{\sqrt{2\pi\sigma_e^2}} \exp\left(-\frac{1}{2}\left(\frac{c_e - \mu_e}{\sigma_e}\right)^2\right)$$

The mean and variance of the normal distribution, here denoted by  $\mu_e$  and  $\sigma_e^2$ , are estimated over the transformed counterfeiting factor index,  $c_e$  and given by  $\hat{\mu}_e$  and  $\hat{\sigma}_e^2$ . This enables the calculation of the counterfeit import propensity index (GTRIC-e) across provenance economies, corresponding to the cumulative distribution function of  $c_e$ .

### ***Construction of GTRIC***

The combined index of GTRIC-e and GTRIC-p, denoted by GTRIC, is an index that approximates the relative proneness of particular product types, imported by Sweden from specific trading partners, to be counterfeit and/or pirated.

#### *Step 1: Establishing intensities for products and provenance economies*

In this step, the proneness to contain counterfeit and pirated products will be established for each trade flow from a given provenance economy and in a given product category.

The general proneness of product category  $p$  to be infringed, from any economy, is denoted by  $P_p$  and given by GTRIC-p so that:

$$P_p = F_{LTN}(c_p)$$

where  $F_{LTN}(c_p)$  is the cumulative probability function of  $f_{LTN}(c_p)$ .

Furthermore, the general propensity of infringing goods of any type from economy  $e$  is denoted by  $P_e$  and given by GTRIC-e, so that:

$$P_e = G_{LTN}(c_e)$$

where  $G_{LTN}(c_e)$  is the cumulative probability function of  $g_{LTN}(c_e)$ .

The general likelihood of items of type  $p$  originating from economy  $e$  to be counterfeit or pirated is then denoted by  $P_{ep}$  and approximated by:

$$P_{ep} = P_p P_e$$

Therefore,  $P_{ep} \in [\varepsilon_p \varepsilon_e ; 1]$ ,  $\forall e, p$ , with  $\varepsilon_p \varepsilon_e$  denoting the minimum average counterfeit export rate for each sensitive product category and each provenance economy. It is assumed that  $\varepsilon_e = \varepsilon_p = 0.05$ .

*Step 2: Calculating the absolute value*

$\alpha$  is the fixed point, i.e. the maximum average counterfeit rate of a given type of infringing good  $p$  originating from a given economy  $e$ .  $\alpha$  can therefore be applied onto likelihood of goods of type  $p$  from trading partner  $e$  to be infringed ( $\alpha P^{jk}$ ).

As a result, a matrix of counterfeit proneness  $C$  is obtained.

$$C = \begin{pmatrix} \alpha P_{11} & \alpha P_{12} & & \alpha P_{1P} \\ \alpha P_{21} & \ddots & & \\ & & \alpha P_{ep} & \\ & & & \ddots \\ \alpha P_{E1} & & & \alpha P_{EP} \end{pmatrix} \text{ with dimension } E \times P$$

The matrix of Swedish imports is denoted by  $M$ . Applying  $C$  on  $M$  yields the absolute volume of counterfeit and pirated imports in the Sweden. In particular, the imports matrix  $M$  is given by:

$$M = \begin{pmatrix} m_{11} & m_{12} & & m_{1P} \\ m_{21} & \ddots & & \\ & & m_{ep} & \\ & & & \ddots \\ m_{E1} & & & m_{EP} \end{pmatrix} \text{ with dimension } E \times P$$

Hence, the element  $m_{ep}$  denotes Swedish imports of product category  $p$  from partner  $e$ , with  $e = [1, \dots, E]$  and  $p = [1, \dots, P]$ .

Denoted by  $\Psi$ , the product-by-economy percentage of counterfeit and pirated imports can be determined as the following:

$$\Psi = C'M \div M$$

The value of total imports of counterfeit and pirated goods, denoted by the scalar  $TC$ , is then given by:

$$TC = I_1' \Psi I_2$$

where  $I_1$  is an identity matrix with dimension  $E \times 1$ , and  $I_2$  is an identity matrix with dimension  $P \times 1$ .

By denoting total world trade by the scalar  $TM = I_1 M' I_2$ , the share of imports of counterfeit and pirated products into total Swedish imports,  $S_{TC}$ , is determined by:

$$S_{TC} = \frac{TC}{TM}$$

## A.2. Construction of the GTRIC for products infringing Swedish IPR

### *Construction of Swedish GTRIC-p*

Swedish GTRIC-p is constructed in three steps:

- For each product category, the seizure percentages for sensitive goods are formed.
- From these, a counterfeit source factor is established for each industry, based on the industries' weight in terms of total trade.
- Based on these factors, the GTRIC-p is formed.

#### *Step 1: Measuring product seizure frequencies*

$w_q$  is the seized value of product type  $q$  infringing Swedish residents' IPR from *any* provenance economy in a given year. The relative seizure frequency (seizure percentages) of good  $q$ , denoted below as  $\eta_q$ , is then defined by:

$$\eta_q = \frac{w_q}{\sum_q w_q}, \text{ such that } \sum_q \eta_q = 1$$

#### *Step 2: Measuring product-specific counterfeiting factors*

$e_q$  is the global sales value (exports plus domestic sales) of all Swedish branded products of type  $q$ , so that  $E = \sum_q e_q$  is defined as the global registered sales by Swedish manufacturing industries of *all* sensitive goods.

The share of good  $q$  in Swedish total sales, denoted by  $\zeta_q$ , is therefore given by:

$$\zeta_q = \frac{e_q}{E}, \text{ such that } \sum_q \zeta_q = 1$$

The counterfeiting factor of product category  $q$ , denoted  $C_q$ , is then determined as the following:

$$C_q = \frac{\eta_q}{\zeta_q}$$

The counterfeiting factor reflects the sensitivity of infringements of Swedish trademarks and patents occurring in a particular product category, relative to its share in Swedish global sales. These constitute the foundation for forming GTRIC-p.

#### *Step 3: Establishing Swedish GTRIC-p*

GTRIC-p is constructed from a transformation of the counterfeiting factor; it measures the relative proneness with which Swedish trademarks and patents in different types of product categories are subject to counterfeiting and piracy. The transformation of the counterfeiting factor is based on two main assumptions, described in OECD/EUIPO (2016):

1. The first (A5) is that the counterfeiting factor for goods infringing Swedish IPR of a particular product category is positively correlated with the actual degree of trade in counterfeit and pirated goods covered by that chapter. The counterfeiting factors must thus reflect the real intensity of actual counterfeit trade for products infringing Swedish IPR in the given product categories.

2. The second (A6) acknowledges that the assumption A5 may not be entirely correct. For instance, the fact Swedish IPR infringing goods are detected more frequently in certain categories could imply that differences in counterfeiting factors across products merely reflect that some goods infringing Swedish IPR are easier to detect than others, or that some of these goods, for one reason or another, have been specially targeted by customs worldwide. The counterfeiting factors of product categories with lower counterfeiting factors could, therefore, underestimate actual counterfeiting and piracy intensities in these cases.

In accordance with assumptions A5 and A6, GTRIC-p for products infringing Swedish IPR traded worldwide is established by applying a positive monotonic transformation of the counterfeiting factor index using natural logarithms. This standard technique of linearisation of a non-linear relationship – in the case of this study between counterfeiting factors and actual infringement activities – allows the index to be flattened and gives a higher relative weight to lower counterfeiting factors (Verbeek, 2008).

In addition, in order to address the possibility of outliers at both ends of the counterfeiting factor index – i.e. some categories may be measured as particularly susceptible to infringement even though they are not, whereas others may be measured as unsusceptible although they are – it is assumed that GTRIC-p follows a left-truncated normal distribution, with GTRIC-p only taking values of zero or above.

The transformed counterfeiting factor is defined as:

$$c_q = \ln(C_q + 1)$$

Assuming that the transformed counterfeiting factor can be described by a left-truncated normal distribution with  $c_k \geq 0$ , then, following Hald (1952), the density function of GTRIC-p is given by:

$$h_{LTN}(c_q) = \begin{cases} 0 & \text{if } c_q \leq 0 \\ \frac{h(c_q)}{\int_0^{\infty} h(c_q) dc_q} & \text{if } c_q \geq 0 \end{cases}$$

where  $h(c_q)$  is the non-truncated normal distribution for  $c_k$ , specified as:

$$h(c_q) = \frac{1}{\sqrt{2\pi\sigma_q^2}} \exp\left(-\frac{1}{2}\left(\frac{c_q - \mu_q}{\sigma_q}\right)^2\right)$$

The mean and variance of the normal distribution, here denoted by  $\mu_q$  and  $\sigma_q^2$ , are estimated over the transformed counterfeiting factor index,  $c_q$ , and given by  $\hat{\mu}_q$  and  $\hat{\sigma}_q^2$ . This enables calculation of the counterfeit propensity index (GTRIC-p) across HS chapters, corresponding to the cumulative distribution function of  $c_q$ .

### ***Construction of GTRIC-e***

GTRIC-e is also constructed in three steps:

- For each provenance economy, the seizure percentages are calculated.
- From these, each provenance economy's counterfeit source factor is established, based on the provenance economies' weight in terms of Swedish total sales.
- Based on these factors, the GTRIC-e is formed.

*Step 1: Measuring seizure intensities for each destination economy*

$w_d$  is the registered seized value of all types of goods infringing Swedish residents' IP rights (i.e. all  $q$ ) exported to destination economy  $d$  from any provenance economy at a given year.  $\eta_d$  is the relative seizure intensity (seizure percentage) of all products infringing Swedish trademarks and patents that are shipped to country  $d$  in a given year:

$$\eta_d = \frac{w_d}{\sum_d w_d}, \text{ such that } \sum_d \eta_d = 1$$

*Step 2: Measuring destination-specific counterfeiting factors*

$e_d$  is defined as the global registered sales value of Swedish branded or patented products (exports plus domestic manufacturing sales) shipped to  $d$  (including Sweden) and  $E = \sum_d e_d$  is the global value of Swedish sales of sensitive goods to all destination economies.

The share of sales to destination economy  $d$  in Swedish global sales of sensitive goods, denoted  $\zeta_d$ , is then given by:

$$\zeta_d = \frac{e_d}{E}, \text{ such that } \sum_d \zeta_d = 1$$

From this, the economy-specific counterfeiting factor is established by dividing the seizure intensity for economy  $d$  by the share of total sales of sensitive goods to  $d$ :

$$c_d = \frac{\eta_d}{\zeta_d}$$

*Step 3: Establishing GTRIC-e*

GTRIC-e is constructed from a transformation of the counterfeiting factor; it measures the relative proneness with which counterfeit products infringing Swedish trademarks and patents are shipped to a given destination economy. The transformation of the counterfeiting factor is based on two main assumptions, described in OECD/EUIPO, (2016):

1. The first assumption (A7) is that the frequency with which any counterfeit Swedish branded or patented article shipped to a particular destination economy is detected and seized by customs is positively correlated with the actual amount of counterfeit and pirated Swedish products exported to that location.
2. The second assumption (A8) acknowledges that assumption A7 may not be entirely correct. For instance, a high seizure intensity of products infringing Swedish IPR in a particular destination economy could be an indication that the destination economy implements a particular customs profiling scheme or that these products are specially targeted for investigation by customs in that locale. The role some destination economies with low seizure intensities of Swedish IPR infringing products play regarding actual counterfeiting and piracy activity could, therefore, be underrepresented by the index and lead to an underestimation of the scale of counterfeiting activities and piracy targeting Swedish branded or patented products there.

Following assumptions A7 and A8, GTRIC-e for products infringing Swedish IPR is established by applying a positive monotonic transformation of the counterfeiting factor index using natural logarithms. This standard technique of linearisation of a non-linear relationship (in the case of this study, between counterfeiting factors and actual infringement activities) allows the index to be flattened and gives a higher relative weight to lower counterfeiting factors (Verbeek, 2008).

In addition, in order to address the possibility of outliers at both ends of the counterfeiting factor index – i.e. some destination economies may be measured as particularly susceptible to infringement even though they are not, whereas others may be measured as unsusceptible although they are – it is assumed GTRIC-e follows a left-truncated normal distribution, with GTRIC-e only taking values of zero or above.

The transformed general counterfeiting factor across destination economies on which GTRIC-e is based is therefore given by applying logarithms onto economy-specific general counterfeit factors (Verbeek, 2008):

$$c_d = \ln(C_d + 1)$$

In addition, following GTRIC-p, it is assumed that GTRIC-e follows a truncated normal distribution with  $c_d \geq 0$  for all  $d$ . Following Hald (1952), the density function of the left-truncated normal distribution for  $c_d$  is given by:

$$i_{LTN}(c_d) = \begin{cases} 0 & \text{if } c_d \leq 0 \\ \frac{i(c_d)}{\int_0^{\infty} i(c_d) dc_d} & \text{if } c_d \geq 0 \end{cases}$$

where  $i(c_d)$  is the non-truncated normal distribution for  $c_d$  specified as:

$$i(c_d) = \frac{1}{\sqrt{2\pi\sigma_d^2}} \exp\left(-\frac{1}{2}\left(\frac{c_d - \mu_d}{\sigma_d}\right)^2\right)$$

The mean and variance of the normal distribution, here denoted by  $\mu_d$  and  $\sigma_d^2$ , are estimated over the transformed counterfeiting factor index,  $c_d$ , and given by  $\hat{\mu}_d$  and  $\hat{\sigma}_d^2$ . This enables the calculation of the counterfeit propensity index (GTRIC-e) across destination economies, corresponding to the cumulative distribution function of  $c_d$ .

### ***Construction of GTRIC***

The combined index of GTRIC-e and GTRIC-p, denoted GTRIC, is an index that approximates the relative proneness for goods associated with Swedish residents' IP rights in a given product category and a given destination economy to be counterfeit and/or pirated.

#### *Step 1: Establishing proneness for products and destination economies*

The general proneness of Swedish trademarks and patents to be counterfeit or pirated in product category  $q$  is denoted by  $P_q$  and is given by GTRIC-p, so that:

$$P_q = H_{LTN}(c_q)$$

where  $H_{LTN}(c_q)$  is the cumulative probability function of  $h_{LTN}(c_q)$ .

Furthermore, the general proneness of all Swedish trademarks and patents to be infringed and shipped to economy  $d$  is denoted by  $P_d$  and is given by GTRIC-e, so that:

$$P_d = I_{LTN}(c_d)$$

where  $I_{LTN}(c_d)$  is the cumulative probability function of  $i_{LTN}(c_d)$

The general proneness of Swedish residents' IP rights to be counterfeit or pirated in a given product category  $q$  and to be shipped to a given destination  $d$  from any provenance economy is then denoted by  $P_{kd}$  and approximated by:

$$P_{qd} = P_q \times P_d$$

Therefore,  $P_{qd} \in [\varepsilon_q \varepsilon_d ; 1]$ ,  $\forall k, d$ , with  $\varepsilon_q \varepsilon_d$  denoting the minimum average counterfeit export rate for each sensitive product category and each destination economy. It is assumed that  $\varepsilon_q = \varepsilon_d = 0.05$ .

*Step 2: Calculating the absolute value*

$\beta$  is the fixed point, i.e. the maximum average counterfeit rate of Swedish trademarks and patents for a given product type  $q$ , shipped to a given trading partner  $d$ .  $\beta$  can therefore be applied onto the proneness of Swedish-related IP rights of type  $q$  to be counterfeit and shipped to destination partner  $d$  ( $\beta \times P_{qd}$ ).

As a result, a matrix of counterfeit import propensities  $\Lambda$  is obtained.

$$\Lambda = \begin{pmatrix} \beta P_{11} & \beta P_{12} & & \beta P_{1Q} \\ \beta P_{21} & \ddots & & \\ & & \beta P_{dq} & \\ & & & \ddots \\ \beta P_{D1} & & & \beta P_{DQ} \end{pmatrix} \text{ with dimension } D \times Q$$

The matrix of Swedish global sales is denoted by  $E$ . Applying  $\Lambda$  on  $E$  yields the absolute volume of counterfeit and pirated trade in products that infringe Swedish residents' IPR. In particular, the sales matrix  $E$  is given by:

$$E = \begin{pmatrix} e_{11} & e_{12} & & e_{1Q} \\ e_{21} & \ddots & & \\ & & e_{dq} & \\ & & & \ddots \\ e_{D1} & & & e_{DQ} \end{pmatrix} \text{ with dimension } D \times Q$$

Hence, the element  $e_{dq}$  denotes Swedish sales of products in category  $q$  to destination  $d$ , including Sweden, with  $d = [1, \dots, D]$  and  $q = [1, \dots, Q]$ .

Denoted by  $Z$ , the product-by-economy percentage of counterfeit and pirated imports can be determined as the following:

$$Z = \Lambda' E \div E$$

Total trade in counterfeit and pirated goods that infringe Swedish trademarks and patents, denoted by the scalar  $T\Lambda$ , is then given by:

$$T\Lambda = I_1' Z I_2$$

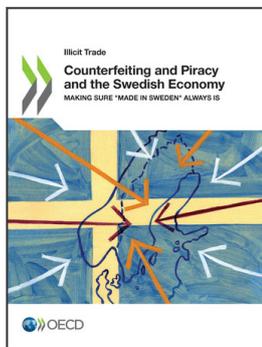
where  $I_1$  is an identity matrix with dimension  $D \times 1$ , and  $I_2$  is an identity matrix with dimension  $Q \times 1$ .

Then, by denoting global Swedish sales by the scalar  $TE = I_1'ZE_2$ , the share of counterfeit and pirated products infringing Swedish residents' IPR in Swedish global manufacturing sales,  $\zeta_{T\Lambda}$ , is determined by:

$$\zeta_{T\Lambda} = \frac{T\Lambda}{TE}$$

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