

A Terminal Dues Model

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The Terminal Dues Model (TDM) consists of a set of Excel 2010 workbooks (spreadsheets) that estimate the economic distortions implied by the current and proposed “terminal dues” arrangements of the Universal Postal Union (UPU) during the period 2014 through 2021. This paper is divided into three sections. The first section describes the terminal dues provisions of the two UPU Conventions covered by this period. The second section explains how the TDM was developed and how others may use the model to derive their own estimates of economic distortions under different scenarios. The third section summarizes three scenarios which have been used in the TDM to develop estimates of terminal dues distortions. Kindly address questions, comments, or corrections to Jim Campbell, jcampbell@jcampbell.com.¹

1. UPU TERMINAL DUES, 2014 TO 2021

Terminal dues are the fees that post offices charge each other for delivery of inbound international *letter post* mail.² Despite its name, the “letter post” is not limited to what are normally called “letters.” The letter post conveys all types of documents and packages up to 2 kg. Letter post items are classified according to three “shapes”: ordinary small letters, large envelopes or “flats,” and “bulky letters” or “small packets,” which are packages weighing up to 2 kg. In this paper, these shapes will be referred to as *letters* (P), *flats* (G), and *small packets* (E), respectively; the standard letter abbreviations (P, G, and E) are derived from French terms. Terminal dues compensate only for the local or “last-mile” delivery of inbound international mail since international mail is collected and transported to the destination country by the origin post office and long distance transportation in the destination country, if any, is compensated by other UPU fees.³

Terminal dues rates are fixed in the Universal Postal Convention, also called the “UPU Convention.” The Convention is revised and adopted every four years by the Universal Postal Union (UPU), an intergovernmental organization and agency of the United Nations.

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² The UPU also establishes delivery rates, called “inward land rates,” for “parcel post” items, i.e., packages weighing up to 30 kg. Distortions caused by inward land rates are not included in the TDM.

³ 2012 UPU Convention, art. 33 (transit charges) and art. 34 (air conveyance dues).

The terminal dues rates currently in effect (in 2016) were established by the 2012 UPU Convention, which was adopted by a general “Congress” of the UPU, a meeting of delegates from all UPU member countries, held in Doha in 2012. The 2012 Convention is effective from 1 January 2014 to 31 December 2017, a four-year period referred to in the UPU as a “cycle.” In September 2016, another UPU Congress will be convened in Istanbul to finalize and adopt a Convention for the 2018-2021 cycle. In February 2016, the two main standing committees of the UPU, the Postal Operations Council (POC) and the Council of Administration (CA), adopted final proposals for the terminal dues provisions of the 2016 Convention. The Istanbul Congress will almost certainly adopt these POC proposals with little or no substantive change. For purposes of the TDM, the February 2016 POC proposals are treated as the terminal dues provisions of the 2016 Convention.⁴

The terminal dues arrangements of the UPU are quite complicated. The main features of UPU terminal dues in the 2014-2017 cycle (established in 2012 Convention) and 2018-2021 cycle (proposed for the 2016 Convention) are described below.

1.1 Terminal dues groups and schedules

Under the UPU Convention, post offices do not charge the same terminal dues rates for delivery of all inbound international mail.⁵ The UPU classifies member countries and territories into four groups for terminal dues purposes.⁶ In the TDM, these groups of countries are denominated as T1 through T4, ranging from the most economically developed countries to the least economically developed, respectively. T1 includes 24 major industrialized countries — 18 Western European countries, United States, Canada, Israel, Japan, Australia, and New Zealand — and 17 small countries and territories. T2 consists of

⁴ On May 25, 2016, the Postal Operations Council issued a revised version of the proposal terminal dues for the target system (Groups T1, T2, and T3). Prop 20.28.1 Rev 1. This revision has been included in the TDM.

⁵ Discrimination between post offices based on nationality appears to violate the “most-favored nation” obligations of the General Agreement on Trade and Tariffs and the General Agreement on Trade in Services. See Alessandra Perrazzelli and Paolo R. Vergano, “Terminal Dues under the UPU Convention and the Gats: an Overview of the Rules and of Their Compatibility,” 23 *Fordham Int’l L.J.* 736 (2000); David Luff, “International Regulation of Postal Services: UPU vs. WTO Rules” in *The Liberalization of Postal Services in Europe*, edited by Damien Geradin (The Hague: Kluwer Law International, 2002). In 2007, World Trade Institute/WTI Advisors, in a study prepared for the International Bureau of the UPU, concluded that the acts UPU are consistent with GATS. World Trade Institute/WTI Advisors, “Implications of the GATS and the Doha-Round Negotiations on the Provision of Postal Services” (25 Apr 2007).

⁶ UPU, 2012 Doha Congress, Res. C 77/2012; POC 2016.1–Doc 12h (rev 1) Annex 1 (12 Feb 2016). The correspondence between TDM terminal dues groups and the UPU group definitions is as follows. T1 refers to what the UPU calls Group 1.1 in the 2014-2017 cycle and Group I in the 2018-2021 cycle. T2 corresponds to Groups 1.2 and 2 (same terminal dues) in the 2014-2017 cycle and Group II in the 2018-2021 cycle. T3 (Group 3, Group III) and T4 (Groups 4 and 5, Group IV) are defined similarly. The TDM uses the terminal dues groups defined by 2012 Doha Congress. Since then two small countries have been moved from one group to another.

Table 1. UPU terminal dues groups and schedules

TDM TD group ¹	Number of countries ²	Approx. % world volume out 2014	Approx. % world volume in 2014	TD schedules 2014-17 ³	TD schedules 2018-21 ³	Origin-destination flows in schedule	Approx. % world volume 2014
T1	28	77.4%	79.9%	T1 H, L	T1 HPG, HE, L	T1-T1	62.7%
T2	24	10.4%	6.0%	T2 H, L	T2 HPG, HE, L	T2-T2; T2 to/from T1	13.0%
T3	41	8.1%	10.1%	T3 H, L	T3 HPG, HE, L	T3-T3; T3 to/from T1 & T2	16.4%
T4	97	4.1%	4.0%	T4 H, L	T4 H, L	T4-T4; T3 to/from T1, T2, & T3	7.9%

¹ Terminal dues model groups correspond to UPU groups as follows: T1 = UPU group 1.1 (2014-2017 cycle); group I (2018-2021 cycle). T2 = groups 1.2 and 2; group II. T3 = group 3; group III. T4 = groups 4 and 5; group IV.

² As of the 2012 Doha Congress there were 192 “member countries” and about 30 territories. Two “member countries” of the UPU are not countries but groups of colonies or former colonies of the United Kingdom and the Netherlands.

³ TD schedules include the following variations: H = bilateral flow more than 75 t; L = bilateral flow less than 75 t; HPG = letters and flats in a flow more than 75 t; E = small packets in a flow more than 75 t.

24 mostly small but relatively prosperous countries such as Aruba, Bermuda, Estonia, Hong Kong, South Korea, Kuwait, Poland, Qatar, Saudi Arabia, and Singapore. T3 includes 41 less developed countries but also prospective industrial giants such as Brazil, China, and Russia. T4 is made up of 97 still less developed countries, but also includes countries with substantial economic potential such as Egypt, India, Iran, Kenya, Nigeria, and Viet Nam.

Different schedules of terminal dues apply to letter post exchanges *between* members of each terminal dues group and to exchanges *to and from* members of each group and members of a more economically advanced group. The T1 schedule of terminal dues applies only to exchanges of letter post items between T1 countries and territories. The T2 schedule applies to T2 to T2 flows and T2 to/from T1 flows. The T3 schedule applies to T3 to T3 flows and T3 to/from T1 and T2 flows. T4 terminal dues apply to all flows to, from, or between T4 countries. See table 1.

Terminal dues schedules may include variations in rates depending on volume or shape. In the 2014-2017 cycle, the four main schedules provide alternative sets of rates depending on whether a bilateral flow (i.e., volume in one direction) is more or less than 75 tonnes (1000 kg). For high volume flows, terminal dues rates are expressed in the form of X per item and Y per kilogram, where X and Y are denominated in SDRs.⁷ For low volume flows, terminal dues are expressed as Z per kilogram, where Z is the kilogram-only rate that results from applying the item and kilogram rates to a standard kilogram of letter post composed of items of average weight. The average weight to be used is specified in the Convention. In the 2014-2017 cycle, the average weight is 81.8 grams (12.23 items per kilogram), the average weight for the worldwide letter post in 2010. In the 2018-2021 cycle,

⁷ SDRs or Special Drawing Rights, is a monetary unit defined by the International Monetary Fund. In January through April 2016, the average value of 1 SDR was US\$ 1.3970 or € 1.2533.

the average weight is 91.9 grams (10.88 items per kilogram), the average weight for the worldwide letter post in 2014. In the 2018-2021 cycle, the T1 and T2 schedules provide different terminal dues for delivery of letters and flats, on the one hand, and small packets, on the other, if the annual flow exceeds 50 tonnes. For T3 exchanges, this distinction applies to annual flows above 75 tonnes in 2018, 2019, and 2020, and above 50 tonnes in 2021. See tables 2 and 3, below.

1.2 Target and transitional systems

UPU member countries and the associated terminal dues schedules are also grouped into two larger categories: the *target system* and the *transitional system*. The target system consists of the T1 and T2 countries and, beginning in 2016, the T3 countries. The transitional system includes T3 countries until 2016 and the T4 countries.⁸

The term “target system” was introduced into the UPU Convention by the 2004 Bucharest Congress pursuant to a decision by the 1999 Beijing Congress. The Beijing Congress amended the Convention to declare that, “The provisions of the present Convention concerning the payment of terminal dues are transitional arrangements, moving towards a country specific payment system.”⁹ An explanatory document of the Beijing Congress declares that in the foreseeable future all countries will pay terminal dues based on the costs of delivery in the destination country.

In future, when it comes to settling terminal dues, relations between all members must be geared to adopting a system based on each country's specific costs. Consequently, by 2002, the POC will have to draw up a transition plan which would lead to the adoption of a system based on each country's specific costs, applicable to all members.¹⁰

The 2004 Bucharest Congress similarly observed that in the target system terminal dues are to be “linked to domestic tariffs [and] at a future date . . . linked direct to costs.”¹¹

In principle, therefore, terminal dues in the target system should be either (1) equivalent to domestic postage for similar services in countries where domestic postage is based on the costs of production or (2) based on the actual costs of service in other

⁸ The T3 countries moved from the “transitional system” to the “target system” in 2016. Prior to 2016, the terminal dues rates and rules for T3 and T4 were the same. From 2016 through 2017, the terminal dues rates remained the same, but T3 countries were obliged to comply with per item/kg formula for flows greater than 75 tonnes.

⁹ 1999 Convention, Art. 47(3).

¹⁰ 1999 Beijing Congress, Doc 37, p. 6.

¹¹ UPU, 2004 Bucharest Congress, Doc. 28 (Terminal Dues), p. 5, para. 21.

countries. Such terminal dues are to be “country specific,” unlike pre-1999 terminal dues, which fixed the same kilogram-only rate of compensation for all countries regardless of domestic postage rates or costs of delivery. In contrast, in the transitional system, a simple kilogram-only rate, unrelated to domestic postage, continues to apply with the understanding that all countries system will eventually be moved to the target system.

In practice, the distinction between the target and transitional systems is not nearly so sharp. As explained below, in the target system virtually all countries charge the terminal dues rates that are established by political agreement and unrelated to domestic postage. About half of the countries in the target system countries charge the same terminal dues rates as countries in the transitional system.

1.3 Terminal dues, 2014-2017 cycle

In the 2014-2017 cycle, terminal dues in the target and transitional systems became more similar than in the previous cycle despite the original differences in concept and objective. Terminal dues in the target system are calculated in a two-step process. First, a *target system formula* is employed to estimate terminal dues rates that are more or less equivalent to domestic postage in each destination country. Then the formula rates are constrained by upper and lower bounds (cap and floor rates). Terminal dues in the target system are converted into kilogram-only rates if a bilateral flow is less than 75 tonnes per year. Terminal dues in the transitional system are set at a kilogram-only rate that is derived from the floor rates for target system countries and the same for all countries. The kilogram-only rate of the transitional system can be converted into the floor kilogram and item rates of the target system if a flow exceeds 75 tonnes in a year.¹²

In principle, the target system formula should be based on the cost concepts used to develop domestic postage rates. The cost of collecting, sorting, transporting, and delivering a document or small package varies with weight and shape. All things being equal, heavier postal items cost more to handle than lighter items, although the relationship is not proportional (a 40-gram letter does not twice as much as to transport and deliver as a 20-gram letter).¹³ Among items of equal weight, a letter in a small envelope is less costly to sort and deliver than a “flat” (a large envelope), and a flat is less costly to handle than a thick, rigid small package. As a result, a modern post office typically has different rate schedules for letters, flats, and small packages — “small packets” in UPU terminology. Rate schedules for each shape are divided into weight steps. For example, a rate schedule for letters may

¹² Terminal dues for the 2014-2017 cycle are established by the 2012 UPU Convention, arts. 29-31.

¹³ It may be that the primary cost-causative factor is volume rather than weight and that weight serves primarily as an indirect measure of volume. For purposes of this discussion, the finer points of accounting for postal costs are immaterial. Whatever method of cost accounting is used, it should apply similarly to international and domestic mail.

have ascending prices for letters weighing less than 20 grams, 20 to 50 grams, and 50 to 100 grams. Postage rates normally increase through the weight steps in a linear manner.

Domestic postage rates for basic first class or priority service therefore can be approximated by a linear formula in which domestic postage (D) is a function of both weight w and shape s . This relationship can be expressed in a simple equation as:

$$D(w, s) = R_{WS}w + R_{PS} \quad (1)$$

In this equation, R_{WS} and R_{PS} are constants. R_{WS} is the charge per unit of weight for shape s , and R_{PS} is the charge per item for that shape. For example, the domestic postage rate might be expressed as SDR 6.36 per kilogram and 0.27 per item. The domestic postage for a 10-gram letter would be SDR 0.33 ($0.06 + 0.27$) or US\$ 0.49, the domestic postage for a 1 ounce letter in the United States in 2014.

In the 2014-2017 cycle, the target system formula follows these domestic mail costing principles, but only up to a point. The UPU formula does not take into account the shape of letter post items. In each destination country, the terminal dues charge is given by a simplified version of equation (1):

$$T_x(w) = R_W w + R_P \quad (2)$$

where T_x is the terminal dues charge prescribed by terminal dues schedule x for an item of weight w , R_w is the kilogram rate, and R_p is the item rate for that rate schedule. The kilogram rate does not reflect that actual progression of charges in the domestic tariff but is given by the following equation:

$$R_W = \frac{0.7 (W_{LP} M + P_1 - 0.1M)}{W_{LP} R_{WF} + R_{PF}} \times R_{WF} \quad (3)$$

In this equation, P_1 and P_2 are the domestic postage rates for a 10-gram letter and a 175-gram flat, respectively. M is the slope of the line joining P_1 and P_2 or, in other words, the rate per kilogram implied by the increase in price from P_1 to P_2 . M is equal to $(P_1 - P_2) / (0.175 - 0.010)$. In equation (3), the numerator gives the domestic postage charge (both weight and item components) for an item of weight W_{LP} implied by P_1 and P_2 . The domestic postage charge is multiplied by 70 percent (0.7) because terminal dues compensate the destination post office only for local delivery; hence, the portion of domestic postage that covers the cost of collection, outward sorting, and transportation (about 30 percent) should be excluded. W_{LP} is the average weight for letter post items worldwide in 2010, 0.0818 kg.¹⁴

¹⁴ UPU, POC C 1 TDG 2011.1 Doc 4a ("Terminal dues model – Results of the studies on costs, flows, tariffs and items per kilogramme") (13 Apr 2011).

R_{WF} and R_{PF} are minimum or “floor” kilogram and item rates for terminal dues, respectively. Floor rates are set by negotiations among the post offices and are unrelated to domestic postage. Equation (3) says that, under the target system formula, the kilogram rate for terminal dues is equal to the floor kilogram rate multiplied the ratio of (1) 70 percent of the total domestic postage charge for an average letter post item implied by the domestic rates for a 10-gram letter and a 175-gram flat divided by (2) the terminal dues charge for an average weight letter post item calculated using the floor kilogram and item rates established by the UPU. Similarly, the price per item is:

$$R_P = 0.7 (W_{LP}M + P_1 - 0.010M) - W_{LP}R_W \quad (4)$$

That is, the terminal dues rate per item is 70 percent of the total domestic postage charge for an average weight letter post item less the weight component implied by the kilogram rate calculated in equation (3).¹⁵

It is apparent that the UPU terminal dues formula in the 2014-2017 cycle yields kilogram and item rates that correspond only very approximately, if at all, to the actual domestic postage rates of a specific destination post office. The initial calculation of the linear equation implied by two domestic postage rates applicable to different shapes — the 10-gram letter rate and 175-gram flat rate — is an estimation at best.¹⁶ This rough linear relationship is used to calculate the domestic postage charge for an item whose weight is equal to the average weight for the global letter post several years earlier, although there is no reason to suppose that this average weight corresponds to the actual average weight of inbound mail received by a specific post office.¹⁷ For items of all other weights, the target system formula yields terminal dues that are derived in large measure from “floor” rates, which are the same for all post offices and which bear no relation to the domestic postage rates of a specific destination post office. For small packets, the link between the target system formula and domestic postage rates for small packets is even weaker than for letters and flats because domestic small packet rates have no role whatsoever in the target system formula.

¹⁵ The POC does not use equations to explicate the calculation of terminal dues. Terminal dues are developed in spreadsheet operations and explained in words in summary documents and Regulations. The 2014-2017 cycle terminal dues formulae in this paper are derived from UPU, “Universal Postal Union - TDG Terminal Dues proposed options - Impact assessment tool V3” (18 Feb 2012), which was available from the UPU internet site, www.upu.int, in 2012. The process of deriving terminal dues from the 2012 UPU Convention is verbally described in 2012 Letter Post Regulations, art. RL 220.

¹⁶ A more accurate method for constructing a linear version of domestic postage rates would be for each destination post office to provide a regression of rates and average weights per weight step for all weight steps for each shape, rather than using arbitrary weights for two weight steps of different shapes.

¹⁷ In fact, in 2014 the average weights for inbound letter post letter post varied substantially depending on terminal dues group of the origin post office. See POC C 3 LPRG 2014.2 Doc 4a Annex 1 (29 Oct 2014).

Table 2. Summary of terminal dues schedules, 2014-2017

Terminal dues schedule	% volume 2014	Formulae (SDR)	Annual increase
T1	67%	Flows > 75 t, target system formula constrained by: — Cap: 0.294/item + 2.294/kg; maximum annual increase 13% — Floor: 0.203 / item + 1.591/kg. Flows < 75 t, per kg rate from above at 12.23 items per kg.	3.0% 2.8%
T2	11%	Flows > 75 t, target system formula constrained by: — Cap: 0.209/item + 1.641/kg — Floor: 0.203 / item + 1.591/kg. Flows < 75 t, per kg rate from above at 12.23 items per kg.	6.0% 2.8%
T3 (after 1 Jan 2016)	22%	Flows > 75 t, 0.203 /item + 1.591/kg. Flows < 75 t, 4.192/kg.	2.8% 2.8% *
T3 (to 31 Dec 2015) & T4		Flows > 75 t, 0.203 /item + 1.591/kg. ** Flows < 75 t, 4.192/kg.	2.8% 2.8% *
<p>* Increase from 2014 to 2015 is 0.072 percent. ** Per kg rate applies to flows greater than 75 t if neither post office requests per item/kg formula. The T4 formula (“revision mechanism”) cannot be invoked by a non-T4 country against a T4 country until first applied by the T4 country. Source: UPU, 2012 Convention, Arts. 29-31; 2013 Letter Post Regulations, Art. RL 220 (target rate formula).</p>			

The terminal dues rates produced by the target system formula are then constrained by cap (maximum) and floor (minimum) rates. See table 2 and Appendix A. In fact, the cap and floor rates are far more consequential for the international letter post than refinements in the target system formula. Revisions in the cap and floor rates are not grounded in economic considerations; they are compromises negotiated by post officials who have commercial interests that both coincide and conflict. The cap rates represent a balance between the common desire to exclude competitors in the international delivery service market by keeping international postage rates artificially low versus the desire of post offices, especially those with high costs or net inbound flows, to be adequately compensated for the cost of delivery. The floor rates represent a balance between the need to obtain the support of low cost post offices, especially developing countries in which domestic postage may be below cost, and the desire of exporting posts to keep their costs as low as possible. Cap and floor rates bear no relationship to the domestic postage or production costs of individual destination post offices.

In the 2014-2017 cycle, the UPU revised its approach from the previous cycle so that the ratio of the item rate to the kilogram rate became the same for all cap and floor rates in the target system. The floor rates and the T2 cap rates were adjusted so that this ratio was changed from 9.9 percent to 12.8 percent, the same as for the T1 cap rates. The origin of the figure of 12.8 percent is historical and non-economic, but consistent use added a

superficial symmetry to the cap and floor rates of the 2014-2017 cycle.¹⁸ In addition, compared to the previous cycle, the annual increase in the T1 cap rates was reduced from 4 percent to 3 percent and the annual increase in the T2 cap rates was increased from 2.4 percent to 6 percent. The floor rates for the target system are increased by 2.8 percent annually, a slight increase from 2.4 percent in the previous cycle.

The cap and floor rates, not the target system formula, establish the terminal dues rates for almost all countries in the target system. According to the POC's projections in 2012,¹⁹ among the 41 countries and territories in the T1 terminal dues system, in 2014 the cap rates would apply in 30 countries and the floor rates in 7. The target system formula rates would apply in only 4 small countries: Gibraltar, Iceland, Isle of Man, and New Zealand. The terminal dues rates in 4 other T1 countries (Australia, Canada, Spain, United States) would be further constrained by a secondary cap rule, which provides that the total terminal dues charge for a letter post item of average weight (in 2010, 0.0818 kg) cannot increase more than 13 percent from the previous year. In the T2 terminal dues schedule, the target system formula is subject to lower cap rates but the same floor rates. Among the 76 countries and territories in the T2 terminal dues schedule, the POC projected (in 2012) that the target system formula would not apply in any country in 2014.

The 2012 UPU Convention further provided, for the first time, that in the 2014-2017 cycle the kilogram and item rates produced by the above procedures — whether by formula or by application of cap and floor rates — would apply only if a bilateral inbound mail flow exceeds 75 tonnes per year. If the flow is less than 75 tonnes, the per kilogram and per item rates are converted into a kilogram-only rate based on the assumption that the average weight per item is equal to the average weight of the worldwide letter post in 2014, 0.0818 kg (12.23 items per kg).²⁰

The kilogram-only rate in the transitional system is also linked to the floor rates in the target system for the first time. Terminal dues rates in 2014 are set at SDR 4.192 per kilogram with annual increases of 2.8 percent.²¹ This is the terminal dues charge that results from applying the floor kilogram and item rates from the target system to a kilogram of

¹⁸ The figure of 12.8 percent was first implied by the kilogram and item cap rates established for all letter post mail in 2003 by the 1999 UPU Convention. Successive Congress maintained the same ratio between the cap kilogram and item rates. There does not seem to be any economic basis for this figure in 2014.

¹⁹ See UPU, "Universal Postal Union - TDG Terminal Dues proposed options - Impact assessment tool V3" (18 Feb 2012).

²⁰ The TDM estimates that in 2014 about 57 percent of the T1 and T2 letter post volume was conveyed in flows weighing less than 75 tonnes.

²¹ These adjustments were carried in such a manner that the kilogram-only rate in the transitional system was the same in 2014 as in 2013.

letter post items with an average weight equal to the worldwide average in 2010. For flows greater than 75 tonnes, either the origin or the destination post office may choose to apply the floor item and kilogram rates instead of the simple per kilogram rate (this option is called the “revision mechanism”).²² Linking the terminal dues in the transitional system to the floor rates in the target system reduced differences between the two systems. In 2012, the POC expected that in 2014 about 30 (of 76) countries and territories in the target system would charge the same terminal dues rates as the countries in the transitional system.

Overall, in the 2014-2017 cycle, the terminal dues of all but about 4 of 220 countries and territories are fixed by political agreement at levels unrelated to the domestic postage rates in the destination country. Even in those 4 countries and territories – Gibraltar, Iceland, Isle of Man, and New Zealand – the relationship between terminal dues and domestic postage is derived from a target system formula that provides a largely arbitrary manipulation of selected domestic postage rates, out-of-date worldwide averages, and politically agreed parameters, rather than a straightforward linearization of relevant domestic postage rates.

1.4 Terminal dues, 2018-2021 cycle

For the 2018-2021 cycle, the UPU Postal Operations Council proposes a similar approach towards setting terminal dues rates for letters and flats and a modified approach for setting rates for small packets. As in the 2014-2017 cycle, a target system formula is used to calculate kilogram and item rates that are derived, in part, from the domestic postage rates of each destination post office in the target system, now including the T3 countries. The major innovation from the 2014-2017 cycle is that the target system formula calculates different terminal dues rates for letters and flats, on the one hand, and small packets, on the other. The formula rates are then constrained by cap and floor rates, with different cap and floor rates for letters/flats and small packets. In the transitional system, the kilogram-only rate is again derived from the floor rates in the target system.²³

In sum, the terminal dues charge for schedule x is given by equation (5),

²² A target system post office may not apply the revision mechanism to letter post mail received from a transitional system post office unless the transitional system post office first applies the revision mechanism to letter post mail received by it.

²³ The terminal dues provisions proposed for the 2016 UPU Convention are set out in UPU, POC 2016.1 Doc 12e Annexes 16, 18, and 20 (16 Feb 2016) and explained in POC 2016.1 Doc 12h (Rev 1, 12 Feb 2016). The terminal dues formulae are derived from a spreadsheet “Impact tool (V1 of the 2018–2021 cycle)” (last edited 4 Mar 2016), available from www.upu.int.

$$T_x(w, s) = R_{WS}w + R_{PS} \quad (5)$$

where T_x is the terminal dues charge prescribed by terminal dues schedule x for an item of weight w and shape s . Unlike in domestic postage rates, however, s can have only two values: a composite of letters and flats (PG) and small packets (E). R_{WS} and R_{PS} are the kilogram and item rates for the two shapes.

For the 2018-2021 cycle, the target system formula for terminal dues applicable to letters (P) and flats (G) is given by the following equations:

$$R_{Wpg} = \frac{0.7 (W_{LP} M + P_1 - 0.1M)}{W_{LP} + K_{pg}} \quad (6)$$

$$R_{Ppg} = K_{pg} R_{Wpg} \quad (7)$$

Equations (6) and (7) are the same as equations (3) and (4) but rewritten in a more concise (and less intuitive) format. W_{LP} is the average weight for the letter post worldwide in 2014, 0.0919 kg, not the average weight for letters and flats, 0.0376 kg.²⁴ The constant K_{pg} is the ratio of the item rate to the kilogram rate for cap and floor rates applicable to letters and flats. This ratio is called the “item to kilogram ratio.”

In 2018-2021 cycle, the “item to kilogram ratio” is a key parameter for terminal dues calculations. Although the UPU expresses this figure as a percentage, it is actually a weight. It is the weight which, for an item of specific weight and at a specific kilogram rate, is equivalent to the item charge. For example, if the terminal dues rates are SDR 2 per kilogram and SDR 0.20 per item, then the terminal dues charge for a 150-gram item is $(0.15 \times 2) + 0.20 = \text{SDR } 0.5$. For a 150-gram item, the item rate has the same effect as adding another 100 grams to the weight and applying only the kilogram rate, i.e., $(0.150 + 0.100) \times 2 = \text{SDR } 0.5$. This extra 100 grams is the “item to kilogram ratio.” In words, equation (6) says that the kilogram rate is (1) the 70 percent of the domestic postage charge for a letter post item of average weight divided by (2) the weight that, at the floor kilogram rate, yields the same total terminal dues charge as applicable to a letter post item of average weight at the floor kilogram and item rates. The same “item to kilogram ratio” is defined for all floor and cap rates applicable to letters and flats. It is equal to the “item to kilogram ratio” implied by the terminal dues rates for the entire letter post in the 2014-2017 cycle, 12.8 percent or, more properly, 0.128 kg.

In the 2018-2021 cycle, cap and floor rates again constrain the application of the

²⁴ According to POC working party, the item to kilogram ratio for letters/flats in 2015 was actually 18.5 percent, not 12.8 percent. UPU, POC C 3 LPRG 2015.1–Doc 6 Annex 2 (26 Mar 2015) at 2.

target system formula with separate cap and floor rates for letters/flats and small packets. See table 3 and Appendix A. The floor rates for letters and flats, $R_{W_{Fpg}}$ and $R_{P_{Fpg}}$, are an extension of the floor rates for the target system in the 2014-2017 cycle. The floor rates for 2018 through 2021 are the floor rates for the letter post in 2017 raised by the 2.8 percent each year, the same annual increase as in the 2014-2017 cycle. The cap rates for letters and flats are likewise a continuation of the cap rates for the letter post in the previous cycle with the same annual increases in the 2018-2021 cycle as in the previous cycle: 3 percent for T1, 6 percent for T2 and T3. There is also a secondary cap rule that limits the increase in terminal dues for a 37.6-gram letter or flat to not more than 13 percent per year.

The target system formula for the terminal dues rates of small packets in the 2018-2021 cycle is given by the following equations:

$$R_{We} = R_{Wpg} \times \frac{W_E + K_{pg}}{W_E + K_e} \quad (8)$$

$$R_{Pe} = K_e R_{We} \quad (9)$$

W_E is the weight of an average small packet in the worldwide letter post in 2014.

In equations (8) and (9), the constant K_e is the “item to kilogram ratio” for small packets. Unlike K_{pg} , K_e cannot be fixed by merely repeating a figure used in previous Conventions. The UPU surveyed domestic postage rates in 2014 and concluded that the “correct” average item to kilogram ratio for target system flows in 2014 is 45.1 percent, 0.451 kg.²⁵ This figure was later revised to 44.5 percent or 0.445 kg.²⁶ The POC proposes to set W_E equal to 0.375 kg even though the UPU’s survey found that the actual average weight was 0.255 kg in 2014.²⁷ In sum, using an arbitrary average weight of 0.375 kg, an historic but non-economic “item to kilogram ratio” for letters/flats of 0.128 kg, and a questionable “item to kilogram ratio” for small packets of 0.445 kg, equation (8) provides that for each destination post office the kilogram rate for small packets is 61.3 percent of the kilogram rate for letters and flats. The item rate is calculated from the kilogram rate using the agreed item to kilogram ratio for small packets.

²⁵ UPU, POC C 3 LPRG 2015.1 Doc 6 Annex 2 (26 Mar 2015). This conclusion apparently assumes that all letter post flows in the target system have the same distribution of items through shapes and weight steps, while another UPU study shows that this distribution varies very substantially for flows between different pairs of terminal dues groups. See UPU, POC C 3 LPRG 2014.2 Doc 4a (10 Oct 2014).

²⁶ UPU, POC C 3 LPRG 2015.2 Doc 5a (1 Oct 2015) at p. 2. Precisely, how the POC arrived at 0.445 kg is unclear. A regression of the domestic postage rates for small packets in the T1 countries indicates a range of values from 3.789 kg to 0.172 kg with several infinite item to kilogram rates because there is no variation in the rates for small packets of different weights.

²⁷ See UPU, POC C 3 LPRG 2015.2 Doc 5a (1 Oct 2015) at 2.

Table 3. Summary of terminal dues schedules, 2018-2021 (proposed by POC)

Schedule	% volume 2014	Formulae (SDR)	Annual increase
T1	67%	Flows > 50 t, target rate formula constrained by: — PG Cap: 0.331/item + 2.585/kg; maximum annual increase 13% — E Cap: 0.705/item + 1.584/kg; maximum annual increase 13% — PG Floor: 0.227/item + 1.774/kg — E Floor: 0.485/item + 1.089/kg. Flows < 50 t, per kg rate from above at 8.16 PG items weighing 0.31 kg and 2.72 E items weighing 0.69 kg.	3.0% 3.0% 2.8% 2.8%
T2	11%	Flows > 50 t, target rate formula constrained by: — PG Cap: 0.264/item + 2.064/kg; maximum annual increase 13% — E Cap: 0.565/item + 1.269/kg; maximum annual increase 13% — PG and E Floor: same rule as T1. Flows < 50 t, same rule as T1 using above cap and floor.	6.0% 9.6% 2.8%
T3		Flows > 75 t, target rate formula constrained by: — PG Cap: 0.234/item + 1.831/kg; maximum annual increase 13% — E Cap: 0.500/item + 1.124/kg; maximum annual increase 13% — PG and E Floor: same rule as T1.* Flows < 75 t, same rule as T1 using above cap and floor.*	6.0% 13.0% 2.8%
T4	22%	Flows > 75 t ** — PG : 0.227/item + 1.774/kg — E : 0.485/item + 1.089/kg. Flows < 75 t, 4.472/kg.	2.8% 2.8% 1.9%
<p>*In T3, the per kg rate applies below 50 t in 2021 (replacing 75 t).</p> <p>** The T4 formula (“revision mechanism”) cannot be invoked by a non-T4 country against a T4 country unless first applied by the T4 country.</p> <p>Source: UPU, Istanbul Congress, Props 20.27.1, 20.28.1 Rev 1, 20.29.1 and Doc 15 (see Prop. 01).</p>			

In the 2018-2021 cycle, the item to kilogram ratio for small packets is used to derive floor and cap rates for small packets from the corresponding floor and cap rates for letters and flats. The floor rates are:

$$R_{WFe} = R_{WFPg} \times \frac{W_E + K_{pg}}{W_E + K_e} \quad (10)$$

$$R_{PFe} = K_e R_{WFe} \quad (11)$$

In the same way, cap rates for 2018 for each terminal dues schedule in the target system are derived from the cap rates for letters and flats. According to the POC’s methodology, however, W_E is not necessarily the same in equations (8) and (10). In equation (8), W_E is described as the “domestic tilting point” or the “weight (in kilograms) around which the domestic rate line will be tilted to the correct item to kg ratio.” In equation (10), W_E is described as the “cap and floor tilting point” or the “weight (in kilograms) around which the caps and floors will be tilted to the correct item to kg ratio.”²⁸ Nonetheless, in both equations the POC proposes to use 0.375 as the average weight for small packets. Hence,

²⁸ “Impact tool (V1 of the 2018–2021 cycle)” (last edited 4 Mar 2016), tab 2018-2021 parameters.

the floor kilogram rate for small packets is 61.3 percent for letters and flats. The cap rates for small packets in 2018 are similarly derived from the cap rates for letters and packets.²⁹

For the years 2019, 2020, and 2021, the cap and floor rates are increased by different amounts as agreed in negotiations among the post offices. The floor rates for small packets are increased 2.8 percent per year, the same as for letters and packets. The cap rates for T1 countries are increased by 3 percent per year, the same as the increase in the cap rates in the previous cycle. The cap rates for T2 countries are increased by 9.6 percent per year, and increase from 6 percent in the previous cycle. The cap rates for T3 countries is set at 13 percent per year, largely to increase the terminal dues on e-commerce packages sent from China. In addition, there is a secondary cap rule that limits the increase terminal dues for 375-gram small packet to not more than 13 percent per year.

As in the 2014-2017 cycle, the cap and floor rates are expected to replace the target system formula in almost all countries. According to the POC's estimates in 2016, in 2018 Israel and Jersey are the only post offices in the T1 terminal dues schedule that will not charge the cap rates for both letters/flats and small packets. Overall, among the 113 countries in the target system, only 7 countries will charge terminal dues according to the target system formula for delivery of inbound mail from any target system country (the other five countries are China, Czech Republic, Grenada, Latvia, and Uruguay).

The per kilogram and per item rate produced by above procedures — whether by formula or by application of cap and floor rates — apply only if the actual inbound mail flows only if the flow exceeds 50 tonnes per year (75 tonnes per year in the T3 rate schedules for the years 2018, 2019 and 2020). If the flow is less than 50 (or 75) tonnes, the per kilogram and per item rates are converted into a kilogram-only rate based on the assumption that the average kilogram of letter post is, as in 2014, composed of 8.16 letter and flat items averaging 37.6 grams each and 2.72 small packets averaging 255 grams each.

In the transitional system in the 2018-2021 cycle, terminal dues rates are set at SDR 4.472 per kg in 2018 with annual increases of 2.8 percent. As in the 2014-2017 cycle, this figure results from applying the floor kilogram and item rates from the target system formula to a kilogram of average weight letter post items weighing 0.919 kg each. For flows greater than 75 tonnes, a destination post office may choose to apply the floor kilogram and item rates instead of the kilogram-only rate.³⁰ See table 3 and Appendix A. In 2018, the POC

²⁹ In the 2018-2021 cycle, the cap and floor rates apply if the total terminal dues charge for a 375-gram small packet using the target system formula rates is greater or less than the total charge that results from the cap or floor rates. This is slightly different from the 2014-2017 cycle in which the kilogram and item rates from the target system formula were individually constrained by the cap and floor rates.

³⁰ A target system post office may not apply the revision mechanism to letter post mail received from a transitional system post office unless the transitional system post office first applies the revision mechanism to letter post mail received by it.

expects about 60 (of 113) countries in the target system to charge the same floor rates as the countries in the transitional system for at least some inbound flows from other target countries.

Overall, in the 2018-2021 cycle, the terminal dues of all but 7 of 220 countries and territories in the UPU are fixed by political agreement at levels unrelated to the domestic postage rates in the destination country. The seven countries are the China, Czech Republic, Grenada, Israel, Jersey, Latvia, and Uruguay. As in the 2014-2017 cycle, even in these countries and territories, the relationship between terminal dues and domestic postage is the result of an essentially arbitrary manipulation of selected domestic postage rates and other figures.

2. THE TERMINAL DUES MODEL

2.1 Overview

In a 2014 report for the U.S. Postal Regulatory Commission, a Danish economic consultant, Copenhagen Economics, explained that

In order not to distort incentives for agents in the value chain, a non-distortionary system for terminal dues must be non-discriminatory (same rate applied for the same service across all delivery operators, also non-designated ones). Moreover, non-distortionary terminal dues would have to equal the price for last-mile handling of domestic letter post items.³¹

The financial distortions implied by the UPU terminal dues system may be estimated by calculating (1) the terminal dues charges and (2) equivalent domestic postage charges for the flow of letter post items, in each direction, between all UPU countries, where “*equivalent domestic postage*” (EDP) is the domestic postage that would be charged for providing delivery services similar to those compensated by terminal dues. Then,

- (1) The *preference* created by the terminal dues system may be defined as the difference between terminal dues charge and EDP. In any given bilateral flow between post offices, the preference may be positive or negative. The preference measures the extent to which private carriers are disadvantaged compared to post offices and domestic mailers are disadvantaged compared to foreign mailers.
- (2) The *net financial transfer* from post office **A** to post office **B** is measured by

³¹ Copenhagen Economics, *The Economics of Terminal Dues*, p. 13. http://www.prc.gov/sites/default/files/reports/The%20Economics%20of%20Terminal%20Dues_final%20report%20300914.pdf.

subtracting the net cost of the preference that **A** gives to **B** in the delivery of inbound letter post (EDP minus terminal dues) from the net benefit of the preference that **A** receives from **B** in the delivery of outbound mail (terminal dues minus EDP). In exchanges with multiple post offices, the net financial transfer by post office **A** is the sum of the net financial transfers from individual bilateral exchanges. The net financial transfer measures the extent a post office benefits or is harmed by the terminal dues system.

- (3) The *total financial transfers* by post office **A** in exchanges with multiple post offices is the sum of the *absolute values* of the positive and negative net financial transfers from individual bilateral exchanges. The total financial transfer measures the extent to the allocation efficiency of the international postal system is compromised.

It may be noted that this approach relies on estimating the distortions created by unjustified *preferences* in access prices for international mail not by calculating “subsidies” for international mail. Calculation of subsidies, in an economic sense, would require information about incremental costs of inbound delivery services which is unavailable. In any case, Copenhagen Economics has identified the correct standard as a matter of public policy. Loading a disproportionate share of the fixed costs of postal services on domestic mailers and providing similar delivery services for international mailers at incremental cost will distort the allocation of buyers’ resources without economic justification.

While simple in principle, calculating the difference between terminal dues and EDP is handicapped by the fact that key quantities are unavailable, including the volumes, weights, and other necessary details of bilateral flows. The TDM offers an approach to estimating the level of terminal dues distortions based upon limited data available from the UPU and plausible assumptions. The TDM first estimates the bilateral volumes, TDs, and EDP for flows between as many nations as possible for the year 2014. Then the TDM “rolls forward” the 2014 data year by year until 2021 based on a scenario of future changes in flows and rates, which may be varied by user input. The final workbook in the TDM provides a summary and analysis of these annual calculations.

Two caveats are in order at the outset. First, the TDM estimates only the distortions *implied* by the 2012 UPU terminal dues system. These estimates do not take account of alternative bilateral arrangements agreed by some post offices. Such side agreements cannot justify a bad UPU system in the first place and, in any case, are constrained by the default rates established by the UPU. Second, all estimates are necessarily approximate. The more specific the mail flow data, the more they should be interpreted as illustrative rather than actual quantities. At the same time, the TDM appears sufficiently grounded in uncontested differences between terminal dues and domestic postage rates and the summary volume data from the UPU that the general patterns of distortions estimated by the TDM are reasonably robust within the limits of each scenario’s assumptions.

2.2 Organization of TDM files

The TDM component workbooks are named according to the following format: TDM_9[x]_[*description*]. In this format, *x* is a letter from *a* to *p* — not all letters are used — and *description* is a short description of the content of the workbook. The sequence of letters indicates the logical sequence of calculations although there are a few instances in which a one workbook uses calculations from a later notebook. Since the letters are sufficient to identify individual workbooks or closely related groups of workbooks, in this paper these workbooks will be referred to as “file 9a,” “file 9b,” etc.

The overall organization of the TDM is as follows. Files 9a through 9f develop estimates of the bilateral volumes, domestic postage rates, and letter post *structure* (distribution of items among the shapes and weight steps and the average weight of each shape/weight step) for the starting year 2014. These estimates are derived primarily from UPU data and studies. Files 9g through 9o “roll forward” the estimates for 2014 through the year 2021. File 9g defines the alternative scenarios used to calculate the annual estimates. The 9h (for 2014 to 2017) and 9n (for 2018 to 2021) files calculate the annual estimates of bilateral volumes, weights, terminal dues, and domestic postage charges. File 9o collects summaries of the annual calculations and combines the data into tables and charts. The 9p files, unlinked from the model, contain the summary calculations of three scenarios. More information on specific files and calculations is given below.

2.3 File 9a: Outbound and inbound volumes per country

File 9a develops outbound and inbound letter post volumes for 2013 for all UPU member countries for which estimates can be obtained. The main source is the UPU database of postal statistics, even though it is incomplete and often inconsistent year to year.

UPU statistics provide *outbound* volumes for 2013 for about 115 of 220 countries and territories. These 115 countries and territories accounted for 1.25 billion letter post items, less than half of the UPU’s estimated global outbound total for 2013 of 3.73 billion items.³² By relying on data for the year before, the year after, or, when necessary, two years before, estimates for another 42 countries can be included, adding 0.36 billion. In a handful of cases, the volume reported for 2013 was disregarded in favor of an average of prior and subsequent years (the only significant instance was the Czech Republic with an estimated outbound volume of 40 million items). In other cases, reported volumes were considered

³² UPU, “Development of Postal Services 2014” (Oct. 2015). The “Development of Postal Services 2014” (hereafter DPS) is an annual powerpoint presentation by the UPU’s staff that summarizes the development of postal services. The DPS 2014 includes the recent estimates of annual postal volumes for the years 1991 through 2014.

too unreliable to use because of very large variations from year to year. The major missing pieces are the volumes from a small number of large, highly commercialized countries. Data from national regulators and annual reports of post offices adds 6 countries and 1.22 billion items. For the post offices of 8 countries (Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, and Netherlands), it is necessary to use plausible ratios of outbound mail volume to domestic mail volumes, accounting for a further 0.95 billion items. The result is a global estimate of 3.72 billion outbound letter post items in 2013 for 175 countries and territories. This agrees remarkably well with the UPU's estimate of 3.73 billion.

Estimates for inbound mail volumes for 2013 were developed in a similar manner although the UPU statistical data base for inbound mail is less complete. Inbound volumes for 2013 are reported for 108 countries (1.72 billion). Using data from prior and subsequent years (sometimes used in preference to volumes reported for 2013) adds 58 countries (0.70 billion). Government or postal sources provided 3 more countries (1.00 billion). Estimates based on plausible ratios of inbound volume to domestic volume were used for 10 countries (0.78 billion). The result is an estimated inbound total of 4.19 billion for 170 countries. The UPU provides no estimate for total inbound volume.

Not all countries with outbound volumes estimates have inbound volume estimates. In total, file 9a provides estimates of the volume of international letter post in 2013, both outbound and inbound, for 166 countries. The data set of volumes is not used directly in the TDM. It is used in file 9f to apportion estimates of regional flows developed by the UPU.

The fact that estimated outbound volume is substantially less than estimated inbound volume may be accounted for by one or more explanations. In general, post offices appear to have better data on outbound mail volumes, for which they collect postage, than on inbound mail volume, for which they collect terminal dues that, in many cases, are based on weight measurements only. Inflated inbound mail volumes may derive from outdated estimates of the average weight per item, which has been declining in recent years. Then, too, post offices that dispatch substantial volumes of remail and ETOE mail may not report such mail as part of their outbound totals. Indeed, several of the 8 countries for there are no outbound volume statistics fall into this category.

2.4 File 9b: Domestic postage

File 9b synthesizes available information on domestic postage rates for 2014. In each cases, domestic postage rates are reported according to the UPU's standard schedule of shapes and weight steps. The source for this file is the UPU's 2016 spreadsheet "tool" for estimating terminal dues in the 2018-2021 cycle.³³ This tool includes a collection of priority

³³ The file is toolTerminalDuesImpactCycle2018To2021V1En from <http://www.upu.int/uploads/>

domestic postage rates by shape and weight step for about 163 countries. Rates for 2014 are provided for 88 countries and 2011 rates for 75 countries. The UPU tool also reports the value added tax applicable to postal services, if any. The UPU tools converts rates from national currency into SDRs using what appears to be a November 2014 exchange rate.

From this UPU data set, file 9b creates a table of 2014 priority domestic postage rates in SDRs, by shape and weight step, for 158 countries. Rates for 2014 are reproduced as reported by the UPU, except that more recent domestic postage rates for the United States are substituted for the UPU data.³⁴ Rates for 2011 are updated to 2014 by multiplying the 2011 rates by the increase in the consumer price index for each country (from the World Bank). In a few cases, file 9b completes the rate schedules reported by the UPU by assuming that rates for one shape also apply to the same weight steps in another shape. Where rates are missing for the small packet 1000 to 1500 gram weight step and/or the 1500 to 2000 gram weight step, file 9b completes the set of rates by using the rate for the small packet 500 to 1000 gram weight step (or the 1000 to 1500 gram weight).³⁵

Of the 158 countries for which domestic postage rate data is available, 136 are included in the list of countries for which estimates of inbound and outbound letter post volumes are available from 9a. These 136 countries represent about 99.4 percent of the total outbound mail volume in 2014. All of the estimates of the TDM thus refer to the exchange of letter post mail between these 136 countries.

2.5 Files 9c and 9d: Terminal dues

Files 9c and 9d develop summary worksheets used to calculate terminal dues in subsequent files. File 9c is slight adaptation of the 2012 UPU “tool” (spreadsheet) for estimating terminal dues in the 2014-2017 cycle. Similarly, file 9d is a minor modification of the 2016 “tool” prepared by the UPU for the 2018-2021 cycle. Changes from the original formats simplify the organization of calculations and make them easier to move to file 9g. In addition, unlike the UPU’s tools, the revised terminal dues worksheets allow calculation of terminal dues to reflect the assumptions about changes in domestic postage rates embodied in a user-defined scenario. This revision reflects actual practice. Terminal dues are in fact recalculated each year based on current domestic postage rates.

tx_sbdownloader/toolTerminalDuesImpactCycle2018To2021V1En.xlsx (16 Mar. 2016). According to the metadata, this file was last modified on 4 Mar. 2016.

³⁴ U.S. Postal Service, “Notice 123” (7 Apr 2014).

³⁵ This assumption will tend to understate the difference between domestic postage (probably more expensive parcel rates) and terminal dues.

2.6 File 9e: Structure of the letter post

File 9e summarizes information about the *structure* of the international letter post in 2014, i.e., the distribution of items among the shapes (P, G, and E) and weight steps and the average weight of each shape/weight step. The structure of the letter post affects both terminal dues charges and equivalent domestic postage. The source for file 9e is the UPU's 2014 "IPK Study" ("IPK" refers to items per kilogram).³⁶

The 2014 IPK Study study estimates the average weight and distribution of letter post mail at the "*shape level*" for exchanges between pairs of terminal dues groups. The study reports, for example, that for mail sent from a T1 country to a T3 country in 2014, the average weights of letters, flats, and small packets, were 14.79 g, 154.32 g, 308.64 g, respectively, and these shapes accounted for 59.3, 11.9, and 28.8 percent of the volume of letter post, respectively. The study was based on inbound letter post reports from 49 post offices.

The 2014 study also provides more detailed "*weight step level*" data for a typical kilogram of international letter post, i.e., not only the average weight for each shape but also the average weight of each weight step of each shape and the distribution of items among these weight steps. For example, the study reports that in an average kilogram of letter post there are 5.17 letters in the 0 to 20 gram weight step, 0.27 letters in the 20 to 50 gram weight step, and 0.31 letters in the 50 to 100 gram weight step. The distribution of letters among these weight steps is 80 percent, 18 percent, and 2 percent, respectively, and the average weight for each weight step is 12 grams, 28 grams, and 68 grams. This more detailed analysis is, however, based on reports from only 15 posts and does not provide differences in mail structure between terminal dues groups.

While shape level data on mail structure is sufficient for calculating terminal dues, weight level data is needed to calculate EDP. It is therefore necessary to transform the typical weight step structure reported in the IPK study into alternative weight step level structures that are compatible with the average weights reported for flows between terminal dues groups. For example, in the weight step level study, the average weight for letters worldwide is 16.07 grams, but the average weight for letters sent from T1 to T2 countries is 19.90 grams. The higher average weight for T1-T2 flows could imply a higher average weight in each weight step or a shift in distribution of letters to the heavier weights steps. Some combination of the two factors is needed to accomplish this transformation in an orderly manner so that transformation algorithm can applied to the wide variation in flows between pairs of terminal dues groups. In the TDM this transformation is

³⁶ UPU, POC C3 LPRG 2014.2 Doc 4a ("Results of the items per kilogramme (IPK) study"). The results of the 2014 IPK Study are reproduced in file 9e in the tabs following "IPK2014" and summarized in "SumIpk2014."

accomplished by relying roughly equally on increases in average weight per weight step and shifts in distribution. For example, for T1 to T2 countries, the TDM assumes that letters in the 0 to 20 gram, 20 to 50 gram, and 50 to 100 gram weight steps have average weights of 13.31, 31.44, and 72.45 grams, respectively, and are distributed to the weight steps in the proportion 75.8 percent, 19.0 percent, and 5.2 percent.³⁷

File 9e also makes use of a 2010 IPK Study, the predecessor to the 2014 study. In 2014 two UPU economists published a study of the relative weights of letter post flows between world regions in 2011.³⁸ This study estimates the total weight of international mail sent from each geographic region to every other geographic region, including international mail sent to other countries in the same region. Using the 2010 IPK study, file 9e translates the 2011 regional weight study into a matrix of interregional volume flows. This translation is approximate because terminal dues groups are not defined by the geographic regions used in the regional weight study. Nonetheless, the translated 2011 regional weight study is necessary step in the TDM. It provides the only available UPU estimate of the relative flows between the major geographic regions of the world and is used in estimating bilateral flows between regions in file 9f.³⁹

2.7 File 9f: Bilateral flows

File 9f develops estimates of bilateral letter post flows between the 136 countries for which both international mail volume and domestic postage rates have been estimated in earlier files. Bilateral flows are not publicly available from any post office so these estimates do not so much represent estimates of actual flows as a hypothetical array of flows that is consistent with regional and global studies by the UPU.

The main sources for file 9e are two studies mentioned above: the UPU's "Development of Postal Services 2014" (DPS 2014) and the 2014 study of interregional weight flows in 2011. The 2014 DPS estimates the volumes of outbound international letter post by geographic region. For example, in 2014, Sub-Saharan Africa accounted for 1.5 percent of all outbound international letter post while South America accounted for 1.3 percent, and Asia 12.7 percent. The largest source of international letter post is "industrialized countries" (not divided by geographic region) which accounted for 77.4 percent of outbound letter post. The 2011 regional weight study (translated into volumes in file 9e) allows a distribution of outbound volumes from each region to other regions.

³⁷ In file 9e, these transformations are shown in the several worksheets after the tab "PGEMorph" and summarized in "SumPGEVars." Only the percentage distributions by weight step are needed to calculate EDP.

³⁸ José Ansón, and Matthias Helble, "Global Postal Connectedness" (2014).

³⁹ See file 9e, tab InterRegDistribute2011 and preceding worksheets.

Unfortunately the geographic regions in two studies are not the same. The “industrialized countries” region in the 2014 DPS corresponds to two whole regions in the 2011 study, Western Europe and North America and part of third region, Asia (Australia, Japan, and New Zealand). The “industrialized countries” region from the 2014 DPS study is allocated to these two and a half regions using the proportions of outbound volumes estimated in file 9a.

These manipulations produce a matrix of flows between geographic regions that is derived from UPU data and consistent with the regional and global outbound volumes reported in the 2014 DPS. But how can these interregional volumes be allocated to bilateral country flows? At this point, file 9f introduces a rough rule of thumb which can be called, an assumption of “*proportional regional participation.*” This assumption may be explained by an example. Suppose that Asia sent to Western Europe 12.2 percent of global letter post and that, based on the country volume estimates in file 9a, Australia accounts for 10.4 percent of all mail exported from Asia while France accounts for 18.4 percent of all letter post imported by Western Europe. Then the flow of mail from Australia to France may be estimated as 0.234 percent of global mail. That is, the model assumes that if Australia accounts for 10.4 of all mail exported by Asian countries, then it accounts for a similar percentage of the mail that Asia exports to Western Europe. The same assumption is made for France on the inbound side. So the percentage of all international mail that Australia sends to France is estimated to be 10.5% x 18.5% x 12.2% or 0.234% of global international mail.

Mathematically, the assumption of “proportional regional participation” may be expressed as follows. The flow from Country i in Region A to Country j in Region B, F_{ij} , can be derived from the inter-regional flow as:

$$F_{ij} = \frac{O_i}{O_A} \times \frac{I_j}{I_B} \times F_{AB} \quad (12)$$

where F_{AB} is the flow from Region A to Region B; O_i and O_A are respectively the total outbound volumes from Country i and Region A; and I_j and I_B are respectively the total inbound volumes to Country j and Region B. If Country i and Country j are in the same Region, A, and F_{AA} is the flow of international letter post between countries in Region A, the equation is:

$$F_{ij} = \frac{O_i}{O_A} \times \frac{I_j}{I_A \times (1 - (I_i/I_A))} \times F_{AB} \quad (13)$$

The assumption of “proportional regional participation” yields a complete set of *relative* bilateral international mail flows that is internally consistent and consistent with

available UPU interregional data.⁴⁰ Each bilateral flow (in each direction) is expressed as a fraction of the total volume of international letter post mail. In file 9f, the total volume of international mail in 2014 is set at 3.50 billion. This is a slight simplification. The 2014 DPS estimates the total outbound international mail in 2014 was 3.46 billion.

The assumption of proportional regional participation is obviously a rough and ready approximation. It relies only on total volumes of outbound and inbound mail sent and received by Countries i and j. In reality, the volume of mail between two countries is also affected by such factors as distance, historical relations, language, currency, etc.⁴¹ However, the assumption of proportional regional participation is substantially constrained by the UPU's regional flow studies.⁴² In the flows module the estimated volume of mail that Country i sends to Country j is based first on the overall interregional volume and only secondarily on the assumption of the proportional regional participation. This constraint limits potential errors implicit in the assumption of proportional regional participation.

2.8 File 9g: TDM Scenarios

In file 9g, the user defines the scenarios that are used to develop estimates of terminal dues distortions in the years 2014 through 2021. Each scenario defines assumptions about three future quantities: (1) the annual change in the *volumes* of letters, flats, and small packets; (2) the annual change in the *average weight* of letters, flats, and small packets; and (3) the annual change in *domestic postage rates* for letters, flats, and small packets. The user may input quantities for each variable for each shape (P, G, E), for each year (2014 through 2021), and for each bilateral pair of terminal dues groups in each direction. It is also possible to override these settings to introduce more country specific settings.

Each scenario in file 9g is defined in a separate sheet named "Scenario1," "Scenario2," etc. The selection of the "current" scenario is made on the section tab, "Scenarios." The current scenario is copied to the worksheet "ScenarioCurr" which is linked to the 9h and 9n files that perform the calculations for each year.

⁴⁰ The assumption of proportional regional participation is also used to subdivide regional flows from Asia in the 2011 Regional Weight Study into flows associated with Groups T1, T2, T3/T4 (treated jointly in the 2014-2017 cycle because the terminal dues are the same) before using the 2010 IPK study to convert weights into volumes. In the North American region, mail flows between the U.S. and Canada have been adjusted to reflect 2011 data from the U.S. Postal Regulatory Commission.

⁴¹ Ansón and Helble, 2013. Unfortunately, the authors' "gravity model" depends on at least one variable that requires access to non-public UPU data.

⁴² Before applying the assumption of proportional regional participation, the volumes of mail for individual countries developed in file 9a must be adjusted so that total volumes per region are consistent with the relative outbound volumes per region reported in the 2014 DPS. See file 9f, tab 2013VolsBaseAdj.

In file 9g, the tab “TdmTdGroups” also allows the user to adjust certain features of the model that are independent of the scenario. On this tab, the user may specify the percentage of priority domestic postage that is considered to be equivalent to terminal dues. As noted, the UPU considers equivalent domestic postage to be equal to 70 percent of priority domestic postage. This tab also allows for definition of two special terminal dues groups. T2 and T3 can be subdivided into countries that specialize in postal e-commerce trade and other countries. In present version of the TDM, “T2E” includes two T2 countries, Hong Kong and Singapore, that export very large quantities of e-commerce items. “T2” by itself refers to the remainder of T2 countries. Similarly “T3E” refers to one T3 country, China, that is a major factor in global e-commerce trade, while T3 alone refers to all other T3 countries. This division allows the user to provide different rates of growth and average weights for e-commerce countries. The separate categorization of e-commerce countries can be expanded to include other countries.⁴³ The creation of T2E and T3E terminal dues groups scheme also allows a simple grouping of countries that is convenient for analytical purposes: Industrialized Countries or ICs (T1), Developing Countries or DCs (T2, T3, and T4) and E-commerce Countries or ECs (T2E and T3E).

Finally, file 9g calculates the domestic postage and terminal dues rates implied by the current scenario for the years 2014-2021. The domestic postage rates are calculated in the section “DomPost” for the years 2014 (DPRates1), 2015 (DPRates2), etc. The starting data set is the 2014 rates calculated in file 9b. For each year, domestic rates in national currency are changed from the previous year by the amount assumed in the current scenario (actual domestic postage rates for 2015 and 2016 may be entered if known). The domestic postage rates then converted into SDRs using the selected set of exchange rates. In 2014, the SDR exchange rates are those calculated by the UPU in the 2016 spreadsheet “tool” for 2018-2021 terminal dues rates (apparently from September 2014). In 2015, the SDR exchange rates are averages of the monthly exchange rates. In 2016 and thereafter, the SDR exchange rates are an average of the first four months of 2016. The terminal dues for both the 2014-2017 and the 2018-2021 cycles depend, to a limited degree, on the domestic postage rates defined in the scenario. These terminal dues rates are summarized in worksheets “SumTD2014_17” and “SumTD2018_21.” The domestic postage and terminal dues rates calculated in file 9g are linked to the 9h and 9n files that perform the calculations for each year.

⁴³ The countries treated as T2E and T3E are defined in file 9g, tab TdmGrps.

2.9 Files 9h and 9n: Annual calculations

Files 9h (Years 01 to 04, i.e., 2014 to 2017) and 9n (Years 05 to 08, i.e., 2018 to 2021) calculate the volume, weight, domestic postage, equivalent domestic postage, and net transfers for each bilateral flow (in each direction) between 136 countries. Each file is based on the annual changes in the the current scenario, the terminal dues options, and the terminal dues rates defined in file 9g, as well as the mail structure, domestic postage rates, and array of bilateral flows from the preceding year. Calculations for Year 01 are based a Year 00 file that contains the output from the 9b (domestic postage), 9e (mail structure), and 9f (flows) files.

The 9h and 9n files must be updated sequentially. A macro located on the “Scenarios” tab of file 9g will update the 9h and 9n files automatically.

The results of the 9h and 9n files are summarized in worksheets which sum the calculated outbound and inbound quantities for each origin country by terminal dues group.⁴⁴ These are linked to file 9o.

2.10 File 9o: Summary

File 9o collects the summary calculations from the 9h and 9n files and creates tables and charts which summarize the annual results and year to year trends.

3. THREE SCENARIOS

So far the TDM has been used to calculate the implications of three scenarios, set out in the appropriate tabs in file 9g and summarized in Tables 3, 4, and 5, below.

Scenario 1, the Base Scenario, continues a relatively conservative interpretation of recent trends in the 2014-2017 cycle followed by a moderation of those rates of change in the 2018-2021 cycle. The calculations which estimate recent trends are found at the end of files 9b (domestic postage) and 9f (flows). Although the TDM allows for user-defined changes in the average weight per shape, none of the scenarios provide for changes in average weight because there is no obvious basis for defining such changes.

⁴⁴ Tabs “Vol,” “Wt,” “DP,” “TD,” and “NT.” A special file “US” records certain information about flows and from the United States.

Table 4. Base Scenario (1)

Flow	Quantity	2014-2017	2018-2021
T1 to World	Volume, annual change	P: -8.5%, G: -12%, E: +10%	P: -5%, G: -8%, E: +10%
T2, T3, T4 to World	Volume, annual change	P: -6%, G: -6%, E: +0%	P: -4%, G: -4%, E: +0%
T2E, T3E to World	Volume, annual change	P: -6%, G: +3%, E: +30%	P: -6%, G: +3%, E: +20%
T1	Dom. postage, annual change	P: +6%, G: +4%, E: +2%	P: +3%, G: +3%, E: +3%
T2	Dom. postage, annual change	P: +2%, G: +2%, E: +2%	P: +2%, G: +2%, E: +2%
T3	Dom. postage, annual change	P: +15%, G: +15%, E: +15%	P: +10%, G: +10%, E: +10%
T4, T2E, T3E	Dom. postage, annual change	P: +5%, G: +5%, E: +5%	P: +5%, G: +5%, E: +5%

Table 5. High Change Scenario (2)

Flow	Quantity	2014-2017	2018-2021
<i>Same as Base Scenario except:</i>			
T1 to World	Volume, annual change	E: +15%	E: +20%
T2E, T3E to World	Volume, annual change	E: +70% (2015), +50% (2016), +40% (2018)	E: +30%
T1	Dom. postage, annual change	E: +5%	E: +5%

Table 6. Low Change Scenario (3)

Flow	Quantity	2014-2017	2018-2021
<i>Same as Base Scenario except:</i>			
T1 to World	Volume, annual change	P: -5%, G: -5%, E: +5%	P: -5%, G: -5%, E: +5%
T2 to World	Volume, annual change	P: +0%, G: +0%, E: +5%	P: +0%, G: +0%, E: +5%
T3, T4 to World	Volume, annual change	No change	No change
T2E, T3E to World	Volume, annual change	P: +0%, G: +0%, E: +15%	P: +0%, G: +0%, E: +15%
All groups	Dom. postage, annual change	P: +2%, G: +2%, E: +2%	P: +2%, G: +2%, E: +2%

Scenario 2, the High Change Scenario, adopts a more expansive view of recent trends for the 2014-2017 cycle followed by a more subdued estimate of changes in the 2018-2021 cycle. For example, the Base Scenario assumes that annual growth in small packet exports from the ECs (e-commerce countries) has been about 30 percent per year and that this rate of growth will continue over the first cycle and decline to 20 percent per year in the second cycle. However, the actual rate of growth of EC small packets is unknown, and it is anecdotally said to be closer to 100 percent per year in recent years. The High Change Scenario assumes that growth in EC small packets will be 70 percent in 2015, declining to 30 percent per year in 2018 and remaining at 30 percent thereafter. In addition, the High Scenario assumes that domestic postage rate for small packets in the Industrialized Countries (ICs) will increase by 5 percent per year over the 2014 to 2021 period (compared to 2 percent in the Base Scenario), due factors such as a loss of economies of scope with document delivery, a need to increase service quality to compete in the market, and a possible increase inflation.

Scenario 3, the Low Change Scenario, generally assumes that the pace of change will

slow, that both declines in document volumes and increases in small packet volume will diminish, and that increases in domestic postage rates will stabilize at about 2 percent per year.

Calculations resulting from these three scenarios are found in the 9p files. These files are not linked to the calculations, so they represent “stable” results for analysis. The scenarios used to produce these files are not intended to be predictions of the future. They are intended to demonstrate the effects of different assumptions on the estimates of the TDM. Tables and charts summarizing the results for each scenario may be found at <http://www.jcampbell.com/UPU-TDs/TDM.html>.