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The cost of a telegram: the evolution of the international regulation of the telegraph.

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Abstract

The telegraph was the first practical use of electricity. It revolutionized commercial communication and facilitated the globalization of business. As the telegraph developed as a medium of international communication, regulation was needed to overcome administrative and technical issues, and, importantly, to establish accounting procedures for the distribution of the revenue to multiple national partners. This paper traces the evolution of revenue allocation models through three international organizations that ultimately lead to the creation of the International Telecommunications Union (ITU) in 1932. The shifts in revenue allocation methods are consistent with a shift in focus of regulation from growth to efficiency over the rapid development of the telegraph network. The procedures put in place are still used in the regulation of international telecommunications but with continuing conflict over their effects. The rules developed in the regulation of the telegraph also set the stage for the rise of expertise in the maintenance of international order and the development of accounting as an epistemic community in international relations.

Keywords: telegraph, International Telecommunications Union, revenue allocation.

Introduction

The telegraph¹ stands out as one of the few methods of communication that have been formally abandoned. It emerged with great fanfare in the mid-1800s as the first practical application of the growing knowledge of electricity and sparked a capital intensive boom as telegraph cables were laid across countries and on the seabed to link continents (Standage, 1998). The telegraph contributed to the globalization of economies and politics by reducing the time for information to flow between points by a factor of a thousand (Keohane & Nye, 2000: 113). No other communications technology had such an incremental impact on the speed of communications. It allowed information and transportation to be decoupled. Within 50 years of its invention, however, other technologies – such as radio and the telephone – were developed offering greater functionality at lower cost. In spite of its limited period of dominance as a means of communications, the lessons learned in forming these networks proved to be essential in the development of many network industries (Carlton & Klamer, 1983). In particular, in its formative years making the telegraph system work across national borders encouraged the emergence of new forms of international coordination (Coddington, 1952; Howland, 2015), the delegation of plenipotentiary powers to technical experts setting the stage for the rise of the professional class and epistemic communities in international regulation (Adler and Haas, 1992), and created an institutional structure capable of handling the modern regulation of radio frequencies or “spectrum” (Glazer, 1962).

A key concern of international telegraph treaties and the organizations that implemented them was to negotiate tariff systems and revenue allocation methods that would make the international flow of telegrams across different national and regional systems seamless from a user’s perspective and to allow the costs of such systems to be reduced and matched to revenues. Over a hundred years later, this remains a key concern of telecommunications regulation (Frieden, 1993; Allemen and Sorce, 1997). Revenue measurement and allocation systems are an under-studied part of management accounting systems and yet they are a set of techniques that have become crucial in the regulation of networked systems involving multiple partners² and in the operation of private networks such as the internet where advertising revenues must be divided among search engines, hosting sites and content providers. The approaches used within networks to recognize and allocate revenue among freely contracting, informed and self-interested parties may also contribute to current debates among financial reporting standard setters on this topic.

The study of management accounting change in this setting, i.e. the systems of revenue measurement and allocation used in different time periods to facilitate the operation of the international telegraph system, expands our understanding of the use and consequences of such techniques beyond the usual contexts. International organizations like the International Telecommunications Union and its predecessors must find accounting procedures that accommodate a wide range of cultures, economic systems and levels of development among member nations. In this respect they are like multinational

¹ The telegraph is defined as a means of written communication by coded signals. Histories of the telegraph typically include optical systems (e.g. semaphore, smoke signals) but for our purposes, the telegraph is limited to communication by using electromagnetic and radio waves. A “telegram” refers to a single message conveyed over the telegraph system. During this period there was discussion of alternative terms for such messages including “telegraphic dispatch” and “telegrapheme” but the term “telegram” became the dominant term in the 1850s.

² For example, when rail service was privatized in the UK a computer system, known as ORCATS, was developed to allocate ticket revenue among multiple private service providers. The characteristics of the allocation method and its consequences have not been discussed in the accounting literature.

corporations that develop centralized narratives and procedures that are subject to local implementation in diverse settings (Cooper and Ezzamel, 2013). Unlike multinational corporations, however, there is a much higher degree of transparency and formal record keeping by international treaty organizations that allows insight into the processes by which management accounting techniques are adopted and changed. In addition, the records of these organizations often provide an extended window of observation to track these changes. With few exceptions (e.g. Spraakman and Wilkie, 2000; Spraakman, 2006; Kininmonth & McKinstry, 2007; Chandar and Miranti, 2009; Richardson and Kilfoyle, 2009; Chandar et al., 2012; Ogata & Spraakman, 2013; Quinn, 2014), most studies of management accounting change focus on relatively short windows, typically two to five years (Quinn, 2014). While short window studies can observe organizational and strategic changes that may be associated with management accounting change, they are less likely to capture changes in the broader institutional environment that may affect the choice of management accounting system as these tend to change over longer time periods (Abbott, 1988: 135). The setting examined in this paper covers the years 1837-1932, a period that includes significant change in the international political, economic and technological environment and well as within the countries that comprised the network.

This study thus contributes to our understanding of the use of accounting in network organizations and specifically within international network organizations. It focuses on change in management accounting procedures over long time horizons and, in particular, draws attention to revenue allocation methods used within networks. The paper traces the development of tariff systems and revenue allocation models through three predecessor organizations that ultimately became the core of the International Telecommunications Union (ITU), now a specialized unit of the United Nations dealing, primarily, with issues related to the use of radio frequencies (“spectrum”) both on earth and in space. The predecessor organizations were two European telegraph unions³ – the German-Austro Telegraph Union (GATU) formed in 1850 and the Western Europe Telegraph Union (WETU)⁴ formed in 1855 – that merged in 1865 to form the International Telegraph Union (ITeU). The International Telegraph Union subsequently merged with the Radio Telegraph Convention (established in 1906) to form the International Telecommunications Union (ITU) in 1932. The ITU continues to hold responsibility for the regulation of the telegraph, telephone and radio spectrum. The timing and connection between these bodies is summarized in Figure 1. For reference, this figure also shows the time period of development of the technologies being regulated culminating with the date of invention of a commercial form of each medium of communication.

[Figure 1]

The paper is organized as follows. I begin by providing a brief history of the telegraph as a technology. This establishes the time period of interest in this paper, i.e. from the invention of a commercially viable telegraph system in 1837 to the disappearance of a distinct regulatory body for international telegraph traffic in 1932. I then review the sources of data used in the paper and identify issues with these sources. The next section identifies the international bodies (known as Unions) that were created to regulate the emerging international telegraph market. Subsequent sections then examine the pricing and revenue allocation methods developed within each body focusing on the technical and political

³ A “Union” in this context is a treaty based organization formed for a specific technological/functional purpose.

⁴ Unlike the German-Austro Telegraph Union, the Western European Telegraph Union did not have an administrative unit and hence the name is conventional within this literature rather than a formal title of an organization.

antecedents and implications for members of the network of each “accounting regime” (Jones & Dugdale, 2001). The paper concludes by identifying the consequences of accounting’s engagement with telegraph regulation for international relations and noting the contributions of this study to our understanding of revenue allocation processes in international network organizations.

A brief technological history of the telegraph⁵

The history of the telegraph is intimately connected to the development of our understanding of magnetism and electricity in the late 1700s and early 1800s. In particular it was quickly recognized that the flow of electrical current along a wire could be used to activate a signal at the far end of the wire and hence be used for distant communication. By 1837 Morse, in the US, and Wheatstone and Cooke, in the UK, had developed commercially viable telegraph systems. This was the first commercial use of knowledge of electricity; electrical lighting and electrically powered machinery following in the 1860s and 1870s.

The telegraph operates by interrupting the current flowing through a wire. Morse devised a system of short and long interruptions that allowed messages to be coded and decoded by skilled operators. The nature of the technology meant that only one message at a time could be transmitted requiring multiple cables for busy routes and rules about when messages could be sent in each direction so as not to interfere with other messages in process. Multiplexing was developed in 1870 allowing multiple messages to be transmitted on a single wire by using different frequencies of electrical current. The telegraph system is thus labour intensive locally and capital intensive in the mode of transmission between locations. Samuel Morse, for example, went to the US Congress in 1843 when he was seeking funds to demonstrate his telegraph system by running a telegraph line between Washington and Baltimore. The line was completed in 1844 at a cost of \$30,000. Subsequent development of the telegraph system in the US and UK was based on private funds. Sauer (1869) provides detailed statistics on the costs of early telegraph systems across different countries in Europe. Fari (2012) notes that in Europe low cost/low risk land based telegraph systems were typically publicly financed while high cost/high risk submarine cables were financed privately. Land-based telegraph systems remained privately owned in the US although there was considerable debate about nationalizing Western Unions’ telegraph system⁶ (Wells, 1873).

The telegraph systems were initially national in scope often using railway right-of-ways⁷ to run cables between destinations (and to serve the coordination needs of the railway companies) but the demand for international communications was strong and telegraph lines were developed between countries in Europe in the late 1840s, stretching to Russia by the early 1850s and to India and China by the late 1850s. In 1851, the Submarine Cable Company completed the first cable connecting the UK and France.

⁵ See Standage (1998) for an accessible overview of the history of the telegraph.

⁶ The Western Union Telegraph Company in the US is a private company. It was founded in 1851 as the “New York and Mississippi Valley Printing Telegraph Company.” It adopted its current name in 1856 after a merger between several private companies. It is not a “union” as used in the rest of this paper. The timing of its name change however suggests that it may have been inspired by the Western European Telegraph Union name.

⁷ Wheatstone and Cooke in the UK for example built their first telegraph system for use by a railroad to coordinate traffic flow along the line. There is a substantial literature on national networks such as the telephone and railroad systems (e.g. John, 2010; Chandar and Miranti, 2009) that is not reviewed here. The focus of this paper is international networks.

By 1858 the first trans-Atlantic telegraph cable had been laid allowing virtually instantaneous communications between the UK and USA. The news services were major customers for the telegraph (Blondheim, 2000)⁸ along with businesses that traded in international markets (Du Boff, 1980) and transportation companies (railways and shipping) who could better exploit assets with current knowledge of schedules and loadings (Lew and Cater, 2006). The telegraph also became a critical element of international relations, allowing news and directions to be sent in real time back-and-forth between a central state and its agents, diplomats, armies or colonies (Nickles, 2003). The telegraph had the unintended effect of reducing the autonomy of diplomats and making centralized control of a far flung empire feasible.

As telegraph systems became interconnected, the need to establish administrative and technical coordination standards grew and hence various bilateral conventions were negotiated between countries to facilitate the exchange of messages and, importantly, to share the costs and revenues of international traffic (see Parry, 1969 for a compendium of these treaties). In general the agreements specified such details as the language of communication, the system of coding messages into electrical impulses, the technical standards of the telegraph lines (such as the voltage to be used), the tariffs to be charged, how traffic and revenue was to be measured, procedures for verifying accounts, the currency to be used in transactions among members, and how and when revenue would be distributed among members.

The telegraph was started as a private sector initiative but in many countries it came to be regarded as the modern equivalent of the postal system and hence as a necessary public good. Governments were also concerned with the strategic use of the telegraph and wanted to maintain oversight of the messages that were sent to prevent use of the medium for espionage and revolution. In addition, there were few barriers to entry and competition between private companies created inefficiencies (such as over-supply of cables on certain routes compared with the demand), cut-throat price competition and bankruptcies (Du Boff, 1984). These issues encouraged nationalization of telegraph companies in many countries and, typically, telegraph operations (and later telephone operations as well) were combined with the postal system (Hochfelder, 2000). This made some sense in that the telegram was still delivered by hand to final customers and the postal system had the infrastructure to complete delivery at low cost. For example, in the UK the telegraph system was in private hands between its invention in 1837 and nationalization in 1870 when it was rolled into the Royal Post⁹. Prior to the formation of the first telegraph union, most continental European countries had nationalized their telegraph systems. In other countries, a strategic consolidation of private companies occurred until economies of scale were achieved (Winseck, 1999). In the USA, for example, the Western Union Telegraph Company achieved the same monopoly over telegrams through acquisitions that had been achieved by nationalization in the UK.

Unfortunately for the inventors of the telegraph, almost as soon as the technology was commercialized various competitors arose that offered superior capabilities and often lower cost. For example, the

⁸ Several newspapers included the word "Telegraph" in their name to signal their access to the latest international news by this medium of communication. For example, there is a Telegraph newspaper (originally called The Daily Telegraph) in the UK, India and Australia. The UK Telegram newspaper was found in 1855.

⁹ <http://distantwriting.co.uk/> accessed January, 2015.

telephone became commercially viable after Bell patented¹⁰ a device in 1876 to convert sound into electrical signals and back into sound allowing direct voice communication rather than being limited to text messages. Similarly, in 1896 Marconi patented¹¹ the use of radio waves to communicate telegraph messages allowing ship-to-shore communications (its intended use) but in many cases also eliminating the need for expensive cables between locations on land as well. These inventions, both of which were regarded as marginal improvements to the telegraph system actually spawned new industries – telephone and radio – which would undercut the value of the telegraph as a medium for communication and news distribution.

By the 1930s the convergence of telegraph, telephone and radio technologies was gaining traction and the regulatory body that formally controlled international telegraph standards was merged with the body controlling radio standards creating a new term – telecommunications – to reflect the emerging synthesis. The telegraph continued in existence with some technological innovations, such as typewriter interfaces and automatic decoding and printing, but its heyday had passed. By the 1970s it had largely disappeared from regular use. The telegraph service has been officially discontinued in some jurisdictions: the US on January 27, 2006; Australia on March 7, 2010; India on July 14, 2013. In other cases telegraphic service has been retained as a novelty or to communicate special events.

Method

The time period covered by this study is bound by the introduction of the first commercially viable telegraph systems in 1837 and ends with the incorporation of telegraph regulation into the International Telecommunications Union in 1932. The primary data for the study are the treaties and regulations that sought to coordinate the international telegraph market, i.e. bilateral telegraph treaties are not considered, only those treaties involving three or more signatories have been included in the discussion. The treaty organizations that sought to create, facilitate and regulate the telegraph network recognized that the technology was evolving rapidly and that regulation would have to keep pace. The treaty process involves negotiations among sovereign nations with the final text being ratified by the government of each signatory to the treaty. This can be a time consuming process and frequently results in ratification with reservations, i.e. certain parts of the convention may not be enforceable within various countries. To prevent these inevitable delays from interfering with the administration of the network, all of the treaties examined after 1857 (the Stuttgart Conference revision of the GATU Treaty) adopted a two part structure. The treaty itself contained constitutional details of the network (for example, putting boundaries around the applicability of the treaty, establishing procedures for the revision of the treaty and allocating the costs of the network governance organization to members) and provided for the refinement of the agreement through the use of regulations (service regulations and operating standards) which did not require signatories' approval prior to them being effective. Operating standards referred to technical engineering standards for the operation of the telegraph while the service regulations provided guidance on the management of the system. The service regulations and treaty documents provide the most direct evidence on the accounting provisions used to manage the telegraph networks.

¹⁰ The patent is Graham, B. A. (1876). U.S. Patent No. 174,465. Washington, DC: U.S. Patent and Trademark Office entitled "An improvement in telegraphy."

¹¹ The Marconi Company Ltd. was originally known as the Wireless Telegraph Trading Signal Company.

The language of the documents referenced in this paper varies depending on the source. The two earliest telegraph unions operated in German and French, respectively. After the merger of these two bodies, French was the official language of operations and records until the ITU became a specialized unit of the United Nations following World War II. In most cases, however, English translations are available after the formation of the International Telegraph Union in 1865 either from private sources (e.g. Sauer, 1868) or from the archives of English language countries who were observers or signatories to the treaty. For earlier documents I have relied on translations provided in secondary sources supplemented by online automated translation services of the original documents to verify the reasonableness of secondary translations provided. The original language of the Treaty is regarded as the definitive version and it is possible that minor variations in meaning have been incorporated into translated documents. There is no reason to assume that, if these variations exist, they have affected the interpretations offered.

Most of the documents used are available through the digital archive of the International Telecommunications Union (<http://www.itu.int/en/history/Pages/LibraryAndArchives.aspx>). Additional documents were located in the US Library of Congress Collection on the Invention of the Telegraph, US Congressional Sets (Annual Report on Foreign Trade), Parry's (1969) Consolidated Treaty Series, published correspondence of Samuel Morse, the British Museum and in press accounts of events available through the British Newspaper Archive (<http://www.britishnewspaperarchive.co.uk/>). In addition, there is a significant secondary literature on the telegraph that has been referenced. In particular, the work of Sauer (1868, 1869) is notable for its frequent mention in diplomatic commentary on telegraph issues as the definitive source on telegraph operations during the period examined. Sauer (1869) is a compendium of historical telegraph statistics that was not commercially published but is available through the British Museum.

Telegraph Unions and Revenue and Cost Accounting for International Communications

The first attempt to connect and coordinate telegraph systems across national borders occurred in Europe where the density of the population, multitude of land borders between nations and the magnitude of international commerce created a demand for international telegraph systems and highlighted the coordination problems that arose when systems based on different technical standards and coding protocols interacted. Similar coordination problems were being experienced by postal systems at the same time (Richardson and Kilfoyle, 2009) and were similarly addressed through the creation of a Union (the Universal Postal Union, UPU).

The first telegraph line in Europe was built in France in 1845 and was immediately nationalized to be used as a means of communication among government offices. It was not until 1849 that France passed legislation allowing the telegraph to be used by the public (Sauer, 1869). This transition from a closed network to a medium of mass communication generated the need to regulate how the telegraph would operate and to negotiate connections across borders.

Shaffner (1869: 788) describes the approach to sending a telegram from the UK to continental Europe at this time that illustrates the issues that consumers faced prior to the creation of the telegraph unions. The UK did not join either of the Telegraph Unions because its telegraph system was privately owned with multiple operators. The sender of a telegraph from the UK to Europe would have to choose which company to use within the UK, identify which submarine cable company to use to cross the English Channel, and to choose the routing within Europe to the final destination. From the final destination, the sender had multiple options for the delivery to the recipient (e.g. by post, foot carrier or by horse)

each with different costs. Depending on the routing, telegraphs might have to be sent in a specific language (i.e. one that the operators throughout the system could understand; this is one reason why a particular routing might be chosen). Each system had specific rules for how many words could be sent in one telegram and the minimum number of words that would be charged so the sender would have to identify the most stringent rules in planning their message. At each point of transfer of the telegram between companies, the telegram was received, decoded, physically transferred to another operator (sometimes, but not always, in the same building) and recoded and transmitted on the next system. There was a significant risk that the message would become garbled in this process particularly if the language of the message was not the native language of the operator. The contract with the sender disclaimed any responsibility for damages due to a faulty or lost message; only the fee would be reimbursed.

Initially countries sought to negotiate bilateral agreements between nations sharing a telegraph link. The first bilateral agreements were formed between the states that made up the Prussian confederation. By 1888, for example, 15 bilateral telegraph treaties were in place within the Prussian confederation (Balbi *et al.*, 2009: 62; Parry, 1969). However, the Prussian confederation was not geographically contiguous and some telegraph connections between member states would have to travel over independent states. Since communication between members of the Confederation was seen as crucial to the aspirations of Prussia to consolidate territory, rather than continue this system of bilateral treaties and attempt to coordinate the terms of treaties to facilitate telegrams over more than two countries, Prussia called for a conference to discuss a different treaty structure that would provide an overarching agreement for telegraph traffic among multiple countries. This represented an innovation in international coordination strategies.

The first multilateral telegraph Treaty and telegraph “Union” was created to coordinate international telegraph flows between Austria and the Prussian states in 1850. Five years later a separate Union was created in Western Europe. These unions join together a German language group of countries and a French (or Latin) language group of countries respectively (Balbi *et al.*, 2009: 63). In 1865 the two European Unions merged to form the International Telegraph Union.

The German-Austro Telegraph Union (GATU)

The German-Austro Telegraph Convention¹² was signed on October 3 1848 between Prussia, Austria, Bavaria and Saxony (Balbi *et al.*, 2009: 63; Parry, 1969: 165-213). The Convention dealt with procedures for exchanging telegraphs across borders and with the issues related to the measurement of revenues and their division among the participating states. The convention established certain basic principles that were carried forward into subsequent Treaties. These include the right of all people to use the telegraph (non-discrimination), the right to privacy (an obligation imposed on those who must transcribe telegrams: unlike the mail system, telegraphs required an intermediary who would know the content of the communication), and an obligation to use the telegram only for legal purposes (and a

¹² The term “treaty” and “convention” are regarded as synonyms within the United Nations (see https://treaties.un.org/Pages/overview.aspx?path=overview/definition/page1_en.xml accessed January 2015). But “conventions” are seen more specifically as “formal multilateral treaties with a broad number of parties. Conventions are normally open for participation by the international community as a whole, or by a large number of states. Usually the instruments negotiated under the auspices of an international organization are entitled conventions.” (ibid). Consistent with these definitions but for clarity, I use the word “Treaty” to refer to the agreement and “Convention” to refer to the organization that implements the Treaty.

corollary right of the state to monitor and stop telegrams thought to be salacious, conspiratorial or illegal). The concern over illegal uses of the telegraph also meant that secret codes were prohibited except by the State (even when such codes could reduce the cost of a telegram).

On the 25th of July 1850 the GATU was formed (formally known as *Deutsch-Österreichischer Telegraphenverein*) as a distinction organization to administer the Treaty and the signatories were expanded at that time to include Prussia, Austria, Bavaria, Saxony, Wurttemberg, Hannover, Baden, Mecklenburg-Schwerin, Lombardy-Venetia, the Netherlands, Modena, Parma, Tuscany and the Papal State. A number of private telegraph companies were also admitted to this Union although they did not have voting rights. These were typically submarine telegraph cable companies who provided the linkage between nations without formally being part of either state system that they connected.

Because of the role that submarine cable companies played in the telegraph system, they were primarily concerned with agreements concerning the payment of transit charges. The Unions included a provision that the countries connected by a submarine cable would jointly negotiate with the submarine cable company to reduce tariffs. The submarine cable companies were also concerned with gaining legislation to protect their cables. For example, the US passed legislation declaring that intentional damage to a submarine telegraph cable was an act of "piracy" (Kaye, 2006: 416). The locations of the cables near land would also have to be clearly marked and "drag net" fishing (i.e. fishing the used nets that rested on the floor of the ocean) prohibited in those areas. In 1884 a "Convention on the Protection of Submarine Cables" was signed by 27 countries¹³ that, among other things, provided for the compensation of fishing ships who sacrificed their nets after accidentally snagging a submarine cable.

At the time of formation of the GATU other European countries were also interested in joining the Union but they could not reach agreement on the Treaty's terms. A stumbling block was Prussia's aspiration to use the telegraph system as a means of consolidating its relationship with various German speaking neighbouring states. Prussia had a large standing army and also was developing the telegraph (and railroad) networks to give it a tactical advantage in the deployment of its army. This advantage would be lost by including countries that were not regarded as close allies in the network. However, as we will see below, when the excluded countries formed their own Union five years later they created regulations that harmonized with the GATU but differed in specific ways largely concerning the distribution of revenues among member states (in addition to certain technical standards such as the acceptable languages of transmission and the system of coding used). These countries continued to see a pan-Europe network to be the preferred outcome.

The GATU Convention created regulations including technical standards to facilitate the flow of telegrams through the system and a common pricing model for telegrams based on the number of words, the distance travelled and the nature of the telegram (state, service and private telegram categories were recognized and given priority in using the system in that order). The Convention adopted a variation of Morse code that was better suited to the German language (i.e. it included codes for letters with umlauts, and matched code length to the frequency of letters in German).

To simplify the accounting/billing of customers, the territory was divided into zones and a separate tariff was set for telegrams based on the number of zones that were crossed. Figure 2 provides two snap

¹³ Great Britain, the Argentine Republic, Austria-Hungary, Belgium, Brazil, Colombia, Costa Rica, Denmark, the Dominican Republic, France, Germany, Greece, Guatemala, Italy, Netherlands, Persia, Portugal, Roumania, Russia, Salvador, Servia, Spain, Sweden and Norway, Turkey, United States and Uruguay.

shots of the evolving tariff regime. Panel A provides the initial tariff structure while Panel B provides the tariff structure at the time of formation of the Western Europe Telegraph Union (discussed below). The two panels show the expansion of zones as the length of available telegraph lines grew and the declining cost (in nominal terms) to the consumer as efficiencies were realized.

[Figure 2]

The tariffs shown in Figure 2 (and Figure 3 discussed below) show a declining cost per km in total. This relationship reflects a fixed cost component in the tariff. The data in Panel B, for example, reflects a pricing model where the tariff equals a fixed cost of 3 Francs and a variable cost of 0.0144 Francs per km ($F < 0.001$). The actual tariff was not continuous but used simpler discrete amounts for each zone. The fixed cost reflects the fact that the destination address included in the telegram was not charged separately and was a common part of all telegrams. The recipient's address was limited to five words; anything beyond this attracted an additional charge. The telegraph system also maintained a hard copy of the telegram on file for 1 year for security purposes and to allow refund claims. There was thus also a customer-level fixed cost associated with that clerical work.

The rules initially adopted harmonized the operations of each country's telegraph system but messages would still have to be received at a border station and physically transferred to the telegram office of the neighbouring state for onward transmission. The conference of signatories in Vienna in 1851 agreed that the telegraph systems of members should be physically integrated. This was a logical progression of the Union's mandate but was only possible after the initial harmonization of standards. The physical integration of the systems would have dramatic effects on cost because of the elimination of duplicate entry of the messages into the system.

The revenue from international telegrams was regarded as "common revenue" of the entire Union (Lyll, 2011: 19). At the end of the year, the total revenue from international telegrams was divided among the participating states according to the total length of telegraph cable within each country¹⁴. This approach may reflect several logics. First, that the likely demand for telegraphs is related to the geographic area to which the system connects. If population density is reasonably even across countries, this basis for revenue allocation may also reflect the actual flow of telegraph traffic. Second, the more likely rationale for this choice of revenue allocation is that the length of telegraph cable is proportional to the cost of building and maintaining the system (ignoring variations in the terrain, weather conditions and relative purchasing power of local currencies). The revenue allocation method also had the effect of encouraging further investment in telegraph lines as an increase in the length of the system within each country would increase its share of international telegram revenues. This effect would be consistent with Prussia's desire to use the telegraph system to consolidate its control over the German speaking countries in Europe.

The Western Europe Telegraph Union (WETU)

The Western Europe Telegraph Union was formed by Belgium, France, Sardinia, Spain and Switzerland on December 29, 1855¹⁵ (Bureau International De L'union Telegraphique, 1915; Parry, 1969: 139-149).

¹⁴ "Les recettes télégraphiques formaient un revenu commun de l'Union, lequel était réparti au prorata de la longueur totale des lignes appartenant à chaque Etat." (Bureau International De L'Union Telegraphique, 1915: 5).

¹⁵ Telegraph Convention [France, Belgium, Sardinia, and the Two Sicilies] in Parry (1969)

The membership in this Union subsequently expanded to include Portugal, Netherlands, Tuscany, Modena, Parma, the Papal State, Sicily and some private cable and telegraph companies. Switzerland tried in 1854 to organize a conference to create a pan-European Union to ensure the “principles of good administration and equal distribution of costs” (cited by Balbi *et al.*, 2009: 66) but was unable to convince the German speaking countries to attend. Instead it joined with France in the creation of WETU. The Swiss delegation was given three objectives by the Swiss government in working to form the WETU: reduce the costs of telegraphs, simplify the regulations, and create a Union that could be harmonized with GATU as easily as possible (Balbi *et al.*, 2009: 67). The WETU was explicitly created as an open-Union: any European country was free to join.

The creation of a separate Western Europe Telegraph Union reflects continuing political tensions within Europe but the aspiration, particularly of the Swiss (Balbi *et al.*, 2009), was that eventually the two bodies would merge to facilitate telegraph traffic throughout the continent. To ease this eventual transition the WETU Convention followed the GATU Convention in terms of content; certain key provisions were duplicated from the GATU such as rights of access to service, privacy etc.

A key change, from an accounting point of view, with the formation of the Union was to reduce the cost of cross-border telegrams by extending the zones for which different tariffs were charged compared with the previous national systems. For example, the first tariff zone was for telegraphs up to 100km. This distance was divided into three separate tariff zones under the GATU (see Figure 2). This was seen as an enticement to small countries with rich connections to border cities of other nations (Balbi *et al.*, 2009: 67). In addition, the tariffs agreed were reduced compared with pre-Union fees and, significantly, were set at a rate lower than GATU rates¹⁶. The data in Figure 3, for example, reflects a pricing model where the tariff equals a fixed cost of 1.56 Francs and a variable cost of 0.00074 Francs per km ($F < 0.001$). Both the fixed and variable components are at about half the GATU rate. This would encourage international telegram routings through the WETU rather than the GATU. Further, the minimum billing for a telegram was set to 15 words¹⁷ compared with the 20 word unit used by the GATU making shorter telegrams less expensive.

[Figure 3]

The WETU also adopted the Morse code system “provisionally” (Article 4) as the basis of transmission rather than the “Continental alphabet” (see Figure 4) which provided economies of scale in training and transmission, and removed the need to recode when a telegraph moved from one system to another. Morse had developed his coding system by examining the number of each letter in the standard kit of American typesetters. He then chose the shortest codes for the most frequently used letters (Morse, 1914). This allowed telegraphs to be sent with the fewest total keystrokes by operators. This innovation reduced the cost of transmission and increased the capacity of the telegraph lines measured in terms of the number of messages that could be sent in a period of time. The adoption of Morse code also facilitated connections between the Western European countries, the Far East and North America where

¹⁶ Williams (1880) shows that, on average, domestic tariffs were declining by over 5% per year. This would have also affected the ability of international systems to maintain their rates.

¹⁷ The use of “word” rather than, say, character is peculiar and required specification of what constituted a word in terms of maximum number of letters, having an ordinary meaning and banning hyphenation and other means of artificially combining words.

Morse code dominated (although a reliable submarine cable connection was not established between Europe and North America for another 15 years).

[Figure 4]

The WETU adopted a slightly different revenue allocation model than the GATU. Again revenue was regarded as common to all countries in the Union but revenue was allocated according to the distance within each country that the telegraph travelled. In other words a count of telegraphs sent within each tariff zone was done and revenue allocated in proportion to the total revenue from telegrams within these zones. Distance was calculated as a straight line between official “points of entry” of the telegraph from a given country and its destination. This implied that countries were not rewarded for the actual length of their telegraph system but only for the effective coverage of those systems. This would encourage the creation of more efficient telegraph system architectures (i.e. more direct point-to-point connections) which generated more revenue for the least investment.

Countries that provided transit services, i.e. telegraph lines between two other countries, were compensated based on a negotiated tariff for this service. This was of particular benefit to countries that were located between centers which generated a lot of telegraph traffic. For example, Switzerland is centrally located and had large volumes of telegraph traffic flowing through its system between, for example, France and Sicily. Under the WETU system, Switzerland received a significant payment for the use of its system whereas its small length of cable would limit its claims to revenue under the GATU system. Balbi *et al.* (2009: fn 27) note that the Swiss telegraph system would have operated at a loss based on domestic telegrams alone but its costs were offset by significant international revenues from transit services.

The International Telegraph Union (ITeU)

As noted above, the German-Austro Telegraph Union and the Western Europe Telegraph Union shared a number of common members. This was necessary as telegraph lines, of course, travelled in all directions from within each nation and, thus, might connect to telegraph systems of nations in either Union. This could create difficulties however where a telegraph would cross between members of each Union and hence be subject to potentially contradictory regulations. Situations were noted where a telegraph would be received and transcribed at the end of one network and then physically transferred to a second operator connected to the other network who would have to re-code and send the message. These types of arrangements added cost to the system and frequently resulted in garbling of the original message. Early telegraph systems suffered from reliability issues due to the re-entry of messages between each carrier.

The merger of these two bodies in 1865¹⁸ allowed the creation of a common set of rules that could be applied to telegraph communication throughout Europe but the Convention also allowed for members beyond Europe as well (for example, the Ottoman Empire, Russia and Sweden-Norway were signatories of the founding document). A constraint on membership was the form of ownership in different countries. The Union was a forum for agreements between state owned telegraph systems but in some countries, the telegraph was still privately owned. For example the UK did not become a member of the Union until after the nationalization of telegraph operations in 1870 and the US did not attend any of the congresses until after World War II when the ITU became part of the United Nations allowing any

¹⁸ The GATU continued to exist until 1871 when German unification was completed.

United Nations member to join the ITU regardless of the structure of ownership of the telegraph system in that country.

The creation of the ITeU coincided with further reductions in the tariff for telegrams

“Formerly there was charged one franc for the single telegram, (10 German miles¹⁹); two francs for 45 miles; three francs, for 100 miles; and four francs, for over 100 miles. The second and third rates are now united, and there is a uniform tariff rate of three francs for all distances over 45 miles. This rate is also the unit for the intercourse of the company with foreign states. While the rate from Seemlin, in Turkey, to Bordeaux, in France, is three francs, the same rate is charged from every Wurtemberg station to every French station”. (US Congressional Report, Annual Report on Foreign Trade, 1866: 384).

The ITeU allowed the use of coded messages by individuals for the first time. This also reduced the cost to consumers and, in particular, for businesses where routine messages could now be sent by means of a single code rather than a sentence of text. Several standard code books were developed to facilitate this process (e.g. Clauson-Thue, 1874; Scott, 1885).

The ITeU adopted the French franc as the benchmark currency for setting tariffs and for reconciliation of revenue between members. France had adopted a gold standard for its currency in 1803 and subsequently created the Latin Monetary Union (LMU) in 1865 which linked its currency value to other countries (Flandreau, 2000). Although the LMU was unsuccessful in stabilizing exchange rates, the French franc continued as the common currency within the telegraph system during this period.

With the creation of the ITeU, the accounting for flows between countries was changed from the simpler approaches used in the predecessor organizations. The new approach focused on the messages sent and received.

“Each State credits the neighbouring State for the full amount of cost²⁰ of all messages transmitted, calculating the tariff from the frontier of the two States to destination. These charges can be settled by common assent, according to the number of messages which cross the frontier, irrespective of the number of words and additional expenses”. (Article 49)

In other words, revenue is split between the two systems in proportion to the distance travelled within each country and the tariff charged to the customer for this service. To simplify the process, however, the number of words is ignored. This allows a simple count of the number of telegrams sent to each tariff zone to be used as the basis for revenue allocation.

“The balance due is paid in the current money of the state in whose favour it is due” (Article 53)

¹⁹ A “German mile” is a unit of measurement that is no longer used but was equal to 7.586 kilometers (subject to local variation in definition among German speaking states: in practice it could be between 1000 meters and 11, 100 meters). This system of measurement was replaced by the metric system in 1872 (after German unification).

²⁰ The term “cost” in this Article of the Treaty is used as a synonym for “tariff”, i.e. the cost to the consumer. This translation by Sauer (1868) is not a literal translation of the actual clause which reads: “Chaque État crédite l'État limitrophe du montant des taxes de toutes les dépêches qu'il lui a transmises, calculées depuis la frontière de ces deux États jusqu'à destination”.

Article 53, reproduced above, signified two policies. First, the final clause of this Article signals that the sharing of revenue is only done on a “net” basis, i.e. the countries compare the number of outgoing messages between the two locations and only provides compensation where there is an imbalance of telegrams. This is significant because it implicitly assumes that the costs in each country are equal and hence the unreconciled amounts are of equal value. The agreement to a common tariff means that the revenue collected in each country is consistent; the cost of providing the services may vary. Secondly, the reconciliation is done in local currencies although the tariff is set in a common currency. This means that currency risk is borne by the country paying the net amount.

Under Article 54 of the Convention, administrations kept a count of the number of messages sent to each country on a monthly basis and at the end of each quarter compensated any administration receiving more messages than it sent. The compensation was based on the domestic tariff for telegrams within the destination state. If messages were received after transit across other states, these states received compensation from the originating country. The transit fee was collected from the senders of the telegram on the basis of a fixed tariff set in the Treaty. Terminal tariffs and transit tariffs were specified in Appendix A and B of the Treaty respectively (see Figure 5). These appendices are complex and although some convergence in tariffs is apparent, the appendices are almost a matrix of all possible originating and receiving countries and the unique charges that would apply to each circumstance.

[Figure 5]

Two features of the tariff are notable. First, the use of tariff zones within a country had been eliminated. This would have the effect of reducing the tariff for the longest distances within a country. Second, the previous GATU members continued to act as a single tariff area under the new regulations. This would make sense given the physical integration of their telegraph systems after 1857.

The accounts are settled quarterly subject to any request for revision based on a review of the data within six months. After six months, if there has been no challenge to the data, the accounts are considered closed. Since one country’s count of telegrams sent should reconcile with another country’s count of telegrams received, this reconciliation should not be problematic save for errors in recording the amounts. The regulations include a materiality clause. If an error is claimed that would adjust the settlement between countries of less than 1%, then it is ignored.

In 1868 a permanent secretariat was established: International Office of the Telegraphic Administrations (Bureau International des Administrations Télégraphiques). This Office was responsible for maintaining information about telegraph traffic and to update and maintain the standards and regulations on an on-going basis. This body allowed all statistics to be centralized and the claims for reimbursement to be generated by this office rather than from each country to all of its partners.

The International Telecommunications Union (ITU)

In 1906 an International Radio Telegraph (IRT) conference was held in Berlin to establish rules for the use of radio signals to send and receive telegraph messages. This conference was attended by 27 countries.²¹ The primary focus of the conference was the use of radio telegraphy between ships and

²¹ Germany, the United States of America, Argentina, Austria, Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Spain, France, Great Britain, Greece, Italy, Japan, Mexico, Monaco, Norway, the Netherlands, Persia, Portugal, Roumania, Russia, Sweden, Turkey, and Uruguay.

shore stations. An issue had arisen that some shore stations were refusing to acknowledge signals if they were not sent by “approved” equipment (i.e. the dominant Marconi radio systems). This created a conflict between private commercial interests and public safety concerns. The Convention²² signed by the participants established the obligation, regardless of the system used, to act on telegraph messages from ships at sea and established the norm that land stations would be organized to prevent signal interference between stations (Supplementary Agreement: Article 1). The Convention also anticipated that the use of radio frequencies would extend into air travel (and even into space). It thus set in place a general framework for regulation of the radio spectrum. The Convention required that each shore station be connected to the telegraph system of its country. This ensured that messages originating onboard ships were forwarded without delay and, perhaps most importantly, that distress signals (the famous Morse Code SOS, ...---...) were passed onto authorities immediately.

Although the IRT Convention was conducted independently of the ITeU (its membership for example reflects shipping interests rather than telegraph interests), it did reference the ITeU regulations recognizing that once the message was received by a shore station it would have to be completed over the land-based telegraph system (Article 10). The transmission over the telegraph system was to follow ITeU regulations regarding rates and revenue allocation. The UK in particular wanted to ensure that the IRT and ITeU were consistent to “to simplify the collection of charges on shipboard, and at the same time the keeping of accounts”. The IRT created a permanent office to administer the agreement and to maintain records of all ships and coastal stations to allow billing for the services provided (Service Regulations 84:7).

Meanwhile with the commercialization of the telephone in 1876 the ITeU had expanded its regulations to include the telephone which shared the same network of poles as the telegraph and had similar international coordination issues regarding rates and revenue sharing. The telephone also began to use part of the radio spectrum for international calls. The potential conflict between telephone, telegraph and radio regulations, was becoming clear. In 1925 the ITeU created two committees to consider these issues: International Long-distance Telephone Consultative Committee (CCIF), and the International Telegraph Consultative Committee (CCIT). In 1927 the IRT created the International Radio Consultative Committee to consider similar issues.

In Madrid in 1932²³ the two bodies – the ITeU and IRT – met and decided to merge to become the ITU. At that time the telegraph regulations were separated from telephone and radio regulations. Section 7 of the Telegraph regulations deal with the tariff system, Section 8 deals with collection systems, Section 27 concerns reimbursements in the case of delivery failures, Section 28 establishes the accounting procedures between countries, while Section 30 defines the role of the Bureau in managing the network.

In spite of the term “international” in the title of Convention, the rules adopted explicitly differentiate between European and extra-European administrations in terms of tariffs and settlement procedures.

²² http://www.itu.int/dms_pub/itu-s/oth/02/01/S02010000124E02PDFE.PDF accessed January 2015.

²³ Also at this time telewriters and Telex services were introduced. These services allowed telegraph messages to be entered directly from conventional keyboards and to be printed automatically on receipt. Although Morse code continued to be used in transmission, technology had eliminated the need for skilled operators.

Accession to the terms of the Convention enables an administration to be “European” for the purposes of the ITU.

The tariffs were divided into three components: a terminal rate for the work done by the originating and destination stations, a transit rate for nations transferring the message between the originating and destination station, and any supplement due to the use of radio transmission or submarine cables. There was a fixed minimum amount for the telegram and a per word charge for the message. The transit rate was set for groups of countries and the terminal rate was based on the country of origin and destination. These rates were set by the countries individually and then applied to all members in the ITU. Members were authorized to reduce rates from the listed tariffs

“Administrations have the right to reduce their terminal and transit rates. These modifications must, however, have as their aim and result, not the creation of competition in charges between existing routes, but rather the opening to the public, at equal rates, of as many routes as possible”. (Article 27(4)(1))

Regardless of which route a telegram actual took between its point of origination and destination, the transit fee charged was the minimum that would arise from the most direct route.

For extra-European telegrams the terminal and transit charges were set by the individual country and added to the cost paid by the sender. The ITU maintained a schedule of fees and provided these to members to ensure consistency of charges to customers.

For those countries in the European zone the accounting provisions stipulate that accounts are to be produced monthly and settled on a quarterly basis. The accounts are settled on a “net” basis, with each administration calculating the number of telegrams sent from them to another country (and the number received). The length of the telegrams is not recorded. During two 28 day periods (in February and August) samples are taken of telegrams in each country to estimate the average length of the message of incoming and outgoing messages and these averages are applied to all messages by that country in the following 6 month period. If there is a difference between the volume of outgoing and incoming telegrams, then the administration will transfer the difference in revenue, calculated at the standard tariff rates and paid in gold (or currency equivalent at that time), to the other administration.

Discussion

The creation of the telegraph unions reflected the growing importance of technical knowledge in society in the late 1800s and the increasing interconnection of technical systems across national boundaries.

“Civilized nations, being desirous to arrange their affairs in the most scientific and effective fashion, feel the need of making use of experience and knowledge wherever it may be found. The recognition of the fact that no people has a monopoly of the best scientific and administrative processes has lead the nations to seek opportunities for the exchange of experience and the knowledge of methods such as are afforded by congresses of experts in various fields of public activity. Many of the unions formed more directly for administrative purposes also incidentally subserve the end of constituting a center for the exchange of reliable information”. (Reinsch, 1907)

The operation of the Telegraph Unions demonstrates the complex interaction between technical knowledge and international relations. There was at the heart of these organizations a desire to

overcome technical and administrative problems to facilitate international communication and to reduce obvious inefficiencies that arose when systems based on different standards interacted. The structure of the Treaties separated the technical functions from the political functions in these areas allowing professionals to find solutions to mundane efficiency issues without having to seek political approval for these changes. The regulations became the domain of professional expertise while the Treaty itself was the level at which sovereign nations could signal their commitment to international objectives and to express specific reservations about the applicability of the Treaty within their territory. This structure was adopted by many international coordinating bodies after this time.

As Howland (2015) notes the ITU, although a Treaty organization, did not restrict membership to sovereign nations. It was an association of governments with telegraph systems. This meant that colonies and other territories, for example, were represented even though the imperial power was not (e.g. India was part of the ITU prior to the UK joining and Egypt was present at a time when it was part of the Ottoman Empire). This approach to inclusion in the governance of international order was distinct from that used in other areas that reinforced the distinction between the dominant states and “less civilized countries.” The ITU also allowed private sector representatives to be non-voting members of the Union. The inclusion of telegraph companies in meetings represents a dramatic shift in international relations and a blurring of the boundary between the public and private sector in the creation of global order. The ITU adopted a one-member, one-vote system that denied the dominance of the great powers. As a Treaty it was unusual in being focused on mutual aspirations rather than resolving differences among nations. The strongly functional orientation of the ITU and its reliance on technical experts made it an innovation in international governance.

The demand for coordination of telegraph services was most pressing where countries shared many common borders and there was significant commerce between nations²⁴. This was the case for Europe and the first two telegraph Unions were established within separate parts of that continent. The division between the GATU and WETU reflected primarily language differences with the Germanic countries associated with the GATU and Latin language group associated with WETU. This difference also reflected long standing political differences within the continent (the Napoleonic Wars were still within living memory). The political issues that divided Europe however were soon overcome by the technical demands of the telegraph system.

At a technical level it was necessary to coordinate such things as the voltage used over the lines, the language of transmission and the coding system to transform messages into electrical signals. Administratively there were two main coordination issues. First, the system of tariffs had to be simplified to make it cost effective for customers to use the system and to have certainty about the charges for a given message. The telegraph system followed the lead set by the postal system in 1840 in having the sender pay for transmission (Richardson, 2008); prior to that time the receiver of mail paid and the cost depended on the ultimate route of delivery used. The data show a reduction in the fixed and variable costs to the consumer of telegrams through this period. In addition, the use of tariff zones was gradually replaced by the use of the nation as a cost object. This approach undermined the

²⁴ The ITU continues this regional focus with six groups operating: Asia-Pacific Telecommunity (APT); Arab Spectrum Management Group (ASMG); African Telecommunications Union (ATU); European Conference of Postal and Telecommunications Administrations (CEPT); Inter-American Telecommunication Commission (CITEL); Regional Commonwealth in the Field of Communications (RCC - representing former Soviet republics).

relationship between cost and distance to some extent but facilitated the development of revenue sharing mechanisms as discussed below.

Second, there were mechanisms put in place to share the revenues between the originating and destination countries and with any countries that provided transit of messages between the originating and destination countries. The telegraph system had high capital costs associated with the installation of poles and lines between locations and significant skilled labour costs for the electricians and telegraph engineers needed to code and transmit signals. Various models were used throughout the history described above. The revenue sharing systems varied over time moving from a focus on investment/fixed cost to a focus on aligning the revenue sharing model and tariff structure.

The revenue allocation models used over the development of the ITU have commonalities and differences. They all share a concern for the cost of implementation of the system hence the allocation of revenues was consistently done on a quarterly basis and used various allocation methods rather than performing a detailed tracking and recording of individual telegram revenues. This is another example of mundane transaction costs affecting administrative procedures (Richardson and Kilfoyle, 2009). The Unions differ primarily in the choice of revenue allocation base. The earliest system allocated revenues on the basis of the length of telegraph cable in each country (GATU). The GATU revenue allocation mechanism is consistent with a policy of encouraging the growth of the domestic telegraph network as additional cable length would be rewarded with greater allocation of international revenues. This in turn was consistent with Prussia's desire to establish a communication system within its Confederation to facilitate the unification of Prussia's territory. In 1871, unification of the German Empire was accomplished. The competing Western Europe Telegraph Union, on the other hand, used the distance travelled by a telegram within a country as the basis for revenue allocation (WETU). These two approaches focus on the fixed costs of transmission but do not relate to the variable costs, i.e. the coding/decoding of messages by operators, since the number of telegrams but not their length in words was used in the allocation of revenues.

When the ITeU was formed, the revenue allocation method used by the WETU was carried over into the merged organization. With the formation of the ITU, the revenue allocation method shifted again to take into account the length of messages sent and hence the variable costs (operator's time) associated with the messages as well. Concern for the cost of implementation, however, is again evident and the number of words was determined by a sample during two collection windows and then applied to the flow of telegrams by count for the remainder of the year. During the transition from the ITeU to the ITU the use of zones in the tariff structure was eliminated and replaced with the nation as the cost object. This approach reduces the focus on distance as a cost driver since countries vary in size. The change would tend to increase cross-subsidization of telegraph service within geographically larger countries (i.e. the same charge would apply between two destinations in spite of significant differences in distance to the originating country) and would tend to increase the returns to geographically smaller countries.

Interestingly, throughout the history provided above, there was no mention of variations in actual cost between countries as a basis for setting the revenue allocation method; nor was cost used as an explicit basis for setting tariffs. Green (1889: 574), President of the Western Union Telegraph Company in the US, in defending the higher telegram rates in the US compared with Europe suggested that European tariffs were subsidized by the state and unrelated to cost or market forces.

“Most of the governments find it necessary to control the telegraph for the very reason that its control by the government in this country has been opposed, namely, to protect the

government from the people. In this country it has not been found desirable to strengthen the government against the untrammelled lawful will of the people. It is probable that very cheap rates for telegraph service are given to the public to reconcile the people to this enormous engine of power and espionage in the hands of the government. The rates within the comparatively narrow limits of any one of these countries for short distances, rarely exceeding five hundred miles, are generally somewhat lower than they are in the United States.”

A commonality of each of the systems reviewed is that revenue was defined by a tariff system agreed to by all countries and denominated in a stable currency. In essence, revenue was defined at standard but the Treaties allowed countries to reduce their tariff below this standard. This set up a dynamic that has continued to the present day where market rates for international telegrams may be below the Treaty tariff amounts. Where there is an imbalance in the flow of telegrams between nations, this will mean that the payment required under the Treaty will exceed the revenue actually collected when the telegrams are sent. This difference between the accounting rates and market rates continues to be of concern in international telecommunications regulation (Alleman and Sorce, 1997).

The evolution of accounting rules described in this article is affected by three macro trends.

First, the rules reflect the emergence of professional knowledge and the increasing importance of this knowledge in public policy. Administratively, a key innovation was the separation of the political and technical aspects of international agreements to allow the experts to amend operating procedures as needs arose without having to seek ratification of each change. This process gave rise to a distinct class of professionals concerned with maintaining international order. The IASB continues this trend and takes it a step further by operating without the equivalent of a Treaty to legitimate the actions of the standard setters (Richardson and Eberlein, 2011).

Second, the rules are part of an emerging system of institutions creating an international order. The Unions were regarded as innovations in international coordination but the international relations literature has largely discounted them as a distinct form of international order (Howland, 2015). The development of transnational regulatory bodies in finance and accounting based on professional expertise suggests that these organizations deserve further analysis as the origin of a system of epistemic international order.

Finally, the changing rules are related to the technological lifecycle of the telegraph. Hurst (1956) has identified a common pattern in the regulation of business in the US prior to the civil war (see also Nonnenmacher, 2001). Initially, regulation focuses on the encouragement of investment and the expansion of business services in the public interest. Once the investment has been made, regulation tends to shift its focus to protecting the social environment and prohibiting practices that may harm the public interest. A parallel shift is seen in the emphasis in international telegraph regulation. The revenue allocation models initially adopted provided an incentive for the expansion of the total size of the network. The GATU, in particular, clearly rewarded investment in new lines through its allocation methods. Once the lines were established, however, the allocation methods changed its focus from fixed cost issues to variable cost issues. Revenue allocation within the network was aligned with the tariff structure for users and allocations were based on the flow of messages and the distance travelled within the receiving country. Although revenue was received in the sending country, the cost of service in the receiving country was thus compensated.

Conclusion

The revenue allocation models of the international telegraph industry stand in sharp contrast to the international postal industry organized under the Universal Postal Union (UPU) at this same time (Richardson and Kilfoyle, 2009). The international mail system eliminated the need for accounting between countries by having each country retain the postage collected domestically for international service. Part of the logic behind this agreement was the idea that letters are part of a reciprocal correspondence, i.e. each outward bound letter was expected to generate a reply. If this was true, retaining the international postage could be rationalized as paying for half of the cost of outward mail (from the point of origination to the international border) and half of the cost of the reply (from the international border to the destination). The international telegraph system, by contrast, always required an accounting for and reallocation of revenue among the network members. This may have reflected the initial demand for telegrams by news services, stock speculators and transportation companies. These users had an asymmetric demand for information with the primary flow being from the periphery of the networks towards the center of financial/colonial networks (and specifically London, Berlin, Paris and Vienna, Wenzlhuemer, 2007, 2012).

As the revenue allocation procedures were refined through the three international organizations leading up to the formation of the ITU, a common theme is that revenue allocation moved from a focus on matching revenue allocation to the investment costs in the system to matching revenue allocations to the value received by customers (i.e. distance traveled, words sent). This shift is consistent with an initial attempt to use regulation to incentivize network growth shifting to an emphasis on incentivizing network efficiency. The pattern observed is consistent with that observed within the regulation of US telegraph industry by states suggesting a generalization of this pattern beyond the US and to specific accounting procedures in addition to the general provisions of regulation. The system also institutionalized a potential conflict between the uses of standard accounting rates for measuring revenue versus market revenues. The accounting rates specified within the treaties are used for reconciliation of accounts between countries while the market rates are the cash compensation received by the country sending the telegram. This distinction continues to generate conflict within international communications networks.

The focus on treaty organizations and relations among nations in this paper responds to Richardson and MacDonald's (2002) call to link accounting history to international business theory (cf. Carnegie and Napier, 2002; Carmona et al., 2010). The creation of an institutional regime to pave the way for the current globalization of business occurred in the late 1800s through treaties and transnational organizations. We have not yet developed a full understanding of the importance of these mechanisms. The ITU, for example, is the first example of an expert dominated international organization. Howland (2015) argues that the ITU and UPU were distinct models of international order that deserve greater attention and suggests that previous work has misinterpreted the nature of its operations. Its policies for membership and separation of Treaty from regulations, in particular, were innovations in international organization. These organizations drew on accounting expertise and accounting procedures to resolve international coordination issues that continue to challenge regulators and global commerce. We need to understand the emergence of accounting as an epistemic community in international relations. This domain deserves further attention by accounting historians.

Figure 1: The Formation of Telegraph Unions and Technological Innovation

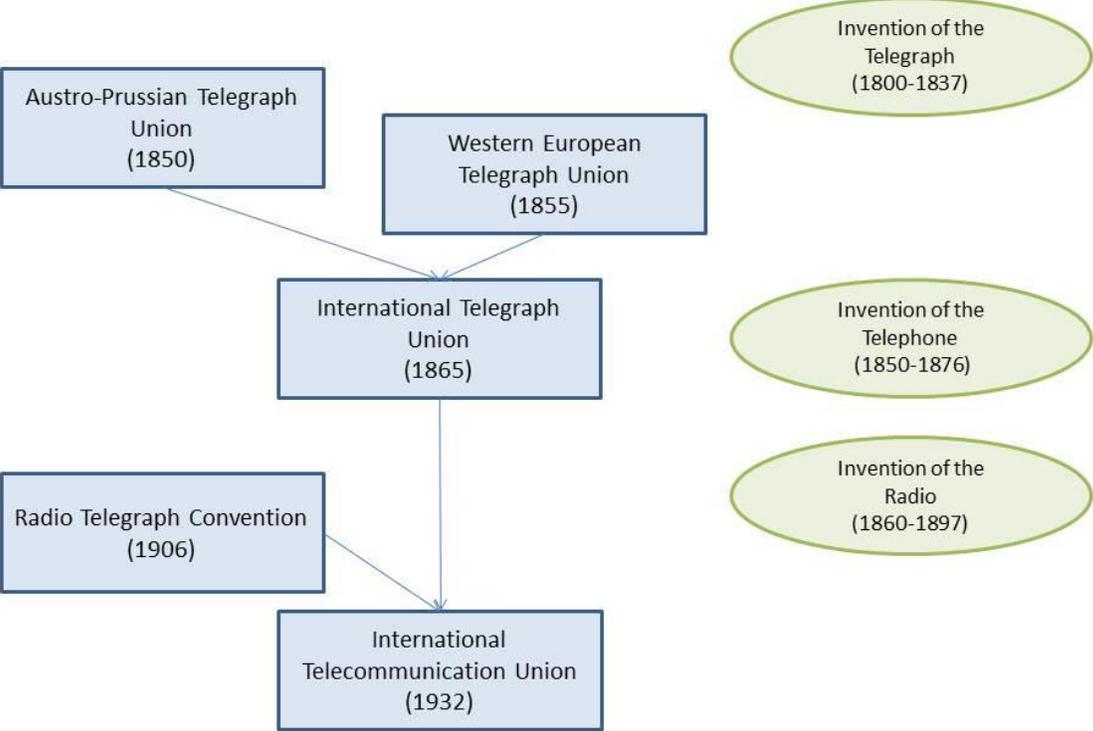


Figure 2: Tariffs of the German-Austro Telegraph Union, 1848 and 1855

Panel A: Tariffs from the 1848 Treaty

Für eine Depesche														
auf Meilen	betragen die Gebühren für Worte													
	bis 20 einschliesslich				von 21 bis 50 einschliesslich				von 51 bis 100 einschliesslich					
	Ö. C. M.	Rheinisch	Ruhr.	Sgr.	Ö. C. M.	Rheinisch	Ruhr.	Sgr.	Ö. C. M.	Rheinisch	Ruhr.	Sgr.		
	fl. kr.				fl. kr.			fl. kr.						
bis einschliesslich 10 Meilen	1	1	12	—	20	2	2	24	1	10	3	3	36	2
über 10 bis einschli. 25 Meilen	2	2	24	1	10	4	4	48	2	20	6	7	12	4
- 25 - - 45 -	3	3	36	2	—	6	7	12	4	—	9	10	48	6
- 45 - - 70 -	4	4	48	2	20	8	9	36	5	30	12	14	24	8
- 70 - - 100 -	5	5	—	3	10	10	12	—	6	20	15	18	—	10

12. S. W.

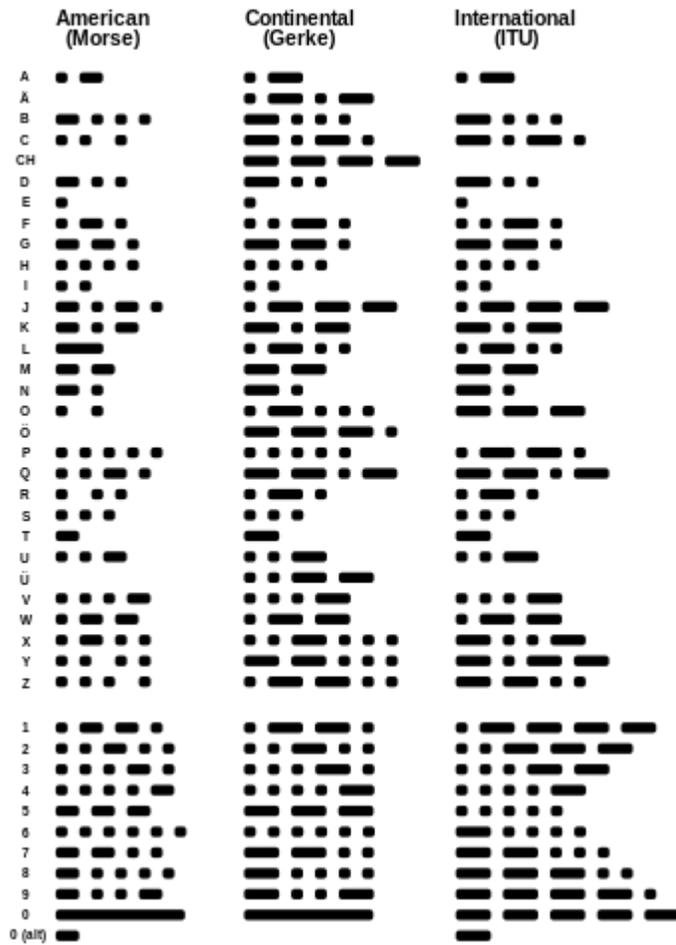
Panel B: Shaffner (1869: 784) translation of the 1855 regulations of the GATU

DISTANCES.	TARIFF OF CHARGES		
	From 1 to 25 words inclusive.	From 26 to 50 words inclusive.	From 50 to 100 words inclusive.
From 1 to 75 kilometers, 1st zone.	2½ francs.	5 francs.	7½ francs.
“ 75 to 190 “ 2d “	5 “	10 “	15 “
“ 190 to 340 “ 3d “	7½ “	15 “	22½ “
“ 340 to 525 “ 4th “	10 “	20 “	30 “
“ 525 to 750 “ 5th “	12½ “	25 “	37½ “
“ 750 to 1015 “ 6th “	15 “	30 “	45 “

Figure 3: Tariffs of the Western Europe Telegraph Union, 1855.

BASES		
PAR DISTANCE.	PAR MOTS.	
	De 1 à 15 mots inclusivement.	Taxe additionnelle. Pour chaque série de 5 mots ou fraction de série au-dessus de 15 indéfiniment.
	fr. c.	fr. c.
1 ^{re} zone, de 1 à 100 kilomètres.....	1 50	0 50
2 ^e zone, au-dessus de 100 jusqu'à 250.....	3 00	1 00
3 ^e — 250 — 450.....	4 50	1 50
4 ^e — 450 — 700.....	6 00	2 00
5 ^e — 700 — 1,000.....	7 50	2 50
Et ainsi de suite, en suivant la même loi, chaque zone excédant de 50 kilomètres la largeur de celle qui précède.		

Figure 4: Competing Telegraph Codes²⁵



²⁵ From http://upload.wikimedia.org/wikipedia/en/thumb/5/5a/Morse_comparison.svg/350px-Morse_comparison.svg.png

Figure 5: Tariffs of the International Telegraph Union, 1865.

TERMINAL RATES.

Names of States.	Description of Tariffs.	Rates.
		Fcs.
Austria	Messages to and from any of the contracting States	3.00
Baden	Messages to and from the Austro-German Union	3.00
	Any other.....	1.00
Bavaria	Messages to and from the Austro-German States	3.00
	All others.....	1.00
Belgium.....	Messages to and from Denmark, Norway, Russia, and Sweden..	1.50
	All others.....	1.00
Denmark	All Messages	1.50
Spain	Messages to and from Denmark, Italy, Norway, Sweden, and the Austro-German Union, except Prussia	3.00
	All others.....	2.50
France	All Messages to and from Denmark, Greece, Russia, Sweden, European Turkey, and the Austro-German Union	3.00
	All others, including Holland and Wurtemberg.....	2.00
Greece	All Messages	1.00
Hanover	Ditto	3.00
Italy	Ditto	3.00
Norway	Ditto	2.00

Primary Material:

British Newspaper Archive <http://www.britishnewspaperarchive.co.uk/>

Bureau International De L'Union Telegraphique , L'Union Télégraphique Internationale (1865-1915), Union Télégraphique Internationale, Berne, 1915,

International Telecommunications Union Archive <http://www.itu.int/en/history/Pages/ITUsHistory.aspx>

US Library of Congress:

Samuel Morse Papers and Invention of the Telegraph Collection

<http://www.loc.gov/collection/samuel-morse-papers/articles-and-essays/invention-of-the-telegraph/>.

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