Information Flows and Global Capital Allocation: Evidence from the Telegraph*

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Abstract

How does information impact the international allocation of capital? Using the global rollout of telegraph cables in the 19th century, I show causal evidence that reductions in information frictions had a significant and positive impact on the bilateral international flow of financial capital from the UK. The results indicate that the telegraph lead to more than a doubling of capital flows. For identification I use a geographic instrument, the ruggedness of the seabed. The effect of the telegraph was stronger for capital flows to businesses than to governments, and was significantly positive for flows to most industries. The telegraph had a direct and sizable impact on capital flows that was distinct from the increase in capital flows due to the tele-

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graph's effect on trade. Using data from historical British newspapers, I show that the annual number of articles mentioning connected countries increased around the arrival of the telegraph. I interpret this as evidence that part of the mechanism through which the telegraph affected capital flows went through the news channel.

JEL Codes: F3, G14, N2, N7

1 Introduction

What factors shape the international flow and allocation of capital? An influential view in the literature holds that information frictions shape capital flows, but well-identified evidence on the role of information frictions for capital flows has remained scant.

This paper presents causal evidence on the impact of information frictions on the international flow of capital. I use the laying of international telegraph cables between the UK and 33 countries in the second half of the 19th century as a source of variation in the international flow of information. The telegraph offers a unique historical setting for understanding the effect of information flows on capital allocation. Before the arrival of telegraph cables, communication happened physically, e.g. via ships or railroads. The telegraph was a faster, more frequent, and more reliable means of communication. The estimation results show that new telegraph connections lead to substantial increases in the bilateral export of financial capital from the UK. For identification, I use the ruggedness of the seabed, which caused exogenous variation in the timing of the arrival of telegraph connections. I estimate that a new telegraph cable leads to an increase of bilateral capital flows to private recipients by 100 to 200%. In comparison, adherence to the gold standard is associated with around 40% higher capital flows in comparable regressions.

In a next step I present direct evidence of the importance of information for capital flows. I collect data on articles in the British press between 1865 and 1914, and show that the telegraph had a causal effect on the number of newspaper articles in the UK press that mention connected countries. Furthermore, the positive effect of the telegraph on capital flows in an IV regression decreases substantively once I control for the number of newspaper articles. I interpret this as evidence that an important channel through which the telegraph impacts capital flows runs through the newspaper channel.

I further document that, despite varying degrees of telegraph technology usage across industries, capital flows to all industries are roughly equally affected by international telegraph cables. Whereas some industries arguably made direct use of international telegraph connections (like raw material producers and industrial firms), other industries (like public utilities and railways) likely did not. This finding suggests that usability of the international telegraph within businesses was not the primary driver of capital flows.

Finally, I document that the telegraph had a direct effect on capital flows that was distinct from the effect of the telegraph on capital flows via an increase in trade. When including trade as a control variable, the telegraph maintains a large and significant effect on capital flows. This supports the view that the telegraph had important and direct effects on the functioning of international capital markets, and the international allocation of financial capital.

This paper is the first to study the effects of the telegraph on international capital flows, and the first to identify and quantify the effects of information frictions on gross cross-border investment. It relates to several strands of literature.

In a seminal study, Portes and Rey (2005) show that capital flows are well described by gravity equations, meaning that bilateral capital flows increase in the economic size of two countries, and decrease in physical distance between them.[1] Portes and Rey argue that information frictions that vary with distance are the primary reason for the importance of physical distance. They show that bilateral telephone traffic is an important variable in a gravity equation of financial flows, and that the inclusion of telephone traffic reduces the absolute size of the (negative) coefficient on distance. My paper extends the evidence in Portes and Rey (2005) by exploiting exogenous variation in bilateral information frictions. I show that information frictions are causal for capital flows, thereby addressing concerns about endogeneity apparent in Portes and Rey (2005), as they do not have an instrument for information frictions. Furthermore, this study differs from Portes and Rey (2005) in that these authors study capital flows in the late 20th century, whereas I study capital flows in the half decade before World War I, thereby demonstrating the importance of information frictions in a different period of time.

A prominent literature in international finance examines why capital flows to some countries and not to others, and in particular why poor countries receive less capital than macroeconomic theory would predict (Lucas, 1990). Researchers have put forward factors like human capital, measurement is-

[1] Other related papers on gravity in international finance include Portes et al. (2001), Martin and Rey (2004), Okawa and van Wincoop (2012), and Pellegrino et al. (2023).

sues, and institutional quality to explain this puzzle (Lucas, 1990; Caselli and Feyrer, 2007; Alfaro et al., 2008).[2] More recently, the international flow of capital has been analyzed through the lenses of international differences in demand and supply of safe assets (Caballero et al., 2008), demographic developments (Auclert et al., 2021), the global financial cycle (Miranda-Agrippino and Rey, 2022), and inequality (Mian et al., 2021). Pellegrino et al. (2023) have argued that geographic distance, cultural distance, foreign investment taxation, and political risk account for a large share of the variation in international capital flows. My paper contributes to our understanding of international capital flows by examining and quantifying the role that influence of information frictions.

Several previous studies have analyzed the impact of the telegraph on financial markets.[3] Garbade and Silber (1978) and Hoag (2006) study several historical episodes in which new telegraph lines (domestic and international) connected geographically distant financial markets. These studies show that the telegraph lead to a substantial narrowing of price differentials across markets, and increased price co-movement of identical assets that were listed in both markets. I contribute to this literature by providing the first evidence and quantification of the effect of the international telegraph on international capital flows. Furthermore, whereas Garbade and Silber (1978) and Hoag (2006) study price formation on secondary markets, I study the issuance of

[2]See Gourinchas and Rey (2014) for a review of this literature.

[3]Relatedly, Lin et al. (2021) have recently studied the impact of the telegraph on banking. Using Chinese data, they document that the domestic telegraph was an important determinant for the expansion of the Chinese bank branch network.

securities in primary markets.[4]

This paper furthermore contributes to the literature on the drivers of financial globalization and its origins. Obstfeld and Taylor (2003) and Obstfeld and Taylor (2004) review the literature on the history of financial globalization. While the role of information and communication technology is generally acknowledged in this literature, it is usually seen as secondary to factors like policy. My study finds large effects of the telegraph on capital flows, suggesting that information and communication technology played an important role in the first wave of globalization in capital markets during the second half of the 19th century.

Finally, this paper relates to several other strands of literature. A recent literature has examined the local economic outcomes of ICT infrastructure connectivity.[5] This paper is related to work that examines the role of information for capital flows and financial markets more broadly[6], the literature examining the impact of the telegraph on trade[7], on home bias in international financial markets[8], on capital allocation and financial openness[9], on

[4]See Field (1998) for a discussion of how increased information flow via the telegraph can lead to more liquidity in secondary markets, which in turn makes it easier to issue in primary markets.

[5]See the review by Bertschek et al. (2016), as well as Eichengreen et al. (2023), Eichengreen et al. (2017), Malgouyres et al. (2021), Hjort and Poulsen (2019), Akerman et al. (2022), Bhuller et al. (2023), Hvide et al. (2022), and D'Andrea and Limodio (2020).

[6]See e.g. Koudijs (2015) and Koudijs (2016) on information flows via ship in the 18th century, as well as recent studies of the role of information for foreign direct investment by Burchardi et al. (2019) and Campante and Yanagizawa-Drott (2018). See also Van Nieuwerburgh and Veldkamp (2009), Mondria et al. (2010), Mondria and Wu (2010), Dziuda and Mondria (2012) on home bias and endogenous information acquisition in financial markets.

[7]See Steinwender (2018), Juhasz and Steinwender (2018), Ejrnaes and Persson (2010), and Cotterlaz and Fize (2021).

[8]See the review by Coeurdacier and Rey (2013).

[9]See e.g. Bau and Matray (2020) and Saffie et al. (2020).

the welfare effects of financial flows/openness[10], as well as the literature on distance lending.[11]

The rest of the paper is structured as follows: Section 2 discusses the historical context, and Section 3 describes the data. Section 4 presents a theoretical framework. Section 5 shows event study estimates, whereas Section 6 shows gravity equation estimates of the impact of the telegraph using the geographical instrument. Section 7 presents and discusses evidence on the mechanism behind the baseline results. Section 8 concludes.

2 Historical Context

The electric telegraph was invented in the first half of the 19th century. As outlined by Standage (1998), telegraph lines were being deployed on land from the 1840's on. While there had been prior international connections by land in mainland Europe, 1851 saw the first underwater telegraph cable being laid between France and the UK, across the English Channel. Several attempts to lay telegraph cables across the Atlantic were subsequently made, but this proved technically difficult, due to several broken and malfunctioning cables. In 1866, the UK and the US were finally connected via a permanently functioning telegraph cable (Steinwender, 2018). Subsequently, virtually all countries worldwide were connected to the global telegraph network. The UK became the world's leading provider of telegraph

[10]See, among others, Prasad et al. (2007), Obstfeld (2009), Kose et al. (2009), Rodrik and Subramanian (2009), Kose et al. (2011), Obstfeld (2021), Passari and Rey (2015), and Korinek (2018).

[11]See Petersen and Rajan (2002), Degryse and Ongena (2005), and Agarwal and Hauswald (2010).

related equipment and worked as a sort of control center for the world's telegraph traffic (Wenzlhuemer, 2013). Whereas ownership of domestic telegraph systems differed by country (e.g. public in the UK, and private in the US), international telegraph cables were usually in private hands (although telegraph companies were sometimes backed by public guarantees, e.g. in cases where private demand for telegraphic communication was too low to sustain the cable by itself, see e.g. Ahvenainen (1996)). Only by the end of the 19th century were there serious challenges to the UK's preeminent role in the global telegraph industry by France and Germany (Ahvenainen, 2004).

The invention and global expansion of the telegraph in the second half of the 19th century happened in a time of rising international integration of financial and goods markets. As detailed e.g. in Bordo et al., eds (2003), the second half of the 19th century saw a hitherto unprecedented rise in the global integration of labor, goods, and capital markets. As argued by Obstfeld and Taylor (2003) and Obstfeld and Taylor (2004), levels of financial globalization before the beginning of World War 1 were similar to those seen at the end of the 20th century. As argued by Cassis (2006), London in particular became the world's most important financial center throughout the first third of the 1800s. London's role as a capital market lay in trade finance, as well as initially the origination of loans to foreign governments, and later on companies. Among the world's other financial centers in the second half of the 19th century, Paris was the second most important, ahead of Berlin. Total listings on the London Stock Exchange in 1913 were more than those at the Paris and the New York Stock Exchanges combined (Cassis, 2006). Furthermore, whereas British capital was invested across the globe, French investors predominantly invested within Europe. According to Cassis (2006), 67.4 percent of French capital exports between 1852 and 1881 went to European recipients, whereas only 29 percent of British capital exports between 1865 and 1881 did so.

The rollout of the global telegraph network and the rise of international financial integration happen before the background of other important changes in the world economy. Since the first half of the 1800s, railways were being built in many parts of the world, and contributed to large reductions in trade costs (Fogel, 1964; Donaldson, 2018; Donaldson and Hornbeck, 2016; Fajgelbaum and Redding, 2018; Hornbeck and Rotemberg, 2021). Being particularly capital intensive investment goods, railways left a big footprint on capital markets, as railroad company bonds came to make up large shares of investments in financial markets. A little later in the 19th century happened the switch from sailing to steamships, which particularly impacted trade costs across the oceans (Pascali, 2017).

2.1 Narrative Evidence on the Telegraph and its Impact on Financial Markets

This section discusses narrative evidence on the telegraph's impact on financial markets. Several popular and academic works have discussed this (Standage, 1998; Winseck and Pike, 2007; Wenzlhuemer, 2013), and Ranald Michie has written a series of papers on the telegraph and its impact on financial markets (Michie, 1985, 1988, 1997).

The telegraph arguably increased the liquidity of secondary markets, by making information broadly and quickly available. This was especially important for foreign bonds, as suggested by this contemporary quote: "The reason why a foreign bond was of an easily negotiable value, and had a recognized status in the world as a convenient system of exchange, was owing to the modern system of telegraphing, and the close connection between one place and another."(Clarke, 1878).[12] Similarly, Inglis (1980) reports that: "The telegraph enabled money [...] to move more quickly across the world." In particular, the telegraph encouraged British investors to engage more with some foreign bonds: "Fast and regular news from Australia encouraged British investors to speculate for the first time in mining shares on colonial stock exchanges (Inglis, 1980)." The importance of the quick transmission of relevant information to investors was recognized by some of the contemporary borrowers on public markets: "The government of New South Wales judged it worthwhile telegraphing its treasurer's financial statement to London, at a cost of more than £1300 a time, to give potential investors fresh news of the latest opportunities waiting for them out in the colony (Inglis, 1980)." Finally, the telegraph may have lowered transaction costs for transferring money abroad. Inglis (1980) reports that in 1889 Australians were able to transfer money in support of the London dock labourer's strike to London within one day.

[12] By L. Cohen, cited in *Hyde Clarke, V.P.S.S., London: Effingham Wilson, Royal Exchange, 1878, p. 45.* Thanks to Sean Stout and Lucie Stoppok for making me aware of this quote.

Increased information flows via the telegraph may have also contributed to increased stock market participation among the population. Hochfelder (2006) studies the case of the stock ticker and bucket shops. The stock ticker was a technology that, receiving information via telegraph cables, produced a steady stream of records of the latest trades on stock exchanges. Upon its invention, stock tickers quickly spread across the USA. A particularly popular business model arose in the so-called bucket shop. The business model of a bucket shop was to give customers free access to real-time stock market information, and to then offer bets (against the house) on the future move of individual stocks. Hochfelder (2006) argues that although many of these bucket shops were fraudulent in nature, they, as well as the information spread via the stock ticker, were a crucial step in familiarizing the general public with the stock market.

While the state was typically an important user of the telegraph (and the importance of the telegraph for empire has been discussed elsewhere, e.g. by Headrick (1979)), use by private businesses and individuals was by far the predominant use of the telegraph. Wenzlhuemer (2013)[p. 239] reports that: "In 1888-1889, 2.6% of India-European telegraph traffic was state, 2.2% press, and 95.3% commercial and private."

3 Data

This section describes the data used and how the variables are constructed. The capital flow data are covered in Section 3.1, the telegraph data in Section 3.2, the seabed ruggedness data in Section 3.2, and other variables in

Section 3.3.

3.1 Capital Exports from the UK

The main dependent variable is capital exports from the UK. The data constitutes a panel of 50 annual periods for 33 countries (giving a total of 1650 observations) between 1865 and 1914. Every observation is the yearly sum of capital called on bonds, stocks, and debentures issued on the London Stock Exchange, by borrowers in one of the 33 non-UK countries. The data are taken from Stone (1999), and supplemented with observations for additional countries from Clemens and Williamson (2004).[13]

The capital flow data make up a very substantial share of British capital exports at the time. According to Clemens and Williamson (2004), the countries in the sample receive 92% of total British capital exports in 1914. The data can be subdivided into flows to public recipients (made up of national, colonial & provincial, and municipal borrowers), and private recipients (all others). Private recipients covers all recipients that are not part of the government, which in this context includes firms with public guarantees. Figure 1 shows the yearly sum of total, public, and private flows throughout the sample period. The data explain a clear cyclical pattern over the sample period (this is accounted for by using time fixed effects in the empirical spec-

[13]Countries taken from Stone (1999): United States, Canada, Argentina, Australia, India, South Africa, Brazil, Russia, New Zealand, Mexico, Japan, China, Egypt, Chile, France, Turkey, Italy, Austria-Hungary, Peru, Spain, Uruguay, Cuba, Germany, Greece. Countries taken from Clemens and Williamson (2004): Ceylon, Colombia, Denmark, Indonesia, Norway, Philippines, Portugal, Sweden, Thailand. Capital flow data for Rhodesia, Burma, and Serbia were available, but could not be matched to a clear telegraph connection date.

ification). Private borrowers can be split into six categories: railways, public utilities, financial, raw materials, industrial & miscellaneous, and shipping. Figure 2 shows the relative allocation of categories of private flows over the sample time. While flows to railway companies account for a substantial share of total capital exports throughout the sample period, flows to shipping are a small share of capital flows throughout; the other categories fluctuate between 5 and 20 % of total yearly capital flows each.

As Table 1 shows, the type of financial instrument typically used varies by recipient group. Whereas 97% of the capital allocated to the public sector was in the form of debentures (long-term, fixed interest debt obligations) and 3% in notes (short-term obligations with flexible interest rates), the picture is more mixed for private recipients. Debentures were the chief form of lending for railways and public utilities, while ordinary shares were frequently used for financial, raw material, and industrial and miscellaneous firms. Preference shares (fixed-interest shares) were often used for industrial & miscellaneous firms, but seldom for other private sectors.[14] Stone (1999) does not include any specific numbers on the nationality or residencies of the ultimate investors in these securities. Although it can not be decisively concluded, it is assumed that the vast majority of investors in instruments on the London Stock Exchange were British.

[Figure 1 about here.]

[Figure 2 about here.]

[Table 1 about here.]

[14] See Stone (1999) for more details on the instruments used, and temporal trends.

3.2 Telegraph Data

The data on telegraph connections are taken from Juhasz and Steinwender (2018), which is largely based on data collected in Wenzlhuemer (2013). From these data, a telegraph dummy is constructed, which takes the value 1 if a country and the UK are connected directly or indirectly (meaning via one or more other countries) via telegraph cables in a given year, and 0 otherwise. The date of the earliest telegraph connection to the UK is available for 33 of the 36 countries for which capital flow data are available.[15]

Figure 3 plots the number of countries with telegraph connections to the UK between 1865-1914. 15 out of 33 countries are already connected to the UK by 1865, meaning that a change in the telegraph connection status is observed for the remaining 18 countries.[16] Figure 4 shows the global geographic spread of the telegraph for the countries in this sample.[17] The countries marked in red indicate that continental Europe, and parts of the Middle East, Northern Africa, Arabia, and India were already connected to the UK via telegraph by 1865. In contrast, the Americas, as well as the Far East, South East Asia, South Africa, Australia and New Zealand were connected to the UK via telegraph only after 1865. Consequently, most of the identifying variation for the impact of the telegraph comes from these countries, and the estimated effects here should be interpreted as local effects

[15]Telegraph connection dates are missing for Burma, Serbia, and Rhodesia.

[16]The countries for which capital flows before and after the switch to the telegraph are observed are: Canada and United States (1866), Cuba (1867), Colombia and Indonesia (1870), China and Japan (1871), Australia (1872), Argentina, Brazil, Chile, and Uruguay (1874), Peru (1875), New Zealand (1876), South Africa (1879), Philippines (1880), Mexico (1881), Thailand (1883).

[17]This graph was created using the 1880 map on historicalmapchart.net.

in this sense.

[Figure 3 about here.]

[Figure 4 about here.]

3.3 Other Variables

This section describes other variables used in the empirical analysis and their construction. All variables and their sources are listed in Table 2.

Data on population and population growth rates are taken from Bolt et al. (2018) and Banks and Wilson (2020). Population growth is used as a lagged variable, and is calculated as the percentage change between year t and year t-1. Since population is assumed to be a slow-moving variable, some observations are interpolated.[18] This allows for the inclusion of additional control variables and observations in the empirical analysis. Data on urbanization are taken from (Banks and Wilson, 2020) and Mitchell (1998), and capture the share of the population living in a city of more than 100,000 inhabitants. Similar to the population data, some observations for urbanization are interpolated.

[Table 2 about here.]

[18] The interpolation is a linear interpolation, done with Stata's *ipolate* command. Specifically, the sample is restricted to all available observations of population (urbanization) between 1855 and 1914, and a linear interpolation of the respective variable on year is assumed for missing observations of logged population (urbanization). This includes extrapolations at the outer edges of the sample period. Observations (regular and interpolated) between 1865 and 1914 are then used, and make up the "interpolated" series. 180 observations (on top of the 1470 available observations) are gained in this way for population. For urbanization, 300 observations (on top of the 1250 available observations) are gained by interpolation. For urbanization, no data is available for China and Indonesia throughout the sample period, so no interpolation can be applied.

4 Theory: Information Frictions and Capital Flows

This section discusses the theoretical framework. I use two different gravity models of financial flows from the literature as potential theoretical frameworks through which one can interpret the empirical results in Section 5 and Section 6. I further discuss a novel interpretation of how information frictions matter for international capital flows in a gravity model of the type introduced by Pellegrino et al. (2023).

4.1 Gravity Theories of International Finance

Portes and Rey (2005) have documented that international capital flows are well-described by gravity models. I.e. capital flows between two countries increase in the size of the two countries, and decrease in bilateral distance. This literature has furthermore emphasized the role that information plays in shaping the flow of capital. Portes and Rey (2005) show that bilateral telephone traffic correlates with bilateral equity portfolio flows, and that the inclusion of telephone traffic as a control variable reduces the size of the coefficient on bilateral distance.

The insights of this literature have been formalized by Okawa and van Wincoop (2012) into a gravity theory of international financial flows. Their model features many countries, a risk-averse representative investor in each country who is faced with a portfolio allocation decision between a set of country-specific risky assets. Okawa and van Wincoop model information frictions as a bilateral multiplication of the perceived degree of riskiness of the respective asset. In other words, investors perceive assets for which they face higher information frictions as being more risky. Formally, the bilateral information friction τ_{ij} means that an investor in country j perceives the variance of the asset in country i as $\tau_{ij}\sigma_i^2$. Hence, ceteris paribus, higher information frictions mean that risk averse investors will invest relatively less in assets of country i. In this model, investors are risk-averse and seek high returns, and information frictions shape how that trade-off is perceived by investors.

Pellegrino et al. (2023) recently proposed a different theory (inspired by Eaton and Kortum (2002)). In their model, there are potentially many bilateral frictions, which shift the utility of the investor. To solve the model, Pellegrino et al. assume that each investor receives an individual 'attachment' draw for each possible investment plant abroad, which makes the plant-specific return perceived by the individual investor random. When aggregating up in this economy, a certain fraction of investors will prefer to invest in a given plant abroad. This fraction increases or decreases with bilateral factors like having a shared language, cultural distance, or bilateral investment taxes.

Formally, Pellegrino et al. (2023) assume that returns of investor z (based in country j) from an investment in plant x (based in country i), is described by:

$$R(x,z) \equiv (1-\tau_{ij}) \cdot r_i \cdot e^{-\lambda(x,z)} \tag{1}$$

$$\lambda(x,z) = \boldsymbol{d}'_{ij}|\beta| - \xi(x,z) - G_j, \tag{2}$$

where τ_{ij} is a tax incurred by investors in country j who invest in country i, r_i is the return on assets in country i. λ captures intermediation costs associated to monitoring, enforcing and acquiring information, where Pellegrino et al. (2023) model $\boldsymbol{d}'_{ij}$ as a vector of measures of bilateral distances, $\xi(x,z)$ is the idiosyncratic attachment of the investor to the plant, and G_j is a proportional rebate for all investors from country j which ensures that the investment intermediary of country j makes zero profits.

4.2 Information Frictions as Uncertainty

When considering the effect of information (and a lack thereof) on economic agents, the behavioral economics literature has stressed the distinction between risk and uncertainty. In this context, risk usually describes a situation of probabilistic outcomes with *known* probabilities, whereas uncertainty [19] refers to a situation with probabilistic outcomes and *unknown* probabilities. This distinction has been recognized and studied in the finance literature (Epstein and Schneider, 2010; Guidolin and Rinaldi, 2013). However, this distinction has not been stressed in the literature on information frictions in international finance.

[19] This is also frequently referred to as 'Knightian uncertainty', following Knight (1921), or equivalently as ambiguity, or model uncertainty in different literatures.

A popular way of modeling uncertainty aversion in economics is the so called 'maxmin' approach, formalized by Gilboa and Schmeidler (1989). In this model, an uncertainty averse agent is faced with a choice between several gambles with probabilistic outcomes and unknown probabilities. Gilboa and Schmeidler (1989) model uncertainty aversion in a max min way, meaning that agents first minimize utility over the range of possible probabilities (this reflects uncertainty aversion), and subsequently maximize their utility by choosing the gamble that gives them the highest utility. In this framework, higher uncertainty is expressed by a larger range of possible probabilities. Intuitively, the minimization over the possible range of distributions reflects the idea that agents are uncertainty averse and hence receive less utility from a larger range of possible probability distributions.

Boyle et al. (2012) use this approach to analyze the effect of uncertainty on a portfolio investment decision. Using the maxmin approach of Gilboa and Schmeidler (1989), Boyle et al. (2012) model higher degrees of uncertainty as a wider range of possible payoffs associated with a given asset. Specifically, a higher degree of uncertainty shows up in the investor's utility function as a higher deduction from the expected payoff of a given asset: $\mu_{ij} = \hat{\mu}_i - \alpha_{ij}$, where μ_{ij} is the mean payoff of asset i as perceived by investor j, $\hat{\mu}_i$ is the mean payoff of asset i, and α_{ij} is the degree of uncertainty that investor j has with respect to asset i. Hence, under maxmin utility, the degree of uncertainty associated with an asset can be thought of as a deduction from its mean payoff.

This approach can be applied in the context of international financial flows as well. Whereas Okawa and van Wincoop (2012) model information frictions as a multiplication of an assets variance, the above deliberations show that information frictions conceptualized as uncertainty can also be thought of as a tax on bilateral returns. Is this view of information frictions consistent with existing gravity theories of international finance? Okawa and van Wincoop (2012) show that modeling information frictions as a bilateral tax does not yield gravity in their setup. The framework of Pellegrino et al. (2023) on the other hand does allow for a bilateral tax on returns and yields gravity. Hence, it is possible to think of information frictions as creating uncertainty, and to derive a gravity theory of financial flows that is consistent with this.

In this paper, I follow the uncertainty view of information frictions, and interpret the availability of communication via the telegraph as reducing the degree of bilateral uncertainty perceived by investors. This view is intuitively appealing when considering the impact of information frictions on international capital flows. An implication of this view is that information frictions do not change the payoff structure of a risky asset per se (as in Okawa and van Wincoop (2012)), but rather change what the investor knows about the payoff structure.

5 Event Study Designs

This section presents event study difference in differences (ES DiD) estimations of the impact of telegraph connections on capital flows from the UK.

5.1 Empirical Strategy

A recent literature has pointed out several econometric concerns regarding the use of two-way fixed effects designs with a simple treatment dummy, in particular in cases of staggered treatment adoption, and heterogeneous and/or dynamic treatment effects (Baker et al., 2021; Goodman-Bacon, 2021; Callaway and Sant'Anna, 2020; Sun and Abraham, 2020; de Chaisemartin and D'Haultfœuille, 2020; Borusyak et al., 2021).

In this paper, I follow two approaches discussed in Baker et al. (2021). First, I use what Borusyak et al. (2021) refer to as the *fully dynamic specification*, i.e. a regression with unit and time fixed effects, as well as a full set of relative event indicators:

$$C_{it} = exp(\alpha_i + \lambda_t + \sum_k \lambda_k \mathbb{1}[t - E_i = k] + \varepsilon_{it}), \tag{3}$$

where C_{it} are bilateral capital flows from the UK to country i in year t, α_i and λ_t are unit and time fixed effects, and $\mathbb{1}[t - E_i = k]$ is an indicator variable for being k years from E_i, the first year in which a direct or indirect telegraph connection between the UK and country i exists.[20]

When estimating Equation (3), one relative time dummy has to be excluded, in order to avoid collinearity. I follow convention, and omit the dummy for the year immediately before a telegraph connection. Furthermore, as argued

[20] I assume here that direct and indirect (i.e. relayed connections) are equivalent events. Most connections, especially the longer ones were relayed several times, so this was a common phenomenon. E.g. the first connection between the UK and the USA went from London via Scotland, Ireland, Newfoundland, and eventually to New York.

by Borusyak and Jaravel (2018), in cases with no never-treated units, two relative time-periods have to be excluded. I follow their recommendation, and exclude the year before the treatment, as well as the most negative relative time indicator for such estimations. As argued by Baker et al. (2021), the fully dynamic specification alleviates some of the variance-weighting issues discussed by Goodman-Bacon (2021), since every relative time indicator is switched on only once per unit, and it has the further benefit of allowing the examination of trends around the introduction of treatments.

Furthermore, I also use what Baker et al. (2021) call the *stacked difference-in-differences (stacked DiD)* approach to staggered adoption settings, following Cengiz et al. (2019). In particular, assume that a number of units receive a treatment at different points in time, and that treatment effects are potentially heterogeneous (i.e. the effect size differs by unit and potentially by time of adoption), and/or dynamic (i.e. the effect size accumulates over time). As emphasized by the literature, using a simple panel regression with two-way fixed effects and a treatment dummy creates potentially undesirable effects, in particular because this approach partially compares units that receive a treatment with units that received the treatment themselves shortly before. Any potential treatment effects of the control units are then subtracted from the treatment effect, which potentially introduces nontrivial biases (Baker et al., 2021).

The stacked DiD approach proposes to look at each adoption event individually, and to select a group of "clean" untreated units for each treatment event (e.g. units that were not treated themselves within a window of plus/minus a certain number of time periods around a particular treatment event). The treated and untreated observations for each adoption event are then stacked into a new dataset (this dataset will generally feature some repeated observations, e.g. since some untreated observations may be used as control units for multiple adoption events), which is used to jointly estimate the average impact of the treatment. The stacked approach has the advantage that control units are arguably not experiencing important treatment effects themselves, since their treatment lies either far away in the future or present.

In particular, consider the *stacked regression*:

$$C_{it} = exp(\alpha_{ig} + \lambda_{tg} + \sum_{k} \lambda_k \mathbb{1}[t - E_i = k] + \varepsilon_{itg}), \tag{4}$$

Equation (4) and Equation (3) differ in that Equation (4) is based on a stacked dataset, whereas Equation (3) is based on a regular panel dataset. Note that Equation (4) includes adoption event-specific time and year-fixed effects.

Both the fully dynamic and the stacked specification face one common issue: the dependent variable, capital exports from the UK to country i, typically contains many zero's.[21] To address this (and to avoid having to add an arbitrary constant to the dependent variable before taking logs), I follow the literature on gravity equations in trade and international finance, and use the PPML estimator, which has been shown to be an efficient log-level estimator (Santos Silva and Tenreyro, 2006).

[21] E.g. 220 out of 825 observations, or 26.6%, of total bilateral capital exports in this sample between 1865 and 1889 are 0's.

Note that Equation (3) and Equation (4) are both consistent with a gravity equation in capital flows (Okawa and van Wincoop, 2012; Pellegrino et al., 2023). In particular, country fixed effects in this empirical setting double as country pair fixed effects, as every bilateral flow originates in the UK. Hence, country fixed effects consume all of the usual factors that are fixed at the country level for the sample period, like country size, geography with respect to the rest of the world, natural resources (to the extent that they are known about), and political and cultural institutions (to the extent that they are constant over time). Furthermore, country fixed effects consume variables that are fixed at the country pair level (e.g. UK-US, UK-Argentina, etc.), such as bilateral distance, colonial history, common language and justice system (again, to the extent that they are fixed over the time period considered). Note that the stacked and the dynamic specification differ slightly in this respect, as the stacked regression features event-specific country and time fixed effects, whereas the dynamic specification features only one fixed effect per country and time period (e.g. in the stacked setting, Thailand has one country fixed effect when it is an untreated unit for the telegraph's adoption in Argentina in 1874, and a different one when it is an untreated unit for Australia in 1872).

5.2 Results: Fully Dynamic Event Study Difference in Differences

This section presents coefficient estimates around the introduction of telegraph cables, based on Equation (3). Figure 5 is based on regressions using aggregate flows (total, public, private) as the dependent variable, whereas

Figure 6 is based on regressions using industry level flows to private entities (railways, public utilities, etc.) as the dependent variable. All regressions in this section are estimated using Stata's *ppmlhdfe* command. The omitted category is generally -1, one year before a country receives a permanent telegraph connection with the UK.

[Figure 5 about here.]

Figure 5 contains some of the baseline results of this paper. It shows the average behaviour of bilateral capital flows around the arrival of telegraph cables. The upper panel suggests that total bilateral capital flows in the ten years before the arrival of the telegraph are roughly fluctuating around zero, exhibit an upward trend from the first year of connection, and start leveling out at a coefficient of around $1 - 1.5$. This means that from about five years after the arrival of a telegraph connection on, capital flows are about twice as large, relative to one year before the connection. Flows to public entities exhibit a similar pattern, but with a less strong increase, to a point estimate of around $0.5 - 1$. Finally, flows to private entities are centered around -1, until about five years before the introduction of the telegraph, then start to rise, and level out at around $1.5 - 2$ from about five years after the introduction of telegraph cables. Again, note that all of these point estimates have to be interpreted relative to the omitted category, which is one year before the eventual telegraph connection.

The pre-trend in flows to private entities could be explained in several different ways. First, pre-trends may raise concerns of reverse causality or simultaneity, with telegraph cables being caused by capital flows, or both being caused by a third factor. While these concerns can not be entirely dismissed, Section 6.1 presents IV estimates using a geographical instrument, which shows that telegraph connections indeed had an effect on capital flows. Second, it could be the case that there is true anticipation, in the sense that investors or entrepreneurs have an expectation that a telegraph line will arrive at some point in the close future, and start creating businesses that are profiting from this new technology several years in advance. This explanation seems plausible, especially for countries that receive the telegraph at later points in the sample, when there was arguably more certainty about the eventual global rollout of the telegraph. Similarly, in some cases the time between the announcement and the actual completion of a telegraph cable may have taken several years, since long distances had to be covered, so it may have been possible to anticipate the completion of telegraph lines in such cases. However, if this type of investment were the main driver of an increase in capital flows, one would expect capital flows to eventually decrease again, whereas they seem to stay at elevated levels long after the introduction of the cable. This indicates a permanent change in the flow of capital towards connected countries. Third, partial connections may have caused reductions of information frictions along the way. E.g. the eventual connection between the UK and Australia was made via India, among other countries. So when a connection between the UK and India was completed in 1864, the time it took for information to flow between Australia and the UK was likely affected then already (a point also emphasized in Juhasz and Steinwender (2018)). Finally, as emphasized in Section 6.1, broken cables were a frequent feature of the laying process of telegraph cables. It therefore could have been the case that cables which were being built faced delays, but that investments based on the cable were already underway.

[Figure 6 about here.]

Figure 6 shows estimates of Equation (3), with industry-level flows as the dependent variable. The results indicate that especially flows to railways, financial companies, raw materials, and industrial companies increased after the introduction of telegraph connections. The graphs also indicate that any pre-trends in private flows around the introduction of telegraph cables are likely to be connected with flows to railways, public utilities, and raw materials. Furthermore, note that flows to industrial companies seem to increase very quickly after the introduction of telegraph connections.[22] When interpreting industry level flows, note that the control group in this case consists only of flows to the same set of industries. Hence, the interpretation in terms of potential substitution patterns across both countries and industries may be a different one here than for aggregate flows as in Figure 5.

Finally, Figure 16 and Figure 17 in the Appendix show coefficient plots with some control variables (control variables were chosen to maximize the number of control variables, as well as the sample size). The results are broadly unchanged.

[22] The omitted year for flows to industrial companies is in general year -3, as these flows exhibit a large drop in year -1, which makes interpretation more difficult.

5.3 Results: Stacked Difference in Differences

This section presents coefficient estimates around the introduction of telegraph cables, based on Equation (4). Figure 7 is based on regressions using aggregate flows (total, public, private) as the dependent variable, whereas Figure 8 is based on regressions using industry level flows to the private sector as the dependent variable. All regressions in this section are estimated using Stata's *ppmlhdfe* command, and the omitted category is generally one year before a country receives a permanent telegraph connection with the UK.

The stacked regression samples used in this section are constructed as follows: within the full dataset of 1650 observations (33 countries between 1865 and 1914), I keep all telegraph adoption events where I observe at least 6 years before and after the event. This eliminates all treated countries that receive treatment in and before 1870. For each treatment cohort, I then select a number of control units which have their own treatment at least ten years before, or fifteen years after the adoption event at hand. For example, when looking at the adoption of the telegraph in Australia in 1872, only countries that got a telegraph connection in 1862 or before, or in 1887 or after are considered as control units. Furthermore, I use those countries as control units that do get treated within ten years before or fifteen years after the event at hand, but only until four years before their own treatment. In the example of the treatment of Australia, South Africa is treated itself in 1879, so less than fifteen years after Australia's treatment, so I only use South African observations as a control for Australia until 1875. All observations more than ten years before or fifteen years after the specific event time are then dropped. This process is repeated for all treatment events, and the thus created individual Diff-in-Diff datasets are finally stacked into one joint dataset, on which Equation (4) is estimated.

Figure 7 shows the results of the stacked regression for aggregate flows. Overall, the results show very similar patterns to those shown in Figure 5, with flows to private entities showing the biggest reaction, but total and public flows increasing as well. Again, flows to private entities display a pre-trend, starting around 3-4 years before the arrival of the telegraph. In total, these results suggest that the comparison of early to late-treated units does not seem to create strong biases in this context.

Figure 20 and Figure 21 in the Appendix show coefficient plots with some control variables (control variables are the same as those used in Section 6.2). The results are broadly unchanged.

Finally, I run collapsed stacked regressions, where I construct a dataset as described above, and estimate Equation (4), but with one telegraph dummy instead of a set of relative treatment dummies. Appendix C.5 in the Appendix shows the results. The results from the collapsed regression are broadly in line with the results in Section 5. Flows to private recipients rise strongly, whereas flows to public recipients are less strongly affected (although point estimates are still very sizeable in some specifications). Total flows seem to be affected as well, indicating that substitution between public and private flows is unlikely to explain the above results.

[Figure 7 about here.]

[Figure 8 about here.]

6 Gravity and Instrumental Variables Estimates

This section presents two-way fixed effects regressions with an instrumented treatment (telegraph) dummy, in order to address concerns about the potential endogeneity of telegraph cables.

6.1 Identification: Seabed Ruggedness

In order to identify the influence of the telegraph on capital flows, this section uses an IV PPML approach, following Windmeijer and Santos Silva (1997) and Juhasz and Steinwender (2018). In particular, consider the following regression.

$$C_{it} = exp(\beta * telegraph_{it} + \alpha_i + \gamma_t + \Delta X_{it} + \varepsilon_{it}), \tag{5}$$

where C_{it} are capital flows (total, public, or private) from the UK to country i in year t, $telegraph_{it}$ is a dummy that is equal to one in a year in which a direct or indirect telegraph connection between the UK and country i exists and zero otherwise, α_i and γ_t are country and year fixed effects respectively, and ΔX_{it} is a matrix of (time-varying) control variables.

When regressing capital flows on a telegraph dummy in Equation (5), the threat to identification comes from potential reverse causality and simultaneity. In terms of reverse causality, telegraph cables may have been laid particularly to countries with high capital flows, as the economic gains from communication via the telegraph would be highest here. Conversely, from a convergence point of view, telegraph cables might have been laid to countries with low capital flows and anticipated catch-up growth. In terms of simultaneity, it may also be the case that both capital flows and telegraph cables are caused by the same underlying fundamental drivers.

To account for potential endogeneity, I use the ruggedness of the seabed as an instrument for the timing of arrival of telegraph cables. This instrument has recently been introduced to the literature by Juhasz and Steinwender (2018). As documented by Juhasz and Steinwender (2018), it was very difficult and costly to lay telegraph cables across rugged parts of the seabed. High levels of seabed ruggedness frequently lead to broken cables, and meant that cables had to be pulled up from the seabed floor and fixed, or that the route of the cable had to be adapted around the rugged parts. Importantly, engineers at the time tried to measure the ruggedness of the seabed, but did not have appropriate instruments to accurately measure what the seabed looked like in this respect. The ruggedness of the seabed is therefore arguably exogenous to capital flows. Early attempts at measuring the seabed are described by Höhler (2002). In particular, between the 1850's and ca. 1914, the typical technique for measuring the seabed was to lower a heavy piece of lead attached to a strong twine into the sea. This method was very laborious and allowed only rough, and typically infrequent measurements of ocean depth. This is illustrated by Figure 9, which displays four different measurements of the seabed along the route of the initial telegraph cable between the UK and the US (the so-called telegraphic plateau), all taken in 1858. Note the generally smooth surface of the seabed, as well as the considerable differences between the four estimates. In the early years of the 1920's, novel techniques of measuring the seabed via sound were invented. An example of a seabed measurement using this new technique is given in Figure 10, which displays a finer and more accurate measurement of the seabed from 1922 along another route in the Atlantic (Newport, Rhode Island to Gibraltar). Hence, anyone who wanted to lay a cable across the ocean before the 1920 had to rely on a very rough way of measuring the seabed, that was in particular ill-suited for capturing elevation changes on small areas (i.e. local measures of ruggedness).

[Figure 9 about here.]

[Figure 10 about here.]

The instrument is constructed and operationalized as follows.[23] For 65 of the countries used in the sample of Juhasz and Steinwender (2018), I locate the telegraph stations and cables through which a country was first connected to the UK. E.g., while France and the UK were first connected via a cable through the English Channel from Dover to Calais in 1851, the UK and the US were first connected in 1866 via individual cables between Scotland and Ireland, Ireland and Newfoundland, Newfoundland and Cape Breton, and from there via land to New York. For each of these undersea cable segments,

[23]This procedure closely follows the procedure in Juhasz and Steinwender (2018), with the difference that Juhasz and Steinwender (2018) use their instrument to instrument for information lags, whereas I instrument for a telegraph connection.

the shortest sea path is calculated. This reflects the idea that producing and laying telegraph cables was very costly, and it would therefore be natural to economize on them by choosing the shortest viable sea route. Around this sea path, a 10 km corridor on both sides (within the sea) is calculated. Along this corridor, the average Riley measure of seabed ruggedness is calculated (see Riley et al. (1999) on the Riley measure of terrain ruggedness, and Nunn and Puga (2012) for the first application of this measure in economics). This measure is calculated for each point within the corridor, by taking the elevation at that point, and calculating the average squared elevation difference between this point and its eight neighboring points. Elevation data for the seabed are taken from GEBCO (2014). For each country, the final measure of ruggedness is then taken as the maximum average ruggedness value over the cable segments that make up the connection. This approach reflects the idea that high values of seabed ruggedness along one cable segment acted as an effective bottleneck for the entire connection between the UK and the respective country.

To turn the ruggedness measure into an instrument, I regress the actual arrival year of the telegraph on the seabed ruggedness measure for each country. Like Juhasz and Steinwender (2018), I include distance from the UK in the linear prediction, in order to account for the possibility that higher values of seabed ruggedness are mechanically (positively) correlated with longer (sea) distances from the UK, and avoid potential bias from omitting distance in this regression. Table 3 shows the linear regression of telegraph connections on seabed ruggedness and distance. The predicted values of telegraph arrival from this regression are then rounded to the closest integer and turned into a dummy variable, which is used as the final instrument. The instrument hence captures *telegraph connections predicted by geography*, and is used to instrument for observed telegraph connections in an IV PPML estimation (Windmeijer and Santos Silva, 1997) of Equation (5). Figure 11 in the appendix shows a scatter plot of predicted and actual telegraph connections.

[Table 3 about here.]

To make seabed ruggedness a suitable instrument for telegraph connections, two conditions have to be fulfilled: exogeneity and relevance. As argued above, due to technological limitations it was impossible in the second half of the 19th century to accurately assess the ruggedness of the seabed. This means that the instrument is arguably exogenous to capital flows. To test for the relevance of the instrument, Table 4 presents an OLS regression of observed telegraph connections on predicted connections, which is the equivalent of a first stage regression (for the actual IV regressions, Stata's *ivpoisson* command is employed, which does not report first stage results). The Kleibergen-Paap rk LM statistic for this regression reports a value of 22.05, so the strength of the instruments is sufficient. Going forth, the respective KP statistic will be reported whenever IV PPML estimation results are presented.

[Table 4 about here.]

6.2 Results

This section presents estimation results of Equation (5), estimated with PPML and IV PPML. The results indicate that the telegraph had an economically very sizeable, statistically significant, and likely causal impact on capital flows, particularly to private entities.

Table 5 contains the baseline PPML results.[24] The results indicate that a bilateral telegraph connection between the UK and another country on average lead to an increase in the flow to private borrowers between 163% (according to the base specification in column 3 without further controls) and a 146% (according to the specification in column 6 with all control variables). The effect of the telegraph for total capital flows is estimated around 65−75%. The coefficient for flows to public recipients is economically large, but relatively imprecisely estimated.

To account for potential endogeneity of the telegraph variable when estimating Equation (5), I instrument for the telegraph using telegraph cables predicted by geographic features. Table 6 contains the baseline IV results. [25] The results indicate that the telegraph increased capital flows to private borrowers by between 213% (according to the base specification in column 3) and 154% (according to the specification with some controls in column 6). The estimation results indicate that flows to public recipients were affected as well, but the effect is estimated less precisely, and appears to be less stable across specifications. The coefficient on the telegraph dummy is

[24] The PPML estimation is implemented with Stata's *ppmlhdfe* command.

[25] The IV PPML estimation is implemented with Stata's *ivpoisson* command.

not statistically significantly different from zero in specifications featuring control variables, an outcome which is not surprising given the use of an IV approach. However, the point estimates remain broadly stable and at economically very significant levels.

When moving from an uninstrumented to an instrumented estimation (so from Table 5 to Table 6), the coefficient on the telegraph dummy generally increases in otherwise comparable specifications. Thus, the PPML estimate on the telegraph appears to be downwardly biased, which suggests that the telegraph in this sample may connect to countries with relatively low pre-telegraph capital flows. This finding could be due to the UK being more active as a lender outside of Europe, whereas France and Germany were more active as capital exporters within Europe, as argued e.g. by Bersch and Kaminsky (2008) and Feis (1930).

Control variables were chosen based on a reading of the literature (Clemens and Williamson, 2004), and in order to maximize sample size. In particular, the inclusion of institutions (Polity 2), as well as schooling was omitted, as they were not consistently available across the sample period. The two most important control variables seem to be logged population and the lagged growth rate of population growth. Both enter positively and significantly in almost all specifications. The two population variables, as well as urbanization are the control variables that best capture dynamic, country-specific macroeconomic effects within this empirical setting. Adhering to the gold standard seems to be associated with higher capital flows generally. Wars lead governments to borrow, which seems to crowd out private borrowing.

Civil wars on the other hand do not seem to have a major influence on capital flows. Higher levels of urbanization are correlated with higher capital flows, possibly indicating a higher demand for capital due to higher economic growth (Clemens and Williamson, 2004).

[Table 5 about here.]

[Table 6 about here.]

7 Mechanism

This section presents evidence on the mechanism through which the telegraph affected capital flows.

7.1 Heterogeneous Effects

This section presents evidence on flows to different subsets of borrowers and what can be learned about the telegraph's impact from this.

7.1.1 Public and Private Borrowers

The degree of information asymmetry involved in public capital markets is arguably different from the degree of information asymmetry involved in private capital markets. The borrower in a public lending transaction is typically only one entity with a publicly known repayment history. Furthermore, lending from the general public to sovereign entities is typically intermediated by a small number of specialized banks, who engage in long-term relations with these borrowers (e.g. Benczúr and Ilut (2016)). In contrast, lending transactions to private borrowers more frequently include borrowers about whom little prior information is available, or about information gathering is generally very difficult.

To test this hypothesis more explicitly, Table 5 and Table 6 report results for capital flows to public and private recipients independently. Across the two tables, the influence of the telegraph is estimated to be larger for flows to private recipients than on flows to public recipients. Furthermore, the impact of the telegraph is generally more precisely estimated for flows to private recipients. Similarly, results from Section 5 show a larger relative impact of the telegraph for private than for public flows. These findings are consistent with the view that the telegraph reduces information asymmetries which are ex ante larger for private recipients of capital flows.

These findings echo results in Portes et al. (2001). They show that bilateral distance and telephone traffic enter with larger absolute coefficients (negative for distance and positive for telephone traffic) in gravity regressions of international trade in corporate equities and bonds, when compared to regressions of international trade in treasury bonds. The authors interpret this as evidence of different levels of information asymmetries being associated with the respective asset classes.

7.1.2 Heterogeneous Effects Across Industries

Flows to different types of businesses may be differentially affected by the telegraph. To explore this possibility, this section presents regression results on the impact of the telegraph on capital flows to several subsets of industries. For each year and each recipient country, the capital flow data to private recipients can be divided into flows to six sets of industries: (i) railways, (ii) public utilities, (iii) financial, (iv) raw materials, (v) industrial & miscellaneous, and (vi) shipping (see Figure 2 for the relative allocation across industries over time).

Table 15 in the Appendix presents collapsed estimates of Equation (4); instead of a set of relative treatment dummies, I use only a *telegraph dummy*, which is always 0, except for observations where a country is post-treatment within a given stack. Using a stacked dataset constructed as in Section 5.3, Table 15 shows estimation results for flows to private industries. Each regression in Table 15 contains stack * country and stack * year fixed effects.

In Table 15, Panel A shows the base specifications for the six dependent variables, with a telegraph dummy and fixed effects as independent variables. Panels B and C subsequently add control variables. The addition of control variables is chosen so as to maximize the sample size as well as the number of control variables in Panel B, which is my preferred specification.

Across most specifications, Railways, Financial Firms, Raw Materials, and Industrial and Miscellaneous firms are strongly impacted by telegraph cables. Coefficients for the four categories are estimated to be roughly between 1.5 and 2.5, implying a rise of 150 - 250% in yearly capital flows for the respective industries in connected countries. While Panel A suggests a positive and significant effect of the telegraph on capital flows to public utilities, the inclusion of control variables renders the impact of the telegraph smaller, or even negative.

The industries in the sample can be split into industries that produce tradeables (like raw materials and industrial and miscellaneous firms), and non-tradeables (like railways and public utilities).[26] Comparing columns 1-2 with columns 4-5, the results in Table 15 do not show a clear pattern as to whether flows to tradeables or non-tradeables experience a stronger increase.

The financial sector saw big relative increases in capital flows, according to Column 3 of Table 15. It seems unlikely that financial firms benefited from increased market access in their output markets, as London was the primary source of international lending in this time period. However, better market access in input markets (i.e. funding markets in London) may explain the increased flow of capital to financial firms. Another mechanism that would explain this finding is that financial firms could have acted as intermediaries, redistributing funds to local firms. Capital flows to financial firms would hence be a form of entrepot trade in capital. Investment in financial firms can thereby be seen as an indirect alternative to direct investment. Growth in the domestic financial sector would thus be in line with 'collateral benefits' of international capital flows, as emphasized e.g. by Kose et al. (2009).

In sum, all private industries except public utilities experience strong increases in capital flows after the introduction of telegraph connections. Interestingly, flows to railways, financial firms, raw materials, and industrial firms all appear to increase markedly, even after conditioning on control variables. The fact that the impact of the telegraph does not vary dramat-

[26] This split has the caveat that non-tradeables can arguably be seen as services used for tradeables, so increases in flows to tradeables might draw flows to non-tradeables after them. Still, if tradeability was the primary driver of the telegraph's impact, one would expect to see a disproportionate increase in flows to tradeables.

ically across entities here suggests that increases in flows are not mainly driven by potentially differential business usability of the telegraph within the business.

7.1.3 Coefficient Plots by Industry

When examining the coefficient plots for the industry level event study regressions in Figure 6 and Figure 8, a similar picture emerges. Flows to industrial firms and raw material producers seem to be most strongly affected, followed by flows to financial firms and railways, as well as public utilities and shipping in some specifications. These findings are broadly in line with the findings and conclusions from Section 7.1.2.

7.2 Capital Flows and Trade

One possible interpretation of the results in Table 5 and Table 6 holds that the telegraph enhances opportunities for trade (Steinwender, 2018; Juhasz and Steinwender, 2018; Cotterlaz and Fize, 2021), and that capital flows merely follow trade flows or enhanced opportunities for trade. In order to control for the impact of trade on capital flows, Panel A of Table 7 reproduces the PPML regressions in Table 5, with the log of aggregate trade flows as an additional control variable.[27] The addition of the control variable for aggregate trade renders the coefficient on the telegraph dummy insignificant and close to zero for most specifications using total and public capital flows as the dependent variable. In contrast, capital flows to private recipients

[27] Aggregate trade is defined as the sum of total imports and exports of the country receiving the capital flows.

are robustly affected by the telegraph, even when controlling for aggregate trade. The coefficient on the telegraph dummy for flows to private recipients drops from around $1 - 1.6$ in Table 5 to around $0.8 - 0.9$ in Panel A of Table 7. Part of this decrease may be because of sample attrition due to the inclusion of control variables, however, as the respective coefficients in columns 7-9 barely change due to the addition of the trade control variable. The consistently large and significant coefficients on aggregate trade indicate that trade generally plays an important role for capital flows.

Could the influence of the telegraph on capital flows be due to trade finance specifically? Xu (2018) documents the importance and extent of international trade finance in the second half of the 19th century. To account for this possibility, Panel B of Table 7 adds the log of trade with the UK as a control variable to the specifications in Table 5.[28] Adding trade with the UK as a control variable has broadly similar effects as adding aggregate trade as a control variable. The telegraph coefficients for private capital flows are larger when controlling for trade with the UK, rather than controlling for aggregate trade. This suggests that trade with the UK accounts for less of the total effect of the telegraph on flows to private recipients.

[Table 7 about here.]

To account for potential endogeneity of the telegraph cable in Table 7, Table 8 presents corresponding IV estimates, instrumenting the telegraph dummy with geographically predicted telegraph connections.[29] While Panel

[28]Trade with the UK is defined as the sum of bilateral imports from and exports to the UK of the country receiving the capital flows.

[29]In their appendix, Acemoglu et al. (2001) derive an analytical expression for the bias

A reproduces the basic IV results with log aggregate trade as an additional control variable, Panel B adds log trade with the UK.

Moving from PPML to IV has similar effects as with the base specification: the point estimate of the telegraph coefficient increases and the standard errors increase as well. In most specifications the telegraph dummy remains significant and economically very sizeable. Controlling for overall trade (Panel A) in particular increases both standard errors and point estimates substantially. Note that these specifications drops around 80 more observations than comparable specifications in Panel B, which may explain part of this difference.

[Table 8 about here.]

In sum, the results in this section suggest that trade flows have a sizeable conditional correlation with capital flows, and that part of the telegraphs effect on capital flows seems to be driven by the trade channel. However, the results also suggest that the telegraph has an economically large, and arguably causal, effect on capital flows that is independent of the trade channel.

7.3 Newspaper Mentions

The literature on the effects of the telegraph emphasizes the large effects of the telegraph on the newspaper business. Standage (1998) (p. 145-146)

that including an endogenous regressor (like trade) introduces into a regression with an exogenous regressor (like the instrumented version of Equation (5)). Following similar arguments as those made by Acemoglu et al. (2001), it can be shown that the direction of bias introduced by including trade as a control variable is downwards.

writes: "[T]hanks to the telegraph, the general public became participants in a continually unfolding global drama, courtesy of their newspapers, which were suddenly able to report on events on the other side of the world within hours of their occurrence. The result was a dramatic change in world-view [...]". Indeed, the emergence of modern news business institutions like news agencies can be tied directly to the telegraph. Many modern news agencies, like Reuters in Europe and the Associated Press in the United States, emerged at the time of the telegraph. Furthermore, news about foreign countries became very popular. Standage (1998) (p. 152-153): "And readers just couldn't get enough foreign news - the more foreign, the better. Instead of limiting their coverage to a small locality, newspapers were able for the first time to give at least the illusion of global coverage, providing a summary of all the significant events of the day, from all over the world, in a single edition."

This suggests that the telegraph dramatically reduced the costs of reporting news from far away countries. To test whether the introduction of the telegraph did lead to an increase in the provision of news about foreign countries, I present an analysis of the frequency with which foreign countries are mentioned in the British press.

To measure the frequency of news mentions of foreign countries, I compile data on the number of times that a given country in the sample is mentioned in British press articles in a given year.[30] A machine-searchable database of

[30]Similar data, but covering the end of the 20th century, is collected in Portes and Rey (2005). In contrast to that paper, I employ the news mention variable in a gravity regression setting, and can causally link it to changes in information frictions.

British press articles is provided by Gale News Vault. For each country in the sample, I compile the different ways of spelling the name of the country (e.g. *Argentine, Argentina, Argentinian*) and query the database for the number of articles that contain at least one of these words for each year in the sample.

To establish whether the telegraph increased the number of news mentions, Table 9 presents regression with news mentions as the dependent variable. Columns 1 and 2 contain PPML regressions, whereas columns 3 and 4 contain IV PPML estimates, using predicted telegraph connections as an instrument. The results indicate that the telegraph increased the number of news mentions of connected countries in the UK press.

[Table 9 about here.]

To further test for the impact of news mentions on capital flows, in Table 10 I add the log of total newspaper mentions to the baseline IV regressions of capital flows on the telegraph dummy. The results in columns 1-3 and 4-6 show that controlling for the number of news mentions renders the telegraph dummy insignificant (although the effect does not shrink to zero). As argued above, the inclusion of further control variables in columns 7-9 renders these estimates somewhat less reliable. These results suggest that news mentions capture an important channel for the effect of the telegraph on capital flows. Furthermore, they suggest that the information provision happening via the telegraph was important (thereby addressing concerns about endogeneity of the telegraph cable to capital flows).

The data further allows for newspaper mentions to be split into six broad categories: (i) Advertising, (ii) Arts, Sports, and Leisure, (iii) Business, (iv) Editorial and Commentary, (v) News, and (vi) People. Table 11, Table 12, and Table 13 add the log of newspaper mentions in the categories of advertising, business, and news, respectively as additional controls in an IV PPML regression of capital flows on the telegraph. The results suggest that advertising, and business related newspaper articles pick up more of the telegraph coefficient than news articles.[31] I interpret this evidence as suggesting that newspaper articles related to business activities are driving the relationship between newspaper mentions and capital flows.

[Table 10 about here.]

[31] Note that the business section contains stock market quotes, so may partially measure capital flows indirectly.

8 Conclusion

How important are information frictions for the international flow of capital? This paper shed light on this question using the international rollout of telegraph cables as a unique historical laboratory.

I presented evidence that the arrival of telegraph cables in the 19th century increased capital flows from the UK to connected countries by substantial amounts. For identification I used the ruggedness of the seabed.

The evidence suggests that the effect of the telegraph was stronger for private than for public recipients. Furthermore, most industries (except for public utilities) were affected by the telegraph. This suggests that the effect of the telegraph was not primarily driven by usability of the telegraph within the business. Strong increases in flows to financial firms suggest an "entre-pot" effect, where financial firms acted as intermediaries for flows to connected countries.

Adding trade as an additional control indicates that part of the telegraph's effect on capital ran through the trade channel. However, the evidence suggests that there was an independent, and direct effect of the telegraph on capital flows.

Finally, I use a dataset of British newspaper articles to show that the telegraph lead to an increase in the number of newspaper articles mentioning connected countries. When including newspaper mentions as a control variable, the telegraph loses a substantial amount of its explanatory power, indicating that an important part of the telegraph's effect on capital flows is captured by newspaper mentions.

As today's technology keeps changing the global exchange of information, history offers valuable lessons on the impact of information frictions on global capital markets in a globalized economy.

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A Scatter Plot of Predicted and Actual Telegraph Connections

[Figure 11 about here.]

B Newspaper Mentions

This section presents further results using the newspaper mentions data.

B.1 Newspaper Mentions: Event Studies

[Figure 12 about here.]

[Figure 13 about here.]

[Figure 14 about here.]

[Figure 15 about here.]

B.2 Newspaper Mentions: Sections

This section presents estimation results using newspaper mentions in different newspaper sections as dependent variables.

[Table 11 about here.]

[Table 12 about here.]

[Table 13 about here.]

C Robustness

C.1 Event Study Diff-in-Diff Plots with Controls

[Figure 16 about here.]

[Figure 17 about here.]

C.2 Event Study Diff-in-Diff Plots, BLW specification

This section reproduces event study plots using the sample proposed by Baker et al. (2021) (BLW): a fully dynamic event study (like 3), but without always treated units and including only observations until the last unit gets treated. Note that in this specification, only one pre-treatment dummy needs to be excluded, as not all units are treated in the sample.

[Figure 18 about here.]

[Figure 19 about here.]

C.3 Stacked Diff-in-Diff Plots with Controls

[Figure 20 about here.]

[Figure 21 about here.]

C.4 Stacked Diff-in-Diff Plots with Trade Controls

[Figure 22 about here.]

[Figure 23 about here.]

[Figure 24 about here.]

[Figure 25 about here.]

C.5 Stacked Regression: Collapsed

This section presents collapsed estimates of Equation (4); instead of a set of relative treatment dummies, I use only a *telegraph dummy*, which is always 0, except for observations where a country is post-treatment within a given stack. Table 14 shows estimation results for aggregate flows, whereas Table 15 shows estimation results for flows to private industries.

[Table 14 about here.]

[Table 15 about here.]

C.6 Stacked Collapsed with Trade Controls

[Table 16 about here.]

[Table 17 about here.]

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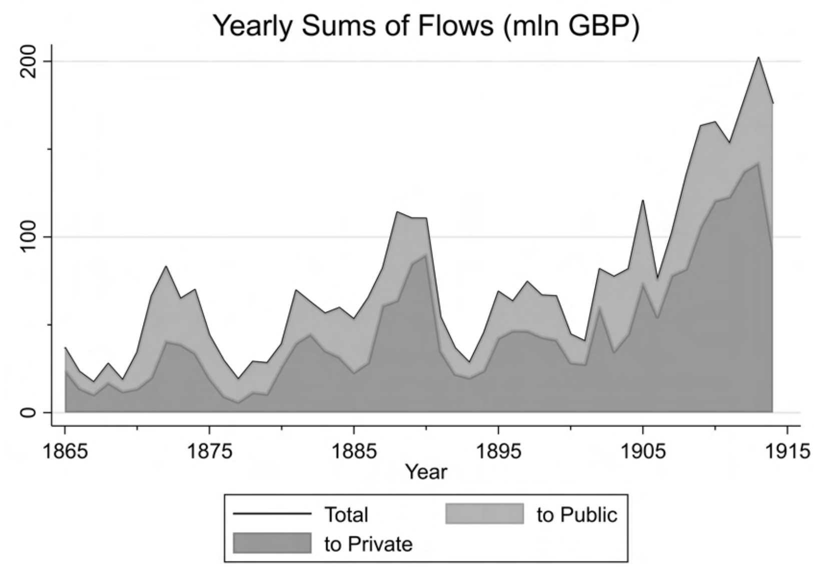

Figure 1: Total, public, and private capital flows by year

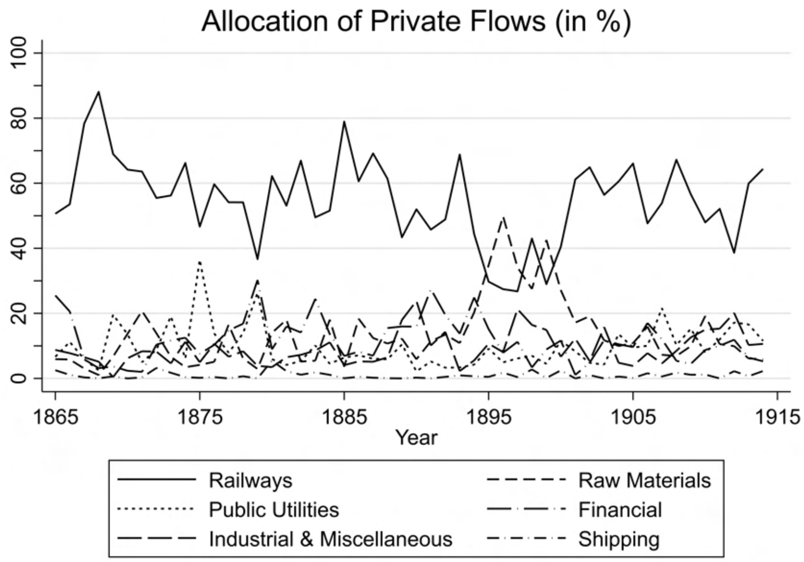

Figure 2: Yearly share of private capital flows per group of recipient

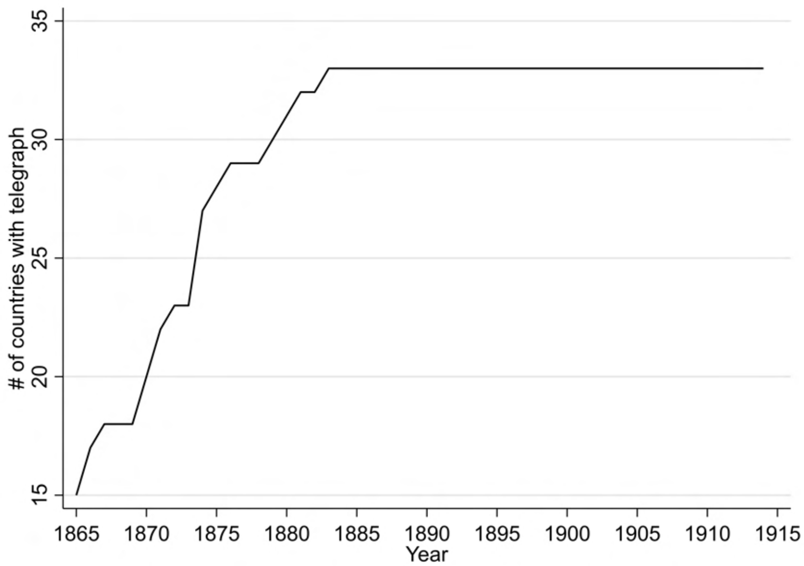

Figure 3: Adoption of Telegraph within Sample

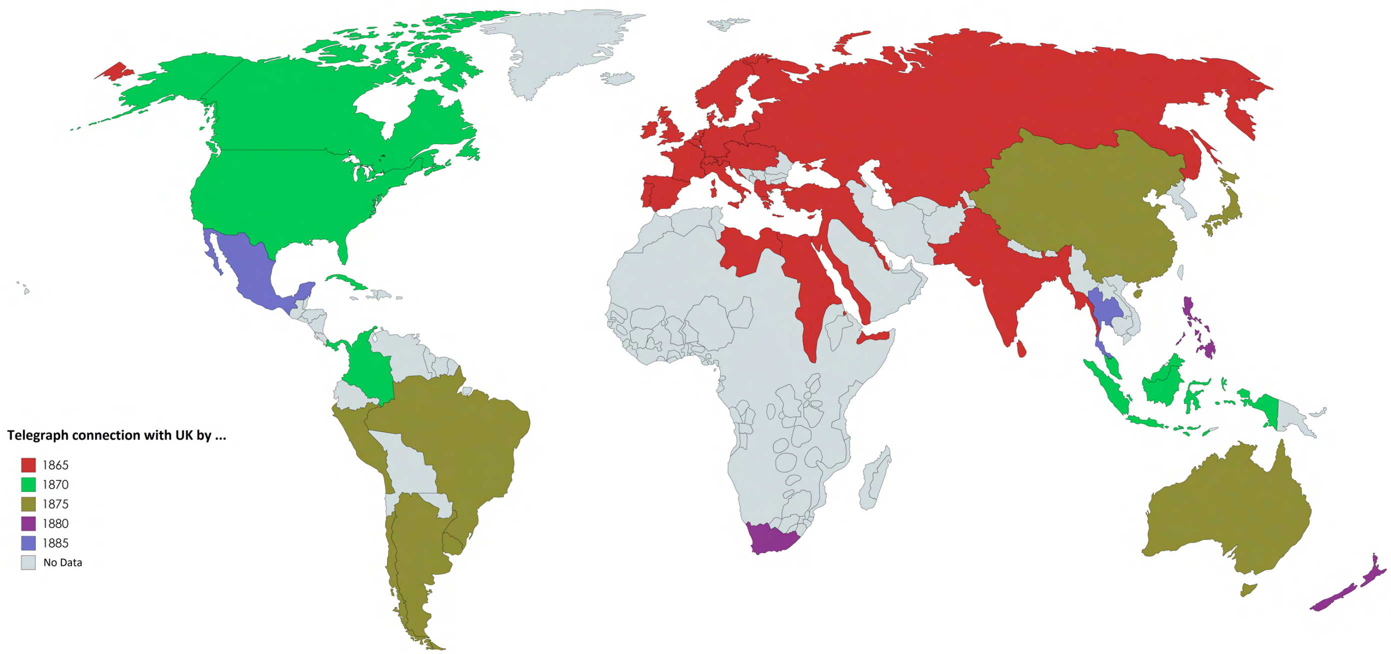

Figure 4: Global geographic spread of the telegraph (1880 boundaries)

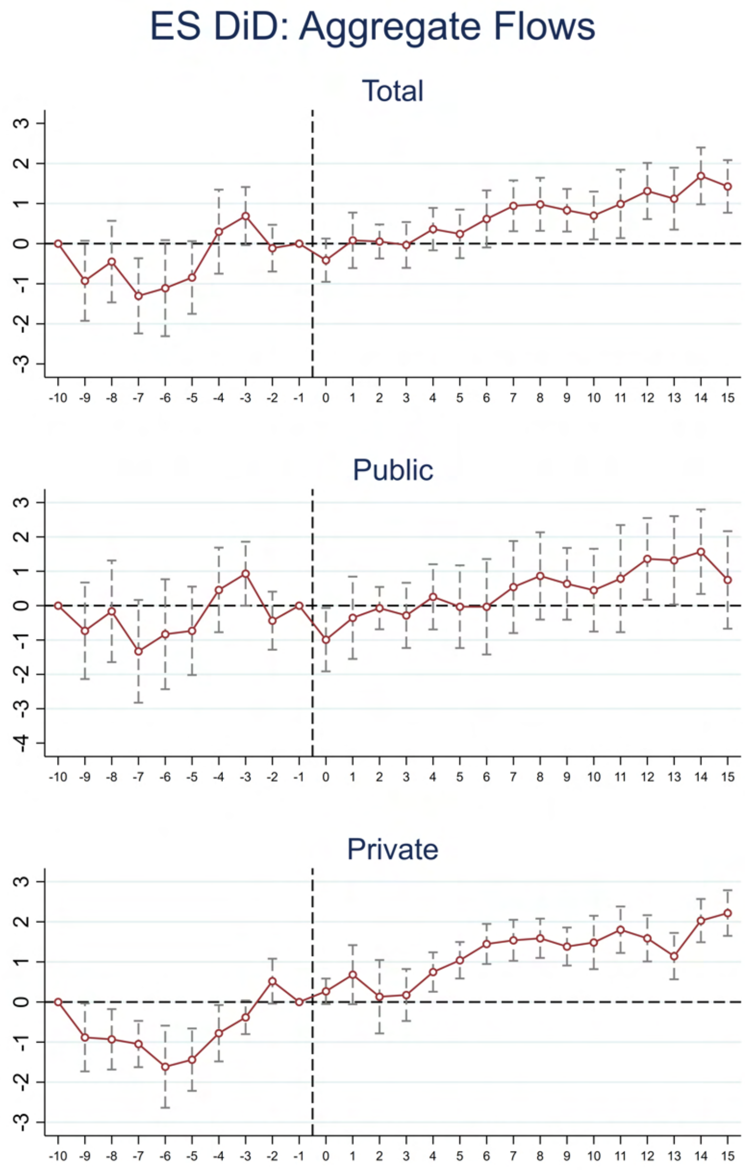

Figure 5: Coefficient Plot around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of estimates of Equation (3), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection. Blue areas shows a 90% confidence interval around the point estimate.

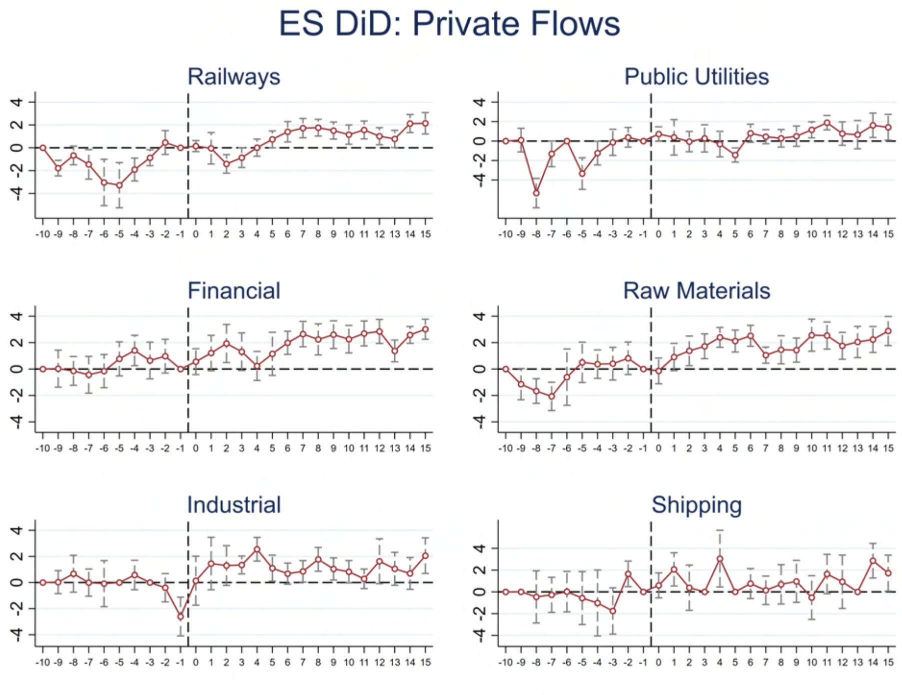

Figure 6: Coefficient Plot around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of Equation (3), with industry-level flows as the dependent variable.. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Blue areas shows a 90% confidence interval around the point estimate.

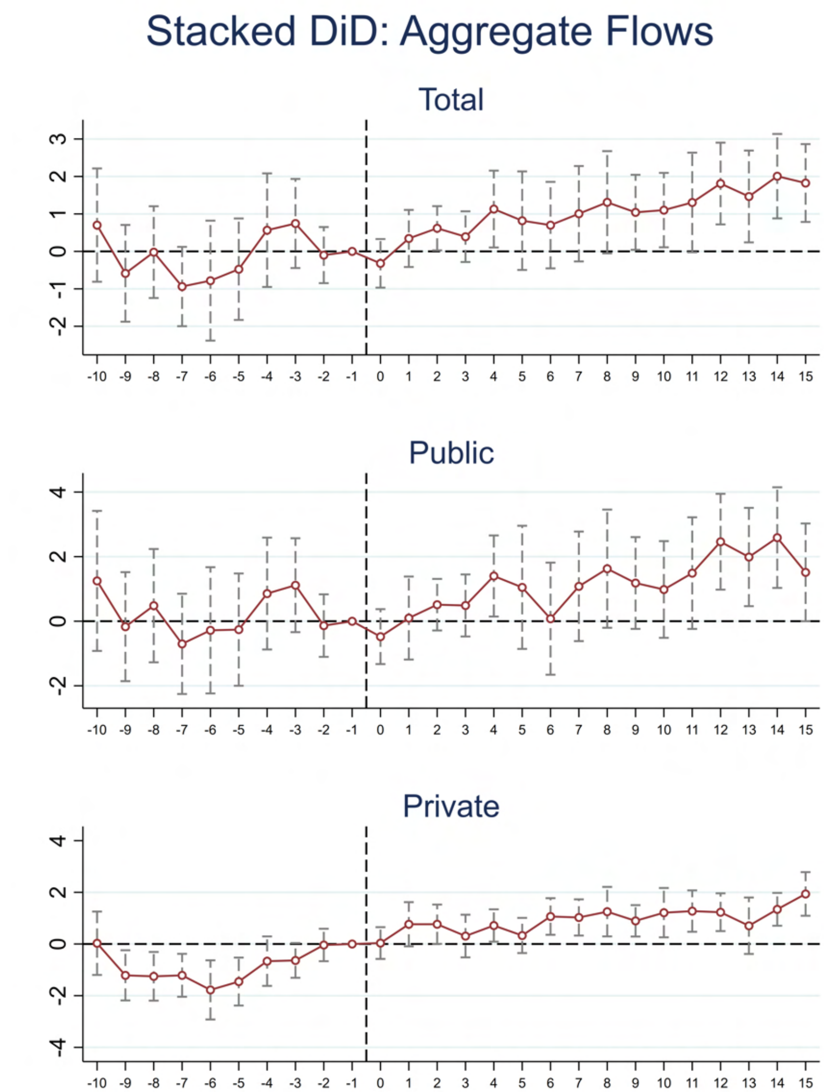

Figure 7: Coefficient Plot around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of Equation (4), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where −3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Blue areas shows a 90% confidence interval around the point estimate.

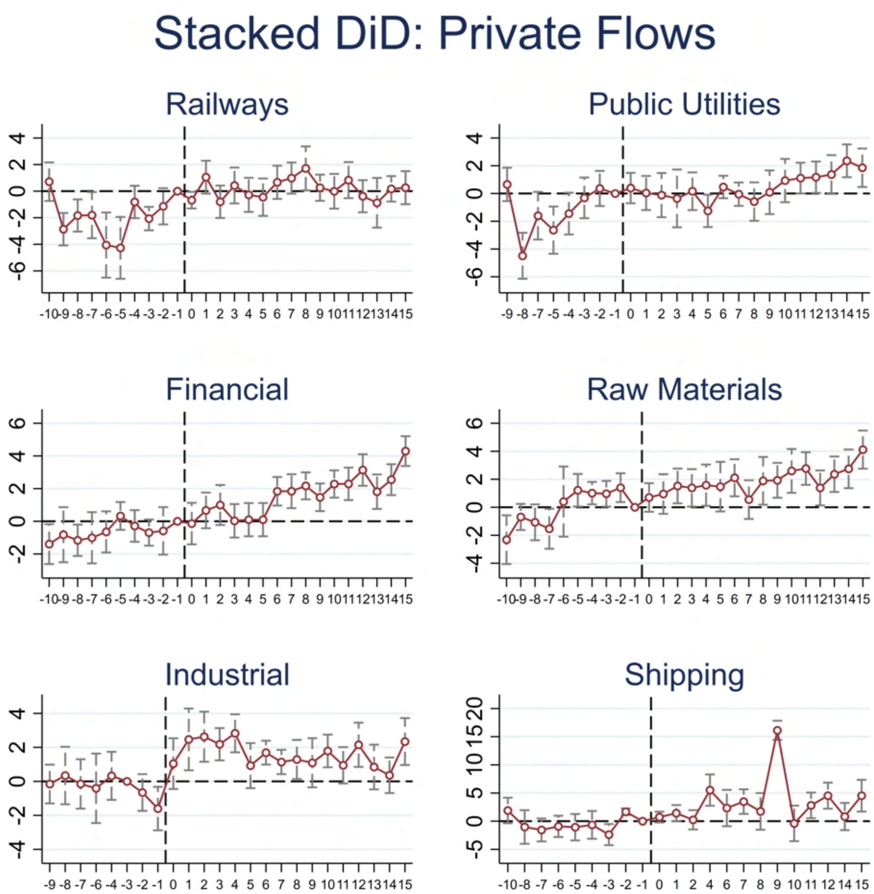

Figure 8: Coefficient Plot around the Arrival of Telegraph Cables
Description: These graphs show coefficient plots of Equation (4), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Blue areas shows a 90% confidence interval around the point estimate.

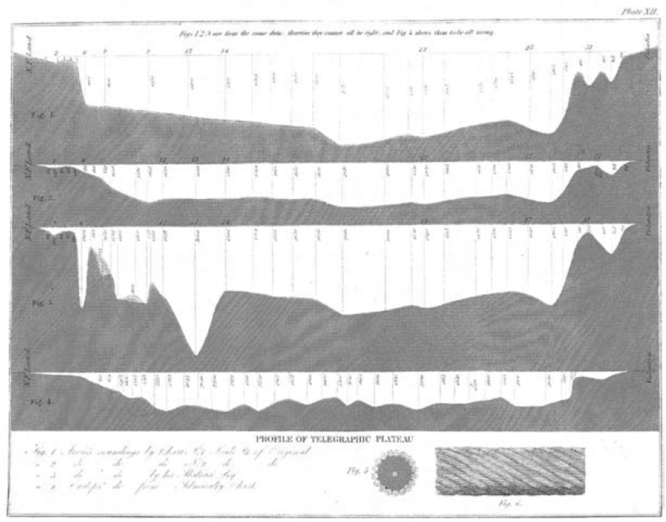

FIGURE 2 *A Profile of the Telegraphic Plateau*. M.F. Maury, *Explanations and Sailing Directions to Accompany the Wind and Current Charts* (2 Vols.), Vol. 1 (Washington: 1858 [8. enlarged edition]), plate XII.

Figure 9: Measurements of the Atlantic seabed, 1858

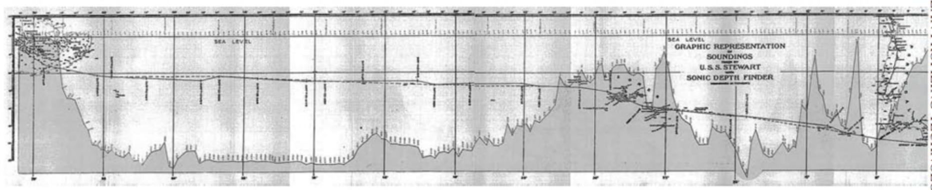

FIGURE 7 *Graphic Representation of the Soundings taken by U.S.S. Stewart with the Sonic Depth Finder*. "Echo Sounding: Test carried out by the U.S.S. 'Stewart' 20th to 29th June 1922", *The Hydrographic Review* 1 (1923): 71–72, enclosed chart.

Figure 10: Measurements of the Atlantic seabed, 1922

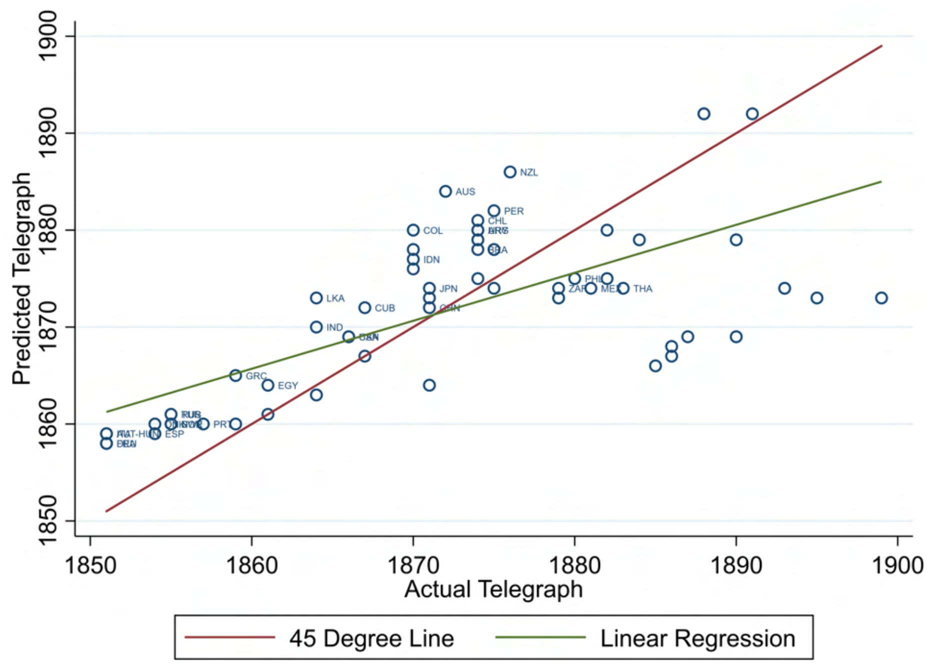

Figure 11: Scatter Plot of Predicated and Actual Telegraph Connections

Description: This graph shows predicted and actual telegraph connections. The red line is the 45° line, where predicted equals actual telegraph connection, whereas the green line is the result of a linear regression of actual on predicted telegraph connections. The observations with name markers are countries that are in the capital flow data, whereas other countries were used only for creating the instrument based on seabed ruggedness.

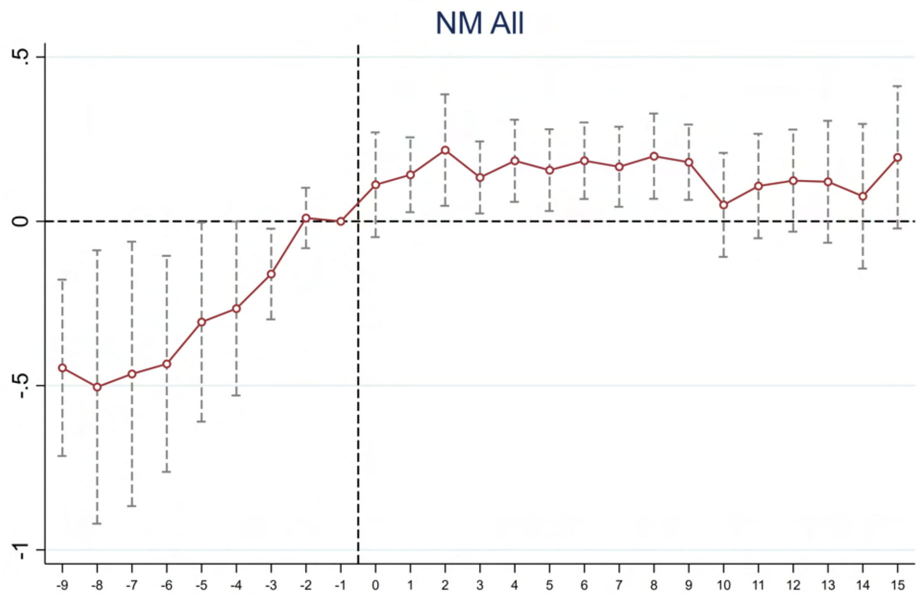

Figure 12: Event Study of Newspaper Articles around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of estimates of Equation (3), with newspaper mentions as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection.

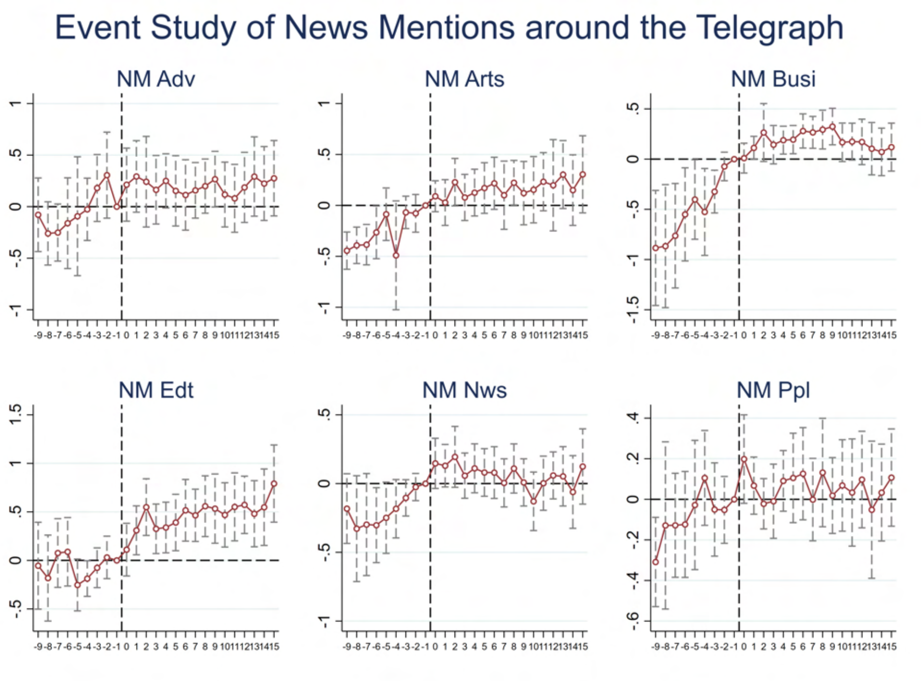

Figure 13: Event Study of Newspaper Articles around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of estimates of Equation (3), with newspaper mentions by article type as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection.

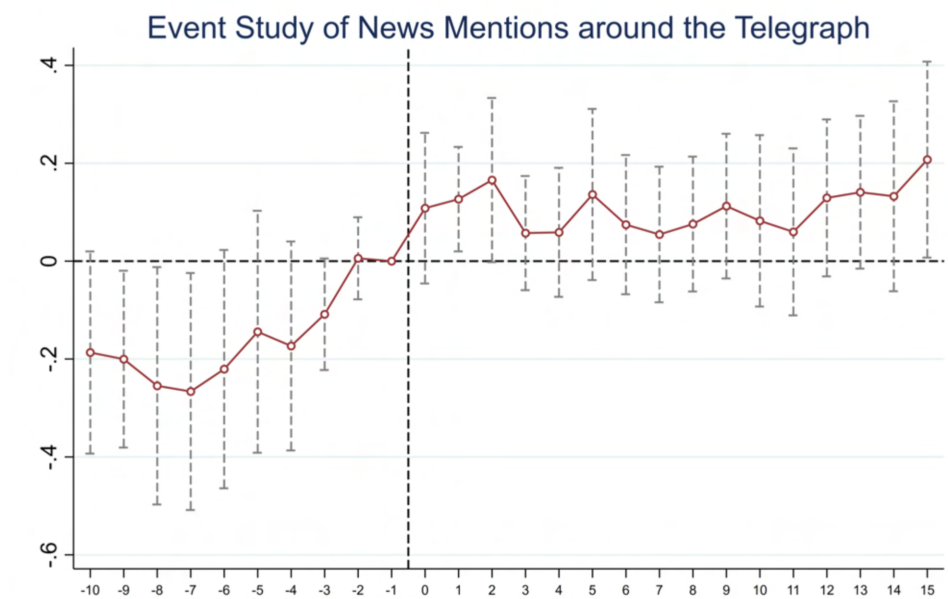

Figure 14: Stacked Event Study of Newspaper Articles around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of estimates of Equation (4), with newspaper mentions as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection.

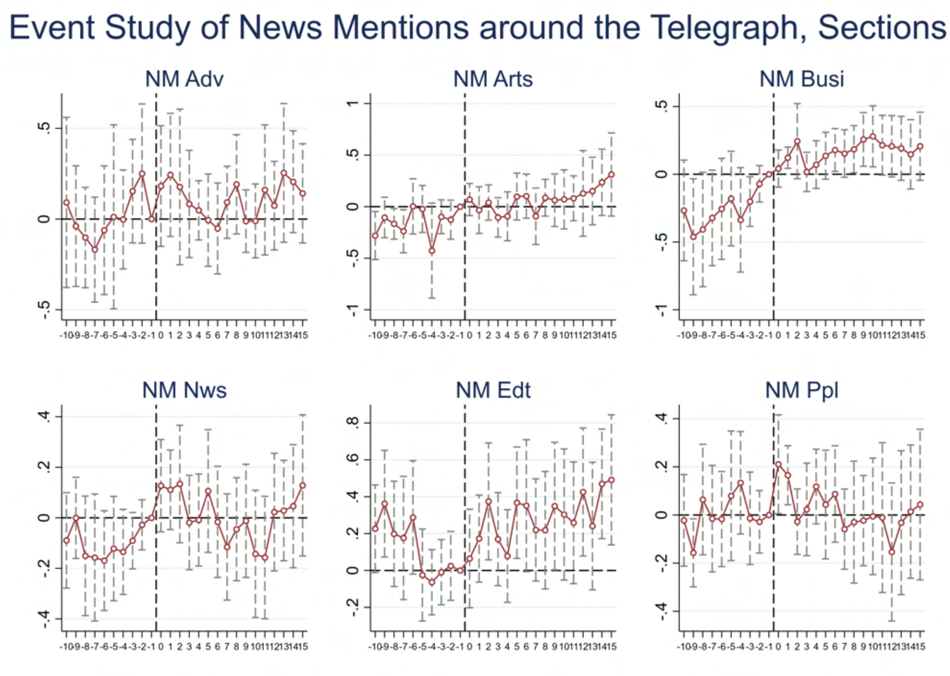

Figure 15: Stacked Event Study of Newspaper Articles around the Arrival of Telegraph Cables

Description: These graphs show coefficient plots of estimates of Equation (4), with newspaper mentions by article type as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection.

Figure 16: Coefficient Plot around the Arrival of Telegraph Cables, Controls
Description: These graphs show coefficient plots of estimates of Equation (3), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

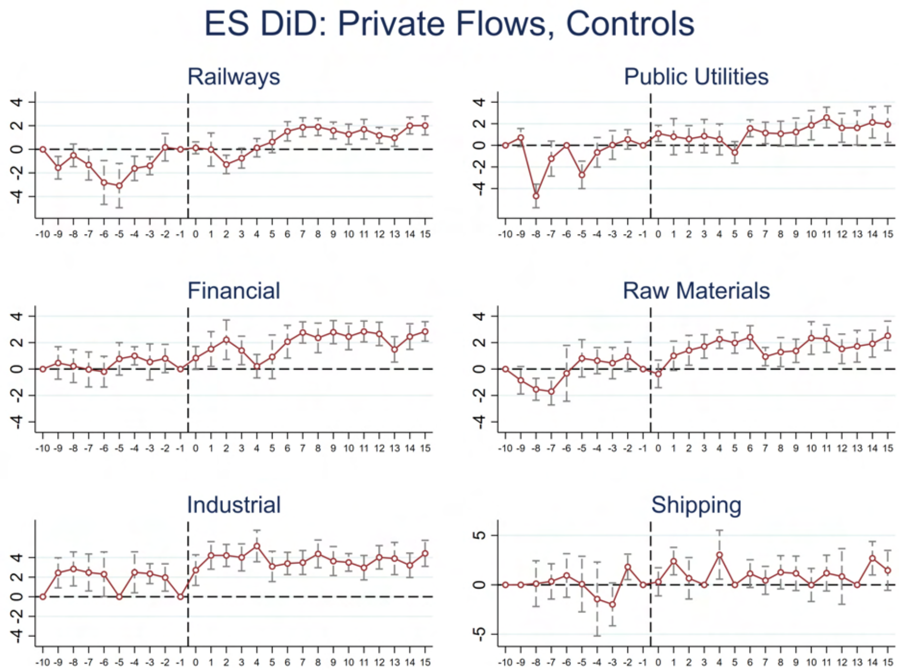

Figure 17: Coefficient Plot around the Arrival of Telegraph Cables, Controls
Description: These graphs show coefficient plots of Equation (3), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

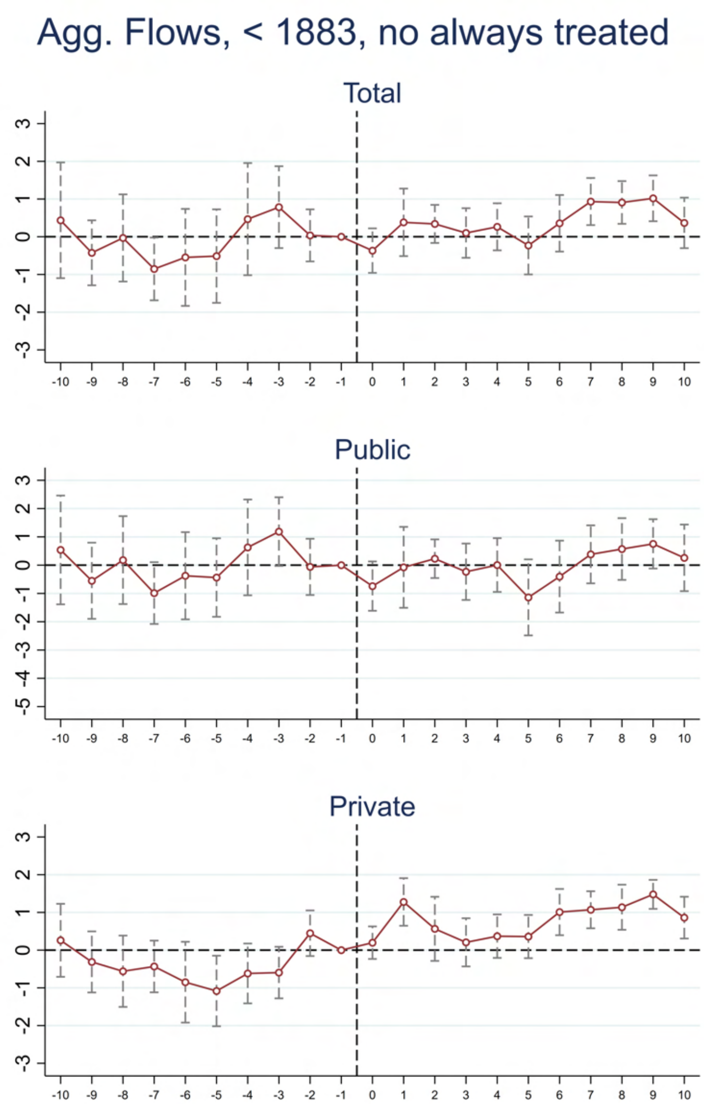

Figure 18: Coefficient Plot around the Arrival of Telegraph Cables, BLW specification

Description: These graphs show coefficient plots of estimates of Equation (3), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection. The sample excludes always treated units, as well as years after 1883, the year in which the last country (Thailand) is connected via telegraph.

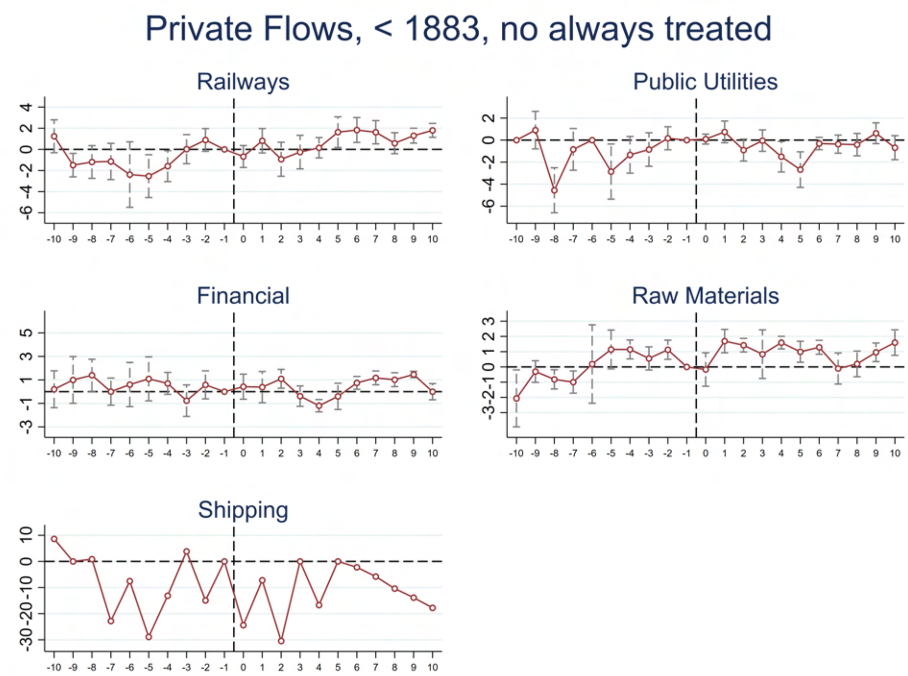

Figure 19: Coefficient Plot around the Arrival of Telegraph Cables, Controls
Description: These graphs show coefficient plots of Equation (3), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable. The dashed line marks the introduction of the telegraph connection. The sample excludes always treated units, as well as years after 1883, the year in which the last country (Thailand) is connected via telegraph.

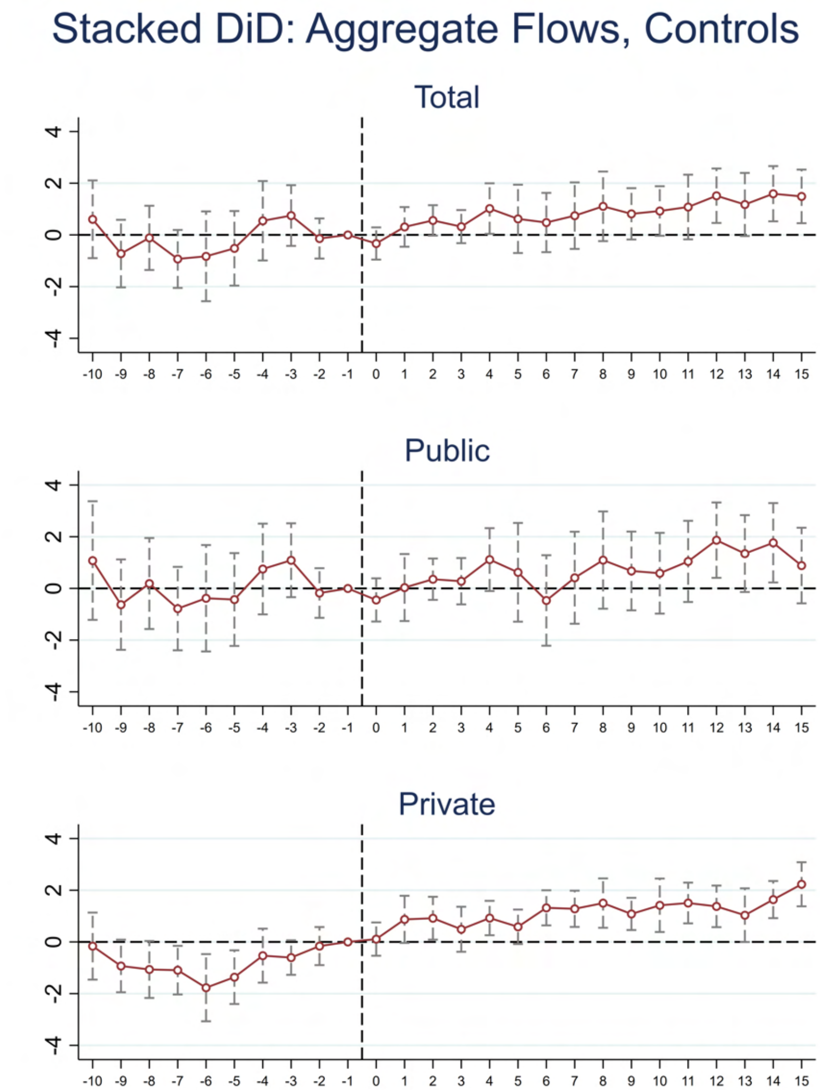

Figure 20: Coefficient Plot around the Arrival of Telegraph Cables, Controls
Description: These graphs show coefficient plots of Equation (4), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

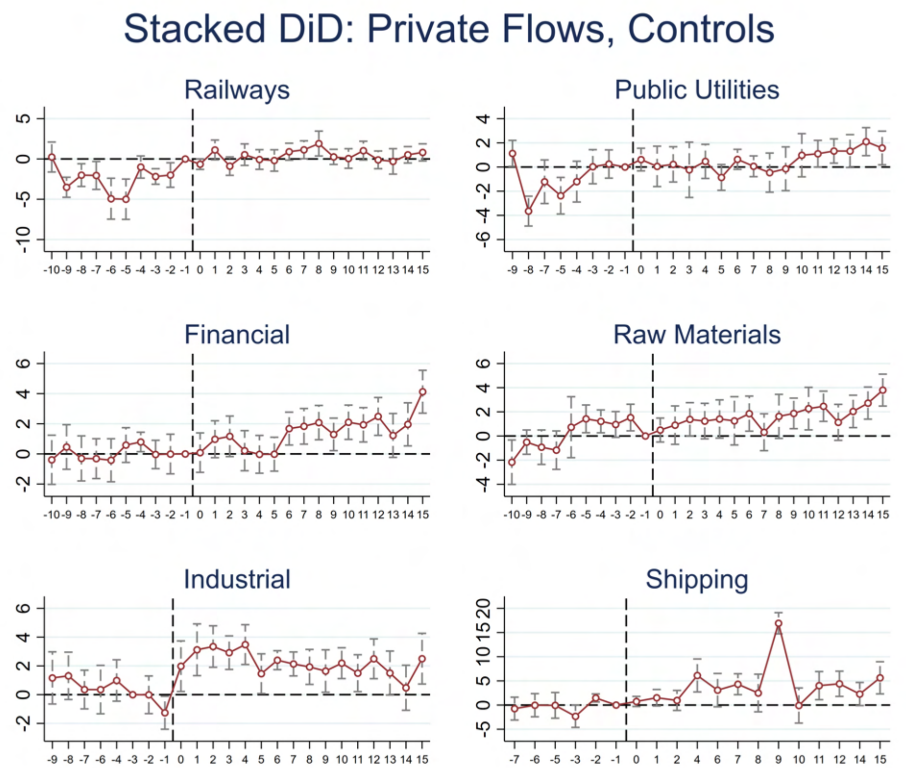

Figure 21: Coefficient Plot around the Arrival of Telegraph Cables, Controls

Description: These graphs show coefficient plots of Equation (4), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

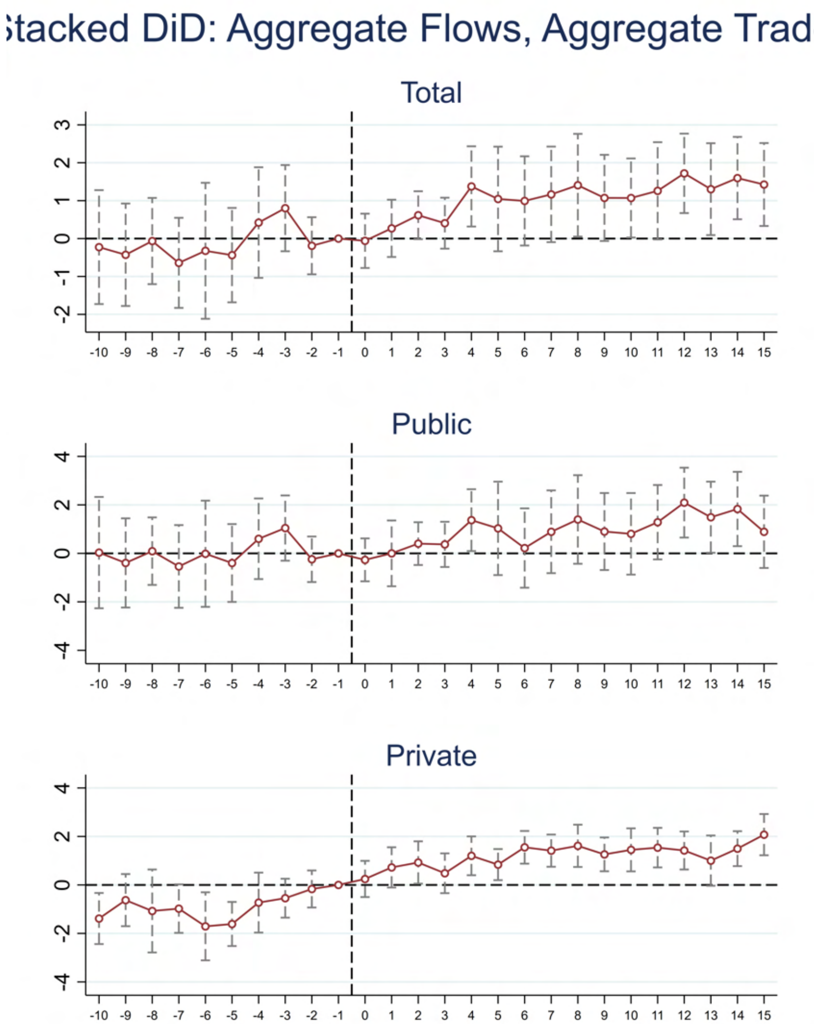

Figure 22: Coefficient Plot around the Arrival of Telegraph Cables, Aggregate Trade

Description: These graphs show coefficient plots of Equation (4), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

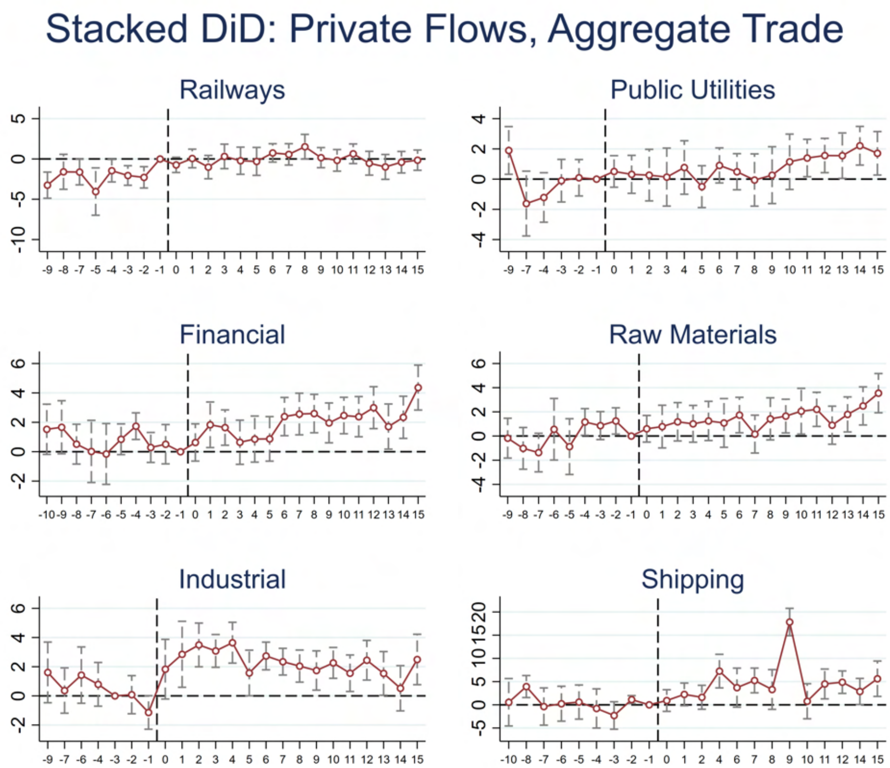

Figure 23: Coefficient Plot around the Arrival of Telegraph Cables, Aggregate Trade

Description: These graphs show coefficient plots of Equation (4), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

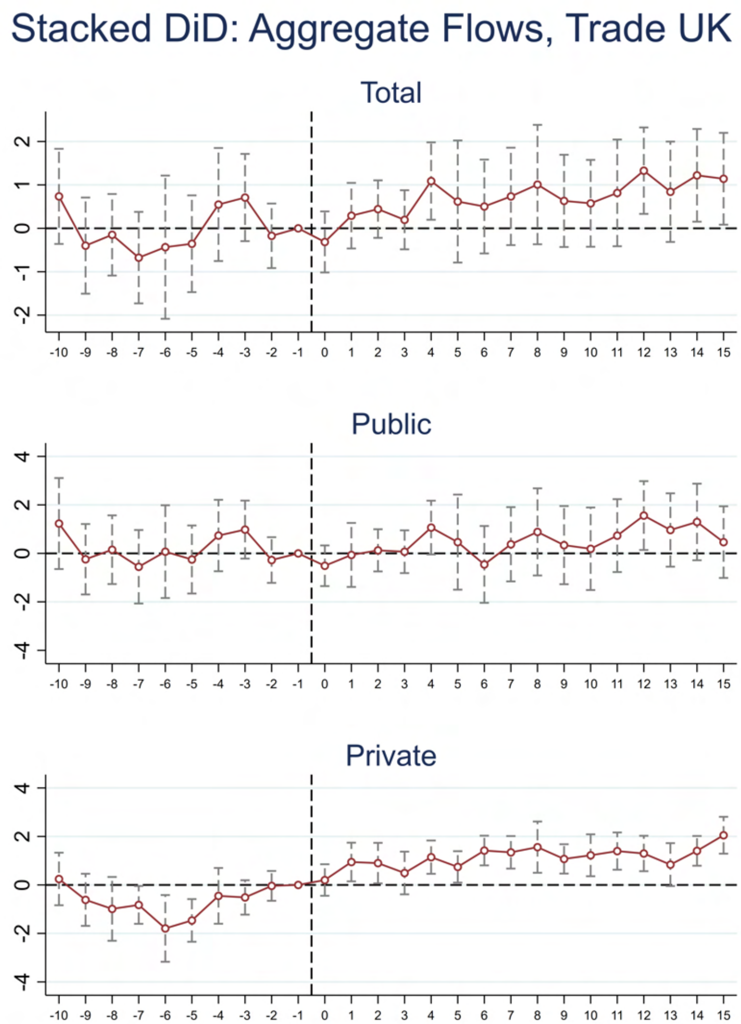

Figure 24: Coefficient Plot around the Arrival of Telegraph Cables, Trade UK

Description: These graphs show coefficient plots of Equation (4), with aggregate flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

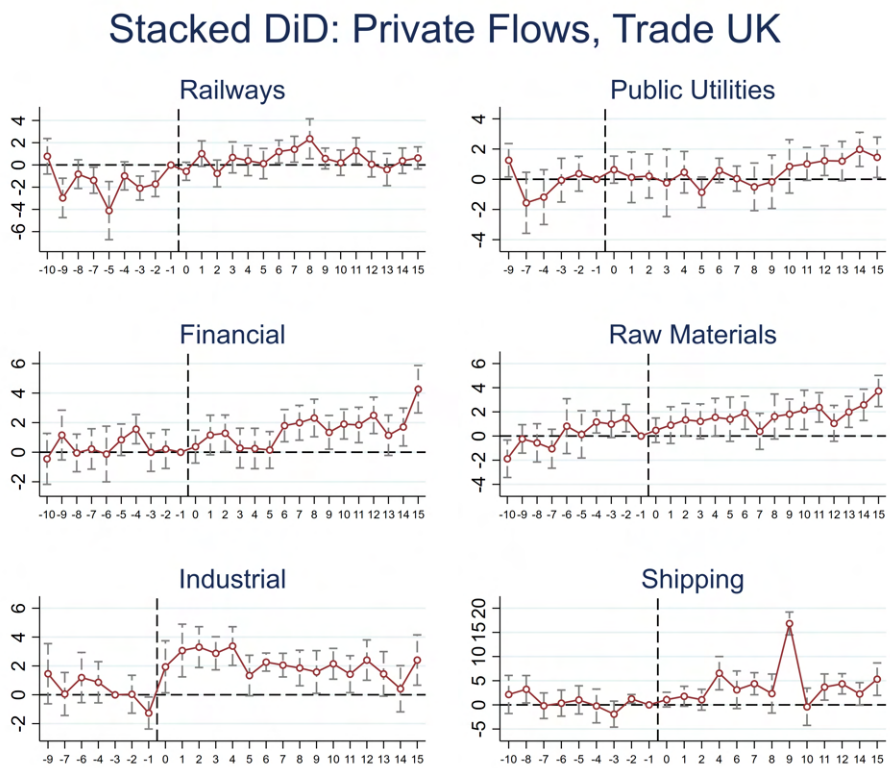

Figure 25: Coefficient Plot around the Arrival of Telegraph Cables, Trade UK

Description: These graphs show coefficient plots of Equation (4), with industry-level flows as the dependent variable. The omitted variable is one year before the introduction of a telegraph cable (except for Industrial, where -3 is omitted for clarity of exposition). The dashed line marks the introduction of the telegraph connection. Regressions include the following control variables: log of population, (lagged) population growth, war, civil war, urbanization, and gold standard adherence.

Table 1: Percentage of Assets issued per Type and Subset of Capital Flow Recipient

	Debentures	Ordinary Shares	Preference Shares	Notes
Government	97	0	0	3
Railways	69	18	8	5
Public Utilities	62	25	9	4
Financial	27	64	9	0
Raw Materials	18	74	7	1
Industrial & Misc.	38	37	24	1
Shipping	46	41	13	0

Every number represents the share of assets per type of recipient issued in this asset class. Each row adds up to 100%, and the numbers are taken from Stone (1999).

Table 2: Variables & Sources

Variable	**Source**
Capital Exports	Stone (1999) & Clemens and Williamson (2004)
Telegraph Connections	Wenzlhuemer (2013) & Juhasz and Steinwender (2018)
Seabed Ruggedness	Own construction, using data from GEBCO (2014)
News Mentions	Own construction, using data from Gale News Vault
Nominal GDP	TRADHIST (Fouquin and Hugot, 2016)
Trade	TRADHIST (Fouquin and Hugot, 2016)
Population	Maddison project (Bolt et al., 2018) & CNTS (Banks and Wilson, 2020)
Gold Standard	Reinhart and Rogoff (2011)
War	COW (Sarkees and Wayman, 2010)
Institutional Quality	Polity 4 (*Polity IV*, 2017)
Urbanization	CNTS (Banks and Wilson, 2020) & Mitchell (1998)

Table 3: Prediction of Telegraph Connections

	(1) Year of Telegraph
Seabed Ruggedness	0.0497***
	(0.00750)
Distance from UK	0.00131***
	(0.000302)
Constant	1857.0***
	(1.925)
Observations	65
R^2	0.497

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table shows a linear regression of the year in which a country is connected to the telegraph on seabed ruggedness and the sea distance from the UK. The predicted values from this regression are rounded to the closest integer, turned into a dummy, and used as the instrument later in the analysis.

Table 4: First Stage Equivalent

	(1)
	Telegraph
Predicted Telegraph	0.541***
	(0.0489)
Constant	0.440***
	(0.0423)
Observations	1650
R^2	0.493
Country FE's	Yes
KP rk LM test	22.05

Clustered standard errors at the country level in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
This table shows a linear regression of the actual telegraph dummy on the predicted telegraph dummy.

Table 5: PPML Regressions of Capital Exports on Telegraph and Controls

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.773**	0.402	1.625***	0.670	0.275	1.461***
	(0.374)	(0.528)	(0.306)	(0.448)	(0.629)	(0.299)
log Population				1.141***	1.003	0.942***
				(0.346)	(0.676)	(0.360)
Pop. Growth				0.210***	0.240***	0.182*
				(0.0611)	(0.0663)	(0.104)
Urbanization				0.0549**	0.0414	0.0613*
				(0.0261)	(0.0365)	(0.0354)
War				0.153	0.564	-0.449***
				(0.324)	(0.375)	(0.128)
Civil War				0.0891	0.0291	0.118
				(0.148)	(0.288)	(0.147)
Gold Standard				0.241	0.0556	0.290
				(0.224)	(0.364)	(0.192)
Observations	1650	1600	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors at the country level in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: IV PPML Regressions of Capital Exports on Telegraph and Controls

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	1.244*	1.619	2.125**	0.499	0.844	1.541
	(0.729)	(1.301)	(1.018)	(0.836)	(1.667)	(1.072)
log Population				1.220***	0.710	0.915*
				(0.466)	(0.885)	(0.473)
Pop. Growth				0.211***	0.237***	0.182**
				(0.0512)	(0.0539)	(0.0775)
Urbanization				0.0520**	0.0484*	0.0623**
				(0.0209)	(0.0292)	(0.0246)
War				0.144	0.581	-0.445***
				(0.294)	(0.368)	(0.169)
Civil War				0.0925	0.0161	0.116
				(0.179)	(0.347)	(0.171)
Gold Standard				0.225	0.0973	0.296**
				(0.143)	(0.239)	(0.117)
Observations	1650	1650	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	22.05	22.05	22.05	21.80	21.80	21.80

This table shows IV PPML estimates of capital flows on a telegraph dummy and control variables. All regressions include country and year fixed effects. The Telegraph dummy is instrumented by predicted telegraph connections in all specifications.

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: PPML Regression of Capital Exports on Telegraph, Trade Controls

Panel A	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.251	-0.182	1.090***	0.223	-0.160	1.041***
	(0.312)	(0.506)	(0.241)	(0.403)	(0.566)	(0.331)
log(Trade)	1.556***	1.554***	1.468***	1.384***	1.459***	1.250***
	(0.190)	(0.284)	(0.197)	(0.178)	(0.265)	(0.175)
log Population				0.458	0.274	0.398
				(0.413)	(0.904)	(0.320)
Pop. Growth				0.129**	0.155**	0.114
				(0.0544)	(0.0622)	(0.0923)
Urbanization				0.0218	0.0177	0.0206
				(0.0193)	(0.0277)	(0.0303)
War				0.0324	0.433	-0.654***
				(0.355)	(0.362)	(0.135)
Civil War				0.270**	0.372	0.207*
				(0.125)	(0.327)	(0.107)
Gold Standard				0.0767	-0.0993	0.136
				(0.209)	(0.325)	(0.211)
Observations	1502	1453	1502	1403	1403	1403
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

Panel B	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.419	0.0323	1.319***	0.390	-0.0451	1.324***
	(0.354)	(0.499)	(0.247)	(0.437)	(0.534)	(0.327)
log(Trade UK)	0.662***	0.745*	0.576***	0.580**	0.889**	0.385***
	(0.233)	(0.417)	(0.158)	(0.248)	(0.376)	(0.136)
log Population				0.754*	0.512	0.614*
				(0.391)	(0.750)	(0.367)
Pop. Growth				0.212***	0.246***	0.187**
				(0.0524)	(0.0540)	(0.0934)
Urbanization				0.0403*	0.0217	0.0516
				(0.0239)	(0.0299)	(0.0328)
War				0.0933	0.493	-0.520***
				(0.321)	(0.326)	(0.141)
Civil War				0.287**	0.358	0.235*
				(0.141)	(0.312)	(0.123)
Gold Standard				0.163	-0.0295	0.225
				(0.223)	(0.359)	(0.199)
Observations	1582	1535	1582	1485	1485	1485
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

This table shows PPML estimates of capital flows on a telegraph dummy, trade, and control variables. Panel A includes the log of aggregate trade as a control variable, and Panel B includes the log of bilateral trade with the UK as a control variable. All specifications include country and year fixed effects. Robust standard errors clustered at the country level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: IV PPML Regressions of Capital Exports on Telegraph, Trade Controls

Panel A	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.977	1.275	2.615	0.921	2.224	3.138
	(0.791)	(1.403)	(2.598)	(1.103)	(4.309)	(5.486)
log(Trade)	1.499***	1.410***	1.398***	1.333***	1.290***	1.164***
	(0.152)	(0.242)	(0.155)	(0.180)	(0.338)	(0.202)
log Population				0.179	-0.828	0.0253
				(0.510)	(1.615)	(0.598)
Pop. Growth				0.135**	0.170**	0.128
				(0.0543)	(0.0701)	(0.0838)
Urbanization				0.0298	0.0432	0.0351
				(0.0206)	(0.0549)	(0.0323)
War				0.0677	0.491	-0.582***
				(0.322)	(0.412)	(0.182)
Civil War				0.256	0.310	0.189
				(0.177)	(0.366)	(0.169)
Gold Standard				0.136	0.0147	0.221
				(0.143)	(0.250)	(0.139)
Observations	1502	1502	1502	1403	1403	1403
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	18.13	18.13	18.13	17.45	17.45	17.45

Panel B	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.512	0.960	1.255*	0.149	0.911	1.191
	(0.583)	(1.062)	(0.739)	(0.681)	(1.431)	(0.959)
log(Trade UK)	0.654***	0.659***	0.580***	0.600***	0.832***	0.394***
	(0.126)	(0.236)	(0.103)	(0.150)	(0.259)	(0.121)
log Population				0.841**	0.109	0.648
				(0.364)	(0.653)	(0.408)
Pop. Growth				0.212***	0.243***	0.186**
				(0.0514)	(0.0546)	(0.0781)
Urbanization				0.0371**	0.0283	0.0500**
				(0.0168)	(0.0235)	(0.0231)
War				0.0822	0.514	-0.527***
				(0.294)	(0.343)	(0.179)
Civil War				0.300	0.302	0.240
				(0.186)	(0.372)	(0.168)
Gold Standard				0.138	0.0298	0.215*
				(0.142)	(0.232)	(0.123)
Observations	1582	1582	1582	1485	1485	1485
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	18.95	18.95	18.95	19.18	19.18	19.18

This table shows IV PPML estimates of capital flows on a telegraph dummy, trade, and control variables. In all specifications, the telegraph dummy is instrumented by predicted telegraph connections. Panel A includes the log of aggregate trade as a control variable, and Panel B includes the log of bilateral trade with the UK as a control variable. Non-converging columns are left empty.
All specifications include country and year fixed effects. Robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Regressions of News Mentions on Telegraph

	(1) NM All	(2) NM All	(3) NM All	(4) NM All
Telegraph	0.327**	0.268***	0.624***	0.333***
	(0.130)	(0.0507)	(0.115)	(0.119)
log Population		0.531***		0.509***
		(0.0607)		(0.0727)
Pop. Growth		0.00159		0.00182
		(0.00324)		(0.00336)
War		0.218***		0.220***
		(0.0488)		(0.0489)
Civil War		0.0953**		0.0937**
		(0.0427)		(0.0429)
Urbanization		0.00607**		0.00638**
		(0.00296)		(0.00307)
Observations	1650	1550	1650	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes
KP rk LM			22.05	21.80

This table shows PPML regressions of newspaper mentions on a telegraph dummy and control variables. In columns 3 and 4, the telegraph dummy is instrumented by predicted telegraph connections. All regressions include country and year fixed effects. Standard errors are clustered at the country level for columns 1-2, and robust for 3-4.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: IV PPML Regression of Capital Exports on Telegraph, Newspaper Articles Control

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.113	0.562	0.862	0.00141	0.947	0.913
	(0.611)	(0.983)	(0.714)	(0.722)	(1.679)	(0.877)
log(NM All)	0.909***	1.070***	0.765***	0.728***	0.980***	0.574***
	(0.157)	(0.274)	(0.118)	(0.165)	(0.265)	(0.126)
log Population				0.655*	-0.227	0.436
				(0.372)	(0.736)	(0.434)
Pop. Growth				0.171***	0.213***	0.139*
				(0.0524)	(0.0557)	(0.0815)
Urbanization				0.0493***	0.0326	0.0646***
				(0.0188)	(0.0249)	(0.0235)
War				-0.0380	0.273	-0.567***
				(0.260)	(0.321)	(0.170)
Civil War				0.0739	-0.0474	0.111
				(0.187)	(0.363)	(0.184)
Gold Standard				0.227*	0.127	0.255**
				(0.138)	(0.220)	(0.117)
Observations	1650	1650	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	22.05	22.05	22.05	21.80	21.80	21.80

This table shows IV PPML regressions of capital flows on a telegraph dummy, the yearly (log) number of all newspaper articles mentioning a specific country in the British press, and control variables. The telegraph dummy is instrumented by predicted telegraph connections.

All regressions include country and year fixed effects. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: IV PPML Regression of Capital Exports on Telegraph, Advertising Control

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.319	0.804	0.927	0.268	1.321	1.018
	(0.571)	(1.024)	(0.640)	(0.748)	(2.073)	(0.863)
log(NM Advertising)	0.733***	0.683***	0.697***	0.612***	0.651***	0.578***
	(0.115)	(0.203)	(0.106)	(0.123)	(0.216)	(0.105)
log Population				0.570	-0.163	0.259
				(0.402)	(0.869)	(0.458)
Pop. Growth				0.190***	0.229***	0.151*
				(0.0504)	(0.0551)	(0.0792)
Urbanization				0.0419**	0.0375	0.0539**
				(0.0192)	(0.0289)	(0.0233)
War				0.0597	0.515	-0.571***
				(0.287)	(0.372)	(0.161)
Civil War				0.147	0.0299	0.189
				(0.191)	(0.370)	(0.181)
Gold Standard				0.192	0.122	0.202*
				(0.143)	(0.235)	(0.118)
Observations	1650	1650	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	22.05	22.05	22.05	21.80	21.80	21.80

This table shows IV PPML regressions of capital flows on a telegraph dummy, the yearly (log) number of all advertising mentions from a specific country in the British press, and control variables. The telegraph dummy is instrumented by predicted telegraph connections.

All regressions include country and year fixed effects. Robust standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: IV PPML Regression of Capital Exports on Telegraph, Business Control

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.377	1.101	0.980	0.243	1.236	1.145
	(0.632)	(1.250)	(0.757)	(0.765)	(1.995)	(1.001)
log(NM Business)	1.249***	1.072***	1.287***	1.017***	0.918***	1.024***
	(0.193)	(0.311)	(0.157)	(0.194)	(0.322)	(0.158)
log Population				0.519	-0.118	0.154
				(0.371)	(0.759)	(0.432)
Pop. Growth				0.172***	0.218***	0.131
				(0.0515)	(0.0571)	(0.0804)
Urbanization				0.0511***	0.0406	0.0683***
				(0.0187)	(0.0292)	(0.0232)
War				0.0340	0.427	-0.511***
				(0.253)	(0.334)	(0.169)
Civil War				0.0605	-0.0254	0.0843
				(0.180)	(0.351)	(0.186)
Gold Standard				0.229*	0.0885	0.280**
				(0.138)	(0.230)	(0.119)
Observations	1650	1650	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	22.05	22.05	22.05	21.80	21.80	21.80

This table shows IV PPML regressions of capital flows on a telegraph dummy, the yearly (log) number of all business mentions from a specific country in the British press, and control variables. The telegraph dummy is instrumented by predicted telegraph connections.
All regressions include country and year fixed effects. Robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: IV PPML Regression of Capital Exports on Telegraph, News Control

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.436	0.808	1.305*	0.143	0.837	1.172
	(0.632)	(0.983)	(0.782)	(0.730)	(1.487)	(0.927)
log(NM News)	0.575***	0.791***	0.434***	0.439***	0.707***	0.285***
	(0.112)	(0.185)	(0.0815)	(0.117)	(0.175)	(0.0876)
log Population				0.877**	0.0799	0.666
				(0.392)	(0.725)	(0.443)
Pop. Growth				0.186***	0.221***	0.159**
				(0.0517)	(0.0540)	(0.0795)
Urbanization				0.0479**	0.0316	0.0617***
				(0.0190)	(0.0238)	(0.0237)
War				-0.0555	0.184	-0.554***
				(0.259)	(0.311)	(0.170)
Civil War				0.0683	-0.0297	0.0954
				(0.180)	(0.362)	(0.170)
Gold Standard				0.245*	0.155	0.283**
				(0.137)	(0.217)	(0.115)
Observations	1650	1650	1650	1550	1550	1550
Country FE's & Year FE's	Yes	Yes	Yes	Yes	Yes	Yes
KP rk LM	22.05	22.05	22.05	21.80	21.80	21.80

This table shows IV PPML regressions of capital flows on a telegraph dummy, the yearly (log) number of all news mentions from a specific country in the British press, and control variables. The telegraph dummy is instrumented by predicted telegraph connections.
All regressions include country and year fixed effects. Robust standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: PPML Stacked Regression of Capital Exports on Telegraph and Controls

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	1.014**	0.721	1.774***	0.733	0.239	1.855***
	(0.432)	(0.566)	(0.286)	(0.530)	(0.714)	(0.342)
log Population				0.877	0.596	-0.385
				(0.705)	(1.180)	(0.329)
Pop. Growth				-0.00329	0.0309	-0.00557
				(0.0160)	(0.0484)	(0.00538)
Urbanization				0.0445	0.0569	0.0367
				(0.0500)	(0.0670)	(0.0440)
War				0.0534	0.215	-0.645**
				(0.364)	(0.431)	(0.314)
Civil War				-0.0871	-0.0910	-0.289
				(0.245)	(0.254)	(0.274)
Gold Standard				-0.118	-0.835*	0.222
				(0.302)	(0.476)	(0.204)
Observations	4097	3745	4083	3989	3697	3975
Stack * Ctry & Stack * Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

Clustered robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: PPML Stacked Regressions of Capital Export Subcategories on Telegraph and Controls

Panel A	(1) Railways	(2) Public Util.	(3) Financials	(4) Raw Mat.	(5) Indust. & Misc.	(6) Shipping
Telegraph	1.767***	1.160**	2.345***	1.890***	1.906***	1.872***
	(0.617)	(0.517)	(0.306)	(0.668)	(0.479)	(0.470)
Observations	3239	3239	3323	3299	3538	1569
Stack * Ctry & Stack * Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

Panel B	(1) Railways	(2) Public Util.	(3) Financials	(4) Raw Mat.	(5) Indust. & Misc.	(6) Shipping
Telegraph	2.489***	0.905	1.485***	1.408*	1.840***	2.216***
	(0.572)	(0.646)	(0.425)	(0.764)	(0.549)	(0.599)
log Population	-2.422***	1.560**	4.565***	1.519	2.057*	-1.695**
	(0.455)	(0.764)	(1.368)	(2.011)	(1.198)	(0.693)
Pop. Growth	0.0211***	0.0557	0.0211	-0.101***	0.272***	-0.0408
	(0.00602)	(0.0518)	(0.0724)	(0.0325)	(0.0743)	(0.0440)
Urbanization	0.00737	0.0689	0.0372	-0.0454	-0.0124	0.112
	(0.0512)	(0.0801)	(0.0766)	(0.0878)	(0.0806)	(0.0813)
War	-0.439	-0.397	-0.954*	-0.404	-0.486	-2.823**
	(0.410)	(0.683)	(0.567)	(0.559)	(0.407)	(1.419)
Civil War	-1.124***	-0.916	0.439	0.880***	0.682**	0
	(0.423)	(0.740)	(0.749)	(0.278)	(0.341)	(.)
Gold Standard	0.341	0.467	0.211	-0.662	0.512	1.435**
	(0.275)	(0.328)	(0.348)	(0.420)	(0.313)	(0.649)
Observations	3213	3191	3267	3273	3439	1474
Stack * Ctry & Stack * Year FE's	Yes	Yes	Yes	Yes	Yes	Yes

Robust clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
This table shows stacked PPML regressions of capital flows to six categories of recipients (columns 1-6) on a telegraph dummy.
Panel A shows the basic specification with only country-stack and year-stack fixed effects; Panel B adds control variables.

Table 16: PPML Stacked Regression of Capital Exports on Telegraph and Aggregate Trade Control

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.878**	0.622	1.649***	0.793	0.411	1.804***
	(0.374)	(0.511)	(0.290)	(0.484)	(0.653)	(0.346)
log(Trade)	1.742***	1.440**	1.486***	1.915***	1.569**	1.619***
	(0.488)	(0.696)	(0.453)	(0.512)	(0.742)	(0.437)
log Population				-0.264	-0.824	-0.856
				(0.835)	(1.581)	(0.561)
Pop. Growth				-0.00512	0.0177	-0.00612
				(0.0116)	(0.0384)	(0.00474)
Urbanization				0.0258	0.0570	0.00691
				(0.0460)	(0.0654)	(0.0468)
War				0.198	0.400	-0.503
				(0.400)	(0.543)	(0.327)
Civil War				0.109	0.00856	-0.0684
				(0.273)	(0.434)	(0.282)
Gold Standard				-0.234	-0.820*	0.0195
				(0.272)	(0.482)	(0.225)
Observations	3585	3447	3585	3479	3399	3479

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: PPML Stacked Regression of Capital Exports on Telegraph and Full Controls

	(1) Total	(2) Public	(3) Private	(4) Total	(5) Public	(6) Private
Telegraph	0.727**	0.480	1.479***	0.498	0.00563	1.620***
	(0.365)	(0.537)	(0.220)	(0.429)	(0.608)	(0.256)
log(Trade UK)	1.378***	1.235	1.178***	1.444***	1.393*	1.231***
	(0.488)	(0.761)	(0.313)	(0.534)	(0.778)	(0.317)
log Population				0.468	0.204	-0.710**
				(0.662)	(1.214)	(0.321)
Pop. Growth				-0.00861	0.0225	-0.00951**
				(0.0131)	(0.0424)	(0.00416)
Urbanization				0.0318	0.0471	0.0226
				(0.0401)	(0.0600)	(0.0342)
War				0.150	0.300	-0.554**
				(0.330)	(0.421)	(0.277)
Civil War				0.0911	0.0855	-0.157
				(0.222)	(0.228)	(0.264)
Gold Standard				-0.189	-0.887**	0.152
				(0.247)	(0.434)	(0.193)
Observations	3904	3594	3900	3796	3546	3792

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$