

Wache, Benjamin

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Information Frictions, Global Capital Markets, and the Telegraph*

Benjamin Wache

Vrije Universiteit Amsterdam and Tinbergen Institute

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Abstract

Do information frictions have a causal impact on the international flow of financial capital? Using the international 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. For identification I use a geographic instrument, the ruggedness of the seabed. The effect of the telegraph is concentrated in capital flows to private recipients (and not distinguishable from zero for flows to public recipients), and particularly sizeable for flows to producers of tradeables (industrial firms and raw material producers). However, the telegraph also had a direct and sizeable impact on capital flows that was independent of the trade channel. Using data on newspaper mentions in the British press, I show that the mechanism through which the telegraph affected capital flows is partially captured by newspaper mentions.

JEL Codes: F3, G14, N2, N7

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1 Introduction

A vast literature studies the determinants of the international flow and allocation of capital. An influential view in the literature holds that information frictions are an important determinant of the flow of capital. Yet, 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 in the second half of the 19th century as a source of variation in the international flow of information. The laying of telegraph cables between the UK and 33 other countries leads to substantial increases in the bilateral export of financial capital from the UK. Using the ruggedness of the seabed, which caused exogenous delays in the timing of the arrival of telegraph connections, for identification, I estimate that a telegraph cable leads to an increase of bilateral capital flows to private recipients by 161 to 213%.

In a next step I present direct evidence of the importance of the information channel 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 news mentions of connected countries. Furthermore, the positive effect of the telegraph on capital flows in an IV regression becomes insignificant (although the point estimate remains sizeable) once I control for news mentions. This suggests that an important part of the mechanism through which the telegraph impacts capital flows runs through the newspaper channel.

In the investigation of the mechanism I further document that the telegraph disproportionately affects capital flows to manufacturing firms and raw materials producers. This finding is in line with the literature showing the effects of the telegraph on trade in physical goods (Steinwender, 2018; Juhasz and Steinwender, 2018). Importantly, however, the telegraph seems to have had a direct effect on capital flows, independent of the trade channel, as the telegraph maintains a significant effect on capital flows even after controlling for trade. Furthermore, the evidence shows that more information sensitive assets (like corporate bonds and equities) are more affected by the introduction of the telegraph, than less information sensitive assets (like government bonds). 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 relates to several strands of literature. In a seminal study, Portes and Rey (2005) show that capital flows are well described by gravity equations.¹ The authors argue that information frictions that vary with distance are the primary reason for this. 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 coefficient on distance. This paper extends the evidence in Portes and Rey (2005), by exploiting exogenous variation in bilateral information frictions. I show that information frictions are causally related to capital flows, thereby addressing concerns about endogeneity. 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. Finally, whereas the telephone allows for communication via speech, the telegraph allows only for written communication.

Several studies have analyzed the impact of the telegraph on financial markets. Garbade and Silber (1978) and Hoag (2006) show for several domestic telegraph connections between financial markets within the US, and the transatlantic telegraph, respectively, that the telegraph lead to a narrowing of price differentials across markets, and increased co-movement of identical assets listed in several markets. I contribute to this literature by providing the first evidence, to my knowledge, of quantitative effects of the telegraph for international capital flows.

A large literature has examined the role of information frictions for trade in physical goods.² Steinwender (2018) uses the trans-Atlantic telegraph to demonstrate that a reduction in information frictions lead to increased price arbitrage, as well as to increased trade volumes (of cotton) between the UK and the USA. Juhasz and Steinwender (2018) use the same empirical setting as this paper, to demonstrate the positive impact of the telegraph on trade in upstream, easily codifiable goods. My findings are in line with this literature, in that I find increased capital flows particularly to firms producing tradeable goods. However, I add to this literature by demonstrating that trade was not the only factor impacting capital flows, and that there was a distinct channel through which information frictions mattered for capital flows.

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

²See e.g. Allen (2014), Anderson and Van Wincoop (2004), Steinwender (2018), Juhasz and Steinwender (2018), Ejrnaes and Persson (2010), Startz (2018), Rauch and Trindade (2002), and Rauch and Trindade (2003).

A recent literature has focused on the local economic outcomes of ICT infrastructure.³ This paper contributes to that literature by highlighting the impact of early ICT infrastructure on financial markets, and the flow of capital in particular.

Finally, this paper is related to recent work that examines the role of information for capital flows and financial markets⁴, as well as the literature on distance lending.⁵

The rest of the paper is structured as follows: Section 2 discusses the historical context. Section 3 explains the empirical strategy and identification, whereas Section 4 describes the data. Section 5 presents the baseline results, whereas Section 6 presents evidence on the mechanism behind these results. Section 7 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 laid 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 laid between France and the UK across the English Channel. Several attempts to lay telegraph cables across the Atlantic were made, but this proved technically difficult, due to several breaking and malfunctioning cables. After several failed attempts, the UK and the US were finally connected via telegraph in 1866 (Steinwender, 2018). From then on, countries worldwide were connected to the global telegraph network. The UK became the world's leading provider of telegraph 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, in cases where private investment or demand for telegraphic communication was too low, see e.g. Ahvenainen (1996)). Only

³See the review by Bertschek et al. (2016), as well as Eichengreen et al. (2016), Eichengreen et al. (2017), Malgouyres et al. (2019), and Hjort and Poulsen (2019).

⁴See 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).

⁵See Petersen and Rajan (2002), Degryse and Ongena (2005), and Agarwal and Hauswald (2010).

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, 2019). 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 happened the switch from sailing to steamships, which particularly impacted trade costs across the oceans (Pascali, 2017).

3 Empirical Strategy

This section describes the empirical strategy. The main hypothesis is that the telegraph had a positive impact on bilateral capital flows to recipients of financial capital.

3.1 Main Specification

$$C_{it} = \exp(\beta * telegraph_{it} + \alpha_i + \gamma_t + \Delta X_{it} + \varepsilon_{it}), \quad (1)$$

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 otherwise⁶, α_i and γ_t are country and year fixed effects respectively, and ΔX_{it} is a matrix of (time-varying) control variables. The control variables include (log) GDP, which proxies for the size of a location (after controlling for country fixed effects), and lagged population changes, which indicate economic growth (cf. the role of population changes for welfare assessments in Redding and Turner (2015)). Other control variables are democratic institutions (Polity2, higher values indicate more democratic institutions), adherence to the gold standard (the dummy equals one if the country adheres to the gold standard in a given year), war (the dummy equals one if the country is engaged in a war in a given year), and urbanization (the share of population that lives in cities in a given year, scaled between 1 and 100), which indicates economic development. The coefficient of interest is β , which assumes the interpretation of the elasticity of C_{it} with respect to the telegraph dummy. Standard errors are generally robust and clustered at the country level; due to convergence problems, they are generally only reported as robust in case of the IV estimates below.

Equation (1) is consistent with a gravity equation in capital flows (Okawa and van Wincoop, 2012) and is estimated via the Poisson pseudo-maximum-likelihood estimator, popularized by Santos Silva and Tenreyro (2006), and commonly applied in many gravity settings. An important advantage of the estimator in this context is that it delivers consistent estimates even in a

⁶I assume here that direct and indirect (i.e. relayed connections) are equivalent in their influence on capital flows. 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.

context with zeros in the dependent variable.⁷

Note that the country fixed effects are also country pair fixed effects in this context. Hence, they consume all of the usual variables that are fixed at the country level for the time 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, the country fixed effects consume variables that are fixed at the country pair level, such as bilateral distance, colonial history, common language and justice system (again, to the extent that they are fixed over the time period considered).

3.2 Identification: Seabed Ruggedness

When regressing capital flows on telegraph cables, the threat to identification comes from potential reverse causality, as well as 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 fundamentals.

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.

The instrument is constructed and operationalized as follows.⁸ For 65 of the

⁷Out of a panel of 1650 observations (33 countries for 50 years), there are 371 zeros for the total flows, 1103 zeros for public flows, and 441 zeros for private flows.

⁸This procedure closely follows the procedure in Juhasz and Steinwender (2018), with

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 cable segments, the shortest sea path is calculated (reflecting the idea that telegraph cables were very costly, and it would therefore be natural to economize on them by choosing the shortest route). Around this sea path, a 10 km corridor on both sides (in 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). Each country pair is finally described by the maximum average ruggedness value over the segments that make up the connection. This approach reflects the idea that high values of seabed ruggedness along one segment acted as a 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. Table 1 shows the regression of telegraph connections on seabed ruggedness and distance. The linearly predicted values of telegraph arrival from this regression are then rounded to the closest integer and turned into a dummy. This dummy signifies *telegraph connections predicted by geography*, and is finally used in an IV PPML regression (Windmeijer and Santos Silva, 1997) of Equation (1), to instrument for the observed telegraph variable.

To make seabed ruggedness a suitable instrument for telegraph connections, two conditions have to be fulfilled: exogeneity and relevance. As argued

the difference that Juhasz and Steinwender (2018) use their instrument to instrument for information lags, whereas I instrument for a telegraph dummy.

Table 1: 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.

above, due to technological limitations it was technically 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 2 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 results are presented.

Table 2: First Stage Equivalent

| | (1) Telegraph |
|---------------------|----------------------|
| Predicted Telegraph | 0.549*** (0.0333) |
| Constant | 0.433*** (0.0331) |
| Observations | 1650 |
| R^2 | 0.420 |
| KP rk LM test | 22.05 |

Robust standard errors 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.

4 Data

This section describes the data used and how the variables are constructed. The capital flow data are covered in Section 4.1, the telegraph data in Section 4.2, the seabed ruggedness data in Section 4.2, and other variables in Section 4.3.

4.1 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).⁹

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 specification). 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 3 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

⁹Countries 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.

firms. Preference shares (fixed-interest shares) were often used for industrial & miscellaneous firms, but seldom for other private sectors.¹⁰ 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.

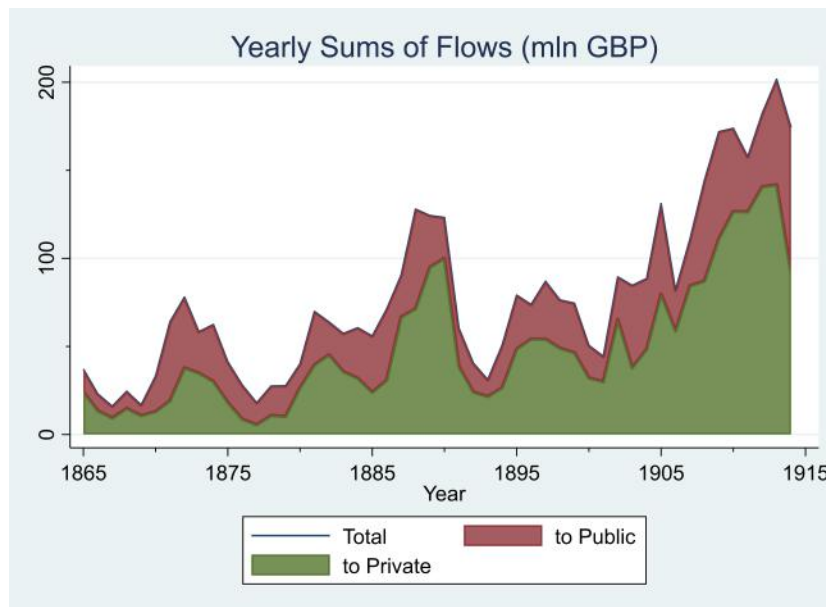


Figure 1: Total, public, and private capital flows by year

4.2 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.¹¹

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

¹⁰See Stone (1999) for more details on the instruments used, and temporal trends.

¹¹Telegraph connection dates are missing for Burma, Serbia, and Rhodesia.

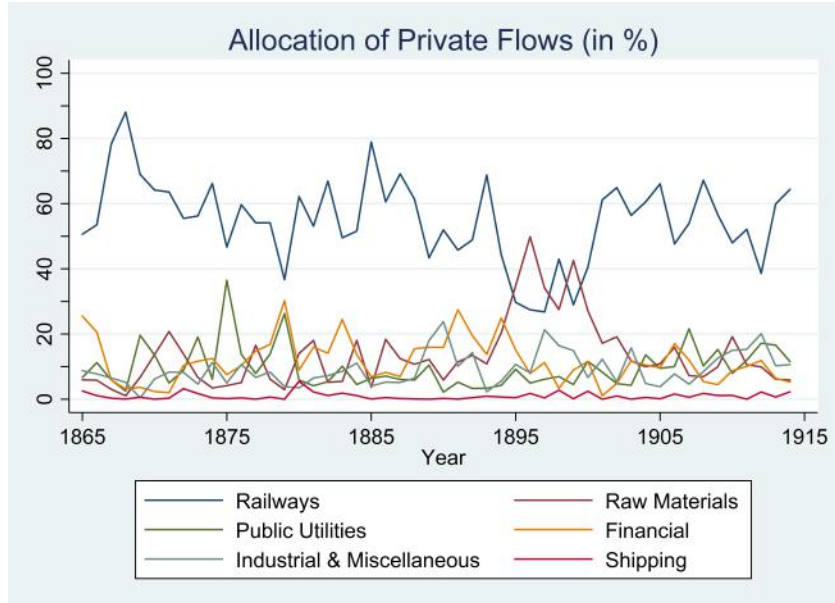


Figure 2: Yearly share of private capital flows per group of recipient

Table 3: 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).

the UK by 1865, meaning that a change in the telegraph connection status is observed for the remaining 18 countries.¹² Figure 4 shows the global geographic spread of the telegraph for the countries in this sample.¹³ 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 in this sense.

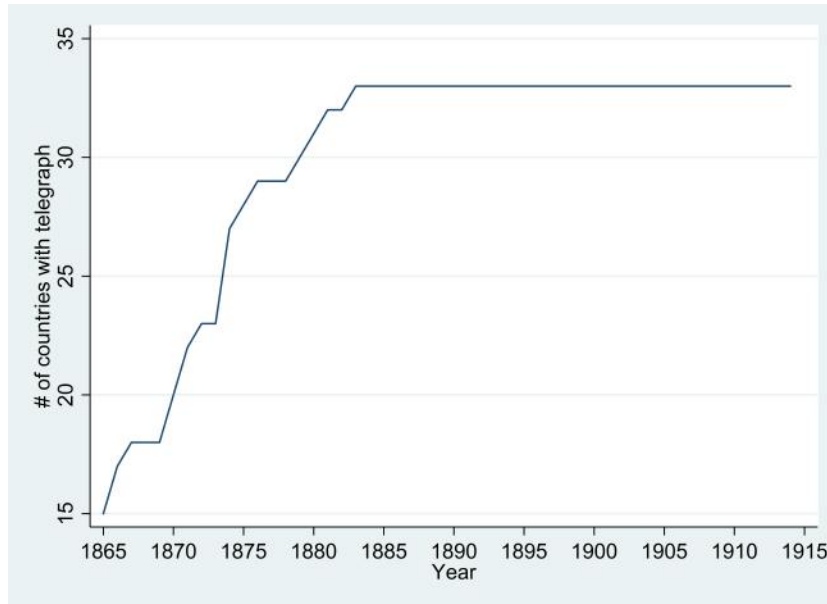


Figure 3: Adoption of Telegraph within Sample

¹²The 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).

¹³This graph was created using the 1880 map on historicalmapchart.net.

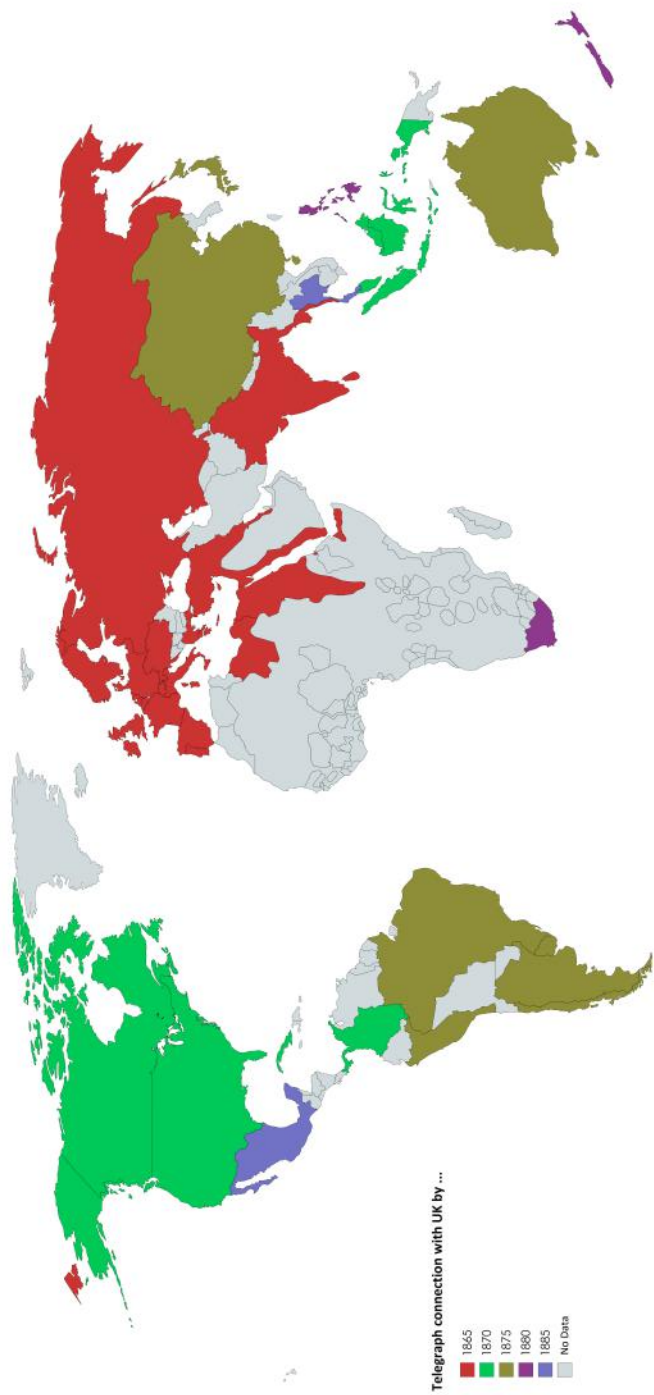


Figure 4: Global geographic spread of the telegraph (1880 boundaries)

4.3 Other Variables

This section describes other variables used in the empirical analysis and their construction. All variables and their sources are listed in Table 4.

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.¹⁴ 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. Appendix A.3 demonstrates that the interpolation does not affect the estimated coefficients in important ways.

Table 4: 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 (<i>Polity IV</i> , 2017) |
| Urbanization | CNTS (Banks and Wilson, 2020) & Mitchell (1998) |

¹⁴The 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.

5 Results

5.1 Baseline Results

This section presents results for Equation (1), estimated with PPML and IV PPML. The results indicate that the telegraph had an economically very sizeable and statistically significant impact on capital flows.

Table 5 contains the baseline PPML results.¹⁵ The results indicate that a bilateral telegraph connection between the UK and another country on average lead to a between 164% (according to the base specification in column 3 without further controls) and a 86% (according to the specification in column 9 with all controls) increase in capital flows to private borrowers. The coefficient for flows to public recipients is very large in some specifications, but relatively imprecisely estimated.

To account for potential endogeneity of the telegraph variable when estimating Equation (1), I instrument for the telegraph using telegraph cables predicted by geographic features. Table 6 contains the baseline IV results.¹⁶ The results indicate that the telegraph causally increased capital flows to private borrowers by between 213% (according to the base specification in column 3) and 197% (according to the specification with full controls in column 9). The estimation results indicate that flows to public recipients were possibly affected as well, but the effect is estimated very imprecisely, and appears to be less stable across specifications.

When moving from uninstrumented to instrumented estimation (so from Table 5 to Table 6), the coefficient on the telegraph dummy generally increases. Thus, the PPML estimate on the telegraph appears to be downwardly biased, which suggests that the telegraph in this sample connects 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).

The two most important control variables seem to be $\log(\text{GDP})$ and the lagged growth rate of population growth. Both enter positively and significantly in almost all specifications. Democratic institutions do not seem to play a major role. Adhering to the gold standard seems to be associated with higher capital flows generally. Wars lead governments to borrow, which

¹⁵The PPML estimation is implemented with Stata's *ppml* command.

¹⁶The IV PPML estimation is implemented with Stata's *ivpoisson* command.

crowds out private borrowing. Higher levels of urbanization are correlated with higher capital flows, possibly indicating a higher demand for capital due to higher economic growth.

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

| | (1) Total | (2) Public | (3) Private | (4) Total | (5) Public | (6) Private | (7) Total | (8) Public | (9) Private |
|--------------------------|--------------------|------------------|---------------------|-----------------------|----------------------|-----------------------|----------------------|---------------------|----------------------|
| Telegraph | 0.782** (0.375) | 0.409 (0.534) | 1.642*** (0.303) | 0.898** (0.393) | 0.565 (0.592) | 1.612*** (0.269) | 0.505 (0.335) | 0.637 (0.512) | 0.864 (0.549) |
| Pop. Growth | | | | 0.187*** (0.0630) | 0.221*** (0.0831) | 0.156 (0.0953) | 0.195*** (0.0429) | 0.173** (0.0755) | 0.209*** (0.0438) |
| War | | | | 0.103 (0.330) | 0.512 (0.378) | -0.453*** (0.138) | 0.435 (0.365) | 0.825** (0.371) | -0.254 (0.168) |
| Urbanization | | | | 0.0840*** (0.0216) | 0.0651* (0.0374) | 0.0867*** (0.0265) | 0.0337 (0.0251) | 0.0391 (0.0410) | 0.0242 (0.0328) |
| log GDP | | | | | | | 0.746 (0.643) | 0.661 (1.062) | 0.674* (0.374) |
| Polity 2 | | | | | | | -0.00111 (0.0349) | -0.0157 (0.0650) | 0.0204 (0.0228) |
| Gold Standard | | | | | | | 0.135 (0.272) | 0.0520 (0.512) | 0.159 (0.183) |
| Observations | 1650 | 1600 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |

This table shows PPML estimates of capital flows on a telegraph dummy and control variables. All regressions include country and year fixed effects.

Robust standard errors clustered at the country level in parentheses

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

5.2 Coefficient Plots

This section shows coefficient plots to examine the dynamic response of capital flows to the arrival of the telegraph. To do so, I run the following regression:

$$C_{it} = \exp\left(\sum_{\tau=-10}^{-1} \beta_{\tau} * I(\text{Telegraph})_{\tau it} + \sum_{\tau=1}^{10} \beta_{\tau} * I(\text{Telegraph})_{\tau it} + \alpha_i + \gamma_t + \varepsilon_{it}\right), \quad (2)$$

where C_{it} are capital flows, and α_i and γ_t and country and year fixed effects, respectively. $I(\text{Telegraph})_{\tau it}$ is an indicator variable that equals one if country i is τ years before/after the arrival of the telegraph in year t . Equation (2) is estimated by PPML, and the coefficients of interest are the β_{τ} , which elicit the movement of capital flows around the introduction of telegraph cables. Note that year $\tau = 0$ is the omitted category in Equation (2), meaning that all coefficients are to be interpreted relative to this

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

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|-------------------|------------------|--------------------|-----------------------|-----------------------|-----------------------|----------------------|---------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 1.203* (0.721) | 1.518 (1.253) | 2.132** (0.995) | 1.027* (0.597) | 1.322 (1.068) | 1.798** (0.756) | 1.261 (0.814) | 2.066 (2.040) | 1.969* (1.031) |
| Pop. Growth | | | | 0.189*** (0.0488) | 0.234*** (0.0596) | 0.157** (0.0745) | 0.205*** (0.0459) | 0.197** (0.0817) | 0.215*** (0.0382) |
| War | | | | 0.118 (0.304) | 0.585 (0.387) | -0.438** (0.175) | 0.456 (0.344) | 0.886** (0.438) | -0.251 (0.176) |
| Urbanization | | | | 0.0843*** (0.0150) | 0.0641*** (0.0240) | 0.0868*** (0.0163) | 0.0422* (0.0249) | 0.0630 (0.0485) | 0.0277 (0.0254) |
| log GDP | | | | | | | 0.688** (0.297) | 0.460 (0.509) | 0.632*** (0.231) |
| Polity 2 | | | | | | | 0.00427 (0.0214) | 0.00270 (0.0410) | 0.0248 (0.0200) |
| Gold Standard | | | | | | | 0.176 (0.161) | 0.143 (0.301) | 0.186 (0.114) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

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

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

base category. Further note that the sample in Equation (2) is restricted to observations that are within ten years of the introduction of a telegraph cable.¹⁷

Figure 5 shows the response of total, public, and private capital flows, five years before and after the introduction of the telegraph.¹⁸ For total capital flows, one can interpret the plot as showing a level shift around the introduction of the telegraph. Whereas the coefficients minus five to minus one are not distinguishable from zero, the coefficients plus two to five are. Flows to public recipients seem to be mostly flat around the introduction of telegraph cables, with the exception of a peak around 3 years before the arrival of the telegraph. In contrast, flows to private recipients seem to be on an increasing trajectory around the arrival of telegraph cables.¹⁹

¹⁷This implies that estimates of country and year fixed effects are based on potentially different samples than those for the baseline regression analysis, which features the full set of observations.

¹⁸Note that the plots omit coefficients more than six years before and after the event, in order to focus on the time around the introduction of the telegraph.

¹⁹Note that the specification in Equation (2) includes year fixed effects, which is equivalent to including a linear time trend.

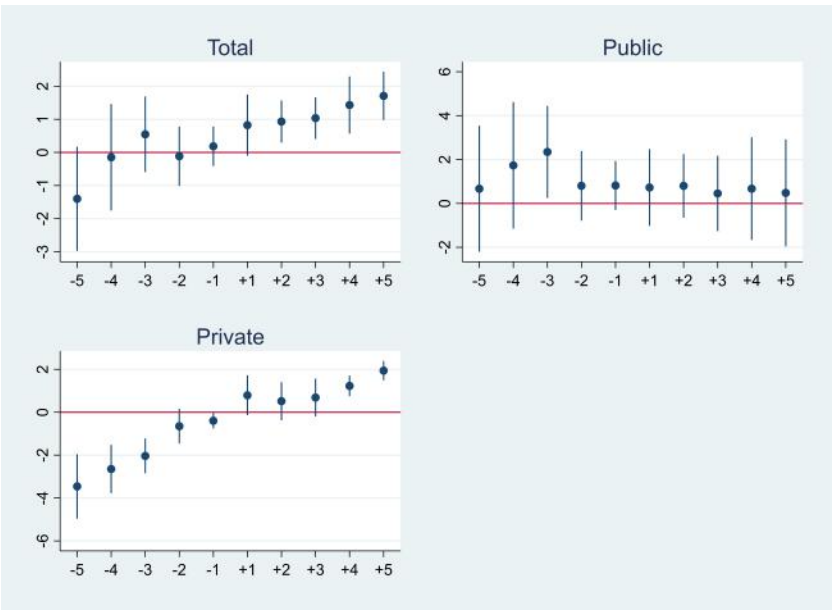


Figure 5: Coefficient Plot around the Arrival of Telegraph Cables

Description: These plots show coefficient plots of estimates of Equation (2). The omitted variable is year 0, the introduction of a telegraph cable, so coefficients have to be interpreted relative to that year.

5.3 Quantification - How Big was the Impact of the Telegraph?

How much did the telegraph matter in quantitative terms? This section uses counterfactual modeling to estimate how much the telegraph mattered in quantitative terms. I use the gravity model of international financial flows in Okawa and van Wincoop (2012), as well as the counterfactual comparative statics exercise therein, combined with the estimates in section 5.1 of the impact of the telegraph on financial flows.

Okawa and van Wincoop (2012) analyze a model in which consumers in many countries can invest into equities in N countries, as well as a risk-free asset and an asset that hedges global risk. From this setting, the authors derive the following gravity equation in asset flows:

$$X_{ij} = \frac{S_i E_j}{E} \frac{\Pi_i P_j}{\tau_{ij}}, \quad (3)$$

where X_{ij} are holdings of country i assets by country j agents, S_i and E_j are country i equity supply and country j equity holdings, respectively, and E are total world asset holdings. Similar to the gravity in trade literature, τ_{ij} captures bilateral frictions between country i and j , whereas Π_i and P_j are multilateral resistance terms for country i as a destination country, and country j as a source country. Whereas τ_{ij} in the trade literature typically captures an ad valorem tax, τ_{ij} in this model is an information friction, capturing asymmetric information between agents in different countries about respective variances of each country's assets. Specifically, from the perspective of country j agents, country i assets have a variance of $\tau_{ij}\sigma_i^2$. The right-hand side in eq. (3) ($\frac{\Pi_i P_j}{\tau_{ij}}$) therefore expresses the bilateral information friction between countries i and j , relative to the information frictions faced by the countries as source and destination countries.

From eq. (3), Okawa and van Wincoop (2012) derive the following formula capturing asset flows for comparative statics as the bilateral information friction moves from τ_{ij} to τ'_{ij} :

$$X'_{ij} = X_{ij} \frac{1}{1 + \frac{X_{ij}}{S_i} \left(\frac{\tau_{ij}}{\tau'_{ij}} - 1 \right) \frac{\tau_{il}}{\tau'_{il}}}, \quad (4)$$

where the last ratio is 1 when $l \neq j$.

Using eq. (4), as well as data on X_{ij} and the results from section 5.1, specif-

ically on the influence of the telegraph on capital flows, it is possible to calculate counterfactual capital flows. Specifically, I will show how I use this formula to arrive at capital flow series for each of the 33 countries in the data in the absence of the telegraph. Since this method will yield similar proportional results for all receiving countries, I will focus on one country to illustrate the method.

Equation (4) can be used to create counterfactual capital flows as follows. One requires data on the actual capital flow at a given point in time, X_{ij} , which are straight-forward to take from the data. Data about the share country i 's assets bought by country j , $\frac{X_{ij}}{S_i}$, in principle require data about country i 's total supply of equities, which is difficult to obtain in this period of time. However, given the UK's dominant position in international capital markets in the sample period, I will impose assumptions on this ratio, as detailed below. Finally, one requires data on the ratio of the actual information friction in relation to the counterfactual information friction, $\frac{\tau_{ij}}{\tau_{ij}^l}$.²⁰ To obtain this ratio, I will follow Okawa and van Wincoop (2012) and assume that

$$\ln(\tau_{ij}) = \sum_{m=1}^M \phi_m z_{ij}^m, \quad (5)$$

where z_{ij}^m are variables capturing bilateral information frictions between countries i and j , and ϕ_m are estimated in a gravity equation like eq. (1) or eq. (3).

In the rest of this section, I assume as a counterfactual scenario that the telegraph technology never arrives, and bilateral information frictions between the UK and all other countries stay at their pre-telegraph level until 1914. This counterfactual is useful for getting a measure of how big the influence of the telegraph was for capital markets in the second half of the 19th century. To calculate the ratio of information frictions in this scenario, I assume that $\tau_{ij} = \exp(0)$ whenever the telegraph is present, and that $\tau_{ij} = \exp(-\beta)$ whenever the telegraph is (assumed to be) not present, where β is estimated

²⁰ As the data only allows me to look at capital flows from the UK to receiving countries, I will not focus on third-country effects (where $l \neq j$). I.e. I will not look at the impact of changes in information frictions between e.g. Australia and the UK on capital flows between Australia and France, but instead only consider the effect on capital flows between Australia and the UK.

according to eq. (1).²¹ Hence, in this situation we get that

$$\frac{\tau_{ij}}{\tau'_{ij}} = \frac{\exp(0)}{\exp(-\beta)} \quad (6)$$

The final important ingredient for the counterfactual capital flow is the ratio of country i 's equities which is bought by country j . Given that the source country in this setting is always the UK, and given that the UK was the dominant capital exporter at the time, I assume a value of 0.9 throughout. Intuitively, this ratio matters because a high ex ante equilibrium value of $\frac{X_{ij}}{S_i}$ implies that it is difficult for country j to sell its assets to another country, whereas a low value implies that country j has enough other potential buyers for its assets. Therefore, for a given change in bilateral information frictions, country j will be able to more readily sell its equities to another country if $\frac{X_{ij}}{S_i}$ is low. Hence, a low value of $\frac{X_{ij}}{S_i}$ will lead to larger changes in X'_{ij} in response to changes in τ'_{ij} , and assuming a high value of the ratio is a conservative assumption in that sense.

fig. 6 shows counterfactual capital flows for New Zealand in a scenario without the telegraph. For each observation, the original data is plotted if the observation is before the year in which New Zealand received the telegraph connection with the UK (in 1876). After that, I assume a counterfactual increase in information frictions according to eq. (5), where the increase is based on eq. (6) and the β is taken from columns 1-3 of Table 5, respectively.

The graphs show that private capital flows are the most affected, whereas public flows are barely affected, and total flows are somewhere in the middle. Specifically, the graphs show a 30% reduction of private capital flows after the removal of the telegraph cable, as well as an 11% reduction for total flows and a 5% reduction for public flows. The size of the effect depends on the telegraph coefficient, as well as the dependency ratio. A larger telegraph coefficient implies a larger change in information frictions, whereas a larger dependency ratio implies that capital flows are less reactive to changes in information frictions (i.e. how easy it is for other countries to buy whatever the UK may not be buying). Since the dependency ratio is assumed to be 0.9 for all types of flows, the variation stems entirely from the estimated

²¹Note that this ratio would be unaffected by the inclusion of "base information frictions" (like e.g. language differences) which are present with and without the telegraph. Due to the particular estimation setting, in which non-time-varying information frictions are subsumed into the country fixed effects, it is not possible to easily recover these coefficients.

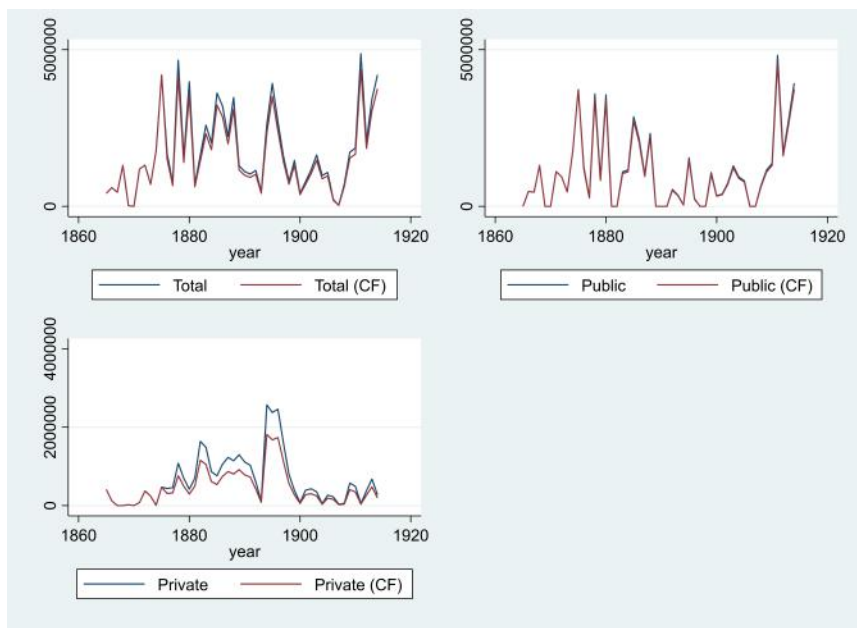


Figure 6: Counterfactual Capital Flows for New Zealand

telegraph coefficient. In the counterfactual scenario, the assets that are not bought by the UK due to increased information frictions will be partially bought up by other countries, and by citizens of New Zealand.

6 Mechanism

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

6.1 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.

6.1.1 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 typ-

ically only one entity with a widely 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.

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 (with the exception of columns 8 and 9 in Table 6, where the impact on public flows is estimated very imprecisely). Furthermore, the impact of the telegraph is generally more precisely estimated for flows to private recipients. 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.

6.1.2 Heterogeneous Effects Across Industries

Different types of business may be differentially affected by having access to 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 subdivided 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 7 presents PPML regression results with capital flows to the respective industries as dependent variable. Every regression in Table 7 contains country and year fixed effects.²²

In Table 7, Panel A shows the base specifications for the six dependent

²²Instrumented PPML regressions of capital flows to industries routinely do not converge in this setting, so I am only presenting PPML regressions in this setting.

variables, with a telegraph dummy and fixed effects as independent variables. Panels B and C subsequently add control variables. Across all specifications, Financials, Raw Materials, and Industrial and Miscellaneous firms are most strongly impacted by telegraph cables. Coefficients for the three categories are estimated to be broadly around 1.6 - 2.4, implying a rise of 160 - 240% 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 railways and public utilities, the inclusion of control variables renders the impact of the telegraph insignificant and closer to zero.

Comparing columns 1-2 with columns 4-5, the results in Table 7 can be interpreted to show a disproportionate impact of the telegraph on tradeables, like raw materials and industrial and miscellaneous firms, and a generally much smaller (and in some specifications insignificant) impact on non-tradeables, like railways and public utilities. This interpretation would be consistent with a market access view, where telegraph connections with the UK (and thus also with many other countries) increase the ability of firms in recipient countries to sell their products abroad.²³ Direct evidence for this mechanism is provided by Steinwender (2018) and Juhasz and Steinwender (2018), who show that the telegraph increased trade volumes, particularly of upstream products. Juhasz and Steinwender (2018) emphasize codifiability as a mechanism: the telegraph facilitated communication regarding simple, uniform upstream goods more than communication regarding complex, customized downstream goods. While the evidence presented here does not make strong predictions about this specific mechanism, it seems plausible to conclude that trade was facilitated by the telegraph.

However, it seems that capital flows to other asset classes were also affected to some extent by the telegraph, as can be seen from Panels A and B. Although Panel C shows no significant impact of the telegraph for railways and public utilities, the results in Panel C should be interpreted with caution, as the inclusion of additional control variables in Panel C (log(GDP) in particular) seems to introduce a bias against finding a positive effect of the telegraph (see Appendix A.1). Together, these results seem to suggest that the telegraph disproportionately affected capital flows to producers of tradeables, and had a smaller, but still positive and significant effect on flows to producers of non-tradeables.

Another way in which to interpret the results is through the lens of assets

²³ Access to input markets should be similarly affected for all industries, notwithstanding potential differences in importance of input market access for different industries.

classes. According to Table 3, ordinary and preference shares were especially prevalent for financial firms and raw materials producers, and to a slightly smaller extent for industrial and miscellaneous firms. This suggests that the telegraph may have contributed to lowering the degree of information asymmetry for these kinds of assets. Interestingly though, Portes et al. (2001) report little difference in their sample between corporate bonds and corporate equities in terms of the degree of information asymmetry.

The financial sector saw big relative increases in capital flows, according to Column 3 of Table 7. It seems unlikely that financial firms benefited from increases 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 intermediates, redistributing funds to local firms that benefit from the telegraph. 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).

6.1.3 Coefficient Plots by Industry

In order to analyse the differential impact of the telegraph on different industries graphically, this section presents coefficient plots for capital flows by industry. Whereas Section 5.2 contains coefficient plots of Equation (2) for aggregate capital flows, this section uses capital flows to different industries as the dependent variable. Figure 7 plots the results.

Capital flows to railways and public utilities exhibit an increase in capital flows five to three years before the arrival of the telegraph. An impact of the telegraph is not clearly discernible. This may be because the telegraph had no significant impact on capital flows to these industries. Note that capital flows to railways in particular made up a large share of capital flows at the time. It therefore seems plausible that the relative influence of the telegraph was small for railways. Capital flows to raw materials and industrial companies on the other hand, exhibit a clear level shift around the introduction of the telegraph. Capital flows to financial firms and shipping companies do not exhibit a striking pattern, but can be interpreted as showing an increase around year 0 as well.

Table 7: PPML Regressions of Capital Export Subcategories on Telegraph and Controls

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------|-----------------------|----------------------|----------------------|------------------------|----------------------|----------------------|
| | Railways | Public Util. | Financials | Raw Mat. | Indust. & Misc. | Shipping |
| Telegraph | 1.638*** (0.454) | 0.908* (0.510) | 1.660*** (0.266) | 2.254*** (0.603) | 2.038*** (0.538) | 0.541 (0.858) |
| Observations | 1500 | 1400 | 1500 | 1550 | 1600 | 989 |
| Country FE's & Year FE's | x | x | x | x | x | x |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) |
| | Railways | Public Util. | Financials | Raw Mat. | Indust. & Misc. | Shipping |
| Telegraph | 1.465*** (0.360) | 1.182** (0.557) | 2.017*** (0.346) | 2.261*** (0.669) | 2.036*** (0.546) | 0.282 (0.862) |
| Pop. Growth | 0.219*** (0.0525) | 0.209* (0.121) | 0.289*** (0.0899) | -0.0673*** (0.0164) | 0.242* (0.145) | -0.0803* (0.0433) |
| War | -0.357 (0.235) | -0.733* (0.391) | -0.0900 (0.444) | -0.479 (0.485) | -0.402* (0.243) | -1.802** (0.919) |
| Urbanization | 0.0903*** (0.0279) | 0.112 (0.0692) | 0.0381 (0.0485) | 0.0497 (0.0574) | 0.121** (0.0540) | -0.0165 (0.0734) |
| Observations | 1400 | 1350 | 1400 | 1450 | 1500 | 946 |
| Country FE's & Year FE's | x | x | x | x | x | x |
| Panel C | (1) | (2) | (3) | (4) | (5) | (6) |
| | Railways | Public Util. | Financials | Raw Mat. | Indust. & Misc. | Shipping |
| Telegraph | 0.441 (0.642) | -0.539 (0.727) | 2.390*** (0.670) | 1.626** (0.808) | 1.906* (1.096) | -0.585 (1.095) |
| Pop. Growth | 0.234*** (0.0335) | 0.246** (0.107) | 0.330*** (0.0806) | -0.205*** (0.0634) | 0.347*** (0.1000) | -0.256 (0.281) |
| War | -0.108 (0.234) | -0.477 (0.493) | 0.851 (0.524) | -0.644 (0.440) | -0.165 (0.265) | -2.822** (1.299) |
| Urbanization | 0.00512 (0.0235) | 0.0475 (0.0748) | 0.0193 (0.0660) | -0.0246 (0.0630) | 0.117* (0.0652) | -0.00236 (0.0874) |
| log GDP | 0.638*** (0.242) | 0.955* (0.559) | 1.092 (0.857) | 0.581 (0.779) | 1.001 (0.764) | 1.410 (0.907) |
| Polity 2 | 0.0274 (0.0262) | -0.0629* (0.0328) | 0.000870 (0.102) | 0.0893** (0.0435) | 0.0233 (0.0469) | 0.0927 (0.145) |
| Gold Standard | -0.00471 (0.166) | -0.303 (0.391) | 0.469 (0.459) | 0.480 (0.359) | 0.484 (0.319) | 0.457 (0.959) |
| Observations | 884 | 938 | 925 | 891 | 938 | 531 |
| Country FE's & Year FE's | x | x | x | x | x | x |

Robust clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

This table shows 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 and year fixed effects; Panel B and C subsequently add control variables.

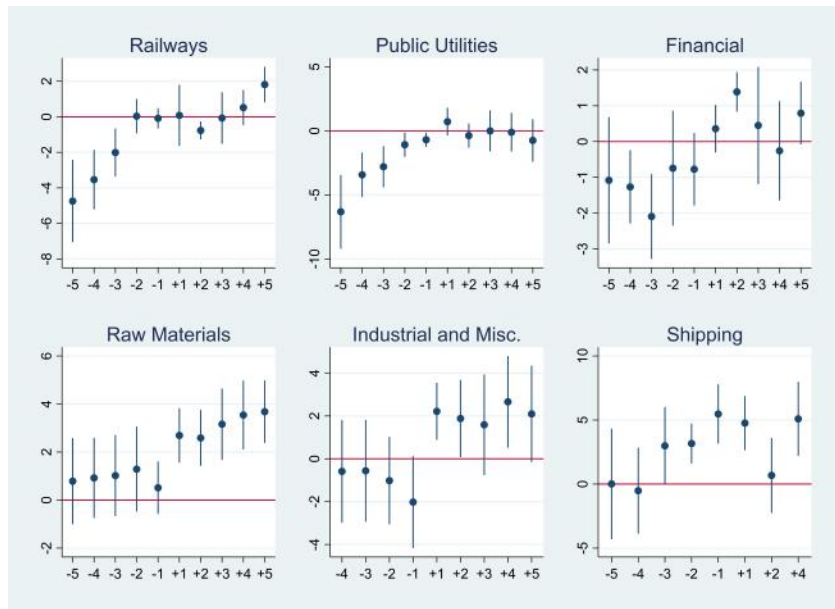


Figure 7: Coefficient Plots around the Arrival of Telegraph Cables, by Industry

Description: These plots show coefficient plots of estimates of Equation (2), with capital flows to different industries as the dependent variable. The omitted variable is year 0, the introduction of a telegraph cable, so coefficients have to be interpreted relative to that year.

6.2 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), and that capital flows merely follow trade flows. In order to control for the impact of trade on capital flows, Panel A of Table 8 reproduces the PPML regressions in Table 5, with the log of aggregate trade flows as an additional control variable.²⁴ 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 seem to be 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 1.6 in Table 5 to around 0.8 – 0.9 in Panel A of Table 8. 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 plays an important role for capital flows.

Could the influence of the telegraph on capital flows be due to trade finance specifically? In a recent paper, 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 8 adds the log of trade with the UK as a control variable to the specifications in Table 5.²⁵ 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.

To account for potential endogeneity of the telegraph cable in Table 8, ?? and ?? present corresponding IV estimates, instrumenting the telegraph dummy with geographically predicted telegraph connections. While ?? reproduces the basic IV results with log aggregate trade as an additional control variable, ?? adds log trade with the UK. Due to convergence problems, only

²⁴Aggregate trade is defined as the sum of total imports and exports of the country receiving the capital flows.

²⁵Trade with the UK is defined as the sum of bilateral imports from and exports to the UK of the country receiving the capital flows.

Table 8: PPML Regression of Capital Exports on Telegraph and Controls,
Trade Controls

| Panel A | | | | | | | | | |
|--------------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| Telegraph | 0.150 (0.382) | -0.288 (0.615) | 0.940*** (0.267) | 0.168 (0.433) | -0.173 (0.692) | 0.846*** (0.301) | 0.443 (0.350) | 0.699 (0.602) | 0.767* (0.418) |
| log(Trade) | 1.448*** (0.265) | 1.240*** (0.434) | 1.482*** (0.243) | 1.413*** (0.260) | 1.343*** (0.391) | 1.416*** (0.230) | 1.010*** (0.297) | 1.477*** (0.516) | 0.845*** (0.244) |
| Pop. Growth | | | | 0.0784 (0.0665) | 0.104 (0.0689) | 0.0709 (0.0990) | 0.163*** (0.0391) | 0.150** (0.0704) | 0.177*** (0.0296) |
| War | | | | 0.0353 (0.373) | 0.489 (0.336) | -0.613*** (0.141) | 0.288 (0.391) | 0.651** (0.331) | -0.443** (0.178) |
| Urbanization | | | | 0.0184 (0.0226) | -0.00439 (0.0351) | 0.0158 (0.0312) | 0.0100 (0.0225) | 0.00850 (0.0339) | -0.00252 (0.0307) |
| log GDP | | | | | | | 0.450 (0.614) | 0.258 (1.105) | 0.403 (0.330) |
| Polity 2 | | | | | | | 0.00494 (0.0355) | 0.0200 (0.0631) | 0.0217 (0.0201) |
| Gold Standard | | | | | | | 0.0413 (0.242) | -0.0868 (0.426) | 0.0924 (0.181) |
| Observations | 1418 | 1371 | 1418 | 1321 | 1321 | 1321 | 967 | 967 | 967 |
| R^2 | 0.784 | 0.339 | 0.889 | 0.795 | 0.357 | 0.897 | 0.837 | 0.405 | 0.925 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| Panel B | | | | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| Telegraph | 0.333 (0.415) | -0.130 (0.601) | 1.220*** (0.241) | 0.386 (0.455) | -0.0256 (0.660) | 1.191*** (0.273) | 0.546 (0.360) | 0.662 (0.542) | 0.932* (0.558) |
| log(Trade UK) | 0.547** (0.226) | 0.421 (0.388) | 0.578*** (0.169) | 0.565** (0.240) | 0.681* (0.408) | 0.503*** (0.148) | 0.0485 (0.270) | 0.173 (0.514) | 0.148 (0.189) |
| Pop. Growth | | | | 0.144** (0.0636) | 0.167*** (0.0562) | 0.137 (0.103) | 0.196*** (0.0408) | 0.177*** (0.0685) | 0.212*** (0.0432) |
| War | | | | 0.0741 (0.348) | 0.480 (0.356) | -0.488*** (0.149) | 0.420 (0.371) | 0.835** (0.362) | -0.286 (0.175) |
| Urbanization | | | | 0.0454 (0.0277) | 0.00911 (0.0389) | 0.0509 (0.0342) | 0.0317 (0.0240) | 0.0358 (0.0384) | 0.0192 (0.0333) |
| log GDP | | | | | | | 0.739 (0.580) | 0.644 (1.001) | 0.606* (0.333) |
| Polity 2 | | | | | | | -0.00259 (0.0360) | -0.0102 (0.0608) | 0.0156 (0.0218) |
| Gold Standard | | | | | | | 0.117 (0.285) | 0.0167 (0.485) | 0.112 (0.224) |
| Observations | 1501 | 1454 | 1501 | 1404 | 1404 | 1404 | 967 | 967 | 967 |
| R^2 | 0.759 | 0.330 | 0.871 | 0.781 | 0.360 | 0.886 | 0.832 | 0.406 | 0.919 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |

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.

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

some estimation results can be presented here.

Moving from PPML to IV seems to have 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 very sizeable.

In sum, the results in this section suggest that trade flows have a sizeable impact on 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 effect on capital flows that is independent of the trade channel.

6.3 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) 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.²⁶ A machine-searchable database of

²⁶Similar data, but covering the end of the 20th century, is collected in Portes and

Table 9: IV PPML Regressions of Capital Exports on Telegraph, Trade Controls

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|---------------------|-------------------|----------------------|-----------------------|----------------------|-----------------------|-------|--------|-----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | | | | | 0.330 (0.685) | | | | 1.312* (0.708) |
| log(Trade) | | | | | 1.277*** (0.292) | | | | 0.812*** (0.204) |
| Pop. Growth | | | | | 0.119* (0.0693) | | | | 0.182*** (0.0363) |
| War | | | | | 0.531 (0.408) | | | | -0.437*** (0.160) |
| Urbanization | | | | | -0.00238 (0.0231) | | | | -0.000924 (0.0225) |
| log GDP | | | | | | | | | 0.398* (0.220) |
| Polity 2 | | | | | | | | | 0.0237 (0.0202) |
| Gold Standard | | | | | | | | | 0.110 (0.111) |
| Observations | | | | | 1321 | | | | 967 |
| Country FE's & Year FE's | | | | | x | | | | x |
| KP rk LM | | | | | 17.34 | | | | 10.52 |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 0.473 (0.474) | 0.579 (0.742) | 1.086* (0.602) | 0.548 (0.517) | 0.603 (0.726) | 1.167* (0.656) | | | 1.816* (1.007) |
| log(Trade UK) | 0.539*** (0.120) | 0.386* (0.222) | 0.584*** (0.0997) | 0.550*** (0.144) | 0.643** (0.251) | 0.505*** (0.110) | | | 0.122 (0.134) |
| Pop. Growth | | | | 0.146** (0.0587) | 0.181*** (0.0668) | 0.137 (0.0882) | | | 0.217*** (0.0386) |
| War | | | | 0.0886 (0.309) | 0.531 (0.374) | -0.490*** (0.182) | | | -0.287 (0.179) |
| Urbanization | | | | 0.0466*** (0.0165) | 0.00994 (0.0237) | 0.0508*** (0.0183) | | | 0.0218 (0.0254) |
| log GDP | | | | | | | | | 0.588*** (0.225) |
| Polity 2 | | | | | | | | | 0.0195 (0.0207) |
| Gold Standard | | | | | | | | | 0.141 (0.128) |
| Observations | 1501 | 1501 | 1501 | 1404 | 1404 | 1404 | | | 967 |
| Country FE's & Year FE's | x | x | x | x | x | x | | | x |
| KP rk LM | 17.64 | 17.64 | 17.64 | 17.34 | 17.34 | 17.34 | | | 8.57 |

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

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

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 10 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 10: Regressions of News Mentions on Telegraph

| | (1) | (2) | (3) | (4) |
|--------------------------|--------------------|-------------------------|---------------------|----------------------|
| | NM All | NM All | NM All | NM All |
| main | | | | |
| Telegraph | 0.327** (0.130) | 0.206*** (0.0485) | 0.624*** (0.115) | 0.782*** (0.266) |
| log GDP | | 0.250*** (0.0365) | | 0.230*** (0.0386) |
| War | | 0.169*** (0.0382) | | 0.179*** (0.0394) |
| Urbanization | | 0.00896*** (0.00277) | | 0.00358 (0.00461) |
| Observations | 1650 | 1098 | 1650 | 1098 |
| Country FE's & Year FE's | x | x | x | x |
| KP rk LM | | | 22.05 | 12.44 |

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.

Robust standard errors in parentheses

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

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.

To further test for the impact of news mentions on capital flows, in Table 11 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 12, Table 13, and Table 14 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.²⁷ This suggests that newspaper articles related to business activities are driving the relationship between newspaper mentions and capital flows.

7 Conclusion

This paper is the first to look at the quantitative impact of telegraph on international financial flows. I present 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 use the ruggedness of the seabed.

The evidence suggests that there were no discernible effects on flows to public recipients, which is consistent with relatively low information frictions in markets for sovereign debt. Capital flows to private recipients on the other hand were strongly affected. The effect is particularly strong for capital flows to industrial firms, as well as producers of raw materials (as compared to railways, public utilities, and financial firms). This heterogeneity may be due to the telegraph particularly affecting output market access for these types

²⁷Note that the business section contains stock market quotes, so may partially measure capital flows indirectly.

Table 11: IV PPML Regression of Capital Exports on Telegraph, All Newspaper Mentions Control

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|---------------------|---------------------|---------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 0.0825 (0.611) | 0.461 (0.965) | 0.898 (0.705) | 0.0673 (0.574) | 0.580 (0.993) | 0.800 (0.623) | 0.966 (0.703) | 1.196 (1.164) | 1.813* (0.955) |
| log(NM All) | 0.909*** (0.157) | 1.091*** (0.276) | 0.757*** (0.116) | 0.787*** (0.162) | 0.973*** (0.272) | 0.643*** (0.121) | 0.243 (0.239) | 0.978** (0.464) | 0.0938 (0.145) |
| Pop. Growth | | | | 0.157*** (0.0504) | 0.225*** (0.0568) | 0.118 (0.0792) | 0.199*** (0.0465) | 0.200*** (0.0765) | 0.212*** (0.0385) |
| War | | | | -0.0561 (0.264) | 0.296 (0.333) | -0.563*** (0.171) | 0.390 (0.302) | 0.556 (0.351) | -0.270 (0.176) |
| Urbanization | | | | 0.0602*** (0.0147) | 0.0249 (0.0204) | 0.0707*** (0.0167) | 0.0411* (0.0247) | 0.0382 (0.0404) | 0.0282 (0.0259) |
| log GDP | | | | | | | 0.536* (0.314) | -0.105 (0.516) | 0.567** (0.259) |
| Polity 2 | | | | | | | -0.00390 (0.0225) | -0.00842 (0.0412) | 0.0215 (0.0202) |
| Gold Standard | | | | | | | 0.150 (0.160) | 0.0941 (0.289) | 0.174 (0.113) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

This table shows IV PPML regressions of capital flows on a telegraph dummy, the yearly (log) number of all newspaper 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, Advertising Mentions Control

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|---------------------|---------------------|---------------------|-----------------------|----------------------|-----------------------|----------------------|---------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 0.299 (0.573) | 0.716 (1.008) | 0.966 (0.637) | 0.343 (0.552) | 0.978 (1.113) | 0.895 (0.579) | 1.122 (0.769) | 2.036 (2.045) | 1.613* (0.894) |
| log(NM Advertising) | 0.729*** (0.115) | 0.688*** (0.204) | 0.692*** (0.105) | 0.659*** (0.121) | 0.643*** (0.223) | 0.619*** (0.103) | 0.120 (0.0972) | 0.0353 (0.227) | 0.199*** (0.0756) |
| Pop. Growth | | | | 0.178*** (0.0490) | 0.241*** (0.0571) | 0.135* (0.0788) | 0.206*** (0.0456) | 0.198** (0.0815) | 0.215*** (0.0382) |
| War | | | | 0.0478 (0.295) | 0.540 (0.380) | -0.566*** (0.158) | 0.440 (0.342) | 0.883** (0.434) | -0.317* (0.168) |
| Urbanization | | | | 0.0502*** (0.0145) | 0.0314 (0.0210) | 0.0538*** (0.0165) | 0.0367 (0.0250) | 0.0612 (0.0504) | 0.0196 (0.0256) |
| log GDP | | | | | | | 0.656** (0.295) | 0.449 (0.489) | 0.589** (0.239) |
| Polity 2 | | | | | | | 0.00109 (0.0216) | 0.00208 (0.0415) | 0.0195 (0.0201) |
| Gold Standard | | | | | | | 0.146 (0.166) | 0.140 (0.302) | 0.110 (0.119) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

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 13: IV PPML Regression of Capital Exports on Telegraph, Business Mentions Control

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|---------------------|---------------------|---------------------|-----------------------|----------------------|-----------------------|-----------------------|---------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 0.345 (0.631) | 0.995 (1.204) | 1.016 (0.753) | 0.246 (0.567) | 0.950 (1.125) | 0.822 (0.643) | 0.595 (0.586) | 0.934 (1.026) | 1.466* (0.872) |
| log(NM Business) | 1.247*** (0.191) | 1.088*** (0.307) | 1.278*** (0.153) | 1.084*** (0.191) | 0.937*** (0.298) | 1.105*** (0.159) | 0.793*** (0.231) | 1.183*** (0.342) | 0.598*** (0.168) |
| Pop. Growth | | | | 0.161*** (0.0500) | 0.228*** (0.0591) | 0.116 (0.0798) | 0.194*** (0.0464) | 0.191** (0.0741) | 0.204*** (0.0395) |
| War | | | | 0.0299 (0.255) | 0.441 (0.334) | -0.500*** (0.168) | 0.332 (0.288) | 0.609* (0.348) | -0.299* (0.171) |
| Urbanization | | | | 0.0584*** (0.0141) | 0.0354* (0.0210) | 0.0645*** (0.0162) | 0.0318 (0.0226) | 0.0287 (0.0351) | 0.0237 (0.0253) |
| log GDP | | | | | | | 0.348 (0.310) | -0.0474 (0.501) | 0.358 (0.257) |
| Polity 2 | | | | | | | -0.000369 (0.0217) | 0.00484 (0.0404) | 0.0215 (0.0198) |
| Gold Standard | | | | | | | 0.128 (0.159) | 0.0217 (0.291) | 0.159 (0.116) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

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 14: IV PPML Regression of Capital Exports on Telegraph, News Mentions Control

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|---------------------|---------------------|----------------------|-----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 0.396 (0.630) | 0.702 (0.959) | 1.331* (0.770) | 0.338 (0.573) | 0.706 (0.935) | 1.177* (0.652) | 1.114 (0.715) | 1.598 (1.221) | 2.030** (1.029) |
| log(NM News) | 0.577*** (0.112) | 0.808*** (0.186) | 0.426*** (0.0805) | 0.479*** (0.115) | 0.715*** (0.182) | 0.337*** (0.0820) | 0.117 (0.192) | 0.684** (0.337) | -0.0319 (0.113) |
| Pop. Growth | | | | 0.168*** (0.0492) | 0.230*** (0.0563) | 0.135* (0.0765) | 0.202*** (0.0459) | 0.207*** (0.0771) | 0.216*** (0.0380) |
| War | | | | -0.0910 (0.265) | 0.192 (0.328) | -0.568*** (0.171) | 0.399 (0.294) | 0.501 (0.357) | -0.237 (0.181) |
| Urbanization | | | | 0.0657*** (0.0147) | 0.0286 (0.0210) | 0.0756*** (0.0166) | 0.0429* (0.0253) | 0.0474 (0.0406) | 0.0272 (0.0257) |
| log GDP | | | | | | | 0.604* (0.313) | 0.0701 (0.522) | 0.659*** (0.253) |
| Polity 2 | | | | | | | -0.00140 (0.0226) | -0.00210 (0.0405) | 0.0266 (0.0206) |
| Gold Standard | | | | | | | 0.163 (0.158) | 0.106 (0.286) | 0.191* (0.114) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

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.

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

of firms (Juhász and Steinwender, 2018). Alternatively, information frictions in capital markets for these firms may have been different than information frictions in capital markets for other types of firms. Manufacturing firms and producers of raw materials (as well as financial firms) issued larger shares of equity (as compared to other private firms, which tended to issue more debt-like assets), which may explain why these assets were particularly information sensitive.

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 newspaper mentions of country names in the British press to show that the telegraph led to an increase in the number of newspaper mentions of connected countries. When including newspaper mentions as a control variable, the telegraph loses a lot of its explanatory power, indicating that an important part of the telegraph's effect on capital flows is captured by newspaper mentions.

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A Robustness

This section contains robustness checks for the baseline results presented in Section 5.1.

A.1 Sample Selection due to Control Variables

For some of the 1650 observations in columns 1-3 in Table 5, some control variable observations are missing. This subsection presents robustness checks on the potential selection bias that may be introduced by moving from the full sample to the one with control variables.

For many of the control variables used here, only a few observations are missing. When moving from columns 1-3 to columns 4-6 in Table 5 and Table 6, only two countries (i.e. 100 observations), China and Indonesia, are lost due to missing observations (urbanization is not available for these two countries). When moving to columns 7-9, the number of complete observations drops by another 562, to 988. Furthermore, the missing observations are concentrated in the pre-telegraph period: Including the full set of control variables reduces the number of pre-telegraph observations from initially 153 for the full sample to 37 in the sample with all control variables included (142 in columns 4-6).

To examine the impact of missing observations on estimates of the effect of the telegraph on capital flows, Table 15 presents estimates using different subsets of observations used in the baseline regression analysis above.

Panel A focuses on results from Table 5. Columns 1-3 reproduce columns 1-3 Table 5 for reference. Columns 4-6 show the basic specification without control variables for the sample in columns 4-6 from Table 5, whereas columns 7-9 shows the basic specification for the sample used in columns 7-9 of Table 5. The results indicate that the inclusion of the full set of control variables reduces the estimated coefficient of the telegraph by half, and renders it insignificant. This suggests that the drop in the coefficient of the telegraph observed between columns 3, 6, and 9 in Table 5 seems to be entirely explained by the sample selection due to missing control variables.

Panel B in Table 15 repeats the same exercise, but for Table 6. The results are the same: the inclusion of control variables introduces a selection bias, which reduces the estimated coefficient on the telegraph dummy by half.

Table 15: Regressions of Capital Exports on Telegraph, Sample Robustness

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|--------------------|------------------|---------------------|--------------------|------------------|---------------------|------------------|------------------|------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| Telegraph | 0.782** (0.375) | 0.409 (0.534) | 1.642*** (0.303) | 0.787** (0.377) | 0.428 (0.536) | 1.662*** (0.302) | 0.214 (0.356) | 0.370 (0.584) | 0.722 (0.458) |
| Observations | 1650 | 1600 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| R^2 | 0.697 | 0.299 | 0.834 | 0.697 | 0.304 | 0.836 | 0.809 | 0.350 | 0.898 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main Telegraph | 1.203* (0.721) | 1.518 (1.253) | 2.132** (0.995) | 1.222* (0.724) | 1.618 (1.299) | 2.174** (1.027) | 0.286 (0.489) | 0.878 (0.988) | 0.992 (0.670) |
| Observations | 1650 | 1650 | 1650 | 1550 | 1550 | 1550 | 988 | 988 | 988 |
| R^2 | | | | | | | | | |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.80 | 21.80 | 21.80 | 10.24 | 10.24 | 10.24 |

Standard errors in parentheses (robust and clustered at the country level for Panel A, robust for Panel B)

All regressions include country and year fixed effects.

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

A.2 Telegraph-Related Capital Flows

To account for the possibility that capital exports from the UK directly finance telegraph-related investments, this section presents regressions in which capital flows to telegraph and telephone companies are subtracted from the aggregate flows. Since capital flows to telegraph and telephone companies are a subset of flows to public utilities, total and private capital flows are affected, whereas flows to public recipients are unaffected. Furthermore, data on capital flows to telegraph and telephone companies are available only for a subset of countries (those for which data come directly from Stone (1999), and not from Clemens and Williamson (2004)), meaning that the respective regressions are based on 1200 observations.

Panel A in Table 16 presents PPML specifications with the corrected capital flow data, whereas Panel B presents IV PPML specifications with the corrected capital flow data. The results show that correcting for flows directly to telegraph-related companies does not change the results; the coefficients on the telegraph dummy stay very sizeable and significant.

Table 16: PPML Regressions of Capital Exports on Telegraph, Telegraph Robustness

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|--------------------|------------------|---------------------|-----------------------|-----------------------|-----------------------|----------------------|---------------------|----------------------|
| | Total (Adj.) | Public (Adj.) | Private (Adj.) | Total (Adj.) | Public (Adj.) | Private (Adj.) | Total (Adj.) | Public (Adj.) | Private (Adj.) |
| Telegraph | 0.784** (0.386) | 0.409 (0.534) | 1.742*** (0.298) | 0.901** (0.406) | 0.565 (0.592) | 1.683*** (0.260) | 0.538 (0.350) | 0.637 (0.512) | 1.045* (0.587) |
| Pop. Growth | | | | 0.188*** (0.0639) | 0.221*** (0.0831) | 0.162* (0.0958) | 0.202*** (0.0393) | 0.173** (0.0755) | 0.219*** (0.0447) |
| War | | | | 0.121 (0.332) | 0.512 (0.378) | -0.449*** (0.149) | 0.474 (0.361) | 0.825** (0.371) | -0.247 (0.174) |
| Urbanization | | | | 0.0857*** (0.0225) | 0.0651* (0.0374) | 0.0871*** (0.0278) | 0.0309 (0.0250) | 0.0391 (0.0410) | 0.0156 (0.0326) |
| log GDP | | | | | | | 0.758 (0.671) | 0.661 (1.062) | 0.687* (0.381) |
| Polity 2 | | | | | | | -0.0130 (0.0483) | -0.0157 (0.0650) | 0.0215 (0.0285) |
| Gold Standard | | | | | | | 0.103 (0.286) | 0.0520 (0.512) | 0.167 (0.186) |
| Observations | 1200 | 1600 | 1200 | 1150 | 1550 | 1150 | 738 | 988 | 738 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Total (Adj.) | Public (Adj.) | Private (Adj.) | Total (Adj.) | Public (Adj.) | Private (Adj.) | Total (Adj.) | Public (Adj.) | Private (Adj.) |
| main | | | | | | | | | |
| Telegraph | 1.273* (0.768) | 1.518 (1.253) | 2.957* (1.777) | 1.075* (0.621) | 1.322 (1.068) | 2.420** (1.155) | 1.174 (0.795) | 2.066 (2.040) | 2.233** (1.135) |
| Pop. Growth | | | | 0.190*** (0.0501) | 0.234*** (0.0596) | 0.167** (0.0780) | 0.210*** (0.0464) | 0.197** (0.0817) | 0.225*** (0.0393) |
| War | | | | 0.140 (0.303) | 0.585 (0.387) | -0.401** (0.177) | 0.489 (0.339) | 0.886** (0.438) | -0.250 (0.176) |
| Urbanization | | | | 0.0862*** (0.0156) | 0.0641*** (0.0240) | 0.0870*** (0.0170) | 0.0386 (0.0256) | 0.0630 (0.0485) | 0.0188 (0.0256) |
| log GDP | | | | | | | 0.709** (0.306) | 0.460 (0.509) | 0.644*** (0.237) |
| Polity 2 | | | | | | | -0.00664 (0.0284) | 0.00270 (0.0410) | 0.0275 (0.0254) |
| Gold Standard | | | | | | | 0.141 (0.169) | 0.143 (0.301) | 0.194* (0.117) |
| Observations | 1200 | 1650 | 1200 | 1150 | 1550 | 1150 | 738 | 988 | 738 |
| R ² | | | | | | | | | |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| KP rk LM | 18.23 | 22.05 | 18.23 | 17.73 | 21.80 | 17.73 | 9.20 | 10.24 | 9.20 |

Standard errors in parentheses (robust and clustered at the country level for Panel A, robust for Panel B)
 All regressions include country and year fixed effects.
 * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.3 Interpolation of Population and Urbanization

In the baseline analysis, both urbanization and population growth are based on partially interpolated variables. The interpolation is done, to increase the sample size, and allow for the inclusion of more variables. This section presents reproductions of the baseline analyses using the non-interpolated variables independent variables. Table 17 uses the non-interpolated population variable and reproduces the baseline PPML (Panel A) and IV PPML (Panel B) analyses; the results do not change in important ways when compared to Table 5 and Table 6. Table 18 uses the non-interpolated urbanization variable and reproduces the baseline PPML (Panel A) and IV PPML (Panel B) analyses; again, the results do not change in important ways when moving from interpolated to the not interpolated data.

Table 17: PPML Regressions of Capital Exports on Telegraph , Population Interpolation Robustness

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|--------------------|------------------|---------------------|-----------------------|----------------------|-----------------------|-----------------------|---------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| Telegraph | 0.782** (0.375) | 0.409 (0.534) | 1.642*** (0.303) | 0.529 (0.420) | 0.0704 (0.617) | 1.326*** (0.257) | 0.438 (0.318) | 0.569 (0.493) | 0.798 (0.526) |
| Pop. Growth | | | | 0.168*** (0.0632) | 0.221*** (0.0793) | 0.116 (0.104) | 0.201*** (0.0417) | 0.186** (0.0782) | 0.209*** (0.0429) |
| War | | | | 0.0770 (0.353) | 0.502 (0.401) | -0.436*** (0.163) | 0.429 (0.364) | 0.815** (0.374) | -0.256 (0.167) |
| Urbanization | | | | 0.0804*** (0.0212) | 0.0524 (0.0347) | 0.0924*** (0.0275) | 0.0355 (0.0248) | 0.0417 (0.0398) | 0.0252 (0.0328) |
| log GDP | | | | | | | 0.731 (0.642) | 0.633 (1.065) | 0.665* (0.373) |
| Polity 2 | | | | | | | -0.000200 (0.0350) | -0.0130 (0.0653) | 0.0207 (0.0228) |
| Gold Standard | | | | | | | 0.142 (0.274) | 0.0648 (0.516) | 0.162 (0.184) |
| Observations | 1650 | 1600 | 1650 | 1363 | 1350 | 1363 | 985 | 985 | 985 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | Private |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main | | | | | | | | | |
| Telegraph | 1.203* (0.721) | 1.518 (1.253) | 2.132** (0.995) | 0.514 (0.537) | | 1.568* (0.813) | 1.230 (0.830) | 2.065 (2.133) | 1.931* (1.042) |
| Pop. Growth | | | | 0.168*** (0.0510) | | 0.117 (0.0793) | 0.208*** (0.0461) | 0.204** (0.0808) | 0.214*** (0.0384) |
| War | | | | 0.0748 (0.321) | | -0.410** (0.192) | 0.454 (0.344) | 0.889** (0.442) | -0.252 (0.175) |
| Urbanization | | | | 0.0803*** (0.0145) | | 0.0924*** (0.0171) | 0.0433* (0.0245) | 0.0641 (0.0464) | 0.0280 (0.0252) |
| log GDP | | | | | | | 0.680** (0.296) | 0.453 (0.499) | 0.628*** (0.231) |
| Polity 2 | | | | | | | 0.00486 (0.0213) | 0.00434 (0.0407) | 0.0249 (0.0199) |
| Gold Standard | | | | | | | 0.181 (0.161) | 0.148 (0.297) | 0.188* (0.113) |
| Observations | 1650 | 1650 | 1650 | 1363 | | 1363 | 985 | 985 | 985 |
| R^2 | | | | | | | | | |
| Country FE's & Year FE's | x | x | x | x | | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 20.58 | | 20.58 | 9.87 | 9.87 | 9.87 |

Standard errors in parentheses (robust and clustered at the country level for Panel A, robust for Panel B)

All regressions include country and year fixed effects.

Column 5 in Panel B can not be reported due to convergence problems

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

Table 18: PPML Regressions of Capital Exports on Telegraph , Urbanization Interpolation Robustness

| Panel A | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|--------------------------|--------------------|------------------|---------------------|-----------------------|--------------------|-----------------------|----------------------|---------------------|----------------------|
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| Telegraph | 0.782** (0.375) | 0.409 (0.534) | 1.642*** (0.303) | 0.843** (0.417) | 0.735 (0.600) | 1.390*** (0.277) | 0.519 (0.339) | 0.698 (0.535) | 0.873 (0.547) |
| Pop. Growth | | | | 0.115* (0.0644) | 0.140* (0.0732) | 0.115 (0.106) | 0.179*** (0.0413) | 0.161** (0.0694) | 0.198*** (0.0430) |
| War | | | | 0.127 (0.462) | 0.570 (0.518) | -0.500*** (0.194) | 0.511 (0.512) | 1.071** (0.509) | -0.335 (0.214) |
| Urbanization | | | | 0.0811*** (0.0314) | 0.0660 (0.0450) | 0.0613* (0.0331) | 0.0335 (0.0256) | 0.0366 (0.0404) | 0.0197 (0.0317) |
| log GDP | | | | | | | 0.718 (0.653) | 0.537 (1.067) | 0.725* (0.401) |
| Polity 2 | | | | | | | 0.000594 (0.0354) | -0.0143 (0.0701) | 0.0227 (0.0217) |
| Gold Standard | | | | | | | 0.147 (0.274) | 0.129 (0.512) | 0.134 (0.181) |
| Observations | 1650 | 1600 | 1650 | 1250 | 1246 | 1250 | 954 | 954 | 954 |
| Country FE's & Year FE's | x | x | x | x | x | x | x | x | x |
| Panel B | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | Private |
| | Total | Public | Private | Total | Public | Private | Total | Public | Private |
| main Telegraph | 1.203* (0.721) | 1.518 (1.253) | 2.132** (0.995) | 1.573** (0.646) | | 3.031** (1.320) | 1.364 (0.883) | 2.396 (2.482) | 2.185* (1.138) |
| Pop. Growth | | | | 0.124** (0.0617) | | 0.122 (0.0929) | 0.188*** (0.0473) | 0.185** (0.0842) | 0.205*** (0.0392) |
| War | | | | 0.201 (0.365) | | -0.418** (0.185) | 0.540 (0.392) | 1.162*** (0.443) | -0.332** (0.169) |
| Urbanization | | | | 0.0908*** (0.0219) | | 0.0670*** (0.0228) | 0.0430 (0.0272) | 0.0657 (0.0542) | 0.0225 (0.0267) |
| log GDP | | | | | | | 0.651** (0.305) | 0.278 (0.544) | 0.679*** (0.240) |
| Polity 2 | | | | | | | 0.00641 (0.0220) | 0.00727 (0.0439) | 0.0274 (0.0203) |
| Gold Standard | | | | | | | 0.193 (0.165) | 0.233 (0.304) | 0.165 (0.116) |
| Observations | 1650 | 1650 | 1650 | 1250 | | 1250 | 954 | 954 | 954 |
| R^2 | | | | | | | | | |
| Country FE's & Year FE's | x | x | x | x | | x | x | x | x |
| KP rk LM | 22.05 | 22.05 | 22.05 | 21.94 | | 21.94 | 10.26 | 10.26 | 10.26 |

Standard errors in parentheses (robust and clustered at the country level for Panel A, robust for Panel B)

All regressions include country and year fixed effects.

Column 5 in Panel B can not be reported due to convergence problems

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