The Historical Dynamics of Financial Exchanges

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Abstract

The historical dynamics of entry and exit in the financial exchange industry are analyzed for a panel of 741 exchanges in 52 countries from 1855 through 2012. We focus on economic, technological, and regulatory factors. Using novel panel data evidence, we empirically test whether these factors are consistent with existing financial theories. We find that US exchanges are 4.6% more likely to exit per year after the passage of the Securities Exchange Act. The telephone, literacy, and regulation are robust predictors of financial exchange dynamics. The upward trend in literacy is an important driver of exchange entry.

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1. Introduction

The past two decades have witnessed dramatic change in the number, location, and structure of global financial exchanges. The number of new financial exchanges has surged worldwide in countries such as Russia and China, as well as in countries with many competing established exchanges and mature domestic financial markets. Additionally, many new liquidity providers have emerged since 2000 as the Internet provides a low-cost open platform for alternative trading systems (ATS) to compete with more traditional exchanges. Despite the emergence of new exchange entrants, the number of cross-border and trans-Atlantic exchange mergers has also increased in recent years. Thus, the market for exchange services is clearly is in a period of transition.

This proliferation of newly formed financial exchanges and alternative trading systems runs counter to predictions that economies of scale will, in the long run, force exchanges to consolidate through exit; specifically, exchanges that attract more trading volume will lower their average costs and generate more liquid markets relative to their competitors. Indeed, the recent acceleration of exchange mergers provides some support for theories of consolidation in the industry. However, the literature on market fragmentation offers no *ex-ante* reason to believe that the number of exchanges will decline monotonically over time. In support of this view, we have seen many specialized exchanges emerge that operate exclusively on the Internet. Given the mixed empirical evidence and contradictory motives faced by financial exchanges, their desire to expand into new markets on one hand, and their quest for efficiency and economies of scale on the other, it is natural to question how exchanges have responded to these forces in the past. Any understanding of how financial exchanges will adapt to changing market conditions going forward, must be made based on the available historical evidence.

In this paper, we investigate the historical exchange industry by analyzing the economic forces driving exchange existence, entry and exit for a novel sample of 741 financial exchanges within 52 countries from 1850 to 2012. The basis/foundation for our statistical analysis is the extensive hand-collected dataset that we constructed on exchange existence, entry, and exit.[1] A detailed description of our data, collection methodology, and sources is available from the authors upon request. Our investigation begins by first documenting the evolutionary pattern of the number of exchanges as well as entry and exit events across sample countries/regions. Next, we test the dual hypotheses, that after controlling for the relevant exogenous factors, (1) exchange *entry* is concentrated in periods of elevated uncertainty and broadening capital investment, and (2) exchange *exit* occurs during periods of increased regulation and emerging communications technology. To test these hypotheses, we execute both a linear and Poisson time series regression to explain: the number of exchanges, exchange entry, and exchange exit. For each of these regressions we utilize both a regional sample, whereby exchanges are grouped by world regions (Americas, Asia, Europe and World), and a US exclusive sample. Finally, to address the inherent data incompleteness problem with exchange exit, as well as provide a robustness check, we employ the proportional hazard model of Cox (1972) and the competing hazard model of Fine and Gray (1999) to study the exit of financial exchanges.

Our results show that the historical record is not consistent with convergence to a single financial exchange in each country, or steady growth in the number of exchanges over time. In regional samples, periods of entry are negatively associated with US Blue Sky laws, but positively associated with communications advances and literacy. Periods of exit coincide with the US Silver Rush, communications advances, and UK securities regulation. The results suggest waves of entry and exit primarily driven by underlying structural change and regulation, not business cycle fluctuations. Within the US sample, we find that entry is affected positively by output growth and literacy, and negatively by regulation. Exit is driven by gold mining and telephone lines. In a proportional hazard setting, we find that US exchanges are 4.6% more likely to exit each year after the passage of the Securities Exchange Act, but a one percent increase in the growth of telephone lines leads to a 0.171%

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[1] The authors are unaware of any other dataset of its kind within the academic literature.

reduction in the likelihood of exit. When going missing from the data is allowed as a competing hazard to exit, our competing hazard model results suggest that the risk of exchange exit is increased by national securities regulation and decreased by telephone lines. In summary, we find that the telephone, literacy, and regulation are robust predictors of financial exchange dynamics in both US and regional datasets.

The goal of this paper is to better understand the historical patterns and commonalities in exchange dynamics across countries. Our hope is that this knowledge will provide historical perspective and context, which will aid interpretation of recent developments in global financial markets. The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 develops our hypotheses for exchange entry and exit. Section 4 details our historical exchange data. Section 5 provides model results for the regional and US samples. Section 6 concludes.

2. Literature Review

Our work is related to four strands of the economic literature. The first strand focuses on liquidity provision in capital markets. Some work in this area predicts consolidation within the market to provide liquidity. For example, Macey and O'Hara (1999), Pirrong (1999), and Hasan and Malkamaki (2001) argue that technology places an emphasis on cost minimization, which forces financial exchanges to consolidate through exit/merger to exploit economies of scale. Exchanges that can attract incremental order flow will lower their costs at the margin, thus reducing trading costs for market participants and in turn further attracting even more order flow. According to these arguments, fragmentation of order flow among competing exchanges should be a temporary phenomenon associated with newly-developed financial markets or emerging economies. Other work in this area, for example Stoll (2001, 2008), argues for market fragmentation due to entry by low-cost startup Internet-based exchanges. Therefore, on balance, the existing literature does not make decisive theoretical predictions about how the number of exchanges should change over time; thus, leaving the answer to this question as an empirical issue.

The second strand that is quite naturally related is the literature on the history of financial exchanges in various countries around the world. Prior research that is most closely related to our analysis includes: (1) Cole (1944), on the number of regional stock exchanges prior to the Securities Exchange Act of 1934; (2) Angel (1998), on the lifespan of a number of US regional exchanges since the Securities Exchange Act; (3) Arnold, Hersch, Mulherin, and Netter (1999), on the distribution of trading volume surrounding exit events and mergers among nine US regional exchanges from the 1930s through the 1990s; (4) Chabot (1999), on the extent of market integration from 1865 to 1885 for major stock exchanges of the United Kingdom and United States; and (5) Jorion and Goetzmann (1999), on the equity premium in the context of international equity markets from 1920 to 1996.[2] When comparing our work to this literature, there are two important insights. First, the existing literature does not explicitly address the economic factors that drive exchange entry and exit, and therefore the dynamics of the market for exchange services. Second, despite numerous books on exchanges in areas around the world, we find substantially more local and regional exchanges through our data collection process than previously documented, suggesting our analysis is more comprehensive than the existing literature.[3]

The third strand compares trading rules and performance across major exchanges around the world. Representative examples include Cumming and Johan (2008), Cumming et al. (2011) and Aitken et al. (2015) who compare market surveillance and trading rules regarding manipulation, insider trading and broker-agency conflicts within 42 exchanges, 25 jurisdictions and 22 exchanges, respectively, and Ramos (2009) and Doidge et al. (2017) who investigate the relative performance of

2 A substantial literature reconstructs and analyzes historical stock market indices in various countries; see Jorion and Goetzmann (1999) for references.

3 For example, see Salsbury and Sweeney (1988), Australia; Armstrong (1997), Canada; Michie (1981), UK; Sears (1973), US.

stocks markets given differences in regulatory environments. While both this strand of the literature and our work investigates exchanges, we utilize a much larger sample of exchanges, over a much longer time series, and focus on exchange entry and exit rather than specific exchange trading rules and performance.

The fourth strand of the literature is methodological and related to hazard models. Hazard models are used to model firm and bank failure. For example, Bhattacharjee et al. (2009) employ a competing hazard model to study firm exit in the UK over a 38-year period and finds that high output growth in the US reduces the risk of a UK firm bankruptcy while increasing the risk of being acquired by a UK competitor. Wheelock and Wilson (2000) find that banks that are less well capitalized or have high loan to asset ratios are more likely to fail, and Brown and Dinc (2011) use panel data on banks in 21 emerging market countries from 1994 to 2000 and show that the risk of a government takeover increases with output growth. While we are unaware of hazard models being utilized to study exchange exit events, we believe the applicability in our exchange setting is natural.

3. Exchange Hypotheses

The life cycle of a financial exchange, from entry to exit, is a dynamic process which is potentially influenced by many factors. In this section, we develop hypotheses regarding specific factors that affect growth in the number of exchanges as well as exchange entry and exit events: (1) macroeconomic fluctuations and the need for efficient capital allocation, (2) periods of resource exploration and discovery associated with heightened uncertainty, (3) advances in communications technology, and (4) shifts in regulatory regimes. We discuss each in turn.

As discussed in Greenwood and Jovanovic (1990) and King and Levine (1993), economic growth and financial market development are positively correlated. Financial exchanges facilitate the flow of capital into high-growth sectors by redirecting funds from other less productive sectors of the economy. We conjecture that economic expansion is associated with increased entry as firms demand more capital for their operations, which in turn increases the demand for trading services; the reverse applies for exit. Within our framework, expansions are associated with entry, while recessions are associated with exit. Controlling for other factors, we should observe a positive correlation between output fluctuations and exchange entry in the data.

We argue that financial exchanges provide more than transaction services; specifically, they supply implicit certification of actively traded securities. The reputation of an exchange provides the basis for market participants to trust the information, trades, and counterparties they deal with on the exchange, a concept that is similar to reputation effects discussed in Edelen and Gervais (2003). While existing exchanges would always like to trade more securities to exploit economies of scale in trading volume, an exchange may refrain from doing so, absent further information about the security, because the cost of trading a fraudulent security is primarily borne by all other securities traded on the exchange. In this case, the benefit of additional trading volume is more than offset by the potential long-run reputational cost due to the negative externality of fraud. When existing financial exchanges choose not to trade new securities, an opportunity arises for entrant exchanges. An entrant can step in to provide liquidity and transaction services for market participants willing to trade the new risky securities. By facilitating trade in the new securities, an entrant can help to identify viable securities for incumbent exchanges to trade without the older exchanges having to risk paying a reputational cost due to fraud. We argue that the role of entrant exchanges is particularly critical during periods of extreme uncertainty that often accompany dramatic changes in the set of investment opportunities. Relevant historical examples include periods such as the California Gold Rush (1848–1855), the US Internet boom (1995–2000), and the recent emergence of cryptocurrencies, all of which experienced the entry of many new firms whose profitability was particularly uncertain. Therefore, we conjecture that exchange entry is likely to increase during periods characterized by heightened uncertainty in the valuation of firms/assets, with the opposite true for exit.

One of the fundamental tasks of any financial exchange is to match the trading interests of buyers and sellers. Operationally, this involves both the buyer and seller communicating their trading intent to the exchange and the exchange matching the purchase and sell orders. Thus, the ease with which market participants and the exchange can communicate, both in terms of time and cost, is likely to impact the productivity and overall efficiency of an exchange's trading operations. Indeed, before the development of mass near-instant communication, new exchanges were typically located at or near the site of the risky asset being priced to minimize both transportation and communication costs. A common example is an entrant exchange located adjacent to a newly-discovered panning stream that trades claims to the uncertain amount of gold embedded in the stream. The emergence of new, more efficient and cost-effective, communications technologies induces competing effects for exchanges. For large incumbent exchanges with lower variables costs, new communications technologies allow trade to occur from more remote locations, allowing for an increase in market share, eventually driving out small local competitors. As an example, consider the Hartford Stock Exchange in Connecticut, which closed within two weeks of the telegraph starting to operate between Hartford and New York City. thereby reducing the need for specialized local exchanges. However, improvements in communications technology also lower entry costs for startup exchanges which would encourage entry and the total number of exchanges. An example of this effect is the online-only exchanges enabled by the development of the Internet.[4] Taken together we argue that theoretically advances in communications technology should have an ambiguous effect on both entry and exit; which effect dominates becomes an empirical question.

Not surprisingly, the regulatory environment is another factor to consider when discussing the dynamics of financial exchanges. At first glance, the direction of the net effect is indeterminant. On one

4 Greenwood and Jovanovic (1999) argue that the technological innovation associated with the IT Revolution of the 1990s favored smaller firms that had recently entered the market. Generalizing this story for the communications advances we mention, new entrant exchanges without reputational capital are needed to price risky entrant firms that do business based on the new technology.

hand, regulation may ultimately increase the viability of exchanges that can comply with the increased regulatory burden by creating a stable supportive environment for them to operate. On the other hand, regulation may inhibit market entry by startups and force some exchanges to close or merge if they cannot shoulder the increased compliance burden. For example, after the implementation of the Securities Exchange Act of 1934, which gave jurisdiction of exchange oversight to the US Securities and Exchange Commission (SEC), many exchanges voluntarily closed rather than submit to a review by the newly-formed regulator. We hypothesize that regulatory oversight is associated with a decrease in entry, with an ambiguous effect on exit.

In summary, we believe that macroeconomic fluctuations, periods of heightened uncertainty, communication advances, and enhanced regulation represent the primary factors that affect exchange dynamics. However, major military conflicts such as World War II halted exchange entry and led to temporary suspensions of trading and exit. During such conflicts, centralized war planning can lead to a reduced need for capital reallocation within an economy, thus demand for the associated trading services provided by exchanges abates. In the empirical work, we account for this by adding war dummies as control variables.

4. Data

We define a financial exchange as any formal organization whose objective is to facilitate trade and economic activity through the pricing and trading of uncertain, inherently risky claims. From a researcher perspective all we know about the life cycle of a financial exchange is the timing and duration of its operation. Consider a hypothetical exchange that enters the market then operates for some period. This exchange can leave the dataset in three ways: exit, going missing, and surviving to the end of the sample (2012). In exit, the exchange is explicitly noted as going out of business and ceasing operations or merging with another exchange. Going missing is more ambiguous: in this case, we note the last recorded mention of the exchange in any of our sources after entry in cases where the exchange does not have an exit date. Thus, an exchange can only go missing if its exit was not directly observed. Survival to the end of the sample is straightforward and easy to detect since these exchanges are currently operating as of 2012.

Thus, our financial exchange data consist of the entry, exit, merger and missing dates that we could confirm for the exchanges identified in our sample of 52 countries. Our current sample consists of 741 exchanges, of which 327 are located within the United States. A comprehensive list of the exchanges in our sample, their respective entry, exit, missing, and merger dates, if known, a description of collection methodology, and a list of sources is available from the authors.[5]

Due to the historical nature of the data collected, data incompleteness is a salient problem. Many of the exchanges we discovered lack entry or exit dates. Therefore, we will work with three alternative subsamples of the data: restricted (R), unrestricted A (UR-A), and unrestricted B (UR-B). The restricted, R, dataset only includes exchanges when complete information is available: entry date as well as an explicit exit date, if the exchange is not currently operating. The unrestricted A, UR-A, dataset consists of all exchanges with at least an entry date and an exit or missing date. We assume that an exchange exits immediately upon going missing from the dataset. Consequently, more exchanges are included in the unrestricted A dataset since many exchanges have missing dates instead of exit dates. Finally, the unrestricted B, UR-B, dataset, consists of all exchanges with an entry date. For UR-B, if an exchange does not have an exit date or a missing date, we assume that the exchange exited the sample three years after entry (i.e. the exchange is "short-lived"). Thus, R is a subset of UR-A, which in turn is a subset of UR-B.[6]

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[5] Due to data incompleteness and limited information going back to 1855, trading volume data at the exchange level is unavailable.

6 All three specifications have their own unique flaws which one could criticize. Dataset R tends to under sample exchanges for which we have limited information, and thus are more obscure. UR-B makes strong assumptions about when exchanges exit after entry if they do not have exit or missing dates (always three years). UR-A is a balance

The financial exchange data are supplemented with information on the timing of significant historical events as well as business cycle data. The historical data include major advances in communications, regulatory events, country and region-specific output growth, and periods of elevated uncertainty during commodity rushes and the Internet boom. For a list of relevant historical events and their respective dating used in the paper, see Table 1.

Several discontinuous events have advanced and shaped the evolution of communications technology as it pertains to financial markets. We consider three binary communications variables: the first is a dummy variable equal to one when the telephone was the state-of-the-art communications technology (1876–1976), the second is an analogous dummy variable for the personal computer pre-Internet (1977–1994), and the third is for the Internet (1995–2012). These variables are denoted by *D_Telephone*, *D_Computer*, and *D_Internet* in the empirical work.

Our country-specific regulation variables mark periods when financial exchanges were directly monitored by a new governmental authority to prevent securities fraud and abuse. Specifically, these periods are after the Securities Exchange Act of 1934 for the United States (1934–2012) and after the Stock Transfer Act of 1963 for the United Kingdom (1965–2012); denote these by *US Reg* and *UK Reg*, respectively.

From the *Historical Statistics of the United States, Millennial Edition* online database, we take as continuous control variables (measured in per-capita growth rates) the annual time series listed in Panel B of Table 2; included are, communication variables: thousands of miles of Western Union telegraph wire, thousands of miles of Bell (AT&T) telephone wire, number of computers, and number of Internet hosts; income as measured by real GDP in 1996 US dollars; commodity rush variables: silver and gold mining in metric tons; and the literacy rate as a percentage of persons above age 14.[7]

between the two which requires the assumption that exchanges exit immediately when they go missing.

7 Included as a proxy for education and financial literacy.

5. Modeling Exchange Numbers, Entry and Exit

5.A Summary Measures

To begin we display the number of exchanges over time. Figure 1 reports the total number of financial exchanges for the R, UR-A, and UR-B datasets, while Figure 2 breaks the R dataset down by region - Africa, Asia, Europe, Middle East (ME), North America (NA), and South America (SA). In Figure 1, we observe an extended upward trend in the number of exchanges through the second half of the 19th century, followed by comparatively little change. Apart from the long-term trend, the figure shows periods with relatively dramatic fluctuations in the number of exchanges, especially when viewed at the regional level in Figure 2. If consolidation towards a limited number of exchanges is indeed occurring through exit, this convergence did not begin on a global level until after the 1930s. Due to growth in emerging markets, particularly Asia, convergence is not at all apparent.

Figures 3 through 5 plot the number of confirmed financial exchange entry, exit, shutdown/merger events respectively in all 52 sample countries from 1850 through 2012. Looking at the number of exchange entry events from 1850 to the present, we see distinct fluctuations in the rate of entry around its long-run trend, particularly from 1865 through 1905. For Canada and the United States, many of these exchanges were mining exchanges formed during the late 19th century, though smaller clusters of new exchanges emerged during the stock market rallies of the 1920s and 1990s. Many of the newly formed exchanges from the 1920s disappeared following the stock market crash of 1929. This pattern is consistent among many of our sample countries. Despite having fewer confirmed exit dates, Figure 5 suggests distinct periods of exit via shutdowns. Mergers follow a similar pattern; consistent with advances in communications technology, they are much more prevalent since the 1980s.

5.B Modeling Regional Exchanges

Given the complexity of our data, we execute multiple regression specifications on several different data partitions. Specifically, we utilize both linear and Poisson regressions to analyze the dynamics of three dependent variables: the number of financial exchanges, exchange entry, and exchange exit events. We partition our data by region, World (full sample), Americas, Asia, Europe, and the US as well as by exchange datasets: restricted (R), unrestricted A (UR-A), and unrestricted B (UR-B).[8]

5.B.i Number of Exchanges

Consider per-capita growth in the aggregate number of exchanges (denoted *Exchanges*, although specified as a rate, not in levels) as the dependent variable in the following annual time-series linear regression within a country or region (or full sample)

$$Exchanges_t = \beta_1 GDP_t + \mathbf{1}\{US \in S\}\beta_2 Silver\ Rush_t + \beta_3 D\_Telephone_t + \beta_4 D\_Computer_t + \beta_5 D\_Internet_t + \beta_6 Literacy_t + \mathbf{1}\{US \in S\}[\beta_7 F\_BlueSky_t + \beta_8 US\ Reg_t] + \mathbf{1}\{UK \in S\}\beta_9 UK\ Reg_t + \beta_W \mathbf{W}_t + \varepsilon_t$$

with forecast error ε_t, where $\mathbf{W}_t \equiv [USCW_t,\ WWI_t,\ WWII_t]'$ includes war dummies $USCW_t$ for the US Civil War (excluded when the US is not in the sample), WWI_t for World War I, and $WWII_t$ for World War II; $\beta_W \equiv [\beta_{USCW},\ \beta_{WWI},\ \beta_{WWII}]$ a 1×3 vector of coefficients; $\mathbf{1}\{US \in S\}$ and $\mathbf{1}\{UK \in S\}$ are indicator functions for the inclusion of the United States and United Kingdom in the sample.[9] The linear regression results, estimated coefficients and robust standard errors for each dataset are shown in Tables 4 (World and Americas) and Table 5 (Asia and Europe). Separate restricted (R), unrestricted A (UR-A), and unrestricted B (UR-B) results are shown as successive columns across the table for each dataset.

Given the varying signs and significance, output growth appears to have a negligible impact on per-capita growth in the number of exchanges. Across models, the sign on output growth is almost

8 We also ran linear regressions with log(1 + Exchanges) as the dependent variable, as a robustness check against the inappropriateness of the linear model due to the nature of Exchanges as a nonnegative count outcome. The results are both qualitatively and quantitatively similar to those reported below and are available upon request.

9 Constant term suppressed throughout.

always negative and only marginally significant in the European UR-A case. We conjecture that growth periods in the business cycle contain much more noise and occur at a higher frequency than is useful for explaining variation in *Exchanges* as an aggregate quantity which depends on both entry and exit events. The commodity rush variable *Silver Rush*, delineating a period of high uncertainty in US asset markets, exhibits a negative and significant coefficient implying a decrease in the growth rate of the number of exchanges of between 3.4% to 10.8%. The result here relies on using the UR-B data selection methodology since it does not obtain for the R and UR-A datasets. This is a counterintuitive result since we conjectured that a commodity rush would lead to increased exchange entry and more exchanges due to a need for mine securities trading.

The estimated coefficient on *D_Telephone* ranges from -0.019 (World, R) to -0.101 (Americas, UR-B) when significant, suggesting that the state-of-the-art telephone reduces exchange growth by up to 10.1%. Note that *D_Telephone* is only significant in the world and Americas datasets, and the estimated coefficient becomes more negative when going from the R to UR-A to UR-B datasets. Thus, we conclude that the introduction of the telephone was particularly pivotal for the exit of more obscure, and thus smaller, exchanges. With a wide range of coefficients, *D_Computer* has an ambiguous effect on exchange growth across regions. Holding all else equal, computerization increases exchange growth by 3.2% for Europe; alternatively, it decreases growth by roughly 10% for Asia. No consistent effect is found for the World and Americas datasets, although the advent of the computer decreased exchange growth by about 6 to 7% in the Americas for the unrestricted samples. We conclude that computerization shifted exchange growth from the young American and Asian periphery to the old European core. *D_Internet* performs best in the Americas and Asia samples. We find that, in unrestricted American datasets, the advent of the Internet decreased the rate of exchange growth by 5.8 to 6.7% per year, similarly, Asia saw its growth slow by 11% after the Internet was introduced, a finding that obtains across, R, UR-A, and UR-B datasets. We conclude that the Internet is associated with additional consolidation, but only in the Americas and Asia, with the effect particularly pronounced in Asia. The young age of emerging Asian economies may explain this result since their financial exchanges may not benefit as much from incumbency compared to European competitors.

The US literacy rate performs very well as an explanatory variable in the world and Americas datasets. We find that a one percentage point increase in the US literacy rate is associated with an increase in the rate of exchange growth of between 5.4% and 21.4%. Therefore, we find that the spread of basic education captured by *Literacy* was a powerful driver of the growth of financial exchanges, primarily in the second half of the 19th century.

We find that, outside of the restricted samples, the adoption of Blue Sky laws at the state level (fraction of US states having adopted Blue Sky securities regulation law) has a significant negative effect on exchange growth. A one percentage point increase in the fraction of US states with an active Blue Sky law leads to at most a 0.13% reduction in exchange growth. This provides additional support for the negative effect of securities regulation on financial exchange growth. Country-level regulation is surprisingly unimportant, with a negative estimated coefficient on *UK Reg* of -0.025 for European data only, but the regulation variables are generally not significant across datasets. Thus, we find that the UK 1963 Stock Transfer Act decreased the rate of exchange growth by 2.5% per year for Europe after its implementation. Regulation does help explain the annual growth rate of the number of exchanges in the other datasets.

The results in Tables 4 and 5 are consistent with some, but not all, of our hypotheses. The communication, regulation and US literacy variables are predominantly the predicted sign and significant, considering the resources necessary to start up or close an exchange, these results support our hypotheses, both statistically and economically. However, the results for output growth and the US Silver Rush have effects inconsistent with our expectations: output growth has no detectable effect and the Silver Rush appeared to have slowed exchange growth by as much as 10.8%.

5.B.ii Exchange Entry

We next model the entry of financial exchanges using exchange entry events as the dependent variable. Given the nature of the data as a nonnegative count outcome, we estimate Poisson regression models of entry, where the dependent variable is the number of exchange entry events each year for a region or full sample. The covariates included as independent variables are identical to those used in our linear regression analysis of the number of exchanges. The annual time-series Poisson model for entry is:

$$\log(Entry_t) = \beta_1 GDP_t + \mathbf{1}\{US \in S\}\beta_2 Silver\ Rush_t + \beta_3 D\_Telephone_t + \beta_4 D\_Computer_t + \beta_5 D\_Internet_t + \beta_6 Literacy_t + \mathbf{1}\{US \in S\}[\beta_7 F\_BlueSky_t + \beta_8 US\ Reg_t] + \mathbf{1}\{UK \in S\}\beta_9 UK\ Reg_t + \beta_W \mathbf{W}_t + \varepsilon_t$$

with forecast error ε_t. Note that this is identical to our model for the number of exchanges with the outcome variable replaced by log entry events per year. Tables 6 and 7 present our results, estimated coefficients and robust standard errors for each model.

Our results for exchange entry in the full sample and Americas (Table 6) are generally stronger than the results for the number of exchanges, but output growth is still insignificant across all datasets for both the full sample and Americas region. Again, our interpretation of this counterintuitive result is that business cycles as represented by output growth occur at too high a frequency to affect the long-term decision to start an exchange via entry. We find that *Silver Rush* and *D_Telephone* are also imprecisely estimated with no detectable effect on exchange formation. However, the other communications variables *D_Computer* and *D_Internet* explain well the observed variation in entry. Specifically, *D_Computer* is significantly positively associated with entry, with an estimated average marginal effect ranging from 1.24 (Americas, R) to 6.061 (world, UR-B). For the Americas-UR-B sample, we find that that average marginal effect of computerization translates economically into an increase in exchange entry of 3.543 exchanges per year. The literacy rate is again a significant positive explanatory variable. The estimated average marginal effect of a one percentage point increase in the literacy rate ranges from 5.125 (Americas, UR-A) to 13.166 (world, UR-B). Thus, the literacy rate is an economically important predictor of exchange entry, with an increase in *Literacy* tied to both exchange formation and growth in the number of exchanges.

There is also continued strong evidence for the negative effect of regulation on entry, particularly in the Americas UR-B sample. The *F_BlueSky* variable performs best in the UR-B datasets, with the largest estimated average marginal effect of -0.534 in the Americas UR-B sample. For the Americas-UR-B dataset, a one percentage point increase in the fraction of US states implementing a Blue Sky law has an average marginal effect of decreasing the number of exchanges entering by roughly 0.5 per year. Our country-level regulation variables show strong divergence. The coefficient on *US Reg* in the Americas-UR-B sample is a significant -2.277 with an average marginal effect on entry events per year of -5.059, while the *UK Reg* does not have a detectable effect with our entry data. In summary, the results in Table 6 largely reinforce our earlier results on the number of exchanges.

Entry results for Asia and Europe are shown in Table 7. The results are qualitatively similar to those discussed previously for the Americas and full sample, with communications technology spurring exchange entry and regulation suppressing it. However, the communications variable *D_Telephone* now becomes an important predictor of exchange entry in the Asia sample, with an estimated marginal effect ranging from 0.593 (Asia, UR-B) to 0.658 (Asia, UR-A). Similarly, *D_Computer* and *D_Internet* are positively associated with entry in both Asian and European samples. The estimated marginal effect of computerization on exchange entry suggests that at most 9 additional exchanges entered per year during the reign of computers as the state-of-the-art technology. The UK securities regulation variable, *UK Reg,* has a negative effect on entry in all but the UR-B dataset with an estimated marginal effect of -8.641 in both the restricted and UR-A samples. A consistent finding throughout this section is that communications technology positively affects entry while regulation dampens it.

5.B.iii Exchange Exit

Our models of exchange exit parallel our entry models, with annual exit events as the dependent variable. We estimate Poisson models of exchange exit, where the dependent variable is equal to the number of exchange exit events each year for a region or full sample. The covariates are the same as those used in the analysis of exchange growth and entry. The annual time-series Poisson model for exit is:

$$\log(Exit_t) = \beta_1 GDP_t + \mathbf{1}\{US \in S\}\beta_2 Silver\ Rush_t + \beta_3 D\_Telephone_t + \beta_4 D\_Computer_t + \beta_5 D\_Internet_t +$$

$$\beta_6 Literacy_t + \mathbf{1}\{US \in S\}[\beta_7 F\_BlueSky_t + \beta_8 US\ Reg_t] + \mathbf{1}\{UK \in S\}\beta_9 UK\ Reg_t + \beta_W \mathbf{W}_t + \varepsilon_t$$

with forecast error ε_t. Tables 8 and 9 provide the relevant results, estimated coefficients and robust standard errors for each model.[10]

In general, the exchange exit results resemble their entry counterparts, even though we observe fewer exit events. The World and Americas results are shown in Table 8. We find that output growth is insignificant across all datasets. However, in contrast to our previous results and against our initial expectations, we now find that *Silver Rush* is significant and positively associated with exit. The estimated average marginal effect of the commodity rush variable ranges from 12.963 (Americas, R) to 48.898 (world, UR-B). Therefore, at most the US Silver Rush is associated with an increase in approximately 49 exchange exit events per year.

Advances in telecommunications, as represented by *D_Telephone*, *D_Computer*, and *D_Internet*, sharply increase exit as hypothesized across all samples examined in Table 8. The magnitude of the estimated average marginal effect is very similar across all three communications variables. After the introduction of the telephone as state-of-the-art, we find an average marginal effect ranging from 13.076 (Americas, R) to 49.923 (world, UR-B). The coefficient on *D_Computer* is

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10 We also ran negative binomial models with exit as the dependent variable. These additional results are available upon request.

significant and positive across all exit models with an average marginal effect ranging from 12.332 (Americas, R) to 49.449 (world, UR-B) exit events per year. Finally, the estimated average marginal effect of *D_Internet* ranges from 13.438 (Americas, R) to 52.8 (world, UR-B). We infer from these results that advances in communications technology have a strong positive effect on exchange exit in the Americas region and full sample, leading to consolidation.

Our state-level regulation variable, *F_BlueSky*, is only significant in restricted samples with marginal effects ranging from -0.26 to -0.553 per percentage point increase in the fraction of US states with a Blue Sky law. This small negative effect on exit is dominated by the communications variables and does not show up consistently across our samples. Contrary to our predictions, nationwide securities regulation in the United States, when significant, has a very small negative effect on exit and the UK regulation variable, *UK Reg,* has no detectable effect on exit in the full sample using our data. The inference for US securities regulation is that it slows exit in the Americas region by at most 2.5 exchanges per year. Overall, the results suggest that the passage of a nationwide securities regulation law decreased the number of exchanges exiting per year by 1 to 2.5 exchanges, which is both statistically and economically meaningful.

Table 9 presents results on financial exchange exit for Asia and Europe. We find that the communications variables show up as consistently significant across our various datasets. The estimated average marginal effect of *D_Telephone* ranges from 4.541 (Asia, R) to 9.137 (Europe, UR-A) exchanges per year and for *D_Computer*, the marginal effect is between 1.093 (Asia, UR-B) and 8.725 (Europe, UR-A) and for the *D_Internet* the range is 1.286 (Asia, UR-B) to 9.733 (Europe, UR-A). Thus, telecommunications advances have an important positive effect on exchange exit in Asian and European data.

The UK securities regulation variable *UK Reg* also has a strong positive effect on exit. Its estimated average marginal effect has a narrow range of 1.025 (Europe, UR-A) to 1.074 (Europe, UR-

B). Thus, the enactment of UK regulation is associated with one additional exchange exiting per year in Europe as a whole. It is important to note, however; that the marginal effect of regulation is almost an order of magnitude smaller than that of communications advances suggesting that exchange exit in Europe was primarily driven by communications advances, not regulation.

5.C Modeling US Exchanges

We complement our regional results by executing regressions with an expanded set of covariates on US exchanges alone. Specifically, we include the impact of Blue Sky laws adoption on US financial exchanges. The name "Blue Sky" law stems from one of the pioneering legal cases on the issue (Hall v. Geiger-Jones Co., US 539, 1917) in which the judge ruled to prevent "speculative schemes which have no more basis than so many feet of blue sky." Table 3 shows the timing of Blue Sky law passage by US state and is a reproduction of Table 1 from Mahoney (2003). For our analysis, a state is included in the sample if we recorded at least five exchanges for that state historically which results in a sample of 14 states to be included in the US regression. We estimate the state-year panel of 14 states with continuous controls for exchange growth as:

$$\begin{aligned} Exchanges_{it} &= \beta_1 GDP_t + \beta_2 Silver\ Mining_t + \beta_3 Gold\ Mining_t + \beta_4 Telegraph_t + \beta_5 Telephone_t + \beta_6 Computer_t + \\ &\quad \beta_7 Internet_t + \beta_8 Literacy_t + \beta_9\ Blue\ Sky_{it} + \beta_{10} US\ Reg_t + \beta_W \mathbf{W}_t + \varepsilon_t \\ &\equiv \mathbf{BZ}_t + \beta Blue\ Sky_{it} + \varepsilon_t \end{aligned}$$

with all continuous variables in per-capita growth rates, where $\mathbf{Z}_t$ is the vector of 12 national controls defined above (continuous controls, national regulation dummy, and war dummies).[11]

The results for the number of US exchanges are reported in Table 10. The results appear to be strongest in the unrestricted B data – where all exchanges with an entry date are utilized. Silver mining, telegraph lines, number of computers and literacy are all significant in the unrestricted B

[11] We also ran regressions on the US exchanges with *binary controls* the results are both qualitatively and quantitatively similar to the continuous control variables reported and are available upon request.

dataset. To interpret, a one percent increase leads to a 0.016% decrease in exchange growth for silver mining, a 0.626% increase for telegraph lines, a 0.008% increase for the number of computers and a 0.165 for the literacy rate. In terms of relative magnitudes, the literacy rate and growth in telegraph lines appear to dominate. Our finding for nationwide regulation is significant in the restricted sample, with a marginal effect of slowing exchange growth by 0.026% once enacted. We conclude that computers, Internet hosts, and literacy positively affect exchange growth in a consistently detectable way across datasets.

For *Entry*, our specification is

$$\log(Entry_{it}) = \mathbf{BZ}_t + \beta Blue\ Sky_{it} + \varepsilon_{it}$$

with results given in Table 11. Recall that entries in the table are marginal effects at the mean for a Poisson regression specified at the state level. Output growth is always significant with the largest marginal effect of 0.06 additional exchange entry events per year occurring in the restricted sample. Growth in silver mining is significant in the restricted and unrestricted B datasets. Telephone lines and computers are consistently significant with a maximum marginal effect of 0.006 and -0.008 entry events for growth in telephone lines and growth in the number of computers respectably. Finally, the impact of the literacy rate ranges from 2.998 to 3.907 in the UR-A and UR-B samples, respectively. To summarize, output growth, telephone lines, and literacy are positively related to entry, while the relationship is negative for silver mining and computers.

At the state-level regulation is significant only in the restricted sample, while the national policy variable *US Reg* is significant across all datasets. The marginal effect of the nationwide law ranges from -1.168 (UR-A) to -1.48 (UR-B) entry events per year. We conclude that the Blue Sky laws encouraged entry while the Securities Exchange Act discouraged it, but the evidence on the Blue Sky laws is limited to the restricted sample. The net effect of regulation when both dummies are active is negative across all datasets.

For *Exit*, we estimate

$$\log(Exit_{it}) = \mathbf{B}\mathbf{Z}_t + \beta Blue\ Sky_{it} + \varepsilon_{it}$$

with results presented in Table 12. The strong predictors here are mining, telephone lines, and computers. Growth in silver mining is consistently significant with marginal effect ranging from -0.012 (R) to -0.013 (UR-A) while gold mining is significant within the unrestricted samples with marginal effects ranging from 0.013 in UR-A and 0.023 in UR-B. Growth in computers is also consistently significant with a marginal effect ranging from -0.011 (UR-B) to -0.014 (UR-A). Surprisingly, the literacy rate is only marginally significant and there is no detectable effect of regulation on exit in our datasets. To conclude, gold mining and telephone lines encourage exit, while silver mining and computers discourage it and securities regulation policy has no detectable effect on exit.

5.D Hazard Models of US Exchange Exit

In this section we model going missing from the data as a competing hazard to exit. We start with the full US sample of financial exchanges. The first data scenario to consider is when all exchanges without an explicit exit date are dropped from the sample *ex-ante*, the restricted sample, so by construction no exchanges can go missing. In this case, it is sufficient to estimate the Cox proportional hazard model with time-varying covariates given by hazard function (exchange in state *i*, year *t*)

$$\lambda(t|\mathbf{Z}(t), Blue\ Sky(i, t)) = \lambda_0(t)\exp(\mathbf{B}\mathbf{Z}(t) + \beta Blue\ Sky(i, t))$$

because the competing hazard event is never observed in the restricted sample. Turn attention first to the Cox hazard model results in Table 13, column 3 (R), which reports estimated hazard ratios and robust standard errors. At $\alpha = 0.05$, the only significant predictors of exit as the sole hazard are telephone lines, Internet hosts, and nationwide regulation. Note that the hazard ratio is interpretable as a marginal effect. For binary variables like *US Reg,* with an estimated hazard ratio of 1.046 in the proportional hazard model, we find that exchanges are 4.6% more likely to exit per year after the passage of the Securities Exchange Act. For continuous variables like *Telephone* with a hazard ratio of

0.829, we find that a one percent increase in the growth of telephone lines leads to a 0.171% reduction in the likelihood of exit. Similarly, a one percent increase in the growth of Internet hosts is associated with a 0.007% decrease in the odds of exit. We find support for telecommunications advances like telephone lines and Internet hosts decreasing the chance of exchange exit and the risk of exit being attenuated by national securities regulation.

We can model the competing hazard directly when some subset of the unrestricted data is included in the sample used for analysis. Exchanges will now go missing and the competing hazard is observed. Results for the competing hazard model, adapted from Fine and Gray (1999), given by hazard function for the subdistribution (going missing, failure type 1; exit, failure type 2)

$$\lambda_1(t|\mathbf{Z}(t), \mathit{Blue\ Sky}(i, t)) = \lambda_{1,\,0}(t)\exp(\mathbf{BZ}(t) + \beta \mathit{Blue\ Sky}(i, t))$$

are presented in Table 13. Column 1 provides estimated subhazard ratios and robust standard errors when the full US sample is used and column 2 excludes the unrestricted B dataset. Subhazard ratios are interpretable like hazard ratios from the proportional hazard model, but they cannot be interpreted directly as marginal effects. Looking at the full sample in column 1, the following covariates are significant: silver mining, telephone lines, Blue Sky laws, and the Securities Exchange Act. Thus, growth in silver mining and telephone lines decreases the hazard of exit, while the application of state-level or national securities regulation increases that risk.

To conclude, across all three hazard models we find that growth in communications technology, particularly telephone lines, diminishes the risk of exit. Both state and Federal securities regulation increase the odds of exit. The two most robust predictors of exchange exit in the US data are growth in telephone lines and national securities regulation.

6. Conclusion

Using a novel panel dataset with an unprecedented level of detail, we investigate the historical dynamics of 741 financial exchanges in a sample of 52 countries to quantify the economic forces driving entry and exit. The historical record is not consistent with convergence to a single financial exchange in each country, or steady growth in the number of exchanges over time. We document periods of exchange entry and exit in many of the countries that we investigate. We consider two classes of models: one class includes binary controls in models across regional cuts of the data, while the other uses continuous controls to look exclusively at US data. In regional samples, periods of entry are negatively associated with US Blue Sky laws, but positively associated with communications advances and literacy. Periods of exit coincide with the US Silver Rush, communications advances, and UK securities regulation. The results suggest waves of entry and exit are primarily driven by underlying structural change and regulation, not business cycle fluctuations.

With continuous controls for US data, we find that entry is affected positively by output growth and literacy, negatively by regulation. Exit is driven by gold mining and telephone lines. We employ the proportional hazard model of Cox (1972) and the competing hazard model of Fine and Gray (1999) to study the exit of financial exchanges, where the competing hazard is going missing from the data. In a proportional hazard setting, we find that US exchanges are 4.6% more likely to exit per year after the passage of the Securities Exchange Act, but a one percent increase in the growth of telephone lines leads to a 0.171% reduction in the likelihood of exit. In summary, we find that the telephone, literacy, and regulation are robust predictors of financial exchange dynamics in both US and regional datasets.

These results suggest that the predicted long-run consolidation or fragmentation of exchanges, through sustained exit or entry, respectively, may only be a transitory phenomenon. We predict that if some demand for liquidity provision services goes unmet by incumbent exchanges, new exchanges will enter to meet that demand. Advances in telecommunications technology may render consolidation through shutdowns and mergers more attractive to firms in the financial exchange industry. However, we predict that such technological advances will not eliminate the role for competing entrant exchanges to resolve uncertainty about the viability of risky claims. This suggests that the economic role for competition among exchanges, including the dynamics of entry and exit, is not yet fully understood by the existing literature and could be explored further in future work.

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Table 1

Timing of Relevant Historical Events

Events listed detail the introduction, and period of, activity or "state-of-the-art-technology", in the case of communications. A dagger (†) denotes a variable used in our empirical work.

Event	Date(s)	Rationale
Silver rush†	1859–1873	Comstock Lode discovery made public to Coinage Act of 1873
Telegraph introduced	1845	First commercial telegraph line in the US; replaced by the telephone
Telephone†	1876–1976	Alexander Graham Bell awarded patent for electric telephone in 1876; replaced by the personal computer
Personal computer†	1977–1994	Apple II, PET, and TRS-80 personal computers introduced in 1977; replaced by the Internet
Internet†	1995–2012	Commercial restrictions on the use of the Internet lifted in 1995; current state-of-the-art technology
UK financial regulation†	1965–2012	Introduction of the Stock Transfer Act of 1963 in the UK
US financial regulation†	1934–2012	Introduction of the Securities Exchange Act in the US (1934)

Table 2

Variable Definitions and Sources

All variables listed are available from 1855–2012 on an annual basis. Continuous US variables sourced from the *Historical Statistics of the United States, Millennial Edition*, where "HSUS Code" corresponds to the specific series code used.

Variable	Definition
	Panel A: Dependent
Entry	Number of exchange entry events
Exit	Number of exchange exit events, includes exchange mergers/buyouts and shutdowns where trading is halted, and assets liquidated due to prevailing market conditions.
Exchanges	Growth rate in number of exchanges actively operating, per capita
	Panel B: Independent Continuous
Computer	Computers (number of computers), per-capita growth rate (US); HSUS Code Cg241
F_BlueSky	Fraction of US states with a Blue Sky law (see Table 3)
Gold Mining	Annual gold yield (metric tons), per-capita growth rate (US); HSUS Code Db94
GDP	Gross Domestic Product growth rate in a country/region, in real per-capita terms, 1996 $US; HSUS Code: Ca9
Internet	Internet hosts, total (number of hosts), per-capita growth rate (US); HSUS Code Dg110
Literacy	Literacy rate, percentage of persons above age 14 (US); HSUS Bc793
Silver Mining	Annual silver yield (metric tons), per-capita growth rate (US); HSUS Code Db95
Telegraph	Western Union telegraph wire (thousands of miles), per-capita growth rate (US); HSUS Code Dg11
Telephone	Bell (AT&T) telephone wire (thousands of miles), per-capita growth rate (US); HSUS Code Dg39
	Panel C: Independent Binary
$Blue\ Sky_{it}$	1 if US state *i* has a Blue Sky law in effect in year *t*, 0 otherwise
$D\_Telephone_t$	1 during telephone as state-of-the-art, $1876 \leq t \leq 1976$, 0 otherwise
$D\_Computer_t$	1 during computer as state-of-the-art, $1977 \leq t \leq 1994$, 0 otherwise
$D\_Internet_t$	1 during internet as state-of-the-art, $1995 \leq t \leq 2012$, 0 otherwise
$Silver\ Rush_t$	1 during US silver rush, $1859 \leq t \leq 1873$, 0 otherwise
$US\ Reg_t$	1 during US Securities and Exchange Act, $1934 \leq t \leq 2012$, 0 otherwise
$UK\ Reg_t$	1 during UK 1963 Stock Transfer Act, $1965 \leq t \leq 2012$, 0 otherwise
$USCW_t$	1 during US Civil War, $1861 \leq t \leq 1865$, 0 otherwise
WWI_t	1 during First World War, $1914 \leq t \leq 1918$, 0 otherwise
$WWII_t$	1 during Second World War, $1938 \leq t \leq 1945$, 0 otherwise

Table 3

Adoption Dates of Blue Sky Laws in the US

This table is sourced from Table 1 within Mahoney (2003) and reproduced here for completeness.

Year	Merit Review	Ex-Ante Fraud	Ex-Post Fraud
1911	Kansas		
1912	Arizona		Louisiana
1913	Arkansas, Idaho, Michigan, Montana, North Dakota, Ohio, South Dakota, Tennessee, Vermont, West Virginia	California, Florida, Georgia, Iowa, Missouri, Nebraska, North Carolina, Texas, Wisconsin	Maine, Oregon
1915		South Carolina	
1916		Mississippi, Virginia	
1917		Minnesota	New Hampshire
1919		Alabama, Illinois, Oklahoma, Utah, Wyoming	
1920		Indiana, Kentucky	Maryland, New Jersey
1921		Massachusetts, New Mexico, Rhode Island	New York
1923		Colorado, Washington	Pennsylvania
1929			Connecticut
1931			Delaware

Table 4

Linear Time Series Regression of the Number of Exchanges
World and Americas (1855-2012)

In all six regressions, the dependent variable is *Exchanges* (cumulative entry minus exit events). Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: α = 0.10 (*), 0.05 (**), 0.01 (***).

	World			Americas		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	-0.096	-0.118	-0.109	-0.038	-0.054	0.017
	(0.114)	(0.11)	(0.112)	(0.093)	(0.103)	(0.159)
Silver Rush	-0.011	-0.015	-0.034**	-0.051	-0.063	-0.108**
	(0.01)	(0.01)	(0.017)	(0.036)	(0.039)	(0.052)
D_Telephone	-0.019***	-0.027***	-0.031***	-0.065***	-0.088***	-0.101***
	(0.007)	(0.007)	(0.009)	(0.022)	(0.024)	(0.027)
D_Computer	0.000	-0.005	-0.009	-0.04*	-0.06**	-0.07**
	(0.01)	(0.011)	(0.011)	(0.023)	(0.024)	(0.027)
D_Internet	-0.006	-0.013	-0.017	-0.039	-0.058**	-0.067**
	(0.009)	(0.01)	(0.01)	(0.024)	(0.025)	(0.028)
Literacy	5.428***	7.038***	9.319***	11.256**	16.421***	21.464***
	(1.73)	(1.872)	(2.866)	(4.591)	(5.639)	(7.886)
F_BlueSky	-0.016	-0.039***	-0.057***	-0.041	-0.083**	-0.13***
	(0.01)	(0.014)	(0.019)	(0.027)	(0.032)	(0.043)
US Reg	-0.003	0.001	0.004	-0.012	0.000	0.006
	(0.006)	(0.006)	(0.007)	(0.011)	(0.013)	(0.017)
UK Reg	-0.006	-0.005	-0.004			
	(0.006)	(0.006)	(0.006)			
Also included: constant, *USCW*, *WWI*, *WWII*						
Pr. $> F$	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.301	0.319	0.314	0.303	0.354	0.341
RMSE	0.019	0.021	0.031	0.051	0.055	0.092
Sample size: 158						

Table 5

Linear Time Series Regression of the Number of Exchanges
Asia and Europe (1855-2012)

In all six regressions, the dependent variable is *Exchanges* (cumulative entry minus exit events). Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: α = 0.10 (*), 0.05 (**), 0.01 (***).

	Asia			Europe		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	-0.202	-0.211	-0.281	-0.102	-0.125*	-0.134
	(0.549)	(0.548)	(0.549)	(0.066)	(0.068)	(0.07)
D_Telephone	-0.09*	-0.09*	-0.092*	-0.006	-0.006	-0.005
	(0.053)	(0.053)	(0.055)	(0.004)	(0.004)	(0.004)
D_Computer	-0.106**	-0.104**	-0.104**	0.032**	0.032**	0.032**
	(0.05)	(0.05)	(0.052)	(0.016)	(0.015)	(0.014)
D_Internet	-0.112**	-0.114**	-0.115**	0.011	0.009	0.01
	(0.051)	(0.051)	(0.053)	(0.016)	(0.016)	(0.015)
UK Reg				-0.026**	-0.025**	-0.025**
				(0.012)	(0.012)	(0.01)
Also included: constant, *WWI*, *WWII*						
Pr. > *F*	0.006	0.004	0.004	0.021	0.019	0.007
R^2	0.114	0.115	0.115	0.132	0.136	0.143
RMSE	0.101	0.101	0.104	0.025	0.024	0.024
Sample size: 158						

Table 6

Poisson Time Series Regression of Exchange Entry
World and Americas (1855-2012)

In all six regressions, the dependent variable is *Entry*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: α = 0.10 (*), 0.05 (**), 0.01 (***).

	World			Americas		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	-0.931	-1.577	-2.16	-0.783	0.433	0.887
	(2.147)	(2.163)	(2.243)	(3.332)	(2.731)	(2.705)
Silver Rush	0.051	-0.094	-0.169	-0.01	-0.229	-0.343
	(0.265)	(0.242)	(0.251)	(0.333)	(0.324)	(0.339)
D_Telephone	0.047	0.127	0.458*	0.155	0.171	0.531*
	(0.268)	(0.232)	(0.252)	(0.337)	(0.272)	(0.303)
D_Computer	1.336***	1.493***	1.629***	1.173**	1.33***	1.595***
	(0.383)	(0.363)	(0.336)	(0.532)	(0.503)	(0.502)
D_Internet	1.968***	2.107***	2.236***	2.131***	2.283***	2.543***
	(0.352)	(0.332)	(0.305)	(0.478)	(0.452)	(0.453)
Literacy	292.871***	356.046***	353.783***	207.647*	334.629***	338.166***
	(87.678)	(77.585)	(82.593)	(113.653)	(94.277)	(100.785)
F_BlueSky	-7.665*	-9.554*	-11.073**	-27.437	-22.823*	-24.065**
	(4.249)	(5.711)	(5.154)	(19.407)	(11.993)	(11.407)
US Reg	-0.219	-0.527*	-0.892***	-1.565***	-1.912***	-2.277***
	(0.316)	(0.287)	(0.285)	(0.433)	(0.383)	(0.372)
UK Reg	-0.088	-0.058	0.113			
	(0.313)	(0.315)	(0.263)			
Also included: constant, *USCW*, *WWI*, *WWII*						
$Pr. > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo-R^2	0.225	0.252	0.294	0.206	0.316	0.403
Sample size: 158						

Table 7

Poisson Time Series Regression of Exchange Entry
Asia and Europe (1855-2012)

In all six regressions, the dependent variable is *Entry*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: α = 0.10 (*), 0.05 (**), 0.01 (***).

	Asia			Europe		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	1.102	0.314	-1.01	-4.072	-4.072	-5.882
	(4.174)	(4.125)	(3.883)	(4.808)	(4.808)	(4.354)
D_Telephone	0.867**	0.889**	0.768**	-0.47	-0.47	-0.349
	(0.418)	(0.42)	(0.378)	(0.427)	(0.427)	(0.381)
D_Computer	1.815***	1.905***	1.788***	16.151***	16.151***	1.417*
	(0.495)	(0.491)	(0.446)	(0.565)	(0.565)	(0.777)
D_Internet	1.931***	1.941***	1.779***	16.829***	16.829***	2.085***
	(0.444)	(0.447)	(0.406)	(0.538)	(0.538)	(0.775)
UK Reg				-15.341***	-15.341***	-0.695
				(0.374)	(0.374)	(0.678)
Also included: constant, *WWI*, *WWII*						
$Pr. > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo-R^2	0.129	0.133	0.127	0.266	0.266	0.205
Sample size: 158						

Table 8

Poisson Time Series Regression of Exchange Exit
World and Americas (1855-2012)

In all six regressions, the dependent variable is *Exit*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: α = 0.10 (*), 0.05 (**), 0.01 (***).

	World			Americas		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	1.969	1.66	0.472	-1.465	1.397	-1.121
	(4.374)	(4.172)	(4.281)	(4.361)	(3.035)	(2.88)
Silver Rush	13.755***	14.971***	16.197***	16.386***	15.208***	14.824***
	(0.647)	(0.641)	(0.642)	(0.818)	(0.655)	(0.672)
D_Telephone	13.947***	15.596***	16.537***	16.528***	15.835***	15.176***
	(0.508)	(0.448)	(0.555)	(0.742)	(0.47)	(0.464)
D_Computer	13.779***	15.479***	16.38***	15.589***	14.974***	14.392***
	(0.691)	(0.631)	(0.648)	(0.825)	(0.607)	(0.609)
D_Internet	14.883***	16.623***	17.49***	16.986***	16.343***	15.66***
	(0.596)	(0.558)	(0.508)	(0.759)	(0.6)	(0.587)
Literacy	-9.982	67.127	35.696	-107.658	9.709	18.367
	(140.48)	(108.915)	(109.169)	(169.336)	(120.543)	(118.938)
F_BlueSky	-32.058***	-1.267	-1.272	-32.938**	-1.254	-1.202
	(11.775)	(1.612)	(1.7)	(15.595)	(1.742)	(1.795)
US Reg	0.338	-0.226	-0.816**	-0.125	-0.788**	-1.326***
	(0.488)	(0.4)	(0.393)	(0.467)	(0.357)	(0.366)
UK Reg	0.329	0.279	0.296			
	(0.432)	(0.425)	(0.404)			
Also included: constant, *USCW*, *WWI*, *WWII*						
$Pr. > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo-R^2	0.248	0.173	0.161	0.099	0.117	0.217
Sample size: 158						

Table 9

Poisson Time Series Regression of Exchange Exit
Asia and Europe (1855-2012)

In all six regressions, the dependent variable is *Exit*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses. Significance levels denoted by: $\alpha = 0.10$ (*), 0.05 (**), 0.01 (***).

	Asia			Europe		
	R	UR-A	UR-B	R	UR-A	UR-B
GDP	7.642	6.201	5.428	10.027	13.886	10.357
	(10.494)	(9.591)	(8.316)	(8.26)	(8.726)	(7.403)
D_Telephone	13.797***	15.156***	1.048	14.941***	14.884***	1.665
	(0.454)	(0.23)	(1.028)	(0.453)	(0.369)	(1.021)
D_Computer	15.937***	17.202***	2.88***	14.211***	14.214***	0.823
	(0.498)	(0.436)	(1.061)	(1.182)	(1.167)	(1.49)
D_Internet	16.444***	17.777***	3.389***	15.827***	15.857***	2.46**
	(0.397)	(0.113)	(1.022)	(0.681)	(0.646)	(1.147)
UK Reg				1.758***	1.67***	1.601***
				(0.644)	(0.633)	(0.538)
Also included: constant, *WWI*, *WWII*						
$Pr. > \chi^2$	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo-R^2	0.288	0.292	0.246	0.328	0.33	0.28
Sample size: 158						

Table 10

Linear US State-level Panel Regression of the Number of Exchanges
Continuous Control Variables (1855-2012)

In all three regressions, the dependent variable is *Exchanges* (cumulative entry minus exit events). Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses, clustered at the state level for 14 US states with 5 or more exchanges at the end of the sample: California, Colorado, Illinois, Massachusetts, Minnesota, Missouri, Nevada, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, and Washington. Nevada is counted as passing a Blue Sky law in 1933 when Federal legislation was enacted (Securities Act of 1933). State-level fixed effects are included. Significance levels: $\alpha = 0.10$ (*), 0.05 (**), 0.01 (***).

	US		
	R	UR-A	UR-B
GDP	0.087	0.206	0.291
	(0.118)	(0.157)	(0.189)
Silver Mining	-0.007	-0.01*	-0.016**
	(0.004)	(0.005)	(0.007)
Gold Mining	-0.009	-0.027	-0.014
	(0.023)	(0.026)	(0.029)
Telegraph	-0.012	0.077	0.626**
	(0.119)	(0.18)	(0.265)
Telephone	0.017	-0.05*	-0.033
	(0.02)	(0.028)	(0.034)
Computer	0.006**	0.009***	0.008**
	(0.003)	(0.003)	(0.003)
Internet	0.006*	0.01**	0.009**
	(0.003)	(0.003)	(0.004)
Literacy	4.638	14.582***	16.569***
	(2.924)	(3.933)	(4.799)
Blue Sky	0.01	-0.004	0.015
	(0.01)	(0.012)	(0.011)
US Reg	-0.026**	-0.014	-0.01
	(0.009)	(0.01)	(0.011)
Also included: constant, *USCW*, *WWI*, *WWII*			
$Pr. > F$	0.000	0.000	0.000
R^2 Within	0.018	0.025	0.034
R^2 Between	0.112	0.092	0.011
R^2 Overall	0.018	0.025	0.034
Sample size: 2212 (14 groups)			

Table 11

**Linear US State-level Panel Regression of Exchange Entry
Continuous Control Variables (1855-2012)**

In all three regressions, the dependent variable is *Entry*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses, clustered at the state level for 14 US states with 5 or more exchanges at the end of the sample: California, Colorado, Illinois, Massachusetts, Minnesota, Missouri, Nevada, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, and Washington. Nevada is counted as passing a Blue Sky law in 1933 when Federal legislation was enacted (Securities Act of 1933). State-level fixed effects are included. Significance levels: α = 0.10 (*), 0.05 (**), 0.01 (***).

	US		
	R	UR-A	UR-B
GDP	6.061***	5.87***	4.702***
	(2.244)	(1.935)	(1.416)
Silver Mining	-0.225***	-0.324*	-0.311**
	(0.074)	(0.176)	(0.126)
Gold Mining	-1.664	-0.521	1.15
	(1.822)	(1.33)	(1.621)
Telegraph	3.116	-0.342	1.319
	(1.893)	(2.433)	(1.799)
Telephone	0.683***	0.488**	0.464**
	(0.25)	(0.232)	(0.196)
Computer	-0.801***	-0.659***	-0.551***
	(0.141)	(0.145)	(0.126)
Internet	0.104	0.108	0.008
	(0.254)	(0.196)	(0.218)
Literacy	78.433	299.879***	390.767***
	(104.617)	(103.258)	(81.878)
Blue Sky	0.909***	0.202	0.241
	(0.326)	(0.333)	(0.335)
US Reg	-1.19***	-1.168***	-1.48***
	(0.291)	(0.323)	(0.406)
Also included: constant, *USCW*, *WWI*, *WWII*			
$Pr. > \chi^2$	0.000	0.000	0.000
Sample size: 2212 (14 groups)			

Table 12

Linear US State-level Panel Regression of Exchange Exit
Continuous Control Variables (1855-2012)

In all three regressions, the dependent variable is *Exit*. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses, clustered at the state level for 14 US states with 5 or more exchanges at the end of the sample: California, Colorado, Illinois, Massachusetts, Minnesota, Missouri, Nevada, New York, Ohio, Oregon, Pennsylvania, Texas, Utah, and Washington. Nevada is counted as passing a Blue Sky law in 1933 when Federal legislation was enacted (Securities Act of 1933). State-level fixed effects are included. Significance levels: α = 0.10 (*), 0.05 (**), 0.01 (***).

	US		
	R	UR-A	UR-B
GDP	0.554	1.356	0.969
	(2.532)	(1.774)	(1.25)
Silver Mining	-1.251***	-1.38***	-1.346***
	(0.347)	(0.456)	(0.406)
Gold Mining	0.934	1.385***	2.397**
	(0.73)	(0.532)	(1.048)
Telegraph	4.285	-2.939	-3.067
	(2.977)	(4.048)	(2.802)
Telephone	-1.13	0.721***	0.497***
	(1.363)	(0.24)	(0.181)
Computer	-1.414***	-1.448***	-1.181***
	(0.504)	(0.463)	(0.42)
Internet	-0.963*	-0.893*	-0.953*
	(0.521)	(0.464)	(0.499)
Literacy	-123.863**	32.904	4.615
	(54.897)	(58.679)	(123.643)
Blue Sky	-0.295	-0.481	-0.678*
	(0.72)	(0.396)	(0.347)
US Reg	0.631	-0.043	-0.868
	(0.59)	(0.264)	(0.555)
Also included: constant, *USCW*, *WWI*, *WWII*			
$Pr. > \chi^2$	0.000	0.000	0.000
Sample size: 2212 (14 groups)			

Table 13

Hazard Model of US Exchange Exit
Continuous Control Variables (1855-2012)

In all three regressions, the hazard variable is *Exit*; competing hazard variable is *Missing*. Figures reported are subhazard ratios, not estimated coefficients. All covariates can vary over time. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided. Robust standard errors are reported in parentheses, clustered at the exchange level. Significance levels: α = 0.10 (*), 0.05 (**), 0.01 (***).

	Competing Hazard: *Missing*		Cox Hazard
	R, UR-A, UR-B	R, UR-A	R
GDP	1.051	1.037	1.084
	(0.087)	(0.081)	(0.079)
Silver Mining	0.959**	0.966*	0.975
	(0.017)	(0.018)	(0.016)
Gold Mining	1	0.999	1.007
	(0.014)	(0.014)	(0.008)
Telegraph	1.525	1.372	1.186
	(0.786)	(0.62)	(0.42)
Telephone	0.805***	0.809***	0.829***
	(0.052)	(0.045)	(0.046)
Computer	0.999	0.998	0.997
	(0.004)	(0.004)	(0.004)
Internet	0.995*	0.994*	0.993**
	(0.003)	(0.003)	(0.003)
Literacy	0.047	0.065	0.187
	(0.097)	(0.13)	(0.344)
Blue Sky	1.143***	1.108***	1.055*
	(0.054)	(0.043)	(0.033)
US Reg	1.07***	1.059***	1.046**
	(0.025)	(0.022)	(0.021)
Also included: constant, *USCW*, *WWI*, *WWII*			
$Pr. > \chi^2$	0.000	0.000	0.000
Observations	5802	5496	4757
Subjects	296	194	120
Failed	96	96	96
Competing	176	74	
Censored	24	24	

Figure 1

Number of Exchanges in All Sample Countries, 1850-2012

Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided.

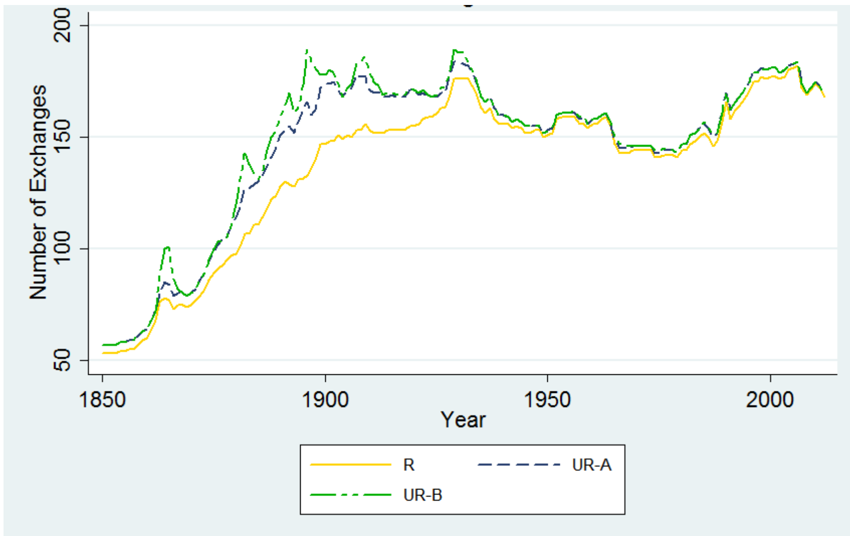


Figure 2

Number of Exchanges by Region, 1553-2012

Figure utilizes subsample R (restricted) where exchanges are counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012). Regions are: Africa, Asia, Europe, Middle East (ME), North America (NA) and South America (SA).

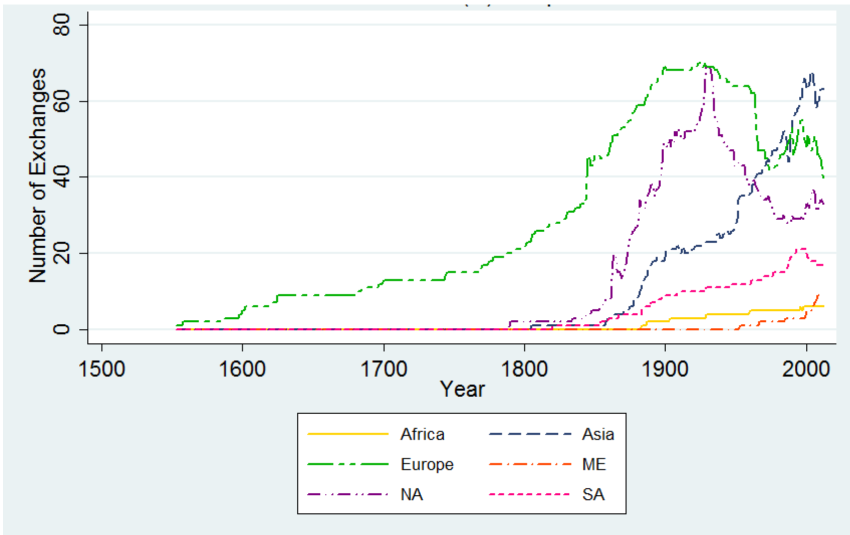


Figure 3

Exchange Entry Events in All Sample Countries, 1850-2012

Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided.

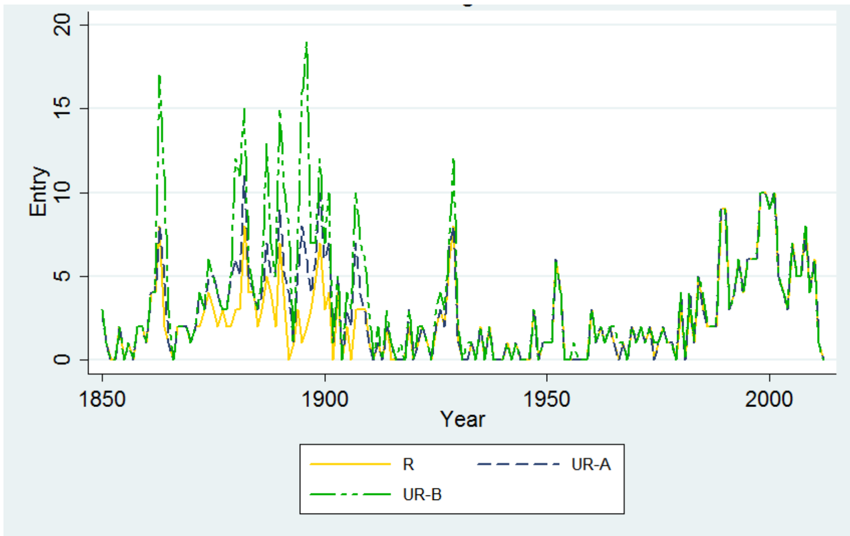


Figure 4

Exchange Exit Events in All Sample Countries, 1850-2012

Exchange exit events are the sum of exchange shutdowns and merger/buyouts. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided.

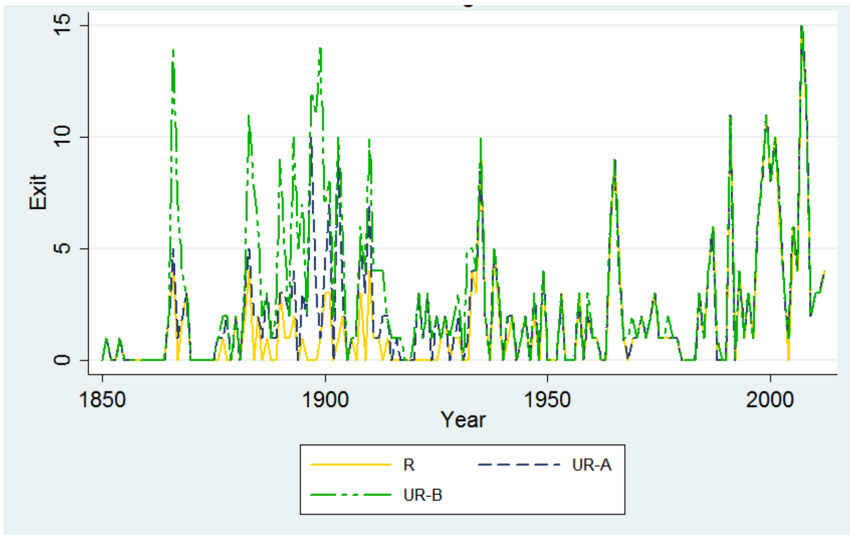
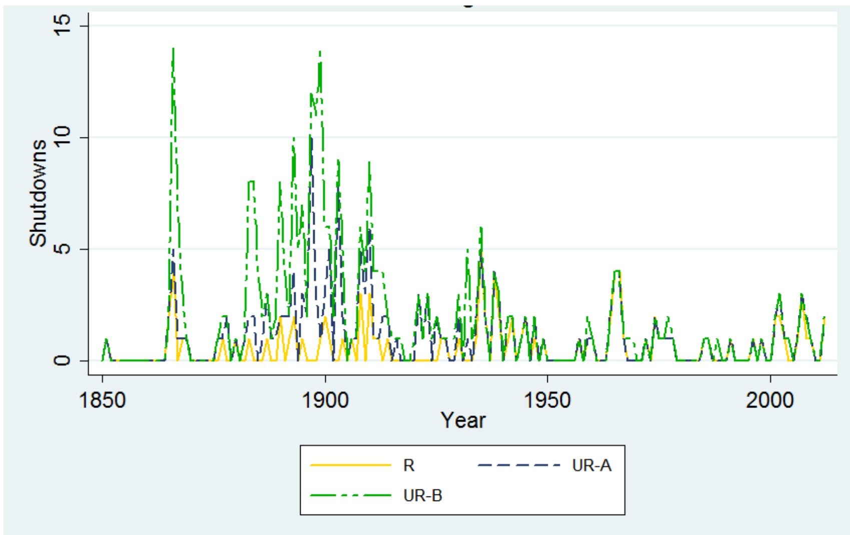


Figure 5

Exchange Shutdown and Merger Events in All Sample Countries, 1850-2012

Panel A displays exchange shutdown events defined as a permanent trading halt and asset liquidation due to prevailing market conditions and Panel B displays merger/buyout events. Subsamples are defined as: R (restricted): counted as missing unless an explicit exit date is provided (or survived to the end of the sample period, 2012), UR-A (unrestricted A): counted as missing unless an explicit exit or missing date is provided, UR-B (unrestricted B): counted as missing unless an entry date is provided.

Panel A: Exchange Shutdowns



Panel B: Exchange Mergers/Buyouts