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Postal Networks and Economic Growth
Did the connection into the early modern postal network foster city growth, evidence from the 16th century Holy Roman Empire and Habsburg Territories

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Abstract

This thesis examines whether integration into the early modern postal network fostered economic activity and thereby urban growth in the Holy Roman Empire and Habsburg territories during the 16th century. Using a newly constructed city-level panel dataset (1400–1650) and a staggered difference-in-differences approach, the postal system is interpreted as an early form of communication infrastructure. The results show no evidence of a positive average effect of postal connectivity on urban growth. Estimated effects on population levels are small or negative, while growth effects remain statistically insignificant. However, a robust pattern of heterogeneity emerges, smaller cities benefit relatively more, whereas larger cities experience no gains or even negative effects. Extensions indicate that proximity to the network is insufficient to generate economic benefits, highlighting the importance of direct integration. Overall, the findings suggest that improved communication alone was not enough to generate sustained urban growth in a fragmented and unstable pre-industrial environment.

Zusammenfassung

Die vorliegende Masterarbeit untersucht, ob eine Anbindung an das frühneuzeitliche Postsystem das Stadtwachstum im Heiligen Römischen Reich und in den Habsburgischen Territorien im 16. Jahrhundert gefördert hat. Auf der Basis eines neu erstellten Paneldatensatzes auf Stadtebene (1400–1650) und eines gestaffelten Differenz-in-Differenzen-Ansatzes wird das Postsystem als frühe Form der Kommunikationsinfrastruktur interpretiert. Die Ergebnisse der Arbeit zeigen dabei keinen positiven durchschnittlichen Effekt der Postanbindung auf das Stadtwachstum. Die geschätzten Effekte der Postanbindung auf das Bevölkerungsniveau sind klein oder negativ, während die Wachstumseffekte statistisch insignifikant bleiben. Es zeigt sich allerdings ein robustes Muster von Heterogenität: Kleinere Städte profitieren relativ stärker, während größere Städte keine Zugewinne oder sogar negative Effekte aufweisen. Erweiterungen zeigen, dass räumliche Nähe zum Netzwerk nicht ausreicht, um wirtschaftliche Vorteile zu generieren, und unterstreichen die Bedeutung eines direkten Anschlusses. Insgesamt deuten die Ergebnisse darauf hin, dass verbesserte Kommunikation allein nicht ausreichte, um nachhaltiges Wachstum in einem fragmentierten und instabilen vorindustriellen Umfeld zu erzeugen.

AI Attribution Statement

This work was created with an even blend of human and AI contributions. AI was used to make stylistic edits, such as changes to structure, wording, and clarity. AI was used to make content edits, such as changes to scope, information, and ideas. AI was prompted for its contributions, or AI assistance was enabled. AI-generated content was reviewed and approved. The following model(s) or application(s) were used: ChatGPT Plus.

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1. Introduction

The establishment of the early modern postal system can be seen as one of the central institutional and infrastructural developments of the late 15th and the 16th century. In this period, a new form of organization of information transmission emerged, which was mainly characterized by an increasing degree of regularity, reliability, and spatial reach. This development has even been described as a "communication revolution," as it fundamentally changed the way in which information was transmitted and perceived across Europe (Behringer 2005). A key element of this transformation was the emergence of the early modern postal system, which, beginning in the late 15th century, created a permanent network of communication routes connecting different regions of the continent. In the Habsburg territories, this development dates back to Maximilian I, who commissioned the establishment of a first postal route connecting Brussels and Innsbruck in 1490, thereby laying the foundations for a structured system of information exchange across his geographically dispersed territories (Winkelbauer 2003).

While the historical importance of this development has been widely acknowledged, particularly its role within the history of communication and state formation, its economic implications remain less investigated. In particular, the question of whether, and to what extent, the emergence and expansion of the postal system affected economic development at the city level has so far received comparatively little attention. Given that the postal network can be interpreted as an early form of information infrastructure, which reduced the time and uncertainty associated with communication across space, it is plausible to expect that its introduction may have influenced economic activity and thereby also urban development. This raises the question of whether the connection into this communication network had measurable economic effects. Particularly, the question arises whether cities that were integrated into the postal system experienced different growth-paths compared to those that remained unconnected. Addressing this question is not only relevant for understanding the economic consequences of the postal system itself but also contributes to a broader discussion on the role of information, infrastructure, and institutions in shaping pre-modern economic development.

The emergence of the early modern postal system has been studied extensively within the historical literature, where it is commonly interpreted as part of a broader transformation of communication in early modern Europe. Behringer (1990) provides a detailed account of the development of the Habsburg-Taxis postal system, highlighting its institutional structure, the role the Taxis-family played, as well as its role in enabling communication across

geographically dispersed territories. Building on this, Behringer (2005) characterizes the increasing regularity, speed, and reliability of information transmission as a "communication revolution," arguing that it fundamentally changed both the perception of space across Europe and the functioning of political and economic systems. This perspective is supported by Schobesberger et al. (2016), who highlight the emergence of interconnectedness through communication networks, forming a backbone of European communication, thereby facilitating the circulation of information across long distances, as well as Caplan (2016), who emphasizes that early modern postal systems were not only used as administrative tools, but as practical infrastructures of exchange, that shaped the conditions under which letters, information, and commercial communication circulated across Europe. While Dallmeier (1977) has collected and summarized the most relevant preserved documents concerning postal history and has put them in context, Winkelbauer (2003), shows the importance of the post for the Habsburg territories and their history by dedicating a whole chapter to the post and the communication reforms, in his comprehensive book about the Habsburgs history in the 16th and 17th century. Similarly, Brayshay (1991) and Brayshay et al. (1998) emphasize the role of early modern postal systems in governance and state control, looking at cases in Britain, while Bretagnolle et al. (2010) illustrate the importance of network structure and spatial organization for the efficiency of postal systems, by investigating the French system. For the Nordics, Linnarsson (2011) shows that the creation of postal systems in early modern Europe was often driven by military and administrative needs, strengthening the interpretation of the post as an institutional response to the problem of governing across distance, while the Russian case investigated by Ottinger and Zelnitskaia (2025) suggests that relay-based transport systems can generate long-run path dependence in urban development, because station placement may follow logistical rules rather than existing economic geography. The historical literature on the early modern post therefore stresses the institutional and infrastructural innovation it played in the organization of communication; however, these contributions are primarily concerned with the historical development and functioning of postal systems and remain largely descriptive in nature, leaving a gap in the economic effects of this system.

On the economic history side, the importance of infrastructure as a determinant of economic development has been emphasized extensively. A large part of this literature focuses on transport infrastructure and shows that improvements in connectivity can affect trade, market access, population distribution, and long-run regional development. For railways, Donaldson (2018) demonstrates positive income effects in colonial India, while Donaldson and Hornbeck (2016) show that railroads contributed to market integration and economic growth in

nineteenth-century United States. Earlier, Fogel (1970) had already established transport infrastructure as a key explanatory factor in economic history, although with more modest effects than previously assumed. Similarly, Keller and Shiue (2004, 2008a) show for nineteenth-century Germany that railways improved market integration by reducing trade costs and increasing connectivity, while also emphasizing the interaction between infrastructure and institutional structures. Beyond trade, infrastructure also affected urban development and the spatial allocation of economic activity. Hornung (2015) shows for Prussia that railway expansion influenced population distribution, Duranton and Turner (2012) find that highways shaped the spatial distribution of economic activity within cities, and Jedwab et al. (2017) emphasize the long-run persistence created by colonial infrastructure in Kenya. While these studies focus mainly on physical transport infrastructure, related evidence also exists for communication infrastructure. Röller and Waverman (2001) show positive growth effects of telecommunications infrastructure, Czernich et al. (2011) find similar effects for broadband internet, and Rogowski et al. (2022) emphasize the broader importance of public infrastructure for economic outcomes, including through governance capacity. Taken together, this literature suggests that improvements in connectivity can have substantial economic implications, but most evidence concerns modern infrastructure, while early modern communication systems such as the postal network have received comparatively little attention.

Closely related to this, is the literature on information, communication, and market integration. In contrast to transport infrastructure, which primarily reduces the costs of moving goods and people, communication technologies reduce the costs and uncertainty of transmitting information, thereby facilitating coordination across space. Dittmar (2011) shows that the printing press, as an early information technology, had significant effects on urban growth and economic development. Koudijs (2016) and Neal (2000) demonstrate the importance of information flows for early modern and pre-modern financial markets, while Steinwender (2018) shows for the telegraph that reductions in information frictions can have substantial real effects by improving economic decision-making. Similar mechanisms are found in the literature on communication technologies and market integration. Andrabi et al. (2020, 2023) show that post offices and telegraph networks contributed to price convergence in colonial India, Hoag (2006) highlights the role of communication technologies for financial information in nineteenth-century U.S. capital markets, and Ploeckl (2023) shows how local and external market access shaped the adoption of the telephone in Bavaria. Keller and Shiue (2004, 2008b) further emphasize that timely and reliable information is crucial for trade and economic development, while Federico (2011) and Clark (2015) show from a broader historical

perspective that pre-industrial market integration depended strongly on the availability and transmission of information. This view is also supported by research on merchant networks, where Greif (2006) highlights the role of information sharing and reputation mechanisms in sustaining long-distance trade, while Trivellato (2009) shows how correspondence and information flows helped merchant networks manage uncertainty and coordinate exchange across regions. This literature suggests that communication is economically important especially in environments characterized by uncertainty, fragmented markets, and limited formal institutions, such as the sixteenth-century Holy Roman Empire and Habsburg territories.

In addition to infrastructure and information, institutions are central for understanding pre-industrial economic development. Since the postal system can also be interpreted as an institution, or at least as an institutionalized infrastructure, this thesis also considers the institutional dimension of the early modern postal network (Behringer 1990; Dallmeier 1977; Winkelbauer 2003). North and Weingast (1989) emphasize the importance of credible commitment, constraints on political authority, and secure property rights for market development, while Acemoglu, Johnson, and Robinson (2001, 2004) argue more generally that institutions shape incentives, reduce uncertainty, and enable long-run economic development. This perspective is particularly relevant for the Holy Roman Empire, where political fragmentation shaped both economic activity and administrative capacity. Geloso and Makovi (2022), however, caution that postal expansion should not automatically be interpreted as effective state capacity or as growth-enhancing infrastructure, showing for nineteenth-century Quebec that post offices did not clearly increase agricultural output. For the Holy Roman Empire, this has to be considered in a different institutional context, as proto-state-type institutions were still forming. Cantoni et al. (2024) show how the rise of fiscal capacity in the Empire was connected to administrative development, state building, and economic outcomes. Moreover, De Long and Shleifer (1993) highlight that differences in political regimes had a significant impact on urban development in pre-industrial Europe, while Lehmann-Hasemeyer and Wahl (2024) summarize many of these mechanisms and their relevance for the pre-modern development of cities.

In this context, the early modern postal system can be interpreted not only as an infrastructural innovation, but also as an institutional one, which facilitated governance and administrative coordination across space. By enabling more reliable and regular communication between political centres and peripheral regions, the postal network contributed to overcoming some of the constraints imposed by fragmented political authority. The literature on institutions

therefore suggests that improvements in administrative capacity and governance structures can have important economic implications, further reinforcing the idea that the establishment of the postal system may have affected economic development through both institutional and informational channels.

Even though the literature on infrastructure, information, and institutions, as well as the detailed historical research on the development of early modern postal systems, is extensive, there remains a notable gap in the empirical analysis of its economic effects. While previous studies have demonstrated that improvements in connectivity and reductions in information frictions can have substantial impacts on economic activity, these insights are most often taken from more modern settings or from different types of technologies. In particular, the question of whether the emergence and expansion of the early modern postal system affected urban economic development at the city level in early modern Europe has so far received comparatively little empirical and attention. The closest related contribution is provided by Sasaki (2024), who investigates the economic effects of postal infrastructure in France from 1500-1850. While this paper offers important evidence that communication networks did not necessarily foster growth directly, its focus lies on France, which experienced a different evolution of the postal system being Crown-run in the beginning and only became open to the public at a later point. Dittmar (2011) provides closely related evidence for the early modern period with a similar empirical set-up, showing that the introduction of the printing press had significant effects on urban growth and economic development. While this highlights the importance of information technologies in a temporally comparable setting, the printing press differs fundamentally from the postal system, as it primarily affected the production and diffusion of knowledge rather than the transmission of information across space.

This thesis contributes to the literature by providing a systematic empirical analysis of the economic effects of the early modern postal system in the Holy Roman Empire and Habsburg territories. It thereby combines insights from the literature on infrastructure, information, and institutions by interpreting the postal system as a hybrid form of communication infrastructure that reduced information frictions, facilitated coordination across space, and contributed to administrative capacity. In doing so, it extends the analysis of information-based economic development to a setting in which communication improvements were implemented through a territorially embedded and institutionally structured network. Empirically, this thesis contributes in three main ways. Firstly, it provides a quantitative assessment of the relationship between postal network connection and urban growth, thereby complementing the largely descriptive historical literature on the postal system. Secondly, it

introduces a newly constructed panel dataset of cities in the Holy Roman Empire and Habsburg territories, covering the period from 1400 to 1650, which combines information on city populations with data on the timing of connection to the postal network as well as a set of control variables. Thirdly, it exploits the staggered expansion of the postal system across cities, which generated variation in the timing of connection and allows for an empirical strategy based on differences in treatment timing. This approach makes it possible to compare cities that became connected to the postal network at different points in time with those that remained unconnected, while accounting for time-invariant city characteristics and common temporal shocks.

From an analytical perspective, the introduction of the postal system can be expected to have affected economic development through its impact on information transmission and coordination. By reducing the time and uncertainty associated with communication, the postal network may have facilitated trade, improved administrative efficiency, and strengthened connections between economic centres as well as facilitated the exchange of payments and the information of prices. At the same time, the effects of postal connectivity are unlikely to have been identical across cities but may instead have depended on pre-existing characteristics such as city size, economic importance, or geographic position within the network. Based on these considerations, this thesis addresses the following research question: Did the connection into the early modern postal system foster economic activity thereby leading to city growth? The hypothesis here would be, that cities connected to the postal network experienced higher levels of growth compared to those that remained unconnected, while allowing for heterogeneous effects depending on initial conditions and network position.

2. Historical Background

2.1. The Political Necessity for a Postal System

In order to understand the empirical setup of this thesis, it is necessary to understand the historical background and the events surrounding the emergence of the early modern postal system. The establishment of a regular and structured system of communication can be seen as one of the central institutional developments of the late 15th and early 16th century, which has been described as a “communication revolution” (Behringer 2005). This development did not only affect the speed and reliability of information transmission, but also fundamentally changed the way political and economic spaces were connected across Europe (Schobesberger et al. 2016). To understand how this system emerged, and why it was established in the specific form observed in the Habsburg territories and the Empire, the political, geographic, and

dynastic conditions of the late 15th century, which created both the necessity and the opportunity for such an institutional innovation have to be considered.

1490 can be considered a central year for the history of the postal system. In this year, Maximilian I, then King of the Holy Roman Empire, commissioned Johann von Taxis with the establishment of a first postal route connecting Brussels and Innsbruck (Behringer 1990). In order to understand why this connection was established, it is crucial to look not only at the immediate administrative needs, but also at the broader political and dynastic developments of the House of Habsburg. The foundations for this development had already been laid under Maximilian's father, Emperor Frederick III. Through his dynastic marriage to Eleonore of Portugal and his broader marriage policy, Frederick III established the basis for the subsequent territorial expansion of the Habsburgs. Although often described as a rather cautious ruler, his strategy of dynastic consolidation and marriages created the conditions for the rapid increase in territorial control under Maximilian I (Hansert 2009).

The most important of these dynastic developments for the emergence of the postal system was Maximilian's marriage to Mary of Burgundy in 1477. Following the death of her father Charles the Bold and later Mary herself in 1482, the Burgundian territories passed to Maximilian I. This transfer of territories represented not only a significant political expansion, but also an important economic addition. The Burgundian lands included some of the most economically advanced regions of Europe, such as Flanders, Brabant, and Holland, whose cities—Bruges, Brussels, and Antwerp—were among the leading commercial centres of the time (Hollegger 2005). At the same time, the consolidation of Habsburg territories in Central Europe further increased the spatial dispersion of Habsburg territories. After Maximilian had been crowned King of the Holy Roman Empire in 1486, continuity of Habsburg rule within the Empire was secured. However, the Habsburg hereditary lands themselves had previously been divided into different lines, most notably a Tyrolean and an Austrian branch. This fragmentation was partially resolved in 1490, when Duke Sigismund of Tyrol abdicated under political and economic pressure and transferred his territories to Maximilian I (Hollegger 2005). With the acquisition of Tyrol and the so-called Further Austrian lands, Maximilian gained control over one of the most important mining regions of the time, particularly rich in silver and copper. These resources formed a crucial economic basis for Habsburg rule and were closely connected to the financial networks of major merchant families such as the Fugger, which would also play a crucial role in the financing of the postal system later (Häberlein 2012). At the same time, the integration of these territories further increased the geographic spread of Habsburg possessions.

In this context, the relocation of the Habsburg capital to Innsbruck becomes particularly

important. Innsbruck was not only located close to the mining regions but also occupied a geographically central position within the Habsburg territories and served as a strategic base for Maximilian's Italian policy (Winkelbauer 2003). The combination of these developments resulted in a territorial structure that was highly fragmented and spatially dispersed. The Habsburg lands now extended from the Burgundian and Low Countries regions to the territories of Tyrol and further into Northern Italy, as well as the core Habsburg hereditary Austrian lands. Governing such a composite monarchy required the coordination of political decisions, administrative processes, and military actions across large distances. It is therefore possible to argue that the establishment of a permanent postal connection between Brussels and Innsbruck was not merely a technical innovation, but rather a direct response to the structural challenges of governing a geographically dispersed polity. The need to transmit information, instructions, and administrative decisions between these regions created strong incentives for the development of a more reliable and faster communication system (Behringer 1990).

In this sense, the emergence of the Habsburg postal system can be understood as the outcome of a specific constellation of political expansion, geographic fragmentation, and administrative necessity. The creation of a permanent and centrally organized communication network was an exceptional development in the context of late 15th-century Europe, where information exchange was still largely irregular and decentralized. By introducing a system characterized by regularity, speed, and territorial reach, the Habsburg postal system represented a fundamentally new way of organizing information flows. This makes its emergence particularly noteworthy, as it provides a rare historical instance in which a large-scale communication infrastructure was introduced in a relatively discrete and coordinated manner.

2.2. The Institutional and Economic Foundations of the Postal System

In addition to the causes that led to its establishment, it is equally important to examine how this necessity translated into the creation of a concrete and functioning system of information transmission. The core innovation of the early modern postal system lay in the establishment of a network of fixed relay stations, so-called *postes*, along the main communication routes. Along the route from Brussels to Innsbruck, stations were installed at regular intervals, which allowed for the systematic exchange of horses as well as the provisioning of both horses and mounted couriers. Exactly this system of relay stations represents one of the key features distinguishing the postal system from earlier messenger systems. Instead of relying on individual messengers travelling long distances, the organization into segments allowed couriers to cover only specific parts of the route, thereby forming a continuous chain of

communication. This significantly reduced travel and transmission times and ensured a higher degree of reliability and regularity. Especially when compared to earlier medieval practices, where messages were often handed to travellers who were frequently on foot, this constituted a substantial improvement in the efficiency of communication and sped up the transmission of information drastically (Behringer 1990). It is precisely this drastic reduction in communication times that has led to characterize the development of the postal system as part of a broader "communication revolution" (Behringer 2005). The increased speed and regularity of information-flows not only accelerated administrative processes but also altered the perception of distance within Europe, effectively bringing previously distant regions closer together. In combination with already existing messenger systems, the introduction of this network connected the economically important regions of the North Sea and Atlantic with those of the Mediterranean and thereby contributed to a new level of economic and political integration across the continent (Schobesberger et al. 2016).

However, the establishment of such a system required not only organizational innovation but also a sustainable financial and institutional framework. In this regard, the Habsburg-Taxis postal system differed in important ways from earlier communication systems. Although the initial initiative for the establishment of the postal routes originated from Maximilian I and was intended to be financed through Habsburg administrative structures, the available evidence suggests that the Taxis family invested private resources into the system from an early stage (Behringer 1990). It can therefore be argued that the postal system was not purely a state-administered institution but rather developed as a hybrid structure combining political authority with private entrepreneurial initiative. The Taxis family appears to have recognized the economic potential of operating such a network and acted accordingly, which suggests that the postal system was from the beginning on also an economic enterprise. This interpretation is further supported by the fact that Maximilian I was frequently facing financial constraints and was often unable to meet his payment obligations, thereby forcing the Taxis to operate with a considerable degree of financial independence with the help of important rich merchant families like the Fugger and the Welser (Häberlein 2012). The financial needs of the system, as well as the frequent absence of payments by the Habsburg, also led to the fact that private actors could use the network in exchange for payment, which would have been one of the important channels of fostering economic activity too. This hybrid institutional structure becomes particularly visible in the contractual arrangements governing the postal system. A central milestone in this context was the postal contract of 1505, which not only specified delivery times, for example, five and a half days from Brussels to Innsbruck, but also defined

the rights and obligations of the chief postmaster and his postmasters (Dallmeier 1977). Importantly, this agreement did not take the form of a unilateral decree, but rather of a contract between Philip I, Maximilian's son, and Franz von Taxis. It can therefore be interpreted as an early example of a contractual relationship between a ruler and a private entrepreneur, and thus as an indication of the increasingly institutionalized and economically oriented nature of the postal system (Behringer 1990).

At the same time, the internal organization of the Taxis enterprise further reflects this dual character. The so-called *Compañía* functioned as a family-based organization, in which key positions and responsibilities were allocated within the family, while a clearly defined head of the organization, initially the chief postmaster and later the general postmaster, exercised centralized authority over the network from Brussels. Local postmasters, on the other hand, were responsible for the operation of individual stations and routes and were granted a certain degree of autonomy, particularly with regard to the management of revenues and employees which gave them a feudal-lord-like status within the Empire (Behringer 1990).This organizational structure was accompanied by a set of privileges and obligations that further institutionalized the postal system. The general postmaster was required to operate and maintain the system at his own expense and to ensure its functioning in both times of peace and war. In return, he was granted extensive rights, including jurisdiction over his personnel, exemption from certain taxes, and safe conduct through all territories of the Empire. Most importantly, he was allowed to retain the profits generated by the system (Dallmeier 1977). Taken together, these elements point towards the emergence of a relatively stable institutional framework, in which political authority and private economic incentives were closely connected. The postal system thus evolved into a structured and increasingly self-sustaining infrastructure, which was capable of operating across territorial boundaries and under varying political conditions. During the first half of the 16th century, this system experienced significant expansion and consolidation. At the same time, the Taxis family was able to secure a quasi-monopolistic position in the transportation of mail in the regions in which it operated. This position was reinforced through both contractual arrangements and political support, particularly under the rule of Charles V, who was able to enforce the privileges of the postal system across his territories. It is therefore possible to characterize the period up to the mid-16th century as a phase of initial success and institutional consolidation of the Habsburg-Taxis postal system. Despite occasional conflicts, payment delays, and internal disputes, the system developed into a functioning and expanding network of communication (Behringer 1990).

From an analytical perspective, the development of the Habsburg postal system is

particularly important because it marked the transition from loosely organized and locally constrained messenger networks to a centralized and institutionalized system of communication. Earlier forms of information transmission were typically irregular, dependent on individual actors, and limited in their geographic scope. In contrast, the Habsburg-Taxis system introduced a structured network based on fixed routes, relay stations, and contractual arrangements, supported by both political authority and economic incentives. This institutionalization of communication created a fundamentally new infrastructure, which enabled a more predictable and scalable exchange of information across territories. As the network expanded over time, cities became connected to this system stepwise, depending on their inclusion in specific routes and extensions. This feature is of particular importance for the empirical analysis, as it allows the expansion of the postal network to be interpreted as a sequence of historically defined integration events, which form the basis for the cohort classification applied in this study.

2.3. The Spatial Expansion and Logic of the Network

The development of the network was not only shaped by political and financial considerations, but also by geographic constraints and the practical requirements of operating a relay-based communication system. Examining this spatial dimension is particularly relevant for the empirical analysis, as it provides important insights into how and why certain cities became connected to the postal network, while others did not.

The initial structure of the network was defined by the main axis connecting Brussels and Innsbruck, which formed the backbone of the early modern postal system. The first main route itself followed a clearly defined geographic path, running from Brussels via Koblenz and Worms, crossing the Rhine at Rheinhausen, continuing through Württemberg and further via Ulm, Füssen, and the Fernpass to Innsbruck, and from there extending into Northern Italy towards Trento and Verona, where it connected to existing Italian messenger systems (Behringer 1990) However, as the system expanded over the course of the 16th century, additional routes and cross-connections were gradually established, linking further regions of the Habsburg territories and beyond. While Innsbruck had functioned as Maximilian I's principal residence due to its strategic position within a transalpine communication network, the dynastic centre of gravity shifted to Vienna after 1526 with the acquisition of Bohemia and Hungary. This led to extensions which included connections to important urban and political centres such as Salzburg, Strasbourg, and the cities of Northern Italy, but also importantly to regions in Central and Eastern Europe, including cities like Buda or Bratislava (Winkelbauer

2003). At the same time, the expansion of the network did not follow a purely uniform or predetermined pattern. In the early phases, routes were subject to frequent adjustments due to a variety of factors, including military conflicts, weather conditions, and the changing location of political centres such as the imperial court (Ohmann 1909). This implies that the network was not the result of a single, centrally planned design, but rather evolved over time through a combination of strategic decisions and practical constraints. A central element shaping the spatial structure of the network was the relay station logic described in the previous subsection. Since communication relied on a chain of stations at regular intervals, the placement of routes was constrained by geographic feasibility and the need to maintain efficient distances between stations. This meant that once a main route was established, additional connections were often created along existing corridors, leading to a path-dependent expansion of the network. As a consequence, many cities became part of the postal system not necessarily because of their intrinsic economic or political importance, but because of their geographic location along these routes. Smaller towns and intermediate cities were incorporated into the network as relay points, even if they were not major economic centres. This feature is particularly important, as it suggests that the inclusion of cities in the postal system was partly driven by logistical considerations rather than purely by economic demand.

At the same time, the expansion of the network was not frictionless and also encountered political resistance at the local level. In particular, many free imperial cities (*freie Reichsstädte*) were initially reluctant to accept the presence of a postal system that was perceived as being controlled by external authorities. These cities were concerned about both the loss of autonomy and the potential surveillance of communication, as well as about the economic implications of granting privileges to the Taxis system (Behringer 1990). As a result, the establishment of postal stations and routes often required negotiation and, in some cases, faced direct opposition. This resistance further illustrates that the expansion of the network was not simply the outcome of economic demand but also shaped by political constraints and conflicts of interest. Still, it would be misleading to interpret the expansion of the network as entirely independent of economic factors. Major commercial centres such as Antwerp, Brussels, or the cities of Northern Italy were clearly important nodes within the system, both as origins and destinations of communication flows. These cities generated substantial demand for information exchange and were therefore more likely to be connected at an early stage (Schobesberger et al. 2016).

However, the overall structure of the network can be understood as the outcome of an interaction between political priorities, economic relevance, and geographic constraints. While economically important cities influenced the direction of major routes, the relay-based

organization of the system ensured that many additional locations were connected as a by-product of this structure. This interaction becomes particularly visible when considering the role of territorial and administrative boundaries. The postal network had to operate across a fragmented political landscape, in which different regions were governed by different authorities. The ability of the Taxis postal system to function across these boundaries was facilitated by imperial privileges such as safe conduct and exemptions from local restrictions. At the same time, these political conditions also influenced the expansion of the network, as the establishment of new routes often required negotiation with local rulers or adaptation to existing territorial structures (Behringer 1990).

From an analytical perspective, these observations are highly relevant for the identification strategy of this thesis. The spatial expansion of the postal network was neither purely random nor fully determined by pre-existing economic development. Instead, it followed a logic that combined political, geographic, and economic factors. It is therefore possible to argue that, while some selection into the network based on economic importance cannot be ruled out, a substantial part of the variation in the timing and placement of postal connections was driven by factors that were plausibly exogenous to local urban growth. In particular, the relay station logic and the reliance on pre-existing geographic corridors imply that many cities were connected as part of a broader network structure, rather than as a direct consequence of their own economic prerequisites. This aspect is crucial for the empirical analysis, as it provides a historical justification for treating the expansion of the postal network as at least partially exogenous. While the network was clearly not randomly assigned, its development was shaped by constraints and considerations that go beyond local economic conditions. This creates a setting in which the connection to the postal system can be used to study its potential effects on urban development, while carefully accounting for remaining sources of endogeneity.

Building on the historical developments outlined above, the emergence of the early modern postal system can be understood as an introduction of a new form of information infrastructure, which fundamentally changed the conditions under which communication across space took place. By establishing a system characterized by regularity, reliability, and territorial reach, the postal network reduced the time and uncertainty linked to the transmission of information and messages. This, in turn, can be expected to have improved not only information about goods and prices, economic interaction, coordination between regions but also potentially strengthened administrative and commercial linkages between cities and regions. At the same time, the expansion of this system occurred gradually and unevenly across space and time. As

the network developed along its main routes and through subsequent extensions, cities became connected into this communication infrastructure at different points in time. Being connected to the postal system therefore meant becoming part of a wider network of information exchange, which may have affected the economic environment in the connected cities. Importantly, this process created variation both across cities and over time, as some cities were integrated into the network earlier, while others were connected only at later stages or not at all within the late 15th and the 16th century. This staggered expansion provides a setting in which the connection to the postal system can be interpreted as a historically grounded change in the information environment of cities. It is therefore possible to examine whether, and to what extent, integration into this network is associated with differences in urban development.

3. Data

This thesis uses a newly constructed city-level panel dataset covering the period from 1400 to 1650. The unit of observation is the city, entering the dataset when having 1000 inhabitants or more, observed at discrete time intervals corresponding to the years 1400, 1500, 1550, 1600, and 1650. The dataset focuses on cities located within the extent of Holy Roman Empire and the Habsburg territories, thereby matching the historical and institutional context outlined in the previous section. Cities are located in present-day Germany, Austria, Switzerland and Belgium, the Netherlands and Luxembourg, as well as Italy north of Rome, and Central and Eastern Europe, including regions corresponding to modern-day Czechia, Hungary, Slovakia, Slovenia and Poland. This geographic scope closely reflects the territorial extent of the Holy Roman Empire and the Habsburg territories during the late 15th and the 16th century. Cities were selected by country, thereby in some cases extending further than the Empire or Habsburg territories. There is one city in modern-day France, namely Strasbourg, as this was an important free imperial city in the Empire, also being connected into the Habsburg-Taxis postal network, which is why it is part of the sample. The selection of countries was done in order to reflect as closely as possible the extend of the Empire, as well as the Habsburg territories during the late 15th and the 16th century (see Figure 3 Appendix), being aware of changing borders and changing dynastic lines, complicating clear geographic assignment.

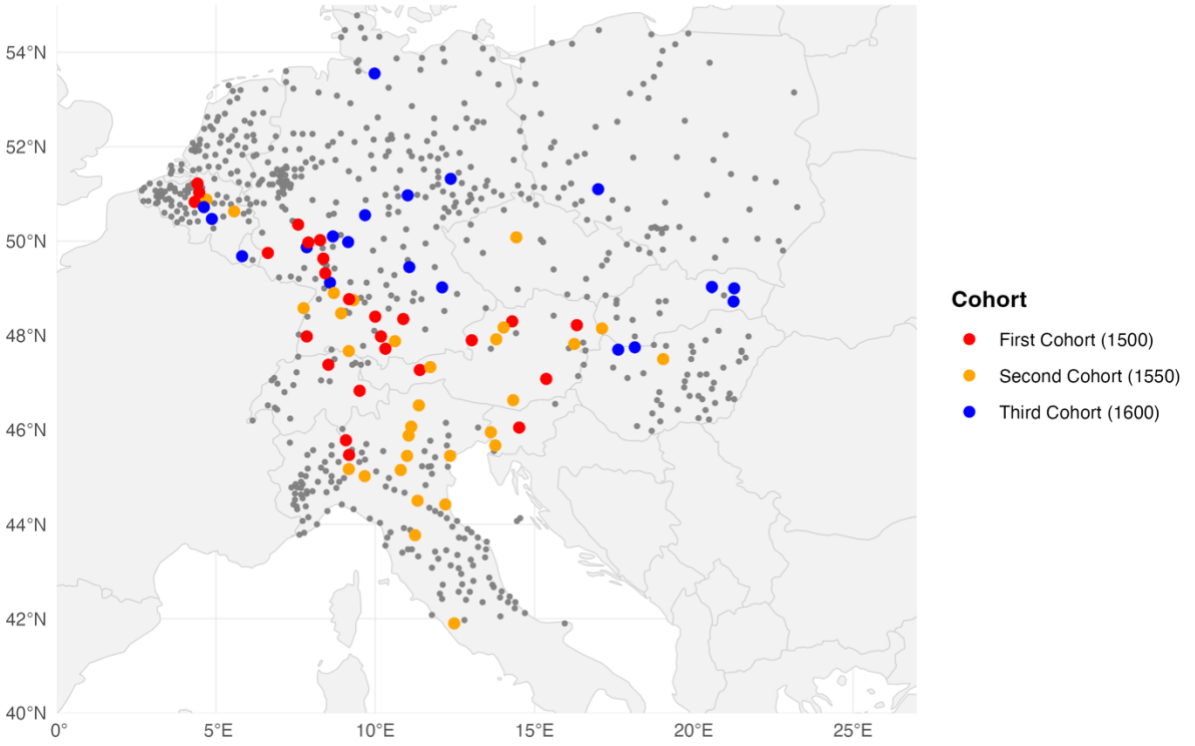
The dataset contains information for 699 cities across the described geographical extent. Population data constitutes the core of the dataset and is drawn from the dataset established by Buringh (2020), whose work again is based on earlier standard sources, namely Bairoch et al. (1988) and De Vries (1984). The dataset by Buringh (2020) was chosen, since it is more granular and allows to investigate cities from a small size, namely 1000 inhabitants, which in

turn allows for a richer sample-size as well as for the investigation of smaller cities which might have been connected more exogenously. This approach allows for the construction of a consistent panel of urban population levels across cities over time, while relying on widely used and established data in economic history. The outcome variable is city population, measured in logarithms. Population levels are derived from the underlying data in thousands of inhabitants (Buringh 2020) and transformed into natural logarithms in order to account for the skewed distribution of city sizes as well as to allow for an interpretation of estimated coefficients in percentage terms. This transformation follows standard practice in the economic history literature on urban growth (Dittmar 2011) and ensures comparability across cities of different sizes. Focusing on population as the primary outcome variable allows for capturing broader patterns of economic development, as city size is commonly interpreted as a proxy for economic activity in pre-industrial settings (De Long and Shleifer 1993) as well as the availability of data for city population is more available then other economic variables such as market access or similar variables. In the case of dynamic regression, a 50-year growth rate of log-population is calculated as a robustness check, and for comparability reasons.

The main explanatory variable captures whether a city is connected into the early modern postal network. A city is considered treated once it becomes part of the Habsburg-Taxis postal system, which established a permanent and regular communication link through the network of relay stations described in the previous section. Information on the timing of postal connections is compiled from historical sources, which provide information of the development and expansion of the postal system across Europe, as well as the routes and relay stations (Behringer 1990; Dallmeier 1977; Ohmann 1909). Based on this information, a dummy-variable is constructed that takes the value one for all city-year observations after a city has been connected into the network and zero otherwise. A central feature of the data is the staggered expansion of the postal system over time, which generates variation in the timing of treatment across cities. In order to capture this structure, cities are grouped into cohorts according to the period in which they were first connected to the network. Specifically, the first cohort includes cities connected by 1500, followed by a second cohort connected by 1550 and a third cohort connected by 1600, while cities that remain unconnected throughout the observation period serve as a control group. Due to the inaccuracy of historical sources as well as the uncertainty of exact years of connection, cities are considered treated if they were connected by the corresponding cohort-year. For the first cohort all cities are connected for sure by latest 1504/05, for the other two they are surely treated up until the respective year (Behringer 1990; Dallmeier 1977; Ohmann 1909). This cohort structure reflects the historical

development of the network and forms the basis for the empirical strategy, as it allows for comparisons between cities that were connected at different points in time and those that were not connected at all. All cities of the dataset as well as their respective treatment timing are illustrated in the map in Figure 1 below:

Figure 1 - Map of Cities and their Connection into the Postal Network



Furthermore, the dataset includes a set of control variables that capture relevant dimensions of economic and institutional development which may be correlated with both postal connectivity and urban growth. First, a dummy for the presence of a printing press is included, to account for early access to information technology and its potential impact on economic development, data is drawn from Dittmar (2011) and Duntze (2024). Second, the presence of a university is controlled for as a proxy for human capital and local knowledge production, which may influence both economic activity and a city's likelihood of being connected to the network, data on universities comes from Darby (1970). Third, a dummy variable indicating the presence of a Roman settlement is included to capture long-run persistence in urban development, as historically important locations may exhibit systematically different growth patterns, the existence of a Roman Site in a city is derived from Stillwell (1976). Lastly, baseline city size, corresponding to a city's size in 1400 or the earliest available population observation, is taken into account to allow for heterogeneous effects depending on initial conditions and to control for differences in pre-existing levels of development. These variables are included to account for some observable factors that may influence both the timing of postal connection and urban

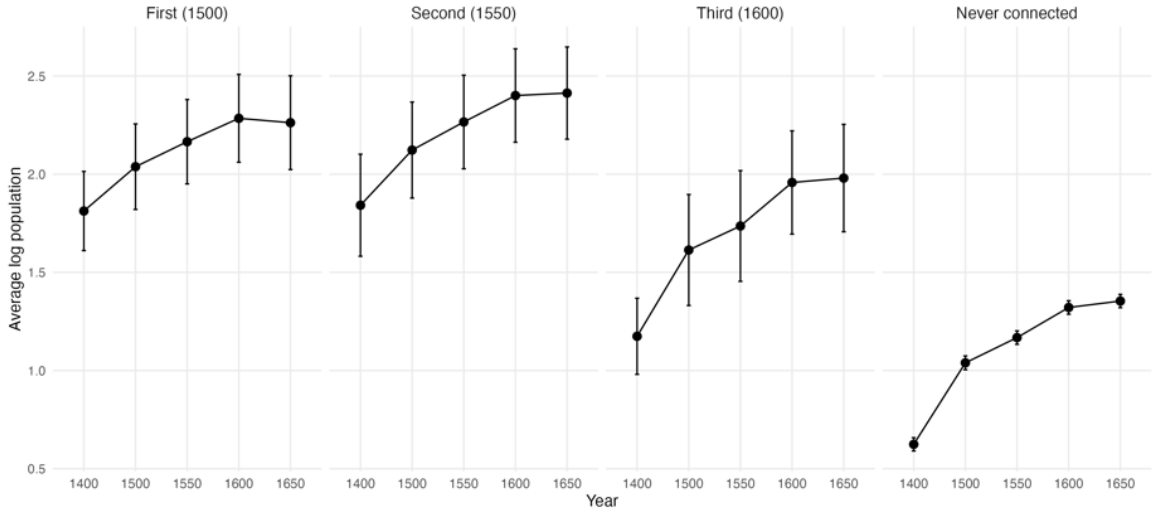
development, thereby reducing concerns about omitted variable bias.

Table 1 - Summary Statistics by Postal Connection Cohort

Cohort	Connection period	Cities	Share of sample (%)	Mean baseline log population	Mean baseline population	Median baseline population	Mean annual growth 1400–1500 (%)
First (1500)	by 1500	25	3.58	1.81	10,840	5,000	0.23
Second (1550)	1501–1550	30	4.29	1.84	14,200	7,500	0.28
Third (1600)	1551–1600	19	2.72	1.17	4,421	3,000	0.44
Never connected	Never connected	625	89.41	0.61	2,998	1,000	0.43

Table 1 summarizes the main characteristics of the dataset by postal connection cohort. It shows that only a small minority of cities became connected to the postal network during the period of observation. In total, 25 cities belong to the first cohort, 30 to the second cohort, and 19 to the third cohort, while 625 cities, corresponding to almost 90% of the sample, remain never connected. The table also shows the substantial differences in baseline city size across cohorts. Cities connected in the first and second cohorts were considerably larger at baseline, with mean baseline populations of around 10,800 and 14,200 inhabitants, respectively, compared to around 4,400 inhabitants in the third cohort and only around 3,000 inhabitants among never-connected cities. Median baseline population levels point in the same direction, showing that never-connected cities were typically much smaller. At the same time, average annual growth between 1400 and 1500 was higher among the third cohort and never-connected cities than among the first two cohorts. These summary statistics therefore highlight both the limited reach of the postal network and the strong differences in initial city size across cohorts, suggesting that treated and never-treated cities followed partly different underlying growth dynamics already before treatment.

Figure 2 - Average Log Population over Time by Cohort



Notes: The figure reports average log population by postal connection cohort. Error bars indicate one standard error around the cohort-year mean. Source: Own calculations based on the constructed city-level panel dataset.

Figure 2 illustrates the evolution of average log population over time across the different connection cohorts. Several patterns emerge. First, cities that were connected earlier to the postal network exhibit systematically higher population levels already before treatment, indicating that selection into the network was not random and that larger and more prominent cities were more likely to become connected at earlier stages. Second, the figure highlights substantial differences between connected and never-connected cities. Never-connected cities start from a much lower population level but display relatively strong population growth over the observed period. This pattern suggests that part of the observed development is driven by convergence dynamics, as initially smaller cities grow faster than larger and earlier-connected cities. Third, while all cohorts experience population growth over time, the growth paths are not identical. The first and second cohorts start from considerably higher levels and grow more slowly after 1500, whereas the never-connected group shows a stronger increase from a much lower baseline. These descriptive patterns underline the importance of controlling for initial conditions and of interpreting the empirical results cautiously, since differences between connected and never-connected cities may reflect both postal connectivity and underlying city-size dynamics. At the same time, the staggered timing of postal connections still provides useful variation for the empirical analysis, but the figure makes clear that this variation is embedded in a heterogeneous urban system with strong pre-existing differences across cohorts. To isolate the effect of postal connectivity on urban development, the following section introduces the empirical strategy.

4. Empirical strategy and findings

4.1 Empirical strategy and Identification

In order to evaluate the effect of postal connectivity on urban development, this thesis exploits the staggered expansion of the early modern postal network across cities over time. As outlined in the previous sections, cities were connected to the Habsburg-Taxis postal system at different points between 1490 and 1600, while a substantial number of cities remained unconnected throughout the observation period. This variation in treatment timing provides the basis for the empirical strategy, allowing for comparisons between cities before and after connection as well as relative to cities that had not yet been connected. The baseline specification follows a two-way fixed effects (TWFE) framework, in which city-level population is regressed on an indicator for postal connection, controlling for both city and time fixed effects. Formally, the specification reads as following:

$$\log(\text{Population}_{it}) = \beta \cdot \text{Post connection}_{it} + \gamma_i + \delta_t + \text{Controls}_{it} + \varepsilon_{it},$$

where γ_i captures city fixed effects and δ_t the time fixed effects. The vector $Controls_{it}$ includes time-varying controls such as the presence of a printing press or a university. Standard errors are clustered at the city level to account for serial correlation within cities over time. Identification in this framework relies on comparing changes in population within cities before and after connection to the postal network to changes in cities that are not yet connected in the same period. Given the staggered timing of treatment, cities that are connected later serve as a control group for earlier-treated cities in pre-treatment periods. While the assignment of postal connection is not completely random, as described before, the historical evidence suggests that the expansion of the network was driven in part by political and geographic considerations, rather than purely by local economic conditions. This provides a setting in which variation in treatment timing can be interpreted as plausibly, at least partly, exogenous to short-run urban growth dynamics.

A potential concern with standard TWFE estimators in settings with staggered treatment adoption is that they may produce biased estimates in the presence of heterogeneous treatment effects across cohorts or over time. To address this issue, in a second step a more dynamic model is applied, using the estimator proposed by Sun and Abraham (2021), which allows for a flexible estimation of cohort-specific and dynamic treatment effects. This approach decomposes the overall treatment effect into period-specific average treatment effects on the treated (ATT), thereby showing pre-treatment trends as well as the evolution of effects after

postal connection for single time periods. Moreover, to account for potential heterogeneity in treatment effects across cities, the analysis allows the impact of postal connectivity to vary with baseline city size. This is implemented through an interaction-term between the treatment indicator and the logarithm of initial population. This specification makes it possible to examine whether the effects of postal integration differ systematically between smaller and larger cities, which is particularly relevant given the descriptive evidence presented above.

Concluding, this empirical strategy combines a fixed-effects framework with methods fit to staggered treatment adoption, allowing for the estimation of both average and heterogeneous effects of postal connection on urban development. The economic and historical causes and implications of all the findings presented in this section will be discussed in the following discussion section.

4.2 Baseline Results – TWFE

Table 2 presents the baseline estimates of the effect of postal connectivity on urban population using the two-way fixed effects specification outlined above. It shows four different specifications, starting from a baseline model including only the treatment variable and fixed effects, and then sequentially adding control variables and the interaction-term with baseline city size.

Table 2 - Baseline Fixed-Effects Estimates

	(1) Post connection	(2) + Controls	(3) + Baseline interaction	(4) + Interaction + Controls
Post connection	−0.078	−0.078	0.067	0.068
	(0.048)	(0.049)	(0.076)	(0.076)
Printing press		−0.006		0.012
		(0.049)		(0.050)
University		0.020		0.021
		(0.089)		(0.088)
Post connection × Baseline log population			−0.088**	−0.091**
			(0.035)	(0.036)
Observations	3421	3421	3421	3421
R-squared	0.922	0.922	0.922	0.922
Within R-squared	0.002	0.002	0.005	0.005
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

* p < 0.1, ** p < 0.05, *** p < 0.01
Dependent variable: log population.
All specifications include city and year fixed effects. Standard errors are clustered at the city level.
Baseline log population and Roman site are time-invariant and therefore absorbed by city fixed effects when included separately.

Across specifications, the estimated coefficient on postal connection is small and statistically insignificant, indicating that there is no evidence of a positive average effect of integration into

the postal network on city population. This result remains stable when including additional controls, which in term are also small and insignificant, suggesting that the absence of an average effect is not driven by observable differences across cities. This is also reflected by the high overall R^2, which indicates a large share of variation in city population is captured by city fixed effects, consistent with persistent differences in urban size across locations.

However, allowing for heterogeneous treatment effects reveals a slightly different result. When interacting the treatment variable with baseline city size, the interaction term is negative and statistically significant, indicating that the effect of postal connectivity declines with increasing initial city size. Also, the estimated coefficient on postal connection changes sign when the interaction with baseline city size is introduced, further indicating that the average effect is sensitive to the underlying heterogeneity across cities. In particular, the negative coefficient of the interaction term implies that larger cities tend to benefit less, or may even experience negative effects, compared to smaller cities. This relationship can be illustrated by computing the level of baseline population at which the estimated treatment effect changes sign, given by $-\beta_1/\beta_2$. Using the estimated coefficients, this threshold lies at approximately 0.75 in logarithmic terms, corresponding to a city size of roughly 2,100 inhabitants. Since β_1 is statistically insignificant, this should not be interpreted as a precise cut-off, but rather as an approximate value, showing the heterogeneity of the results. The significant interaction term indicates that the effect of postal connectivity becomes more negative with city size. While this pattern suggests that smaller cities may have benefited relatively more, the absence of a precisely estimated β_1 implies that such positive effects cannot be established with certainty. Given that the average city in the sample exceeds this threshold, the absence of a positive average effect is consistent with the distribution of city sizes. The relatively low within-R^2 indicates that only a limited share of the remaining within-city variation over time is explained by the included covariates, which is typical in settings with highly persistent outcomes such as urban population. Taken together, these first baseline findings provide no clear evidence of a uniform growth effect of postal connection. Instead, they point towards substantial heterogeneity, with effects that depend on initial city size.

4.3 Dynamic Effects – Sun-Abraham

To assess the dynamic effects of postal connectivity and to add a dynamic perspective to the baseline findings, as well as to account for the differences in timing of connection, this section presents results based on the Sun-Abraham estimator (Sun and Abraham 2021). This approach allows for a flexible estimation of treatment effects over time in settings with staggered

treatment adoption and heterogeneous effects, and in particular enables a direct assessment of pre-treatment trends as well as the evolution of effects following connection. Table 3 shows the average treatment effects on the treated (ATT) based on the Sun-Abraham estimator, with four specifications distinguishing between population levels and 50-year population growth and sequentially including the control variables.

Table 3 - Dynamic Effects: Sun-Abraham Estimates

	(1) Log population	(2) + Controls	(3) 50-year log growth	(4) + Controls
Post connection (ATT)	−0.098*	−0.102**	0.057	0.058
	(0.051)	(0.052)	(0.054)	(0.054)
Printing press		0.012		0.027
		(0.051)		(0.058)
University		0.037		0.050
		(0.088)		(0.074)
Observations	3421	3421	2714	2714
R-squared	0.922	0.922	0.365	0.365
Within R-squared	0.007	0.007	0.005	0.005
City FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

* p < 0.1, ** p < 0.05, *** p < 0.01
Columns (1) and (2) use log population as the dependent variable; columns (3) and (4) use 50-year log population growth.
All specifications include city and time fixed effects. Standard errors are clustered at the city level.
Reported coefficients are aggregated average treatment effects on the treated (ATT) from Sun-Abraham estimators.
Roman site is time-invariant and therefore absorbed by city fixed effects when included separately.

For population levels, the estimated ATT is negative and statistically significant at the 10 percent level in the baseline specification and becomes slightly larger in magnitude and statistically significant at the 5 percent level when controls are included. The inclusion of controls does not change the qualitative result, and the control variables themselves remain small and statistically insignificant. In terms of magnitude, the estimate in specification (2) implies that connected cities had on average about 10 percent lower population levels relative to the control group following postal connection. Taken at face value, this suggests that connected cities did not experience higher population levels after integration into the postal network. However, this estimate should be interpreted cautiously, as the descriptive evidence presented above shows that connected and never-connected cities differ substantially in initial size and in their underlying growth patterns. For population growth, measured over 50-year intervals, the estimated effects are positive but statistically insignificant across both

specifications. The estimates of approximately 0.06 imply that connected cities experienced around 5 to 6 percent higher population growth over a 50-year period relative to the control group; however, these estimates are not statistically significant. This suggests that postal connectivity did not lead to a robust or systematic increase in urban growth over the medium run, even when allowing for dynamic treatment effects.

The overall R^2 remains high for the population level specifications due to the inclusion of city fixed effects, while it is substantially lower for the growth specifications. The lower R^2 reflects that growth rates exhibit less persistence and contain less systematic variation than population levels. The within-R^2 remains low across all specifications, which is typical in settings with highly persistent outcomes. Overall, the ATT estimates provide no evidence of a robust positive average effect of postal connectivity on urban development, neither in terms of population levels nor in terms of medium-run population growth. At the same time, the difference between the negative level estimates and the positive but insignificant growth estimates indicates that the dynamic results require a cautious interpretation.

Table 4 reports the dynamic treatment effects by event time, again using the Sun-Abraham estimator. By tracing outcomes relative to the timing of connection, the specification allows for a direct assessment of pre-treatment trends as well as the evolution of effects after treatment. For the main outcome variable, the pre-treatment coefficients are small and statistically insignificant, providing no formal evidence of differential trends between treated and control cities prior to connection. This absence of statistically significant pre-treatment coefficients is important, as it supports the identifying assumption of parallel trends within the event-study framework. However, given the descriptive differences in baseline size and growth dynamics across cohorts, this evidence should not be interpreted as ruling out all concerns about differences in underlying long-run growth paths.

Table 4 - Dynamic Effects by Event Time: Sun-Abraham Estimates

	(1) Log population	(2) + Controls	(3) 50-year log growth	(4) + Controls
Event time = -3	−0.015	−0.011		
	(0.137)	(0.135)		
Event time = -2	0.087	0.091	0.011	0.012
	(0.061)	(0.064)	(0.162)	(0.163)
Event time = 0	−0.044	−0.047	0.034	0.036
	(0.038)	(0.039)	(0.058)	(0.058)
Event time = 1	−0.060	−0.063	0.066	0.067
	(0.047)	(0.048)	(0.053)	(0.053)
Event time = 2	−0.130**	−0.135**	0.074	0.075
	(0.065)	(0.066)	(0.069)	(0.069)
Event time = 3	−0.300**	−0.311**		
	(0.140)	(0.143)		
Printing press		0.012		0.027
		(0.051)		(0.058)
University		0.037		0.050
		(0.088)		(0.074)
Observations	3421	3421	2714	2714
R-squared	0.922	0.922	0.365	0.365
Within R-squared	0.007	0.007	0.005	0.005
City FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

* p < 0.1, ** p < 0.05, *** p < 0.01

Columns (1) and (2) use log population as the dependent variable; columns (3) and (4) use 50-year log population growth.
All specifications include city and time fixed effects. Standard errors are clustered at the city level.
Reported coefficients are period-specific aggregated treatment effects from Sun-Abraham estimators.
The omitted reference period is the pre-treatment baseline used by the estimator.
Roman site is time-invariant and therefore absorbed by city fixed effects when included separately.

Following connection, the estimated effects on population levels become increasingly negative over time. While the coefficients around the time of treatment remain small and insignificant, they grow in magnitude in later periods and turn statistically significant from event time t = 2 onwards. This result also holds when including the controls. The estimates indicate that population levels in connected cities are approximately 13 percent lower after two periods and up to 30 percent lower after three periods relative to the control group. However, the interpretation of this pattern requires caution, as the latest event-time coefficient is identified

only from the earliest treatment cohort and therefore relies on a smaller set of treated cities. Rather than providing clear evidence of a negative causal effect of postal connection, the level estimates suggest a relative divergence between connected and control cities over time, which may partly reflect the stronger growth of initially smaller never-connected cities.

For population growth, again measured over 50-year intervals, the estimated effects are positive but statistically insignificant across all event times. Although the point estimates increase somewhat in the post-treatment periods, they remain not distinguishable from zero. This implies that the negative pattern observed in population levels is not mirrored by statistically significant negative growth effects following connection. Instead, the growth specifications provide no robust evidence that postal connectivity systematically changed medium-run population growth. Taken together, Table 3 and Table 4 therefore point to an apparent tension between the level and growth specifications: the level estimates are negative, while the growth estimates are positive but statistically insignificant.

To examine this tension more directly, Table A5 in the Appendix reports two additional diagnostic checks. First, the level specification is restricted to the same post-treatment horizon as the growth specification, since the growth event study stops at event time $t = 2$ whereas the level specification includes event time $t = 3$. Once this later horizon is excluded, the level ATT becomes smaller in magnitude and loses statistical significance. Second, the Sun-Abraham estimator is re-estimated after dropping never-connected cities, so that identification comes only from not-yet-treated cities. In this specification, the negative level effect disappears and changes sign, while remaining statistically insignificant. The growth estimates also remain positive but statistically insignificant when only eventually treated cities are used. These diagnostics suggest that the negative level estimates in the full sample are sensitive to the event-time horizon and, in particular, to the inclusion of never-connected cities as controls. This is consistent with the descriptive evidence that never-connected cities were much smaller at baseline and grew faster over the observed period. The dynamic results should therefore not be interpreted as strong evidence that postal connection reduced urban population. Instead, they provide no robust evidence of a positive average effect, while also highlighting the limitations of the empirical setting and the role of convergence dynamics among initially smaller cities.

Overall, the dynamic estimates provide no robust evidence that postal connectivity generated a positive average effect on urban development, either in population levels or in 50-year growth. At the same time, the negative level effects should be interpreted cautiously, since the

diagnostic checks suggest that they are sensitive to the event-time horizon and to the inclusion of smaller, faster-growing never-connected cities as controls.

4.4 Cohort-Specific Evidence - DiD

As an additional check, cohort-specific difference-in-differences estimates are reported in Table A1 in the Appendix. These estimates allow for a direct comparison of treatment effects across the different waves of postal network expansion. For population levels, the estimated effects are small and statistically insignificant across all cohorts, indicating that the baseline findings are not driven by a single phase of expansion and are broadly consistent across treatment timing. The regression-based estimates are complemented by simple mean-based 2×2 difference-in-differences calculations, reported in Table A2 in the Appendix, which illustrate the underlying patterns.

For population growth, measured over 50-year intervals, the results reveal some heterogeneity across cohorts. In particular, a positive and statistically significant effect is observed for the first cohort, suggesting that cities connected at the earliest stage of the network experienced higher population growth in the period following connection. The magnitude of this effect implies an increase in population growth of around 20 percent over the respective 50-year interval. In contrast, the estimates for the second and third cohorts are negative but statistically insignificant, indicating no comparable growth effects for later-connected cities.

Taken together, these results point to some variation in the growth response across cohorts, with evidence of a positive effect concentrated among early-connected cities. At the same time, this pattern is not reflected in the population level estimates and is not observed for later cohorts. The cohort-specific analysis therefore suggests that early integration into the postal network may have been associated with higher short- to medium-run growth for the first cohort, but that this effect is not uniform across cohorts and does not translate into systematic differences in long-run population levels.

4.5 Extensions and Robustness

To further test and assess the robustness of the findings above, this section considers an alternative definition of postal connectivity that expands the treatment group to include not only directly connected cities, but also cities located within a 25-kilometre radius of a postal station. This specification accounts for the possibility that the effects of the postal network may have extended beyond directly connected locations, for instance through local spillovers or indirect access to communication infrastructure. The threshold of 25 kilometres is chosen since this was

approximately the average distance a courier would travel by foot at the time of the introduction of the postal system (Behringer 1990). Under this expanded definition, the treatment group increases by 50 additional cities, capturing locations that were not directly connected but might have benefitted from proximity to the network.

Table 5 - Fixed-Effects Estimates with Expanded Treatment Definition

	(1) Expanded connection	(2) + Controls	(3) + Baseline interaction	(4) + Interaction + Controls
Connection (incl. radius)	−0.074*	−0.074*	0.038	0.039
	(0.038)	(0.039)	(0.052)	(0.052)
Printing press		−0.005		0.020
		(0.049)		(0.050)
University		0.019		0.023
		(0.089)		(0.087)
Connection × Baseline log population			−0.090***	−0.093***
			(0.029)	(0.030)
Observations	3421	3421	3421	3421
R-squared	0.922	0.922	0.922	0.922
Within R-squared	0.002	0.002	0.007	0.008
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

* p < 0.1, ** p < 0.05, *** p < 0.01
Dependent variable: log population.
The treatment variable equals one if a city is either directly connected to the postal network or located within a 25 km radius of a connected city.
All specifications include city and year fixed effects. Standard errors are clustered at the city level.

Table 5 reports the corresponding fixed-effects estimates. Under this expanded treatment definition, the coefficient on postal connection becomes weakly statistically significant in the baseline specification, in contrast to the results in Table 2, where no statistically significant average effect of postal connection was detected. However, the magnitude remains small and negative, indicating that even when including nearby cities, there is no evidence of a positive average impact on population levels.

At the same time, the interaction between postal connection and baseline city size remains negative and highly statistically significant, with coefficients of around -0.09, which is close to those obtained in the baseline specification in Table 2. This indicates that the heterogeneous effect by initial city size is not sensitive to the definition of treatment. If anything, the significance level increases when including nearby cities, reinforcing the robustness of the heterogeneity result. Using the interaction specification, the implied turning point can again be derived as the ratio of the main effect to the interaction coefficient. In the baseline results in Table 2, this threshold was approximately 0.75 in log population, corresponding to around 2,100 inhabitants. Under the expanded treatment definition, the turning point decreases to roughly 0.42, corresponding to about 1,500 inhabitants. This implies

that positive effects, if present, are concentrated among even smaller cities. The qualitative interpretation therefore remains similar: only relatively small cities might have benefited from access to the postal system in terms of long-run population levels. These results reinforce the main finding that the impact of postal connectivity is not uniform across cities. While the expanded treatment definition also reveals a weakly significant negative average effect, the dominant pattern remains one of strong heterogeneity, with possible benefits of network access limited to relatively small urban centres and no evidence of gains for larger cities.

Additional evidence on the expanded treatment definition is provided by the cohort-specific estimates in Table A3 and the corresponding mean-based results in Table A4 in the Appendix. Extending the treatment group to include nearby cities alters the cohort-specific patterns observed previously. In particular, for the first cohort, the earlier positive growth effect becomes smaller and statistically insignificant, while the effect on population levels turns negative and statistically significant. This suggests that the previously observed growth advantage is driven primarily by directly connected cities and does not extend to cities that were only indirectly exposed to the network. The mean-based estimates in Table A4 point to positive growth differences; however, these effects become smaller and lose statistical significance once city and time fixed effects are included in Table A3. This indicates that part of the differences reflects underlying heterogeneity between cities rather than a causal effect of postal connectivity. Overall, the results indicate that proximity to the postal network alone is not sufficient to generate comparable effects, pointing to the importance of direct integration into the system.

To summarize, the empirical analysis provides consistent but differentiated findings across the different specifications. The baseline TWFE estimates show no evidence of a positive average effect of postal connectivity on population levels, while the interaction with baseline city size points to substantial heterogeneity, since the estimated effect becomes more negative as initial city size increases, with potential gains concentrated among relatively small cities. The dynamic Sun-Abraham estimates are consistent with the absence of a robust positive average effect. While the full-sample ATT estimates are negative and statistically significant for population levels, the growth estimates remain positive but statistically insignificant. As shown by the diagnostic checks in Table A5, the negative level estimates are sensitive to the event-time horizon and to the inclusion of never-connected cities as controls. They should therefore not be interpreted as strong evidence that postal connection reduced urban population, but rather as indicating that the dynamic results are affected by convergence dynamics and differences

between connected and never-connected cities.

The cohort-specific estimates add further differentiation. Population-level effects remain small and insignificant across all cohorts, although the first cohort shows a positive and statistically significant effect on 50-year growth, suggesting that early-connected cities may have experienced some short- to medium-run growth advantage. Finally, the expanded treatment definition shows that including cities within a 25-kilometre radius of a postal station does not generate stronger evidence of positive average effects. The interaction with baseline city size remains negative, highly significant, and very close in magnitude to the baseline TWFE results. The implied turning point shifts from around 2,100 inhabitants in Table 2 to around 1,500 inhabitants in Table 5, reinforcing the conclusion that possible benefits were limited to small cities rather than larger urban centres. This is further supported by the cohort-specific evidence under the expanded treatment definition, which shows that the effects observed for early-connected cities do not extend to nearby locations and therefore seem to depend on direct access to the network.

Taken as a whole, these findings suggest that the expansion of the early modern postal network did not generate broad-based urban growth effects. Instead, the estimated effects are limited, heterogeneous, and sensitive to the empirical comparison group. The most robust finding is not a uniform positive or negative average effect, but rather heterogeneity by initial city size, with possible benefits concentrated among smaller cities. This raises the question of why improvements in communication infrastructure did not translate into more widespread economic gains, as one might expect from the theoretical and economic-historical literature, and why potential benefits appear to have been confined to smaller cities. The following section addresses these questions by putting the empirical results into their historical and economic context and by discussing the mechanisms through which the postal system may have affected urban development, as well as other developments that may have shaped the observed outcomes.

5. Discussion

5.1 The Postal Network as an Infrastructure

As shown in the introduction, a lot of economic literature highlights the importance of infrastructure and information flows for economic development. Reductions in communication and information frictions are generally expected to improve market efficiency, facilitate coordination, and ultimately foster economic growth. In the context of early modern Europe, the spread of information technologies has been shown to have meaningful economic effects.

For example, the introduction of the printing press contributed to urban growth by accelerating the diffusion of knowledge (Dittmar 2011), while reductions in information frictions, such as the introduction of the telegraph, can have real effects on economic activity (Steinwender 2018). Similarly, studies on communication technologies in historical settings find that improvements in information transmission can lead to increased market integration and price convergence (Andrabi et al. 2020, 2023). At the same time, the broader infrastructure literature, particularly on transport networks, documents strong and persistent effects on economic outcomes. Investments in transport infrastructure, such as railways, are found to significantly increase trade, market access, and regional growth (Donaldson 2018; Hornung 2015; Keller and Shiue 2008a).

Most of these findings, however, are based on infrastructure that directly facilitates the movement of goods and people on the one hand and on industrial and post-industrial settings on the other. In contrast, the empirical results of this thesis show no robust evidence that the expansion of the early modern postal network led to higher urban population levels or sustained growth. Across the range of different specifications, the estimated average effects provide no robust evidence of a positive effect, while population growth effects remain statistically insignificant following connection into the network. This contrasts with the stronger effects often found in the broader infrastructure literature and suggests that the economic impact of the postal system may have differed from that of transport infrastructure as well as from later communication infrastructures.

A key reason for this difference may lie in the nature and purpose of the postal system itself. As outlined in the historical background, the establishment of the early modern postal network under Maximilian I was primarily motivated by the need to connect the geographically dispersed Habsburg territories and to facilitate administrative coordination across space. The system was designed to transmit information quickly and reliably between political centres, rather than to support commercial exchange or the physical movement of goods primarily (Behringer 1990; Winkelbauer 2003). In this sense, the postal network represents a form of communication infrastructure whose primary function was political and administrative rather than economic at least throughout the 16th century. While the introduction of the postal system undoubtedly reduced the time required to transmit information and may also have facilitated faster communication in financial transactions or the coordination of payments by merchants and other economic actors, it did not directly lower the costs of transporting goods. Trade in the early modern period continued to depend on slow and costly physical transport, and market integration remained limited by geographic, institutional, and political constraints, especially

in the highly fragmented Holy Roman Empire. As a result, improvements in communication alone might not have been enough to generate the kinds of economic effects observed for transport infrastructure, where reductions in trade costs operate more directly. This distinction is consistent with the literature on market integration and economic development, which emphasizes that trade expansion depends not only on information flows, but also on the physical and institutional conditions that enable exchange (Clark 2015; Keller and Shiue 2008b). In the absence of substantial improvements in transport capacity or institutional integration, the benefits of faster communication are likely to remain limited. The findings of this thesis therefore suggest that, while the early modern postal system constituted an important step in the development of communication networks, its economic effects were constrained by the broader structural environment in which it operated.

Although the postal system reduced communication frictions, it left the fundamental constraints on trade and market integration largely unchanged. This explains why the empirical analysis does not detect broad-based growth effects and highlights the importance of distinguishing between different types of infrastructure when assessing their economic consequences.

5.2 The Postal Network and its Institutional Aspects

The effectiveness of the postal network must also be understood within the broader institutional and economic environment in which it operated. A large body of literature emphasizes that sustained economic growth depends not only on technological improvements or infrastructure, but crucially on the presence of well-functioning markets and supportive institutions. Institutions that ensure secure property rights, reduce transaction costs, and facilitate exchange are central to long-run development (Acemoglu et al. 2004; Greif 2006; North and Weingast 1989). Improvements in communication can enhance coordination and reduce information frictions, but they do not substitute for the underlying institutional framework.

The empirical findings of this thesis are consistent with this perspective. The absence of robust growth effects and the sensitivity of the level estimates suggest that constraints beyond communication were likely in place. Even though information could be transmitted more quickly, cities were often unable to translate this advantage into sustained economic expansion. This points to the influence of the broader economic and institutional setting in shaping the impact of the postal network.

In the context of early modern Central Europe, these constraints were particularly visible. As outlined in the historical background, the Holy Roman Empire was characterized by

a high degree of political fragmentation, with numerous territorial units exercising local authority. This fragmentation implied the existence of internal trade barriers, differing regulations, and limited coordination across regions. As a result, markets remained relatively localized, and long-distance trade was still costly and difficult to organize. Even where better information was available, the ability of merchants and cities to exploit it was constrained by these structural barriers. Evidence on European market integration suggests that substantial integration occurred only gradually and was far from complete during this time period (Clark 2015; Federico 2011). At the same time, institutional capacity was limited. The absence of strong central authority meant that the enforcement of contracts, the standardization of rules, and the provision of public goods varied considerably across regions. Recent work highlights that the development of fiscal and administrative capacity within the Holy Roman Empire was uneven and often constrained by political structures (Cantoni et al. 2024). In such an environment, the benefits of improved communication were likely to remain restricted, as economic actors continued to face uncertainty and high transaction costs in exchange. These considerations suggest that the economic impact of the postal network was shaped less by connectivity itself than by the conditions under which it operated. While the postal system reduced communication frictions, it did so in an environment where markets were fragmented and institutions limited, thereby constraining its potential to generate broader urban growth.

5.3 Heterogeneous Effects and City Size

As shown in the empirical section, there was a clear pattern of heterogeneity across cities. Literature suggests that the effects of infrastructure and information technologies are unlikely to be uniform, but instead depend on initial conditions, such as the level of development and the degree of market integration. For example, the spread of the printing press generated uneven effects across cities, benefiting some locations more than others depending on their pre-existing economic structure (Dittmar 2011). Similarly, urban growth in the pre-industrial period has been shown to depend on political and economic conditions that vary across cities (De Long and Shleifer 1993). In this sense, the impact of improved communication is likely to differ depending on how well cities were already integrated into existing networks.

The empirical findings of this thesis are consistent with this perspective. Across specifications, the interaction between postal connectivity and baseline city size is consistently negative and statistically significant, indicating that the effect of connection decreases with the initial size of a city. The approximate turning points were at 2,100 inhabitants in the baseline specification and around 1,500 inhabitants when the treatment definition is expanded. This

pattern suggests that possible positive effects of postal connectivity, if present, were concentrated among relatively small cities, while the estimated effects decline with initial city size. In contrast to the absence of a robust average effect, this heterogeneity emerges as a central and stable outcome of the results. A reasonable explanation for this pattern lies in the different marginal benefits of improved communication across cities. Smaller cities in early modern Europe were often relatively more isolated and less integrated into long-distance trade and information networks. For these locations, connection to the postal system likely meant a meaningful reduction in isolation, improving access to information, facilitating coordination, and potentially enabling participation in wider economic and administrative networks. In relative terms, these gains could be substantial, even if their absolute economic impact remained limited.

By contrast, larger cities were often already embedded in established commercial and political networks. Major urban centres maintained extensive merchant connections, financial relationships, and informal channels of information exchange well before the introduction of the postal system. Historical evidence on large trading houses, such as the Fugger, illustrates that information and coordination mechanisms were already in place for leading economic centres (Häberlein 2012). Similarly, the broader urban system was characterized by a hierarchical structure in which larger cities occupied central positions in trade and governance (De Vries 1984). In this context, the introduction of a formal postal network provided relatively limited additional benefits, as these cities already had access to alternative means of communication and coordination. Moreover, these places were more likely to already have market- as well as other commercial rights, meaning they were most likely already economically active. The marginal gain from improved information transmission was therefore considerably smaller.

All together, these aspects explain why the effects of the postal network were shaped by differences in initial conditions rather than by a uniform impact of connectivity. The network did not fundamentally alter the structure of the urban system but instead provided relatively greater benefits to previously less connected locations. These findings highlight that even where infrastructure improves communication, its economic impact depends critically on the position of cities within existing economic and institutional networks.

5.4 Postal Connection and Indirect Access

Infrastructure is often expected to generate not only direct effects for connected locations, but also indirect effects for nearby areas through spillovers. In the context of communication

networks, one might therefore expect that cities located in proximity to the postal network could also benefit from improved access to information, even without being directly integrated into the network. Such indirect effects could arise, for example, through informal transmission of information, local interactions, or secondary access via nearby connected cities (Behringer 1990; Schobesberger et al. 2016).

The empirical results, however, provide little support for this theory in the case of the postal network. Extending the treatment definition to include cities within a 25-kilometre radius of a postal station does not reveal such effects. While the expanded treatment leads to a weakly significant negative average effect in some specifications, the cohort-specific analysis shows that previously observed patterns do not persist. In particular, the positive growth effect identified for the first cohort becomes smaller and statistically insignificant, and the overall pattern remains consistent with the absence of robust growth effects. Similarly, mean-based comparisons indicate positive differences, but these do not hold once fixed effects are taken into account. These findings suggest that geographic proximity to the postal network was not sufficient to generate meaningful economic benefits.

A key explanation for this result lies in the structure of the postal system itself. As discussed in the historical background, the early modern postal network was organized as a relay system with fixed stations and predefined routes, enabling the rapid transmission of information between specific nodes. Access to the system depended on being directly connected to these routes, as only designated stations were integrated into the regular exchange of messages (Behringer 1990; Ohmann 1909), while the speed of information towards close cities was likely not sped up sufficiently enough to make a big difference. In this sense, the network did not operate as a continuously diffusing infrastructure, but rather as a system in which benefits were concentrated to cities completely integrated into the network.

From an economic perspective, this implies that the advantages of improved communication were tied to institutional and physical access to the network, rather than to geographic proximity alone. Cities that were not directly connected faced barriers to participation in the system, limiting their ability to benefit from faster information flows. Informal or indirect access was unlikely to fully replicate the advantages of direct integration, particularly in a context where communication relied on structured routes and regulated exchanges. Overall, the evidence suggests that any potential economic effects of the postal system were more likely linked to direct inclusion in the network than to geographic proximity alone.

5.5 Historical Context and External Developments

The limited and heterogeneous empirical effects of the postal network must also be put into the broader macro-historical context in which it operated. As shown in the literature, improvements in information technologies and institutions can generate persistent economic effects by facilitating coordination and integration over time even in pre-industrial Europe (Dittmar 2011; Lehmann-Hasemeyer and Wahl 2024). On the other side, recent work on early modern postal systems in France finds only limited evidence for growth effects, even where communication infrastructure was expanded significantly and in a more centralized political landscape (Sasaki 2024). Against this background, the absence of robust growth effects in the present analysis is not entirely unexpected, but calls for a closer consideration of the historical environment.

The empirical findings of this thesis provide no robust evidence of sustained growth effects and suggest that the scope for urban population growth was limited, particularly in the period after 1600. This pattern coincides with a phase of major political and economic disruption across Central Europe. Most notably, the Thirty Years' War from 1618 to 1648 led to widespread destruction, significant population losses, and a breakdown of economic activity in large parts of the Holy Roman Empire and the Habsburg Territories. But even before, the 16th and early 17th centuries were characterized by almost continuous military conflict across Central Europe and its neighboring regions. Major confrontations such as the Italian Wars, the Habsburg-Ottoman conflicts, and the Dutch Revolt placed persistent fiscal and military pressure on the Habsburg territories, while also disrupting key trade routes and economic centers. Within the Holy Roman Empire, religious tensions following the Reformation culminated in repeated internal conflicts and wars ultimately leading to the Thirty Years' War (Grafton and Bell 2018). In such a setting of prolonged instability and structural disruption, the potential benefits of improved communication were likely overshadowed by the broader macroeconomic consequences of conflict. In such an environment, any potential gains from improved communication may have been offset by the severe negative effects of war, conflict, and instability.

The late fifteenth and early sixteenth centuries were initially characterized by a phase of economic expansion, reflected in the strong population growth observed between 1400 and 1500, which was also a long-run result of the recovery from the Black Death (Belich 2022). This development was supported by increasing urbanization, the expansion of regional and long-distance trade networks, and the rise of large commercial and financial actors for example in the case of the Empire, the Fugger, at the end of the medieval and the beginning of the early modern period (De Vries 1984; Häberlein 2012). At the same time, structural changes,

including the shift of trade from the South and the Mediterranean towards Atlantic routes, a long-run consequence of the sack of Constantinople by the Ottomans, monetary disruptions associated with the Price Revolution, due to high silver inflows from the New World, introduced new pressures and uneven developments across regions. As a result, while early growth dynamics created favourable conditions for economic expansion, these were neither uniform nor sustained across Central Europe in the longer run. In combination with the ongoing political and confessional fragmentation following the Reformation, which was especially present in the Holy Roman Empire, this limited the extent to which cities could benefit from improved communication (Grafton and Bell 2018). Even where information could be transmitted more efficiently, the underlying conditions for economic expansion remained constrained.

The comparison with existing literature on postal networks in this time-frame within Europe further supports this interpretation. Sasaki (2024), analyzing the expansion of the postal system in preindustrial France, also finds limited evidence of positive economic effects. Despite differences in political structure, France being more centralized than the Holy Roman Empire and the Habsburg territories, the overall pattern is similar, suggesting that the impact of early modern postal systems was generally constrained. This consistency across contexts indicates that the absence of strong growth effects is not solely driven by regional factors, but reflects broader characteristics of communication infrastructure in pre-industrial economies as well as the political and religious conflicts and turmoils in the course of the 16th and early 17th century. To conclude, the economic impact of the postal network was shaped not only by its internal structure and the characteristics of connected cities, but also by the wider historical environment. Large-scale political conflict, structural economic shifts, and persistent fragmentation limited the potential for communication improvements to translate into sustained urban growth.

6. Conclusion

This thesis examined whether integration into the early modern postal network fostered urban growth in the Holy Roman Empire and Habsburg territories during the 16th century. Building on the literature on infrastructure, information, and institutions, the postal system was interpreted as an early form of communication infrastructure as well as an instituional enhancemnet that reduced information frictions and improved coordination across space. Exploiting the staggered expansion of the Habsburg-Taxis network and the newly constructed city-level panel dataset, the empirical analysis aimed to estimate the effect of postal

connectivity on urban population development.

The results provide no evidence of a positive average effect of postal connection on city growth. Across the main specifications, including two-way fixed effects, dynamic Sun-Abraham estimates, and cohort-specific difference-in-differences, the estimated effects provide no robust evidence of a positive average effect. Level estimates are small or negative in the full sample, while growth effects remain statistically insignificant. At the same time, a consistent and robust pattern of heterogeneity emerges: the effect of postal connectivity declines with initial city size. Smaller cities appear to benefit relatively more, while estimated effects decline with initial city size and show no clear gains for larger cities. This heterogeneity represents the most stable empirical finding of the analysis. The extensions further sharpen this interpretation. Expanding the treatment group to include cities within a 25-kilometre radius does not generate stronger effects, indicating that indirect access to the network was not sufficient to generate comparable effects. Moreover, the positive growth effect identified for early-connected cities disappears under the expanded treatment definition, suggesting that it is driven by direct integration rather than broader spillovers. Overall, the empirical evidence points to limited, heterogeneous, and context-dependent effects rather than a uniform growth impact of postal connectivity.

The discussion highlights that these findings are consistent with the specific nature of the postal system and the environment in which it operated. Unlike transport infrastructure, the postal network did not reduce the costs of moving goods, but primarily improved the transmission of information. In a fragmented political and economic landscape such as the Holy Roman Empire and the Habsburg territories, where markets were localized and institutional capacity limited, improvements in communication alone do not appear to have been sufficient to generate sustained urban growth. At the same time, the system's primary function was administrative and political, reflecting the need to govern geographically dispersed territories rather than to facilitate commercial exchange. The broader historical context further helps explain the results. The investigated period was characterized by structural economic changes and persistent political instability, culminating in the Thirty Years' War, which severely disrupted economic activity and urban development. These conditions likely constrained the extent to which cities could benefit from improved communication. The comparison with Sasaki (2024) supports this interpretation, as similar limited effects are found in the context of preindustrial France, suggesting that the absence of strong growth effects is not only specific to the Holy Roman Empire and the Habsburg territories but might reflect more general features of early modern communication infrastructure.

This thesis contributes to the literature by providing a systematic empirical analysis of the economic effects of the early modern postal system and by extending the study of information infrastructure to a pre-industrial setting. The findings show that reductions in communication frictions alone do not necessarily translate into economic growth and that their impact depends critically on initial conditions and the broader institutional and economic environment. More generally, the results highlight the importance of distinguishing between different types of infrastructure and of embedding their analysis within the historical context in which they operate.

The analysis also has its limitations and therefore leaves room for further research. First, future work could build on this thesis by using more granular population data or additional economic outcome variables, such as trade activity, market prices, fiscal revenues, or information flows, where such data become available. Second, a more detailed reconstruction of postal routes, station-level access, and actual usage of the postal system could help distinguish more clearly between formal network connection and the intensity of communication. Third, comparing the Habsburg-Taxis network with postal systems in other European regions could help assess whether the limited and heterogeneous effects found here were specific to the fragmented institutional environment of the Holy Roman Empire and Habsburg territories, or instead reflected broader features of early modern communication infrastructure. If the historical information is available these extensions could bring more interesting insights into the topic of communication and connectivity and their respective growth effects in a pre-industrial setting.

Summing up, the early modern postal network constituted a major innovation in communication and an important element of political and administrative integration. However, its economic impact on urban growth was limited and uneven, showing that the relationship between infrastructure and development is conditional, rather than universal.

Literature

Acemoglu, Daron, Simon Johnson, and James Robinson. 2004. *Institutions as the Fundamental Cause of Long-Run Growth*. No. W10481. National Bureau of Economic Research.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. 'The Colonial Origins of Comparative Development: An Empirical Investigation'. *American Economic Review* 91 (5): 1369–401.

Andrabi, Tahir, Sheetal Bharat, and Michael Kuehlwein. 2020. 'Post Offices and British Indian Grain Price Convergence'. *Economic History of Developing Regions* 35 (1): 23–49.

Andrabi, Tahir, Sheetal Bharat, and Michael Kuehlwein. 2023. 'Information and Price Convergence: Government Telegraphs in British India'. *The Indian Economic and Social History Review* (New Delhi, India) 60: 334.

Bairoch, Paul, Jean Batou, and Pierre Chèvre. 1988. *La Population Des Villes Européennes : Banque de Données et Analyse Sommaire Des Résultats : 800 - 1850*. The Population of European Cities. Librairie Droz.

Behringer, Wolfgang. 1990. *Thurn und Taxis: die Geschichte ihrer Post und ihrer Unternehmen*. Piper.

Behringer, Wolfgang. 2005. '"Von Der Gutenberg-Galaxis Zur Taxis-Galaxis". Die Kommunikationsrevolution: Ein Konzept Zum Besseren Verständnis Der Frühen Neuzeit'. *Historische Zeitschrift. Beihefte* 41: 39–54. JSTOR.

Belich, James. 2022. *The World the Plague Made: The Black Death and the Rise of Europe*. Princeton University Press.

Brayshay, Mark. 1991. 'Royal Post-Horse Routes in England and Wales: The Evolution of the Network in the Later-Sixteenth and Early-Seventeenth Century'. *Journal of Historical Geography* (London) 17: 373–89.

Brayshay, Mark, Philip Harrison, and Brian Chalkley. 1998. 'Knowledge, Nationhood and Governance: The Speed of the Royal Post in Early-Modern England'. *Journal of Historical Geography* 24 (3): 265–88.

Bretagnolle, Anne, Timothée Giraud, and Nicolas Verdier. 2010. 'Modelling the Efficiency of a Transport Network: The Case of Horse Postal Routes in Pre-Industrial France (1632-1833)'. *Espace Géographique* 39: 131.

Buringh, Eltjo. 2020. 'European Urban Population, 700 - 2000'. Version V1. DANS Data Station Social Sciences and Humanities.

Cantoni, Davide, Cathrin Mohr, and Matthias Weigand. 2024. 'The Rise of Fiscal Capacity: Administration and State Consolidation in the Holy Roman Empire'. *Econometrica* 92 (5): 1439–72.

Caplan, Jay. 2016. *Postal Culture in Europe, 1500-1800*. Oxford University Studies in the Enlightenment, 2016:04. Voltaire Foundation.

Clark, Gregory. 2015. 'Markets before Economic Growth: The Grain Market of Medieval England'. *Cliometrica* (Berlin/Heidelberg) 9: 287.

Czernich, Nina, Oliver Falck, Tobias Kretschmer, and Ludger Woessmann. 2011. 'Broadband Infrastructure and Economic Growth'. *The Economic Journal (London)* (Oxford, UK) 121: 532.

Dallmeier, Martin. 1977. *Quellen Zur Geschichte Des Europäischen Postwesens : 1501 - 1806. 2, Urkunden-Regesten*. Thurn-Und-Taxis-Studien / 9. Laßleben.

Darby, Henry C. 1970. *The New Cambridge Modern History. 14, Atlas / Ed. by H. C. Darby and Harold Fullard*. Univ. Press.

De Long, J. Bradford, and Andrei Shleifer. 1993. 'Princes or Merchants? City Growth before the Industrial Revolution'. *Journal of Law and Economics* 36 (2): 671–702.

De Vries, Jan. 1984. *European Urbanization : 1500 - 1800*. Harvard Studies in Urban History. Harvard Univ. Press.

Dittmar, Jeremiah E. 2011. 'Information Technology and Economic Change: The Impact of the Printing Press'. *The Quarterly Journal of Economics* (CARY) 126: 1172.

Donaldson, Dave. 2018. 'Railroads of the Raj: Estimating the Impact of Transportation Infrastructure'. *The American Economic Review* (NASHVILLE) 108: 934.

Donaldson, Dave, and Richard Hornbeck. 2016. ‘RAILROADS AND AMERICAN ECONOMIC GROWTH: A “MARKET ACCESS” APPROACH’. *The Quarterly Journal of Economics* (CARY) 131: 858.

Duntze, Oliver. 2024. *GWMap*. Gesamtkatalog Der Wiegendrucke. https://umap.openstreetmap.fr/de/map/gwmap_1014171#5/50.444/13.975.

Duranton, Gilles, and Matthew A. Turner. 2012. ‘Urban Growth and Transportation’. *The Review of Economic Studies* (OXFORD) 79: 1440.

Federico, Giovanni. 2011. ‘When Did European Markets Integrate?’ *European Review of Economic History* 15 (1): 93–126. JSTOR.

Fogel, Robert William. 1970. *Railroads and American Economic Growth: Essays in Econometric History*. 2. print. Johns Hopkins Univ. Pr.

Geloso, Vincent, and Michael Makovi. 2022. ‘State Capacity and the Post Office: Evidence from Nineteenth Century Quebec’. *Journal of Government and Economics* 5.

Grafton, Anthony, and David A. Bell. 2018. *The West: A New History*. First edition. W.W. Norton & Company, Inc.

Greif, Avner. 2006. *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. Political Economy of Institutions and Decisions. Cambridge University Press. Cambridge Core.

Häberlein, Mark. 2012. *The Fuggers of Augsburg : Pursuing Wealth and Honor in Renaissance Germany*. Studies in Early Modern German History. University of Virginia Press. eBook Collection (EBSCOhost).

Hansert, Andrea C. 2009. *Die Habsburger : Geschichte Einer Herrscherdynastie*. Imhof Kulturgeschichte. Imhof.

Hoag, Christopher. 2006. ‘The Atlantic Telegraph Cable and Capital Market Information Flows’. *The Journal of Economic History* 66 (2): 342–53. JSTOR.

Hollegger, Manfred. 2005. *Maximilian I. : (1459 - 1519) : Herrscher Und Mensch Einer Zeitenwende*. Urban-Taschenbücher / Band 442. Verlag W. Kohlhammer.

Hornung, Erik. 2015. ‘RAILROADS AND GROWTH IN PRUSSIA: Railroads and Growth in Prussia’. *Journal of the European Economic Association* 13 (4): 699–736.

Jedwab, Remi, Edward Kerby, and Alexander Moradi. 2017. ‘HISTORY, PATH DEPENDENCE AND DEVELOPMENT: EVIDENCE FROM COLONIAL RAILWAYS, SETTLERS AND CITIES IN KENYA’. *The Economic Journal (London)* (OXFORD) 127: 1494.

Keller, Wolfgang, and Carol Shiue. 2008a. *Institutions, Technology, and Trade*. No. W13913. National Bureau of Economic Research.

Keller, Wolfgang, and Carol Shiue. 2008b. ‘Tariffs, Trains, and Trade: The Role of Institutions versus Technology in the Expansion of Markets’. *C.E.P.R. Discussion Papers, CEPR Discussion Papers*, January 1.

Keller, Wolfgang., and Carol H. Shiue. 2004. *Market Integration and Economic Development : A Long-Run Comparison*. Market Integration and Economic Development, edited by National Bureau of Economic Research. National Bureau of Economic Research.

Koudijs, Peter. 2016. ‘The Boats That Did Not Sail: Asset Price Volatility in a Natural Experiment’. *The Journal of Finance* 71 (3): 1185–226.

Lehmann-Hasemeyer, Sibylle, and Fabian Wahl. 2024. *Regional and Urban Development in Europe*. Edited by Claude Diebolt and Michael Haupert. Vol. 1. Cham.

Linnarsson, Magnus. 2011. *The Development of the Swedish Post Office, c. 1600–1721*. Södertörn Studies in History.

Neal, Larry. 2000. ‘How It All Began: The Monetary and Financial Architecture of Europe during the First Global Capital Markets, 1648–1815’. *Financial History Review* 7 (2): 117–40.

North, Douglass C., and Barry R. Weingast. 1989. ‘Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth-Century England’. *The Journal of Economic History* 49 (4): 803–32. Cambridge Core.

Ohmann, Fritz. 1909. ‘Die Anfänge Des Postwesens Und Die Taxis’. In *Die Anfänge Des Postwesens Und Das Emporkommen Der Taxis in Italien*. Duncker & Humblot.

Ottinger, Sebastian, and Elizaveta Zelnitskaia. 2025. *Post(-Mongol) Roads to Path Dependence*. The Center for Economic Research and Graduate Education - Economics Institute, Prague.

Ploeckl, Florian. 2023. 'Market Access and Information Technology Adoption: Historical Evidence from the Telephone in Bavaria'. *The Journal of Economic History* 83 (1): 275–308. Cambridge Core.

Rogowski, Jon C., John Gerring, Matthew Maguire, and Lee Cojocaru. 2022. 'Public Infrastructure and Economic Development'. *American Journal of Political Science* 66 (4): 885–901. JSTOR.

Röller, Lars-Hendrik, and Leonard Waverman. 2001. 'Telecommunications Infrastructure and Economic Development: A Simultaneous Approach'. *The American Economic Review* (Nashville) 91: 923.

Sasaki, Yu. 2024. 'Postal Growth: How the State-Sponsored Post Affected Growth in Preindustrial France, 1500–1850'. Preprint, SSRN.

Schobesberger, Nikolaus, Paul Arblaster, Mario Infelise, et al. 2016. 'European Postal Networks'. In *News Networks in Early Modern Europe*, edited by Noah Moxham and Joad Raymond. Brill. JSTOR.

Steinwender, Claudia. 2018. 'Real Effects of Information Frictions: When the States and the Kingdom Became United'. *The American Economic Review* (NASHVILLE) 108: 696.

Stillwell, Richard. 1976. *The Princeton Encyclopedia of Classical Sites*. Edited by William L. MacDonald and Marian Holland McAllister. Princeton University Press.

Sun, Liyang, and Sarah Abraham. 2021. 'Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects'. *Themed Issue: Treatment Effect 1* 225 (2).

Trivellato, Francesca. 2009. *The Familiarity of Strangers : The Sephardic Diaspora, Livorno, and Cross-Cultural Trade in the Early Modern Period*. 1st ed. Yale University Press,.

Winkelbauer, Thomas. 2003. *Ständefreiheit Und Fürstenmacht: Länder Und Untertanen Des Hauses Habsburg Im Konfessionellen Zeitalter*. Österreichische Geschichte 1522-1699. Ueberreuter.

Appendix



Figure 3 – Map of the extent of the Holy Roman Empire and the Habsburg territories under Charles V (1500-1558) taken from Grafton and Bell (2018).

Table A1 - Cohort-Specific Difference-in-Differences Estimates

Term	First cohort (1500)	Second cohort (1550)	Third cohort (1600)
Post × Treated (log population)	0.002	-0.031	-0.016
	(0.046)	(0.044)	(0.038)
Post × Treated (50-year log growth)	0.211*	-0.049	-0.071
	(0.116)	(0.041)	(0.059)
Observations (log population)	1264	1276	1268
Observations (50-year log growth)	1278	1274	1254
City FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

The first coefficient row reports cohort-specific 2x2 difference-in-differences estimates with log population as the dependent variable.
The second coefficient row reports cohort-specific 2x2 difference-in-differences estimates with 50-year log population growth as the dependent variable.
All specifications include city and time fixed effects. Standard errors are clustered at the city level.
* p < 0.1, ** p < 0.05, *** p < 0.01

Table A1 – Cohort-Specific DiD

Table A2 - Simple 2×2 Difference-in-Differences Estimates (Group Means)

Cohort	Pre	Post	DiD estimate (log population)	Effect log population (%)	DiD estimate (50-year log growth)	Effect 50-year growth (%)	# Treated cities	# Control cities
First (1500)	1400	1550	-0.191	-17.39	0.205	22.73	25	644
Second (1550)	1500	1600	-0.004	-0.41	-0.049	-4.75	30	625
Third (1600)	1550	1650	0.058	5.95	-0.071	-6.89	19	625

The table reports simple 2×2 difference-in-differences estimates based on mean outcomes.
Each cohort is compared to cities not yet connected in the respective period.
Log population estimates compare population levels between the pre- and post-period.
50-year log growth estimates compare growth over the pre-treatment interval with growth over the post-treatment interval.
Percentage effects are computed as $100 \times (\exp(\beta) - 1)$.

Table A2 – Descriptive means of cohorts

Table A3 - Cohort-Specific Difference-in-Differences Estimates with Expanded Radius Treatment

Term	First cohort (1500)	Second cohort (1550)	Third cohort (1600)
Post × Treated (log population)	-0.160**	-0.066	0.043
	(0.066)	(0.065)	(0.058)
Post × Treated (50-year log growth)	0.094	-0.033	-0.014
	(0.082)	(0.039)	(0.058)
Observations (log population)	1254	1216	1196
Observations (50-year log growth)	1254	1216	1196
City FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

The first coefficient row reports cohort-specific 2x2 difference-in-differences estimates with log population as the dependent variable.
The second coefficient row reports cohort-specific 2x2 difference-in-differences estimates with 50-year log population growth as the dependent variable.
The treatment group includes directly connected cities and cities within a 25 km radius of a connected postal city.
Radius cities are assigned to the cohort of the nearest directly connected postal city within 25 km.
All specifications include city and time fixed effects. Standard errors are clustered at the city level.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3 – Expanded treatment group

Table A4 - Simple 2×2 Difference-in-Differences Estimates with Expanded Radius Treatment

Cohort	Pre	Post	DiD estimate (log population)	Effect log population (%)	DiD estimate (50-year log growth)	Effect 50-year growth (%)	# Treated cities	# Control cities
First (1500)	1400	1550	0.677	96.82	0.097	10.14	44	665
Second (1550)	1500	1600	0.521	68.31	-0.032	-3.13	42	624
Third (1600)	1550	1650	0.773	116.55	-0.015	-1.50	32	597

The table reports simple 2×2 difference-in-differences estimates based on mean outcomes.
The treatment group includes directly connected cities and cities within a 25 km radius of a connected postal city.
Radius cities are assigned to the cohort of the nearest directly connected postal city within 25 km.
Each cohort is compared to cities not yet connected under the expanded treatment definition.
Percentage effects are computed as $100 \times (\exp(\beta) - 1)$.

Table A4 – Means of expanded treatment group

Table A5 - Diagnostic Sun-Abraham Estimates

	(1) Original levels	(2) Levels, horizon ≤ +2	(3) Levels, not-yet controls	(4) Original growth	(5) Growth, not-yet controls
Post connection (ATT)	−0.102**	−0.075	0.050	0.058	0.022
	(0.052)	(0.046)	(0.036)	(0.054)	(0.039)
Printing press	0.012	0.009	0.213*	0.027	0.147
	(0.051)	(0.051)	(0.121)	(0.058)	(0.120)
University	0.037	0.020	−0.104	0.050	0.128
	(0.088)	(0.089)	(0.160)	(0.074)	(0.081)
Observations	3421	3396	370	2714	296
R-squared	0.922	0.922	0.951	0.365	0.326
Outcome	Log population	Log population	Log population	50-year log growth	50-year log growth
Control group	Not-yet and never	Not-yet and never	Not-yet only	Not-yet and never	Not-yet only
Post-treatment horizon	Up to +3	Up to +2	Up to +3	Up to +2	Up to +2
Within R-squared	0.007	0.006	0.054	0.005	0.019
City FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

* p < 0.1, ** p < 0.05, *** p < 0.01

The table reports diagnostic Sun-Abraham estimates used to assess the consistency between level and growth specifications.

Column (2) restricts the level specification to the same post-treatment horizon as the growth specification by excluding treated observations beyond event time +2.

Columns (3) and (5) drop never-connected cities, so identification comes only from not-yet-treated cities.

All specifications include city and time fixed effects as well as controls for printing press, university, and Roman site.

Standard errors are clustered at the city level.

Roman site is time-invariant and therefore absorbed by city fixed effects when included separately.

Table A5 – Sun-Abraham Diagnostics