Institutional Commitment and Economic Revival: Evidence from Palace-Building in Renaissance Rome

Alyssa Rusonik*

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Supplementary Online Appendix

In this appendix, I detail the data construction process for all datasets employed in the paper: on Roman palace-building; on Roman patron demographics; on papal absences from Rome; and on aggregate palace-building trends in Rome, Florence, and Venice. Classification, measurement and definition choices are discussed.

*HEC Paris. alyssa.rusonik@hec.edu

A Roman Palace-building

A.1 The Nolli Map

To gather data on investment in real estate, I rely heavily on Giambattista Nolli's seminal 1748 map of Rome, *La pianta grande di Roma* (hereafter referred to, as the Nolli Map; see Figure 1). The project took him a decade to complete, was the first to use surveyors' methods for all of Rome, and remains among the most accurate and detailed maps of the city ever created.[1] The original map is a masterpiece comprised of twelve engraved copper plates and measuring 1.76m by 2.08m; so extraordinary is the level of attention that even the interiors of some structures are accurately depicted.

Figure 1: Giambattista Nolli's "La pianta grande di Roma" (c. 1748)

[1]Modern satellite data suggests negligible margins of error (Tice et al., 2021).

Figure 2: A view of the digital Nolli map interface. Pictured is the entry on Palazzo Palma con Torre.

The digitized map is presently hosted on the servers of Stanford University where it can be freely accessed and explored: https://nolli.stanford.edu/

In 2005, it was first digitized by a team of urban historians and architects under the leadership of Tice et al. (2021). The researchers populated the map with entries such that a detailed history of each landmark is available, including all important construction projects, restoration work, major acquisitions, and any other events relevant to the architectural history of the city. An example of an entry for a single landmark is presented in Figure 2.

I use these entries to collect data on the name (historical and modern), "type" (e.g., church, palazzo, street, fountain, etc.), prominent architects and patrons, and current condition of 1320 landmarks. I also collect descriptions of all events, and the corresponding start and end years of the project, associated to each landmark. My compilation yields over 5,000 project observations over the course of the city's history.

A.2 Variable Definitions

All of the variables used in the main empirical analysis are described in Table 1. In the dataset itself, there is further granularity. "Rebuilt" projects are further separated into two sub-categories: "repaired/restored/improvements" and "repurposed/consecrated," the latter of which includes acquisitions. There are dummies for institutional patrons (i.e., when the builder is a group, such as an Order), non-Catholic religious patrons, lay-and-prelate building teams, historically significant events at a site, special event at a site, notarial/record-keeping

entry (if an entry does not bear on an event but just on the existence of records). I also maintain meta data not just on the sources used for each classification, but also on the source type, source language, and number of sources (see Section A.5)

A.3 Classification

The data classification exercise has two goals. First, it serves to identify suitable investment projects. The main criteria of eligibility are induced by the type of the landmark and the "inheritability" of the venture: these narrow the considered projects to those which meet the intuitive criteria of what we heuristically refer to as "private palace-building". Second, the data is classified to characterize the type of patron and nature of the investment project.

A.3.1 Idenfifying Palace-Building Projects

Type The goal here is to identify (broadly) the plausible sites at which one might find palace-building projects. I define a "palace" broadly and consider any buildings containing a mention of a plausibly-residential site in their description: that is, those listed as Castle; Palace; Palace, Arch; Palace, Chapel; Palace, Gardens; Palace, Obelisk; Palace, Orphanage; Palace, Prison; Palace, Ruins; Palace, Tower; Palace, Tower, Prison; Palace, Villa; Residence; Residence, Tower; Tower; and Tower, Residence.[2]

While a "church" or "prison" per se would not be related to "plausibly residential and inheritable real estate" and is in no way connected to palace-building, a landmark listed as a "Palace, Tower, Prison" suggests a site at some point used as a prison and at some point as a normal palace. It thus merits inclusion in the hypothetical landmark, at least to be considered as a candidate source for palace-building-related projects.

[2]The comprehensive list of all "types" in the Nolli Map is as follows: Academy; Arch; Bank; Barracks; Boarding House, Hospital; Bridge; Castle; Cemetery; Chapel; Chapel, Bank; Chapel, Residence; Church; Church, Arch; Church, Boarding House; Church, Boarding House, Hospital; Church, Boarding House, Hospice; Church, College; Church, College, Residence; Church, Confraternity; Church, Convent; Church, Convent, Ruins; Church, Convent, Tower; Church, Hospital; Church, Hospital, College; Church, Hospice; Church, Hospice, Ruins; Church, Monastery; Church, Monastery, Orphanage; Church, Monastery, Ruins; Church, Monastery, Ruins, Tower; Church, Monastery, Tower; Church, Novitiate; Church, Novitiate, School; Church, Oratory; Church, Orphanage; Church, Palace; Church, Piazza, Fountain; Church, Residence; Church, Residence, Arch; Church, Residence, School; Church, Residence, Tower; Church, Ruins; Church, School; Church, Tower; Column; Column, Piazza; College; Customs House; Customs House, Ruins; Customs House, Tower; Factory; Fountain; Fountain, Piazza; Fountain, Street; Gate; Gardens; Granary; Hayshed; Hospital; Hospice; Mint; Monastery; Obelisk; Oratory; Oratory, Arch; Oratory, Confraternity; Oratory, Confraternity, Church; Oratory, Orphanage; Palace; Palace, Arch; Palace, Barracks; Palace, Chapel; Palace, Gardens; Palace, Hospice; Palace, Obelisk; Palace, Orphanage; Palace, Prison; Palace, Ruins; Palace, Tower; Palace, Tower, Prison; Palace, Villa; Piazza; Piazza, Arch; Piazza, Fountain; Piazza, Fountain, Obelisk; Piazza, Obelisk; Piazza, Obelisk, Fountain; Piazza, Ruins; Piazza, Ruins, Column; Piazza, Street; Piazza; Fountain; Prison; Residence; Residence, Ruins; Residence, School; Residence, Tower; Ruins; Ruins, Arch; Ruins, Bridge; Ruins, Column or Obelisk; Ruins, Palace; Ruins, Walls; Sacristy; Salt Work; School; Seminary; Stable; Street; Street, Arch; Street, Fountain; Street, Ruins; Street, Tower; Synagogue; Theater; Tower; Tower, Residence; University; Villa; Walls. Only those identified above are plausibly related to any kind of residential palace-building exercise.

Variable	Description
	Data obtained from the map
ID	Location ID on the Nolli Map; a unique identifier of a (palace-)site
Name	Name when Nolli was making the map (c. 1736-48)
Modern Name	Name in the 21st century
Type	Landmark type in its "final" form (e.g., palazzo, street, academy, church, etc.)
Architects	All (prominent) architects engaged with connections to building over its "lifetime"
Patrons	All (prominent) patrons engaged with connections to building over its "lifetime"
Start year	First year of project
End year	Last year of project
Current condition	Condition in 21st century, if available
Description	Description of event (furnished by historians)
	Manual classification of events
All investment (= active project)	A dummy variable capturing an instance of real estate investment.
Built	The building was built/some institution was established for the first time, or very significant construction took place.[a]
Rebuilt	Work was done on an existing building (reconstruction, improvement, etc.).[b]
Inheritable	Records whether or not the construction associated to the project was inheritable (e.g., a residential palazzo). Need not reflect current state.
Prelate patron	Records whether there is a patron who is a high-ranking ecclesiastical official overseeing the particular project.
Reigning pope	The name of the reigning pope at the start of the project.
Reigning pope's relative	The patron is a close relative of the reigning pope at the time of the project's inception.
Supplementary notes	A record of additional sources consulted, separate from Nolli map, used to classify the entry.
	Constructed variables
Prelate population	The number of active prelates, as per the Cardinal consistories.
Lay population	The number of active laymen, as per the Lista d'Oro.
Since last project[c]	Number of years since the last project at the same site (and higher-order polynomial terms).
Previous project length[c]	Total length of the previous project at the same site (and higher-order polynomial terms).
Project length	Number of years in which project is active (and higher-order polynomial terms).
Century-long project	Plausible measurement error: project is exactly a century long, with start- and end-dates exactly at the turn of a century.

Table 1: Description of variables

[a] For example, if, on the territory, there was a palace, and they added a military fort, that merits the "built" tag because the purpose of the added infrastructure is different. Adding a chapel or cloister to an existing church is best classified as an "improvement" rather than as new construction.
[b] "All investment" is a union of "built" and "rebuilt" projects.
[c] Censored variables. In quantitative analysis, these are modulated by a dummy variable ("has a previous project").

Inheritability Considering inheritability, in turn, allows for the isolation of the true palace-building ventures of interest. I define inheritability in operational fashion: whether the site can, conceivably, be passed down to some heir. This intentionally avoids considering palace-like structures but which serve commercial-like uses (e.g., official papal residences). Because many palaces served multiple functions simultaneously (an otherwise residential palace could have room for shopkeepers, for instance),however, it does not make sense to restrict to purely residential buildings. Hence, inheritability represents the natural criterion (– whose choice is discussed in greater detail in section A.3.5).

A.3.2 The Dataset

I retain only landmarks which see investment in the appropriate time-period (1300-1599 for some aggregate trends; I further restrict to 1378-1599 for all empirical analysis). I exclude projects whose investments are eventually unclassifiable in my framework, or those events unrelated to private palace-building activity despite bearing on an ostensibly appropriate landmark.[3] Of 161 plausible-palaces on record between 1378 and 1599, 146 are retained for the final empirical sample. On the project level, of 298 palace-related projects 1300-1599, 233 are retained; for the sample restriction 1378-1599, of 289 candidate projects, 231 are retained.

Figure 3 provides an example of the classification process for a single entry. As is the case in the figure, most of the classification effort bore on identifying the patrons (was the patron a prelate or layman?) and, secondarily, on the nature of the construction (was the project novel enough to warrant being considered a "new" or "built" project?)

After dropping isolated and sporadic mentions of rent or palace dereliction[4] and nine unclassifiable projects without credible dating, I obtain a dataset with 231 projects at 146 distinct palace sites. Table 2 presents an overview.

A.3.3 What is a prelate?

The definition of the term "prelate" is somewhat elusive. The boundaries between religious and secular were blurred, and careers could cross lines. Some non-clerical offices in the Church could be bought by lay officials, for example, whereupon a religious title (such as "Monsignor") could be conferred even if no vows were taken.

I take an operational approach and define a prelate as the direct beneficiary of the 1475 papal reform of inheritance laws: a prelate is a religious official who had been bound by inheritance constraints before the reform. Importantly, as the classification only occurs

[3]For instance, the Lateran Palace – part of the Vatican complex – is not comparable to private palace-construction initiatives, and is much more akin to a government building than a private residence.

[4]In reality, such events ought not to be sparse, but the digitized Nolli map's coverage thereof is not systematic enough to be exploitable; the map's focus is on significant construction events influencing a site's architectural history.

(a) Nolli map excerpt annotated with classification details

(b) Baldassini's tomb in Chaalis Abbey, France (Image from Wikipedia Commons)

Figure 3: An Example of data classification: the Palazzo Baldassini

43.7% of entries in the final sample required additional data to complete the classification. In most such cases, there was insufficient information to immediately classify a patron as prelate or lay (though sometimes the missing data is also on the novelty of the construction). A patron's occupation is sufficient grounds to identify their status. For example, the Palazzo Baldassini – in those days, the Palazzo Palma con Torre – was, the Nolli map entry tells, "constructed by Antonio da Sangallo the Younger under Melchiorre Baldassini" between 1515 and 1518. Baldassini's identity as prelate or layman is not obvious. But Sangallo the Younger is a fashionable architect: his are Palazzo Farnese (completed later by Michelangelo), Santa Maria di Loreto, Villa Madama (following the death of Raphael), even parts of St. Peter's Basilica. To hire an architect of this calibre, Melchiorre Baldassini can be no ordinary patron. But just who he is remains a mystery: my consultation of the papers, books, archival lists, biographies, and urban histories that typically contain the answers I need are fruitless. The furtive Baldassini declines all requests for closer acquaintance and takes his secret to the grave. Rather literally, in fact. It is his tomb that reveals the answer. I come across a photo of a marble effigy sleeping peacefully on a bed of books; a Latin inscription pays homage to an illustrious career as a jurist. Then I discover a paper by Sénéchal (1999) marveling at a surprising discovery in Chaalis of the tomb of one Melchiorre Baldassini, one of the most eminent Roman legal scholars of the early 16thC. I thus identify the patron as a layman, and the project is classified. All classifications retained in the final dataset are unambiguous; the very few projects for which it was not possible to produce compelling direct evidence of a patron's status have been dropped from the final dataset.

conditional on a palace-building project, I do not need to draw any hypothetical boundaries regarding how high-ranking an ecclesiastical official needs to be to count as a prelate: if a patron is building a palace, they are powerful enough to build one.

A.3.4 How robust is the distinction between prelate and lay?

Lee (1983) notes that, in the fifteenth century, most cardinals came from outside Rome, and were, therefore, easily distinguishable from the powerful lay families. Until the Sack of Rome (1527), these are two largely distinct groups.

Eventually, family-rise and palace-building became a two-brother effort: one layman for marriage and begetting an heir; the other – clerical, for career advancement, even the cardinalate. By the late sixteenth century, this was the usual story, maybe even the modal case, which renders somewhat meaningless the distinction between lay and prelate on the individual level – the family becomes the relevant unit of analysis. However, my data is set

		All			Prelates		Laity	
Sample: Nolli Map	all records	1378-1599	1378-1469	1470-1599	1378-1469	1470-1599	1378-1469	1470-1599
Panel A: Roman construction								
No. map mentions	5025							
No. sites	1319							
No. active palace sites	328	161	28	151				
Currently extant	247	134	22	127				
Partially extant	25	13	4	10				
Demolished	52	13	2	13				
Panel B: Palace-building projects								
No. palace-building projects		231	23	208	10	78	13	130
No. building projects		117	14	103	7	25	7	78
No. reconstruction projects		114	9	105	3	53	6	52
No. palace sites (retained)		146	21	133	9	50	13	106
Panel C: Inheritable project lengths (years)								
min length		1	1	1	1	1	1	1
max length		126	101	126	56	101	101	126
mean length		22.95	41.30	20.52	18.8	9.71	58.62	27.50
median length		1	50	1	9.5	1	51	1

Table 2: Summary Statistics: Project Characteristics

Sites are precise geographic identifiers (akin to a street address). A "palace" pools together all plausibly-inheritable real estate. Panel A bears only on raw data from the Nolli map and contains all potential-palaces. Condition status (extant, partially extant, demolished) refers to the current condition of a site and is sometimes missing in the data. A "map mention" is any entry in the digitized map with an event (start-)date. Panel B and C, in turn, concern themselves with projects retained for the empirical design – that is, those which meet the definitions of inheritability or a particular type of construction. Precise definitions (e.g., of the distinction between "built" and "reconstructed" projects, of "inheritability," etc.) are presented in Table 1.

relatively early, and there are only two such observations (one in 1541, one in 1590), well outside the window of difference-in-difference identification. So this is nowhere a concern for the empirical analysis.

That selection into the prelate group becomes endogenous over time mitigates the degree to which one can quantify the long-term treatment effects of the bull (hence the restriction of the difference-in-difference time-frame to a short-term analysis), but it in no way detracts from the crucial qualitative observation that palace construction is helped by the presence of beneficiaries of the papal bull.

I will not endeavour to argue that families with and without high-ranking ecclesiastical officials by the late 16th century are still close to indistinguishable. Nor do I need to do so. After the boundary between the two groups becomes permeable, treatment is endogenized to some degree, and available on a costly and lagged "opt-in" basis. If pursuing access to the Church becomes more desirable than it was in the past as a result of the papal bull, this only underscores its efficacy. In fact, this suggests another dimension of wisdom to the policy: it is plausible that the bull allowed the papacy to simultaneously foster economic growth in the city and attract representatives of powerful families – or otherwise more competent workers – to join its ranks.

A.3.5 Why measure inheritable investment?

This question, implicitly, has two parts: first is the question "why measure inheritable investment if one is interested in urban revival or economic development?", and, second, "why measure inheritable investment – and not 'private' or 'residential' or something else?"

In short, inheritable real estate is optimal for eliciting long-term attitudes, is prevalent enough to have rich, exploitable data, and has high economic significance so as to be meaningful. Conversely, a definition of "private" residence or "purely residential structure" would map poorly onto early-modern urban life – even though, in many ways, these words with their modern connotations provide a near-perfect approximation of the word "inheritable" in the 15th and 16th centuries. Inheritability is a historically meaningful, verifiable criterion. It captures precisely the asset class at the heart of the reforms and the credibility mechanism. In other words, this is just a matter of nomenclature: the goal is to identify projects in which patrons invest in palace-building motivated by their own private gain, and to avoid state-sponsored or commercial ventures.

Eliciting long-term attitudes Palaces were illiquid, costly, and designed to remain within a family, as a primary store of wealth and sign of power, for many generations. Outside options existed: Rome had an active rental market; the city had an unusually transitory elite, and every new pope, every new cardinal, every ambassador and wealthy immigrant wanted lodgings – but very few, before the reforms, built new ones (Fragnito, 1993). So, the choice to invest in a palace for any patron reveals their confidence in the city's future economic prospects in a way that investment in liquid or movable assets would not.

Prevalence A palazzo served many purposes. It was not just a residence. It was a family heirloom; a symbol of power and wealth; an impressive reminder to friends and a warning to enemies; a fortress and a hub of economic activity. That it also happened to be the investment of choice throughout the Renaissance (see Goldthwaite (1993)) underscores the ambition – and consequently the potency – of the 1475-1480 papal bulls. Palaces also played a vital role in commercial and rental markets long after their construction was over, with floors reserved for vendors (including storefronts and storage) and tenants. Narrative evidence is abundant in confirming that early-modern Romans delighted in opportunities to spend illustrious sums of money on projects they thought would advantage their family for generations (Nussdorfer (1997), Goldthwaite (1993)).

Economic Significance Unlike the occasional Church commission, which brought, at best, sporadic economic activity, sustained investment in real estate meant a steady income for artisans, stonemasons, builders, and skilled and unskilled labourers at all stages of the con-

struction process (Goldthwaite, 1993; Bartlett, 2013)). Palace-building was, in other words, one of the primary economic engines of the Renaissance.

Especially for a city with almost no industry and whose most meaningful export was the sale of indulgences and mediation,[5] consistent labour demand was a promise of long-term economic activity – and a hope for a natural corrective to the demographic problems that plague a city with a minimal natural birthrate. Partner (1980) and Bartlett (2013) even suggest that the construction boom in the late fifteenth century and early sixteenth century led to an influx of workers from Lombardy settling in the city. Expectations of stable future employment lured entire families to Rome. Temporary spikes in labour demand induced, at best, temporary relocation of workers, and seldom led to mass migrations of wives and children.[6]

Why measure "inheritable" and not "private" (or "private, residential") investment? A word on classification. The dichotomy between "private" and "public" spheres may appear natural now, but would have been meaningless in early-modern Italy – and so would a classification of investment projects on such grounds. Several urban historians and micro-historians (cf, e.g., Cohen and Cohen (2001-2002) and Nussdorfer (1997)) demonstrate that distinctions of "private" and "public" were not easily drawn in early-modern Roman space. Public life was full of private matters and of relations of friendship, kinship, loyalty, and enmity. Private institutions like the family, the kin-group, the band of friends, the clientele were all susceptible to political trends (Cohen and Cohen, 2019, chapter 9). Projected onto the spaces they occupied, public and private life remained just as difficult to disentangle. Private spaces often had public functions and vice versa. To classify palace-building projects along these lines in hopes of identifying purely-residential spaces would, then, be artificial and overly reductionist. Even the word "space" had not yet taken its contemporary meaning as a theatre or domain of existence; it described only concepts relating to measurement and objects.[7]

[5]There was a market for masses, dedicated prayers, for Romans as for visitors, and another kind of indulgences: an absolution from solemn vows. So petitioners would come to Rome to litigate for absolution and remission. Rome exported justice, too: it was a court of last appeal (Southern, 1961), and – earlier than many monarchies – Rome exported its capacity to arbitrate and rule on cases, for instance in the *Sacra Romana Rota*, the highest ecclesiastical tribunal in the Church, which handled cases from across Europe (Salonen, 2016). See also Blastenbrei (2006), Fosi (1993) and Fosi (2011) for examples of seminal historical accounts of criminal justice in sixteenth century papal Rome.

[6]For more on Lombard workers in Rome, see, for example, Pineiro (2020) and Fregna (1990).

[7]A thorough discussion of early-modern "space" can be found in Cohen and Cohen (2019) and Agnew (2005). Separating space along the private-public dichotomy would be anachronistic. Nonetheless, some distinctions were felt in the sovereignty one exercised, mediated primarily by boundaries created by windows and doors (Cohen and Cohen (2001-2002)). Agnew (2005) points out that measurement of space was somewhat teleological, and reflected purpose and effort: the distance of a stone's throw or an arrow's flight, the number of days it would take to plow a field.

Inheritability – whether a building can be (or is) bequeathed –, on the other hand, is a meaningful, concrete, verifiable property, and one far better suited to our discussion of investment patterns. It is also reflective of the way early-modern Romans thought. "Family" was a broader word than it is today; the connection was felt and maintained through property transfer.

A.4 Manual Corrections

There are a few dating inaccuracies I identify in the Nolli data, which I correct manually. These corrections are all logged in the dataset. Within the sample, there are two corrected and one filled in (formerly missing) end-dates (altogether irrelevant for my analysis), and one inaccurate patron name given (in 1594). There was also one inaccurate start-date where a pope was listed as patron (making clear he was already pope) though his tenure actually began later (I moved the project start-date to the first year of the pope's tenure). In two instances, I was able to identify and correct the start-dates of projects which had been listed without descriptions (from 1585 to 1548 and from 1500 to 1522). To ensure consistency, I introduce two mechanical adjustments: in one case, two projects are listed with the same start-year of 1450 but appear fundamentally different (construction by a cardinal, followed by an acquisition by a lay family); I, therefore, change the second project's start-year by one year, which preserves them within the same decade (which is anyways the level for identification in the data). Insofar as these are two separate projects, and not a collaboration across patron types, I find it worthwhile to separate the two to reimpose the implied chronology – especially as the choice of round start-date reflects ambiguity in the underlying data. In the second case, I change a start year from 1500 to 1550 to be consistent with previous entry (which has end-date of 1550).

A.5 Sources

In the uncleaned data for 1300-1599, 38.26% of entries require additional data for a classification (39.45% for 1378-1599). Of the projects retained for the final dataset (1378-1599), 45.06% required additional data. The distributions of the number of projects are provided in Table 3.

Table 4 displays the distributions by type and language of source. I use four main types of sources: primary sources (archival, geneological or taken from databases derived from archival sources); academic sources (books and papers); institutional sources (Italian heritage or museum websites); and encyclopedic sources. The most common classification strategy relied, first, on institutional (especially Italian heritage websites) and encyclopedic sources to provide basic information about patron identities. Where these proved lacking or insufficient, I would escalate in hierarchical fashion, eventually reaching academic sources,

Panel A: Raw Data (1300–1599)			
Number of sources	Frequency	Percent	Cumulative
0	184	61.74	61.74
1	86	28.86	90.60
2	23	7.72	98.32
3	5	1.68	100.00
Total	298	100.00	
Panel B: Retained Data (1300–1599)			
Number of sources	Frequency	Percent	Cumulative
0	128	54.94	54.94
1	80	34.33	89.27
2	21	9.01	98.28
3	4	1.72	100.00
Total	233	100.00	
Panel C: Raw Data (1378–1599)			
Number of sources	Frequency	Percent	Cumulative
0	175	60.55	60.55
1	86	29.76	90.31
2	23	7.96	98.27
3	5	1.73	100.00
Total	289	100.00	
Panel D: Retained Data (1378–1599)			
Number of sources	Frequency	Percent	Cumulative
0	126	54.55	54.55
1	80	34.63	89.18
2	21	9.09	98.27
3	4	1.73	100.00
Total	231	100.00	

Table 3: Number of Supplementary Sources Used for Classification of a Project

until a satisfactory level of detail was obtained and ambiguity was alleviated entirely.

Panel A: Source Type	
Source type	Percent
Primary	9.52
Academic	17.14
Institutional	24.76
Encyclopedic	51.43
Other	13.33
Panel B: Source Language	
Language	Percent
English	49.52
French	10.48
Italian	46.67
Polish	0.95
Portuguese	2.86
Spanish	0.95

Table 4: Type and Language Composition of Sources Used for Project Classification

Percentages do not sum to 100% as a single project often relies on sources of multiple types and multiple languages. Primary sources are archival, geneological or taken from secondary-archival databases – such as a database of all cardinals. Academic sources are books and papers. Institutional sources are Italian heritage or museum websites. Encyclopedic sources are taken from encyclopedias (including Wikipedia). Miscellaneous sources are relegated to the "other" category and include images. (NB: the use of multiple sources of the same type will be counted as a single source-type in this table, but multiple individual sources for the purposes of Table 3, so there is no one-to-one correspondence between the tables.)

B Patron Demographic Data

B.1 Prelate demographic proxy: Cardinal Consistories

I approximate the group of "plausible ecclesiastical patrons" by the number of living cardinals. While a broader set of ecclesiastical officials were affected by the reform, in practice, ecclesiastical officials lower-ranked than cardinals engaging in palace-building was very exceptional, and does not warrant a dilution of the per-capita weights.[8]

Furthermore, only the cardinals themselves have direct voting power in papal elections, so they alone participate meaningfully in the commitment mechanism described before. Hence

[8]In the entire sample, there are eight prelate projects not sponsored by cardinals. Except one, who is a wealthy abbot, the patrons are all bishops. Of the eight, only two launch their projects before 1550, one of whom is promoted to a cardinalate within eight years. These are so clearly outliers that to include all bishops would render uninterpretable the per-capita measures.

for the purpose of identifying a reasonable proxy, it is natural for the discussion to bear on cardinals (with the inclusion of the pope).[9]

I collect data from the consistories of cardinals from records found in Miranda (1998–2023), which contain the mention of every cardinal promoted to the office by each pope. For each ecclesiastical official who attains at least a cardinalate, I collect data on the start and end year of his tenure (the end year corresponds to the death of the cardinal[10]). I use these records to construct an index of the number of high-ranking ecclesiastical officials in office in every year from 1099 to 1700.

I discard any cardinals who pass away before assuming office, those who decline the promotion, and those for whom the year of death is not known. In the entire time-interval from 1305 to 1700, there are a total of 1248 active cardinals; there are also 4 who declined promotions and 6 who are dropped for the above reasons, all of whom are found in consistories pre-1450. I retain data on "antipopes" and "pseudocardinals" in an effort to produce conservative estimates, though the inclusion of pseudocardinals is not a consequential decision for empirical analysis: after 1450, there are none at all. Records of all of these cases are noted in the dataset.

B.2 Lay demographic proxy: Civic magistrates from the *Lista d'Oro*

There is a diverse cast of candidate "powerful laymen," from ancient noble families to merchants and an emergent nouveau riche immigrant class. Meanwhile the concept of a "hereditary nobility" – traceable and codified as it was, for example, in Venice – did not exist in fifteenth-century Rome.

In the absence of censuses and consistent measures of wealth, high-ranking local statesmen offer a natural proxy. Historians often consider political office to be an excellent indicator of considerable power, wealth and influence, and make use of records of public servants where nobles are difficult or impossible to capture. Perhaps most importantly, there were significant barriers to entry for illustrious careers in public office – not dissimilar, in fact, from those associated to rising in the Church.

Created and managed by the archivist, genealogist, and historian Claudio de Dominicis, the Accademia Moroniana is an invaluable resource for the study of important Roman families. The Accademia's comprehensive *lista d'oro della magistratura capitolina* meticulously

[9]The hierarchy of the Catholic Church, from top to bottom, is as follows: the pope, cardinals, archbishops, bishops, priests, and deacons. With very few exceptions, only cardinals were required to reside in Rome.

[10]The data contain only three exceptions: over the course of over 700 years, there were four cardinals who left office to marry or who, due to the sudden death of a family-member, were compelled to change careers as the sole heirs of a family fortune. Among these is the famous example of Ferdinand de' Medici, who, following his brother's death, assumed the role of Grand Duke of Tuscany and Duke of Siena, and submitted his resignation so as to be able to marry and secure a continuation of the dynasty.

records the names and extremal dates of tenure of all capitoline magistrates[11] in the city from 1305 to 1865 (De Dominicis, 2009). I likewise use these data to construct an index of the number of powerful laymen in office in a given year.

Equating "laity" with high-ranking capitoline magistrates necessarily underestimates the number of powerful laymen, leading to a more conservative estimate. This is because departure from office seldom corresponded to a death (as was the case for prelates), because some old powerful families (the so-called great barons) almost never held civic office, and, finally, because it is natural to expect the city population to grow even faster than the number of civic offices (indeed, the latter were set by statute). All of this means that the estimates that follow should be taken as a lower bound.[12] In all cases, results are unit-free or given in real terms (e.g., in numbers of projects).

B.2.1 Populations

Figure 4 presents the populations of cardinals and high-ranking civil officials and confirms the validity of the empirical design. First, given differences in growth rates, empirical analysis ought to rely primarily on per-capita measures, else the results will be driven by the demographics; second, the "local smoothness" suggests that the observed changes in investment are not the result of a discontinuity at the population level. That there are no drastic jumps throughout the sample period, but especially in the prelate population c.1470-80 or shortly thereafter, obviates concerns over results driven by possibly-endogenous aggregate entry into the cardinalate.

C Papal Absences from Rome

This dataset documents periods when the Pope was absent from Rome or when papal authority in the city was compromised between 1378 and 1599. Each observation represents a departure-return episode characterized by the year of departure, the year of return, and the nature of the absence. The data were compiled almost exclusively from scholarly sources on papal history during this period.[13]

[11] As captured by the Magistratura capitolina (which includes the conservatori and priori dei caporioni). Elite and semi-elite Romans, mostly civic nobles, rotated though the offices with rather short tenure, via a kind of curated lottery.

[12] As all identification is dynamic, treatment effects are underestimated if the proxy increasingly underestimates the true lay population over time (which is contextually most probable). Treatment effects would be overestimated if and only if the proxy grew faster than the true lay population. (Treatment effects would be immune to the population estimate if the underestimate of the lay population is consistent over time.) However, it is extremely improbable that governmental offices would grow faster than the number of powerful lay families.

[13] There are a couple of exceptions where general-knowledge sources were consulted; all sources remain documented in the dataset.

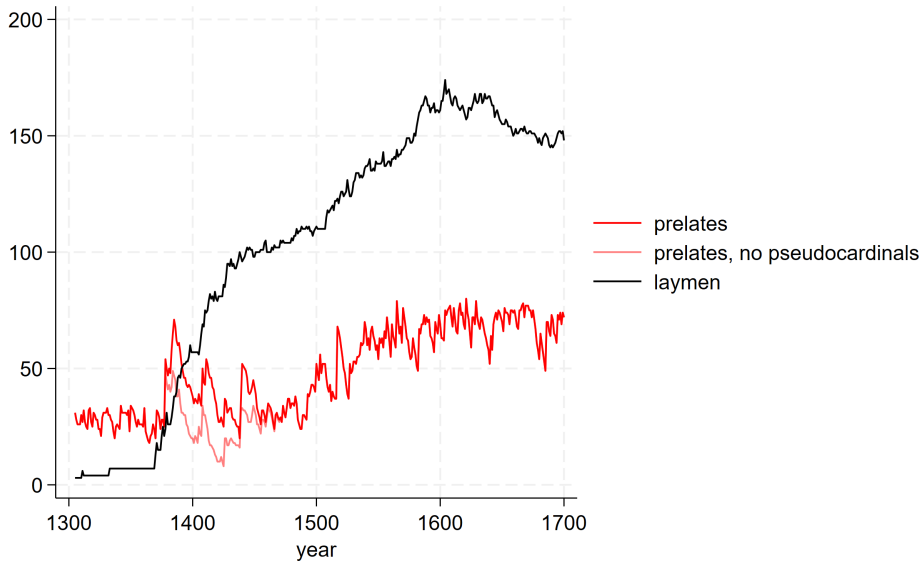

Figure 4: Prelate and Lay populations

The number of cardinals remains quite constant over time: their population is a reflection of the needs of the papacy. The number of powerful laymen grows with the overall prosperity and size of Rome. Prelate populations are taken from cardinal consistories; lay populations are derived from occupants of high-ranking civil service positions. The demograhpic trends for prelates with the exclusion of antipopes and pseudocardinals are displayed in the dataseries labelled "prelates, no pseudocardinals".

C.1 Variable definitions

The dataset distinguishes between five types of papal absence or compromised authority through binary indicator variables.

The "antipope outside Rome" variable identifies periods when a rival claimant to the papacy operated from outside Rome, most notably during the Western Schism (1378-1417) and the subsequent challenges from Antipopes Clement VIII, Benedict XIV, and Felix V. The "no Roman pope" variable captures instances when the legitimate pope physically left Rome for extended periods, such as Urban VI's temporary departure to secure his position against Clement VII, Martin V's travels through Italian states after his election at Constance, and Eugenio IV's flight to Florence following a popular uprising. The "plague absence" variable marks absences due to a plague outbreak, while "diplomacy absence" denotes absences for diplomatic or military purposes (including Pius II's attendance at the Congress of Mantua, Alexander VI's flight during the French invasion, Julius II's military campaigns against Bologna and Mirandola, Clement VII's escape during the Sack of Rome, and Paul III's time at the Council of Trent). Finally, the "partial absence" variable identifies periods when popes maintained divided attention between Rome and other locations. This variable captures, for instance, Pius II's frequent travels to and patronage of Pienza between 1459

and 1464, where construction activity documented by Adams (1985) confirms his sustained engagement outside Rome. Table 5 summarizes all of the variables of this dataset.

Variable	Definition
departureyr	Year in which the pope departed Rome or papal authority in Rome was compromised
return_yr	Year in which the pope returned to Rome or papal authority was restored
antipope_outside_rome	Binary indicator equal to 1 if a rival claimant to the papacy operated from outside Rome during this period, 0 otherwise
no_roman_pope	Binary indicator equal to 1 if the legitimate pope physically left Rome for an extended period, 0 otherwise
plague_absence	Binary indicator equal to 1 if the pope departed Rome due to plague, 0 otherwise
diplomacy_absence	Binary indicator equal to 1 if the pope departed Rome for diplomatic or military purposes, 0 otherwise
partial_absence	Binary indicator equal to 1 if the pope maintained divided attention between Rome and other locations while continuing some activities in Rome, 0 otherwise

Table 5: Variable Definitions: Papal Absence from Rome (1378-1599)

Each observation represents a distinct episode of papal absence or compromised authority. The five binary indicators are mutually exclusive for any given episode. See main text for detailed discussion of coding decisions and historical sources.

For the purpose of empirical analysis, I define two variables: one which pools all papal absences, and one which collects only the "exogenous" ones, plausibly interpretable as a signal of waning papal interest in being in Rome. That is, the latter pools only no_roman_pope and partial_absence while the former includes also diplomacy_absence, plague_absence and partial_absence. This allows me to make sure that results are driven by exogenous, interpretable absences. An overview of papal absences is presented in Table 6.

	Endogenous absences	All absences	Contested rule (antipopes)
1378-1469	22	23	58
1470-1599	0	5	0

Table 6: Years of Papal Absences from Rome

Endogenous absences are those which are plausilbly interpretable as indicative of popes' disinterest in being in Rome, at least temporarily. All absences includes also exogenous (uninterpretable) absences – e.g., those due to plagues or diplomatic missions. Periods of contested rule are those characterized by the existence of antipopes elsewhere. These are used for placebo tests, to check for the importance of external tensions affecting Rome and ascertain that there is a real change taking place *intramuros*.

Empirical analysis in the paper is also not affected by the inclusion, into periods of contested rule, the 1453 plot of the humanist Stefano Porcari to overthrow the popes and establish a republic. He was caught and hanged before violence could erupt. (Not reported as effects of interest are identical.)

D ArCO: Palace-building in Rome, Florence and Venice

This dataset is a clean, aggregate measure of Italian palaces for the period 1100-1600. It is built from ArCo ("Architettura della Conoscenza"; Architecture of Knowledge), the Italian Ministry of Culture's Cultural Heritage Knowledge Graph, accessed via its public SPARQL endpoint (https://dati.beniculturali.it/sparql).

D.1 Dataset construction

To cast a wide net over palatial architecture despite heterogeneous cataloging, I use a label-first strategy across several top-level cultural property classes (HistoricBuilding, ArchitecturalOrLandscapeHeritage, MonumentalComplex, CulturalProperty, HistoricSite, Museum). Candidate records are identified when their labels (from rdfs:label or l0:name) match palatial terms in Italian, including patterns such as "palaz", "palag" (palagio), "broletto", "pretori", "vescovad"/"episcop", "reggia", "villa", "residenz", "dimor" combined with "nobili" or "signoril", and Venetian "Ca' …". Labels are matched case-insensitively, accepting unlabeled language or Italian language tags to maximize recall.

D.1.1 Technical Implementation

Collection proceeds in two phases to reduce load on the public endpoint. Phase 1 obtains only building IRIs and labels using keyset pagination (ORDER BY ?building with a seek cursor) rather than large OFFSET scans, improving stability and performance. I then apply a lightweight geographic prefilter (Phase 1.5) that resolves city names through ArCo's location model (address/site/location paths, with labels via clvapit) and retains only candidates located in Rome, Florence, or Venice. Phase 2 hydrates the filtered IRIs in batches using VALUES, collecting optional fields for location (city, province, region) and multiple dating shapes, including dating labels and time literals (tiapit:time) for begin/end nodes where available. Requests implement timeouts, short inter-request sleeps, and exponential-backoff retries to handle throttling and intermittent resets typical of public endpoints.

D.1.2 Dating

From the most informative available dating text per record (preferring explicit time literals and structured begin/end dates, falling back to dating labels and ultimately the object's label), I construct standardized temporal variables. I extract exact 4-digit years when present; otherwise I parse Italian century expressions and qualified forms (e.g., "XVI secolo", "prima

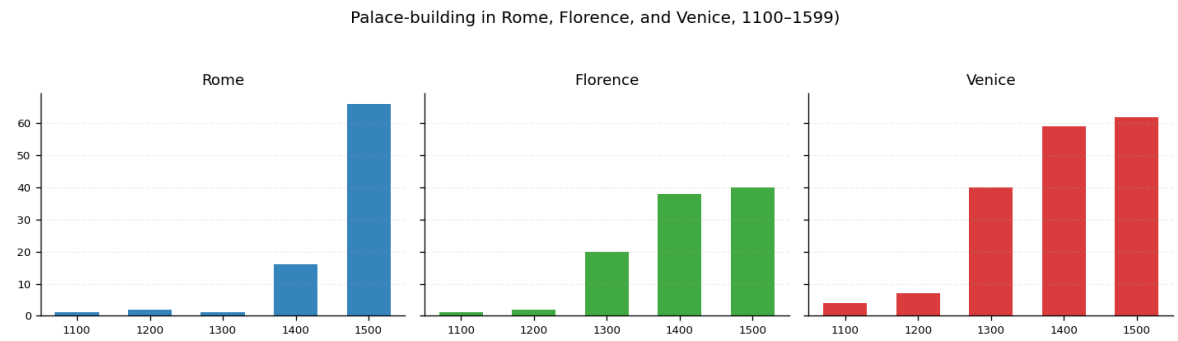

Figure 5: Palace-building in Italian City-States

With data obtained from the Beni Culturali's ArCO, I plot palace-building eras in three major Italian city-states by century of construction. Each graph shows the number of palaces built, by century of the construction start-date, in Rome, Florence and Venice, respectively. The trend is clear: palace-building begins considerably later in Rome, and the pattern is much sharper as well.

metà", "secondo quarto", ranges like "XIV–XV secolo") to impute a representative start year. I report both the exact year and the imputed start year, select a single start-year that prefers exact evidence, tag the parsing method (date_method) and whether the year is imputed. For maximal accuracy, due to the coarseness of most of the data, I pass to the start-year century. Indeed, in the data for the three cities, only 2.4% has explicit start-years (and they are all restricted to Venice); the rest are imputed.

D.1.3 Cleaning

I then clean and normalize fields: labels are canonicalized (trimmed, whitespace collapsed, Title Case), cities are Title Case, and provinces uppercased. I retain records with start-year in the 1100–1600 window and deduplicate by keeping the earliest start-year per unique (label_norm, city_norm) pair, after sorting by (label_norm, city_norm, start_year). The final dataset contains cleaned location fields, the selected dating text, method flags, exact and imputed years, the chosen start_year, and the century.

D.2 Discussion & Limitations

It is clear that coverage varies with cataloging practices, which are, unfortunately, coarser than the granular data of the Nolli map. I restrict to Florence and Venice as the right comparisons for Rome not only because they are conceptually appealing counterfactuals to Rome but also because these cities are likely to have the most systematic and comparable levels of coverage to Rome within ArCO. The three should be internally consistent, and hence give an accurate reflection of aggregate trends. Figure 5 presents these aggregate trends.

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