5-1-2012

Florentine Palaces, Costly Signaling, and Lineage Survival

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FLORENTINE PALACES, COSTLY SIGNALING,
AND LINEAGE SURVIVAL

by

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B.A., English, Colorado College, 1989
M.A., Anthropology, University of New Mexico, 2004

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

May, 2012
ACKNOWLEDGMENTS

Like all dissertations, this one was possible only with the help of a large number of people. I would like to thank my dissertation committee, Dr. James Boone, Dr. Geoffrey Miller, Dr. Michael Graves, and Dr. Osbjorn Pearson for their advice, their suggestions, and above all their patience. I would also like to thank Dr. Ann Ramenofsky, who made it possible for me to remain in graduate school.

I would also like to thank Dr. James Gallison, Michael Jennings, Dr. Matthew Edwards, and Jeff Hokanson with HDR, Inc. for their moral support. I must also thank them for giving me the flexibility I needed to finish this dissertation and for sending me on projects that generated enough frequent flyer miles to send me to Italy.

Most of all, I would like to thank my wife, Anne Compton, who made this dissertation possible in more ways than I can possibly list here.
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ABSTRACT

My dissertation evaluated whether the palaces built in Florence, Italy during the Renaissance are a form of costly signaling. Costly signaling theory was developed to explain why organisms have attributes and behaviors that appear to defy basic Darwinian logic by having costs that are not offset by obvious benefits. The theory proposes that such attributes and behaviors persist because they are reliable signals of information about the signalers. Signal audiences use the information content of signals to rank signalers and to modify their interactions with signalers in ways that benefit signalers. These interactions can involve mate choice, predation avoidance, status competition, or any other interactions that improve the likelihood that signalers have offspring that survive to reproduce themselves.

My research collected information on 206 standing palaces built during the Florentine republic of 1282 to 1532 and during the first several decades of the succeeding Medici Duchy. My research also used primary documentary records of elections to government and guild offices, with political success used as a proxy measure for overall status. I also used electoral records as a source of demographic data. The elections
records were then used to evaluate the reproductive and political success of palace builders, their families, and their contemporaries.

My research found that palaces are consistent with expectations for costly signals, especially during the period of de facto Medici rule from 1434 to 1494. My research also found that palace builders had much higher than average reproductive and political success. However, they built their palaces after they had completed their reproductive lives and when they were halfway through their political careers. This timing means that palace construction did not benefit palace builders. The benefits of palace building appear instead to have been intended for the eldest sons of palace builders, who were able to maintain their fathers’ high levels of political and reproductive success. I conclude that palaces were a costly signal of families’ ability and willingness to invest resources in their inheriting sons to ensure that those sons could preserve families as demographic entities and as members of the sociopolitical elite.
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CHAPTER 1. INTRODUCTION

“I think that I have given myself more honor, and my soul more satisfaction, by having spent money than having earned it, above all, with regard to the building I have done.” Giovanni Rucellai (Goy 2002, italics mine).

A hugely successful merchant in a city-state dominated socially, politically, and economically by merchants, Giovanni Rucellai was a member of an elite that completely reshaped the urban fabric of Florence, Italy over the course of the Renaissance. With money earned from international banking, cloth manufacture, and other businesses, Florentine elites spent lavishly on public buildings, churches, and palaces between the late 1200s and early 1500s, producing a city that is today a UNESCO World Heritage Site. Rucellai’s contribution was the façade of the church of Santa Maria Novella and construction of an architectural landmark of a palace that is still owned by the family today. But these buildings are more than just landmarks of Renaissance architecture. They are also the most durable and costly element of an explosion of consumer goods that made the cities of the Italian Renaissance—especially Florence—the birthplace of modern consumer culture (Jardine 1996).

As international trade began to resume in the 1200s, Florentine merchants and bankers invested in manufacturing, international finance, transport, and other activities. By late in the century, these merchants and bankers had become wealthy enough to challenge Florence’s noble rulers for power. In 1282, the city-state radically revised its government, adopting a republican constitution that gave political power to merchants
and bankers and barred member of the hereditary nobility from most elected offices. This republican political system would survive 250 years of warfare, populist revolts, and financial and demographic upheaval. Republican government ended in 1532, when the Medici were constitutionally recognized as the city-state’s hereditary rulers. Republican rule and economic expansion in Florence produced a remarkable level of socioeconomic opportunity and a distribution of wealth as equal as that of the United States today (Goldthwaite 1995). Armed with this new wealth, Florentines of all classes bought huge amounts of art, books, clothing, and other consumer goods.

One of the most lasting aspects of this consumer culture was monumental architecture. In the late 1200s, the new republic began several huge publicly funded construction projects, including the cathedral of Santa Maria del Fiore (beginning 1296), the Palazzo della Signoria (beginning 1299), and new city walls (beginning 1299). Meanwhile, private funding allowed for the construction or extensive renovation of some 140 churches between 1348 and 1648 (Goldthwaite 1995). Palaces formed another manifestation of this trend. Elite Florentine domestic architecture changed considerably over the republican period. In the 1100s and early 1200s, elite urban domestic architecture consisted of sprawling, haphazardly designed houses that integrated defensive towers and that were built by hereditary noble lineages to house multiple nuclear families; towers were also constructed by non-kin mutual protection societies (Lansing 1991). Hundreds of these towers overlooked the city in the early 1200s (Villani 1906 [1348]). After the shift to republican government, the merchant elite began to build homes with a very different character, houses commissioned by individual heads of household for individual nuclear families. The earliest palaces of the republic period
incorporated defensive features, but also included storefronts and warehouse space with large street-level doors. These early palaces were stylistically severe, with little or no elaboration of their stone facades. But by the late 1300s, palaces became increasingly elaborate structures designed by professional architects inspired by new treatises on architectural style, including Leon Battista Alberti’s 1450 *De re aedificatoria.* Contemporary accounts report that palace construction surged in the 1400s, when more than 100 palaces were built or extensively renovated, at least 30 between 1450 and 1478 alone (Wirtz 2000).

But why did elites build these palaces? What benefits did builders receive for their colossal outlays of resources on these outsize family homes? Archaeologists consider palaces as a key component of socio-political complexity. Increasing variation in house size, culminating in the appearance of palaces, is seen as indicating increasing differences in individual status and resource control (Feinman, et al. 1998; Maisels 1999; Trigger 1990). While this interpretation explains why palaces appear, it does not explain why they persist through time. Resource control is necessary for palace construction—no individual can build a palace without controlling the requisite labor and materials. However, resource control is not sufficient to explain why individuals committed those resources to buildings that grossly exceed the requirements of sheltering a household. Moreover, most archaeological examinations of palaces consider case studies where these buildings are a small portion of the total built environment. The palace at Knossos is almost a self-contained village; a city like Florence with hundreds of palaces is the product of a very different cultural, economic, and political context.
In this sense, Renaissance Florence, with its palaces and other consumer goods, stand at the midpoint between ancient complex societies with their relatively limited array of consumer choices and modern industrialized western society with its near-endless array of consumer products. Palaces, as an exemplar of Renaissance consumer behavior, are therefore a useful case study for how we choose to commit our time, energy, and other resources on goods that grossly exceed our basic functional needs. In short, the palaces of the Renaissance are a case study not only of the long elite practice of building giant houses, they are also the most lasting remnant of the deep roots of the massive consumer culture that today represents roughly 70 percent of U.S. economic activity.

This dissertation takes costly signaling as its theoretical starting point. Costly signaling theory was developed to answer why organisms have behaviors and physical attributes that have high costs in terms of time, energy, and other resources but that lack any apparent benefits that would justify those costs. Costly signaling can be thought of as the biological equivalent of conspicuous consumption as first systematically described by the economist Thorsten Veblen (1973 [1899]). Veblen’s greatest insight was explaining why people purchase goods that don’t make any sense in pure economic terms—why drive a Rolls Royce when a Honda works just as well? He said the answer is that people use observable traits, such as clothes or choices of leisure activity, to demonstrate their status, which you can’t see. He said that variation in specific types of goods allows people to rank each other’s status. Conspicuously consumed goods and services therefore convey information about an individual’s control of resources and thus of their status.
Costly signaling asks the same question for all biological organisms—why do organisms have behaviors and attributes that don’t make sense in Darwinian terms? An outgrowth of evolutionary ecology, costly signaling theory was formulated to explain characteristics that appear to have high costs and no obvious benefits and that therefore violate Darwinian logic. The theory proposes that these traits persist because they have an underlying function—they serve as honest signals of hidden qualities and allow individuals to evaluate and rank each other and thereby pick the best interaction partners. That can mean the best mate, the best ally in a fight, the weakest prey—anything that benefits health or reproductive success. Costly signaling has been documented in dozens of species (Johnstone 1995; Searcy and Nowicki 2005), including experimental studies (Matyjasik, et al. 2000; Moller and de Lope 1994). Although not always apparent from the bulk of the literature, female organisms can and do signal in competitions for status and territory (Bywater, et al. 2008; Emlen 2008; Polo and Veiga 2006). Although generally examined for its role in differential reproductive success, costly signaling may also be part of predator-prey interaction (Vega-Redondo and Hasson 1993). It has even been documented in plants (Blas, et al. 2006; Lev-Yadun 2005). It has been applied to human behaviors as diverse as religious practices (Sosis and Alcorta 2003), altruism (Gintis, et al. 2001), status acquisition (Boone 1998), and the effectiveness of television advertising (Ambler and Hollier 2004). What has received comparatively less attention is the role of costly signaling in pre-modern complex societies and the possibility that costly signaling might change over time.
The Data Sets

My choice of Florence during the republic as a test case was very deliberate. Preliminary research suggested that if costly signaling were to be testable anywhere with positive results, it would be in Florence during its Renaissance-era period of republican government between 1282 and 1532. As Rucellai’s diary entry demonstrates, Florentines of the time were highly aware of the use of material goods as measures of social status. In other words, the utility of conspicuous consumption in status competition was a concept emic to the society. Florence was also interesting for not having an entrenched elite—instead of the elites being hereditary aristocrats as was the case almost everywhere else in Europe, the Florentine elite was more like elites today—membership was fluid and open to change. Under those conditions, it seemed extremely likely that hypotheses based on costly signaling theory were likely to be relevant.

Preliminary research found that Renaissance Florence also offered two ideal data sets. The first data set was at least 100 Renaissance-era palaces that had been extensively documented by architectural historians. I expected that I could locate many additional palaces that had been largely overlooked by historians who had focused on the most architecturally interesting and best-preserved palaces. This data set meant that I had a source of information on a potential costly signal. The second data set was an incredibly fine grained original documentary record of thousands and thousands of Florentine men competing for dozens of republic-era government offices over the entire 1282-1532 span of the Florentine republic. This data set meant that I had data on signalers and their peers—approximately 20 percent of Florentine men participated in government office, meaning the election data encompassed not only the upper end of the elites but also a
significant portion of the middle class. Because of the way this election data was assembled by Florentine record-keepers, it also provided demographic data that could be used to reconstruct male life histories and familial relationships. The elections data were ideal because being considered for office and being elected to office was both a reflection of existing status and a source of future status for Florentine men and their extended families. The elections data meant that I had data on the signalers—the palace builders—and their peers. The bulk of the study period was determined by the temporal range of the elections data (1282-1532), but I also included the first several decades of the post-republic Medici Duchy to evaluate the effects of dramatic social and political change on palace construction.

**Organization of the Dissertation**

This dissertation begins in Chapter 2 with an extensive discussion of costly signaling theory and two alternative theoretical explanations for costly behaviors and attributes that serve as alternative hypotheses in the data analysis. Chapter 3 is an overview of Florentine history, focusing on the late 1200s to mid 1500s and paying particular attention to economic history. Chapter 4 is an overview of the Florentine republic’s election system and the related election data, important given the centrality of election data to my research. Chapter 5 describes the Florentine palace data set, focusing on the stylistic variation in these buildings. Chapter 6 describes the specific hypotheses I test using the data described in chapters 4 and 5. Chapter 7 presents the results of analysis of the palace data and whether those palaces appear to be costly signals. Chapter 8 examines the elections data to determine whether palace builders benefited in
reproductive or political terms by building their palaces. Chapter 9 presents the overall conclusions, including the relevance of my findings to modern U.S. consumer behavior.
CHAPTER 2. COSTLY SIGNALING AND ITS ALTERNATIVES

Human behavior that appears to defy basic cost-benefit logic, including building enormous houses, is made possible by control of resources in excess of the raw minimum needed to survive to reproductive age and ensure that offspring themselves survive. In human populations where individuals vary greatly in their control of resources, a small subset will control the resources that make monumental architecture and other grandiose outlays of time, energy, and material possible. Although some monumental architecture may be truly communal, the majority appears to have been constructed by societies in which some individuals control much more resources than others, allowing them to commission monumental constructions for their own use (Trigger 1990). Monumental architecture is therefore “the most public material embodiment of the power of the upper classes” (Trigger 1990:126) and one of the key identifying traits for socio-politically complex societies with permanent, ingrained differences in status. But why do powerful individuals need to do anything to demonstrate their ability to control resources? My research is intended primarily as a test of one explanation—costly signaling theory. To better understand my results, I compare hypotheses derived from costly signaling theory with hypotheses derived from two alternative explanations also drawn from Darwinian theory: waste behavior and indices. This chapter first discusses costly signaling, then describes indices and waste behavior and how they differ from costly signals.

Costly Signaling

Costly signaling theory offers an explanation for the evolutionary logic behind phenotypic attributes (whether physical characteristics or behaviors) that appear to lack
benefits that justify their costs to an organism’s energetic budget (Bleige Bird and Smith 2005; Bleige Bird, et al. 2001; Boone 1998, 2000; Gintis, et al. 2001; Grafen 1990a; Johnstone 1995, 1997; Johnstone and Grafen 1992, 1993; Searcy and Nowicki 2005; Zahavi 1975; Zahavi and Zahavi 1997). The question such attributes raise is why they persist. From a Darwinian perspective, attributes must offer a selective benefit or be selectively neutral, on average, to persist across generations. Costly signaling theory proposes that some costly attributes persist because they serve to convey reliable information about individuals’ underlying characteristics and because the information benefits both the signaler and the signal’s audience. If delivering signals that convey information has a cost, then that cost ensures that the signals are honest. In short, costliness makes deception impossible or at least highly unlikely.

What this means in practice is exemplified by one of the clearest and best-documented cases of costly signaling, peacock tail feather displays (the following example draws on research by Loyau, Saint Jalme, Cagniant, et al. 2005; Loyau, Saint Jalme and Sorci 2005; Petrie and Williams 1993). These displays are costly to individual peacocks—they require considerable energy to produce and maintain, and they impair flight, exposing individuals to predation. Tail feather displays therefore appear to defy basic Darwinian logic. Like all sexually reproducing organisms, male and female peacocks have competing interests, as reproduction is much less costly in time and energy for males than females. In theory, peacocks should therefore attempt to have as many offspring as possible, while peahens should attempt to have the highest-quality offspring possible. Costly signaling theory proposes that peacock tail feather displays serve as “honest” signals of individual peacocks’ fitness-related qualities that cannot be
directly observed. In the case of peacocks, the degree of elaboration of tail feather
displays correlates with individual peacocks’ genetic quality and their past and current
health state: the healthier an individual peacock, the longer his tail feathers and the more
eyespots in his display. In addition, the number of eyespots appears to correlate with
genes that provide the ability to maintain good health despite parasite infestation. The
information content of a costly signal helps both the signaler and the signal audience by
allowing both parties to rank interaction partners for the purpose of mate choice, alliance
formation, predation avoidance, or other interactions that result in the differential survival
of individuals in a population. For peahens, variation in peacock eyespots and tail feather
length allows females to rank males as potential mates. Males with more eyespots and
longer tail feathers benefit from their investment in tail feathers by attracting more
females and fathering more offspring—peahens that mate with peacocks with longer tails
have more offspring than peahens that mate with lower-quality males. Peahens benefit by
selecting peacocks with phenotypic and genotypic qualities that translate into healthy
offspring.

The Origins and Development of Costly Signaling Theory

Costly signaling was formalized in the 1970s through the work of the economist
Michael Spence and the biologist Amotz Zahavi, but the theory’s real creator may be
Thorstein Veblen, whose *Theory of the Leisure Class* proposed that wealthy individuals
consume goods and services conspicuously to demonstrate that they have sufficient
wealth to fund conspicuous spending (Veblen 1973 [1899]). Veblen noted that
conspicuous consumption was particularly important during periods of high social and
economic mobility, which made information on individuals’ status unreliable and subject
to change, and that conspicuous consumption of goods was more important than consumption of services among highly mobile populations because of the greater visibility of material displays compared to behavioral displays. By analyzing the intensity of conspicuous consumption, observers could rank the unobservable wealth of individual consumers in much the same way that costly signals allow signal recipients to rank the underlying qualities of signalers (Bleige Bird and Smith 2005).

The first formal description of costly signaling was Spence’s job market signaling model, which addressed the problem of how employers can hire workers with the highest future productivity when employers lack reliable information about prospective employees’ future productivity on the job (Spence 1973). His model proposed that level of education is a signal that a prospective employer can observe of an employee’s future productivity, which a prospective employer cannot observe. The model says that education is less costly in time and effort for high-productivity employees than for low-productivity employees, making it an honest signal of an employee’s future productivity on the job. This signaling model therefore explains why job applicants will invest in education in keeping with their future productivity in the workplace. It also explains why employers hire educated employees at high wages and less-educated workers at lower wages. Spence’s model further says that the level of education that employers expect of prospective employees must be low enough that high-productivity individuals will not choose to forego that level of education but high enough to bar low-productivity individuals from achieving the expected education level. The result is two “social” equilibriums in education level: high-productivity individuals will opt for the minimum level of education that is beyond the capabilities of low-productivity individuals, while
low-productivity individuals will invest in the absolute minimum level of education needed to get any job at all. The overall result is that the population of job seekers will have a limited number of levels of education instead of a continuous distribution of education levels.

Costly signaling as a biological theory was originally conceived by Amotz Zahavi, who proposed that a signal will vary in intensity depending on the quality of the signaler such that a signal is a “handicap” that only a high-quality individual can afford (Zahavi 1975). Zahavi focused in large part on signals in mate choice situations. Handicaps could appear and persist in mating situations if both the male signalers and female signal recipients benefited from males’ ability to demonstrate their differences in quality using signals.

Zahavi’s original conceptualization of “handicaps,” where only high-quality males could afford them, received mixed support from models of the theory. These early models found that handicap traits were unlikely to spread in a population if only high-quality males could afford the handicaps. However, handicaps could evolve if the intensity of the signal was linked to both the underlying quality being demonstrated by the signal and to the viability of the signaler (for a review, see Searcy and Nowicki 2005).

This integration of handicaps and mating strategies made Zahavi’s handicap principal an alternative to Fisher runaway processes (Fisher 1930) as explanations for the evolution of elaborate phenotypic features. Unlike Fisher processes, Zahavi’s handicap principle allows for long-term evolutionary stability of extravagant male displays and female preference for elaborate males, while Fisher “runaway” processes do not explain the evolution of evolutionarily stable outcomes (Eshel, et al. 2002). It is theoretically
possible in costly signaling theory for high-quality males to signal so much more intensely than lower-quality males that higher-quality males see a net reduction in viability, but in such cases females will avoid mating with these over-signaling males and the trait will not persist, preventing costly signals from reaching the extreme outcomes possible with Fisher runaway processes (Noldeke and Samuelson 2003). Overall, therefore, Fisherian runaway processes and costly signaling of good genetic quality may be endpoints in a continuum (Kokko, et al. 2002). Bleige Bird and Smith note that Fisher runaway processes may also apply to cultural evolution (sensu Boyd and Richerson 1985), although the existence of such processes has little empirical support (Bleige Bird and Smith 2005).

Zahavi’s original “handicap” principle was not widely accepted until it was formally proven in two papers by Alan Grafen demonstrating that costly signaling could be an evolutionarily stable solution—in other words, that costly signaling could persist in a population (Grafen 1990a, b). Grafen’s model predicts how the costs of signaling will vary across individuals in a population. This variation stems from the benefits of signaling to signalers’ reproductive fitness and from the negative effect of the cost of signaling on signalers’ viability, or fitness exclusive of reproductive success (per Maynard Smith 1985). Grafen’s model says that some individuals will be of high quality such that they have large energetic budgets that allow them to signal at a high absolute cost and to receive the greatest benefits. However, because these high-quality individuals have large energetic budgets, high-cost signals represent a comparatively small portion of their total energetic reserves. Costly signals for high-quality individuals are thus very expensive in absolute terms but less expensive in relative terms. Low-quality individuals
produce the least costly signals in absolute terms because of their smaller energetic budgets, but they need signal only at a low level to distinguish themselves from even lower-quality individuals and thus have a low proportional cost for signaling. These variations in costs ensure that the magnitude of an individual’s signal correlates with that individual’s unobservable quality and therefore that the signal is honest. The result on a population level is that signal intensity will increase continuously with signaler quality—every individual’s signal will be only slightly more intense than the signals made by the next-highest-quality individual.

Grafen distinguishes between different types of handicaps. The construction of palaces and most other behavioral signals are probably what Grafen calls a “strategic choice handicap” (Grafen 1990a p. 539). In strategic choice handicaps, organisms decide their level of signaling. Marginal costs for a particular level of signal are higher for low-quality than high-quality individuals. Alternately, palaces may be condition dependent handicaps, but those are “approximations of strategic choice handicaps” (Grafen 1990a p. 540)

One limitation of Grafen’s original models is that they failed to recognize the possibility of perception error by signal recipients. A later paper by Johnstone and Grafen found that costly signaling could still be an evolutionarily stable solution if signalers who signal at higher intensities will be accurately perceived as signaling at higher intensities while signalers who signal at lower intensities may be misinterpreted as signaling at extremely low levels (Johnstone and Grafen 1992). Johnstone later expanded this model—still based on the original Grafen model—to treat signal intensity as a discrete variable instead of a continuous variable (Johnstone 1994). The revised model’s intent
was to determine whether the possibility that signal recipients could misinterpret signals due to perception error could produce results analogous to the “all or nothing” displays that are often observed in real behavior (Cullen 1966).

Johnstone’s all or nothing model predicts that signal intensity will not vary continuously by signaler quality as predicted by Grafen’s original models, but will instead increase in a series of steps or tiers. Below a particular quality level, individuals will not signal at all because of the likelihood that their low-intensity signals will be misinterpreted. As a result, those low-quality individuals’ absolute cost for signaling will be at or near zero. Signal intensity jumps sharply for the middle-quality individuals who are able to afford the minimum threshold cost of a signal that can be reliably interpreted. The increase in absolute signal cost flattens out for high-quality signalers, presumably because these individuals see a diminishing return on signals because of the small number of even higher-quality signalers with whom they are in competition.

Johnstone’s model for the role of error has received empirical support from findings indicating that exaggeration of signal intensity prevents misinterpretation and beta error and is especially important when there are many signals in close proximity (Wiley 1994). Another model supports Johnstone’s stepped distribution in its finding that evolutionarily stable solutions are possible for situations in which costly signals transmit partial information (not perfect information) with the outcome that signalers display in particular ranges of values, not precise and continuously distributed values (Enquist, et al. 1998). Johnstone’s model is also interesting for its similarity with Spence’s job market signaling model, which finds stability for a binary system in which low-productivity applicants invest almost nothing in education and high-productivity
applicants invest the minimum needed to indicate high productivity and not more, resulting in two tiers of signal intensity and making education an “all or nothing” display (Spence 1973).

Grafen’s handicap model and therefore Johnstone’s error-prone signaling model rested on a problematic assumption that was described in a series of papers by Thomas Getty (Getty 1998; Getty 2006). Getty said that Grafen assumed that signalers trade the viability costs of signaling for fitness benefits in a simple additive fashion—basically, a unit of viability is exchanged for a unit of fitness. Getty said this assumption fails to recognize that viability has continued benefits over an organism’s life history. If the costs of signaling to viability are too high, the resulting reduction in the signaling organism’s fitness can drop to zero—a dead organism cannot have offspring. Getty showed that Zahavi was basically correct about the importance of signal costs in ensuring signal honesty, but that the differences in costs between high and low quality signalers should be decreasing proportional marginal costs.

Getty said instead that signalers might pay higher absolute costs for big signals than lower-quality signalers pay for small signals. Alternately, higher-quality signalers may receive greater fitness benefits from a given signal intensity, effectively reducing the viability cost per increased unit of fitness. In either case, this approach essentially means that high-quality individuals are high quality because they are more efficient at obtaining and using resources (time, energy, etc.) more efficiently than low-quality individuals. Higher-quality signalers do not “waste” more than low-quality signalers (Getty 2006).

 Getty’s criticisms have been confirmed by mathematical analyses finding that signaling does not need to be wasteful to be honest and that any trait may be exaggerated
when other individuals use that trait to assess condition; what matters, therefore, is the marginal cost of the signal for individual signalers (Bergstrom, et al. 2002). The secondary sexual traits that dominate theoretical and empirical tests of costly signaling theory often reflect both nutritional status and health, meaning that females who choose males with costly secondary sexual traits may be selecting high viability, not high genetic quality (Andersson 1986). Similarly, Nur and Hasson’s models of handicaps found that “in nearly all plausible situations… those individuals displaying the greatest handicap [and therefore receiving the greatest fitness benefit] will at the same time survive best, and vice versa” (Nur and Hasson 1984). If signaling has too great an impact on viability it may lead to the signal disappearing from a population—females will not mate with males who signal at such high intensities that they dramatically reduce their viability (Noldeke and Samuelson 2003). These findings mean that costly signals do not require a tradeoff between fitness and viability in the way Zahavi originally predicted in order to be costly or honest.

A final lesson of Getty’s reevaluation of signal costs is that signalers do not need to increase their fitness via signaling to its theoretical maximum in order for signaling to persist in a population. Instead, all signalers in a population only need to receive increasing benefits as a function of increasing signal intensity or signals must be exaggerated to account for receivers’ sensory bias or perception error (Getty 1998). This conclusion fits nicely with my emphasis on Johnstone’s error-prone signaling model. For the purposes of my research, I assume that Getty’s reevaluation of signal costs does not invalidate Johnstone’s error-prone signaling model, but Getty’s work does indicate that a
direct viability-fitness tradeoff may not be necessary and that signal intensity reflects individual efficiency, not “waste.”

**The Conditions of Costly Signaling**

The theoretical work on costly signaling has shown that there are four conditions necessary for costly signaling to appear and persist in a population of organisms. The first condition is that individuals must vary in underlying and unobservable fitness-related characteristics. In practice, these characteristics can be any attribute that relates to resource holding potential (Boone and Kessler 1999) and differential efficiency in the ability to obtain and use resources (Getty 1998; Getty 2006). In human beings, the fundamental underlying quality may be general intelligence, which studies suggest correlates very well with fitness (Luxen and Buunk 2006). General intelligence underlies individual differences in social and career success and overall ability to navigate complex daily tasks (Gottfredson 1997). General intelligence may be the root cause of differences in health, and in modern societies may explain the correlation between health and socio-economic status (Gottfredson 2004). Altruism has been suggested as a costly signal specifically of general intelligence (Millet and Dewitte 2007). Ultimately, however, it is theoretically valid to assume in keeping with Getty that the specific underlying trait being signaled is not important so long as that trait is beneficial and inheritable and can produce differential efficiency at obtaining and using resources. This approach to analysis allows me to sidestep one of the consistent challenges for studies of costly signaling, the difficulty of measuring quality in a given test case (Irschick, et al. 2007).

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1 Luxen and Bunk (2006) further suggest that general intelligence may actually be a costly signal of fitness.
Second, information about these characteristics must be valuable to interaction partners and conveyable via perceptible signals. Costly signals must therefore be phenotypic expressions and can thus include behaviors and physical attributes and, in the case of human beings, artifacts (Dawkins 1982; Dunnell 1989b; Zahavi and Zahavi 1997). Costly signals can consist of multiple behavioral and physiological components—they need not be limited to a single behavior (Hebets and Papaj 2005). These behaviors or attributes are not necessarily present in organisms exclusively as signals. Many signals are high-intensity versions of routine behaviors or attributes, although in some cases selection leads to the evolution of distinct morphological or behavioral traits that serve an almost entirely signaling function (Lotem, et al. 1999). Organisms can also use a range of different signals for different situations, or can preferentially use a particular signal based on their individual phenotypic strengths and the underlying quality they are signaling (Johnstone 1996).

Third, individuals must have competing interests, such that false signals would benefit the signaler but not the audience. To ensure that signals are honest, signal cost and underlying individual quality must correlate such that high-quality individuals can signal at higher intensity than low-quality individuals. The need for signaling in a population and the intensity of the lowest-quality signals are determined by the quality of the lowest-quality signalers, with higher-quality signalers adopting levels of intensity out of reach of those lowest-quality signalers. Interestingly, Veblen viewed the system as working the other way, with each socioeconomic class attempting to emulate the class above such that conspicuous consumption was ultimately driven by the highest socioeconomic class (Trigg 2001). However, high-intensity signals do not need to be
extremely costly for high-quality signalers, as individuals with higher underlying quality may pay lower marginal costs per incremental unit of signaling than those of lower quality (Johnstone, et al. 1997). Moreover, signals need only to be reliable on average, and occasional deception in a particular organism does not rule out the overall honesty of a particular costly signal (Johnstone and Grafen 1993; Kokko 1997).

Signal intensity is defined as the total energetic cost of a signal to an individual’s total energetic budget. A signaler’s energetic budget is determined by the sum effect of genotypic or phenotypic attributes that contribute to differential individual ability to obtain and control resources. This broad definition of quality follows from Getty’s observation that costly signaling is driven not by the amount of “waste” involved in producing a signal, but rather by the differential overall efficiency with which individuals can obtain, use, and control resources that can be allocated to self-preservation, mating, and other fitness-related tasks (Getty 2006). This definition differs from earlier formulations of costly signaling, which stated that signals must be functionally related to the qualities being signaled (Johnstone 1995). The actual costs of costly signaling can be difficult to measure, and empirical tests have found the cost of many potential costly signals to be insufficiently high to adversely affect fitness (Kotiaho 2001). In addition, the tendency to conduct population-level evaluations of signal costs limits many empirical studies’ validity because the tradeoff between costs and benefits operates on an individual level (ibid.). In addition, signaling responds to changes in organisms’ ability to extract and use resources as a result of fluctuations in their ecological, cultural, and social environment. If these changes are frequent enough or rapid enough, they may complicate
empirical analyses of signal costs. The use of individuals’ ability to obtain and use resources as a source of energetic reserves for signaling therefore simplifies analysis.

The fourth condition is that signal audiences must use the information content of signals to modify their behavior in ways that benefit themselves and the signaler. This modification can involve mate choice, alliances, predation avoidance, or any other change that increases the likelihood that the signaler has offspring and that those offspring survive to reproductive age. Among human beings and other social animals, one likely payoff for costly signaling may be increased status. Status is ultimately a reflection of individuals’ social power to impose costs and dispense benefits to conspecifics (Boone and Kessler 1999). Because of their social power, higher status individuals or families have greater food security and are therefore better equipped to survive downturns (Boone 2000). In human societies, high-status individuals tend to be healthier than low-status individuals, even in comparatively simple societies, leading some researchers to suggest that there is no basis for the long-held assumption that human beings traditionally lived in egalitarian societies and that status differentiation has considerable time-depth in human behavior (Ames 2010). Experimental results indicate that individuals arbitrarily labeled as “high status” are able to obtain more resources from others than individuals arbitrarily labeled “low status” (Ball, et al. 2001). Similarly, experiments by Nelissen et al found that individuals wearing luxury brand-labeled clothing received increased compliance, higher preference, and financial benefits relative to individuals wearing label-free but otherwise identical clothing (Nelissen and Meijers 2011). In other words, status has a direct payoff in individual fitness and viability.
The importance of individuals’ variation in their efficiency of resource acquisition and control helps clarify the linkage between Veblen’s conspicuous consumption and costly signaling (Veblen 1973 [1899]). Status is a reflection in part of individual resource holding potential and the possession of inalienable commodities (Noë, et al. 1991), but status must be earned by demonstrating that resource holding potential. Veblen recognized that the conspicuous consumption of non-utilitarian goods could serve as a status marker and allow observers to identify distinctions among individuals competing for status. Costly signaling expands on this concept by linking status ranking and fitness (see Bleige Bird and Smith 2005 for discussion).

**Costly Signaling in the Social Sciences**

**Anthropology and Archaeology**

Although generally considered to be the development of evolutionary ecologists working on non-human organisms, costly signaling theory is in large part the result of work in the social sciences (Cronk 2005). Costly signaling has been evaluated in a large number of anthropological case studies and research questions (Bird and O'Connell 2006; Bleige Bird, et al. 2001). Miller has proposed that costly signaling is responsible for the evolution of some human cognitive capabilities and physiological attributes (Miller 2000). The theory has proven useful in interpreting male hunting practices in hunter-gatherer societies, both modern (Bleige Bird and Bird ; Bleige Bird, et al. 2001; Hawkes and Bliege Bird 2002; Hawkes, et al. 2010; Smith and Bleige Bird) and prehistoric (Hildebrandt and McGuire 2002; McGuire and Hildebrandt 2005). These researchers have used costly signaling to explain hunters’ pursuit of prey with a low caloric return relative to the time and energy needed to capture that prey and have quantified the
benefits of costly hunting strategies among modern hunters in terms of reproductive success and the ability to form alliances with high-status individuals. This relationship between food sharing and costly signaling is not universal, however, suggesting that human signaling behavior is culturally and environmentally mediated (Gurven 2005). Costly signaling may be one mechanism that results in cooperation (Gintis, et al. 2001) and altruism (Roberts 1998), with studies finding that individuals who share “selflessly” often receive very tangible rewards (Rao 2001). In research on archaeologically and historically known complex societies, Boone suggests that costly signaling is the mechanism underlying Kwakiutl potlatch ceremonies (Boone 2000), Neiman has examined Maya stelae and pyramids as costly signals of elite resource holding potential (Neiman 1997), and Neiman and his colleagues have also applied the theory to the archaeology of enslaved individuals in 18th century Virginia (Galle 2006; Neiman 2006). Glatz and Plourde used costly signaling theory to explain how Bronze Age Anatolian monuments functioned in competition between early states (Glatz and Plourde 2011). In modern complex societies, researchers have used costly signaling to explain religious behavior (Henrich 2009; Sosis and Alcorta 2003).

My case study differs in several ways from this previous work. The most important difference is that my data sets allow me to evaluate individual-level signaling behavior and individual-level benefits, something obviously impossible with prehistoric studies. In addition, my data sets allow me to evaluate costly signaling in a large, highly complex, market-based culture that more closely approximates our own modern industrialized conditions than do case studies involving small hunter-gatherer groups.
Economics and Market Research

Costly signaling has gained a large and growing following in economics and market research (for overviews of recent research, see Connelly, et al. 2011; Kirmani and Rao 2000). Below, I mention several examples to indicate the breadth of this research. Costly signaling has been shown to explain why conspicuously expensive to produce advertisements are more successful than less conspicuously expensive advertisements, particularly in crowded and highly competitive markets such as soft drinks (Ambler and Hollier 2004). Costly signaling theory has also been used to explain so-called Veblen effects, when demand for goods increases because those goods are more expensive, not because they are greater in quantity or quality (Bagwell and Bernheim 1996). Veblen effects emerge when there are both inexpensive and expensive versions of the same durable good; consumers able to afford the higher-price version will choose it rather than a large quantity of inexpensive versions or higher-quality versions. This type of demand makes taxes on luxury goods especially useful for revenue purposes, as the higher cost of a heavily taxed product will only increase demand for that product (Miller 1975). Costly signaling also explains the prominence of brand names in consumer goods. Low-cost and high-cost consumer goods are less likely to have obvious branding than middle-cost goods; subtle high-cost goods are preferred only by consumers seeking in-group status; and people prefer obvious brands when in highly public contexts (Berger and Ward 2010). Similarly, experimental research finds that consumers use price and brand name to evaluate the prestige of consumer goods, not their quality (Brucks, et al. 2000). Market research based on costly signaling has also found that different subgroups within a broader population choose to consume conspicuously—for example, different ethnic
groups in the United States consume different conspicuous goods, although these differences disappear when adjusted for income (Charles, et al. 2007). Economic models indicate that the demand for conspicuous consumption goods may be driven by individuals’ desire to distinguish themselves from the poor, not by a desire to appear to be rich (Corneo and Jeanne 1997).

What these studies lack is measurements of Darwinian benefits—they do not evaluate whether costly signaling paid off in terms of fitness. Individuals in highly industrialized, media-saturated modern consumer societies may behave as if their purchases operate as costly signals, but those purchases may have virtually no actual benefit (Miller 2009). My data sets allow me to evaluate whether costly signaling had benefits in a society that had some characteristics in common with modern cultures but that had far fewer consumer goods and much less pervasive branding and advertising.

**Alternatives**

Costly signaling does not explain all costly attributes—not all signals are costly (Maynard Smith 1994), and not all costly attributes are signals. By explicitly recognizing the possibility of alternative hypotheses, I hope to produce more interesting and useful results than simply rejecting the null hypothesis (Stephens, et al. 2007; Towner and Luttbeg 2007). I can produce answers other than “costly signaling” and “not costly signaling.” I consider two alternative explanations to costly signaling as an explanation for palace construction: that palaces are indices, or that palaces are a form of waste or conservative bet-hedging behavior.
Indices

One alternative of considerable significance to the proposed research is that some costly attributes are indices, a category of behaviors and attributes first defined by John Maynard Smith (Maynard Smith and Harper 1995). Indices are physical or behavioral attributes that are directly tied in a hardwired fashion to the trait of interest to observers (Maynard Smith and Harper 1995), a definition that Maynard Smith himself recognized as vague and requiring additional thought (Harper 2006). One example is roaring by red deer, the loudness of which may be linked to body size (see Searcy and Nowicki 2005 for discussion). More broadly, indices may be thought of traits that scale allometrically with other traits in the same way that some ornaments scale allometrically with body size (Kodric-Brown, et al. 2006) or how specific portions of the brain scale with body size (Finlay and Darlington 1995). The intensity or cost of the index trait is only high enough to convey the information the trait needs to convey (Maynard Smith and Harper 1995). Because indices are directly physiologically linked to the trait of interest, they cannot be deceptive. In contrast, costly signals involve traits where deception is a possibility, and the costs of costly signals are therefore higher than necessary for purely information purposes because the additional cost guarantees their honesty (ibid.). To evolve, costly signals would have been selected for at some point by signal observers changing their behavior toward signalers in response to the signal (ibid.).

Although indices are sometimes defined as being cost-free because of their hardwired relation to other attributes (Hasson 1997), another definition sees the costs of indices as being purely developmental (Vehrencamp, et al. 2007; Vehrencamp 2000). This latter definition requires that costly signals have a viability cost in exchange for their
fitness benefit while requiring that indices have costs that contribute to viability and fitness (Vanhooydonck, et al. 2007). For example, red deer pay a cost to be large and therefore to roar loudly, but that cost is purely developmental and is therefore spread out over their early life history and does not reduce individuals’ viability.

Interestingly, Spence’s model of job-market signaling also discusses indices. In Spence’s definition, indices are observable and unchangeable, where signals are observable and changeable, albeit at a cost (Spence 1973). Spence says that indices have information content only if regularities emerge in repeated observations of correlations between an index and another quality. In Spence’s example, if high-productivity women tend to have higher educations than high-productivity men, then "women" becomes an index of higher productivity. Indices thereby create the possibility for multiple signal equilibria across a population due to combination with signals.

Although indices are generally conceived of as being physiologically constrained (Vanhooydonck, et al. 2007), indices could, in theory, include traits that are environmentally or socially constrained. One example may be the practice in India of brides wearing dowries in the form of gold jewelry (Roulet 1996). In this case, the signal (the jewelry) is not a proxy indicator of the quality being displayed (the family’s investment in the bride); instead, the jewelry and the quality being signaled are effectively the same.

Indices are poorly defined, a fact admitted by Maynard Smith (Harper 2006). There are two primary problems with the index concept, and I believe the lack of a solid definition may be the root cause. The first problem is that there is no good reason to distinguish between developmental costs and other costs (Searcy and Nowicki 2005).
Moreover, signals may have both a developmental cost—the cost involved in producing the physical attribute used to make the signal—and a cost of the signaling behavior itself (Dawkins 1993). Both types of costs could come at the expense of fitness or viability, depending on the organism, attribute, and behavior in question.

That potentially false distinction in types of costs is related to the second problem with the index concept. A good phenotypic trick (sensu Dennett 1995) can undo the direct linkage between an index and its related attribute. In the case of the red deer example, researchers have found that individual deer can manipulate their vocal chords to maximize roar volume, albeit at an energetic cost, thereby creating a disconnect between roar volume and body size and therefore bringing deer roars more in line with expectations for costly signaling (Searcy and Nowicki 2005).

“Waste” or Bet Hedging

Another important alternative explanation of costly human behavior is Robert Dunnell’s theory of waste, which posits that actions such as the construction of monumental architecture lower population size by reducing fecundity and provide a pool of time and resources that can be reallocated to subsistence or reproduction under less than ideal conditions (Dunnell 1999). Dunnell’s basis for the theory was the question of whether it was possible for short-term reductions in reproductive success to translate into improved long-term fitness. Dunnell suggested that all human activity could be classified as directly connected to reproduction and survival, waste, or biological or cultural storage (Dunnell 1989a). He suggested that engaging in non-reproductive “waste” behavior (defined as any behavior that did not contribute to reproduction or survival) would keep population sizes below carrying capacity by diverting time and energy from reproduction.
and into “waste” activity. This waste activity would then provide a pool of “excess” time and resources that could be reallocated to subsistence, reproduction, or storage when necessary to ensure survival.

Dunnell further posited that waste would be most beneficial and therefore most likely to appear and persist in environments with large scale and unpredictable environmental variation caused by variation in resources themselves or by changing intensity of competition for those resources. Note that “large scale” and “unpredictable” are meaningful only in comparative terms. It is therefore probably more useful to see this component of the waste theory as stating that in a given area, populations in portions of the area with relatively less predictable or larger-scale environmental variation are more likely to engage in waste behavior than populations in portions of the area with more predictable and/or smaller-scale environmental variability. Waste behavior will only spread later to areas with more predictable environments and regularly high overall productivity (Aranyosi 1999).

This model has been applied primarily to public ritual facilities (for example, see Aranyosi 1999). Graves and Ladefoged expanded Dunnell’s theory to the role of intergroup aggression and integration, suggesting that waste behavior that focuses on integrative ritual architecture will tend to occur in areas that have sponsored intergroup aggression and that provided leadership for integration (Graves and Ladefoged 1995). Such ritual facilities symbolize, create, and maintain social structures and, perhaps most important for my research, benefit individuals who have access to the pooled labor needed to build ritual facilities. This relationship between ritual facilities and symbols of social structures means that waste can have an information component, like costly
signals, although in the case of waste the information is not the point but rather a secondary feature.

Note that Dunnell’s bet hedging is in part a reaction to the oversimplification of classic cultural evolution, which suggested that monumental architecture was a reflection of increased productivity (Graves and Ladefoged 1995); In contrast, the waste hypothesis is a more nuanced response to finer-grained fluctuation in productivity (Shepardson 2006).

Dunnell drew theoretical support for waste from the biological literature on bet hedging (Dunnell 1999). In biology, researchers distinguish between two types of bet hedging, conservative and diversified (Philippi and Seger 1989). Both types are strategies that reduce variance in the fitness of offspring when organisms live in unpredictable environments that lead to widely varying juvenile mortality. Diversified bet hedging involves having a large number of offspring to maximize genotypic and phenotypic variation in the hope that some variants will be well equipped to survive unpredictable environmental conditions (Donaldson-Matasci, et al. 2008; Ellis, et al. 2009). Conservative bet hedging involves reducing the total number of offspring in favor of having a smaller number of higher-quality offspring who are then better equipped to deal with a range of environmental conditions (ibid.). Both strategies have been proven experimentally to work in bacteria populations (Beaumont, et al. 2009).

Selection favors diversified bet hedging when environments are variable across individuals and favors conservative bet hedging when environmental conditions can affect entire populations and occur on generational time scales (Ellis, et al. 2009). To offset this lower yearly reproductive success, species in highly variable environments
often have longer lifespans (Nevoux, et al. 2010). Interestingly, a computer simulation of
Dunnell’s waste hypothesis found that populations in highly variable and unpredictable
environments that engage in waste behavior will have longer lives than populations that
do not engage in waste behavior (Madsen, et al. 1999). Genetic and behavioral evidence
suggests that both conservative and diversified bet hedging have considerable time depth
in human beings, possibly emerging as much as 200,000 years ago (Ellis, et al. 2009).

Boone and Kessler suggest that conservative bet hedging could benefit human
populations even if environmental crises are infrequent but severe by allowing individual
lineages to obtain more status and use that status to provision offspring during famines
(Boone and Kessler 1999). Researchers in biology have made the similar observation that
the costs of costly signaling may be in reduction in future reproductive success rather
than in viability (Kotiaho 2001). This theoretical tack links costly signaling and
conservative bet hedging into a single package of related behaviors involving a tradeoff
between maximizing the number of offspring and maximizing status that can be used to
provision offspring (Shepardson 2006).

The conservative and diversified strategies are not mutually exclusive. In theory,
the relative frequency of diversified and conservative strategies in a population may
oscillate in response to very long term changes in environmental conditions that favor
one or the other (ibid.). However, this theoretical oscillation raises another possibility: it
may be possible for bet hedgers to be outcompeted by non-bet hedgers in a process
similar to a Hawks and Doves game, rendering bet hedging evolutionarily unstable
(Grafen 1999).
The utility of indices and “waste” or conservative bet hedging is in pointing to alternative hypotheses for use in interpreting the patterning in my data sets. I will evaluate the goodness of fit of the data with hypotheses based on costly signaling versus indices and with hypotheses based on costly signaling versus waste. Those hypotheses will be detailed in chapter 6, but I first turn to the historic context, a detailed discussion of the Florentine election system and how that data will be used, and a detailed discussion of the record of standing Renaissance palaces and how that data will be used.
CHAPTER 3. THE HISTORIC CONTEXT

Over the course of the middle ages and Renaissance, Florence experience dramatic economic, social, political change and transformed from a small remnant of the Roman empire to the locus of a new Mediterranean world economy, then to a marginal player in a new world of nation-states. This chapter is intended as a very high-level summary of the city’s history, particularly its political and economic history. Doing real justice to the period’s complexities would require hundreds, if not thousands, of pages. This summary is drawn from many sources (Brucker 1969, 1977; Cochrane 1973; Hale 1977; Hearder and Morris 2006; Hibbert 1994; Schevill 1961). Because of the importance of the political system in understanding the data on palace builders, the government’s offices and electoral procedures during the republic era are covered in detail in the next chapter.

Florence was founded in the final decades of the Roman Republic, around 59 BC. The city measured less than .8 kilometers east-west and less than .8 kilometers north-south, and included baths, temples, capitol, forum, and an amphitheater, all in a standard Roman grid. The population is estimated at 10,000 in the second century AD. Due to plague, political instability, invasions, and other factors, the population dropped to about 1,000 in the 500s, when the Lombards invaded northern Italy and established a military ruling class. Although Venice, Naples, and the Exarchate of Ravenna (which would become the Papal States) remained independent, Florence became part of a Lombard duchy. In the 750s, the Franks invaded Lombard Italy. In 756 the Frankish king Pepin gave the Exarchate of Ravenna to Pope Stephen II, and in 774 Pepin’s successor
Charlemagne confirmed Pepin’s decision, making the Papal States officially independent but in fact control by the Frankish throne. In 781, Charlemagne named his son Pepin "King of Italy," starting the imperial practice of crowning their sons as rulers of the peninsula. In 800, Pope Leo III crowned Charlemagne Holy Roman Emperor. After Charlemagne’s death, his heirs divided the empire and never fully integrated Italy with the rest of their territories. Local Italian rulers were then drawn into the frequent competitions between French and German claimants to the Imperial crown. The Papacy was a constant player in these contests. Pope Gregory VII, who took office in 1073, sought to expand Papal authority, leading then-Holy Roman Emperor Henry IV to depose the pope. In turn Gregory VII excommunicated Henry, in part with support from Countess Matilda of Tuscany, who made Florence the official seat of the Tuscan government. "A pattern was beginning to emerge in Italian history as rulers from beyond the Alps used Italy as a battleground, but through their rivalries created a power vacuum in which cities could acquire autonomy and grow in size as refugees entered from the countryside. And in the cities dynamic the life of the commune was beginning to develop as de facto republics emerged." (Hearder and Morris 2006, p. 53-54).

Matilda's successors as ruler of Tuscany proved unpopular with Florentines, who ignored their Imperial overseers and established de facto independent rule. The city was transformed, increasing in population from about 2,500 in the 700s to about 20,000 by the mid 1000s and 30,000 by 1170s, when new city walls were built to incorporate the expanding suburbs. Powerful noble families began to move from estates outside the city to the city itself, building the towers that would characterize the skyline until the late 1200s. These urban nobles began to use their private armies to attack rural Tuscan nobles
and even small Tuscan towns. They also began to intermarry with the emergent class of wealthy merchants. This mixed noble and merchant elite soon took complete charge of the city’s government, including military affairs and guilds.

In response to this and other Italian mischief, Emperor Frederick I “Barbarossa” invaded Italy in 1154. His forces were defeated in 1176 by the Lombard League of Italian states, which did not include Florence. As part of the terms of defeat, in 1187 Frederick formally recognized the independence of several northern Italian city-states, including Florence. Frederick died in 1190, and was replaced by Henry VI, who died seven years later. Henry’s succession was disputed between his Hohenstaufen house represented by Constance of Sicily and the rival Welf (or Guelph) house represented by Henry’s son Frederick. With papal support, Frederick II eventually became Holy Roman Emperor in 1215. The Guelf party therefore became the Papal party in Italy, while the Hohenstaufen house represented Imperial interests and was known as the Ghibelline faction for the family’s rally cry, “Hie Weibling.” Florence became one of several proxy battlefields for competing Guelph and Ghibelline interests. Villani (Villani 1906 [1348]) attributes the beginning of Florentine violence associated with the broader conflict to the assassination in 1216 of Buondelmonte dei Buondelmonti, an urban noble. When Frederick II was crowned emperor by Pope Honorius III, he named his illegitimate son Frederick of Antioch the empire’s overseer of Florence. This act made the Ghibelline faction ascendant over the Guelph faction. In 1248, Guelph families left Florence for their rural castles, and the Ghibellines pulled down 36 Guelph towers. However, Frederick II was soon excommunicated for his failure to organize a crusade, then died in 1250, destroying Ghibelline power in Italy. The Guelph faction returned to Florence, defeated and exiled.
Ghibelline forces, and destroyed more than 100 palaces, almost 600 houses, 90 towers, and many businesses, according to contemporary Florentine historians (Machiavelli 2010 [1525]; Villani 1906 [1348]). The Guelph party then established a new Florentine government headed by a foreign Capitano del Popolo and a council of 12 anziani, two from each district of the city. The new Florentine government attacked Siena, which had become a Ghibelline refuge, but lost the war, allowing the Ghibelline faction to retake power in Florence. Meanwhile, Pope Clement IV refused to recognize the new emperor, Manfred, instead favoring his Guelf rival Charles of Anjou. In 1266, Charles defeated Manfred at the Battle of Benevento, making the Guelf party ascendant in Florence and elsewhere and allowing the Florentine Guelf party to expel the Ghibellines party from the city.

The Republic Era, 1282-1532

Pre-Reform Republic Period, 1280-1343

Under Guelph government, Florence gained the basics of the political, economic, physical, and demographic conditions that would persist until the Medici duchy. The city’s streets were paved with stone, replacing the earlier brick, the population reached about 45,000 by the end of the 1200s, and banking and wool dominated the economy. In 1282, the Guelph government formally instituted guild-based government by electing the first six Priori delle Arti, with each Prior representing a different district of the city and a different one of the seven major guilds. Most of the previous governors of the city had been nobles, not guild members. For the first decade of republican government, Priors were elected in large part by the outgoing Priors in consultation with the major guilds. In 1292-1293, the government instituted the “Ordinances of Justice,” which enfranchised
some of the minor guilds and created the position of Gonfaloniere di Giustizia
("Standard-bearer of Justice") to execute judicial sentences pronounced by the Podestà
(the chief judicial official, who was always a foreigner) and to lead the guild militia. The
ordinances also barred the hereditary nobility (or “magnates”) from office, although the
truth may be more accurately stated as being that families associated with internal
warfare were declared magnates to justify their banning from political life (Becker 1965).
The “magnates” formally identified in 1343 and in other years included a mix of ancient
feudal noble lineages and new families that had grown wealthy through trade, suggesting
that designation as “magnate” was a means of marginalizing specific individuals
(Klapisch-Zuber 1997). This use of the magnate designation continued until 1434.

The nobility and some members of the guild of lawyers and notaries almost
immediately began a campaign to overturn the Ordinances of Justice, but were opposed
by the militia, workers, and members of lesser guilds. The effort also failed because of
competing interests between two factions within the alliance of nobles and the guild of
lawyers and notaries; the “White” faction of nobles (which included Dante and Petrarch)
and the “Black” faction of merchants and bankers. These factions engaged in running
street battles until the Blacks drew on their alliance with Pope Boniface VIII (1294-1303)
to have the Whites exiled. Boniface had allied with Charles of Valois, brother of the
French King Philip IV. Boniface’s successors, Clement V (1303-1316) and John XXII
(1316-1334) moved the Papacy to France, where it would remain until 1377.

Hoping to end Guelf-Ghibelline conflict in Italy, Emperor Henry VII launched an
expedition to Italy in 1310-1313. Although the Pope initially endorsed the campaign, he
soon shifted his alliance to Florence and the other Italian cities that resisted the imperial
assault. When Henry VII attacked Florence, the city was prepared for a siege, and Henry’s assault collapsed due to disease and a lack of food. Henry withdrew to Pisa and died of malaria in 1313. The remnants of Ghibelline power in Italy sought to capitalize on Henry’s death by planning an attack on Florence, which responded by temporarily accepting oversight of the city government by the Kingdom of Naples in exchange for military assistance. When the Neapolitan overseer left in 1328, Florence returned to republican government. In 1342, republican government was again interrupted when the city’s army commander, Count Gauthier di Brienne of France, the Duke of Athens, was voted Lord of Florence for a year to address the economic crisis created by the collapse of the Bardi, Peruzzi, and Acciaiuoli banks. Although the Duke of Athens had originally drawn on popular support, this support vanished when he imposed new taxes and he was forced to flee the city. However, the lesser guilds retained some of the power they had gained through their support of the Duke of Athens after his departure. In response, the greater guilds imposed several limits on political office-holding: officers had to be born in the city of fathers also born in the city and they had to be free of Ghibelline sympathy, a rule that could in practice be used to eliminate any perceived enemy of the state who could not be barred for other reasons.

**Post-Reform Republic Period, 1343-1433**

In the early 1340s, the population of Florence reached as high as 100,000 to 120,000 people, and work began on a new line of city walls that would ultimately stand into the mid 1800s. But much of this newly enclosed space would remain empty for centuries: the Black Death reached Italy in 1347 and Florence in 1348, followed by severe outbreaks in 1363, 1374, 1383, and 1400. The population was devastated,
dropping to approximately 42,000 individuals by 1348. Like other Italian governments, Florence froze most wages, doubled doctor’s salaries, imposed new limits on immigration and emigration, and increased penalties for crime. These measures were intended to control the disease itself and to reduce the risks of political instability. Note that there is considerable scholarly debate on the actual pre- and post-plague population of Florence, producing a wide range of estimates (Day 2002).

In 1375, mercenaries under Sir John Hawkwood entered Florentine territory to extract bribes in exchange for promises not to pillage cities. Florence believed Hawkwood's actions to be at the behest of his former employer, the Papacy, and declared war on the pope, in part because dissident alleged “Ghibelline sympathizers” believed that war would hurt the pro-Papacy Guelph party. In response, the Guelph party planned to stage a coup and seize control of the Florentine government, but the Ghibelline faction and lower-class supporters discovered the plans and attacked Guelph party members’ palaces. This strife culminated in 1378 with the Revolt of the Ciompi, when lower-class wool workers (ciompi) demanded the right to form a guild and forced the officials of the existing government out of the city.

Under the guild regime of 1378-1382, office was open to all guilds (not just the major guilds and a small number of minor guilds as was previously the case), and the government worked closely with guilds on policy decisions. However, the regime placed limits on membership—cloth laborers were excluded despite (or because of) their role in the Ciompi revolt, and the small number of magnates who were allowed to participate in government were barred from many offices. In 1379, the sons of foreign-born fathers were barred from office. Thus, despite initial promises of greater openness, the
government after the Ciompi revolt quickly came to be dominated by a small number of individuals—Bendetto Alberti, Tommaso Strozzi, Giogio Scali, Uguccione de' Ricci, Bettino Covoni, Bernardo Velluti, Giovanni Dini, Paolo Malefici, Donato Ricchi, and Tommaso Guidetti. In January 1382, reports of a possible coup against these individuals led to yet another period of intra-city conflict between competing interest groups. When resolved, this political infighting once again left the greater guilds in power. However, eligibility requirements for government office were loosened, allowing more artisans and craftsmen to enter office, and the years from 1382 to 1433 are considered to be the most broadly democratic in the republic’s history.

By the early 1400s, a new group of powerful individuals—especially Niccolo da Uzzano (who built a palace in 1415), Gino Capponi, and Maso degli Albizzi—gained behind-the-scenes influence over political office. At Maso degli Albizzi’s death in 1417, power passed to his son Rinaldo degli Albizzi, who built a palace in 1418. However, Rinaldo’s lack of political skill led to accusations that he mishandled a military campaign in 1428. Support began to build for a competing faction that included the Medici, particularly Cosimo de Medici.

Cosimo was born in 1389 to Giovanni di Bicci de Medici, who founded a bank and owned a wool manufacturing business. Giovanni held political office several times and was considered a supporter of the lower classes. Under his guidance, the Medici bank became incredibly successful, in large part by capturing all Papal business under Pope John XXIII (1410-1415) and his successors after the end of the Avignonese “captivity” of the Papacy and the reunification of the Papacy in Rome in 1420. When Giovanni died in 1429, he left his business to Cosimo and his brother Lorenzo. Cosimo married a member
of the powerful Bardi family, and was also allied with the Portinari, Malespini, Cavalcanti, and Tornabuoni families. In 1433, Rinaldo Albizzi brought charges of treason against Cosimo, who bribed his jailers and fled to Venice. When the Albizzi and their associates Rindolfo Peruzzi and family, Palla Strozzi and family (who built a palace in 1420), and Giovanni Guicciardini and family (the owners of a palace built in around 1380) banished Agnolo Acciaiuoli, a member of another old family, upper-class support began to shift to the Medici and their allies. In 1434, the ruling class assembled to appoint a new Balia to eliminate anti-Medici forces from political office, end Medici exile, and banish members of the Albizzi, Peruzzi, Guasconi, Strozzi, Guadagni, Guicciardini, and other families.

**Medici Oligarchy Period, 1434-1494**

On his return, Cosimo de Medici became de facto ruler of the city, and by the mid 1450s (after the Medici palace was built) all government decisions underwent Medici vetting. The taxation system was used to ruin, then banish, critics. However, the constitution and political institutions were largely unchanged, and several political challengers emerged during the period. Medici support for Francesco Sforza’s claim to the Duchy of Milan proved extremely costly to the Medici and required new taxes in Florence. Efforts by Neri Capponi and Gianozzo Manetti (both from palace-owning families) to back Sforza’s enemies in Italy failed, however, and the Medici were not ousted. Similarly, during a recession in 1458, Lucca Pitti launched efforts to reduce Medici power (interestingly, the same year as he began work on his palace). However, the effort actually increased Medici power by leading to the exile of some of the family’s opponents.
When Cosimo died in 1464, his son Piero retained power, but with new opposition from Niccolo Soderini, who used his time in political office to have some Medici controls over the government eliminated. After Soderini left office, support built for a more aggressive assault on Medici power led by the Party of the Hill, so called for their association with Luca Pitti and his enormous palace. Leading members included Agnolo Acciaiuoli (whose family had owned palaces since the 1300s or even earlier) and Diotatalvi Neroni (a former Medici confidante who built a palace next door to Cosimo in 1446). When Duke Francesco Sforza of Milan died and named his son Galeazzo Maria as successor in 1466, the Party of the Hill called for ending alliance with Milan in favor of alliance with Venice. When Piero Medici learned of these plans, he borrowed 10,000 florins from a cousin to buy bread, wine, and weapons to arm a mob to defend his palace. Francesco Sassetti, a business associate of Piero’s, met with the Party on the Hill members and arranged a deal under which they could remain in the city and eligible for office.

Piero died in 1469, and Medici authority and business operations passed to his son Lorenzo. In 1473, Lorenzo signed an alliance with Galeazzo Sforza of Milan and broke up a Papal-Neapolitan alliance against Florence by forming a political relationship with the Neapolitan despot Ferrante. Meanwhile, Lorenzo delayed responding to a loan request from Pope Sixtus IV because of Lorenzo’s concern about Papal territorial ambitions. The Pope turned instead to the Pazzi bank. The Pazzi bank’s representative in Rome told Jacopo de' Pazzi, the head of the family, that he had created an anti-Medici conspiracy that included the pope's nephew Girolamo Riario, Lord of Imola, as well as Francesco Salviati, the Pope's nominee as Archbishop of Pisa who has been barred entry
to Tuscany by Lorenzo de' Medici. The conspirators attacked the Medici at the cathedral of Florence on 26 April 1478 (two years after construction of the Pazzi palace), killing Lorenzo's brother Giuliano, but failing to assassinate Lorenzo. The conspirators also seized the Palazzo della Signoria, but the city hall was quickly retaken by the city militia. Francesco and Jacopo de' Pazzi were executed, Pazzi property was seized, and Pazzi family men and men married to Pazzi family women were barred from office. In response, the Pope excommunicated the Medici and their supporters. In 1479, Lorenzo negotiated peace, and his success allowed him to create a new council to supersede the existing city government. Pope Sixtus IV was replaced in 1484 by Innocent VIII, who allied with Lorenzo. Distracted by politics, Lorenzo let Medici banking operations falter, reducing the family's wealth.

**Late Republic Period, 1494-1532**

Lorenzo died in 1492 and was replaced by his son Piero. In 1494, the French king Charles VIII invaded Italy to attack Naples. Piero met with Charles and negotiated neutrality for Florence. On his return to Florence, his appeasement of France led to the Medici being exiled; Piero died in exile in 1494. The radical cleric Girolamo Savonarola, who had moved to Florence in 1481, negotiated neutrality for Florence and seized control of the city’s government. Under Savonarola, the city’s government was reformed to add a new sovereign body, the Consiglio Maggior of 3,000 members, some of whom also sat on an 80-member Consiglio Minor. Savonarola advocated against luxury and against merchant activity, eventually alienating large portions of the Florentine population. He also made enemies with Pope Alexander VI, who opposed the French presence in Italy. Alexander VI formed a league including Venice, Milan, and Spain, but Florence refused
to participate. In 1498, Savonarola was hanged due to Papal condemnation. Piero Soderini was selected as Gonfaloniere for life. In 1503, Pope Alexander VI died, and his replacement Julius II started wars against Bologna, Perugia, and Venice in an effort to expand Papal power. Julius II initially asked for French and Spanish support, but later called for the expulsion of foreigners from Italy. The Papal army was decimated by French forces in 1512, but the French then retired from the field due to threats of invasion of France by Spain and England. The Pope's forces were left free to march on Florence with an army that included Cardinal Giovanni de' Medici, the 36-year-old second son of Lorenzo. When Papal forces neared Florence, Medici supporters in the city demanded the resignation of Gonfaloniere Soderini. Cardinal Giuliano de' Medici entered Florence in September 1512, disbanded the city militia, and placed Medici supporters in office. Three years later, Cardinal Giovanni de Medici was named Pope Leo X.

Meanwhile, Medici supporters appointed Lorenzo, the son of the Piero Medici who died in exile in 1494, as the unofficial head of government. Lorenzo became increasingly authoritarian, requiring that government meetings take place at the Palazzo Medici, not Palazzo della Signoria. Lorenzo died in 1519 after marrying a cousin of Francois I, King of France. His heir was his daughter Caterina, so the Archbishop of Florence, Giulio de Medici, the pope's cousin, was made head of the Florentine government. When Giulio left for Rome on Leo X's death in 1521 (where he remained after becoming Pope Clement VII in 1523), two Medici bastards were placed in charge of Florence: Ippolito, the illegitimate son of Giuliano de Medici, and Alessandro, who was officially the illegitimate son of Lorenzo but who was rumored to be the son of Archbishop Giulio de Medici and a slave or cousin.
Pope Clement VII antagonized Holy Roman Emperor Charles V, who attacked Rome in 1527. Florentines then exiled the Medici, reestablished the militia, and named Niccolo Capponi as Gonfaloniere for a year. However, Clement VII negotiated peace with Charles V and agreed to crown him in Rome; in exchange, Charles V agreed to reinstall the Medici in Florence. Niccolo Capponi argued for appeasement of the Papacy, but his proposal was rejected and he was replaced by Francesco Carducci, who bolstered defenses, increased the size of the militia, and placed Michelangelo in charge of designing defenses. Charles V’s forces besieged Florence in 1529 and the city surrendered in 1530. Historians view Charles’ invasion as a critical milestone in the history of the modern nation-state: his huge army was beyond the financial means of Florence and other small states, which would never again be able to play the pivotal roles they had before the 1500s.

**The Medici Duchy Era and Beyond, 1533-1860**

In 1533, Francesco Guicciardini, the pope’s representative, appointed Alessandro de’ Medici (one of the Medici bastards) as head of government with the title Duke of Florence. Alessandro became increasingly authoritarian, ordering construction of a fort designed to both defend the city and to suppress rebellion and impounding all privately owned weapons. Alessandro was assassinated in 1537 by his distant cousin and carousing partner Lorenzino de’ Medici. Francesco Guicciardini recommended that succession go to Cosimo de’ Medici, a direct descendant of Giovanni di Bicci de’ Medici. Cosimo was named Duke of Florence in 1537, and immediately eliminated all traces of republican government. In 1569, Cosimo was named Grand Duke of Tuscany. Hereditary Medici rule lasted until 1737, when the family died out and power was seized by the Hapsburgs
of Austria. The Duchy of Tuscany joined Italy in 1860, and Florence was capitol of Italy from 1865 to 1871, when parts of the city were modernized, the city walls largely torn down, and the population finally returned to pre-plague levels.

**What the Historic Context Means**

History as generally written involves only the most powerful members of the most powerful families. However, my research cuts across the artificial line of men who appear in the historiography of Renaissance Florence and the men who appear only in the details or original historic documents. While many powerful individuals built palaces, not all did. My analysis largely ignores global political history and its players, instead focusing on the decisions made by dozens of palace builders, many of who left little trace in Florentine historiography. Where all these men did appear is in the election records, which I describe in detail in the next chapter. At the level of the election data, the status of the most powerful member of the Medici does not receive any greater a priori analytical weight than any other member of the politically active class. At the level of my palace data, the Medici palace has no greater a priori analytical weight than any other palace. Instead, my data focuses on the individual election results, individual life histories, and individual decisions regarding palace construction to understand the day-to-day history that underlies the sweeping Europe-wide history of invasions, dynasties, and geopolitics. My data therefore are about the essential stability of the republican government, sociopolitical fluidity, and economic opportunity that characterized Florence during my study period.
Economic History

The republic era in Florence was accompanied by structural changes in the economy. The old nobility had drawn its wealth from rural landholdings, ensuring economic stability for noble families from year to year and across generations. Wealth for the newly wealthy merchant class was far more volatile. Mercantile wealth was a product of individual skill, business contacts, and luck, and a series of bad decisions or bad luck could quickly destroy a merchant’s fortune. But the payoff for those who succeeded could be enormous. The obvious standouts were the Medici, who went from new immigrants to the city in the 1200s to the city’s de facto rulers in the 1400s to rulers of a territorial state with marriage ties to the French throne in the 1500s.

In broad terms, the Florentine economy can be characterized by explosive growth mixed with sharp recessions from the mid 1200s to about 1500, followed by a period of economic maturity and slow growth that continued well past 1600. In the 1200s, Florentine merchants began to expand their economic reach to Tuscany and later to northern Italy and the western Mediterranean, and focused on raw materials and new markets for the nascent wool industry, as well as imports of wheat and other food. Beginning in the mid 1200s, merchants dramatically expanded their international activity, building extensive trade networks that reached as far as the Levant and England for raw materials, southern Italy for food, and northern Europe for sales of wool cloth. Florentine bankers began to loan enormous sums to foreign rulers, and the Florin became the de facto international currency in Europe soon after the first coins were minted in 1252. From an ecological or geopolitical perspective, this expansion of trade and finance transformed Florence’s effective catchment area—the area from which the city drew
resources—from Tuscany to the entire Mediterranean. In other words, the wealth of Renaissance Florence came not from a small region, as it had in the 1100s and earlier, but from most of the known world (Bacci 1996). In essence, Florence imported carrying capacity from its trading partners (Rees 1996).

The banking industry suffered a massive crisis in 1344, when the English King Edward III defaulted on loans made by the Bardi and Peruzzi banks. The economic situation deteriorated further in 1348, when the plague reached Florence and the population collapsed. Trade recovered after 1350, fueled by the expansion of the wool cloth industry and the new silk industry to new markets in France, the Papal States, the Ottoman Empire, and Germany. Meanwhile, Florentine bankers created the world’s first large international exchange markets in Geneva and Lyons and became the primary bankers to the Papacy during and after the schism of 1378 to 1420.

Beginning around 1500, Florentine merchants and bankers began to lose ground to foreign rivals as Northern European economies expanded. The Genoese dominance of Spanish finances beginning in 1492 pushed Florence out of important trade and banking markets in Naples and Northern Europe. Meanwhile, Genoa and other Italian cities began to mint their own gold coins, ending the dominance of the florin in international finance. However, individual Florentine families and companies remained economically powerful in the 1500s, and many sixteenth century Florentine businesses were much larger than their fifteenth century predecessors. Although the 1500s have not been studied as thoroughly as the 1400s, there is evidence that the late years of the republic and early years of the Medici duchy are better considered a period of economic maturity rather than economic decline (Goldthwaite 2009). The economic stability of the early 1500s came in
spite of warfare on the Italian peninsula. In particular, the poor may have fared especially well by exploiting new job opportunities made possible by a wartime economy. Elites may also have benefited from war, using insider information about foreign and domestic policy and international diplomacy that they gained while holding political office to manipulate the market for government bonds; however, this strategy also would have meant less investment in industry (Lachmann 2003).

Despite these fluctuations, republican rule and economic expansion in Florence produced a level of socioeconomic opportunity rare by the standards of late Medieval and Renaissance Europe. Even the poor experienced economic opportunity, with wages for unskilled laborers increasing significantly after the plague of 1348 (Brown 1989). Overall, wages increased dramatically after the plague, remained high into early 1400s, then increased sharply again between 1420 and 1460. After 1460, wages began to drop slowly, then declined sharply after the 1520s. General economic prosperity and the benefits of post-plague wage rates for the poor produced a remarkably equal distribution of wealth. The Florentine tax assessment of 1427 suggests that wealth may have been more equitably distributed in Florence than in the United States in the 1990s (Goldthwaite 1995; Goldthwaite 2009; Herlihy, Klapish-Zuber, et al. 2002) (Table 1).
Table 1. Distribution of wealth, Florence in 1427 and the United States in 1995.

<table>
<thead>
<tr>
<th>Wealth</th>
<th>Florence 1427</th>
<th>U.S. 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 1%</td>
<td>27.0</td>
<td>38.5</td>
</tr>
<tr>
<td>Top 5%</td>
<td>54.1</td>
<td>60.3</td>
</tr>
<tr>
<td>Top 10%</td>
<td>68.9</td>
<td>71.8</td>
</tr>
<tr>
<td>Top 20%</td>
<td>84.2</td>
<td>83.9</td>
</tr>
<tr>
<td>Top 40%</td>
<td>99.7</td>
<td>95.3</td>
</tr>
</tbody>
</table>


The 1427 tax assessment, which recorded extensive data on household wealth, suggests that many Florentine households were quite comfortable, with 63 percent of households falling in Goldthwaite’s middling or higher brackets before deductions, a figure that included dependents, debts, and other exemptions from household wealth for taxation purposes (Table 2). The catasto also exempted personal dwellings in calculations of total wealth before deductions. Goldthwaite estimates that the catasto did not record approximately 6000 to 7000 desperately poor households, including servants, the homeless, and residents of religious orders. Even with that expanded number of households, 37 percent of all households fell in the middling or wealthier brackets. Note that Goldthwaite’s “poor” and “propertyless poor” categories consist of households with less wealth than an unskilled construction worker could earn in a year. I assume that all palace builders were part of the upper rich bracket.
Table 2. Distribution of wealth in 1427 catasto.

<table>
<thead>
<tr>
<th>Class</th>
<th>Range of Wealth (Florins)</th>
<th>Wealth Before Tax Deductions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Percentage of Total Wealth</td>
<td>Number of Households</td>
<td>Percentage of Households</td>
</tr>
<tr>
<td>Upper rich</td>
<td>5001+</td>
<td>45.93</td>
<td>372</td>
<td>3.8</td>
</tr>
<tr>
<td>Upper middling</td>
<td>1001-5000</td>
<td>37.24</td>
<td>1,747</td>
<td>17.86</td>
</tr>
<tr>
<td>Middling</td>
<td>101-1000</td>
<td>15.91</td>
<td>4,027</td>
<td>41.18</td>
</tr>
<tr>
<td>Lower middling</td>
<td>36-100</td>
<td>.75</td>
<td>1,172</td>
<td>11.98</td>
</tr>
<tr>
<td>Poor</td>
<td>1-35</td>
<td>.18</td>
<td>1,031</td>
<td>10.54</td>
</tr>
<tr>
<td>Propertyless poor</td>
<td>0</td>
<td>0</td>
<td>1,431</td>
<td>14.63</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>9,780</td>
<td></td>
</tr>
</tbody>
</table>

Source: Goldthwaite 2009.

It should be noted that the 1427 catasto was unique in its breadth of data collection. Earlier tax assessments were unduly influenced by individual assessors’ personal evaluations of household wealth (a problem the 1427 catasto attempted to address), and later tax assessments evaluated only real estate held for investment purposes. Unfortunately for my purposes, this means that it is impossible to assess the household wealth of the vast majority of palace owning households. Only three palace-owning households in my data set can be found in the catasto, one Albizzi household with 17,864 florins in total investments and a palace I estimate to have cost 7,412 florins, one Da Uzzano household with 50,869 florins in total investments and a palace I estimate to have cost 8,735 florins, and one Strozzi household with an absurd 162,906 florins in total investments and a palace I estimate to have cost 5,941 florins. These three households were the 60th, 8th, and 1st wealthiest households in the 1427 catasto. However, 1427 was well before palace building increased dramatically.
For most of the merchant elite, success was unstable from year to year or generation to generation. Business investments were by nature volatile. For example, the Bardi family never regained its financial prominence its bank collapsed in the 1340s. Florentine parents from all classes paid large dowries for their daughters and split their remaining estates roughly evenly among their sons, requiring sons to build fortunes of their own. Constant intermarriage broke down barriers between the merchant elite, the old aristocracy, and newly arrived families. Fluidity also resulted from the linkage between business success and elite. Membership in the financial elite was therefore tenuous, with considerable turnover. Between 1352 and 1480, only about 25 to 40 percent of Florentine families persisted in the wealthiest top 10 percent wealth bracket from one twenty-five-year census to the next, and only about 40 to 55 percent of Florentine families persisted in the top 25 percent (Padgett 2010).

Women were marginalized, both economically and socially. However, women did have some control over family fiscal policy, including the transfer of money and real property, through a combination of legal statutes, family influence, and the ability to convert dowries into gifts for their offspring (Kuehn 1996).

This fluidity in the elite was the result in part of the constant influx of new residents to the city, including many immigrants who became guild members and therefore eligible to participate in politics. The result was a steady increase in the number of individuals in the pool of potential office holders, from 5,350 in 1382 to 8,000 in 1484 (Herlihy, Litchfield, et al. 2002).

The business relationships that fueled Florentine economic growth were less strictly commercial than business ties today. Letters written by Florentine merchants and
bankers make frequent references to the importance of two-way flows of products and finances and of mutually beneficial trade relationships between Florentine businessmen to such an extreme that Padgett says the relationships sound almost like competitive gift giving, but “Unlike the potlatch, this economic-cum-social exchange behavior did not lead to ruin” (Padgett and McLean 2003). The creation of commercial credit relationships generally preceded election to high government office, such that business success and financial status translated into political success and political status (ibid.)

The elite began to close doors to new members during the Late Republic and Medici Duchy, when the adoption of primogeniture increased the concentration of wealth in a smaller number of individuals (Emigh 2003). The increasingly wealthy rich also began to set themselves apart in other ways, such as by founding private schools and avoiding professional activity that involved manual labor, including retailing.

The wealth of the Florentine Renaissance fueled a surge in the purchase of consumer goods, a phenomenon that appears to be a hallmark of the appearance of cities that dominate world trade (Braudel 1984; Fisher 1948; Schama 1988). Many middle- and lower-class Florentines purchased paintings, and the 15th century painter Neri di Bicci recorded selling nearly a quarter of his products to members of the artisan class (Antal 1986; Goldthwaite 1995; Goldthwaite 2009). Sculptors made copies of their works in multiple materials for sale at different price points (Goldthwaite, 1995). Books became increasingly affordable in the late 1400s (Jardine 1996). Imports of oriental rugs, Moorish and Spanish pottery, and other goods increased in the 1400s. Over the course of the 1400s and early 1500s, middle-class households saw an increase in home ownership (reaching at least 73 percent), savings, employment of servants, consumption of meat,
and consumption of durable goods, all suggesting increased wealth (Goldthwaite 2009). Clothing appears to have been a particularly significant area of consumer spending. A total of 96 sumptuary laws were passed between 1281 and 1531, with sharp increases from about 1360 to 1420 (probably in response to higher wages and thus greater spending by the lower classes following the plague) and again from about 1470 to 1480. The vast majority of sumptuary laws targeted women’s clothing, although some were also designed to limit spending on funerals and other public family rituals, and these laws were enforced equally against all classes, even the wealthy and feudal nobles (Killerby 2002; Rainey 1985). This spending has led some researchers to call the Renaissance the birthplace of modern consumer culture (Goldthwaite 1995; Jardine 1996). It also helped to fuel economic growth in Florence, as the majority of artistic output was purchased from Florentine artisans by Florentine buyers.

But while Florentines of all socio-economic levels bought art, the artisan economy of the 1400s and 1500s was driven primarily by increasing consumption of durable goods by the wealthy. After the first part of the 1400s, tax burdens decreased and political situation stabilized, confirming merchant elite domination of government. The 1427 catasto and associated procedures produced a tax system that focused on objective valuations of investments, not wages or salaries and not personal assessments of individuals’ taxable wealth. This tax system “may have played a part in freeing the rich from the fear that conspicuous consumption made them vulnerable to taxation” (Goldthwaite 2009, p. 378).

Merchant elites did buy land, but they appear to have used this land as a business investment, not as a strategy of emulating noble feudal landowners. Rural villas were
rare, and land was managed in ways to maximize profits and minimize owners’ management burden (Emigh 2003). The Florentine elite did not hoard cash or easily convertible luxury goods like jewels and plate. For example, a colossally expensive suit of parade armor made by Benedetto Salutati in 1469 that was worth about 4,500 florins (as much as a small palace) was melted down immediately after it was used and converted back to money. Instead, elites consumed massive amounts of clothing and furnishings for altars. “The rich spent even more on personal adornment than on furnishings for their homes, and the difference becomes ever more notable through the sixteenth century” (Goldthwaite 2009 p. 381). Men began to wear clothing as luxurious as women, a point where Florence differed from Venice, where elite men wore uniforms reflecting their political office (Wills 2002).

The demand for private chapels led to the construction or extensive renovation of some 140 churches between 1348 and 1648, and church construction projects were increasingly designed to maximize the number of chapels that could be sponsored by wealthy donors (Goldthwaite 1995). These chapels were incredibly expensive—in 1464, Bongianni Gianfigliazzi estimated his chapel in Santa Trinita could be built and decorated for 2,600-2,700 florins, half what he thought his palace was worth (ibid.).

But as Gianfigliazzi’s estimate suggests, it was palaces that constituted the ultimate in elite conspicuous consumption. In very broad terms, palaces appeared in the late 1200s, became slowly more common over the course of the 1300s, then became a fixture of the urban landscape in the 1400s, especially after Cosimo de Medici built his palace in 1444. The rate of construction of elite palaces dramatically reshaped large parts of the city. For example, the Palazzo Strozzi replaced four small houses, nine shops,
some with living quarters, and two large buildings, one with three shops and the other
with a tower (Goldthwaite 1995). Construction labor became difficult to find as workers
took jobs on palace projects, and so many palaces were built that contemporaries
expressed concerns about the availability of housing for the lower classes. It is these
palaces that my research focuses on, and I discuss them in detail later in this dissertation.
CHAPTER 4. THE FLORENTINE ELECTION PROCESS

The Florentine republic chose its officials through a mix of a democratic electoral system and a random drawing of lots that was overseen by—and sometimes manipulated by—the politically powerful. The process produced a remarkable documentary record that made my analysis possible. The richness of that documentary record is a reflection in large part of the openness of the Florentine political system. Political office in the Republic was open to adult male guild members who held a share of the public debt, a system of forced loans to the state in exchange for interest payments. This portion of the population has been estimated at 5,000 to 6,000 individuals in the late 1300s, or roughly 8-10 percent of the population (Brucker 1969, 1998). The government had dozens of executive offices, and these positions changed hands every few months. Guilds had their own governing officials. These government and guild bodies remained in place and politically important even during the republic’s dominance by the Medici from 1434 to 1494. Indeed, selection for office may have been more a reflection of approval during these periods, when election procedures came under indirect Medici control (Hale 1977). Florentines viewed holding office and even being evaluated for eligibility to be marks of social status (Herlihy, Klapisch-Zuber, et al. 2002), making the election records a critical data set in my analysis by serving as a measure of individuals’ status. This chapter therefore presents a grossly simplified overview of the political process; vastly more detail can be found in the extensive literature on the subject (Najemy 1982; Padgett 2000; Rubinstein 1997; Stephens 1983).
Government Offices

Prior to the establishment of de facto self-government in the 1200s, Florence and many other Italian cities were ruled by consuls who shared power with local bishops. These consuls were selected by a variety of methods, including by councils, by general assembly, and in some cases by lot, a system intended to reduce the risk of corruption. Consuls co-ruled with podestas, the first of whom were appointed by Emperor Frederick Barbarossa in 1162. The office of podesta was usually filled by a non-native of the city and was expected to oversee justice and internal security.

Florence’s republican guild-based government that was created in 1282 to replace the consul and podesta was led by the three executive branches of the tre Maggiori. In the government’s original form, the top offices were the six priors, each representing one of the six divisions of the city (the Sestieri) and each representing a different major guild (the guilds of lawyers and notaries, merchants, money changers, wool masters, silk masters, doctors and apothecaries, and furriers and leather masters). For the first decade of the republic, Priors were selected through consultations between the outgoing Priors, senior members of the major guilds, and other influential parties. Priors held office for two months, during which time they were required to live in the Palazzo della Signoria. The priors were assisted by a notary who was selected using the same procedures. The Priori initiated all legislation, which was developed with the advice of two councils, the Buonuomini (who numbered 12 and who held three-month terms) and the Gonfalonieri di Compagnia (who numbered 16 during most of the Republic and who held four-month terms). In some cases, legislation was given final approval by very large Consiglio del Popolo or Consiglio del Comune consisting of hundreds or thousands of adult male guild
members. In certain circumstances special temporary ad-hoc commissions were created to oversee specific political issues. In 1293, the political system was revised slightly to include some minor guilds in political life and to bar all nobles from office. The 1293 reforms also created a seventh prior, formally called the Gonfaloniere di Giustizia (Standard-bearer of Justice), who led the guild militia and was responsible for executing judicial sentences pronounced by the Podestà, who as under the pre-republic system was a foreigner and the chief judicial official. The Gonfaloniere di Guistizia held office for two-month terms.

In 1328, the system of drawing lots for office was created. Under this system, adult male guild members voted by neighborhood for who would be eligible to potentially serve in government office. Candidates had to be enrolled in one of the guilds and (at least initially) to actually exercise a trade. This step was called the scrutiny, which was supposed to take place every five years. The names of the individuals with the most votes were then placed into bags, the “borse.” The actual timing of new scrutinies and assembly of new borse was subject to political manipulation—it could be to the advantage of the group in power to delay holding a scrutiny and creating new bags of eligible names. However, political crises generally led to new scrutinies. For example, a new scrutiny was held and new borse created immediately after Cosimo de Medici was recalled from exile in 1434.

The borse containing the name slips were stored by monks in the sacristy of the Basilica of Santa Croce. Every two to four months, depending on the office, the borse were taken to the Palazzo della Signoria and opened in the presence of the Gonfaloniere di Giustizia, the Priors, and other officials. Extractions of names by the Notaio of the
Riformagioni, an administrative official, began with the oldest existing borse. Names were drawn and their current eligibility for office was determined. Initial extraction from the bags meant that a man had been "seen." To be “seated” in office, the “seen” man had to be reviewed for several criteria: he could not have held office too recently, he could not have immediate family members currently in office, he had to be at least 40 years old for the office of Gonfaloniere di Guistizia and at least 30 years old for other offices, he had to be physically in the city, and he could not be in tax arrears. Names were also drawn of dead men, who were not seated but whose names were often retained in the borse. Names were drawn until the right number of office holders was "seated."

Although designed to prevent corruption and abuse, the process of selecting office holders by lot was subject to a certain amount of interference. By the 1340s, candidates were sometimes pre-selected prior to the neighborhood-level elections, thereby limiting the pool of potential office-holders to individuals considered loyal to the de facto ruling party. The use of these measures increased under Albizzi dominance in the late 1300s and further still under the Medici oligarchy.

In 1343, following the attempt of Walter of Brienne to assume the Lordship of Florence, the groups who defeated him implemented several reforms of the system of selection for the highest offices. They removed the prohibition against nobles holding office, although the change lasted less than a year, continuing magnates’ increasing political and social marginalization (Klapisch-Zuber 1997). The new power brokers also redistricted the city from six Sestieri into four Quartieri, each subdivided into four Gonfalonii, which helped to organize the populations living in land newly enclosed by the walls completed in 1334. Finally, they settled on the number of office holders that would
remain in place until the end of the republic: one Gonfaloniere di Giustizia; one Notaio; eight priors, two from each quarter; election of priors both from both the Arti Maggiori and Arti Minori; 12 Buonuomini, and 16 Gonfalonieri di Compagnia, one from each of the four Gonfaloni.

The power of the tre Maggiori began to decline in 1480, when some executive power shifted to a new Council of Seventy. The tre Maggiori’s power further declined with the creation in 1494 of the Consiglio Maggiore, a body with more than 3,000 members that suspended the old electoral system and instead substituted a system of selection by the Consiglio through Electors (who were themselves ineligible to hold office). The Consiglio Maggiore was disbanded in 1512 when Cardinal Giovanni de’ Medici entered Florence. The political system was restored to its pre-1494 form, although with de facto control of elections again in the hands of the Medici party as it had been during the Medici oligarchy from 1434 to 1494. The Consiglio Maggiore was replaced by a Senate of 70 and a Council of 100. It was restored during the brief period of non-Medici government between 1527 and 1530. When the Medici were restored and named hereditary rulers in 1532, elections ceased and the old political offices were replaced by a Magistrato Supremo that reported directly to the Duke and that stood over a Senate of 48 members and a Council of 200 members.

**Guild Offices**

The government during the republic ultimately rested on a base of trade guilds and their members. The city’s first guild, the Arte di Calimala (the merchants’ guild) was founded sometime between 1150 and 1200. The remaining guilds were founded in the 1200s. After guild government emerged full-force in the 1300s, guilds lost most of their
traditional economic functions and instead became mostly political entities. Many members had no actual related business activity, and many individuals were members of multiple guilds.

The city had seven major guilds and 14 minor guilds. Unlike most Italian cities, guilds were not created to oversee new professions and industries; instead, existing guilds were broadened. For example, the silk guild grew to include upholsterers, embroiderers, mercers, feather merchants, and goldsmiths. The seven major guilds were the Arte dei Giudici e Notai (lawyers and notaries); the Calimala or Mercatanti (merchants); the Arte del Cambio (money changers); the Arte della Lana (wool masters); the Arte della Seta or Por S. Maria (silk masters), the Arte dei Medici e Speziali (doctors and apothecaries); and the Arte dei Vaiai e Pellicciaia (furriers and leather masters). The fourteen minor guilds were the Arte dei Beccai (butchers); the Arte dei Calzolai (shoemakers); the Arte dei Fabbri (blacksmiths); the Arte dei Linaiuoli e Rigattieri (linen drapers and used clothes dealers); the Arte dei Maestri di Pietra e Legname (builders); the Arte dei Vinattieri (wine sellers); the Arte di Albergatori (innkeepers); the Arte di Oliandoli e Pizzicagnoli (oil dealers and sausage and cheese sellers); the Arte dei Cuoiari e Galigai (minor leather masters); the Arte dei Corazzai e Spadai (armorers); the Arte dei Coreggiai (belt makers); the Arte dei Chiavaioi (locksmiths); the Arte dei Legnaioli (carpenters); and the Arte dei Fornai (bakers).

As with guilds elsewhere in pre-modern Europe, the guilds in Florence enforced manufacturing and production standards and settled internal disputes. The guilds were governed by a group of consuls who were drawn by lot—using basically the same scrutiny and lottery process as political offices—from the pool of eligible guild masters.
Consuls served for four-month terms; the number of consuls varied from guild to guild. Because Florentine guilds were so intertwined with political office, guild membership did not necessarily reflect an individual’s profession. The Medici and other families were members of multiple guilds. The nobility joined guilds in increasing numbers in the 1400s to participate in government. Many guild members had interests in multiple professions, and their membership in a particular guild was therefore a matter of choice and politics.

In addition to guild consuls, guild election records include the six members of the Mercanzia, or commercial court. Magistrates were drawn from the five most commercial major guilds (the Mercatanti, Cambio, Lana, Seta, and Medici e Speziali) with a sixth member from one of the minor guilds. The Mercanzia participated in the drawings for the tre Maggiori. It also oversaw bankruptcy, fraud, commercial dealings with foreign states, and other economic and legal issues, and enforced guild consuls’ judgments against their members and oversaw the selection of those consuls. In the late 1400s, the Mercanzia lost importance due to changes in the election system promulgated by Lorenzo de Medici.

The Scope of the Electoral Data

My analysis uses the election data encoded by David Herlihy beginning in the 1960s and since recoded for dissemination via the Internet (Herlihy, Litchfield, et al. 2002). For several reasons, Herlihy’s election data for the tre Maggiori is not complete. The names of individuals seen but not seated for the positions of Gonfalonieri di Giustizia, Notai, and Prior before 1345 are not included. The names of men seated on the Buonuomini and Gonfalonieri di Compagnia are missing for the years before 1329, for the years 1348-49, and for some years from 1355 to 1404. Men seen but not seated for tre
Maggiore offices between August 1497 and October 1512 are missing due to the suspension of old procedures in favor of the Consiglio Maggiore. Herlihy’s guild election data starts for the year 1393. Due to lost volumes of original records, election results are complete only for 1393 to 1421, 1429 to 1443, 1465 to 1474, 1480 to 1497, and 1507 through 1532. Birth records start in 1429, the year the Florentine government began requiring all potential office holders born after 1381 to register their year of birth. Because the tre Maggiori, guild, and birth records include first name, multiple patronymic names, and surname, it is possible to use the elections data to create rough genealogies—all but a tiny fraction of the records include the father’s name and usually the grandfather’s name as well. The demographic data that appears later in this dissertation use the election records to determine the number of sons fathers had and the ages at which those fathers’ had sons. The election records are admittedly spotty, but they still contain some 166,000 records of individual births and individual draws for guild and government office (Table 3). They are most complete for the Medici oligarchy period and least compete for the pre-reform republic period. Fortunately, they are not incomplete for particular families or individuals, and I believe that my analysis would not be dramatically altered if more complete records existed. To overcome potential issues with missing data, my analysis using election records evaluates counts of tre Maggiori office draws and seats separately and overall draws and seats separately, and breaks the analysis down into subperiods to allow for comparisons of palace builders and palace builder families with their temporal peers.
Table 3. Number of records in election data.

<table>
<thead>
<tr>
<th>Election Data Set</th>
<th>Number of Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tre maggiori</td>
<td>c. 82,000</td>
</tr>
<tr>
<td>Guild elections</td>
<td>c. 63,000</td>
</tr>
<tr>
<td>Birth records</td>
<td>c. 21,000</td>
</tr>
</tbody>
</table>


The Significance of Being Drawn and Being Seated for Office

Participation in tre maggiori and guild offices was both a reflection of existing status and a source of future status. Because it required popular approval from residents of the neighborhood, being placed into the bags for tre maggiori office was a mark of high status at the neighborhood level, even if that person’s name was never drawn for high office. Similarly, being drawn for guild office even without being seated was a mark of high status in a professional organization. In the case of both guild office and tre maggiori office, popular approval of eligibility for office on the neighborhood or guild level was a result in part of patronage relationships. Candidates who were successful at the neighborhood level were probably successful because they had existing small-scale patronage relationships and had promised once in office to provide their supporters with additional patronage that had real financial value, such as favorable tax assessments (Padgett 2000).

Being elected to government office was also a reflection of past business relationships, according to an extensive statistical analysis of election and economic data (Padgett and McLean 2003). That study found that the more likely men were to have
commercial credit relationships, the more likely they were to have served together in high
government office. In most cases, these commercial credit relationships were formed
before men served together, such that election to office followed several years of active
business activity. “Indeed election to political office was the republican method for
translating economic wealth into public recognition and status. Through this electoral
method, economic and political elites, while not at all identical, became correlated. This
electoral connection was one institutional device that ensured that Florentine
businessmen behaved in social-exchange as well as economic-exchange terms…. 
Otherwise, they would not get elected to political office, with all the status consequences
for them and for their family which that implied.” (Padgett and McLean 2003, p. 27-28).

Once seated in government office, men could use their positions to make good on
their promises of patronage for their supporters; they could also use their positions to
create patronage relationships with Florentines from the lower and middling classes
(Goldthwaite, 2009). While in office, government and guild officials would have created
new social and business networks with their peers, particularly when serving as priors,
who were required to spend their two-month terms housed together in the Palazzo della
Signoria. But most importantly, office holders would have been in control of Florentine
government policy. Lorenzo de’ Medici said that public finance and taxation were the
primary issues of state policy and therefore the primary concern of office-holders (Kent
2004). Office-holders could shape policy to benefit themselves and their allies. For
example, Florentine state finances depended in large part on a series of forced loans that
paid very high interest rates, making them safe and valuable investments. By setting state
policy regarding the size, timing, and source of these loans, office-holders could provide direct financial benefits to particular groups or individuals.

Not surprisingly, Florentines viewed election to office as a critical element in family status. Families kept lists detailing which members had served in which offices, and extended families considered the year when the first family member served as a prior to mark the family’s entry into the ranks of the city’s elite, and they often referred to offices as “honors” (Kent 2004). My use of the elections data as a measure of social status would therefore be recognizable to Florentine elites.
CHAPTER 5. AN OVERVIEW OF FLORENTINE PALACES

The shift in Florence to republican government coincided with a massive construction spree. The new republic began several huge publicly funded construction projects, including the cathedral of Santa Maria del Fiore (beginning 1296), the Palazzo della Signoria (beginning 1299), and new city walls (beginning 1299). Roughly 140 churches were built or extensively renovated between 1348 and 1648. Religious, government, and other public construction projects were overseen by committees of private individuals, including individuals who had contributed funding to the projects. While sitting on these committees, individuals learned about project management, architecture, style, and architects, and they used that knowledge to produce another architectural legacy of the Florentine renaissance, palaces (Goldthwaite 1995). Palaces changed stylistically over the course of the republic era. Those stylistic changes and their temporal pattering were the starting point for my research; this chapter discusses the changing face of Florentine elite domestic architecture between the foundation of the Republic and into the early years of the Duchy.

In broad terms, palaces first appeared in the mid to late 1200s as simple stone-faced structures with little obvious “style.” Prior to the appearance of the recognizable palaces that stand today, elites lived in rambling urban compounds that consisted of multiple, barely integrated structures. The early palaces were characterized by features designed as much for function as for aesthetics: many early palaces incorporate clearly defensive features such as towers, and all palaces built before the late 1300s have multiple ground-floor doorways that opened onto warehouse and storefront space.
Despite their functionality and stylistic simplicity, the early palaces were still recognized as such when they were built—early chroniclers made a distinction between domestic architecture as a whole and “palazzo” (for example, see Villani 1906 [1348]). In the late 1300s, palaces began to change dramatically. In place of multiple warehouse or storefront doorways, palaces began to be designed with a single main entrance. Façades became more elaborate, and interiors gained formal colonnaded courtyards. The best-known palaces of the 1400s expand on the basic stylistic elements of the late 1300s but were much more elaborate, with far more complex stone façades, greater variety in the treatment of details such as window surrounds and string courses, and more symmetry. But beyond the best-known palaces of the 1400s, entirely new styles appeared that used stucco in place of costly stone for façades. These simpler and less-expensive styles came to dominate construction in the late 1400s and early 1500s, but they were still considered palaces when built: Francesco Baldovinetti, in his list assembled in the mid 1500s of landmark structures built between 1487 and 1520, calls several of these stucco-façade structures “palazzi” but says that many would “now be considered merely large houses” (Ginori Lisci 1985; von Fabriczy 1905). In other words, “palazzo” was a term that described buildings that contemporaries considered the most opulent dwellings. Stylistic diversity increased again in the 1500s, when the comparatively sober Renaissance styles began to be supplemented by Mannerist aesthetics that emphasized experiment and variety.

**Identifying the Palaces**

My first step in identifying palaces was the extensive architectural historical literature on Florentine palace construction (Bucci 1971; Carlini, et al. 2001; Ginori Lisci
1985; Mandelli, et al. 1989; Vannucci 1995; Wirtz 2000). I also referred to contemporary accounts that described palaces in sufficient detail to determine their address; particularly useful was a list of the ownership and location of palaces that was assembled in the early 1500s by Francesco Baldovinetti, who lived from 1477 to 1545 (von Fabriczy 1905). Using these sources, I was able to identify 135 palaces built between the late 1200s and 1600. I suspected that these palaces were the best-preserved and most architecturally significant examples and that most modern authors overlooked palaces that were in poor condition or architecturally uninteresting. I also suspected that these identified palaces were the structures with the best-documented history—their dates of construction are well known, as are their owners, architects, and other details. These 135 palaces were plotted on aerial photographs using ArcGIS software; Ginori Lisci’s maps of the exact spatial extent of palaces he described were particularly useful. The result was a GIS polygon shapefile of all palaces identified by previous architectural history research. Each GIS record was associated with a spreadsheet record with the building’s construction date, its owners, its renovation history, its stylistic details, and its size. I also used the work of architectural historians to build a catalog of stylistic attributes that architects have identified as being associated with specific ranges of construction dates. I then overlaid the GIS-based aerial photographs with an axonometric map of Florence drawn in 1584 by Stephano Buonsignori, a monk employed as a map maker by the Florentine Grand Duke Francesco I (Figure 1). Buonsignori’s map is astonishingly precise and accurate. On a building-by-building level, however, it is only precise and accurate for the 228 landmark structures Buonsignori labeled (a list that includes 28 palaces). For example, Buonsignori’s depiction of the Palazzo della Signoria, the Uffizi,
and the Ponte Vecchio shows the details of the landmark buildings to be basically correct and the relationships between blocks to be basically correct (Figure 2). Part of the difference between Buonsignori’s map and aerial photographs is due to a slight difference in perspective—aerial photographs are taken from a nearly vertical position over the city, while Buonsignori drew his map from a hill south of the city. However, the largest difference is between the widths of streets as depicted by Buonsignori and as they actually exist. Buonsignori drew streets wider than they actually were, I suspect as a way of ensuring that those streets were visible in his map, as many streets in the city are so narrow that they are invisible even on modern high-resolution aerial photographs.

Buonsignori was also inaccurate in his depictions of individual non-landmark buildings. Buonsignori’s map therefore proved less than useful in identifying individual buildings as “palaces,” but it was essential in identifying land that was not developed in 1584 and in identifying the land associated with monasteries and convents. This information allowed me to identify city blocks that were built up by 1584 and that therefore potentially contained palaces that were not documented by architectural historians.
Figure 1. Stefano Buonsignori's 1584 map of Florence.
Figure 2. Detail of Buonsignori's 1585 map overlaid on a modern aerial photograph.

Buonsignori’s map was also used in conjunction with aerial photographs and architectural historical research to create GIS polygon shapefiles of the boundaries of monasteries, convents, churches, blocks of mixed residential and business properties, government buildings, and undeveloped land (Figure 3, which shows the same area as in Figure 2 with the Ponte Vecchio in light green and the Uffizi and Palazzo della Signoria in brown). This shapefile allowed me to determine the footprint (length, width, and area) of the built environment and of individual structures.
I then used Google Street View to examine the blocks that I had identified as being built up in 1584, using the Google photographs to identify blocks that contained only comparatively recent buildings based on the lack of stylistic attributes observed on recorded palaces. Some of these buildings probably have very old roots despite their modern appearance. For example, I’m reasonably certain that the coin-operated laundry by my hotel is in a medieval building, judging from the interior construction, but the exterior appears to have been heavily modified in the 1800s. I also consulted historic photographs to identify possible palaces that were visible in the 1800s but that are no longer apparent (Bargellini and Pucci 1969). Several events have considerably altered the
city since the early 1800s. Florence was the capitol of Italy from 1865 to 1871, when parts of the city were massively renovated. For example, the old market and the former Jewish ghetto southwest of the Duomo were torn down to create a new plaza and to build new buildings. This renovation led to efforts to preserve medieval and renaissance buildings in the city. Several buildings—including at least one palace—were destroyed by German forces during the Second World War. The examination of Google Street View photographs and historic photographs resulted in a map of blocks requiring closer inspection.

The final step, close inspection of blocks that potentially contained intact Renaissance-era palaces, was conducted on foot in March 2010 by myself and Anne Compton. We used high-resolution aerial photographs with labeled streets to navigate and survey every block in the city that I had previously judged likely to preserve recognizable palaces built during the study period. We extensively photographed all palaces from the study period that had been identified by architectural historians. We also extensively photographed all buildings with stylistic attributes consistent with palaces built during the study period. We also took notes on the aerial photographs regarding buildings’ spatial extent. Information on spatial extent was then added to the GIS polygon shapefile. During survey we also estimated palace heights. These heights were later cross-checked against published architectural drawings and elevation data available through Google Earth software.

Background research, analysis of aerial and Google Street View photographs, and pedestrian survey identified 206 palaces. Of those 206 palaces, I was able to find published information on the original family name of the builders of 153 palaces and the
specific individual name of the builders of 94 of those 153 palaces. I should note that this sample of 206 palaces does not represent all standing Renaissance-era palaces in Florence. I initially recorded another dozen or so palaces during pedestrian survey, then later removed them from my sample due to stylistic anomalies suggesting that they might have been built after my study period, possibly even as Renaissance Revival structures in the 1800s. I overlooked several other Renaissance-era palaces due to their subsequent modification. For example, Mandelli (1989) describes a palace that I saw absolutely no trace of due to later renovation. I also have rough documentary and photographic records of several palaces near the bridges over the Arno that were destroyed during the Second World War by retreating German forces; these palaces are not included in my sample because of the difficulty of determining their precise location and spatial extent. Finally, Machiavelli and other contemporary historians describe many incidents of palaces being destroyed by mobs, and I have not made any effort to include those structures. The 206 palaces discussed here should therefore be considered a representative sample of palace architecture built between about 1280 and 1600. My hunch is that I mostly overlooked palaces that were built in the early 1500s; the stylistically simple palaces built in these years would have been comparatively easy to modify.

My next task, once these 206 palaces were identified, was to determine the date of their construction. Only 86 of the palaces had specific documented years of construction based on original records. The remainder I dated based on their stylistic attributes. To assess style, I began with the 86 most precisely dated palaces (those dated to a specific year, not a range of years) and architectural historians’ descriptions of critical stylistic trends to define attributes that were temporally sensitive and consistent across individual
palaces. I then used those attributes to identify and assign date ranges to nine stylistic types (Table 4). I assumed that the earliest precisely-dated example of a type was the earliest example and that the latest precisely-dated example of a type was the latest example. When evaluating building style, I used the façade as it currently appears. Several palaces were heavily renovated during the study period or after the study period, and I did not use renovated palaces to determine the date ranges for specific stylistic elements except where documentary evidence was strong regarding the specific dates of specific components that were renovated. For example, the Palazzo Medici-Riccardi was modified in 1517 to enclose an open loggia using kneeling windows with pediments. These nine styles overlap temporally but can be sorted to show broad stylistic change over time (Figure 4). Unless otherwise noted, all construction dates refer to the year when construction began, not when construction was completed. These styles were developed for their utility in grouping palaces and in determining their rough ages. They are also relative categories of façade cost, a subject I discuss in detail in the next chapter. The 16 palaces described as “post study period styles” are palaces for which I have extensive documentary evidence indicating that they were built between 1280 and 1600 but then so extensively renovated that their original façades cannot be seen.
Table 4. Count of palaces by style.

<table>
<thead>
<tr>
<th>Style</th>
<th>Date Range</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medieval Styles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medieval Plain</td>
<td>*1260-*1420</td>
<td>33</td>
</tr>
<tr>
<td>Medieval Rusticated</td>
<td>*1310-*1400</td>
<td>14</td>
</tr>
<tr>
<td>Transitional Rusticated</td>
<td>*1350-1475</td>
<td>10</td>
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<tr>
<td><strong>Early and Middle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renaissance Rusticated</td>
<td>1444-1489</td>
<td>11</td>
</tr>
<tr>
<td>Sgraffito</td>
<td>1446-*1575</td>
<td>20</td>
</tr>
<tr>
<td>Corner Ashlars</td>
<td>1470-*1575</td>
<td>25</td>
</tr>
<tr>
<td>Stucco</td>
<td>*1475-1575</td>
<td>46</td>
</tr>
<tr>
<td><strong>Late Renaissance Styles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mannerist Rusticated</td>
<td>1520-1600</td>
<td>7</td>
</tr>
<tr>
<td>Mannerist Stucco</td>
<td>1520-1600</td>
<td>24</td>
</tr>
<tr>
<td><strong>Post-Study Period Styles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1600-present</td>
<td>16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>206</strong></td>
</tr>
</tbody>
</table>

*Indicates approximate dates.
Figure 4. Box plots of date ranges for palace styles.

**Medieval Styles, 1260-1475**

The palaces that are the subject of my research appeared roughly the same time as the foundation of the republic in 1282. The earliest well-dated example is the Palazzo Mozzi, built in approximately 1260 or possibly a couple of decades later. Prior to the republic, the landmarks of Florentine domestic architecture were stone towers. At the end of the 11th century, historical sources attest to only five towers in Florence, but records indicate that there were at least 35 by the late 1100 and more than 150 by the end of the 1200s as Florence became a battleground between competing Guelf and Ghibelline parties (Grimaldi 2005; Mercanti and Straffi 2003; Villani 1906 [1348]). These towers
are unquestionably defensive and utilitarian structures, featuring small windows, crenellated roofs, few doors and sometimes no ground-floor doors at all, and interior wells. When originally built, they were very tall—the Monaldi tower is still 50 m tall—but in 1250, as part of efforts to control elite internecine warfare, towers were limited in height to 50 braccia, or about 29 meters. Towers were owned by two groups. The first group was alliances of hereditary noble families, which often integrated towers into residential compounds that were basically aggregations of preexisting houses. These tower-houses are largely gone, although the city still preserves a handful of palaces that look like towers that have been stretched sideways to make more living space. Towers were also owned by non-kin mutual protection societies (Lansing 1991). At least 54 towers still stand. Many are now integrated into palaces and other large buildings, with modifications to make them more usable as living space. For example, the Palazzo degli Albizzi was extensively renovated in the 1600s, including the construction of a plaster façade, but the medieval tower that makes up part of the palace is still clearly visible (Figure 5).
In the late 1200s, families began to build the palaces that still stand today, including the Mozzi palace built in the 1260s or possibly as much as a few decades later and the Spini palace built in 1289. My sample includes 57 palaces that can be classified as broadly medieval in style, almost all of which are within the area enclosed by the city walls that were completed in 1260 (Figure 6). Contemporary documentary evidence, especially Machiavelli’s history of Florence, suggest that other early palaces probably stood into the 1300s, but the ease with which they were destroyed by armed mobs, fires, and floods suggests that these now-vanished palaces were probably built of wood or other less durable materials (Goldthwaite 1972). In their original form, many of the palaces of the 1200s and early 1300s that have since been destroyed or renovated out of existence...
were barely recognizable as single structures—contemporary accounts describe buildings that were internally divided into stores, warehouses, and apartments in a fashion so random as to have individual households living in rooms that were connected internally but actually part of neighboring structures (ibid.). I have subdivided the 57 medieval palaces into three stylistic types, Medieval Plain, Medieval Rusticated, and Transitional Rusticated.

![Figure 6. Medieval style palaces in the study sample.](image)

**Medieval Plain Style Palaces—1260-1420**

Medieval plain style palaces, the earliest style I identified, have very simple, undecorated stone façades. These palaces have ground-floor façades constructed of stone ashlar—stones cut to fit, like bricks—while upper floors have rubble façades,
constructed of more or less unshaped stone. In some cases, the upper floors have brick façades. These palaces all had multiple ground-floor openings for warehouses and storefronts. Many of these warehouse or storefront openings are surmounted by small windows, which provided ventilation for interior rooms. They lack formal courtyards, instead having spaces that are little more than shafts for air and light. Stone carved crests appeared by the 1300s, and consist of rectangular stone slabs with coats of arms. Also characteristic are wrought-iron fixtures such as torch supports, brackets to hold cloth standards, and rings for horse leads; some of the ironwork still visible on palace façades is original. Many have defensive features such as crenellated towers, and their façades are usually pierced by holes that originally held supports for external wood balconies that served at least partially as defensive features. The windows of these early palaces are single-light and surrounded by simple arches that are flush with the surrounding façades. Façades often have string courses between floors; these string courses are very simple but do help to reinforce the visual impression of horizontality (most towers had no string courses, reinforcing their verticality). Finally, while difficult to quantify, these early medieval palaces have little “style” other than an impression of mass and stone. These attributes are all visible on the Palazzo Acciaiouli built in the 1280s, which has a façade that combines ground-floor ashlar construction and upper floor rubble construction, multiple storefront openings, warehouse ventilation windows, balcony support holes, and an incorporated tower (Figure 7). The Acciaiouli palace also has a carved stone coat of arms on the façade. This design element, which is common among all palaces in my sample, would have identified the owner to passersby.
About 1350, ashlar façades began to replace rubble façades on above-ground floors (Figure 8). About the same time, the alignment of storefront openings and windows on vertical axes became more regular, possibly to align private architecture with the style established by Arnolfo di Cambio in his designs for renovations of buildings near the Palazzo della Signoria (Ginori Lisci 1985).
Figure 8. Casa Ridolfi, built after 1350; the stucco top floor is later.
My sample includes 33 Medieval Plain style palaces. Where more precise construction dates were not available, Medieval Plain style palaces were assumed for analytic purposes to date to 1280 if they had above-ground rubble façades and to 1350 if they had above-ground ashlar façades. Well-dated examples of the style are almost all from the late 1200s to mid-1300s, but one example may have built as late as the 1420s.

**Medieval Rusticated Style Palaces—1310-1400**

Beginning in approximately 1310, façades began to appear with rusticated ground floor ashlars, in which stones are cut to highlight their edges or cut with false joints to make large blocks appear to be multiple smaller blocks of stone (Figure 9). These Medieval Rusticated style palaces are otherwise identical to Medieval Plain style palaces. Rusticated ashlars would later become common on palace façades and almost a defining element of the largest Renaissance palaces. Where more precise construction dates were not available, palaces of this style were assumed to date to 1350 for analytic purposes. My sample includes 14 Medieval Rusticated style palaces. The style persisted until about 1400.
In the mid 1300s, three stylistic traits appeared that represented a dramatic change from the medieval plain and medieval rusticated styles. The first new attribute, and one that was unfortunately difficult to observe on aerial photographs and during survey, was formal courtyards in place of the haphazard air shafts found in some earlier palaces. The second attribute was the appearance of main entries in place of the earlier banks of warehouse or storefront openings. The third stylistic trait was the use of elaborately rusticated ashlars on ground floor façades and smooth ashlars on above-ground façades. All three of these stylistic attributes are present on the Palazzo Capponi delle Rovinate, built starting in 1415 with a single main entrance in a rusticated ashlar façade with a

Figure 9. Rusticated ashlar ground floor façade, Palazzo del Bembo.

Transitional Rusticated, 1350-1475
heavy emphasis on the horizontal axis (Figure 10) (note that the large windows by the
door are later additions). The palace is considered the stylistic ancestor of the landmark
apalaces of the 1400s (Ginori Lisci 1985). The palace has interior warehouse space,
indicated by the small square windows high in the first-floor façade, but this storage
space was not on display as it was in earlier styles, and most of these palaces’ owners
probably conducted most business at dedicated warehouses, not at their houses
(Goldthwaite 1972). The Palazzo Capponi delle Rovinate is also significant for being the
first palace in the city whose architect is known—Filippo Brunelleschi, who later
designed the dome for the cathedral of Santa Maria del Fiore. I have also included the
Palazzo Davanzati, built about 1350, in my transitional rusticated style; although that
palace has multiple warehouse style doors, it has the first documented formal courtyard
and an unprecedented smooth rusticated ashlar ground-floor façade (Figure 11). In
broader terms, these transitional rusticated palaces are significant for their emphasis on
unified design, stylistic distinction from neighboring structures, and systematically
planned private interior space, and they probably represent the first palaces that
approximate the feel of a modern private residence (Goldthwaite 1972).
Figure 10. Palazzo Capponi delle Rovinate, built beginning in 1415.
Figure 11. Palazzo Davanzati, built approximately 1350.

My sample includes 10 transitional rusticated style palaces. All 10 have documented construction dates, or at least documented construction decades. All but two were built between 1372 and 1415. The two stylistic holdouts built in the second half of the 1400s may reflect some of the decision making steps in palace design. The Palazzo
Neroni, built beginning in about 1460, was unfinished when parts of the family were exiled due to their opposition to the Medici; the palace was subsequently finished in a simpler than planned style. The other is the Minerbetti palace, built in 1475 by unifying two medieval structures; its design may reflect a desire to limit construction costs by preserving existing façade stonework.

Early and Middle Renaissance Styles, 1444-1575

The Medici, Strozzi, Pitti, and other landmark Renaissance palaces that stand out today and doubtless stood out when built appeared in 1444, a decade into the Medici Oligarchy period, and drew stylistic inspiration from the transitional rusticated palaces of the late 1300s and early 1400s. But these landmark palaces were not the only stylistic variant to appear during the Medici oligarchy—they were accompanied by palaces that share some stylistic traits but that were much simpler and doubtless much less expensive to build. I have grouped these early and middle Renaissance palaces into four styles: Renaissance rusticated, sgraffito, corner ashlar, and stucco. My sample includes 102 palaces built in these four styles. Compared to the medieval palaces, the palaces of the early and middle Renaissance are much more likely to be situated beyond the 1260 city walls (Figure 12). Contemporary evidence suggests that many of the palaces of the Medici oligarchy period, when these styles appeared, were built with the overt support of the Medici family (including design advice, aid in buying properties, and transfers of ownership between families) (Kent 1987).
Figure 12. Early to middle Renaissance style palaces.

**Renaissance Rusticated Palaces, 1444-1489**

The Palazzo Medici-Riccardi, built beginning in 1444, established the style for a small number of very large and highly visible palaces built in the 1400s\(^2\) in what I have called the Renaissance rusticated style. In place of the simple rusticated ashlars of the transitional rusticated palaces, the Medici palace has three tiers of different types of rustication (Figure 13); other palaces of the style have similarly mixed rustication. The style is also characterized by elaborate cornices, windows, and string course. This extensive stonework would have required far more skilled labor than the comparatively simple details of the earlier palace styles. Many of these carved details incorporate family

\(^2\) The Palazzo Borghese was built in 1437 and may have been roughly similar to the Palazzo Medici-Riccardi, but the palace was massively renovated in 1632 and its original appearance is not documented.
emblems or crests. For example, the upper-floor windows of the Medici palace all incorporate family emblems in addition to the large family coats of arms on the corners of the building. This extensive identification of palace façades marks a change from the simple coats of arms of earlier palace styles. The two-light mullioned windows are also an important element. They are found only on Renaissance rusticated palaces and on a handful of public buildings, most significantly the Palazzo della Signoria, which has been modified since its construction in ways that reduce its symmetry and therefore make it look less like the palace designs it inspired (Trachtenberg 1999). The benches lining the façade are found on several Renaissance rusticated palaces and are almost exclusive to that style, although a small number of stucco and corner ashlar palaces have similar benches. They probably served as outdoor waiting areas for people hoping to become part of the palace owners’ patronage networks. These palaces are also truly vast—note the size of the pedestrians relative to the size of the door of the Medici palace. My sample includes 11 Renaissance rusticated style palaces, all of which have well-documented construction dates. It is also significant that eight of the 11 Renaissance rusticated palaces also have known architects—Filippo Brunelleschi, Giuliano da Maiano, Leon Battista Alberti, Michelozzo di Bartolomeo Michelozzi, Giuliano da Sangallo, and Simone del Pollaiolo (Il Cronaca). The Renaissance rusticated style lasted only from 1444 to 1489.
The massive rough-hewn ground-floor ashlars of the Medici palace are found on seven of 11 Renaissance rusticated style palaces. The other four have smooth ground-floor rusticated ashlars. The best known of these palaces, the Palazzo Rucellai (Figure 14), is also significant for being designed by Leon Battista Alberti. Between 1443 and 1452, Alberti wrote the Renaissance’s first theoretical book on architecture, *De re aedificatoria* (On the Art of Building) (Alberti 1452). Written expressly for connoisseurs as well as architects, the book became something of a cultural touchstone for educated elites when it was printed in 1485 (earlier editions were reproduced by hand), and Lorenzo di Medici is known to have read it (Goldthwaite 1980). The Palazzo Rucellai also highlights several important elements in palace design. First, although the palace is
on a street corner, only the main façade is decorated with rusticated ashlars, while the side street façade is covered by vastly less costly stucco with haphazardly arranged windows (Figure 15). Presumably, Giovanni Rucellai felt that building a costly façade on a 3 meter wide side street was not a good use of money; instead, he commissioned stone façade for the side of his palace facing a small plaza as much as 25 meters across. The Palazzo Rucellai is also interesting for having an incomplete façade. The adjacent property’s owner refused to sell, forcing the builders to end the façade partway through a column of window arches (Figure 16). The façade of the Palazzo Rucellai is also a useful example of how the dramatically increased elaboration of Renaissance rusticated façades compared to transitional rusticated façades allowed for much more advertisement of the builder’s identity. As noted above, coats of arms are found on palace façades beginning in the late 1200s (and possibly earlier). What distinguishes the Renaissance rusticated façades is that family emblems are found on string courses, window arches, and other design elements (for example, the billowing sails on the string course in Figure 16).
Figure 14. Palazzo Rucellai, built starting in 1446.
Figure 15. Palazzo Rucellai, undecorated side street façade.
Lower-Cost Styles, 1446-1575

Only two years after construction started on the Renaissance rusticated Medici palace, a new stylistic variant emerged. This new variant, the sgraffito-covered façade style, was one of three new palace styles that were almost certainly far less expensive to build than the Renaissance rusticated style with its elaborate stone façades. These three
lower cost styles—sgraffito, corner ashlars, and stucco—were built in small numbers during the Medici oligarchy but dominated palace construction after the Medici were expelled in 1494 (my data also suggest no palaces were built between 1494 and Savonarola’s execution in 1498). These lower-cost, less-elaborate palaces were designed by professional architects (especially Simone del Pollaiolo, aka Il Cronaca (1451-1508) and Bartolommeo di Angiolo Baglioni, aka Baccio d'Agnolo (1462-1543)) who were well known in Florence but lacked the international fame of Alberti. An increasing number of these sgraffito, stucco, and corner ashlar palaces were built with four floors, with the top floors open loggia. Although most palaces continued to be built in the urban core, in 1520, the Palazzo Pandolfini was built in what was a semi-rural part of city, the first of what would become a minor trend in palace construction. Perhaps due to the lower cost of these simpler styles, palace construction appears to have surged in the late 1400s and early 1500s (Varchi and Razzi 1721; von Fabriczy 1905), displacing many workshops. Palace construction dropped after 1520 due to political instability and war before resuming in the 1550s after the Medici dukes had solidified their power as hereditary rulers of the city.

These three less elaborate styles have several attributes in common. Their façades are covered almost entirely with stucco, not stone. Stone façade decoration is limited to door and window arches and in one style the corners of buildings. Two-light windows disappeared completely, while ground-floor windows gradually became larger and lower and began to have surrounds with pediments in place of the earlier arched windows. Many of these palaces have small ground-floor windows that were used to sell wine.
Although beyond the scope of my research, interiors also changed in the 1500s. Rooms became smaller and more specialized and contained more furniture. However, rooms still had far fewer contents than would be normal today. An inventory of Giovanni di Bartolommeo Bartolini’s possessions at his death found that his bedroom contained a four-poster bed with a mattress, quilt, bed cover, sheets, and hangings (Ginori Lisci 1985). The bed was surrounded by benches with cushions. The room also contained a day bed on a large chest and two paintings, one in a gold frame. His antechamber (probably the center of his social interactions and the most important room in the house) contained a bed with two mattresses, a quilt, sheets, and a bedcover; various gold and silver leather hangings, a walnut wardrobe, five paintings, a mirror, a box containing coins, two prayer books, a chest containing coins, a gold ring, a cameo, a copper bowl, and 12 antique silver medallions; a box containing a medal depicting Alexander the Great; several glasses; and at least five pieces of majolica pottery. This small inventory would have barely made a dent in the floor space of a room that probably measured at least 40 square meters.

*Sgraffito, 1446-1558*

Sgraffito façades appeared immediately after Renaissance rusticated style appeared. The same year as work began on the Palazzo Rucellai (1446), construction started on the first well-documented sgraffito-covered palace, the Palazzo di Montuauto (Figure 17). Sgraffito is a form of stucco inscribed with designs to produce monochrome decoration. The early version of sgraffito appeared in 1446 but was rare until the 1470s; it disappeared around 1510. The early version of sgraffito is relatively simple, consisting of false architectural detail, including false rusticated ashlar, string courses, and pilasters,
surrounded by floral patterns. The use of sgraffito to mimic rustication is significant, as it makes these palaces similar in appearance to Renaissance Rusticated palaces. The Palazzo di Montuauto façade seems, incidentally, to be similar to the Palazzo Rucellai—compare, for example the sgraffito pilasters and wide, elaborate string courses with the stone analogues on the Palazzo Rucellai. In fact, sgraffito palace façades may have been the model for the Palazzo Rucellai, not vice versa (Forster 1976). My sample includes 13 examples of these early sgraffito façades. A more baroque style with greater emphasis on figures and somewhat less depiction of architectural elements appeared in 1510 and lasted until 1558 (Figure 18). Over the life of the sgraffito style, ground floor windows became larger and extended closer to ground level. My sample includes seven later sgraffito façades. Despite years of exposure to the elements, these sgraffito façades have held up well—my sample includes a very poorly maintained palace that still preserves bits of sgraffito. On other palaces, the sgraffito façades have probably been restored.
Figure 17. Early style sgraffito on Palazzo di Montuauto, built 1446.
Corner Ashlar, 1470-1575

In about 1470, another palace style variant appeared, stucco façades with ashlers only on building corners. My sample includes 25 of these corner ashlar style palaces. The style persisted until approximately 1575, but it was most common during the late republic period. The three earliest examples are poorly dated and include one palace that was not finished for more than 25 years after it was started, and the style was probably very rare until after 1490. These palaces have very severe, simple façades, with rusticated ashlar decoration only around their windows and doors and on the corners of the buildings (Figure 19). These ashlar corners are clearly similar to the corners of the Palazzo Medici façade but without the costly ashlers on the rest of the façade. Like the sgraffito style, the
corner ashlar style appears to be a low-cost alternative style inspired by the key elements of the Renaissance rusticated style.

**Figure 19.** Palazzo Martellini-Rosselini del Turco, a corner ashlar style palace built in approximately 1500.

**Stucco, 1470-1575**

All-stucco façades, with rusticated ashlars only around windows and doors, appeared in about 1475 and lasted until 1575 (Figure 20). My sample includes 46 such palaces, which doubtless represent the least expensive façade treatment in my sample. Largely ignored by architectural historians due to their lack of stylistic details, some of these palaces may have been somewhat more interesting when new, when several were covered with frescoes (Figure 21). One author (Forster 1976) has suggested that stucco façades (including those on my corner ashlar style) would have served as a blank slate
that could be decorated and redecorated quickly and at low cost to meet changing fashions.

Figure 20. All stucco façade of the Palazzo Berti, built approximately 1500.
The year 1520 saw construction of the first two Mannerist palaces to be built in Florence. The style, already popular in Rome, featured new types of elaboration such as balconies, less emphasis on symmetry, and a much greater willingness to experiment. My sample includes 24 Mannerist palaces with façades covered mostly with stucco (a style I refer to as Mannerist stucco) and 7 Mannerist palaces with façades covered with rusticated ashlars (a style I refer to as Mannerist rusticated). Other than the two early exceptions, all of these Mannerist palaces were built after the 1533 foundation of the Medici Duchy, and many were built well out from the city center in what was then undeveloped land (Figure 22). Not surprisingly, the façades of these early ducal era
palaces often have Medici coats of arms and busts of Medici dukes to commemorate families’ ties with the ruling dynasty. The style persisted well into the 1600s. I have included the 31 Mannerist palaces in my data set as a way of capturing the post-republic patterning in palace style and related variables.

Figure 22. Palaces built in the Mannerist style.

The first Mannerist stone façade, the Palazzo Bartolini-Salimbeni, was built beginning in 1520. The niches, mix of window treatments, and columns by the main door all distinguish this palace from the comparatively simple and severe stucco and corner ashlar palaces that were much more popular at the time (Figure 23). The façade features a Latin inscription aimed at critics of the style, “it is easier to criticize than imitate.” Other
Mannerist palaces feature the city’s only Renaissance-era brick façade (Figure 24) and a façade decorated with dozens of busts of famous Florentines (Figure 25). These examples summarize well the style’s lack of consistency—in a very real way, Mannerist palaces are identifiable because they look very different from one another and very different from the earlier styles.
Figure 23. The Mannerist façade of the Palazzo Bartolini-Salimbeni, built starting in 1520.
Figure 24. The Mannerist façade of the Palazzo Grifoni, built in 1563.
The Costs of Construction

The creation of distinct palace styles allowed me to assign rough dates to these structures, including the palaces for which I lacked documented years of construction. These styles also helped me to estimate how much the different palace styles cost to build. Surprisingly for a society of bookkeepers, businessmen, and obsessive personal record keepers, Florentine elites appear to have kept few records on what their palaces cost to build. The most precise, detailed accounting is for the Palazzo Bartolini Salimbeni, built beginning in 1520 by Giovanni Bartolini (Ginori Lisci 1985). Total spending on the palace, not including furniture or architect’s fees, was 38,823 lire (or
approximately 5,546 florins). Of that total, 11,998 lire were spent on masonry (31 percent), 8,044 lire on timber (21 percent), and 12,803 lire (33 percent) were spent on the spectacular and, for the time, unusual Mannerist rusticated façade. Only 1,929 lire, or 5 percent of the total cost, was spent on acquiring land. The remaining 10 percent of construction costs went to metalwork and other expenses. Of the total construction cost, 13,760 lire, or about 35 percent, went to labor expenses.

The Palazzo Bartolini-Salimbeni occupies a 671 square meter footprint and is 21 meters tall, for a total volume of 14,091 cubic meters of built space. The decorated portion of the façade measures 1,071 square meters. Using the construction cost figures detailed above, the palace cost Giovanni Bartolini 3.28 florins for each cubic meter of built space and .893 florins for each square meter of decorated façade. There are three other data points for palace construction costs. The Palazzo Strozzi cost roughly 35,000 florins to build (Goldthwaite 2009), 6.3 times as much as the Palazzo Bartolini-Salimbeni. However the Palazzo Strozzi is much larger, occupying 81,230 cubic meters and having 4,896 square meters of decorated façade. Using the construction figures indicated by the Palazzo Bartolini-Salimbeni accounts yields a total cost for the Palazzo Strozzi of 32,062 florins; a difference of less than 9 percent from the actual cost. I suspect that the 35,000 florin cost of the Palazzo Strozzi may have included the cost to acquire properties that were converted into the plaza immediately east of the palace. Two other extant records of palace construction costs are somewhat less precise. Extensive renovations at the Palazzo Bardi-Busini to turn the existing palace into the sgraffito-style structure visible today cost about 3,700 florins in 1483; the project included construction of an entirely new façade as well as interior renovations (my estimate for the total cost of
the palace is 7369 florins) (Goldthwaite 1980). In the mid 1500s, construction of a stucco façade and associated interior work to merge a newly acquired structure with an existing palace cost the Da Gagliano family 2,200 florins (ibid.). These figures suggest that the costs of building the Palazzo Bartolini-Salimbeni are roughly comparable to the cost of building other palaces.

The figures of 3.28 florins for each cubic meter of built space and .893 florins for each square meter of decorated façade are based on the cost of a palace with an elaborate stone façade. I believe that construction costs would have been much lower for a less elaborate façade. In current construction, stone façades cost two to four times as much as stucco façades. Using this starting point, I ranked the façade styles in terms of the amount of elaborate stone work and assigned a façade cost modification value of .5 for stucco palaces, .6 for mannerist stucco and corner ashlar palaces due to their greater amount of stone work, .7 for sgraffito palaces, .8 for medieval plain palaces, .9 for medieval rusticated and transitional rusticated palaces, and 1 for Renaissance and Mannerist rusticated palaces, the most elaborate styles. These cost modification values are deliberately conservative. My hunch is the range of façade construction costs was actually much broader, but experiments with more widely dispersed variables did not significantly alter the results of palace analysis that I present in chapter 7.

This equation does not consider the difference in the cost of building a palace in an empty lot compared to tearing down existing buildings or compared to merging existing buildings into a larger structure. Bartolini’s accounting suggests the costs of acquiring property for redevelopment were a small portion (5 percent) of the total cost of construction. I have also made no attempt to consider the costs of interior decoration, and
my cost equation therefore assumes that palace interiors of all periods and all styles were equally costly to complete. I also assume that the number of floors did not affect palace construction costs—my calculations assume that buildings of similar heights and volumes but with different numbers of floors were equally costly to build.

I discuss the calculated costs for the palaces in my sample in chapter 7. But the two data points for palace cost discussed above—the 35,000 florin cost of the Palazzo Strozzi and the 5,546 florin cost of the Palazzo Bartolini-Salimbeni—show that these structures were extraordinarily expensive. Unskilled laborers earned about 20 to 40 florins per year, while junior staff in the large banking and merchant businesses earned 12 to 200 florins per year (Goldthwaite 2009). These palaces were also costly even relative to the value of Florentine companies. Filippo Strozzi, builder of the 35,000-florin Palazzo Strozzi, left an estate that included 35,000 florins in investments excluding his palace (ibid.). In 1451, the Medici business conglomerate was worth almost 91,000 florins; my equation estimates that the family’s palace cost about 30,000 florins to build (ibid.).

These costs were not an investment, as palaces lost value dramatically when resold. The Da Gagliano palace sold in 1579 for 5,410 florins, only about 2.5 times the cost of just building the façade and associated interior renovations (ibid.). In 1489, the Alberti were ordered by the Florentine government to transfer a palace to the Corsi family in exchange for forgiveness of an 830 florin debt (Ginori Lisci 1985), far less than the roughly 4,140 florins I calculate the palace to have cost to build. The massive 1400s core of the Palazzo Pitti palace was sold in 1589 to Duke Cosimo I's wife Eleonara di Toledo for about 9,000 florins (ibid.), much less than the roughly 30,000 florins I
estimate it cost to build. They were also poor investments as rental properties, yielding approximately 3 percent of their value per year (Goldthwaite 1972). Significantly, Florentine palaces were rarely designed to be subdivided, unlike contemporary Venetian palaces (Goldthwaite 1980; Wills 2002).
CHAPTER 6. HYPOTHESES

Are palaces costly signals or indices or a form of waste behavior? Answering that question involves the intersection of resource control, palace cost, and reproductive and political success and analyzing how the patterning in those variables relates to the four conditions necessary for costly signaling to persist in a population. Those four conditions can be recast as specific hypotheses that can be tested using the data on palaces, political success, and demographics discussed in the previous chapters. This chapter describes those hypotheses; the hypotheses are then tested in chapters 7 and 8.

First Condition

The first condition necessary for costly signaling to persist is that individuals must vary in underlying and unobservable fitness-related characteristics. As I explained in chapter 2, it is theoretically valid to assume that the specific underlying trait being signaled is not important so long as that trait is beneficial and inheritable and can produce differences in individuals’ ability to obtain and use resources. This analysis follows from Getty’s finding that high-quality individuals are high quality because they are more efficient at obtaining and using resources (time, energy, etc.) more efficiently than low-quality individuals (Getty 2006), and it avoids the difficult process of directly measuring individual quality (Irschick, et al. 2007).

For analytic purposes, I assume that wealth is a valid proxy measure for differential ability to obtain and use resources and that wealth (and therefore resource control) cannot be directly observed. Florentines obviously varied in household wealth. What matters is how household wealth varied across the population. I use a fitted growth
curve of household wealth versus rank of household wealth from the 1427 tax assessment to evaluate the shape of the distribution of differences in wealth. My analysis assumes that the distribution of household wealth in 1427 was representative of the study period as a whole. In other words, I assume that the shape of the wealth distribution did not change over the course of my study period despite constant shifts in the specific identities of the wealthiest households and of the actual cash value of their wealth. It is the shape of this distribution of household wealth that serves as the source of hypotheses regarding the relationship between palace cost and household wealth, which I discuss in detail later in this chapter.

**Second Condition**

The second condition necessary for costly signaling to persist is that information about individuals’ underlying characteristics must be valuable to interaction partners and conveyable via perceptible signals. Given the social and economic importance of wealth in Renaissance Florence, I assume that information on signalers’ control of resources is useful to signal recipients. As costly structures paid for with cash, palaces obviously conveyed information about builders’ wealth. What is more important is the specific nature of variation among palaces in attributes that would convey information about their cost and therefore about the resources needed to build them. I hypothesize that if palaces were costly signals, they will vary dramatically in cost and in the attributes that contribute to cost, especially footprint, height, volume, and decorated façade area. The case for costly signaling will be strengthened if specific stylistic elements appear to convey information beyond information about palace cost. If palaces are indices, they will emphasize information linked only to cost. If palaces are costly signals, then costly
signaling-related stylistic attributes should become more common, while “non-functional” attributes should vary stochastically in frequency (Dunnell 1978; Neiman 1995). For example, particular types of window decoration might show essentially random variation across time. Finally, if palaces are costly signals they will also have considerable stylistic variation within particular periods. If palaces are indices, they will vary in cost but will have comparatively little stylistic variation.

In addition to assuming that palaces are perceptible signals of wealth, I also assume that the costs of palaces were subject to perception error. Most of the palaces in Florence were not side by side, they vary stylistically, and they can be hard to see due to narrow streets, making direct comparisons impossible. Moreover, human beings are poor at judging size visually without a scale, and the error increases as the object’s size increases (Coren, et al. 1979; Teghtsoonian 1971). The total size of individual palaces would be particularly hard to ascertain for palaces not located on corner lots, as their depth from the street would have been impossible to see. This risk of signal perception error leads me to use Johnstone’s error-prone signaling model described in chapter 2 (Johnstone 1994).

**Third Condition**

The third condition necessary for costly signaling to persist is that individuals must have competing interests, such that false signals would benefit the signaler but not the audience. To ensure that signals are honest, signal cost and underlying individual quality must correlate such that high-quality individuals can signal at higher intensity than low-quality individuals. To evaluate this correlation, I determine the cost of individual palaces then use those costs to produce a fitted growth curve of palace cost
versus rank of palace cost. This process brings palace costs into a form consistent with Johnstone’s error-prone signaling model, which assumes a fixed number of discrete and evenly spaced quality levels, signal levels, and perceived advertising levels (Johnstone 1994). For my purposes, signal levels are equivalent to palace costs and quality levels are equivalent to rank of palace cost. This curve for palace costs will be compared to a fitted curve for the distribution of household wealth versus rank of household wealth.

I expect that if palaces were indices, all builders would spend a roughly equal proportion of their wealth on palace construction. If palaces were costly signals, builders should spend much more variable proportions of their wealth on palace construction. In other words, if palaces are an index of wealth, then the fitted growth curve for palace cost versus rank of palace cost should match the beta term for wealth versus rank of wealth. The greater the difference between the beta term for the fitted growth curve for wealth and the fitted growth curve for palaces, the better palaces fit with an interpretation that palaces were costly signals. The smaller the difference between the beta term for the fitted growth curve for wealth versus rank of wealth and the growth curve for palace cost versus rank of palace cost, the better palaces fit with an interpretation that palaces were an index.

To determine the wealth curve, I used the total household wealth data in the 1427 catasto (Herlihy, Klapisch-Zuber, et al. 2002). Household tax assessments fitted comparison of fitted regression curves for household wealth versus rank of household wealth for all 9,780 households in the in 1427 catasto finds that a growth curve relationship has much more explanatory power than a linear relationship: the R square value for a fitted growth curve is .925, compared to an R square value of .151 for a linear
relationship. The shape of the curve is driven by a small number of very wealthy households at the top of the income distribution. That the number of very wealthy households is a small percentage of the total number of households is indicated by the very small beta term (.001) for the growth curve—the curve would be steeper if household wealth were more tightly clustered. I therefore use a growth curve for wealth versus rank of wealth as the baseline instead of a linear relationship.

Of course, the majority of those households were not in any position to build a palace. What is important is the regression of wealth versus rank of wealth for the portion of the population theoretically able to build a palace. As more of the population is removed from the sample, the beta term of the fitted growth curve increases. For the 372 households with more than 5,000 florins in investments in 1427 (Goldthwaite’s very rich), the growth regression equation slope increases to .005 (R-squared .831, significance .000) (Table 5). For the 50 wealthiest households (taxable investments of 19,119 florins or more), the beta term of the projected growth curve increases to .028 (R Squared .767, significance .000) (Table 5, Figure 26). I use this 50 households figure because my palace sample size suggests that roughly 50 palaces were built or massively renovated per generation.

Table 5. Wealth vs. rank of wealth growth curve statistics, 1427 catasto.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Wealth Curve Beta Term</th>
<th>R Square</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>All households</td>
<td>.001</td>
<td>.925</td>
<td>.000</td>
</tr>
<tr>
<td>Wealth greater than 5,000 florins</td>
<td>.005</td>
<td>.831</td>
<td>.000</td>
</tr>
<tr>
<td>Wealthiest 50 households</td>
<td>.028</td>
<td>.767</td>
<td>.000</td>
</tr>
</tbody>
</table>
Figure 26. Wealth vs. rank of wealth, 50 wealthiest households in 1427 catasto.

To repeat, the magnitude of the difference between the beta term or slope of the wealth curve and the beta term or slope of the palace cost curve will indicate the strength of an interpretation that palaces were costly signals or indices. However, in addition to being distinct from the wealth curve, if palaces were costly signals then the curve for palace costs will have several steps or tiers in keeping with the predictions of Johnstone’s error-prone signaling model. In Johnstone’s model, the fitness of signal recipients
depends on their ability to accurately estimate signaler quality from signaler advertisements. Signalers therefore benefit from preventing perception errors by signal recipients. If there is no perception error, the curve of palace cost versus rank of palace cost is essentially roughly linear and smooth such that signal intensity is a continuously increasing function of quality. All signalers signal above zero and all signal slightly more than the next-highest-quality signaler. If error is present, many individuals do not signal at all or signal at the lowest possible level, creating what Johnstone calls an “initial flat.” The advertising level of higher quality individuals increases in a series of steps. The number of steps that can be distinguished decreases as error increases. In addition, the smaller the number of signalers able to advertise above the minimum “initial flat” level, the more strongly they advertise. That prediction differs from the normal prediction of costly signaling theory that the signaling ability of the lowest-quality individual determines the intensity of higher quality individuals’ signals.

To summarize, I will test condition three (the linkage between signal cost and underlying quality) by comparing the beta term or slope of palace cost versus rank of palace cost with the beta term or slope of wealth versus rank of wealth based on the curve for the 50 wealthiest households in the 1427 catasto. This comparison is best understood visually (Figure 27). If palaces were indices, they should have a beta term or slope very similar to the slope for household wealth. This outcome would indicate that all wealthy households spent an equal percentage of their wealth on their palaces. If palaces were costly signals, they should have a beta term or slope very different from the slope for household wealth. If palaces were costly signals they are also likely to have steps or tiers, although a lack of steps will not definitely falsify palaces as costly signals. I use 10
percent differences in adjacently ranked palace costs to identify steps or tiers; Johnstone’s error-prone signaling model suggests that 10 percent perception error is the minimum error rate needed to produce steps or tiers (Johnstone 1994).

**Figure 27. Distribution of indices and costly signals with perception error versus distribution of wealth.**

**Fourth Condition**

The fourth condition for costly signals to persist is that signal audiences must use the information content of signals to modify their behavior in ways that benefit themselves and the signaler. I test the benefits of palaces as costly signals in two ways. First, I evaluate the number of sons who appear in the elections data and compare this figure for palace builders, their relatives, and a control population. The number of sons who appear in the elections data is used as a proxy for overall reproductive success.
Second, I evaluate status as reflected by political success, measured in terms of the number of times drawn for and seated for tre maggiore and guild office. As discussed in the overview of the election process, being drawn for office meant that a man had been chosen by men in his neighborhood as somebody worth having in high government office. Being seated in office meant that these men had been vetted by their political peers and superiors, that they were considered worthy of office, and that they were financially solvent. Of particular importance is how reproductive and political success differs for palace builders relative to their immediate relatives and to the politically active population as a whole, including non-palace builders. If palaces were costly signals, condition four indicates that palace builders should have greater reproductive and political success than other men in my sample. In addition, palace construction should precede any political or reproductive benefits. If palaces are a form of conservative bet hedging, then palace builders should have fewer sons than the rest of the politically active population. Conservative bet hedging will gain additional support if the palaces were more likely to be constructed during periods of large scale and unpredictable environmental variability, especially economic variability. Palace construction should subsequently all but stop during severe downturns.

**Summary of Hypotheses**

To summarize my hypotheses in the simplest possible terms, if palaces were costly signals they should be variable over time and within periods in terms of style and size, have attributes that are costly but have no specific non-decorative function, and should have a curve for cost versus rank of cost that is very distinct from the curve for household wealth versus rank of household wealth and that has several steps or tiers. If
palaces do not have these qualities, it suggests that they were indices, not costly signals. In addition, if palaces were costly signals they should be built by men who subsequently had significantly greater reproductive and political success than their peers. If palace builders had less reproductive success than their peers, it suggests that palaces were a form of conservative bet hedging.
CHAPTER 7. ANALYZING THE PALACE RECORD

For palaces to be costly signals, they must be costly in ways that are consistent with the theory’s predictions. Costliness by itself is not sufficient to rule out alternative hypotheses. Do these palaces differ from overall housing construction in ways consistent with costly signals or other functional but ostensibly wasteful behaviors? Do they vary with each other in ways consistent with costly signaling? In particular, are palaces larger than necessary for housing, are they costly, is their costliness visible, and is the distribution of the costliness of individual palaces more consistent with the growth curve predicted for signals with perception error or with the linear distribution predicted for indices? This chapter evaluates several measures of palace cost, discusses how those costs relate to the predictions of costly signaling theory, and summarizes the findings and their ramifications for the analysis of the data on political and reproductive success. It evaluates palace costs for the both entire sample and for specific periods and styles. This chapter also discusses some possible meanings for the palace styles. In other words, if these palaces were costly signals, what information was being signaled?

As discussed in the previous chapter, my sample includes 206 palaces built between approximately 1280 and 1600 and representing examples of nine specific styles (Table 6).
### Table 6. Counts of palaces by style and period.

<table>
<thead>
<tr>
<th>Style</th>
<th>Pre-Reform Republic</th>
<th>Post-Reform Republic</th>
<th>Medici Oligarchy</th>
<th>Late Republic</th>
<th>Medici Duchy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medieval Plain</td>
<td>19</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Medieval Rusticated</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Transitional Rusticated</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Renaissance Rusticated</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Sgraffito</td>
<td>0</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Corner Ashlars</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>18</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Stucco</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>41</td>
<td>2</td>
<td>46</td>
</tr>
<tr>
<td>Mannerist Stucco</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>Mannerist Rusticated</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Later Styles</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
<td>37</td>
<td>40</td>
<td>73</td>
<td>32</td>
<td>206</td>
</tr>
</tbody>
</table>

**Palaces and the Built Environment**

Although not a strictly necessary component of costly signaling, the theory does suggest that costly signals will be extravagant, particularly at the upper range of signaler quality or signal intensity. Spatial analysis shows that the palaces in this sample are dramatically larger than strictly “necessary” for the needs of housing a family. The palaces in this sample occupy a significant percentage of the built environment of the city. The city walls that were largely complete by 1334 and that stood until the 1800s enclose approximately 4,851,000 square meters of space (Figure 28). Approximately
1,381,000 square meters of that area (28.4 percent) was the Arno River, pastures, orchards, and other undeveloped land. Approximately 787,000 square meters, or 16.2 percent, was occupied by roads and squares. Churches, monasteries, convents, and hospitals and their walled grounds occupied a total footprint (length and width only) of approximately 791,000 square meters, or 16.3 percent of the city. This figure would have been even higher for much of my study period. Many of the convents and monasteries inside the 1334 city walls were founded decades or even centuries before the walls were built, and they controlled large amounts of land. These religious establishments probably represented an even greater percentage of the built environment prior to the second half of the 1400s, when for the first time these organizations were allowed to sell land to private individuals for development (Goldthwaite 1995; Kent 1987). However, at their peak monastic houses housed only a few thousand men and women (Goldthwaite 2009; Strocchia 2009). Small houses, apartment blocks, shops, warehouses, and other mixed-used buildings occupied a footprint of 1,240,000 square meters, or 25.6 percent of the city. In his 1472 *Cronaca fiorentina*, Benedetto Dei (Dei, et al. 1984) said the city had 270 woolen goods shops, 83 silk shops, 66 apothecary shops, 84 woodworker shops, 54 sculptors and stonecutters, 70 butcher's shops, 8 shops of poulterers and sellers of game, 44 goldsmiths, silversmiths, and jewelers shops, 30 shops of workers in gold leaf and silver wire, and 33 banks. These shops are included in that 1,240,000 square meter area.

The 174 Palaces in my sample that were built during the republic have a total footprint of 156,000 square meters, including courtyards but not including gardens. This figure represents 3.2 percent of the total area of the city within the 1334 walls. The majority (113, or 65 percent) of these palaces are within the core of the city, defined here
for analysis purposes as the 1,106,000 square meters enclosed by the 1260 city walls. The footprint of the Republic-era palaces within the 1260 walls total 96,000 square meters, or 8.7 percent of the city’s core.

![Map of the distribution of palaces, religious organizations, and general purpose built space in 1584.](image)

These figures mean that the majority of the city’s roughly 60,000 residents, their stores, and their places of work all occupied 1,240,000 square meters of built space. Assuming that buildings were 3.5 floors high (a ballpark figure arrived at by examining Buonsignori’s map, standing older buildings, and mid-1800s photographs), translates into 4,340,000 square meters of actual floor space. Assuming a population of 60,000 individuals, that figure translates into 72 square meters of floor space per person.
including housing, shops, warehouses, factories, and other non-religious and non-governmental space. The 174 Republic-era palaces in my sample total 156,000 square meters of footprint spread across an average of 3.3 floors and totaling 479,000 square meters of actual floor space. In the 1427 catasto, the average household was 4.4 individuals, although 52.5 percent of the population lived in households of six or more individuals and the wealthiest households tended to be much larger than poorer households, with an average of six residents for the wealthiest (Herlihy and Klapisch-Zuber 1985). Elite households also included servants and slaves, which were not usually included in the catasto. In the mid 1500s, 45 percent of all households included at least one servant (Goldthwaite 2009). It is therefore safe to assume that elite households could have held as many as 10 individuals including servants.

What these figures mean is that palace residents each occupied an average of 275 square meters of floor space. The range is enormous—the residents of the very small Palazzo Benci probably occupied 107 square meters per person (assuming a six-person household in keeping with the structure’s small size), while each resident of the much larger Palazzo Medici rattled around in 883 square meters of space (assuming a 10-person household in keeping with the palace’s huge size). As discussed in the previous chapter, early palaces included shop space, and all palaces probably included warehouse space for family supplies. However, all of this palace shop and warehouse space was exclusively for the family’s use or benefit—I can find no evidence suggesting that palace owners rented out commercial space. The figures are even higher for the ducal period. The 31 ducal-era palaces have a 40,000 square meter footprint, or 1 percent of city, and contain 112,000 square meters of floor space spread across an average of 3.2 floors.
Assuming 10-person households based on evidence of increasing elite household size in the 1500s (Herlihy and Klapisch-Zuber 1985), that translates an average of 394 square meters of floor space per person for residents of ducal-era palaces.

For comparison purposes, cross-cultural samples suggest that individuals occupy an average of 10 square meters of built space per person (Naroll 1962), although that figure is the product of some problematic assumptions (Brown 1987). A 2005 U.S. Energy Information Administration study found that in 2004 the average American house contained 202 square meters of floor space, or 78.5 square meters per person (Berry 2005). In sum, the average Florentine of the Republic era occupied roughly as much space at home, at work, and while shopping (72 square meters) as the average American occupies only while at home. Palace residents, in contrast, occupied an average of 3.5 times as much house floor space as the average American. Arriving at a newly built palace for the first time would probably have been a revelation, particularly after traversing the city’s narrow, crowded streets (Goldthwaite 1972). I discuss variation in palace floor space in greater detail below. The point I wish to make here is that whether costly signals or something else, Florentine palaces were clearly much larger than necessary for purely functional reasons.

The colossal size of these palaces may have had functional components, of course. Contemporary accounts mention that palace space was occasionally used to house troops, weapons, and food stores, including during the Pitti-Medici conflict (Kent 1987). Even the decorative Renaissance palaces therefore had a defensive component despite the lack of towers, crenellations, and other obvious defensive features—their colossal main doors could be closed and barred against intruders, and their stone and brick construction
would have been proof against the torches of angry mobs. The huge size of these palaces may also have reduced the impact of plague on their inhabitants: there is some evidence that the plague spread more easily in crowded housing conditions (Carmichael 1986). Finally, palace construction may have had an unintentional altruistic component. The need for masons and other skilled and unskilled laborers created jobs and prevented elites from freezing hard currency in static storage or in business investments that did not create jobs. However, these potential functional reasons for palace construction do not rule out palaces also operating as costly signals.

**Neighborhood Distribution**

For the most part, the palaces in my sample are evenly distributed among the neighborhoods that served as the first step in the process of political office. For the Pre-Reform Republic period, the count of palaces by sestiere (the neighborhood divisions that existed until 1343) is too high in the Oltrano district (p-value = .027) and too low in the Porta del Duomo district (p-value = .027). However, this variation may be in part because of the size of the districts: Oltrano is by far the largest of the sestiere, and Porta del Duomo is the second-smallest. In addition, small changes in the counts of palaces would bring all six sestiere into the same range.

After 1343 the city was divided into four quarters, each subdivided into four gonfalone. The variation in the number of palaces by quarter does not vary significantly for the post-reform republic period, the Medici oligarchy period, or the late republic period. There are statistically significant variations in the number of palaces by gonfalone, but I am reluctant to give this variation any significance for two reasons. First, gonfalone vary dramatically in size, with the smallest measuring only 44,000 square
meters and the largest measuring 586,000 square meters. The small size of some
gonfalone would have made it difficult for individuals to find lots for sale that were large
enough for a palace. Second, the gonfalone boundaries are poorly documented (Herlihy
and Klapisch-Zuber 1985), and moving these boundaries by just a block in any direction
would dramatically change my counts of palaces per gonfalone.

In sum, therefore, palaces are more or less evenly distributed by neighborhood
within the city. This finding makes sense given the neighborhood roots of the political
system—because offices were more or less evenly distributed by neighborhood, high-
status potential office-holders should also be evenly distributed. The even distribution of
palaces by neighborhood also has implications for builders’ business networks. Padgett
has found a statistically strong relationship between living in the same neighborhood and
partnering for business purposes that crosses social and economic ties (Padgett and
McLean 2003). Machiavelli and others mention the importance of palaces, especially
those with benches, as meeting places for public discussions of politics, etc. (Kent 1987).
Palaces may also have been the center of lineage power. Palaces were usually built in
neighborhoods where extended families already had a significant presence, and palace
builders without prestigious kin built near their in-laws (Kent 1987). This emphasis on
neighborhood probably limited interest in building palaces in the undeveloped areas
toward the city walls (ibid.). Unfortunately, my lack of detailed data on family ownership
of non-palace real estate makes any meaningful analysis of family concentration
impossible.
Ranking Palaces

Palaces were therefore far larger than housing on average. However, to function as costly signals, palaces have to vary in ways that can be observed to allow them to be ranked. It is this ranking that allows observers to judge builders and builders’ resource control. For analytic purposes, I assume that palaces were ranked based on their total size and degree of elaboration, factors I measure using an estimate of their total construction cost.

To understand the costs of building these palaces, it is best to think of them as three dimensional envelopes containing a variable number of floors. Part of the exterior of each envelope is elaborately decorated, part is only finished but not decorated, and part is shared with a neighboring structure. This section discusses how palaces vary in terms of their footprint, height, total volume, number of floors, and amount of decorated façade. For each variable, I evaluate differences for the entire temporal span of my data, for each of the four periods of the Republic era and for the ducal era, and for each of the nine palace styles described in the previous chapter.

Note that the rest of this chapter omits several palaces built during the study period. For one, I have omitted the Palazzo Pitti in its current form. The palace was expanded dramatically beginning in 1558 when the Medici dukes purchased the property to serve as their official residence, and again beginning in 1620. The extent of expansion made the Pitti palace vastly larger than any other palace in Florence: in the late 1500s it was more than three times as large as the next-largest palace. However, this expansion was made using government funds, and the Pitti Palace in its late 1500s form is better thought of as a government building. Indeed, it was connected to the Palazzo della
Signoria by the Uffizi corridor to facilitate its use for state functions. I have also omitted 16 palaces that were so modified after 1600 that I cannot with certainty determine their original style, extent of façade decoration, footprint, height, and other variables.

**Footprint**

The republic era palaces have an average footprint (length and width, but not height) of 845 square meters, with a range of 240 to 3,532 square meters and a standard deviation 569 square meters. Footprint sizes are not normally distributed (Kolmogorov-Smirnov test significance .001), with a long right tail (Figure 29). Footprint varies significantly, but not strongly, by period (Kruskal-Wallis test significance .061)\(^3\) (Figure 30). However, none of the pairwise period-to-period comparisons of footprint are significantly different when using the Games-Howell method\(^4\). Footprint varies significantly by style (Kruskal-Wallis significance .000), and Games-Howell pairwise comparisons show that transitional rusticated style palaces have significantly larger footprints than medieval plain (significance .094) and stucco (significance .079) palaces and that Renaissance rusticated palaces have significantly larger footprints than medieval plain (significance .092) and stucco (significance .085) palaces (Figure 31).

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\(^3\) I use a significance of .1 instead of .05 as a rough cutoff for statistically significant relationships throughout this analysis. Although this threshold is lower than is conventional for hypothesis testing, I feel that using the .1 significance level and reporting actual significance best conveys the variation in the data. I also believe that the .1 level is appropriate given the small sample sizes involved in many of these statistical tests.

\(^4\) My analysis uses the Games-Howell method throughout for pairwise comparisons. The Games-Howell method is analogous to the ANOVA method. However, it can be used with samples of different sizes and variances. In addition, it is considered more likely to find significant differences than the Tamhane’s T2, Dunnett’s T3, and Dunnett’s C methods.
Figure 29. Box plot of republic-era palace footprint (square meters).
Figure 30. Box plot of republic-era palace footprint by period (square meters).
Figure 31. Box plot of republic era palace footprints by style (square meters).

Ducal-era palace footprints vary significantly from palace footprints during the four republic periods (Kruskal-Wallis test significance .004). Games-Howell pairwise comparisons show that ducal era palaces have significantly larger footprints than pre-reform republic palaces (significance .015) and late republic palaces (significance .059). There are also significant difference in footprint by style (Kruskal-Wallis test significance .000), with Games-Howell pairwise comparisons showing that that Mannerist stucco palaces have significantly larger footprints than medieval plain (significance .036), medieval rusticated (significance .087), sgraffito (significance .093), and stucco (significance .017) style palaces.
Number of Floors

Republic-era palaces have an average of 3.3 floors, with a range of 2 to 5 floors and a standard deviation of 0.5. The number of floors is not normally distributed (Kolmogorov-Smirnov test significance .000), probably because number of floors falls in an essentially bimodal distribution, with virtually all palaces having either three or four floors. The number of floors varies significantly by period (Kruskal-Wallis test significance .000), and Games-Howell pairwise comparisons find that pre-reform republic palace have more floors than post-reform republic palaces (significance .001), Medici oligarchy (significance .000) and late republic (significance .000) palaces. Number of floors also varies significantly by style (Kruskal-Wallis test significance .000), with Games-Howell pairwise comparisons finding medieval plain palaces to have significantly more floors than Renaissance rusticated (significance .000), corner ashlar (significance .014), and stucco (significance .030) palaces; medieval rusticated palaces having more floors than Renaissance rusticated palaces (significance .015); and stucco palaces having more floors than Renaissance rusticated palaces (significance .080).

According to architectural historians, three floors was a defining element of what I have called Renaissance rusticated palaces; these figures confirm that these palaces were more likely to be three floors high and that Medieval plain, medieval rusticated, and stucco palaces were more likely to be four floors high. The number of floors for ducal-era palaces falls in the same range as Republic-era palaces, and no specific pairwise comparisons are significant.
Floor Space

Total palace floor space averages 2,781 square meters, with a range of 643 to 12,184 square meters and a standard deviation of 1,853 square meters. As with all these statistics, floor space is not normally distributed (Kolmogorov-Smirnov significance .000). Floor space in square meters does not vary significantly by period during the republic era (Kruskal-Wallis test significance .146). However, it does vary significantly by style (Kruskal-Wallis test significance .001), with Games-Howell pairwise comparisons showing that stucco palaces have significantly less floor space than transitional rusticated (significance .046), Renaissance rusticated (significance .083), and corner ashlar (significance .077) palaces (Figure 32). If ducal-period palaces are included, floor space varies significantly by period (Kruskal-Wallis test significance .015), but a Games-Howell test finds no specific pairwise differences. With ducal era palaces included, floor space still varies significantly by style (Kruskal-Wallis test significance .000), with Games-Howell pairwise comparisons finding that stucco palaces also have significantly less floor space than Mannerist stucco palaces (significance .027).
Figure 32. Box plot of republic-era palace floor space by style (square meters).

**Height**

The height of republic-era palaces averages 19 meters and ranges from 13 to 36 meters, with a standard deviation of 3.6 meters. What is interesting about this figure is that towers were limited by a 1250 law to about 29 meters high, and I intuitively expected palaces to be much closer to that height. Once again, this figure is not normally distributed (Kolmogorov-Smirnov test significance .001). Height varies significantly by period (Kruskal-Wallis significance .005) (Figure 33). Games-Howell pairwise comparisons show that late republic period palaces are significantly shorter than pre-reform republic palaces (significance .030) and post-reform republic palaces (significance
Height also varies significantly by style (Kruskal-Wallis test significance .000) (Figure 34). Games-Howell pairwise comparisons show that sgraffito palaces are significantly shorter than medieval plain (significance .010), medieval rusticated (significance .010), Renaissance rusticated (significance .007), and corner ashlar (significance .041) palaces, while stucco palaces are significantly shorter than medieval plain (significance .019), medieval rusticated (significance .014), Renaissance rusticated (significance .014), and corner ashlar palaces (significance .098).

Figure 33. Box plot of republic-era palace height by period (meters).
Figure 34. Box plot of republic-era palace height by style (meters).

Adding palaces built during the Medici Duchy, height still varies significantly by period (Kruskal-Wallis significance .000), but Games-Howell pairwise comparisons do not find ducal era palaces to be differ significantly in height from palaces built during the Republic periods. Height still varies significantly by style when ducal era palaces are included (Kruskal-Wallis significance .027), and Games-Howell pairwise comparisons show that Mannerist stucco style palaces are significantly shorter than Renaissance rusticated style palaces (significance .038).

The heights of individual floors are probably highly variable at each palace, and I did not analyze this attribute due to the difficulty of determining true floor height from
the exterior. However, the average floor is 5.8 m high. Because of this height, the windows in many palaces are 2 m off the floor and too high to see out of.

**Volume**

Although height and footprint help to understand how large palaces are, palace volume is probably a much better measure of these structures’ true size. Among republic-era palaces, volume averages 16,468 cubic meters, ranges from 4,080 to 81,236 cubic meters with a very high standard deviation of 12,927 cubic meters, and is not normally distributed (Kolmogorov-Smirnov test significance .001). Volume varies significantly by period (Kruskal-Wallis test significance .006), and Games-Howell pairwise comparisons find that pre-reform republic palaces have smaller volumes than Medici oligarchy period palaces (significance .095) (Figure 35). Volume also varies significantly by style (Kruskal-Wallis significance .000) (Figure 36). Games-Howell pairwise comparisons find that transitional rusticated palaces have significantly larger volumes than medieval plain (significance .080), sgraffito (significance .095), and stucco (significance .030) palaces. Renaissance rusticated palaces similarly have much larger volumes than medieval plain (significance .060), sgraffito (significance .060), and stucco (significance .039) palaces.

Adding ducal period palaces, volume still varies significantly by period (Kruskal-Wallis test significance .006), with Games-Howell comparisons showing ducal period palaces to have significantly larger volumes than pre-reform republic palaces (significance .049) and late republic palaces (significance .083). The addition of ducal era palaces also preserves the significant difference in volume (Kruskal-Wallis test significance .000), with Games-Howell pairwise comparisons showing Mannerist stucco places to have significantly larger volumes than stucco palaces (significance .027).
Figure 35. Box plot of republic-era palace volume by period (cubic meters).
Useable Space

Palaces also vary significantly in the number of cubic meters of volume per square meter of floor space. This variable ultimately reflects the height of ceilings—palaces with high ratios of volume to floor space have higher ceilings than palaces with low ratios of volume to floor space. On average, Republic-era palaces have 6.1 cubic meters of volume per square meter of floor space, with a range of 3 to 12 and a standard deviation 1.3; this variable is not normally distributed (Kolmogorov-Smirnov test significance .001). This “inefficiency” variable differs significantly by period (Kruskal-Wallis test significance .001) (Figure 37). Games-Howell pairwise comparisons find that
post-reform republic palaces are significantly less “efficient” than pre-reform palaces (significance .055), and that Medici oligarchy palaces are significantly less “efficient” than pre-reform republic (significance .009) and late republic (significance .074) palaces. Spatial inefficiency also varies significantly by style (Kruskal-Wallis test significance .000) (Figure 38). Games-Howell pairwise comparisons show that transitional rusticated palaces are significantly less “efficient” than medieval plain (significance .081), sgraffito (significance .024), and stucco (significance .065) palaces, and that Renaissance rusticated palaces are significantly less “efficient” than medieval plain (significance .004), medieval rusticated (significance .004), sgraffito (significance .002), corner ashlar (significance .033), and stucco (significance .004) palaces. In other words, transitional rusticated and Renaissance rusticated structures have far fewer square meters of usable floor space per cubic meter of volume than other styles, enough to make the palaces of the post-reform republic and Medici oligarchy periods less efficient in use of space than the pre-reform republic and late republic period palaces. Adding ducal-era palaces does not change these results—while there remains a significant difference in inefficiency by period (Kruskal-Wallis test significance .005) and style (Kruskal-Wallis test significance .000), Games-Howell pairwise comparisons find no significant specific differences in the efficiency of ducal era palaces and the Republic periods or in Mannerist palaces relative to earlier styles.
Figure 37. Box plot of republic-era palace spatial inefficiency by period (cubic meters of volume per square meter of floor space).
Figure 38. Box plot of republic-era palace inefficiency by style (cubic meters of volume per square meter of floor space)

Decorated Façade Area

Palace envelopes—the complete exterior of the structure—average 2,781 square meters and range from 926 to 21,344 square meters with a standard deviation of 2,300 square meters. However, about two-thirds of that envelope on average directly abuts adjacent buildings. The actual portion of republic-era palace façades that are exposed to view averages 972 square meters and ranges from 180 to 5,267 square meters with a standard deviation of 770 square meters; this figure is not normally distributed (Kolmogorov-Smirnov significance .000). Total exposed façade area does not vary significantly by period (Kruskal-Wallis test significance .102) but it does vary by style
Games-Howell pairwise comparisons find that medieval plain palaces have less exposed façade area than Renaissance rusticated palaces (significance .048) and corner ashlar palaces (significance .061). Transitional rusticated palaces have less façade area than renaissance rusticated palaces (significance .092). Sgraffito palaces have less façade area than Renaissance rusticated (significance .035) and corner ashlar palaces (significance .041). Stucco palaces have less façade area than medieval plain (significance .083), medieval rusticated (significance .021), Renaissance rusticated (significance .017), and corner ashlar (significance .000) palaces.

When ducal-era palaces are included, façade area remains significantly different by style (Kruskal-Wallis test significance .000) but not by period (Kruskal-Wallis test significance .111). Games-Howell pairwise comparisons finds that Mannerist rusticated palaces have significantly more façade area than sgraffito (significance .081) and stucco (significance .053) palaces and that Mannerist stucco palaces have significantly more façade area than stucco palaces (significance .007).

In broad terms, these results mean that Renaissance rusticated and corner ashlar palaces were more likely than average to be built on lots with long street exposures, such as corner lots, thereby exposing more of the building envelope to view, while stucco palaces tended to be located on narrow lots and in the middle of blocks.

The more important variable is the portion of those exposed façades that were decorated. On average, republic-era palaces had an average of 730 square meters of decorated façade area, with a range of 158 to 6,515 square meters and a standard deviation 761 square meters, and non-normal distribution (Kolmogorov-Smirnov test significance .000). Decorated façade area varies significantly by period (Kruskal-Wallis
test significance .042) (Figure 39), and Games-Howell pairwise comparisons show that Medici oligarchy palaces have significantly more decorated façade area than late republic palaces (significance .098). Decorated façade area also varies significantly by style (Kruskal-Wallis test significance .000) (Figure 40). Games-Howell pairwise comparisons find a limited number of significant differences, however—stucco palaces have significantly less decorated façade area than medieval plain (significance .040), medieval rusticated (significance .094), and corner ashlar (significance .050) palaces. Surprisingly, Renaissance rusticated palaces do not have significantly more decorated façade area than stucco palaces, probably because of the massive range and small number of Renaissance rusticated palaces.

Figure 39. Box plot of decorated façade area by period (square meters).
Figure 40. Box plot of decorated façade area by style (square meters).

If ducal-era palaces are also considered, decorated façade area still varies significantly by period (Kruskal-Wallis test significance .034) and by style (Kruskal-Wallis test significance .000). Games-Howell pairwise comparisons find that Medici duchy period palaces have more decorated façade area than late republic palaces (significance .085), but the addition of the ducal era collapses all republic periods into the same range, such that Medici oligarchy palaces are no longer statistically distinguishable from late republic palaces. Stylistically, Games-Howell pairwise comparisons of all republic and ducal era palaces finds that only two differences are significant—stucco
palaces have less decorated façade area than Medieval plain (significance .036) and Mannerist rusticated (significance .020) palaces.

**Cost Statistics**

As discussed in the previous chapter, documented costs for palace construction indicate that the actual cost in florins of building any specific palace can be estimated using the following formula:

\[
\text{Cost} = \left( \frac{\text{Volume}}{3.28} \right) + \left( \frac{\text{Decorated Façade Area}}{.893} \right) \times \text{Style Value}.
\]

Style values are .5 for stucco palaces, .6 for mannerist stucco and corner ashlar palaces, .7 for sgraffito palaces, .8 for medieval plain palaces, .9 for medieval rusticated and transitional rusticated palaces, and 1 for Renaissance and Mannerist rusticated palaces. These cost modification values are deliberately conservative. The range of façade construction costs was probably much broader in reality. However, experimenting with other variables (for example, making stucco palace façades one quarter as costly as Renaissance rusticated façades) did not dramatically alter the results discussed below. As discussed in the previous chapter, the costs obtained using this formula are close to actual palace construction costs in the small number of cases where those costs are documented.

The resulting figures have a huge range. The palaces built during the republic era cost an average of 5,650 florins but range from 1,355 florins to 32,062 florins with a standard deviation of 4,613 florins and a non-normal distribution (Kolmogorov-Smirnov test of normality significance .000). The lack of normality is driven in large part by the five high-side outliers, palaces with costs of more than 16,223 florins. These outliers are not surprising—they include the Medici palace, the Strozzi palace, the 15th century core
of the Pitti palace, and two palaces built by men who were very close Medici allies and who married Medici wives.

Republic-era palace costs differ significantly by period (Kruskal-Wallis test significance .041) (Figure 41). Games-Howell pairwise comparisons find that Medici oligarchy palaces are significantly more expensive than late republic palaces (significance .088). Palace costs also vary significantly by style (Kruskal-Wallis test significance .000) (Figure 42). Games-Howell pairwise comparisons indicate that transitional rusticated palaces were significantly more expensive than stucco palaces (significance .026), that Renaissance rusticated palaces were significantly more expensive than medieval plain (significance .072), medieval rusticated (significance .096), sgraffito (significance .064) and stucco (significance .041) palaces, and that corner ashlar palaces were significantly more expensive than stucco palaces (significance .023).

Adding palaces built during the Medici duchy, palace costs still vary significantly by period (Kruskal-Wallis test significance .003); ducal period palaces were more expensive than pre-reform republic (significance .090) and late republic (significance .058) palaces; however, the addition of ducal era palaces also eliminates the significance of the difference between costs for the Medici oligarchy and late republic periods. Palace costs with the ducal era also remain significantly different by style (Kruskal-Wallis test significance .000). Games-Howell pairwise comparisons show that Mannerist stucco palaces are significantly more expensive than stucco palaces (significance .016).
Figure 41. Box plot of republic-era palace cost by period.
Figure 42. Box plot of republic-era palace cost by style.

Cost and Façade Visibility

Intuitively, I expected palaces to be located on high-visibility lots, especially in the case of the larger, fancier, and costlier palaces. Filarete’s *Trattato di Architectura*, written from 1461 to 1464, says the position of the Medici palace at the head of a major street and at the intersection of three streets is one of the structure’s most notable features (Filarete 1965 [1464]). Lindow says visibility was generally considered an important element in palace design (Lindow 2007). However, my data indicate that visibility was not a factor in palace location, no matter how the data were analyzed. For example, linear regressions of palace cost versus street width for all republic-era palaces is statistically
significant (significance .013) but almost entirely lacking in explanatory power, with an R-square value of only .040.

**Costly Signal or Index**

This analysis shows that palaces are indeed costly and that their costliness varies by period and by style. But do palace costs vary in ways consistent with expectations for costly signals, or do palace costs fit better with expectations for indices? As discussed in chapter 6, I expected that if palaces were indices then all builders would spend a roughly equal proportion of their wealth on palace construction. If palaces were costly signals, builders should spend much more variable proportions of their wealth on palace construction. As discussed in chapter 6, I used the shape of the distribution of wealth for the 50 wealthiest households in the 1427 catasto as the baseline for evaluating whether palace costs were more in line with predictions for costly signals or indices. It is worth noting here that the 1427 catasto includes three palace-owning households: one Albizzi household with 17,864 florins in total investments and a palace I estimate to have cost 7,412 florins, one Da Uzzano household with 50,869 florins in total investments and a palace I estimate to have cost 8,735 florins, and one Strozzi household with an absurd 162,906 florins in total investments and a palace I estimate to have cost 5,941 florins. These three households were the 60th, 8th, and 1st most-wealthy households in the 1427 catasto.

If palaces are an index of wealth, then the fitted growth curve for palace cost versus rank of palace cost should match the beta term for wealth versus rank of wealth (.028). The greater the difference between the beta term for the fitted growth curve for wealth and the fitted growth curve for palaces, the better palaces fit with an interpretation
that palaces were costly signals. The smaller the difference between the beta term for the fitted growth curve for wealth versus rank of wealth and the growth curve for palace cost versus rank of palace cost, the better palaces fit with an interpretation that palaces were an index. The key is an indication that expenditures on palaces were not directly tied to wealth. Basically, I am using the slope of the wealth curve as the expected shape of expenditure on palace construction. Where the actual slope of the growth curve for palace construction is above or below that slope it suggests that palace construction expenditure could be modified by individual signalers and not hardwired to wealth.

For the following figures, intercept for fitted growth curve and wealth growth curve are the same such that the lowest-ranked palace in each case sets the baseline for both curves. The Y axis (cost) is the same in all graphs to maximize comparability.

Note that the following analysis are not changed by using log of wealth and log of palace cost—the beta term in the growth curve equation becomes the slope of a linear regression equation. The beta term of any particular growth curve equation for the non-transformed data is exactly the same as the slope for any particular linear regression equation. Moreover, the relative x-y plots remain the same, just not curved. I have chosen to display these results using growth curves in part to maximize the ease of interpreting the cost values. Because palace costs have been calculated, albeit roughly, in actual units of real-world currency, I wanted to emphasize actual values instead of log transformed values.

For all 189 analyzable palaces in the data set, the beta term of the growth curve for palace cost vs. rank of palace cost is .012 (R Square for growth .963, significance .000). The beta term is steeper for only republic-era palaces, at .014 (R Square .957,
significance .000) (Figure 43). Those results combine more than 300 years of palace construction and nine palace styles. Comparisons of the wealth and palace cost slopes by period and by style are more analytically relevant and considerably more interesting.

Figure 43. Palace cost vs. rank of palace cost, all republic-era palaces.

**Index or Costly Signal by Period**

Comparing the growth curves for palace cost versus rank of palace cost against growth curves for wealth versus rank of wealth produces very different results for different periods (Table 7). These figures suggest that the cost of Medici oligarchy period palaces are most different from predicted distribution of costs for an index, while the cost of late republic period palaces best fits with the index prediction.
Table 7. Palace cost vs. rank of palace cost growth curve statistics by period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Palace Cost Beta Term</th>
<th>Difference from Wealth Beta Term</th>
<th>Rank of Difference</th>
<th>R Square, Palace Cost Growth Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>All palaces</td>
<td>.012</td>
<td>.014</td>
<td>n/a</td>
<td>.963</td>
</tr>
<tr>
<td>Pre-Reform</td>
<td>.078</td>
<td>.050</td>
<td>2</td>
<td>.886</td>
</tr>
<tr>
<td>Post-Reform</td>
<td>.054</td>
<td>.026</td>
<td>4</td>
<td>.978</td>
</tr>
<tr>
<td>Oligarchy</td>
<td>.082</td>
<td>.054</td>
<td>1</td>
<td>.940</td>
</tr>
<tr>
<td>Late Republic</td>
<td>.031</td>
<td>.003</td>
<td>5</td>
<td>.969</td>
</tr>
<tr>
<td>Duchy</td>
<td>.067</td>
<td>.039</td>
<td>3</td>
<td>.934</td>
</tr>
</tbody>
</table>

During the pre-reform republic period, proportional palace expenditures exceeded expected expenditures based on wealth by the second-greatest extent of the five periods, although graphic presentation suggests the degree of difference may be much smaller if only the less-costly pre-reform republic palaces are considered (Figure 44). This patterning suggests palaces built during the pre-reform republic period are a better fit with a costly signaling interpretation.
Figure 44. Palace cost vs. rank of palace cost, pre-reform republic-period.

During the post-reform republic period, palace cost versus rank of palace cost has the second-smallest degree of difference from the wealth curve (Figure 45). This patterning suggests palaces built during the post-reform republic period are a better fit with an interpretation that palaces were indices.
The costs of palaces constructed during the Medici Oligarchy period have the greatest difference from the predictions of the wealth curve, a difference that is preserved when presented graphically (Figure 46). This patterning suggests palaces built during the Medici Oligarchy period are a very good fit with an interpretation that they were costly signals. The four costliest palaces were built by individuals who were exceptionally wealthy and enmeshed in behind the scenes power struggles: Cosimo de’ Medici, the period’s de facto ruler; Filippo Strozzi, who was exiled in 1434 at the return to Florence of Cosimo de’ Medici but who was allowed to return in 1466, Luca Pitti, who was
Cosimo’s right-hand-man in the 1450s and early 1460s; and the Tornabuoni family, which was allied to the Medici through marriage ties.

Figure 46. Palace cost vs. rank of palace cost, Medici oligarchy period.

Palaces built during the late republic period palaces fit very closely with the wealth curve both in numeric terms and graphically (Figure 47). This patterning strongly suggests that palaces built during the late republic were indices, not costly signals. The two most costly palaces of the period were built by the Da Gagliano family, which left almost no documentary trace, and by Giovanni Francesco Ridolfi, a member of a very large lineage that had first served in tre maggiore office in 1287.
Figure 47. Palace cost vs. rank of palace cost, late republic-period.

Palaces built during the Medici Duchy fall somewhere in the middle, both numerically and graphically (Figure 48).
In sum, palaces built during the Medici oligarchy period look most like costly signals, not indices. Palaces built during the late republic period look most like indices and least like costly signals. The cost of palaces built during the Medici oligarchy diverge most from the distribution predicted by the wealth curve in part because of the small number of very high-profile palaces built during the period—the extremely large, elaborate, and costly Medici, Strozzi, and Pitti palaces. But the divergence is driven also by the cluster of palaces in the middle of the period’s palace cost distribution. The late republic period is dominated by comparatively small, simple, and less-costly palaces that are all tightly clustered in cost with the exception of two very high outlier values. The
cost distribution of palaces built in the other periods fall in between the extremes of the Medici oligarchy and late republic periods, making interpretation of costly signal versus index more ambiguous.

**Index or Costly Signal by Style**

A comparison of palace costs and the wealth curve also finds dramatic differences when evaluated by palace style (Table 8), although the small numbers of palaces in each individual style mean that some of these comparisons are dramatically skewed by exceptionally high-cost palaces. The limited utility shows clearly when presented graphically (Figure 49, Figure 50, Figure 51, Figure 52, Figure 53, Figure 54, Figure 55, Figure 56, Figure 57). However, two points can be made from the data on the distribution of palace costs by style. The first point is that several of these styles show noticeable steps or tiers in their cost distributions. In some cases these steps are an artifact of small numbers of palaces, as is definitely the case for Mannerist rusticated palaces (Figure 56). A small sample size may also be driving the appearance of a stepped or tiered distribution for Renaissance rusticated palaces, but the small sample size does not change the fact that the gaps in palace costs for the style are quite large (Figure 52). Steps or tiers are also visible in palace styles with larger sample sizes, for example in the case of the sgraffito (Figure 53) and corner ashlar styles (Figure 54). I discuss these steps or tiers in greater detail below to explain how palace construction period and style combine to produce steps or tiers similar to the predictions of Johnstone’s error-prone signaling model.
Table 8. Palace cost vs. rank of palace cost growth curve statistics by style.

<table>
<thead>
<tr>
<th>Style</th>
<th>Palace Cost Beta Term</th>
<th>Difference from Wealth Beta Term</th>
<th>Rank of Difference</th>
<th>R Square, Palace Cost Growth Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medieval Plain</td>
<td>.054</td>
<td>.026</td>
<td>2</td>
<td>.928</td>
</tr>
<tr>
<td>Medieval Rusticated</td>
<td>.132</td>
<td>.104</td>
<td>6</td>
<td>.978</td>
</tr>
<tr>
<td>Transitional Rusticated</td>
<td>.150</td>
<td>.122</td>
<td>7</td>
<td>.916</td>
</tr>
<tr>
<td>Renaissance Rusticated</td>
<td>.202</td>
<td>.174</td>
<td>8</td>
<td>.905</td>
</tr>
<tr>
<td>Sgraffito</td>
<td>.086</td>
<td>.058</td>
<td>4</td>
<td>.934</td>
</tr>
<tr>
<td>Corner Ashlars</td>
<td>.082</td>
<td>.054</td>
<td>3</td>
<td>.973</td>
</tr>
<tr>
<td>Stucco</td>
<td>.036</td>
<td>.008</td>
<td>1</td>
<td>.979</td>
</tr>
<tr>
<td>Mannerist Rusticated</td>
<td>.309</td>
<td>.281</td>
<td>9</td>
<td>.874</td>
</tr>
<tr>
<td>Mannerist Stucco</td>
<td>.089</td>
<td>.061</td>
<td>5</td>
<td>.932</td>
</tr>
</tbody>
</table>

The second point that these figures make clear is that there is a strong consistency between styles that individually look more like costly signals and the strength of a costly signal interpretation for the periods during which those styles were dominant. For example, all Renaissance rusticated style palaces in my data were built during the Medici oligarchy period, the period whose palaces are most consistent with expectations for costly signals. Renaissance rusticated style palaces have the second-greatest difference between their cost growth curve beta term and the wealth growth curve beta term, suggesting that Renaissance rusticated style palaces are more consistent with costly signals (Figure 52). The situation is similar for the late republic period. Nearly all the
stucco style palaces were built during the late republic, the period when palaces were most consistent with an index interpretation, and stucco style palaces by themselves have the smallest difference between the growth curve beta term for their costs and the growth curve beta term for the wealth distribution, suggesting that they are in line with expectations for indices (Figure 55). In other words, the dominant style in each period is responsible for much of the strength of a costly signaling or index interpretation for palace costs for each period.

![Cost vs. Rank of Cost](Figure 49. Palace cost vs. rank of palace cost, medieval plain style.)
Figure 50. Palace cost vs. rank of palace cost, medieval rusticated style.
Figure 51. Palace cost vs. rank of palace cost, transitional rusticated style.
Figure 52. Palace cost vs. rank of palace cost, Renaissance rusticated style.
Figure 53. Palace cost vs. rank of palace cost, sgraffito style.
Figure 54. Palace cost vs. rank of palace cost, corner ashlar style.
Figure 55. Palace cost vs. rank of palace cost, stucco style.
Figure 56. Palace cost vs. rank of palace cost, Mannerist rusticated style.
Figure 57. Palace cost vs. rank of palace cost, Mannerist stucco style.

Signal Perception Error by Period

The divergence of palace cost from wealth is not the only way to evaluate whether palaces are more consistent with an interpretation that they are costly signals or indices. As discussed in the hypotheses chapter, palace size and cost (and thus relative signal intensity) are probably easily misinterpreted by observers, and this signal perception error means that palaces should fit better with models of signaling with error than with models that do not account for error. I predict that if palaces were costly signals, palace cost versus rank of cost should show steps or tiers in keeping with Johnstone’s error-prone
signaling model (Johnstone 1994). This section analyzes palaces by period and style to evaluate whether these steps are apparent.

For each period, I look at the data in three ways. First, I assume that a difference of more than 10 percent in the cost of a palace from the next-most-expensive palace indicates a significant break. I used 10 percent differences as breaks because Johnstone’s model suggests that 10 percent perception error is the minimum error rate needed to produce steps or tiers. I then compare graphic plots of palace cost versus rank of palace cost to see if those steps indicated by 10 percent cost increases are apparent. Finally, I compare plots of palace cost versus rank of palace cost to see if those same steps are readily apparent when the cost scale of the plot is on a logarithmic scale under the assumption that error rates may be a log-scale phenomenon (Teghtsoonian 1971). I also look at the position in each cost distribution of different palace styles to evaluate how style contributes to overall patterning in palace costs by period.

There are two caveats that should be kept in mind regarding the following analysis. The first is that Johnstone’s model discusses “initial flats” where low-quality signalers do not signal at all or signal at an extremely low level because perception error makes it impossible for them to signal intensely enough for their signals to be perceived at all. I assume that the “initial flat” in my data is non-palace housing. This data is obviously missing from my sample. If plotted, these non-palaces would be a long “initial flat” that ends where my figures begin.

This issue of missing data raises another caveat: the breaks in the distributions below that I interpret as steps may actually represent missing data—palaces destroyed or massively modified since they were built. My response is that it is unlikely that a few
palaces in fairly narrow cost ranges would be missing. What is more likely is that I am missing palaces at the low end of the cost distributions. Most of the palaces that I initially recorded in the field then later removed from the sample because of uncertainty about their ages were comparatively small and were mostly stucco style palaces probably built during the late republic period.

**Pre-Reform Republic Period**

Examination of the costs of the 24 pre-reform republic period palaces finds jumps of more than 10 percent in palace costs between 5,300 florins and 6,700 florins and between 7,800 florins and 9,900 florins. These two steps are clear in a plot of palace cost versus rank of palace cost (Figure 58) and in a plot of log of palace cost versus rank of palace cost (Figure 59). Below 5,300 florins, palace costs increase in a roughly continuous distribution. The presence of these steps or tiers reinforces the finding of the comparison of palace costs versus wealth distribution that pre-reform republic period palaces are more consistent with the expectations for costly signals than for indices. Stylistic variation appears to have little significance—medieval rusticated style palaces are mixed more or less randomly among the medieval plain style palaces.
Figure 58. Palace cost vs. rank of palace cost, pre-reform republic period.
Examination of the costs of the 36 post-reform republic period palaces finds no jumps of more than 10 percent in palace costs. Although apparent steps are visible in a plot of palace cost versus rank of palace cost (Figure 60) and in a plot of log of palace cost versus rank of palace cost (Figure 61), these steps are less than 10 percent. The lack of steps or tiers reinforces the finding of the comparison of palace costs versus wealth distribution that post-reform republic period palaces are more consistent with the expectations for indices than for costly signals. Stylistically, transitional rusticated
palaces dominate the high end of the cost distribution, but they are not unique to the high end.

Figure 60. Palace cost vs. rank of palace cost, post-reform republic period.
Figure 61. Log of palace cost vs. rank of palace cost, post-reform republic period.

**Medici Oligarchy Period**

Examination of the costs of the 32 Medici oligarchy period palaces finds jumps of more than 10 percent in palace costs between 5,000 florins and 7,000 florins and between 10,900 and 18,500 florins; the four palaces over 18,500 florins include the landmark Pitti, Strozzi, and Medici palaces. These steps are obvious in a plot of palace cost versus rank of palace cost (Figure 62) and in a plot of log of palace cost versus rank of palace cost (Figure 63). Below step 1 and between steps 1 and 2, palace costs increase in a roughly continuous distribution. The presence of these steps or tiers reinforces the finding of the comparison of palace costs versus wealth distribution that Medici oligarchy period
palaces are more consistent with the expectations for costly signals than for indices. Stylistic variation is not surprising at the very high end—the high-cost examples are all Renaissance rusticated style palaces—but it is probably significant that the Renaissance rusticated style is basically absent from the first step and that stucco and sgraffito style palaces are absent and rare, respectively, in the second step. This pattern confirms my earlier interpretation of the sgraffito style as a low-cost alternative to the Renaissance rusticated style.

**Figure 62. Palace cost vs. rank of palace cost, Medici oligarchy period.**
Late Republic

Examination of the costs of the 69 late republic period palaces finds jumps of more than 10 percent in palace costs to occur between 11,800 and 16,200 florins; only two palaces cost more than 16,200 florins and both are among the complete data set’s outlier values. The late republic period therefore basically lacks steps in palace cost. This lack of steps is clear in a plot of palace cost versus rank of palace cost (Figure 64) and in a plot of log of palace cost versus rank of palace cost (Figure 65). Below 11,800 florins, palace costs increase in a roughly continuous distribution. This near-lack of steps or tiers is consistent with the interpretation that late republic palaces are a better fit with an
interpretation that they were indices, not costly signals. Stucco style palaces dominate the low end of the cost distribution, while corner ashlar palaces dominate the high end. In contrast to its position during the Medici oligarchy period, the sgraffito style is scattered throughout the cost distribution.

Figure 64. Palace cost vs. rank of palace cost, late republic period.
Figure 65. Log scale of palace cost vs. rank of palace cost, late republic period.

Medici Duchy

Examination of the costs of the 28 Medici Duchy palaces finds jumps of more than 10 percent in palace costs between 3,200 florins and 3,900 florins and between 11,000 florins and 15,000 florins. These steps are evident in a plot of palace cost versus rank of palace cost (Figure 66) and in a plot of log of palace cost versus rank of palace cost (Figure 67). Between these two steps palace costs increase steadily. The earlier comparison of palace costs versus wealth distribution found the Ducal period to be in the middle of the ranking of index or costly signal by period, and that ambiguous interpretation is continued here. Stylistic variation by cost is interesting mostly for the
distribution of Mannerist stucco palaces throughout the ranking, a pattern that probably reflects how much actual stylistic diversity I compressed into the Mannerist stucco style.

Figure 66. Palace cost vs. rank of palace cost, Medici duchy period.
Where none of these distributions of palace costs by period fit with Johnstone’s predictions is at the high end. Johnstone’s model predicts that signal intensity or cost will flatten out. I expected the same pattern in the palace data because of diminishing returns with increasing signal cost. I think the reason that costs do not flatten out is partly the effects of very high levels of perception error at the top end, roughly in keeping with Johnstone’s model of the effects of scale in compounding perception error. I also suspect that the individuals who built the most expensive palaces may have been competing on two levels. In addition to signaling to other Florentines in competition for power within the city, the Medici, Strozzi, Pitti, and other builders of very high-cost palaces were

Figure 67. Log scale of palace cost vs. rank of palace cost, Medici duchy period.
probably signaling to top-level elites in other states as part of their efforts to become powerful in international terms by assuming control of the city. Although the Strozzi and Pitti challenged the Medici at various times, the Medici ultimately won this content to become the unquestionably dominant family in 1533, when the family was named hereditary rulers of Florence and Caterina de’ Medici was married to the second son of the king of France, a far more prestigious marriage partner than the son of any Florentine lineage.

**Costly Signaling or Bet Hedging?**

The question of whether palaces were part of a conservative bet-hedging strategy will be addressed in detail in the next chapter, which covers variation in the reproductive and political success of palace builders relative to other subsets of the Florentine population. However, one part of the conservative bet hedging or “waste” model can be evaluated here. The model suggests that palaces should first appear during periods of large scale and unpredictable environmental variation. Palace construction should subsequently be more common when productivity is relatively high then all but stop during downturns in resource availability. Converted into the basically capitalist Florentine society, this should mean more palace construction during economic booms and less construction during economic busts. Separately, information is not part of the conservative bet hedging model. If palace styles convey information, it suggests that palaces were involved in costly signaling, a conclusion that would gain support if stylistic change correlates in time with societal changes that alter the signaling environment. However, the presence or absence of information content in palaces does not rule out bet hedging or waste, which do not involve information transfer.
The earliest extant palaces date to the very early years of the republic or possibly a decade or two before. The late 1200s were arguably unpredictable in political terms, but the political triumph of guild forces over the aristocracy represents the culmination of decades of increasing importance of merchants in Florentine politics. The early years of the republic are therefore best seen as the final stabilization of a shift from noble to merchant government, not as a period of large-scale environmental variation. The origins of Florentine palace building are therefore ambiguous on the question of costly signaling vs. bet hedging. Moreover, the entire history of the Florentine republic can be seen as unpredictable in economic and political terms. If palaces are a form of bet hedging, after their original appearance they should be most common during periods of stability in preparation for periods of instability. My data show that palace construction was much more common during the politically unstable but economically stable late republic period than during all other periods, including the politically and socially stable and economically dynamic Medici oligarchy (Table 9). The rate of late republic palace construction is even greater when considering the complete lapse in palace construction between 1494 and 1498, the period of Savonarola’s dominance of the city. For the remaining years of the late republic period, 2.1 palaces were built per year. This patterning is therefore ambiguous with regard to conservative bet hedging or waste in that palace construction rates cannot be directly tied to broad changes in resource availability—should I assign greater importance to the economic maturity of the late republic period or to the fact that palace construction continued even in the economic and demographic wake of the plague years in the mid 1300s?
Table 9. Count of palaces by period and per year.

<table>
<thead>
<tr>
<th>Build Period</th>
<th>Date Range</th>
<th>N</th>
<th>N per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Republic</td>
<td>1280-1433</td>
<td>61</td>
<td>0.4</td>
</tr>
<tr>
<td>Medici Oligarchy</td>
<td>1434-1493</td>
<td>41</td>
<td>0.7</td>
</tr>
<tr>
<td>Late Republic</td>
<td>1494-1532</td>
<td>72</td>
<td>1.9</td>
</tr>
<tr>
<td>Medici Duchy</td>
<td>1533-1600</td>
<td>32</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>206</td>
<td></td>
<td>0.6</td>
</tr>
</tbody>
</table>

The presence of stylistic elements on palace façades that clearly convey information does not rule out palaces as elements in conservative bet hedging, but it does provide additional support for palaces operating as costly signals. Style can be a very effective way of conveying information, especially when applied to high-visibility artifacts such as building façades and especially when the message is simple and easily understood (Wobst 1977). Several archaeologists have suggested that the style of elite goods, especially monumental architecture, is particularly useful for conveying messages related to ideology (DeMarrais, et al. 1996) and for obtaining support from craft specialists who provide products for elite markets (Baines, et al. 1998). Early Florentine palaces do not convey much obvious information, ideological or otherwise, save for their coats of arms identifying their owners. But Medici oligarchy and late republic period palaces can be interpreted as conveying messages about republican political ideology. Many Renaissance rusticated palaces have mullioned windows that are not found on any other palace styles of palace. Where those windows are found is on the Palazzo della Signoria, the city’s hall of government, the Bargello (the republic’s prison), and on the state-owned granary-turned church of Orsanmichele. Mullioned windows appear first on the Medici palace, which was built a decade after the family had assumed de facto control.
of the city. The sgraffito style palaces that appeared immediately after the Renaissance rusticated style do not have mullioned windows, but they do emulate in stucco the latter style’s massive rusticated ashlar façades. So where the Renaissance rusticated palaces evoke architectural landmarks of republican government, the Sgraffito palaces evoke their larger, costlier Renaissance rusticated neighbors and possibly a tenuous link to the republican architectural brand.

Palaces’ stylistic elements may have information content that is not obvious to modern observers. For example, the Pazzi palace may have been deliberately designed to show anti-Medicean tendencies. The round windows on main Pazzi façade are unusual in Florentine domestic architecture, but they do appear on the Pazzi Chapel and the Palazzo di Parte Guelfa, a "symbol of the city's mercantile oligarchy and traditional alliance with the papacy, [that] had been left unfinished, deprived of funding and attention as a result of Medicean politics" (Andres, et al. 1988). The palaces of the early Duchy are much more transparent in their meaning. Many are decorated with Medici coats of arms, busts of Medici Dukes, and other elements that are clearly intended to demonstrate allegiance with the ruling family.

Summing Up—Are Palaces Costly Signals?

The analysis of the palace record suggests that the palaces built during the pre-reform republic and Medici oligarchy periods are very consistent with expectations for costly signaling. The palaces of the pre-reform republic period are the second-best fit with expectations for costly signaling based on the difference between the distribution of palace costs and the distribution of wealth. Pre-reform republic palaces also have two of the steps or tiers in palace cost that I expected due to the likelihood of signal perception.
error. The early years of the republic were a boom time for merchants and the period of sorting out what, exactly, the republic meant, a process that included a continuation of the armed factional strife that plagued the decades prior to the establishment of guild government. The main elements of these early palaces’ styles—the incorporation of defensive elements and their multiple ground-floor storefront and warehouse doors—encapsulate the tension between the bad old days of noble conflict and the business-oriented present, a tension that manifested most clearly in the republic’s marginalization of the nobility.

The Medici oligarchy period has the best fit with expectations for costly signaling based on the difference between the distribution of palace costs and the distribution of wealth. The period’s five palace styles include the most and least costly styles in my sample, and the differences in the cost of those different styles break the period’s palaces into two steps or tiers. The oligarchy was a period of economic opportunity, with high wages even for the poor. With the poorest consumers able to afford costly consumer goods, costly signaling theory suggests elites would have increased their spending on palaces as the highest-end signals in order to distinguish themselves from the poor and middle classes. The result was that the highest-end signalers—especially the Medici, Strozzi, and Pitti—would have built their vast and colossally expensive Renaissance rusticated palaces to distinguish themselves from the merely wealthy who built the period’s sgraffito, stucco, and corner ashlar style palaces.

The post-reform republic period and late republic period fit better with the expectations for indices. The post-reform republic period has the fourth-worst fit with expectations for costly signals based on the comparison of palace cost and wealth. No
steps or tiers are visible in the distribution of palace costs. Election data suggests that the period was very open socially and politically, in part because of reforms made after the Ciompi revolt and societal adjustments required by the demographic effects of the plague. The cost of the period’s palaces fits with that sociopolitical context, although the appearance of the transitional rusticated style did set the groundwork for the Medici palace and other Renaissance rusticated style palaces.

The late republic period was the worst fit with the expectations for palaces as costly signals based on the comparison of palace costs and the growth curve for wealth. Although one step or tier is visible in the data, it is at the very high end of palace costs and includes only two palaces. The late republic was politically unstable but economically mature, with increased concentration of wealth in a smaller number of families and less opportunity for new families to become wealthy. It was also a period of increasing efforts by elite families to concentrate wealth in a smaller number of offspring, a subject I discuss in detail in the conclusion chapter. The period’s elites also began to abandon direct roles in business. In this context, palaces appear to have lost their role as signals and instead became an index of wealth.

The analysis of palaces built during the early decades of the Medici Duchy is ambiguous—the distribution of palace costs relative to the wealth curve can be interpreted as consistent with costly signals or indices. Two steps are present in the distribution of palace costs, but one is at the very low end and one at the very high end. This ambiguous patterning may reflect the small sample size. As noted previously, my sample of ducal-era palaces biases recognized landmark structures and includes no palaces observed during survey. However, the mixed results may also reflect a mix of
elite reactions to the increasing aristocratization of the formerly merchant elite that began
during the late republic period but that became truly entrenched during the duchy.
CHAPTER 8. ANALYZING THE PALACE BUILDERS

For palaces to be costly signals, they should benefit their builders in ways that result in improved fitness. My analysis of palace builders and their families uses data extracted from the Florentine elections data to evaluate political and reproductive success. Reproductive success is obviously linked to individual fitness. Political success is linked to fitness for two reasons. First, individuals who appeared in the elections data had already acquired some measure of status among their peers, who had elected for those individuals to move into the pool of potential government office-holders. This status could have been translated into improved resource control and the ability to provision themselves and their offspring with the benefits of greater resource control. My sample of palace builders includes 94 individuals identified by contemporary documents or architectural historians’ research as being the builders of palaces between the late 1200s and 1600. Those 94 individuals built a total of 86 palaces (a small number of palaces were built by brothers and one was built by two brothers and their uncle). Eight of those 94 individuals built palaces during the Medici Duchy and therefore have no trace in the elections data. My sample also includes 25 individuals who purchased a total of existing palaces (including six men who were active only during the Duchy).

I then used the election records to find palace builders’ and palace buyers’ fathers, who were identified on the assumption that builders’ and buyers’ second names followed patronymic conventions. Note that my discussion of fathers in the following analysis collapses the fathers of palace builders and palace buyers. Builders’ and buyers’ brothers, sons, grandsons, and great-grandsons were identified following the same logic. Builders’
and buyers’ first sons were assumed to be the inheritors of their fathers’ palaces. Inheritance of a palace by the eldest son may not have been immediate—there may have been a period when siblings negotiated the eventual buyout of shares in a palace by the oldest son. However, the general pattern in Florence was for the first-born son to eventually buy his brothers’ shares in their fathers’ palaces. I was able to confirm inheritance by the first-born son in about a third of the cases using documentary records. Where first sons died young, second sons were assumed to be their fathers’ inheritors. Younger sons were classified as “descendants” to distinguish them from likely inheritors.

The control group is all individuals in the election database from the Rucellai family. The extraction of elections records for individuals was extremely time-consuming and could not be automated. Producing a list of all individuals, their probable birth dates, their election results, and their known male offspring would have taken thousands of hours. The Rucellai family was selected as the control because it was a large family that survived the Renaissance, included wealthy, middling, and poor households, and was politically active but not active enough to be exiled or executed. The resulting control group has 302 individuals. The control group includes 12 individuals for whom year of birth or years of political or reproductive activity could not be determined. Some individuals in the control group also appear in the lists of builders, inheritors, fathers, and descendants. This choice was deliberate—most of the city’s largest lineages included a small number of palace builders, and I thought the control group should reflect the complete spectrum of individuals who participated in politics. Note that my data only includes individuals who appeared in election records. It does not include women or illegitimate male offspring (unless they were given their fathers’ name as a patronymic).
My demographic data includes a total of 905 individuals (Table 10). The data includes 14 individuals who built or bought palaces during the Medici Duchy. These 14 men cannot be analyzed due to a lack of information on their political careers, offspring, and other events resulting from the end of elections record-keeping with the Ducal-era cessation of republican government. The remaining 891 individuals who were politically active during the republic are analyzed below for the entire republic era and for the same four republic periods as were used for analysis of the palace record. Individuals are grouped into periods based on the years when they were first politically and reproductively active, not when they were born. So, for example, individuals born in 1404 are included in the Medici oligarchy period, as they would have been old enough to hold office in 1434. If one of these individuals survived beyond 1494, the end of the Medici Oligarchy period, their late-life career will still be included in the analysis of the Medici Oligarchy period.
Table 10. Counts of individuals in the demographic data.

<table>
<thead>
<tr>
<th>Period and Person Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Reform Republic</strong></td>
<td>24</td>
</tr>
<tr>
<td>Builder</td>
<td>5</td>
</tr>
<tr>
<td>Father</td>
<td>4</td>
</tr>
<tr>
<td>Inheritor</td>
<td>3</td>
</tr>
<tr>
<td>Descendant</td>
<td>5</td>
</tr>
<tr>
<td>Control</td>
<td>7</td>
</tr>
<tr>
<td><strong>Post-Reform Republic</strong></td>
<td>142</td>
</tr>
<tr>
<td>Builder</td>
<td>17</td>
</tr>
<tr>
<td>Brother</td>
<td>17</td>
</tr>
<tr>
<td>Father</td>
<td>28</td>
</tr>
<tr>
<td>Inheritor</td>
<td>15</td>
</tr>
<tr>
<td>Descendant</td>
<td>12</td>
</tr>
<tr>
<td>Control</td>
<td>53</td>
</tr>
<tr>
<td><strong>Medici Oligarchy</strong></td>
<td>393</td>
</tr>
<tr>
<td>Builder</td>
<td>39</td>
</tr>
<tr>
<td>Buyer</td>
<td>9</td>
</tr>
<tr>
<td>Brother</td>
<td>82</td>
</tr>
<tr>
<td>Father</td>
<td>39</td>
</tr>
<tr>
<td>Inheritor</td>
<td>38</td>
</tr>
<tr>
<td>Descendant</td>
<td>56</td>
</tr>
<tr>
<td>Control</td>
<td>130</td>
</tr>
<tr>
<td><strong>Late Republic</strong></td>
<td>320</td>
</tr>
<tr>
<td>Builder</td>
<td>25</td>
</tr>
<tr>
<td>Buyer</td>
<td>10</td>
</tr>
<tr>
<td>Brother</td>
<td>38</td>
</tr>
<tr>
<td>Father</td>
<td>5</td>
</tr>
<tr>
<td>Inheritor</td>
<td>52</td>
</tr>
<tr>
<td>Descendant</td>
<td>00</td>
</tr>
<tr>
<td>Control</td>
<td>100</td>
</tr>
<tr>
<td><strong>Duchy</strong></td>
<td>14</td>
</tr>
<tr>
<td>Builder</td>
<td>8</td>
</tr>
<tr>
<td>Buyer</td>
<td>6</td>
</tr>
<tr>
<td><strong>Active Period Unclear</strong></td>
<td>12</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>905</td>
</tr>
</tbody>
</table>
Reproductive Success

Evolutionary models such as costly signaling and bet hedging often use reproductive success to measure the benefits of a trait or behavior, especially when applied to non-human organisms. The following analysis is able to evaluate the reproductive success for a significant subset of the Florentine population during the republic. However, the data have several limitations: they include only males who had their fathers’ first name as a patronymic and who appeared in the election records, whether in birth records, guild election records, or tre maggiore election records. This analysis therefore omits several groups: females, males who were never part of the electoral process, males who only appeared in election records in the years for which the records are missing or were not coded by Herlihy (Herlihy, Litchfield, et al. 2002), and males whose names did not follow normal naming conventions, a group that probably includes unrecognized illegitimate sons. The data also do not include sons who died when very young unless those sons’ births were registered for electoral purposes.

Age at First Son

Average age at the birth of a first son averages 33.4 years and despite small differences does not vary significantly by type of person for the entire republic era (Kruskal-Wallis test significance .663) (Table 11; Figure 68). Palace builders had their first sons at the same age at their fathers, brothers, descendants, and the control group. Average age at first son also does not vary across types of individuals for specific periods of the republic area (Kruskal-Wallis test significance ranges from .420 to .731).

It appears than on average, the men in my sample had their first sons at unusually early ages. Herlihy and Klapisch-Zuber report that their data, especially the 1427 catasto,
indicate an average male age at first birth of 40.2 years, with a standard deviation of 10.15 years (Herlihy and Klapisch-Zuber 1985). They also note that wealthy men tended to be slightly but not significantly older than average at first birth. The men in my data had their first sons an average of 6.8 years younger than the men in the Herlihy and Klapisch-Zuber sample.

Table 11. Average age at first son.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Age at First Son</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>35.7</td>
</tr>
<tr>
<td>Buyer</td>
<td>32.1</td>
</tr>
<tr>
<td>Brother</td>
<td>34.1</td>
</tr>
<tr>
<td>Father</td>
<td>32.3</td>
</tr>
<tr>
<td>Inheritor</td>
<td>32.5</td>
</tr>
<tr>
<td>Descendant</td>
<td>33.7</td>
</tr>
<tr>
<td>Control</td>
<td>33.1</td>
</tr>
<tr>
<td>Average</td>
<td>33.4</td>
</tr>
</tbody>
</table>
Age at Last Son

For the entire republic era, the age at birth of last son averages 40.9 years and varies significantly by type of person (Kruskal-Wallis test significance .012) (Table 12; Figure 69). However, Games-Howell pairwise comparison finds only one significant difference—palace builders have a later last son than inheritors (significance .005). The average for all groups is well below when males would have lost fertility, at least in modern populations: a review of research on male fertility, mostly in the United States, found a significant drop after age 50 (Kidd, et al. 2001). This difference in age at last son disappears when analyzed by period—no type of individuals has a statistically significant
later age at last son than any other (Kruskal-Wallis test significance ranges from .060 to .873).

Table 12. Average age at last son.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Age at Last Son</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>44.8</td>
</tr>
<tr>
<td>Buyer</td>
<td>36.6</td>
</tr>
<tr>
<td>Brother</td>
<td>41.5</td>
</tr>
<tr>
<td>Father</td>
<td>41.8</td>
</tr>
<tr>
<td>Inheritor</td>
<td>37.7</td>
</tr>
<tr>
<td>Descendant</td>
<td>40.5</td>
</tr>
<tr>
<td>Control</td>
<td>40.0</td>
</tr>
<tr>
<td>Average</td>
<td>40.9</td>
</tr>
</tbody>
</table>
Figure 69. Boxplot of age at birth of last son.

Number of Reproductive Years

The number of years between first known son and last known son is an indicator of the total reproductive success of the parents. For the entire republic era, the number of years between the first and last known son averages 8.3 years and varies significantly by type of person (Kruskal-Wallis test significance .001) (Table 13; Figure 70). Games-Howell pairwise comparisons find that builders have significantly longer ranges between first and last son than inheritors (significance .047) and that fathers have longer periods of reproduction than inheritors (significance .003). Analysis of the number of years between first and last son by period finds no significant variation in the pre-reform
republic period (Kruskal-Wallis test significance .878) or in the post-reform republic period (Kruskal-Wallis test significance .421). However, there is a significant difference during the Medici oligarchy period (Kruskal-Wallis test significance .015), where a Games-Howell pairwise comparison found only one significant pairwise difference—fathers have longer reproductive life than inheritors (significance .020). There is also a significant difference in the number of years between first and last son during the late republic period (Kruskal-Wallis test significance .017), but pairwise comparisons are not possible due to the limitations of the late republic elections data (fathers and descendants have too few cases to allow for comparisons).
Table 13. Average number of years between first and last son.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Number of Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>10.6</td>
</tr>
<tr>
<td>Builder</td>
<td>10.1</td>
</tr>
<tr>
<td>Brother</td>
<td>8.4</td>
</tr>
<tr>
<td>Descendant</td>
<td>7.8</td>
</tr>
<tr>
<td>Control</td>
<td>7.2</td>
</tr>
<tr>
<td>Inheritor</td>
<td>6.3</td>
</tr>
<tr>
<td>Buyer</td>
<td>5.5</td>
</tr>
<tr>
<td>Average</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Figure 70. Boxplot of number of years between birth of first and last known son.
**Number of Sons**

The variable most likely to correspond to total reproductive success is the number of known sons. The average number of known sons varies significantly by type of person (Kruskal-Wallis test significance .000) (Table 14; Figure 71). Games-Howell pairwise comparisons show that palace builders have significantly more sons than brothers (significance .013), descendants (significance .000), and the control group (significance .000). Builders’ brothers have fewer sons than builders (significance .013) and fathers (significance .000) but more sons than builders’ descendants (significance .005). Palace buyers have fewer sons than fathers (significance .043). Non-inheriting descendants have fewer known sons than brothers (significance .005), builders (significance .000), fathers (significance .000), inheritors (significance .000), and the control group (significance .026). Fathers have more sons than brothers (significance .000), buyers (significance .043), descendants (significance .000), inheritors (significance .002), and the control group (significance .000).

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Sons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>3.0</td>
</tr>
<tr>
<td>Builder</td>
<td>2.5</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2.1</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.7</td>
</tr>
<tr>
<td>Brother</td>
<td>1.4</td>
</tr>
<tr>
<td>Control</td>
<td>1.2</td>
</tr>
<tr>
<td>Descendant</td>
<td>0.7</td>
</tr>
<tr>
<td>Average</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Figure 71. Boxplot of number of known sons.

Virtually all of the palace builders and buyers in my sample had sons. Only 11 of the 105 republic-era palace builders and palace buyers in my sample had no identifiable sons. Of those 11 men, two were bishops. It is likely, although not certain, that those 11 men were unmarried. Herlihy and Klapisch-Zuber calculate that about 4.5 percent of men age 50 or older were probably permanent bachelors, and approximately 12 percent of all Florentine men never married (Herlihy and Klapisch-Zuber 1985). In my sample, 10.5 percent of palace builders and buyers had no known sons and may have been permanent bachelors, a figure roughly in keeping with Herlihy and Klapisch-Zuber’s findings.
The variation in my data may reflect differences in wealth. In the early 1400s, wealthy women had an average of three children while poor women had an average of two, in part because of the apparently high cost of raising children in the city (Herlihy and Klapisch-Zuber 1985). In general, sons were far more common than daughters (suspiciously so) (ibid.). However, assuming parents had a roughly equal number of sons and daughters, the palace builders, palace builders’ fathers, and palace builders’ inheritors in my sample had extremely large families by Florentine standards. Cross-checks of men in my sample who also appeared in the 1427 catasto also allowed me to evaluate whether the number of offspring correlated with wealth. Herlihy and Klapisch-Zuber (1985) found that each child required about 750 florins of investment to support, suggesting that there was a roughly linear relationship between wealth and number of children. Herlihy and Klapisch-Zuber suggested that this relationship broke down for extremely large families and extremely wealthy families, and that appears to be the case with the men in my sample, where the relationship between wealth and number of offspring is weak (p-value for linear regression of wealth vs. children = .540). My sample is all drawn from wealthiest roughly 15 percent of the population, and I suspect that my sample falls into the portion of the population wealthy enough to have much lower per-child incremental costs.

Of course, my data only reflect sons whose names appeared in elections records. It is entirely possible that, for example, the control group had as many sons as palace builders but that they did not enter political life. The available data give me no way to determine whether individuals in my data are missing sons except for men who were alive and old enough to have families in the 1427 catasto, which contains detailed
demographic data. Cross-checks of counts of sons from the elections data with counts of sons from the catasto found that none of my counts of sons are high and that only a small proportion (approximately 15 percent) had one son listed in the catasto who was not listed in the elections data. It is likely that many of these “missing” sons died too young to appear in the elections data.

The numbers of known sons varies considerably within each period. During the pre-reform republic period, the number of known sons varies significantly by type of person (Kruskal-Wallis test significance .021) (Table 15). Games-Howell pairwise comparisons show only that fathers have more sons on average than descendants (significance .011). The differences are partly the result of the small sample size for the period—for example, there are only six descendants in my sample during this period.

**Table 15. Average number of known sons, pre-reform republic period.**

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Sons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.7</td>
</tr>
<tr>
<td>Builder</td>
<td>2.3</td>
</tr>
<tr>
<td>Father</td>
<td>2.3</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2</td>
</tr>
<tr>
<td>Descendant</td>
<td>0</td>
</tr>
<tr>
<td>Average</td>
<td>1.8</td>
</tr>
</tbody>
</table>

The number of known sons also varies significantly for the post-reform republic period (Kruskal-Wallis test significance .000) (Table 16). Games-Howell pairwise comparisons show that fathers have more sons on average than brothers (significance .017), descendants (significance .014), and the control group (significance .006).
Table 16. Average number of known sons, post-reform republic period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Sons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>3.1</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2.7</td>
</tr>
<tr>
<td>Builder</td>
<td>2.5</td>
</tr>
<tr>
<td>Control</td>
<td>1.6</td>
</tr>
<tr>
<td>Brother</td>
<td>1.3</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.2</td>
</tr>
<tr>
<td>Average</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The range of pairwise differences in numbers of known sons increases during the Medici oligarchy period. Again, the number of known sons varies significantly by type of person (Kruskal-Wallis test significance .000) (Table 17). Games-Howell pairwise comparisons show that fathers have more sons on average than brothers (significance .000), descendants (significance .000), inheritors (significance .017), and the control group (significance .000). Palace builders have more sons than descendants (significance .005) and the control group (significance .009). Inheritors have more sons than descendants (significance .047).

Table 17. Average number of known sons, Medici oligarchy period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Sons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>3.2</td>
</tr>
<tr>
<td>Builder</td>
<td>2.6</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2.0</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.8</td>
</tr>
<tr>
<td>Brother</td>
<td>1.6</td>
</tr>
<tr>
<td>Control</td>
<td>1.1</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.0</td>
</tr>
<tr>
<td>Average</td>
<td>1.7</td>
</tr>
</tbody>
</table>
The number of known sons continues to vary significantly by type of person during the late republic period (Kruskal-Wallis test significance .000) (Table 18). Games-Howell pairwise comparisons show only that descendants have fewer sons than builders (significance .028) and inheritors (significance .000) and that inheritors have more sons than the control group (significance .005) and descendants (significance .000). Note that fathers and buyers are omitted because they have too few cases for Games-Howell comparisons. Also note that the small numbers of sons in the late republic period is the result of data truncated by the end of elections, not by a societal drop in fertility.

Table 18. Average number of known sons, late republic period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Sons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>2.3</td>
</tr>
<tr>
<td>Inheritor</td>
<td>1.9</td>
</tr>
<tr>
<td>Brother</td>
<td>1.0</td>
</tr>
<tr>
<td>Buyer</td>
<td>1</td>
</tr>
<tr>
<td>Father</td>
<td>1</td>
</tr>
<tr>
<td>Control</td>
<td>0.6</td>
</tr>
<tr>
<td>Descendant</td>
<td>0.3</td>
</tr>
<tr>
<td>Average</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**Summary of Reproductive Success**

In broad terms, palace builders and their fathers have a slightly longer reproductive life and more sons than the overall population. Palace-builders inheritors had a larger number of sons than average although an average reproductive lifespan. Because of variations in the data from period to period, it is better to compare the relative fitness of different types of individuals within period than to compare across periods. What can be compared across periods is the degree of the difference between builders’,
fathers’, and inheritors’ reproductive success and the rest of the population (Table 19; pre-reform republic period is omitted due to the small sample size). Overall, palace builders’ reproductive success relative to the control group and to the overall average increases dramatically over time. Fathers’ reproductive success is even greater than their sons’ and increases dramatically between the post-reform republic period and the Medici oligarchy period; the figures for fathers in the late republic period are based on a very small sample of fathers and are of limited accuracy. Palace builders’ inheritors saw a sharp increase in reproductive success in the late republic period.

The data suggest that palace builders’ fathers and their grandfathers had phenotypic qualities (and possibly underlying genetic qualities) that produced sons with very high fitness. This high level of fitness suggests considerable parental investment—individuals’ number of offspring can be highly variable for genetic and phenotypic reasons and because of variations in early life experience (Voland 1998), and research has found that individual life expectancy at birth determines most of the variation in age at first birth across cultures (Low 2000). The data further suggest that this level of investment increased over time. In the case of palace builders, keep in mind that age at palace construction and age at last sons’ birth are statistically indistinguishable. This suggests that palace construction may have been a component in parental investment. Inheritors’ reproductive success improved dramatically between the Medici oligarchy and late republic periods, possibly due to this parental investment and because of changes in elite marriage and inheritance patterns: during the late republic, elite families married off fewer daughters and began giving the bulk of their estates to their eldest sons in place of
the earlier pattern of partible inheritance. These changes will be discussed in greater
detail in the conclusion.

Table 19. Difference from average reproductive success by period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Post-Reform Republic</th>
<th>Medici Oligarchy</th>
<th>Late Republic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>149%</td>
<td>187%</td>
<td>111%</td>
</tr>
<tr>
<td>Builder</td>
<td>121%</td>
<td>151%</td>
<td>249%</td>
</tr>
<tr>
<td>Buyer</td>
<td>n/a</td>
<td>106%</td>
<td>111%</td>
</tr>
<tr>
<td>Brother</td>
<td>63%</td>
<td>96%</td>
<td>111%</td>
</tr>
<tr>
<td>Inheritor</td>
<td>129%</td>
<td>117%</td>
<td>213%</td>
</tr>
<tr>
<td>Descendant</td>
<td>57%</td>
<td>59%</td>
<td>32%</td>
</tr>
<tr>
<td>Control</td>
<td>78%</td>
<td>67%</td>
<td>69%</td>
</tr>
</tbody>
</table>

Political Success

The number of times individuals were drawn for guild and government positions and the number of times they were elected to those positions are indicators of those individuals’ social connectedness and their status. These election data are therefore a measure of individual viability that is at least partly independent of pure wealth.

Total Number of Draws

The average number of draws for guild and tre maggiore office varies significantly by type of person for the republic era as a whole (Kruskal-Wallis test significance .000) (Table 20; Figure 72). Games-Howell pairwise comparisons show that builders were drawn more times than descendants (significance .001) and the control population (significance .001). Fathers were drawn more often than brothers (significance .002), buyers (significance .011), descendants (significance .000), and the control
population (significance .000). Inheritors were drawn more often than descendants (significance .001) and the control population (significance .001).

**Table 20. Average number of draws.**

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>10.4</td>
</tr>
<tr>
<td>Builder</td>
<td>7.4</td>
</tr>
<tr>
<td>Inheritor</td>
<td>7.1</td>
</tr>
<tr>
<td>Brother</td>
<td>5.7</td>
</tr>
<tr>
<td>Buyer</td>
<td>4.6</td>
</tr>
<tr>
<td>Descendant</td>
<td>3.8</td>
</tr>
<tr>
<td>Control</td>
<td>3.3</td>
</tr>
<tr>
<td>Average</td>
<td>5.3</td>
</tr>
</tbody>
</table>
When analyzed by period, number of seats does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .829). The number of draws does vary significantly during the post-reform republic period (Kruskal-Wallis test significance .001). Games-Howell pairwise comparisons find only that builders were drawn more often than the control group (significance .008).

The number of draws also varies significantly during the Medici oligarchy period (Kruskal-Wallis test significance .000) (Table 21). Games-Howell pairwise comparisons find that builders were drawn more often than the control group (significance .003). Fathers were drawn more than brothers (significance .009), descendants (significance .009), and sisters (significance .001).

**Figure 72. Boxplot of number of election draws.**
.000), and the control group (significance .000). Brothers were drawn more often than the control group (significance .004). Inheritors were drawn more often than descendants (significance .006) and the control group (significance .000). The number of draws varies significantly during the late republic period (Kruskal-Wallis test significance .000) (Table 22). However, Games-Howell pairwise comparisons find only that inheritors were drawn more often than descendants (significance .011) and the control group (significance .000). Note that the small numbers for seats during the late republic period are due to the end of elections at the period’s close.
Table 21. Average number of draws, Medici oligarchy period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>11.6</td>
</tr>
<tr>
<td>Inheritor</td>
<td>9.8</td>
</tr>
<tr>
<td>Buyer</td>
<td>8.3</td>
</tr>
<tr>
<td>Builder</td>
<td>7.2</td>
</tr>
<tr>
<td>Brother</td>
<td>6.8</td>
</tr>
<tr>
<td>Descendant</td>
<td>5.5</td>
</tr>
<tr>
<td>Control</td>
<td>3.7</td>
</tr>
<tr>
<td>Average</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Table 22. Average number of draws, late republic period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>3.8</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2.9</td>
</tr>
<tr>
<td>Brother</td>
<td>2.3</td>
</tr>
<tr>
<td>Father</td>
<td>2.2</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.2</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.5</td>
</tr>
<tr>
<td>Control</td>
<td>0.9</td>
</tr>
<tr>
<td>Average</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Total Number of Seats

The total number of times that individuals were seated for all guild and tre maggiore offices varies significantly for the entire republic era (Kruskal-Wallis test significance .000) (Table 23; Figure 73). Games-Howell pairwise comparisons show that builders were seated more times than brothers (significance .012), descendants (significance .000), and the control group (significance .000). Fathers were seated more times than brothers (significance .000), buyers (significance .002), inheritors
(significance .026), descendants (significance .000), and the control group (significance .000). Inheritors were seated more times than the control group (significance .000) and descendants (significance .001). Brothers were seated more times than the control group (significance .016).

Table 23. Average number of seats.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>5.2</td>
</tr>
<tr>
<td>Builder</td>
<td>3.7</td>
</tr>
<tr>
<td>Inheritor</td>
<td>3.0</td>
</tr>
<tr>
<td>Brother</td>
<td>2.0</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.7</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.4</td>
</tr>
<tr>
<td>Control</td>
<td>1.1</td>
</tr>
<tr>
<td>Average</td>
<td>2.1</td>
</tr>
</tbody>
</table>
When analyzed period by period, the number of seats does not vary significantly by type of person during the pre-reform republic period (Kruskal-Wallis test significance .793). It varies significantly during the post-reform republic period (Kruskal-Wallis test significance .001), but a Games-Howell pairwise comparison show only that builders had significantly more seats than the control group (.002). Number of seats also varies significantly during the Medici oligarchy period (Kruskal-Wallis test significance .000) (Table 24). Games-Howell pairwise comparisons show that builders had significantly more seats than descendants (significance .040) and the control group (significance .000). Brothers had more seats than the control group (significance .005). Fathers had more
seats than brothers (significance .002), descendants (significance .000), and the control group (significance .000). Inheritors had more seats than descendants (significance .015) and the control group (significance .000). Significant differences continue during the late republic period (Kruskal-Wallis test significance .000) (Table 25). Games-Howell pairwise comparisons show that builders had significantly more seats than control (.027) and that inheritors had significantly more seats than control (.000) and descendants (.005).

Table 24. Average number of seats, Medici oligarchy period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>5.2</td>
</tr>
<tr>
<td>Inheritor</td>
<td>3.7</td>
</tr>
<tr>
<td>Builder</td>
<td>3.4</td>
</tr>
<tr>
<td>Buyer</td>
<td>3.0</td>
</tr>
<tr>
<td>Brother</td>
<td>2.2</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.7</td>
</tr>
<tr>
<td>Control</td>
<td>0.8</td>
</tr>
<tr>
<td>Average</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Table 25. Average number of seats, late republic period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>2.3</td>
</tr>
<tr>
<td>Inheritor</td>
<td>1.6</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.2</td>
</tr>
<tr>
<td>Brother</td>
<td>0.9</td>
</tr>
<tr>
<td>Descendant</td>
<td>0.4</td>
</tr>
<tr>
<td>Father</td>
<td>0.3</td>
</tr>
<tr>
<td>Control</td>
<td>0.2</td>
</tr>
<tr>
<td>Average</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Number of Tre Maggiore Draws

Evaluation for and election to government offices carried much more prestige than guild offices, which were responsible only for guild policy. Moreover, the tre maggiore data are more complete than the guild data. The number of draws only for tre maggiore offices varies significantly for the entire republic era (Kruskal-Wallis test significance .000) (Table 26; Figure 74). Games-Howell pairwise comparisons show that builders were drawn for tre maggiore positions more often than brothers (significance .043), descendants (significance .000), and the control group (significance .000). Fathers were drawn more often than brothers (significance .013), descendants (significance .000), and the control group (significance .000). Inheritors were drawn more often than descendants (significance .000) and the control group (significance .000). Brothers were drawn more than the control group (significance .001).

Table 26. Average number of tre maggiore draws.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>6.5</td>
</tr>
<tr>
<td>Builder</td>
<td>5.9</td>
</tr>
<tr>
<td>Inheritor</td>
<td>5.3</td>
</tr>
<tr>
<td>Buyer</td>
<td>4.9</td>
</tr>
<tr>
<td>Brother</td>
<td>4.0</td>
</tr>
<tr>
<td>Descendant</td>
<td>2.7</td>
</tr>
<tr>
<td>Control</td>
<td>2.3</td>
</tr>
<tr>
<td>Average</td>
<td>3.7</td>
</tr>
</tbody>
</table>
Figure 74. Boxplot of number of tre maggiore draws.

The number of draws for tre maggiore offices does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .909). It does vary significantly for the post reform republic period (Kruskal-Wallis test significance .003), with a Games-Howell pairwise comparison finding that builders were drawn more often than the control group (significance .025).

The number of significant differences increases during the later periods. The number of draws varies significantly for the Medici oligarchy period (Kruskal-Wallis test significance .000), during which period Games-Howell pairwise comparisons find that builders were drawn more often than the control group (significance .014), brothers were
drawn more often than the control group (significance .004), fathers were drawn more often than descendants (significance .006) and the control group (significance .000), and inheritors were drawn more than the control group (significance .000) and descendants (significance .007). Significant variation in the number of tre maggiore draws continues in the late republic period (Kruskal-Wallis test significance .000). Games-Howell pairwise comparisons find that builders were drawn more often than the control group (significance .002) and descendants (significance .008), while inheritors were drawn more often than descendants (significance .002) and the control group (significance .000).

**Number of Tre Maggiore Seats**

If being drawn and “seen” for tre maggiore offices indicated a certain level of status, being evaluated for and elected to, or seated in, office translated into much more status and actual power. The number of times individuals were seated for tre maggiore office varies significantly by type of individual for the republic era (Kruskal-Wallis test significance .000) (Table 27; Figure 75). Games-Howell pairwise comparisons show that palace builders were seated more often than brothers (significance .000), descendants (significance .000), and the control group (significance .000). Fathers were seated more often than brothers (significance .003), descendants (significance .000), and the control group (significance .000). Inheritors were seated more often than brothers (significance .044), descendants (significance .000), and the control group (significance .000). Brothers were seated more than the control group (significance .007).
Table 27. Average number of seats to tre maggiore offices.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Number of Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>3.2</td>
</tr>
<tr>
<td>Father</td>
<td>3.1</td>
</tr>
<tr>
<td>Inheritor</td>
<td>2.4</td>
</tr>
<tr>
<td>Buyer</td>
<td>2.1</td>
</tr>
<tr>
<td>Brother</td>
<td>1.5</td>
</tr>
<tr>
<td>Descendant</td>
<td>1.0</td>
</tr>
<tr>
<td>Control</td>
<td>0.7</td>
</tr>
<tr>
<td>Average</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Figure 75. Boxplot of number of tre maggiore seats.
The number of seats to tre maggiore offices does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .856). The number of seats does vary significantly during the post-reform republic period (Kruskal-Wallis test significance .001), a period for which a Games-Howell comparison finds only that palace builders were seated more often than the control group (significance .008).

The number of seats varies significantly during the Medici oligarchy period (Kruskal-Wallis test significance .000), and the scope of significant differences increases. Builders were seated more often than the control group (significance .000), brothers were seated more often than the control group (significance .001), fathers were seated more often than the control group (significance .000) and descendants (significance .009), inheritors were seated more often than the control group (significance .000), and descendants were seated more often than the control group (significance .033). The number of tre maggiore seats also varies significantly during the late republic period (The number of seats varies significantly during the Medici Oligarchy period (Kruskal-Wallis test significance .000). Games-Howell pairwise comparisons show that builders had more tre maggiore seats than descendants (significance .014) and the control group (significance .006). Inheritors had more seats than descendants (significance .001) and the control group (significance .000).

Percentage of Tre Maggiore Draws Resulting in Seat

Individuals in my sample varied significantly in their win rate for tre maggiore offices, calculated as the number of seats divided by the number of draws (Kruskal-Wallis test significance .000) (Table 28). For the republic era as a whole, Games-Howell pairwise comparisons find that palace builders had a higher win rate than brothers
(significance .000), descendants (significance .000), and the control group (significance .000). Fathers had a higher win rate than brothers ((significance .049), descendants (significance .013), and the control group (significance .000). Inheritors had a higher win rate than brothers (significance .018), descendants (significance .003), and the control group (significance .000).

Table 28. Average percentage of draws resulting in seat, tre maggiore offices.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Average Percent Won</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>53.1%</td>
</tr>
<tr>
<td>Father</td>
<td>47.5%</td>
</tr>
<tr>
<td>Inheritor</td>
<td>47.3%</td>
</tr>
<tr>
<td>Buyer</td>
<td>39.4%</td>
</tr>
<tr>
<td>Brother</td>
<td>31.8%</td>
</tr>
<tr>
<td>Descendant</td>
<td>29.3%</td>
</tr>
<tr>
<td>Control</td>
<td>24.3%</td>
</tr>
<tr>
<td>Average</td>
<td>35.3%</td>
</tr>
</tbody>
</table>

Percentage of tre maggiore draws resulting in a seat does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .889) or the post-reform republic period (Kruskal-Wallis test significance .184). It does vary significantly during the Medici oligarchy period (Kruskal-Wallis test significance .000), when Games-Howell pairwise comparisons find that palace builders had a higher win rate than the control group (significance .000), that fathers had a higher win rate than the control group (significance .001), and that inheritors had a higher win rate than the control group (significance .004). The win rate also varies significantly during the late republic period (Kruskal Wallis test significance .001), although a Games-Howell pairwise comparison finds only that inheritors had a higher win rate than descendants (significance .006) and the control group (significance .015).
Age at First and Last Office

The age at which Florentines in my sample first held office (including both guild and tre maggiore office) does not vary significantly for the entire republic era (Kruskal-Wallis test significance .073) or for any specific period (Table 29). On average, Florentines first held office six years after becoming eligible for office on their thirtieth birthdays.

Table 29. Average age at first office.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Age at First Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>37.5</td>
</tr>
<tr>
<td>Father</td>
<td>36.7</td>
</tr>
<tr>
<td>Buyer</td>
<td>36.3</td>
</tr>
<tr>
<td>Brother</td>
<td>36.6</td>
</tr>
<tr>
<td>Inheritor</td>
<td>36.1</td>
</tr>
<tr>
<td>Control</td>
<td>35.2</td>
</tr>
<tr>
<td>Descendant</td>
<td>34.7</td>
</tr>
<tr>
<td>Average</td>
<td>36.1</td>
</tr>
</tbody>
</table>

The age at which individuals held their last office varies significantly for the republic era (Kruskal-Wallis test significance .000) (Table 30; Figure 76). Builders were significantly older at their last seat than brothers (significance .013), buyers (significance .023), descendants (significance .000), and the control group (significance .000). Fathers were significantly older at their last seat than descendants (significance .001) and the control group (significance .001)
Table 30. Average age at last seat.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Age at Last Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>56.2</td>
</tr>
<tr>
<td>Father</td>
<td>54.2</td>
</tr>
<tr>
<td>Inheritor</td>
<td>49.8</td>
</tr>
<tr>
<td>Brother</td>
<td>48.4</td>
</tr>
<tr>
<td>Buyer</td>
<td>46.6</td>
</tr>
<tr>
<td>Control</td>
<td>44.5</td>
</tr>
<tr>
<td>Descendant</td>
<td>44.7</td>
</tr>
<tr>
<td>Average</td>
<td>49.2</td>
</tr>
</tbody>
</table>

Figure 76. Boxplot of age at last seat.
Age at last seat does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .632), but it does vary significantly during the post-reform republic period (Kruskal-Wallis test significance .001). Games-Howell pairwise comparisons for the post-reform republic period show that builders were significantly older at their last seat than descendants (significance .013), inheritors (significance .046), or the control group (significance .000). Fathers were significantly older at last seat than descendants (significance .001) and the control group (significance .001). Age at last seat varies significantly for the Medici oligarchy period (Kruskal-Wallis test significance .001), when Games-Howell pairwise comparisons find that builders were significantly older at last seat than the control group (significance .006), that fathers were significantly older at last seat than the control group (significance .042), and inheritors were significantly older than the control group (significance .027). Age at last seat does not vary significantly during the late republic, presumably because of the end of republican government and the resulting truncation of political careers (Kruskal-Wallis test significance .675).

**Number of Politically Active Years**

The number of years between first and last seat, a measure of political lifespan, varies significantly for the republic era (Kruskal-Wallis test significance .000) (Table 31; Figure 77). Games-Howell comparisons find that builders had a longer political lifespan that descendants (significance .003) and the control group (significance .000) and that fathers had a longer political lifespan than descendants (significance .007) and the control group (significance .000).
Table 31. Years between first and last seat, republic era

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Years Between First and Last Seat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder</td>
<td>19.2</td>
</tr>
<tr>
<td>Father</td>
<td>18.4</td>
</tr>
<tr>
<td>Inheritor</td>
<td>13.4</td>
</tr>
<tr>
<td>Brother</td>
<td>12.5</td>
</tr>
<tr>
<td>Descendant</td>
<td>10.5</td>
</tr>
<tr>
<td>Buyer</td>
<td>10.2</td>
</tr>
<tr>
<td>Control</td>
<td>9.8</td>
</tr>
<tr>
<td>Average</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Figure 77. Boxplot of number of years between first and last seat.
The length of political lifespan does not vary significantly during the pre-reform republic period (Kruskal-Wallis test significance .883). It does vary significantly during the post reform republic period (Kruskal-Wallis test significance .014), but the only significant Games-Howell pairwise comparison is that builders had a longer political lifespan than the control group (significance .003). Political lifespan varies significantly for the Medici oligarchy period (Kruskal-Wallis test significance .002), and Games-Howell pairwise comparisons show that builders were in political life for more years than the control group (significance .031), fathers were in political life longer than the control group (significance .003), and inheritors were in political life more years than the control group (significance .028). Political lifespan does not vary significantly during the late republic period (Kruskal-Wallis test significance .171), probably because political careers were truncated by the creation of the Duchy.

**Rejections for Office**

As discussed in the review of the electoral system, individuals drawn for office could be rejected for several reasons. The most common reasons were the death of the individual prior to his drawing, insufficient age, and “in speculo” status (Table 32). The analysis below covers only tre maggiore offices because of the more complete transcription of those results into the election database my research used.
Table 32. Reasons for electoral rejection, republic era.

<table>
<thead>
<tr>
<th>Result</th>
<th>Tre Maggiore Offices</th>
<th>Guild Offices</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated</td>
<td>40.3%</td>
<td>37.5%</td>
<td>39.1%</td>
</tr>
<tr>
<td>Minor</td>
<td>23.3%</td>
<td>21.0%</td>
<td>22.3%</td>
</tr>
<tr>
<td>In speculo</td>
<td>10.1%</td>
<td>29.9%</td>
<td>18.7%</td>
</tr>
<tr>
<td>Dead</td>
<td>16.8%</td>
<td>9.7%</td>
<td>13.7%</td>
</tr>
<tr>
<td>Other</td>
<td>9.5%</td>
<td>1.9%</td>
<td>6.2%</td>
</tr>
</tbody>
</table>

Rejection for “in speculo” status usually means the individual owed taxes or fines to the state or other parties as part of legal proceedings (Herlihy, Litchfield, et al. 2002). I intuitively expected that there would be a relationship between in speculo status and palace construction if the costs of palaces placed a huge and unsustainable burden on their builders, buyers, or inheritors. For the republic era as a whole, the frequency of in speculo status varies significantly by type of individual (Kruskal-Wallis test significance .004) (Table 33), but there are no significant Games-Howell pairwise comparisons. The number of in speculo draws does not vary significantly for the pre-reform republic period (Kruskal-Wallis test significance 1.00), the post-reform republic period (Kruskal-Wallis test significance .357), or the late republic period (Kruskal-Wallis test significance .104). In speculo draws do vary significantly during the Medici oligarchy period (Kruskal-Wallis test significance .015), but there are no significant Games-Howell pairwise comparisons. Some of the variation in the number of in speculo draws is due to the number of total tre maggiore draws: a linear regression of in speculo draws per person versus total tre maggiore draws per person is statistically significant (significance .000) and moderately explanatory (R Square .363). In other words, the more often a man was drawn, the more likely he was to be in speculo for one of those drawings.
Table 33. Average number of in speculo tre maggiore draws.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Number of In Speculo Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buyer</td>
<td>0.71</td>
</tr>
<tr>
<td>Inheritor</td>
<td>0.58</td>
</tr>
<tr>
<td>Builder</td>
<td>0.48</td>
</tr>
<tr>
<td>Father</td>
<td>0.40</td>
</tr>
<tr>
<td>Brother</td>
<td>0.36</td>
</tr>
<tr>
<td>Control</td>
<td>0.36</td>
</tr>
<tr>
<td>Descendant</td>
<td>0.27</td>
</tr>
<tr>
<td>Average</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Being drawn as a minor appears to have been a reflection of young men being deliberately entered in the pool of potential office-holders by their parents and therefore reflects a particular type of status-seeking behavior by parents on behalf of their offspring. Minor draws vary significantly for the republic era as a whole (Kruskal-Wallis test significance .000) (Table 34). Games-Howell pairwise comparisons find that members of the control group were less likely to be drawn as minors than brothers (significance .000), descendants (significance .041), fathers (significance .007), and inheritors (significance .009). However, the patterning is weak when considered by period. There is no significant variation in the number of minor draws during the pre-reform republic period (Kruskal-Wallis test significance 1.00) or the post-reform republic period (Kruskal-Wallis test significance .266). The number of minor draws varies significantly during the Medici oligarchy period (Kruskal-Wallis test significance .000), when Games-Howell pairwise comparisons find that members of the control group were drawn as minors less often than brothers (significance .024) and fathers (significance .012). The number of minor draws also varies significantly during the late republic period.
(Kruskal-Wallis test significance .006), but there are no significant pairwise comparisons.

Much of the variation in the number of minor draws per person is due to the number of total tre maggiore draws per person: a linear regression of minor tre maggiore draws versus total tre maggiore is statistically significant (significance .000) and has considerable explanatory power (R Square .524). In other words, the more often a man was drawn, the more likely that he was under age for some of those drawings.

Table 34. Average number of minor draws for tre maggiore office, republic era.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Number of Minor Draws</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>1.63</td>
</tr>
<tr>
<td>Buyer</td>
<td>1.57</td>
</tr>
<tr>
<td>Brother</td>
<td>1.42</td>
</tr>
<tr>
<td>Inheritor</td>
<td>1.34</td>
</tr>
<tr>
<td>Descendant</td>
<td>0.89</td>
</tr>
<tr>
<td>Builder</td>
<td>0.85</td>
</tr>
<tr>
<td>Control</td>
<td>0.54</td>
</tr>
<tr>
<td>Average</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Summary of Political Success

Measured in terms of total draws for guild and tre maggiore office, total seats for guild and tre maggiore office, draws for tre maggiore office alone, seats for tre maggiore office alone, percentage of draws resulting in seats, or length of political career, palace builders and their fathers consistently outperformed the population as a whole. Palace inheritors also performed well, although not as well as their fathers or grandfathers. Non-inheriting descendants of palace builders and the control group performed much less well in terms of political success. As with reproductive success, the political success of palace builders, their fathers, and their probable inheritors in terms of number of times seated in
The tre maggiore office increased over time (Table 35; pre-reform republic omitted due to a small sample size). Note that the late republic figure for fathers is based on a very small sample size and may also reflect the period’s truncation by the creation of the Duchy.

Table 35. Difference from average number of tre maggiore seats by period.

<table>
<thead>
<tr>
<th>Type of Person</th>
<th>Post-Reform Republic</th>
<th>Medici Oligarchy</th>
<th>Late Republic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father</td>
<td>121%</td>
<td>135%</td>
<td>35%</td>
</tr>
<tr>
<td>Builder</td>
<td>133%</td>
<td>146%</td>
<td>174%</td>
</tr>
<tr>
<td>Buyer</td>
<td>0%</td>
<td>150%</td>
<td>83%</td>
</tr>
<tr>
<td>Brother</td>
<td>82%</td>
<td>93%</td>
<td>111%</td>
</tr>
<tr>
<td>Inheritor</td>
<td>100%</td>
<td>136%</td>
<td>155%</td>
</tr>
<tr>
<td>Descendant</td>
<td>90%</td>
<td>93%</td>
<td>68%</td>
</tr>
<tr>
<td>Control</td>
<td>85%</td>
<td>58%</td>
<td>67%</td>
</tr>
</tbody>
</table>

Palace Builder Life History

On average, all palace builders followed a similar course through their reproductive and political lives. They had their first son at age 36 (when their wives would have been roughly 25 years old on average), were seated for their first office at age 38, completed their palaces at age 45 (at least a decade after their fathers’ deaths in all cases where I have relevant data), had their last son at the same age (45 years old, when their first wives would have been roughly 34 years old), and were seated for their last office at age 56. These ages differ significantly (Kruskal-Wallis test significance .000), and Games-Howell pairwise comparisons find that differences in all stages are statistically different (alpha less than or equal to .005) except age at first seat and age at first son, which are not significantly different (significance .830), and age at palace acquisition or construction start and age at last son, which are also indistinguishable.
(significance 1.000). Age at death is particularly variable but averages roughly 70 years. Of course, these averages collapse considerable individual variation (Figure 78).

Figure 78. Boxplot of palace builder ages at life history events.

These figures vary slightly by period (Table 36, which combines the pre-reform and post-reform republic periods to avoid statistical problems caused by the small number of builders from the pre-reform republic period). Palace builders were seated for their first office at a significantly earlier age during the late republic than during other periods. Palace builders were seated for their last office at significantly later ages during the pre- and post-reform republic periods than during later periods. The very low figure
for the age at last seat for the late republic is due to the end of elections in 1533 and is not an empirically significant difference.

Table 36. Palace builder average ages at life history events by period.

<table>
<thead>
<tr>
<th>Age at Life History Event</th>
<th>Pre- and Post-Reform Republic</th>
<th>Medici Oligarchy</th>
<th>Late Republic</th>
<th>Average</th>
<th>95% Low for Mean</th>
<th>95% High for Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>First son</td>
<td>34.6</td>
<td>36.5</td>
<td>34.8</td>
<td>35.7</td>
<td>33.4</td>
<td>39.8</td>
</tr>
<tr>
<td>First seat</td>
<td>36.2</td>
<td>39.3</td>
<td>34.3</td>
<td>37.5</td>
<td>35.0</td>
<td>40.0</td>
</tr>
<tr>
<td>Palace start</td>
<td>44.0</td>
<td>46.5</td>
<td>42.4</td>
<td>44.7</td>
<td>41.9</td>
<td>47.4</td>
</tr>
<tr>
<td>Last son</td>
<td>44.6</td>
<td>45.4</td>
<td>43</td>
<td>44.8</td>
<td>41.9</td>
<td>47.7</td>
</tr>
<tr>
<td>Last seat</td>
<td>64.1</td>
<td>55.8</td>
<td>43.5</td>
<td>56.2</td>
<td>52.7</td>
<td>59.7</td>
</tr>
</tbody>
</table>

The data clearly indicate that palace builders had greater reproductive and political success than the rest of my sample population. But the details of their life histories show that palace builders built their palaces after the end of their reproductive lives and about half way through their political careers. This timing is very different from what I expected if palaces were costly signals. Costly signaling theory states that signal recipients will change their behavior toward signalers in response to signals. If palaces were costly signals designed to use signalers’ resources to improve their reproductive and political success, palaces would have been built before the start of builders’ reproductive and political careers. For example, if builders were attempting to attract high-quality brides, their palaces would have been completed before they began having legitimate offspring. Instead, the patterning in my sample shows that palace builders built their palaces after they had completed their known reproductive careers and about half of their political careers. Palace builders were on average about 45 years old when their palaces
were built. Although there is variation in that age by period, it is not significant and is
driven by the small number of palaces built by identified builders during the pre-reform
republic period (Figure 79). At 45 years old, the average palace builder had a nine-year-
old son, a second son, and possibly a third son and had first served in office seven years
earlier. His father had almost certainly died—palace builders’ fathers were in theory 80
years old on average when their sons’ palaces were built, but only 5.4 percent of the
individuals in my sample for whom I have an age at death lived to 80 years or older.

**Figure 79. Boxplot of builder age when palace constructed.**

In other words, the timing of palace construction was a function of the builder’s
age when his first son was born, his age when he first held office, his age when he had his
last son, and his total number of sons. A linear regression of these four variables is statistically significant in predicting the age of a builder when his palace was built (significance .007), and the combination of these variables explains more than half of the variation in age at palace construction (R Square .514). All four variables and the constant are statistically significant (significance ≤ .05). Adding age at last seat to this equation actually reduces its significance (significance .014) and only slightly increases its explanatory power (R Square .520). In short, a palace builder’s reproductive and political life history prior to palace construction determined when he built that palace. Palace construction is a capstone of the builder’s life history.

This timing differs considerably from that of modern consumers. In modern populations, experiments suggest that men looking for mates spend more on conspicuous luxury goods (Griskevicius, et al. 2007). This is not to say that Florentine men did not spend money as part of mate searches, but rather that palaces were not part of that strategy. Florentine men also differed from modern populations in their age at the end of their reproductive lives—reviews of research on modern male fertility, mostly in the United States, found a significant drop after age 50, five years after the average Florentine palace builder stopped having legitimate sons (Kidd, et al. 2001).

**Is Palace Cost a Factor?**

When developing my hypotheses, I expected that palace cost would correlate with benefits to signalers such that individuals who built more expensive palaces would receive greater reproductive or political success. Counter to my expectations, I was able to find not a single even remotely significant correlation between palace cost and any of the variables discussed in this chapter except number of guild draws, but even that
variable had virtually no explanatory power (Table 38). However, this finding is consistent with my finding that palace construction followed builders’ reproductive years and about halfway through their political careers. Analysis of palace inheritors produced similar results—even for palace builders’ inheriting sons, palace cost did not correlate in a statistically significant way with any of the variables discussed in this chapter (Table 38). The results are also similar when evaluated for individual periods.

**Table 37. Regressions of palace cost vs. success, palace builders.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>R Square</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at palace completion</td>
<td>.019</td>
<td>.206</td>
</tr>
<tr>
<td>Age at first son</td>
<td>.039</td>
<td>.136</td>
</tr>
<tr>
<td>Age at last son</td>
<td>.032</td>
<td>.174</td>
</tr>
<tr>
<td>Number of reproductive years</td>
<td>.001</td>
<td>.862</td>
</tr>
<tr>
<td>Number of known sons</td>
<td>.001</td>
<td>.831</td>
</tr>
<tr>
<td>Number of tre maggiore draws</td>
<td>.012</td>
<td>.366</td>
</tr>
<tr>
<td>Number of tre maggiore seats</td>
<td>.003</td>
<td>.664</td>
</tr>
<tr>
<td>Number of guild draws</td>
<td>.076</td>
<td>.018</td>
</tr>
<tr>
<td>Number of guild seats</td>
<td>.002</td>
<td>.680</td>
</tr>
<tr>
<td>Years of political activity</td>
<td>.000</td>
<td>.957</td>
</tr>
</tbody>
</table>

**Table 38. Regressions of palace cost vs. success, builders’ inheriting sons.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>R Square</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at palace completion</td>
<td>.002</td>
<td>.721</td>
</tr>
<tr>
<td>Age at first son</td>
<td>.093</td>
<td>.080</td>
</tr>
<tr>
<td>Age at last son</td>
<td>.122</td>
<td>.043</td>
</tr>
<tr>
<td>Number of reproductive years</td>
<td>.029</td>
<td>.333</td>
</tr>
<tr>
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<td>.404</td>
</tr>
<tr>
<td>Number of tre maggiore draws</td>
<td>.004</td>
<td>.637</td>
</tr>
<tr>
<td>Number of tre maggiore seats</td>
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<td>.575</td>
</tr>
<tr>
<td>Number of guild draws</td>
<td>.025</td>
<td>.256</td>
</tr>
<tr>
<td>Number of guild seats</td>
<td>.007</td>
<td>.540</td>
</tr>
<tr>
<td>Years of political activity</td>
<td>.002</td>
<td>.794</td>
</tr>
</tbody>
</table>
Summarizing the Benefits of Palace Construction: Is Lineage Survival the Answer?

If palaces were built after their builders had ended their reproductive lives and were well into their political lives, what was the real benefit of building a palace? The answer may be that palaces increased the likelihood that families’ reproductive and political success would persist across generations.

Florentines defined status on three separate axes: wealth, participation in politics, and lineage size (Padgett 2010). Although Padgett’s research shows that Renaissance Florentine elite lineages survived at rates greater than Renaissance and early modern elite lineages in England, France, Germany, and Holland, Florentine families were still subject to significant generation to generation variability. Between 1352 and 1480, only about 25 to 40 percent of Florentine families persisted in the top 10 percent of wealth from one 25-year period to the next (ibid.). In politics, only 30 to 55 percent of lineages that had at least one priorate seat every 30 years preserved that status from one 30-year period to the next (ibid.). In contrast, average lineage size in terms of the number of households per extended family increased between 1352 and 1480 (ibid.). However, Padgett’s research found little statistical correlation between these three axes of political participation, wealth, and lineage size, so a family’s possession of one element of status did not guarantee its possession of the other two. That lack of linkage is despite the association between business partnerships and political office holding such that men who had commercial ties also tended to serve in office together (Padgett and McLean 2003).

Padgett finds that marriage was one way to limit generation to generation losses of status. About 80 to 90 percent of Florentine families that married same-status spouses
between 1352 and 1480 preserved their political and or financial status across generations (Padgett 2010). Padgett’s research provides statistical corroboration for earlier research finding that elite marriage acted as a buffer against economic and political mobility (Molho 1994; Padgett 2010).

However, the role of marriage in preserving elite status began to break down in the early 1500s due to the increasing cost of marriage and increased elite concern about preserving wealth across generations. With the increasingly mature economy of the 1500s, merchants had lower risks of catastrophic losses but also less opportunity for huge gains (Goldthwaite 2009). Elites responded by shifting from partible inheritance to primogeniture (Emigh 2003; Goldthwaite 2009). They also reduced the number of sons allowed to marry and delayed the age at which those sons married (Johansson 1987).

Meanwhile, dowries paid by Florentine elites increased almost 45 percent over the 1400s and another 25 percent between 1500 and 1530, the bulk of my late republic period (Strocchia 2009). This increase in dowries is viewed as the main cause for the huge increase in the number of nuns in Florence: the percentage of the population in convents increased from 0.45 in 1338 to 5.2 percent in 1552, and these numbers were dominated by young women from elite lineages (ibid.). These forces led to reduced fertility among elite families and eventually to the complete disappearance of many elite lineages during the 1700s (Litchfield 1969).

Palaces may have acted as a strategy similar to marriage ties in preserving elite families and as a strategy that functioned over the long term, beyond the years of republican government. My data show that palace builders’ fathers had the same high level of reproductive and political success as their palace-building sons. Builders’ fathers
had even greater reproductive success on average than their palace-builder sons, although the difference is not statistically significant. After their fathers’ deaths, palace builders began construction of their palaces, probably using funds inherited from their fathers. Given that partible inheritance was the rule for most of the Renaissance, palace builders’ brothers probably received a roughly equal inheritance, but chose not to spend that inheritance on palace construction. Despite their inheritances presumably being equal to palace builders, palace builders’ brothers had much less political or reproductive success, and they are statistically indistinguishable from the control group in most measures. Palace builders’ political and reproductive success persisted to their first-born sons and their first-born sons’ first-born sons, who despite partible inheritance probably inherited or eventually acquired their fathers’ and grandfathers’ palaces. Building a palace therefore preserved a family’s reproductive and political success across multiple generations starting with the builder’s father.

Men who bought existing palaces had far less reproductive or political success than men who built their own palaces. Although men who bought existing palaces had slightly higher than average reproductive and political success, the difference was not great enough to distinguish them statistically from the control group. However, the political and reproductive statistics for the probable inheritors of men who bought existing palaces cannot be distinguished from the statistics for the likely inheritors of men who built new palaces. So while buying an existing palace did not benefit the buyer, it did benefit his eldest son—the inheriting sons of men who bought used palaces received the same benefits in reproductive and political terms as the inheriting sons of men who built new palaces.
Losing a palace due to financial difficulty, exile of a family member, or other causes was not detrimental to the success of palace builders. Compared to men who kept the palaces they built, the palace builders who lost their palaces had the same number of offspring (Kruskal-Wallis test significance .481), the same number of reproductive years (Kruskal-Wallis test significance .502), the same age at first son (Kruskal-Wallis test significance .599) and last son (Kruskal-Wallis test significance .610), the same age at first seat (Kruskal-Wallis test significance .596) and last seat (Kruskal-Wallis test significance .194), the same number of total draws (Kruskal-Wallis test significance .668), and the same number of total seats (Kruskal-Wallis test significance 1.00).

However, the number of men who lost their palaces is very small. Among the 86 families that built new palaces during the republic era, only nine families lost those palaces before the end of the republic. Of those nine losses, seven took place during the original builder’s life, and six of those losses were due to the builder’s exile following their involvement in anti-Medici plots (including members of the Albizzi, Strozzi, Neroni, and Pazzi families). These plotters were well into their political and reproductive lives before they were exiled, which probably explains the lack of damage to their political and reproductive success.

In general, documentary sources say that plotters’ offspring were not punished unless they were also guilty of treason. That pattern shows in my data. The probable inheritors of men who built then lost palaces had the same levels of political and reproductive success as the inheritors of men who did not lose their palaces. Padgett’s findings agree—his research found no correlation between exile for political reasons and lineage survival (Padgett 2010).
The benefits of palace construction to inheritors led to much greater long-term lineage survival as measured by persistence through the Medici Duchy era, which ended in 1737 with the death of the last Medici. A total of 429 families had members who served as prior at some point during the republic, an indicator of high political status. Of those 429 families, 220 served in the 48-member ducal senate-era and/or were members of the Order of St. Stephen, a religious military order of knights founded by Cosimo I de Medici in 1561. Membership in these organizations was considered an indication of elite status during the ducal era. These numbers mean that 51.3 percent of families in the republic era political elite were also political elites during the ducal era. Some of the families that disappeared from the political elite during the ducal era probably vanished because they died out. My research identified 102 families that owned palaces at some point during the republic era, 87 of which that had members who served as prior. Of those 87 families, 71 had members in the ducal senate and/or Order of St. Stephen, an 81.6 percent rate of preservation of elite political status (and biological persistence) and a considerably higher rate of political survival than the overall average for families with high political status during the republic. Of the 36 palaces built between the start of the ducal period and 1600, 29, or 80.5 percent, were built by families with members in the Senate and/or the Order of St. Stephen or by families that were nobles in Tuscany or elsewhere. These figures show that the lineage survival benefits of palace construction that begin during the Medici oligarchy period become critical during the increased competition for elite marriage ties during the late republic and into the duchy, when elite families abandoned partible inheritance for sons and stopped attempting to marry off all their daughters.
Costly Signals, Indices, or Bet Hedging?

For an attribute to be costly signaling, it must elicit a response from signal recipients that benefit the signaler. If palaces had a benefit for their builders, it did not involve reproduction or entry into politics. Palace builders did have a longer-than-average political lifespan, part of which occurred after they had built their palaces. However, palace builders’ fathers and their inheritors had roughly similar reproductive success, political success, and even number of years in politics.

My results therefore suggest that palaces were part of a multigenerational strategy (deliberate or otherwise) to preserve families in biological terms and in terms of political status. In the first generation, high-quality fathers of eventual palace builders have an average of three sons. One of those sons (the first or only living son in about two-thirds of the identified cases) choses after getting married, having children, and entering political life to build a palace, probably using his portion of his father’s estate to help fund construction. When he builds his palace, that individual already knows that he has greater success in reproductive and political terms than his brothers. The palace builder’s probable inheritor (almost always his first son) then inherits a portion of his father’s wealth but ultimately inherits the entirety of this his father’s palace and has a level of political and reproductive success nearly as good as his father’s. That level of political and reproductive success persists through the palace builder’s grandson, great-grandson, etc., resulting in a family line that is much more likely than its non-palace-building peers to survive into the Medici Duchy.

Costly signaling theory requires that signals convey information about underlying, unobservable qualities. As I discussed in the theory section, the specific nature of this
quality is not important. What is important is that the quality provides its possessors with greater ability to obtain, control, and use resources. Controlling resources was obviously necessary for palace construction—cash paid for the labor and materials. However, controlling resources was not sufficient for palace construction. Many but not all elite families built palaces. As noted above, the 1427 catasto and its 9,780 Florentine households includes only three households that definitely owned palaces in the years the tax assessment was conducted. Given that one of those households was the 60th-wealthiest household in the city and the other two were the first and eight-wealthiest households, it is intuitively likely that another 57 households had the resources necessary to build a palace. The patterning in the data on the political and reproductive success of palace builders’ inheritors strongly suggests that the information content of palaces as signals involved palace building parents’ ability to provision their inheriting sons with resources essential in ensuring those sons’ ability to marry high-status brides and to obtain high-status political careers.

What can also be said with certainty is that Florentine palace building was not a form of conservative bet hedging or “waste.” Palace builders had more offspring than the control group. This Florentine elite strategy of having many offspring is common in pre-modern, pre-demographic transition societies undergoing economic development, a situation that general leads to greater fertility and greater income inequality (Dahan and Tsiddon 1998). A model of a hypothetical patriarchal society suggests that for human populations in high variability environments with high mortality (conditions that characterized Renaissance Florence), one optimal choice is to have many children but to bias inheritance to a small number of those children, leading to unequal family wealth in
the next generation (Mace 1998). Florentine elites, with their partible inheritance but de facto primogeniture for palaces, may be a real-world example of this modeled behavior, and they fit better with this behavior beginning in the 1500s when they began to abandon partible inheritance. There is some evidence that conservative bet hedging may have been practiced by the Florentine poor, who could not afford wet nurses and who documentary evidence suggests used “fertility reduction” strategies spanning the range from non-reproductive sexual practices to infanticide due to the very high cost of raising children (Herlihy and Klapisch-Zuber 1985). But among the elite, bet hedging took the form of the diversified strategy, in which parents have as many offspring as possible in the hopes that one or some will survive and thrive. That said, there is limited evidence in my data that palace builders did hedge their bets slightly relative to their fathers. Palace builders’ fathers had slightly more sons than palace builders, although the difference is not statistically significant. Assuming that palace builders had the same theoretical maximum reproductive capability as their fathers, this finding suggests builders traded off some portion of their reproductive potential to provision their inheriting sons. Dunnell said that there was nothing about waste behavior that was necessarily incompatible with costly signaling, and it looks like both things may be at work here, but support for palace-building elites’ use of a conservative bet hedging strategy has only limited support in my data.
CHAPTER 9. CONCLUSION AND DISCUSSION: WERE PALACES COSTLY SIGNALS?

My research started with a single question—does costly signaling apply to human consumer behavior, specifically the construction of very large houses by Florentine elites during the Renaissance, or do alternative hypotheses fit better with the data? The answer is more complex than I expected, and it appears that palace construction was highly elastic and responded to changes in elites’ social, political, and/or economic context.

During some periods, all elites who built palaces spent similar percentages of their wealth on their palaces, and the distribution of palace costs lacks steps or tiers; these patterns suggest that palaces during those periods were indices of wealth and thus of resource control. But during other periods, elites who built palaces spent highly variable percentages of their wealth on palaces and the cost of those palaces have several steps or tiers, consistent with my expectations for costly signals.

Florentine elite residences prior to the republic were assemblages of smaller houses that were unified by knocking holes in connecting walls to allow members of extended families to share space and to access towers that were built into the fabric of these sprawling multi-building residences. Pre-republic elite architecture therefore appears to have been explicitly functional—their form was dictated by the need to defend against attacks by rival families and to house large extended families. The only stylistic elaboration is the presence of family coats of arms on some, but by no means all, surviving towers. The palaces of the pre-reform republic period, while stylistically severe compared to later styles, do have purely stylistic architectural elements not found on
towers. For example, the earliest palaces of the republic have string courses that serve to enhance their horizontal axes. These palaces would therefore have stood out dramatically from older neighboring buildings for their width and their unified façades and would have conveyed information about builders’ resources. Moreover, their functional ground-floor warehouse or storefront openings strongly suggest a move away from defense as a functional requirement. Instead, these palaces would have been a functional component in the city’s mercantile economy and therefore a symbol of elite participation in this economy, conveying a very different type of information from the earlier elite towers and multi-building residences. However, the palaces of this period are the second-best fit with an interpretation that they are costly signals, suggesting that reliable information about resource control was important to elites of the period. I suspect that need for costly signals was a response in part to the shift from the pre-republic noble elite to the increasingly merchant elite of the republic era.

The transition from elite houses that were purely functional to elite houses with a signaling role is consistent with how weapons evolve among non-human animals. A comparison of weapons across species finds that most weapons are used in competitions with rivals for burrows or territories that will be used to provision mates and offspring (Emlen 2008). Weapons often appear first as unimpressive but deadly weapons then evolve into elaborate, showy weapons used in assessment displays in which individuals face little risk of physical injury (ibid.). Similarly, the simple but functional towers used in pre-republic elite ground battles were replaced with republic-era palaces used in non-combat status displays.
Most palaces built during the post-reform republic period were stylistically very similar to the palaces of the pre-reform republic period. The minor stylistic changes to palace architecture were probably part of the broader renovations of façades on several streets near the Palazzo della Signoria to replace wood buildings with stone and to harmonize building façades. Florentines may have seen the period’s palaces as part of this larger reconstruction effort, not as stylistically innovative intrusions into the urban fabric. The palaces of the post-reform republic period are the second-best fit with an interpretation that they were indices, not costly signals. It is therefore significant that the republic in the late 1300s and early 1400s, prior to the Medici oligarchy, has been called the most open to newcomers to political status (Brucker 1977; Goldthwaite 2009; Padgett 2010). This openness may have meant that there was relatively little need for status competition, as obtaining political office did not depend on an individual’s status beyond the basic requirements of being an adult male Florentine who was a member of a guild. However, the stylistic roots of the much different Medici Oligarchy period had already appeared in the form of the transitional rusticated style, the style that replaced the warehouse or storefront doors that defined the first generation of republic-era palaces with a single monumental entrance. Transitional rusticated palaces anticipate many attributes of the Renaissance rusticated style and are nearly as good a fit with a costly signaling interpretation as the Renaissance rusticated palaces.

The palaces of the Medici oligarchy period continue to use several stylistic elements that appeared in the post-reform republic period, but they are far more stylistically elaborate and stylistically diverse. The most elaborate palaces of the Medici oligarchy period, the Renaissance rusticated style palaces, would have been architectural
landmarks even before their completion and would have been obviously costly. Contemporary accounts describe crowds stopping to watch construction of the enormous Palazzo Strozzi (Goldthwaite 2009), and I suspect that all of the larger Medici oligarchy period palaces drew similar attention. It is the largest of the Renaissance rusticated palaces that cause the palaces of the Medici oligarchy period to be the best fit with a costly signaling interpretation. But the specific ways in which the Renaissance Rusticated style was more elaborate than its predecessors is also important. The palaces of this style appropriated mullioned windows, deep rustication, and other architectural elements previously seen only on the Palazzo della Signoria and other buildings owned by the city government. The stylistic attributes of the Renaissance rusticated style palaces were coopted in turn by the fake architectural elements of the much less costly sgraffito style. Meanwhile, a small number of palace builders opted to build in two very simple and severe styles—corner ashlar and stucco—that were probably less expensive even than sgraffito. The result was an assemblage of palaces with costs that varied dramatically across a very wide range and that would have been relatively easy for observers to rank.

I suspect that the good fit of Medici oligarchy period palaces with a costly signaling interpretation is due in part to the Medici family’s behind-the-scenes control of government. Under the Medici, political power was harder to obtain, as individuals eligible for government offices had to survive scrutiny by a panel of hand-picked Medici supporters in place of the comparatively politically unaffiliated panels of the republic prior to Medici dominance. Obtaining and preserving the level of status that afforded entry into the Medici inner circle would have had a huge payoff, creating a need for status competition that could translate into political power.
The palaces of the Medici oligarchy period, as the best fit with costly signaling, also indicate the analytic utility of Johnstone’s error-prone signaling model. In that model, the smaller the number of signalers who able to advertise above the minimum “initial flat” level, the more strongly they advertise. That prediction differs from the normal prediction of costly signaling theory that the signaling ability of the lowest-quality individual determines the intensity of higher quality individuals’ signals. I believe the costliest palaces may have multiple audiences, including an audience that did not exist before Medici domination. The Medici created of a role as de facto rulers of the city and thereby opened a new level of status—firsts among equals. Significantly, the Medici oligarchy period saw palace construction by the Strozzi, Pazzi, and Pitti, who were at times in direct competition with the Medici for this role as de facto rulers. These individuals were competing for status with other elites, but also for broad-based status as rulers of the city, which would have required buyoff from the entire population and from foreign rulers. The upper tiers of Medici oligarchy palace construction, the tiers dominated by Renaissance rusticated style palaces, may have been designed to signal not to the Florentine elite, but instead to the Florentine populace and to the rulers of other city-states and nations. I believe it is no coincidence that virtually all Medici Oligarchy period palaces can still be linked to particular families, while far fewer Late Republic period palaces can be ascribed to a family. Of the 40 Medici Oligarchy palaces in my sample, I found documentary evidence identifying the builder in all but four cases. In contrast, only 45 of the 73 Late Republic period palaces have a known builder. The inference is that Medici Oligarchy period palaces were built by much higher-profile lineages.
The increased elaboration of palaces during the Medici oligarchy suggests that elite spending on palaces was similar to modern U.S. consumer behavior, where there is a very strong correlation between the visibility of consumer expenditures and the elasticity of the proportion of income spent on particular goods (Heffetz 2011, which found spending on cars to be the most elastic in the categories analyzed). Research on modern consumption of luxury goods suggests that visibility is critical in understanding the motivation for consumers’ choices of one product over another (Berger and Ward 2010; Han, et al. 2010). These studies found that consumers interested in acquiring broad status tend to purchase conspicuous luxury goods, especially items with obvious logos. The elaboration of the Renaissance rusticated style is in large part to stylistic elements such as massive rusticated ashlars and mullioned windows that these palaces share with the Palazzo della Signoria, a structure they were clearly designed to emulate. The Palazzo della Signoria and its architectural style may be analogous to a logo—the Palazzo della Signoria is the logo of the Florentine Republic “Brand,” something recognized at the time (Machiavelli 2010 [1525]). I believe that the Renaissance Rusticated style is a deliberate attempt to coopt the attributes of this Florentine brand for use by individual elites, a process that started with the construction of the Palazzo Medici in 1444. The sgraffito style, which appeared in 1446, is analogous to modern counterfeits, which tend to copy brands with high-visibility logos (Han, et al. 2010). This line of inference suggests that Medici Oligarchy-period builders of Renaissance Rusticated palaces were attempting to gain status from a broad range of their contemporaries by building structures similar to the seat of government and that that builders of sgraffito palaces were attempting to emulate the builders of Renaissance Rusticated palaces.
This is not to say that the elaborate palaces of the Medici oligarchy period (and the Renaissance as a whole) were completely non-functional. Windows were placed high off floors, making them hard to see out of when open; this limited visibility may have served to guard daughters from view (Perilloux, et al. 2008). Palaces may have helped to reduce plague mortality, which appears to have correlated with crowding (Carmichael 1986). In addition, palaces often had their own wells, which could have had health benefits (Goldthwaite 1972). Even after they lost their ground-floor warehouse or storefront openings, palaces still included warehouse space, including stores of weapons and food, so the “extra” space was not entirely wasted (Ginori Lisci 1985).

Unfortunately, the period’s architectural theorists and Florentine elites themselves were surprisingly silent about how interior space they used interior space, making it very difficult to evaluate the function of the vast rooms these palaces contained (Goldthwaite 1972).

The palaces of the late republic period preserved only the three less costly and less elaborate styles that first appeared during the Medici oligarchy. Their lack of elaboration and their relatively continuous distribution in cost across a relatively narrow range would have made the period’s palaces difficult to rank, and they are the most consistent with predictions for indices. The lack of tiers and the large number of late republic palaces suggests a large pool of potential signalers per Johnstone’s error-prone signaling model. I believe that the change from palaces as costly signals during the Medici oligarchy period to a large number of palaces as indices during the late republic period is due to the shift to a large but closed elite, a change seen in the shift from partible inheritance to primogeniture and in the creation of special schools and other
measures that would have divided the elite socially from the rest of the population (Emigh 2003). In this context, late republic elites would have had a smaller interaction sphere and may therefore have had less need to signal to large audiences of strangers. Studies have found that consumers interested only in status within their economic peer group tend to purchase goods with subtle or no logos and will pay a premium for such goods (Berger and Ward 2010; Han, et al. 2010). The late republic palaces are dominated by the very simple stucco and corner ashlar styles (57 of 73 late republic palaces in my sample are stucco or corner ashlar style). These palaces have simple façades and are palatial primarily in their size, making them much more subtle than Renaissance rusticated palaces and thus consistent with signals associated with in-group status competition.

In addition to a change in the environment for status competition, the transition from the Medici oligarchy to the late republic included a change in the broader economic climate. The late republic period was a period of economic stability for the population of Florence as a whole, but elites had less opportunity for the spectacular successes of the Medici Oligarchy and earlier periods and bore the economic brunt of political instability and frequent warfare (Goldthwaite 2009). Studies of modern U.S. consumers’ expenditures have found that spending on luxury goods responds more to the economic climate than non-luxury goods (Ait-Sahalia, et al. 2004). During the global recession that began in 2008, wealthy consumers shifted spending from luxury collectibles such as automobiles and boats and luxury consumables such as clothes and art to goods with greater long-term tangible value, such as houses (Sontag 2009). If Florentine elites had similar responses to their economic climate, perhaps many elites that during the Medici
oligarchy would have purchased non-durable luxury goods shifted instead to purchasing durable palaces, creating the large number of relatively small late republic palaces.

The end of the republic and the creation of the Medici duchy obviously represent a dramatic change in the social and political environment. I believe that the extensive stylistic experimentation encapsulated in the Mannerists styles is a reflection of elite efforts to determine the parameters of appropriate signals in this changed environment. The period saw the construction of palaces in the old stucco and corner ashlar styles, but also saw the construction of palaces with highly varied and elaborate decorative treatments. Perhaps not surprisingly, palaces of the early Ducal era are not a strong fit with either interpretation—they are at the midpoint in period-by-period rankings of the relative strength of costly signaling and index interpretations. The palace architecture experiments of the early decades of the Duchy were a short-lived phenomenon, and Florentine elite architecture settled by the early 1600s into a homogenous baroque style that would persist until the 1800s.

This oscillation through time between palaces that have costs more consistent with costly signaling and palaces with costs more consistent with indices suggests that these two modes of information transfer may be unstable solutions. Searcy and Nowick (Searcy and Nowicki 2005) suggest that Maynard Smith’s exemplar of indices—deer bellowing—is a poor example because individual deer can manipulate their bodies to increase the volume of their calls. In other words, individuals can learn a phenotypic good trick that undermines the correlation of body size and the volume of calls. In the case of palaces, the comparatively index-like palace styles of the post-reform republic period of the late 1300s are undone by the development of the more costly transitional
rusticated style and then, in 1444, by the vastly more costly Renaissance rusticated style that first appeared with the Palazzo Medici. The Medici palace is a phenotypic good trick. When the Albizzi and other exceptionally wealthy and powerful lineages of the pre-oligarchy periods built palaces, their palaces represented a very small proportion of the wealth of their builders. The Medici committed far more resources to palace construction, creating a competitive environment in which palaces could serve as costly signals. In other words, I believe it is the most costly, elaborate palaces of the Medici oligarchy period that forced other palace builders to spend heavily to keep up. This actually makes palaces as costly signals a better fit with Veblen’s predictions than those of Zahavi and other costly signaling researchers: Veblen said that it is the highest-quality signalers who drive signal intensity (Veblen 1973 [1899]), not the lowest-quality signalers as predicted by Grafen and others (Grafen 1990a, b). However, the Medici oligarchy period’s highly variable spending on palace construction appears to have been unsustainable over the long term, and during the late republic period families’ proportional palace construction costs became more or less fixed, in line with predictions for indices. My suspicion is that this shift from costly signal to index for specific behaviors such as palace construction is probably offset by opposite shifts in other behaviors, for example chapel construction, such that at any time a population has some behaviors that look like costly signals and some behaviors that look like indices. This possibility is a topic for future research.

**Signals of What?**

But if palaces were costly signals (to varying degrees depending on the period), what were they signals of? The fact that the signaling—palace construction—followed marriage, reproduction, and entry into political office suggests that building a palace did
not result in a change of behavior by builders’ contemporaries toward the builders. I believe instead that palace construction was involved with preserving lineages (both in demographic terms and in status) across generations. Specifically, I believe that palaces served as costly signals of the financial support parents were willing to provide to their offspring to allow them to marry and maximize their reproductive potential and political careers.

Statistical analysis by Padgett finds that wealthy families tended to marry other wealthy families, that politically powerful families tended to marry other politically powerful families, and that large families tended to marry other large families (Padgett 2010). However, the marriage partners tended to differ in other dimensions—for example, a wealthy couple could differ in political power. The result is that statistical analysis finds that wealthy families were not the same as large families were not the same as politically powerful families and therefore that the three dimensions of status in Florence did not correlate. However, marriage is the most consistent element—couples rarely married up or down (ibid.) because marriage ties were both a reflection of a family’s status and a source of that status—marriage confirmed status, it did not change status (Bender 2009).

As discussed above, palace builders had significantly more sons than my control population. My data on the number of sons is more precisely a measure of the number of sons who were entered into the pool of potential office holders. Many of these sons were registered early in their lives for future eligibility for office. This patterning suggests that fathers were at least partially responsible for the entry of their sons into political life. As discussed above, palace builders’ first sons were most likely to inherit fathers’ palaces.
despite the long tradition of partible inheritance among sons—inheriting siblings usually made financial arrangements to ensure that first sons eventually owned entire palaces (Goldthwaite 1972). Elites were also more likely than average to have multi-generational households that included sons and their wives. Sons would also benefit from their fathers’ personal relations that underlay business ventures; these patrilineal business ties were critical in business (Padgett and McLean 2003).

Palace builders’ sons would also inherit a durable statement of a lineage’s status. Contemporary documents make it clear that palaces were viewed as critical elements in the status of lineages that were to remain in family hands if at all possible. Filippo Strozzi and Giovanni Rucellai both left wills with extensive instructions on steps to ensure that their palaces remained in family hands (Goldthwaite 1972). These efforts succeeded—the Palazzo Rucellai is still owned by the family, and the Palazzo Strozzi was in the family until the 1900s. Michelangelo Buonarroti’s stated purpose in building his palace was to reestablish his family’s membership in the Florentine elite after generations of absence from political life (ibid.). In contemporary accounts, palace builders claimed that their houses were in keeping with their status (Kent 1987). Unfortunately, I have no information on the role of palace builders’ wives in the decision to build palaces: women were largely silent in the period’s documentary history, leading many scholars to question whether women benefited from the renaissance at all (Trexler 1993).

Sons of palace builders were therefore provisioned with entry into political life, with high-quality housing prior to their parents’ deaths, with business relations, and with a visible indicator of the family’s possession of sufficient wealth to build and keep a
palace. Intuitively, these factors would have helped attract high-quality wives for the sons of palace builders, especially the first sons who would eventually inherit those palaces.

The data actually suggest that there is some multi-generational bet hedging involved in this offspring provisioning strategy. Builders’ fathers have slightly more sons than palace builders (p-value .026). Assuming that palace builders had the same theoretical reproductive capability as their fathers, this finding suggests builders traded off some of their reproductive potential to provision their inheriting sons with more resources that otherwise would have to be split among more offspring. Palace builders’ inheriting sons were therefore provisioned sufficiently to have a comparable number of sons as their fathers (p-value .192). Palace builders’ inheriting sons were seated in office less often than their fathers (p-value .034), but this difference may be an artifact of the truncation of demographic and political data due to the end of the republic. Palace builders did have fewer sons on average than their fathers, but the difference is not statistically significant. More extreme conservative bet hedging may have been in operation for poor and middle-class Florentines, who had smaller families on average than the wealthy. Support among non-elites for massive public and religious building projects may have been involved in variance reduction strategies. This topic is a question for future research.

I believe that palace builders’ daughters would have been similarly provisioned, although my evidence is inferential. Data on dowries shows that elites prior to about 1500 took steps to maximize all their daughters’ likelihood of marrying (Kirshner and Molho 1978). Dowries increased sharply after the plague of 1348 and continued to soar into the early 1500s (Molho 1994), including a 45 percent increase over the 1400s (Strocchia
The increase in dowries made marriage more expensive and reduced male interest in finding wives (ibid). Well aware of the need to repopulate the city, the government in 1425 created a state-run dowry fund that guaranteed payment in exchange for an initial investment. Although the details varied over time, for most of the 1400s if parents deposited 60 florins in the dowry fund the husband of their daughter would receive a dowry of 140 florins after a 5-year investment, 250 florins after a 7.5-year investment, 365 florins after an 11-year investment, and 500 florins after a 15-year investment. The dowry was payable at the consummation of a marriage unless the maturity date had not been reached, in which case payment was delayed. The initial required investment made participation impossible for the poor and many middling households—of the 9,780 households in the 1427 tax assessment, 3,033 households, or 31 percent, had taxable assets of less than 60 florins. The dowry fund was dominated by individuals with family names, suggesting middling to high status (Kirshner and Molho 1978). Parents did not pick and choose among their daughters. Instead, they invested equally for all daughters who survived to about 2-5 years old (ibid). Kirshner and Molho believe that the dowry data suggests families (at least in the 1400s) tried to marry off all their daughters, not just some of their daughters. Wives participated actively in these decisions and in finding appropriate spouses for their sons and daughters (Bender 2009).

Dowries were often very large. For the period 1425 to 1442, dowries paid by the state dowry investment fund averaged 405 florins, with a maximum of 3,000 florins and a minimum of 14 florins (Kirshner and Molho 1978). Note that the least costly republic-era palace in my sample had an estimated cost of 1,355 florins. Dowries were particularly large among the highest-status elites. In 1444, palace inheritor Piero de Medici received a...
dowry of 1,200 florins from the family of his wife, Lucrezia Tornabuoni. After marrying Alessandra di Filippo Valori in 1450, Carlo di Salvestro Gondi acquired a 1,600-florin dowry, only 500 florins of which came from state dowry fund payouts. In 1453, Piero di Messer Andrea de Pazzi, the brother of a palace builder, paid his future son-in-law Bartolomeo Valori a dowry of 2,000 florins. Dowries were generally accompanied by reverse payments in the form of clothes and accessories by husbands to their brides; usually totaling one third to two thirds of the dowry (Klapisch-Zuber 1987). Marriage therefore represented a considerable movement of cash from family to family.

In exchange for large investments in dowries, parents were able to marry their daughters at younger ages. Overall, Florentine girls married at an average age of 17.2 or 18.0. Brides with very high dowries married at about 16.9 years (Bender 2009). Daughter’s ages were important in the Florentine marriage market: Florentine parents appear to have lied about daughters’ ages, claiming that daughters were younger than they really were to make them more marriageable (Molho 1988).

The husbands of brides with high dowries married slightly later than average. Overall, Florentine men married at an average age of 28.9 or 30.0, depending on how the age is calculated (Bender 2009; Herlihy and Klapisch-Zuber 1985). The husbands of high-dowry wives averaged 29.9 years old (Bender 2009). However, this higher-than-average age probably reflects men delaying marriage until they could form their own households: 75 percent of married men in Bender’s 1425-29 data were heads of households (ibid.). The sons of palace builders, who tended to live with their parents after marriage, could have married while still living at home. In my data set, the palace-inheriting sons of palace builders had a lower age at first son, suggesting earlier marriage
(31.3 years versus 33.4 years, p-value .088). In other words, being the likely inheritor of a palace builder may have offset the need to delay marriage to a bride with a large dowry. Building a palace would therefore mean a longer reproductive life for the builder’s first son.

Building a palace may also have signaled a father’s ability to provision children from illicit relationships. Prostitution was legal and regulated after 1403, when the government created a panel charged with finding locations for brothels and attracting foreign prostitutes to the city. Prostitutes drew clients from all levels of society (Brackett 1993). Although extant records of prostitutes’ customers include few with family names indicative of relatively high status, it is possible that elite customers’ names were deliberately omitted (Trexler 1993). In any event, some elite Florentine males almost certainly fathered some offspring with female prostitutes. Some elite Florentine men also probably fathered children with their slaves, although probably on a scale orders of magnitude lower than in other slave-holding complex societies (Betzig 1992). The 1427 tax assessment records 294 slaves living in 261 households (Goldthwaite 2009); these slaves were virtually all women who worked as household servants in wealthy households (Herlihy and Klapisch-Zuber 1985). In either case, data from the dowry fund shows that fathers of illegitimate offspring provided for dowries, although these dowries were smaller than average and more illegitimate daughters entered convents than average (Kirshner and Molho 1978; Molho 1994). However, I do not have data on whether the palace builders in my sample had illegitimate offspring with their servants or slaves. If illegitimate sons were recognized by their fathers, they are indistinguishable from legitimate sons in the election data. For example, Carlo di Cosimo de' Medici (1428 or
1430 - May 29, 1492) was the illegitimate son of Cosimo de' Medici (the Elder) and a slave Circassian named Magdalene. Because Carlo’s surname is Medici and because his name includes a patronymic identifying his father, if Carlo appeared in the election data I would have no way of identifying whether he was an illegitimate son.

Although inferential, I believe that the data on marriage patterns explains what, exactly, palace builders were signaling. Palace builders embarked on their construction projects after their first offspring had survived early childhood—palace construction starts about a decade after the birth of first sons. Palaces would have been a signal of the family’s intent to remain in Florence, its status as a lineage, and its willingness to invest wealth and status in descendants. Unlike palaces and many other forms of wealth, dowries and counterdowries would not have been directly observable. They Darwinian payoff was ensuring that offspring were married longer and therefore had more years to reproduce and that offspring were provided with the benefits of their parents’ acquired status. This payoff would explain my findings that palace-building lineages were more likely to survive than non-palace building lineages—palace builders and their inheritors out-reproduced their contemporaries, filling the massive demographic niche left by the repeated plague events than began in the 1300s.

The need for parental provisioning increased in the early 1500s. The mature economy of the 1500s meant that merchants had fewer opportunities for huge business successes (Goldthwaite 2009). Elites appear to have responded by formally shifting from partible inheritance to primogeniture (Emigh 2003; Goldthwaite 2009). They also reduced the number of sons allowed to marry and delayed the age at which those sons married (Johansson 1987). Meanwhile, after increasing 45 percent over the 1400s,
dowries shot up another 25 percent between 1500 and 1530 (Strocchia 2009). This increase in dowries contributed to a dramatic increase in the number of nuns, who represented just 0.45 percent of the population in 1338 but 5.2 percent of the population in 1552, numbers were dominated by young women from elite lineages (ibid.). As discussed above, these factors led to the disappearance of many elite lineages during the 1700s (Litchfield 1969). In this context, elite families that were able to give their offspring a greater likelihood of reproductive success or a stronger position in government office would have benefited greatly.

If palaces were an effort to preserve lineage status by signaling parents’ willingness to invest in offspring, do Florentine palaces have a modern analogue? My research began in part with a hunch that palaces were the ancestors of the so-called McMansions of the U.S. housing boom that started in the late 1990s. That housing boom—now viewed in hindsight as a bubble—was accompanied by a huge increase in the size of American houses. U.S. Census Bureau data indicate that the average U.S. house in 1973 measured 1,660 square feet, then increased to 2,521 square feet in 2007—a 52 percent increase that was probably driven in part by suburban houses nearly as large as the smaller Florentine palaces. This increase in size was accompanied by a colossal surge in the price of American houses between the late 1990s and about 2006. Many consumers used the increased value of their houses to purchase a huge range of consumer goods. Many of these goods—granite countertops, stainless steel appliances, and home entertainment systems—were justified as adding even more value to homes as investment properties (Mian and Sufi 2010), but consumers also used the perceived value of their homes to create what market researchers call the near-luxury market typified by goods
such as Starbucks coffee, Coach handbags, and C-class Mercedes-Benz automobiles (Gross 2003). When housing values collapsed, consumers stopped spending money on improvements (White 2009), and by 2011 houses were worth about what they were a century earlier when adjusted for inflation (Mulbrandon 2011), especially when the increase in average house size and features is considered (Harrison 2009). However, during the bubble years, homeowners viewed their houses as having real monetary value and attempted to convert that monetary value into goods. Florentine palaces, like McMansions, were large and costly, but there is one extremely important difference: Florentine elites did not view their palaces as investments and sold those palaces only under extreme duress for a fraction of their original construction costs. The large houses of the modern-day United States therefore appear to be a poor fit as modern counterparts to Florentine Renaissance palaces. However, there is an expenditure common to modern U.S. upper-income households that shares many attributes in common with both McMansions and Florentine palaces: sending offspring to expensive colleges and universities.

As with houses during the real estate bubble, the cost of higher education has increased dramatically in the past several decades: adjusted for inflation, tuition has more than doubled over the past 30 years (Gillen 2008). As with the real estate bubble, the increase in tuition has been made possible in part by the availability of low-interest loans (Harris 2011). Unlike housing before and after the bubble, however, higher education does have a measurable payoff in long-term earnings, so the decision by parents and their offspring to spend large amounts on tuition is economically rational: “The sustained and widespread increases in tuition indicate that they are, like the rise in housing prices, a
rational response to the circumstances faced by market participants. Schools charge ever more because they can, and students and their families pay ever more because the earnings differential between college–and high school–educated workers leads them to believe that a college degree is a good investment” (Gillen 2008, p. 8). Because of the steady increase in the cost of education, economists have recently begun debating whether higher education is a bubble (Daniel 2011; Lowrey 2011).

But what does higher education have in common with palaces? Like palaces, higher education has a purely functional ancestry (training individuals for specific high-skilled trades such as law and the clergy). Palaces were obviously available only to the wealthy, a condition that is increasingly true for higher education in the United States (Leonhardt 2011). And, most important, modern parents’ spending on higher education is similar to Florentine elite parents’ spending on palaces in that it ensures the preservation of wealth and status across generations (Goldstein 2011), despite the limited ability of college degrees to directly improve students’ abilities (Fang 2006; Miller 2009). And, to an even greater degree than palaces, college degrees are worthless if resold.

The issue of whether higher education is a costly signal of parental investment in offspring designed to preserve parents’ reproductive success and status across generations is obviously a subject too large to be examined in detail here. The point I wish to make is that during some but not all of the Florentine Renaissance, palaces were costly signals of wealth, and that modern U.S. college degrees may be a very similar phenomenon. This patterning strongly suggests that costly signaling in market-based complex societies is a pervasive but highly plastic source of human decision making, one that dynamically
adjusts signaling behavior to changes in signalers’ social, cultural, and economic environments.
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