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'Iconic Design' as Deadweight Loss: Rent Acquisition by Design in the Constrained London Office Market

Paul Cheshire (SERC, LSE)
Gerard Dericks (University of Oxford and SERC, LSE)

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Paul Cheshire* and Gerard Dericks**

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* Spatial Economics Research Centre, LSE
** University of Oxford and Spatial Economics Research Centre, LSE

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Abstract
Britain's land use regulation (planning) system imposes very tight restrictions on the supply of office space so creating substantial rents. An unmeasured part of the costs associated with these restrictions likely comes from compliance costs, one form of which could be rent-seeking activity (Krueger, 1974) of a gentlemanly form: employing a 'trophy architect' to get 'more rentable space' on a given site (Cheshire & Hilber, 2008). This paper finds evidence strongly supportive of this hypothesis. It employs an hedonic approach on a sample of offices sold between 1998 and 2011, defining trophy architects (TAs) as those who had won a major lifetime achievement award. Much of London is covered by absolute height restrictions but outside these areas we show that i) for a given site a building designed by a TA is more valuable, but ii) this only arises because a TA squeezes more space on a given site – an extra 19 stories, increasing the site value by an estimated 130 percent. Planning restrictiveness also varies within London by jurisdiction and the price of space is higher where restrictiveness is tighter. While these effects of trophy architects could be windfall gains to developers, we suggest a more likely interpretation is that they represent the additional but difficult to measure returns demanded for the extra risk and delays imposed by using a TA to try to game the system - hence a form of compliance cost and a deadweight loss associated with England's planning system.

Keywords: Land use regulation, regulatory costs, rent-seeking, office markets
JEL classification: H3, J6, Q15, R52

[the Minister]… "will only approve skyscrapers of exceptional design. For a building of this size to be acceptable, the quality of its design is critical… the proposed tower is of highest architectural quality" (Deputy Prime Minister of the United Kingdom, John Prescott, 2003)

1. Introduction

Tall buildings command a premium – often substantially greater than the cost of making them taller. The number of tall buildings per capita varies remarkably widely in cities around the world. We might expect there to be more in big cities, especially where such cities are crowded onto islands such as New York or Hong Kong or constrained by growth boundaries. But while the New York metro area is more than twice as populous as Hong Kong, Hong Kong has eight times as many skyscrapers[1] – buildings over 100 metres tall – per person than New York. Sao Paulo has less than half the incidence of skyscrapers per person as New York, but curiously nearly 1.75 times as many high rise buildings – buildings over 35 metres. A medium sized, provincial city such as Brisbane, Australia, has six times as many skyscrapers per person as Paris and eight times as many as London. Topping all cities in the tall buildings league table is a real surprise: Benidorm in Spain. This is a small city with some 71,000 residents but 1.15 times as many skyscrapers and nearly 17 times as many high rise buildings per resident as New York. In both these leagues, London, despite being the second largest in terms of population in its metro area and with one of the most tightly constraining growth boundaries in the world, comes right near the bottom. Sao Paulo, for example, with a comparable population has more than four times as many skyscrapers and nearly five times as many high rise buildings as London, while Houston, only 40% the size of London, has three and a half times as many skyscrapers per resident. The only tall building league London tops is the proportion of its skyscrapers designed by famous architects: on the definition used in this paper – nearly 25 percent compared to only 3 percent in Chicago and zero in Brussels or Benidorm. We will argue in this paper that while some of these across city differences are explained by size and some by topography a great deal is explained by regulation.

An increasing volume of literature demonstrates that British land markets, and especially those in England, are some of the most tightly regulated in the developed world (Cheshire and Sheppard, 2002, 2005; Evans and Hartwich, 2005; Cheshire and Hilber, 2008; Hilber and

[1] Information on the number of skyscrapers or high rise buildings by city is from http://www.emporis.com/; data on population are from official figures and estimated to comparable metro areas, represented by Functional Urban Regions or Metropolitan Statistical Areas.

Vermeulen, 2012; Cheshire *et al.* 2013). Land supply for urban development has been highly constrained since 1947 and supply for each legal category of use is separately regulated. There are also tight regulations on building heights throughout Britain. The British land use regulation system is, moreover, representative of a system in which all decisions about significant development proposals are subject to individual decision by a political process known as 'development control' leading to uncertain outcomes and lengthy bargaining (Ball, 2011). This is a quasi-judicial process and decisions can be appealed right up to national government with the final authority residing with the Cabinet minister responsible. The quotation at the head of this article is taken from such an appeal decision letter from the then responsible minister, John (now Lord) Prescott, deciding to override the rejection at the lower level and give development permission for the Shard – now the tallest building in London (indeed Europe).

Given such a system it was not surprising that Cheshire and Hilber (2008) found the regulatory burden on office development in London was the highest estimated for any location in Western Europe. The measure used was the Regulatory Tax (RT) - the difference between the price of office space and its marginal construction costs[2]. Expressed as a percentage tax on marginal construction costs, over the period 1999-2005 in London's West End, the RT averaged 809 percent (Cheshire and Hilber 2008). Even more surprisingly Cheshire and Hilber estimated an RT rate on offices in Birmingham - an economically depressed city in the British Midlands build on a flat plain – averaging 250% over 1999-2005. No researcher has reported that regulatory restrictions in the US impose any RT on commercial development – usually attributed to the localised fiscal system that generates significant incentives for local communities to bid for commercial development, often by providing property tax exemptions. Cheshire and Hilber (2008) provided evidence that regulatory restrictiveness was the main cause of the high values of RT observed in Britain, although the change of business property taxes in 1990 from a partly local to an entirely and transparently national tax had also played a measurable part.

We have, therefore, good evidence that the system of land use regulation in Britain raises the price of land available for development and creates very significant economic rents. As an example, if a landowner in many parts of southeast England could obtain permission to

[2] See Glaeser *et al*. (2005).

convert a hectare of agricultural land to housing its price would rise from some £10,000 to £8 million overnight (VOA, 2012). In an influential paper Krueger (1974) pointed out that if regulatory restrictions create economic rents, people and economic agents will compete for them and compete in a variety of ways ranging from outright illegality via, for example, bribery or extortion (think the privatisation of former Soviet industries) to various more gentle and legal ways.

Krueger's context was physical, quantitative restrictions on imports in developing countries controlled by licenses (although this was suggested as representative of a wider range of government imposed quantitative restrictions). Whatever form the competition for such licenses took, however, she further demonstrated that the competitive rent-seeking behaviour it induced represented a deadweight loss and the outcome was suboptimal in welfare terms. Specifically that quantitative restrictions not only led to an economy producing inside its transformation curve but that such quantitative restrictions, under all circumstances, led to an outcome in welfare terms lower than would have been associated with tariffs having an equivalent impact on trade.

Krueger's model translates almost precisely into the context of British land use planning. In Britain we impose very tight restrictions on quantities of land (and space, via height restrictions) for every economic use but do not impose significant taxes. As Cheshire and Sheppard (2003) showed it is possible to restrict urban land take for residential use by i) direct quantitative controls; ii) taxing the development of 'greenfield' sites; or even iii) by taxing transport costs. Again, the conclusion was that if the goal was to restrict urban land take to any given level, doing so by imposing a tax on land consumption or even taxing transport costs produced superior welfare outcomes to physical restrictions.

Despite the size of the economic rents potentially at stake, the British land use planning system appears to produce surprisingly few cases of proven corruption. The purpose of this paper is, however, to demonstrate that it does produce a more gentlemanly form of rent-seeking behaviour on the part of developers: the employment of 'trophy architects' (TA) to game the system and allow the developer to squeeze more lettable space onto a given site. We find that such TAs do this by being able to build taller. We further show that the ability to get more building space onto a given site interacts with the local restrictiveness of the planning system. Additional economic rents do not however arise from a higher price per square metre of space in a TA building: if anything such space is worth less, certainly for older buildings. The rents are acquired because buildings designed by TAs are systematically and very significantly bigger if located where there is any possibility of persuading decision makers to permit buildings to be taller.

We then compare the direct costs of TAs – their buildings turn out to be more expensive per floor to build – with the value of the extra space they generate. We find that they appear to represent a hugely profitable form of not just *rent-seeking* but *rent-acquisition* for the developer. The extent to which this implies a lower level of welfare to the community at large depends in part, however, on what social value – if any – TA-designed buildings generate. While there is evidence that housing designed by outstanding architects (Ahlfeldt and Maennig, 2010; Ahlfeldt and Mastro, 2011) can raise values for surrounding residents as well, our data do not suggest that this is the case with commercial buildings: not only do buildings designed by TAs not command a premium per m^2 but there is no evidence that, all else controlled for, being located with more listed buildings or more Conservation Area close-by increases a building's price.

A further issue is that we can only measure the direct costs associated with employing a TA, but it is likely that the British planning system imposes its own difficult to quantify costs due to the process of development control described above. Each stage of the planning decision is subject to uncertainty and appeal, and it is likely that large TA schemes will be subject to greater scrutiny and be appealed at every stage with a high probability that the final decision will ultimately be made by the Cabinet minister responsible. This adds legal costs and waiting time but also increases uncertainty implying developers would demand a higher realised rate of return when they successfully employ a TA as a means of getting permission to build extra space on a given site. Indeed if one were to make the opposite assumption – that there are no £50 notes lying around waiting to be picked up – then the rent we estimate for a representative site successfully developed using a TA is in fact a measure of these additional costs: costs which are the outcome of the value of the regulatory tax and, because decisions are not rule-determined but can be 'negotiated', of navigating the British planning system's decision-making process while subject to the extra uncertainty imposed by taking the TA route. Just as with rent-seeking behaviour these costs, however, will still be a deadweight loss in welfare terms.

We use a data set of 515 individual office buildings. Since some were transacted more than once we have observations on 625 sales. We defined 'trophy' architect designed buildings blind of the data and as objectively as possible: buildings by an architect who at the time planning permission was granted had already won the most prestigious lifetime achievement award from one of the three major architectural bodies: the RIBA Gold Medal, AIA Gold Medal and the Pritzker Prize. While certainly giving a clear definition of 'trophy' architect it had the disadvantage that it restricted the number of such buildings to 51. This total includes buildings which were not sold and also some which by our definition of TA sales feature only in the sample of transacted buildings. Given this quite small sample, that the results are as significant and robust as they prove to be, one might even say reinforces their credibility. We test for their robustness by re-running the main models systematically dropping the tallest, two tallest and three tallest TA buildings and find that results do not change in any significant way.

We are attributing causation: we believe the evidence very strongly supports the hypothesis that TAs are hired to game the planning rules and tend successfully to do so. The planning system in London is known to constrain the supply of office space (Cheshire & Hilber, 2008) and so generate 'rents' potentially available to those who successfully gain permission for extra office space. We also have qualitative evidence such as the quotation from the decision-making Cabinet minister with which we introduce the paper. So we would strongly argue that this interpretation of our findings – that the employment of TAs is essentially a form of rent seeking behaviour – is the obviously plausible interpretation. Further circumstantial evidence in support of this interpretation is given by the findings with respect to the variations in local restrictiveness in planning across the Boroughs of London both in terms of the size of buildings and their value per square metre. There are, however, other conceivable explanations for the observed fact that TA buildings are so much bigger all else controlled for and are thus able to more than double the residual value of a site. It could be that high profile companies want to make design statements and so both employ TAs and commission bigger buildings; or it could be that only TAs have the capability to design big buildings. We look for evidence to support either of these possibilities and in effect find none. In the city with the highest incidence of high rise buildings relative to population, Benidorm, there are none designed by TAs; in London, at the other extreme, a quarter of all skyscrapers are designed by TAs.

We start by showing that a TA building provides more floorspace on a given site all else equal, and that this extra floorspace comes from building taller. We then analyse the impact of a TA's building in terms of the price per m^2 of built space and in terms of the price per m^2 of site area. In Section 5, we compare the increase in the value of the built space on a representative site in the City of London associated with a TA to the costs employing a TA imposes on a developer. We find that a TA is likely to earn a handsome rent for the developer although this conclusion does assume that the planning outcome is certain when a TA is employed – perhaps far too strong an assumption. Section 6 briefly reviews evidence that might support alternative causal explanations for what we observe but does not find any to undermine our interpretation.

2. The Planning System in London

To understand how the rents we claim arise are generated and how prestigious design can be used to seek them, it is essential to understand some details of England's planning system and its particular features in London[3]. It rests on a process known as development control, exercised by the Local Planning Authority (LPA) which is the smallest governmental jurisdiction, in London, a Borough (although the Greater London Authority has some planning powers). There are 357 such LPAs in England and 14 within inner London. The framework and policies were established by the Town and Country Planning Act of 1947. This has been frequently added to and revised but to date not in ways which have changed its fundamental features. The main aims are to:

1. Contain urban development with growth boundaries and Greenbelts. These Greenbelts cover an area some 1.5 times that of all urban areas in England together;
2. Maintain green space within cities
3. Separate conflicting uses (such as residential and industrial);

[3]Planning in the three countries of Great Britain shares many features but there are specific differences, particularly in Scotland. There are also some particular features of planning in London, especially in the City of London and Docklands – see the text.

4. Require specific, legally defined, land use categories (such as retail, offices, light or heavy industry) to locate on particular sites or zones and allocate land and specific sites for those uses;
5. Since 1996 require new development of 'traditional town centre uses' (especially retail) to be on designated sites in town centres; making out of town, large format retail development, including malls, in effect impossible;
6. Restrict 'over-development' by means of 'plot ratios' – equivalent to Floor Area Ratios (FARs); despite this, since about 1990, planning policies have increasingly aimed at -
7. Densification – by building at higher densities and by means of targeting new development to 'brownfield' sites; the original 60% brownfield target has been exceeded;
8. Conservation of historic or interesting neighbourhoods or particular buildings either by means of; 'Conservation Area' status – where there are stringent restrictions to any development which would change the external appearance of an existing building or build taller than surrounding structures; by 'Listing' a particular building in which case restrictions on change are even tighter, covering internal as well as external appearance and structure; or by proximity to such structures or lying within protected long-distance viewing corridors of them.

While planning policy as currently observed was effectively established in 1947, there were earlier legal provisions with some features of planning going back to the 19th century. In London there were particular such provisions relevant to this paper. Before about 1875 finance and technology restricted building heights but the invention of lifts (elevators) and steel frames (see Turvey, 1998) allowed for much taller buildings. Height and building sizes first became strictly controlled in London following the London Council Act of 1890, which set a statutory limit of 27m plus two-storeys in the roof; decreased in 1894 to 24m and 6m to the rooftop (Inwood, 2005; Simon, 1996). Absolute height limits were introduced on grounds of safety as a result of lobbying from the London Fire Brigade who did not possess ladders long enough to evacuate taller structures[4]. Therefore neither skyscrapers – nor anything resembling skyscrapers – were built in London until after 1956, when the widespread

[4] Although urban legend has it that Queen Victoria took exception to tall buildings after the construction of Queen Anne's Mansions in 1873 blocked her view of parliament from Buckingham Palace.

availability of fire lifts made it impossible to continue to defend antiquated height restrictions.

Plot-ratio restrictions[5] introduced in the 1951 London County Council Development Plan remained in force, however. For most areas in London the allowable plot-ratio was 5:1, for central areas of the City, close to the Bank of England, the allowed ratio was 5½:1; for other areas, deemed sensitive to increased density, the restriction was set at 2:1 (City of London, 2010). Nonetheless these plot-ratios were regularly circumvented by developers skilled in exploiting loopholes in planning law such as the notorious Third Schedule (Marriott, 1989, p.171) and increasingly overridden by government dispensation (House of Commons, 2002). Thus it was not until the 1960s that any London building was allowed to be taller than St Pauls Cathedral – completed in 1710. Although these plot-ratios were gradually removed by LPAs during the 1980s and 1990s in favour of the current discretionary system of development control, to this day there are protected sight corridors along which no building may be higher than the base of the dome of St Pauls (see Figure 2), and additional height restricted zones specified for areas surrounding the London Monument, the Tower of London, the Thames River, and a number of historic and skyline features (City of London, 2012).

To summarise, therefore, the planning and related policies that are strictly relevant for the analysis in this paper are:

1. Decisions on development applications are rendered by means of 'development control' – so decisions to permit any legally defined development are discretionary and subject to appeal, rather than rule-governed, except for the rules identified in points 3 and 4 below. This process is quasi-judicial in character and ultimate power of decisions rests with the responsible Cabinet minister when the appeal process is exhausted[6];
2. Absolute height restrictions for 'safety reasons' prior to 1956;

[5] More commonly known outside the UK as floor-area ratios (FAR), plot-ratios are an implicit restriction on permissible building height.

[6] Development has a legal definition under the 1947 Act and subsequent amendments to that Act. In effect it relates to any change of use of an existing plot of land or building not exempt. Very small extensions or alterations outside Conservation Areas are exempt but all office construction or change of use from, say, a shop to an office even without physical alteration would constitute 'development' and need permission from the LPA.

3. Plot-ratios restricting the allowable floor area on a given site thereafter until the 1980s and 1990s;
4. Binding height restrictions within; Conservations Areas, Protected views of St Pauls, the Monument, the Tower of London, the Thames Policy area, and an absolute ban on the re-development of the numerous listed buildings in Central London.

3. Data

Descriptive statistics are shown in Tables 1 and 2.

3.1 Sample of buildings and sales

Data on office building characteristics and sale prices were obtained from Estates Gazette (EG) and Real Capital Analytics (RCA). Combined, the EG and RCA data sum to 2,932 unique sales in central and outer London between 1998 and 2011. This dataset however had to be cleaned and supplemented with additional information about individual buildings. Several 'offices' turned out to be small parts of buildings, above apartments, for example. We restricted the sample to buildings which were purpose-built office buildings or now predominately used as office space with only minor other uses – flats, shops or restaurants – within them. We also discarded all buildings – only a handful – outside Inner London[7], and sales which occurred less than 12 months following the previous sale (Clapp and Giacotto, 1999). The location of buildings in the sample is shown in Figure 1. The resulting final number of distinct buildings was 515 which, allowing for those sold more than once, yielded a total of 625 sales.

3.2 Trophy Architects

Architectural excellence is necessarily a subjective judgment but peer recognition seems the most objective measure available. We have taken the lifetime achievement awards from Royal Institute of British Architects (RIBA), the American Institute of Architects (AIA), and the Pritzker Prize as the most prestigious and obvious recognition of architectural excellence within the architectural community. We deem winners of these awards to be 'trophy architects' (TA). We adopt this term partly because if the purpose of employing a TA is to improve the developers' chances of building bigger, the lifetime achievement award will have strong signalling power of architectural merit to planners and politicians making

[7] For the relevant definition of Inner London see Dericks (2013).

decisions. For regressions on building size, buildings are recognised as designed by 'TAs' if the architect's first TA award was conferred *before* the building in question received planning permission. For the regressions involving building sales, a sale is defined as a TA sale if the architect received their first TA award *before* the building was sold. Additionally, for both the sales and size regressions the architect who won the relevant TA award must have been alive and working at the time the building was designed[8]. Given this additional criterion and the exclusivity of these awards the number of potential TA buildings is limited. Nevertheless we have been able to identify and acquire the necessary attributes on 43 TA buildings for the size analyses and 58 sales of such buildings during the period covered by our data[9]. Of the 43 buildings designed by TAs in the size sample, 7 were built before 1956 (between 1870 and 1928), and therefore in an era when available technology or statutory regulations absolutely restricted their height. These pre-1956 buildings are referred to as 'Pre-Modern' TA buildings in contrast to 'Modern' TA buildings. 15 of the 36 modern TA buildings are located outside a height protected area and so had potential flexibility with respect to their size via the process of development control and appeal.

3.3 Spatial units

Data has been assembled from various sources and for different spatial units. These include;

Administrative Regions: London LPAs, responsible, for example, for the implementation of planning policy. The sample of 515 buildings falls in ten LPAs of inner London corresponding to the primary locations of office buildings; the City of London, the City of Westminster, Tower Hamlets (containing the Docklands), Southwark, Lambeth, Kensington and Chelsea, Hammersmith and Fulham, Islington, Hackney, and Camden. Although the sample of 515 buildings is spread across 10 LPAs, 84% of the 515 are located in just four: the City of Westminster, Camden, Islington, and the City of London.

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[8] Notably the 'alive and working' stipulation removes all buildings in London designed by the prominent architectural firm Skidmore, Owings, & Merrill; three of whose principal partners would have been considered trophy architects while active.

[9] The 51 trophy architect buildings which comprise our 43 size and 58 sales observations were designed by; Norman Foster (14), Richard Rogers (8), Cesar Pelli (3), Denys Lasdun (3), Edwin Lutyens (3), Aston Webb (2), Renzo Piano (2), James Stirling (2), John Belcher (2), Thomas Edward Colcutt (1), Rem Koolhas (1), Jean Nouvel (1), Ieoh Ming Pei (1), Michael and Patricia Hopkins (1), Ralph Erskine (1), Howard Robertson (1), Albert Richardson (1), William Curtis Green (1), John James Burnet (1), Reginald Blomfield (1), and Alfred Waterhouse (1). The building size sample of TAs is not a subset of the building sales sample because some buildings had architects who had not yet won an applicable TA award at the time they were designed, but had done so by the time the building in question was sold.

Postcode sectors: these areas, much smaller than LPAs, were used to construct the employment density variable explained below. In Greater London 546 had a sampled property in, or within, 2km of its boundary. A map of these 546 postcode sectors and the locations of sampled buildings is shown in Figure 1.

GIS Data

Digital Ordinance Survey data was used to locate all stations, parks, public gardens and water ways or bodies of water. It was also used to calculate the area of the site on which each building was located and building footprints.

3.4 Planning data

Important to the work was information on the operation of the planning system and on the historic conservation designations discussed above. Data on Conservation Areas was acquired from English Heritage as was data on the 'Listed' status of buildings. Of the 515 buildings in the sample, 50% are located within a Conservation Area and 14% are Listed.

As Table 3 shows, a large percentage of the total land area in the four LPAs where the great majority of our sampled buildings were located is covered by Conservation Areas.

The variable *Conservation density 300m* was approximated by randomly adding one point for each $100m^2$ of Conservation Area within each Conservation Area's perimeter, with a minimum distance between points of 4m, and then calculating the number of points which fell into a 300m radius of each building. The variable *Listed building density 300m* was calculated by spatially matching the point map of Listed buildings from English Heritage with the Ordnance Survey containing a map of each building's site (or plot). Then a point was randomly placed within each Listed building's site for every $10m^2$ of its total area, with a minimum inter-point distance of 1m. The number of such points which fell within 300m of each office building in the sample was then summed to create the variable.

For the analyses of the effects of Height Protected Area status on building size, buildings are recognized as such if they were built within any of the following areas after the relevant height restriction came into force; Conservation Areas, St Pauls Heights Policy Area, Monument Viewing Corridors, Tower of London Local Setting, London Strategic Viewing Corridors, Thames Policy Area, or areas deemed sensitive due to proximity to historic or landmark structures. A current map of these areas is presented in Figure 2. For the price models, buildings were only defined as located in a Conservation Area if the building was located within a Conservation Area at the time of sale.

3.5 Parks and Gardens

A digital map of London's parks and gardens was acquired from English Heritage. The variable *Parks and gardens density* was calculated by placing a random point within the perimeter of each park or garden for each $10m^2$, with a minimum distance between points of 1m. Then the total number of points within a 300m radius of each office property was counted. This distance was chosen for *Parks and garden*, *Conservation*, and *Listed building density* as in each case it performed better in our hedonic model than 100m or 500m radii.

3.6 Planning Permission Refusal Rate

London Boroughs, the LPAs, have varying degrees of regulatory restrictiveness. We use data on office planning refusal rates from 1990 to 2008 for all ten Boroughs covering the 515 properties in the sample obtained from the data generated by Hilber and Vermeulen (2012). As has been discussed widely in the literature (Cheshire and Sheppard, 1989; Hilber and Vermeulen, 2012; or Cheshire *et al*. 2013) planning permission refusal rates are potentially endogenous. Since planning applications cost considerable resources would-be developers will likely adjust their application submissions depending on the expected restrictiveness of the LPA in question. Two London LPAs have exceptional planning regimes (the City of London and the Docklands – within the Borough of Tower Hamlets – but for most of its effective development covered by a special purpose planning authority – the London Docklands Corporation) so measured 'planning restrictiveness' may imply something rather different in these two areas. Both the issue of endogeneity and this caveat must be borne in mind. Because of the special planning regimes in the City of London and the Docklands, specific dummies are included in the building size models for these LPAs.

3.7 Employment Density

The most detailed statistics on the location of employment in London are those for postcode sectors from the NOMIS Annual Business Inquiry (ABI) Employee Analysis. This data begins in 2000 and the most recent collected for this analysis is for 2008. Following Wheaton *et al*. (1997) who found that the primary driver of office demand in London was financial and business services employment, we only include employment in those sectors in our measure;

that is from employees in 2003 SIC codes J or K, corresponding to banking, finance, business services and insurance. There is a structural break in the data between 2005 and 2006. We therefore re-scaled our 2006-08 post-code sector values *pro rata* using the scaling factor provided by the ONS for London SIC codes J and K.

Using the resulting data a map of employment density was constructed from the 546 postcode sectors mapped in Figure 1. Water features, Parks and Gardens, and the Barbican residential development were then removed to eliminate the areas where office employees could not be located. Then the number of points corresponding to the employment counts within the remaining boundaries of each of the 546 postcode sectors were randomly placed within each boundary for each year between 2000 and 2008, and then the number of employees within a radial buffer of 600m from each property at the year of sale was calculated. 600m was chosen after all employment densities between 100-1,000m in 100m increments, 1500m, and 2000m were separately tested in the hedonic model, and it was found that coefficient size and statistical significance peaked at 600m and declined monotonically in both directions from there. Previous empirical studies of the effect of employment density on value such as Arzaghi and Henderson (2008) or Jennen and Brounen (2009) found that employment within 500m of office buildings corresponded to the optimal radial bandwidth for New York and Amsterdam.

For our building size analyses, because the employment density measure was only available from 2000 while many of the buildings were built before the 20th century, the average 600m employment density between 2000 and 2008 is used as a proxy for the employment density relevant for the building at the time of construction.

For regressions utilising building sale-prices as the dependent variable, the corresponding employment density at the time of sale was calculated as a fractionally time-weighted average of the current (at time-of-sale) and previous year employment density levels, weighted *pro rata* according to the number of months elapsed between the sale and the month (September) that ABI surveys were administered. Buildings sold before September 2000 and after September 2008 are given, respectively, their 2000 and 2008 600m ABI employment density values.

We note that employment density as measured is to some extent definitionally endogenous with respect to building size since employment in the building in question is included in the postcode sector's employment count. So in effect, every building adds to its own density, and therefore big (occupied) buildings help cause higher density as measured in the ABI survey. In practice this effect is likely to be small, however, since the average employment count per 600m radial distance from each property over the period 2000-08 is 47,971 and a reasonable estimate of the average number of workers in a fully occupied building is 583[10] – or 1.22% of the total number of employees in the average 600m radial zone. There could also be an issue of endogeneity as a result of unobserved physical and environmental characteristics influencing the colocation of both employment and larger/more expensive office buildings. However, to the extent that these unobserved characteristics are correlated with employment density, this relationship merely serves to improve the function of employment as a 'portmanteau' control variable in our analyses (Ioannidis and Silver, 1999)[11].

3.8 Access to Labour Force

Access to the labour force is estimated by taking the distance in metres to the nearest underground or other rail station. Although simple, this statistically outperforms other apparently more sophisticated measures of buildings' accessibility to the labour force (see Dericks, 2013).

3.9 Submarket Area

Submarkets were defined according to Estates Gazette's market definition shown below.

City Core: EC1A, EC2M, EC2N, EC2R, EC2Y, EC2V, EC2A (only Finsbury Pavement, Finsbury Square, Appold Street and Chiswell Street), EC3, EC4 (excluding EC4A & EC4Y)

City Fringe: EC1M, EC1N (excluding postcode sector 2), EC1R, EC1V, EC1Y, EC2A (excluding Finsbury Pavement, Finsbury Square, Appold Street and Chiswell Street), E1

Southbank: SE1 postcode sectors, 0, 1, 2 & 9

Docklands: E14

[10] The average building size in the sample is 10,496m^2. If we take a very dense working environment of 18m^2 per worker, that leaves us with an average of some 583 workers per building

[11] Only if we were interested in the pure effect of employment density on building prices or size would this potential endogeneity need to be addressed.

Midtown: EC4A & EC4Y, EC1N (postcode sector 2), WC1, WC2 (excluding Leicester Square)

West End: W1, SW1, NW1 sectors 2 (Euston Road only), 3, 5 & 6, Leicester Square (WC2) and W2 sectors 1, 2 & 6

South Central: Remainder of SE1 and all of SE11

North Central: Remainder of NW1 and N1 and all of E8

West Central: Remainder of W2 and all of W6, W8, W14, SW3, SW5, SW6, SW7 & SW10

3.10 Building Characteristics

Data on building characteristics such as its age, the number of floors[12], the number of basements, single or multi-tenant, and air conditioning (A/C) was gathered from Estates Gazette, Real Capital Analytics, internet research, and site visits to each building. The quality measure comes from Estates Gazette, which grades each floor of a building either A or B. Buildings with only grade A space are graded as an A, both A and B space graded as A/B, and B space only is the omitted dummy variable.

Whereas most hedonic studies include a building's age and possibly a dummy variable indicating whether the building has ever been refurbished, we try here to use a more accurate measure for obsolescence by calculating the number of years at the time of sale since the building had been built or last refurbished. This variable is called *Depreciation Age*. Additionally, a dummy for the decade in which the building was constructed is included.

3.11 Time-Dummies

Time-dummies are fractionally time-weighted as set out in Dericks (2013), allowing the price change between 1997-98 to be estimated in spite of no observations sampled before 1998, and reducing temporal aggregation bias in price estimates (Geltner, 1993).

[12] Like employment density the number of floors may also be endogenous with respect to prices (see Koster *et al*, 2011). Although suitable instruments for the number of floors were not found, this should not be problematic as the focus of this study is not the estimation of the causal relation between floor height and sale price.

4. Analysis

4.1 Can TAs build bigger?

The first question is whether TAs have been able to build more office space on a given plot of land since 1956, when binding height restrictions were lifted. Before 1956 the height of a building – no matter who designed it – was fixed by either statutory regulations or technology so we do not expect to find any TA effect for buildings built before that year. We also do not expect to find that even the most acclaimed architects would have been able to flex the regulations governing the height and appearance of buildings built in a designated Height Protected Area[13]. We test this hypothesis for both height alone and for total floorspace relative to site size. The results are reported in Tables 4, 5 and 6. As will be obvious we are attempting to identify a TA effect off a small sample of, in effect, 15 buildings. This point is addressed below and in Tables A1 to A3.

Table 4 reports the results where total floorspace relative to site area is the dependent variable. Model 1 simply lumps all TA buildings together. We see that these buildings are indeed significantly bigger. Since we only expect TAs to be able to build bigger outside a Height Protected Area and after 1956, Model 2 interacts a Modern TA dummy for the building with built outside a Height Protected Area[14]. The results are stronger and the interacted TA effect is significant at the 1 percent level, while the uninteracted TA effect fades; confirming that the ability of a TA to get more space on a site is indeed confined to sites outside Height Protected Areas. We also see that buildings tend to have less floorspace on a given site the more restrictive the local planning system. Subsequent models add the decade in which the building was constructed, dummies for the City of London and Docklands, and then in Model (5), the local density of employment around the building. The basic results are confirmed – indeed become more significant.

Given the relatively small number of TA buildings outside a Height Protected Area there has to be concern as to the robustness of these findings. The results reported in Table A1 provide some robustness checks. We apply the quite stringent test of successively dropping the tallest TA building outside a Height Protected Area, then the second tallest and then the third tallest. Very reassuringly almost nothing changes – even parameter estimates – except obviously the

[13] Though we have found one exception - New Court, St Swithin's Lane by Rem Koolhas was built in a Conservation Area.

[14] Namely; (Building designed by TA) x (Outside Height Protected Area).

estimated extent of the additional floorspace a TA generates for a given site outside a Height Protected Area.

The way TAs succeed in getting more office space on a given site is revealed in Table 5. They are extremely successful at building taller. They can add on average 19 extra floors to a building outside a Height Protected Area. If we assume 4 vertical metres per floor, that would mean that office buildings built by a TA outside a Height Protected Area are on average 76m *taller* than buildings designed by standard architects. Recall that 30m was the maximum permissible total height of all buildings built between 1894 and 1956.

Corroborating results reported in Table 4, the un-interacted TA dummy has no effect on building height. It is only outside Height Protected Areas that TAs can successfully exert their influence on the planning system. Indeed within Height Protected Areas all office buildings tend to be lower and the effect of a more restrictive local planning regime disappears. Local employment density is significantly and positively related to building height. As before results are not affected by successively dropping the tallest buildings from the model (see Table A2).

That TAs are able to build taller buildings does not exclude the possibility that a part of their ability to get more floorspace on a given site stems from being able to squeeze a larger footprint for a given total site area too. The results for testing this idea are shown in Table 6, and it appears that if anything TAs in general build at lower footprint to site area ratios. The effect of other variables on the size of the building footprint relative to that of the site remain much as previous results would lead one to expect. More restrictive LPAs are still associated with smaller building footprints other things controlled for.

There is, of course, what might be thought of as a natural limit to the footprint/site area ratio: it cannot exceed a value of 1. But even here ingenuity by design could triumph. There is an interesting exception to this rule currently under construction in the City of London – the 36-floor 'Walkie-talkie' building designed by aspirant TA Rafael Viñoly. This building has a tapered base but bulges outwards towards its roof, and so while its footprint/site ratio is still restricted to a value of 1, its mean floorplate/site area ratio in fact exceeds that value.

4.2 What is the value associated with a TA?

Having established that where there is any flexibility in London's land use planning system, TAs are able to get more space on a given site by building a great deal taller than regular architects can, the issue is what value does this generate? More rentable space will add to the sale price of a building, other things equal, but other factors associated with TA design might increase construction costs, raise or reduce the rent per m^2 or increase maintenance costs. A less conventional layout might reduce the rent per m^2 or reduce the proportion of space that was lettable; unconventional building materials or design might impose additional maintenance costs (for example, the costs of cleaning angled windows in Norman Foster's 40-floor Gherkin building). There might also be a greater chance of the building becoming 'Listed' and therefore impossible to either adapt or redevelop – effectively freezing the use of the site in perpetuity and so eliminating any redevelopment option value.

We address this issue by means of a 'classic' hedonic model. We fully recognise the potential problems of omitted variables but our focus of interest is on several characteristics of buildings and their settings at the same time and also on specific price estimates. These allow us in the next section to compare the gross value of the 'rents' associated with employing a TA in a highly regulated environment with the costs of the TA. We have, however, made great efforts to seek out as wide a range of relevant control variables as possible to mitigate problems associated with omitted variables.

Results are reported in Tables 7 and 8. Note that whereas previously we have been analysing the physical characteristics of 515 buildings, the sample size now consists of the 625 sales of completed between 1998 and 2011. We are measuring 'price' in terms of the capital value of transacted buildings. White tests do not reject homoskedasticity, and so normal standard errors are reported.

The dependent variable in the models reported in Table 7 is the price per m^2 of the building – so we are abstracting from the size effect that TAs achieve. Models 1 to 4 of Table 7 are identical save that they variously include decade built and submarket dummies. In Model 1 we observe parameter estimates which in most cases conform to priors and are significant. Some wholly insignificant variables are not shown: for example in no models experimented with did the number of parking spaces have any significant effect on the price per m^2 of buildings. This is perhaps not surprising for London given the reliance on public mass transit for commuting to work and the congestion charge on cars using the central zone where almost all the buildings are located. Otherwise the price per square metre rises significantly as the restrictiveness of the local planning regime becomes tighter, the higher is local employment density, if the building is within a Conservation Area (but being surrounded by a higher density of Conservation Areas does not significantly affect the price), and the more Listed buildings there are in the local area. More area of parks and gardens around the building add to its value as does its height (there is, in London, a documented rental premium for higher floors briefly discussed in Cheshire and Hilber 2008; see Koster *et al.*, 2013 for a more detailed analysis), the better the state of the building and its reported quality. Not surprisingly price paid per m^2 rises with the proportion of the structure occupied and being let to a single tenant also increases value.

The impact of a building being Listed, while never substantial, varies with how the model is formulated. In the first two models being Listed suggests the building will have a higher value, but this effect disappears when submarket and the period of construction are controlled for. However, when TA is split between Modern and Pre-Modern, the Listed building premium again becomes significant. As the majority of Pre-Modern TA buildings are listed (5 of 7), it is possible that the Pre-Modern TA effect is confounding the earlier estimations of the Listed coefficient. Having more Listed buildings in the vicinity of the building sold seems to increase its value, but this effect disappears entirely when the 'black-box' submarket dummies are included. Perhaps the least expected finding is that proximity to rail stations has no significant effect on building price. This may be due to multicollinearity with the employment density measure, however. Not only is it likely that higher employment densities and rail stations tend to be co-located but there would be a clear issue of causation if we were trying to identify the impact of either on building values. Nevertheless local employment density is consistently significant; suggestive evidence of localised agglomeration economies.

The point of interest here, however, is the impact on price per m^2 of being designed by a TA. Looking at the first four models this appears to be entirely non-significant. It makes no statistically significant difference to the price per m^2 at all. However in Model (5), reported in the final column, when TA buildings are divided between modern and pre-modern there is a significant negative discount on price per square metre of pre-modern TA buildings. This discount may arise because such buildings are both obsolete in design *and* especially defended from modernisation due to their TA status. We also checked for possible interaction between the TA variables and the proportion of the building occupied on the grounds that TA design might impact on occupancy rates achieved at time of sale. There turned out to be no such affect so this source of possible bias is not relevant.

Thus TAs – at least those building in the modern era – do not appear to have any significant impact on the unit price of space in the buildings they design. But we have already seen that they achieve larger – notably taller – buildings on a given site if that site is not in a height restricted zone including Conservation Areas. So now let us turn to the impact that they have on the total value of a building on a given site. The results are reported in Table 8 where the dependent variable is the price paid for the building per unit area of its site.

The models follow closely those reported in Table 7 but include whether the building was inside a Height Protected Area when constructed and also interacts this with whether designed by a TA. In effect we are analysing here what net effect more space has on the total price paid for an office building on a given site.

Not very surprisingly given previous findings we observe that sites of a given area with TA buildings outside a Height Protected Area are worth significantly more: the buildings on such sites are taller so there is more lettable space in them. Inside Height Protected Areas TAs do not affect the price per m2 of sites in a statistically significant way although there is perhaps some indication that buildings designed by pre-modern TAs have a negative influence on site values; although never statistically significant, parameter values are consistently negative.

Other variables in Table 8 tend to be less significant than those for the unit price of space within buildings shown in Table 7. The positive effect of a more restrictive local planning regime continues to be associated with an increase in site values all else controlled for. Local employment density and local concentrations of parks and gardens remains significant as does the impact of the rated quality of space and the proportion occupied. However the ‘depreciation age’ is rather less significant and the impact of surrounding Listed buildings and Conservation Areas is weakened when period of construction and submarket area are controlled for.

We see that in all specifications the interactive benefit of a TA building built outside a Height Protected Area (and so getting those extra floors on a given site associated with such buildings) outweighs any potential drawbacks such as additional maintenance costs associated with its design. However the total effect on a building's price relative to the size of its site, if it is designed by a TA outside a Height Protected Area, is the value of the TA and 'TA outside Height Protected Area' coefficients summed. In the most preferred specification – reported as Model 4 – the net effect of these two factors is approximately 0.83, or, given the semi-log specification, roughly a 130% increase in building price for a given site size[15]. Buildings inside a Height Protected Area, however, do not get the extra floors associated with TAs outside these areas, and so there would be a net cost associated with employing a TA to design a building there.

We experimented[16] with including the number of above ground floors to see if this would, so to speak, steal the 'TA outside a Conservation Area' effect. It did – consistent with the previous interpretation of results reported in Table 8: that the extra value TAs achieve designing a building located outside a Height Protected Area stems from their ability to flex the planning system and build taller.

Finally (see Table A3) we tested the robustness of the results by successively dropping the tallest TA buildings from the sample. Table A3 Model 1 repeats the estimate of Table 8 Model 4. We can see from this table that as the tallest, then two and three tallest buildings, are dropped the estimates remain reassuringly unchanged and still significant. In effect the results are not sensitive to eliminating observations despite the relatively small number of TA buildings and despite dropping the tallest buildings selectively.

Taken together, although it appears that TAs have no significant influence on the price per unit of floorspace, because of the fact that they can stack more units of floorspace on a given amount of land they are, overall, able to increase the price of a building built on that land, so long as the site is outside a Height Protected Area where building height becomes in some sense, negotiable.

[15] See Kennedy (1981) for this calculation.
[16] Results available from the authors.

5. What is the net value of rents obtainable by design?

This, however, is only part of the story. TAs may be able to generate more value but they also cost more. From Table 5 we know that TAs outside a Height Protected Area can increase the number of floors in their buildings by approximately 19. This would mean that employing a TA would allow a developer to go from a typical allowable building height of 8 floors (our sample mean) to 27 floors. Just how valuable is this increase in floorspace to a developer once any extra costs, explicitly associated with TA building and design have been paid? In order to address this question we use data on; (i) permissible development area land cost, (ii) gross internal area construction costs for standard and TA designed office buildings by height, (iii) design fees for standard and trophy architects, and (iv) net-to-gross floorplate ratios by building height – that is the ratio of lettable space to gross internal area[17]. All office construction cost data were provided by the construction consultants Gardiner & Theobald. The hypothetical building in question is supposed to have a 1,600m^2 footprint (i.e. 40m a side squared), a 2,000m^2 site area (our sample mean), and to be located in the City of London[18].

The data from Gardiner & Theobald show that construction costs per m^2 rise fastest going from 20 to 30 floors, but are comparatively flat for buildings both below and above this height. This relationship is graphed in Figure 3 with the net lettable-to-gross floorspace ratio also shown as a function of the number of floors.

Adding land and design costs to construction costs gives us an estimate for the total building cost. However, TAs charge a premium compared to standard architects for their design fees, and the buildings they design will generally incur additional construction costs over-and-above that of a standard building. Figure 4 shows estimates of the total construction costs for a standard office building, and an expensive and 'cheap' TA office building. The expensive and cheap TA buildings assume upper and lower bound estimates for land and trophy construction costs, respectively.

[17] As buildings increase in height each floor must allocate a greater percentage of space to structural support, plant operations, and additional lifts. This requirement reduces the ratio of lettable floorspace to gross internal area as the building increases in height. For instance, using a reduced sample of 387 buildings, a regression of the number of lifts on the number of floors, holding footprint constant, shows that on average for every 5-floor increase in height, buildings are provided with 2 additional lifts (see Dericks, 2013). It is easy to see how as a building gets taller its lettable office space is gradually 'hollowed out' by these and other structural requirements.

[18] The City of London was chosen as it is the historic financial centre of London and one of two prominent tall building locations, the other being Canary Wharf (Docklands).

The next step derives estimates for the sale-price that can be achieved once a building is built and let. To construct these estimates we use the coefficients in Table 7, Model (5), and apply them to the sample means of the 165 buildings located in the City of London, or to the particular values assumed. Namely we assume that the building is designed by a TA, is outside a Height Restricted Area, is not listed, was built in the 2010s and is brand new (no depreciation age), has 1 basement floor, has A/C, and is Grade A office space – our highest designation. Other independent variables are assumed to be their sample means for the City of London. These values are shown in Table 9.

Using these assumed values combined with the time-dummy coefficient estimates from Table 7 we calculate an estimated sale-price/m^2 time-series for this hypothetical building at 8 and 27-floors across the study period. The results are displayed in Figure 5 along with estimates for the cost/m^2 of expensive TA and standard architect buildings by number of floors.

As we can see from the substantial gap between the estimated building price and cost of construction as represented in Figure 5, there appears to be a considerable rent to be earned from securing planning permission to build 'tall'; even when using a TA. This has been true regardless of market conditions since at least 1997. Note that in Figure 5, differences between 8 and 27-floor building costs £/m^2 are indistinguishable. This is because the fixed cost of land is divided among greater total floorspace in the 27-floor building, and therefore in spite of higher *construction* costs £/m^2, the 8 and 27-floor buildings *total* cost £/m^2 for each architect type is practically identical. Conservatively assuming a **£**8,000/m^2 price achieved in 2011[19,20]on our standardised City of London site, we find that an 8-floor standard architect building would earn profits of **£**56m while the 27-floor expensive TA building would earn profits of £129m: implying economic rents of **£**73m[21]. Since the two projects are mutually exclusive, if sufficient capital can be raised and if additional design and construction costs are in fact the only extra costs associated with employing a TA, then other things equal the 27-floor TA building is the superior investment[22].

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[19] At 2011 'prime' rent levels, £8,000/m^2 would suggest a very plausible yield of 6.78%. Source: Gardiner & Theobald.

[20] Year of sale and construction are assumed identical. However, since construction costs rise monotonically over the period, construction costs would be marginally lower than 2011 values for a new building sold in 2011 due to construction in fact beginning several years prior to 2011.

[21] See Table A10.

[22] The greater cost of capital was subsumed in construction costs.

These results are formalized in Figure 6. On the vertical axis we have marginal revenues from the sale of each additional floor[23]. On the horizontal access we have the number of floors in the building, which is a close approximation to the supply of space. f^r represents the normal height restriction imposed on buildings by local councils, which in the City of London is approximately 8-floors. f^t is the floor height achievable with a TA outside a Height Protected Area, which according to our estimates is 27-floors. f^{t*} and f^{s*} represent the number of floors required to equate marginal construction costs with marginal revenues of an additional floor for a trophy and standard architect designed building respectively: the heights at which building profits are maximised. In a partial equilibrium setting and using our cost data we find that standard-cost buildings will achieve profit maximisation at about 90-floors and TAs at about 84-floors. Profit from building $f^r = 8$-floors is $\pi^8 + \Pi^8$ (assuming with a standard architect), and profit from building $f^t = 27$ floors with a TA is $\Pi^8 + \Pi^{27}$. The additional cost of the 27-floor TA building arising as a result of the increased design and construction costs relative to the standard architect is $\pi^8 + \pi^{27}$. Therefore rents accruing to the $f^t = 27$-floor TA building for building tall are $\Pi^8 + \Pi^{27} - \pi^8 - \Pi^8 = \Pi^{27} - \pi^8$. The gross social costs attributable to height restrictions for a TA building of $f^{t*} = 84$-floors are supernumerary construction costs of $\pi^8 + \pi^{27} + \pi^{84}$ and a deadweight loss of Π^{84}, whereas for a standard architect building gross social costs are deadweight losses of $\pi^{27} + \Pi^{27} + \pi^{84} + \Pi^{84} + \pi^{90}$: which is equivalent to the total economic rents theoretically available to a flawless political entrepreneur.

Taking our office price and cost information and applying them to hypothetical standard and TA buildings of 8, 27, 84, and 90 floor heights respectively we can estimate the magnitude of these profits and social losses[24]. Using our data we find that; $\pi^8 =$ £3m, $\Pi^8 =$ £53m, $\pi^{27} =$ £5m, $\Pi^{27} =$ £76m, $\pi^{84} =$ £17m, $\Pi^{84} =$ £149m, and $\pi^{90} =$ £13m. This suggests that for a new TA office building in the City of London height restrictions prevent the developer and therefore society from realising gross gains of $\pi^{27} + \Pi^{27} + \pi^{84} + \Pi^{84} + \pi^{90} =$ £260m by restricting a standard architect to build 8-floors as opposed to profit maximising 90. TAs in the right location however are able to claw back some of these lost social gains through

[23] Note that Marginal Revenue per Floor is assumed to be downward sloping because the net lettable to gross floorspace ratio decreases with building height, and not because of assuming a downward sloping demand curve with respect to additional floors. Indeed this assumption is conservative given the rental premium obtainable from higher floors (Koster *et al*. 2013).

[24] Appendix 4: Calculating Economic Rents: TA Size Increases and Profitability.

height concessions from planners to the tune of some £73m[25]. These results are summarised in Table 10.

Of course this analysis is only for the gross costs of a single hypothetical building. As such it represents a partial equilibrium outcome, since if restrictions were relaxed the total supply of office space would greatly increase, the price of office space would fall, construction costs might rise, and optimal building heights would therefore decrease until the marginal cost of space was again in line with now lower marginal revenues. It is also important to repeat that the partial equilibrium estimation above omits any aesthetic or other external benefits which may arise from building height controls or the use of TAs. This last assumption is at least based on the observation the TAs neither add value per m2 to the buildings they design nor – as far as our data reveal – to surrounding office buildings.

In order to estimate the *net* social welfare loss/benefit associated with building height controls and the employment of TAs to appropriate resulting rents we would require hedonic estimation of the value of any external benefits and estimation of a general equilibrium model of office and construction markets. Although these further extensions are beyond the possibilities of the data, the high costs of the planning controls (£260m for an average building) arising from these extremely conservative estimates of office value in one of the most *permissive* local planning authorities in London (The City of London) point to significant potential problems with the current planning regime in terms of overall welfare generation.

Given the apparent substantial rents (£73m) to be earned from hiring a TA to build tall in non-Height Protected Areas, the natural question to ask is why developers do not all seek and acquire rents this way? The most likely answer is that of course there are no £50 notes lying around on the pavement, let alone £73 million pound notes. The estimates made so far assume no extra costs beyond those associated with actual construction. There are likely to be two additional and important sources of cost however. The first is extra costs negotiating a way through the process of development control ultimately to obtain permissions to build and the costs of delay this imposes. The second is more intangible. It is the higher expected rate

[25] Section 106 concessions allow the government to capture some of these potential rents from developers.

of return that would be required by the developer to offset for the greater risks that trying to game the planning regulations imposes. Above all the outcome will be more uncertain.

Kufner (2011) argues that planning applications for tall buildings in London require extra time to process and we provide some evidence in Tables 11 and 12 to support such claims. There is also likely to be a substantial increase in the uncertainty of the outcome. An increase in uncertainty associated with attempting to build higher using a TA will be translated by the developer into higher risk. Developers will therefore demand a greater expected return. Mayo and Sheppard (2001) refer to this type of costly, time-consuming, and uncertain process and outcome as 'stochastic development control'. They found that the regulatory variance (riskiness) of the development process was more important in reducing building supply than the actual length of planning delay. Furthermore, there may be additional planning costs when attempting to build exceptionally tall. For instance city planners generally require additional and more extensive impact assessments for tall buildings[26], legal assistance may be protracted, the architect may be asked to successively redesign the proposal at various stages of the planning negotiation[27], the planning authority may take additional time to deliberate[28], and permission may still be ultimately refused at the local or national level (Kufner, 2011). Therefore, in order to assess the actual profit incentives facing developers to hire TAs one should rescale expected returns by a discount rate commensurate with the additional planning risks and delays, and account for the additional costs of submitting a large scale development proposal to a local authority. Consequently the estimate above that £73 million in rents can be captured merely by hiring a TA is very substantially inflated. Indeed if the development process is a competitive one, then it could be that the most appropriate interpretation of the £73 million 'rents' acquired by employing a TA to develop in a non-Height Protected area of the City of London is, in fact, an estimate of the hidden compliance costs imposed by the British planning system. These costs are the result of an interaction between its use of a negotiable and so uncertain 'development control' process for making decisions and the tight

[26] Additional assessments are: impact on TV/radio and air traffic assessment; more extensive environmental impact, sunlight and daylight assessment; wind-tunnel assessment, London views management framework assessment (LVMF) and Tower of London world heritage site assessment. These assessments require consultation with: London City airport, BAA safeguarding team, Royal Parks, Mayor of London, Surveyor to the Tower of London, Surveyor to the Fabric of St Paul's Cathedral, International Council on Monuments and Sites (UNESCO), Design Council/CABE, adjoining LPAs on development which is likely to affect land in the LPA, LPAs with Strategic Views identified in LVMF.

[27] Powell (2006) for instance shows how at least 10 successive design proposals of Norman Foster's 'Gherkin' at 30 St Mary Axe were given to the City of London for review until their final approval.

[28] Kufner (2011) suggests that these additional regulatory demands increase the duration of the planning approval process for tall buildings by from 1 to 2.5 years.

restriction imposed on the supply of commercial space creating rents. To investigate this issue of uncertainty and greater costs in at least an illustrative way, data was obtained from the City of London on the development histories of six office buildings approved between 1999 and 2009. This sample of buildings was purposely split evenly between 'average' height and 'tall' buildings. Table 11 compares the proposed and accepted sizes of these buildings, and Table 12 shows their planning approval timeframes.

From Table 11 we see that both 'average' and 'tall' buildings may have their initially proposed sizes either increased or decreased before final planning approval although the variation observed for 'tall' buildings greatly exceeds that for the conventional ones. In Table 12, time elapsed to resolve the first planning application is perhaps the best metric for direct comparison of planning delay because once the first application has been accepted, future application approvals are generally processed more quickly[29]. Taking a look at planning application timescales, Table 12 appears to show that first applications for 'tall' buildings require between 6-18 months of additional deliberation before a decision and two of the three were ultimately decided by the Cabinet minister responsible whereas this was true of none of the normal buildings. Taken together with the additional assessment requirements noted in footnote 26, there appear to be substantial additional costs imposed by attempting to build tall. Unfortunately these various costs are so difficult to estimate with any certainty that our building cost consultants Gardiner & Theobald were unable to quote an expected value for them.

In addition to these planning costs and uncertainties associated with building tall there is a further possible complicating factor: the speed with which TA buildings can be let. The TA rents estimated here assume that upon sale the building will have achieved the same occupancy rate as the sample average (88%). Of course in reality new developments are likely to be speculative, and it is far from certain that the building will be fully let on completion. Indeed, major projects with planning permission are routinely paused or abandoned in London due to a failure to secure a sufficient number of pre-lets. Any

[29] Private communication with City of London Planning Authority to whom we are grateful for supplying this data.

difference in the ability of average compared to tall buildings to secure first tenants and then become fully-let may further offset apparent economic rents and so reduce actual profits[30].

We look at this – at least for this small sample of buildings – in Table 13. We see that, unsurprisingly, the bespoke (built for specific occupiers) Riverbank House and 'Gherkin' buildings were quick to obtain their first tenants. They achieved the fastest first and complete lettings of, respectively, the 'average' and 'tall' buildings. It took the 'tall' 'Gherkin' 69 more months to achieve this than the 'average' Riverbank House, however. Looking at the non-bespoke buildings the two other 'average' buildings achieved first lettings between 16-43 months and full lettings 28-60+ months *before* the other two 'tall' buildings. This small case study suggests that in general tall/large buildings do indeed struggle to secure full tenancy compared to their smaller counterparts.

Yet another possible way in which the employment of a TA might influence developers' expected revenues would be if TA buildings systematically conceded different rent-free periods in order to attract tenants. Note that since building sales can (and generally are) timed by developers to coincide with full occupation, exceptional rent-free concessions to TAs would not necessarily show up in the sale price/m^2 analysis of Table 7[31]; nevertheless such differentials would be relevant to any aspiring developer. However, the results reported in Appendix 2 provide no evidence that rent-free periods vary significantly between type of architect or the amount of space leased.

In sum, it appears that at least a substantial proportion of the additional £73m 'rent' estimated above needs to be set against identifiable additional costs and the additional time (6-18 months) and expense, incurred in obtaining planning approval for tall buildings, and the longer period required to fully let such a building (16-60+ months). Assuming the TA building could; (i) be let for rents of £538/m^2 per year[32], (ii) receive gradual lettings and a 24 month additional wait to fully let the building from construction start (taking a total of 48 months), and therefore sell it, and (iii) interest rates of 10%; the net cost to the developer of

[30] For instance, 'The Shard' 32 London Bridge didn't secure a single office tenant until nearly 10 months after its opening.

[31] Note that it is superfluous to test for increased rents in TA buildings, since any rental-price anomalies would directly translate into higher sale prices, which were not observed in Table 7.

[32] Source: Gardiner & Theobald. This assumption yields annual rents for our hypothetical 8 and 27-floor building of £2m and £5m/year if fully let.

this slower take-up would be the difference in the *gain* in total rental payments over the longer letting period of £8m, and the *cost* in additional interest payments on the construction loan of £22m. On net therefore, this letting delay costs the developer £14m. These results are summarised in Table 14. We then must also add the unquantifiable costs associated with the required higher rate of expected return to the developer to compensate for the risky business of going down the Trophy Architect route and trying to build tall rather than taking the much less risky route provided by a building of standard permitted heights. Assuming that developers cannot earn supernormal returns would suggest that these 'unquantifiable' costs are equivalent to £73m − £14m = £59m.

6. Causation

We have been arguing that the causal relationship is that planning restrictions are exceptionally tight in London making space scarce so that if it is possible to obtain a permission to put more lettable building space on a given site there is a potential 'rent' available to the developer and that the employment of a TA is a means by which developers can game the system to obtain such permission. Thus employing a TA is a rent-seeking mechanism. There are however at least two alternative possible explanations for our finding that TAs do provide very much more lettable space on a given site. The first might be that firms wanting to build prestigious buildings to make a statement may both build tall and employ a TA to do so. Another possibility might be that the technical skills required to design and build tall buildings are rare and highly skewed in their distribution to TAs. These two alternative causal explanations are explored in Appendix 3, where we have collected data on the bespoke status (that is buildings commissioned by a firm for its own occupation) of all the 'tall' – over 20 storey – buildings and modern TA buildings in London. We find no evidence that either tall or TA buildings are systematically more likely to be bespoke. Furthermore in Appendix 3, the second alternative explanation for our results – that only TAs have the capability to build tall – is also rejected. Table compares the tallest buildings in five international cities; selected because they are known to have less restrictive land use regulatory systems than London. In these five cities only 2.3% of tall buildings were designed by TAs compared to 24.3% in London. Moreover in the two least regulated cities, Brussels (which had the lowest estimated level of regulatory tax of any European office centre in Cheshire and Hilber, 2008) and Benidorm, not a single tall building was designed by a TA. Moreover, this second possible explanation can also be countered by noting that our very definition of TA buildings means that buildings which were designed by a TA before they won a relevant award are not considered to be 'TA buildings'. This fact means that in practice many buildings by the same designer have different 'TA' statuses.[33] Although architects can certainly gain skills as they progress throughout their career, it is unlikely that tall building know-how is always or even often gained simultaneously with 'trophy' recognition. Clearly the ability to design tall buildings is not a skill restricted to the architects we define as TAs.

7. Conclusion

We have come a long way to answering one of the questions posed at the start: why does the incidence of tall buildings vary so much across cities? London has very few because of very tight regulation combined with high costs in negotiating exceptions by using a TA. While it is a partial equilibrium result, the profit maximising height for a new office building in London, if such a building could be built employing a normal architect, would be 90 floors while normally new office buildings are only 8 floors. That such a tall building would be profit maximising reflects the restrictions on London's supply of office space investigated in Cheshire and Hilber (2008).

This paper provides evidence consistent with Krueger's 1974 analysis. If you have a system of regulation which imposes quantitative restrictions on the supply of some 'good' it will create rents. This provides an incentive for actors to try to appropriate those rents: rent-seeking behaviour. In the planning system operating in London we find that agents can appropriate those rents literally by design. They can employ TAs who, where the regime is at all flexible – that is in the areas not absolutely but discretionally regulated for height – can use their prestige or superior aesthetic skills to persuade planners and politicians to permit more building space on a given site, notably by allowing a taller building. We cannot discriminate between the alternative ways that TAs are able to persuade decision makers to allow them to build taller: it could be aesthetic quality – which is subjective, or it could be the signalling power of a major lifetime achievement award. 'Trophy' architect buildings, however, are a lot taller – 19 floors taller – on average. This is because the system is one in which each significant decision is in some sense negotiated. Even if the local jurisdiction

[33] One Canada Square (50F) and 25 Bank Street (33F) are two such buildings. Both were built by current TA Cesar Pelli, but only 25 Bank Street was constructed after Cesar Pelli had won a relevant award.

rejects the proposal (the evidence suggests there are repeated rejections, followed by negotiations, followed by revised proposals) there is still a process of appeal. This in turn can then be followed by an appeal to the national political process. The final decision-making power lies with the Cabinet minister responsible (now the Secretary of State for Communities and Local Government). To pursue an appeal so far is only worth it for very large and expensive proposed developments. The examples of the planning process illustrated in Tables 12 and 13 illustrate that at least in these instances two thirds of the proposals for tall buildings were determined at this level.

The extra space a TA can stack on a given site increases the overall sale-price of a typical building they design, on a typical site, by an average of 140% (from £82m to £197m). Using construction cost data from Gardiner & Theobald our results suggests that with a straightforward application of these additional revenues and allowing for the additional direct costs entailed in employing a TA with a building having the mean characteristics of such buildings, then the rent achievable on an average site in the City of London would be £73m.

However, while £73m may be a best estimate of the value of the rents that employing a TA appears to generate, it is at best a substantial overestimate of any 'profits'. This is because hiring a TA does not just involve additional direct design and construction costs – which we allow for – but it also involves a significantly longer, more complex and much more uncertain planning and letting process. These costs we cannot completely measure. We do not have data on how many TA buildings are conceived and on design plans commissioned but which are never even proposed. We do not have specific data on TA designed proposals which are unsuccessful. However we have measured an increase of 6-18 months in the average time between initial application and application acceptance, and increases in the time needed to achieve full occupancy of between 28-60+ months associated with tall TA as compared to normal architect buildings. This longer letting period appeared to cost a developer using a TA an additional expected £14m, but other costs were unquantifiable. Furthermore there will almost certainly be a higher discount rate applied for the extra risk and uncertainty that gaming the planning system likely entails. All these costs mean that the expected 'rent' acquired by TAs for a typical City of London site is much less than £73m. Indeed if we turn the telescope around the other way so to speak and assume now that large denomination bank notes are not lying around on the pavements of London to be picked up, the £73m could be interpreted as simply a measure of the costs imposed by the planning system if it is to be gamed successfully; a measure of the difference in compliance costs of building a normal building with a normal architect and a tall one using a TA.

The result that TAs do not increase the sale-price per square metre of office buildings may be new to the literature. Although previous studies have found a positive effect on the 'price' of both officially recognized and subjectively 'good' office architecture[34], these employed rents and not transaction prices as their dependent variable. As a result they may not have captured the additional costs associated with the ownership of an architecturally iconic building, including the increased chance in the British context that it would ultimately be added to a Conservation Area or Listed. If landlords can pass on some but not all of these additional costs to tenants, the result will be lower revenues and sale prices for owners in spite of higher rents for tenants. If true, this could reconcile the apparent paradox between this paper's findings and existing research. This interpretation is bolstered by the fact that when Fuerst *et al.*, (2011) use office sale-prices as opposed to rents they also fail to find a significant price effect for TAs[35]. It is, moreover, consistent with the finding of Eichholtz *et al*. (2010) that the bankable value of 'green buildings' lies in their energy saving properties, measured in Energy Star ratings, and not in their less tangible green characteristics as reflected by LEED certification.

Rent-seeking behaviour is, in welfare terms, a deadweight loss. However assuming that, consistent with our findings, TAs do not increase – even reduce – the per m^2 sale price of office buildings, the existence of external benefits to good architecture – for which we find some supporting evidence – implies that the gap between the sale price (internal benefits) of buildings with good architecture and the total benefits such buildings provide to the public may be positive and significant. To the extent that this is true, good architecture would be underprovided by the private market and developers would require external incentives to employ the services of TAs, and thereby (potentially) generate some additional external benefits; thus adding to total welfare derived from the stock of buildings. The way in which

[34] Hough and Kratz (1983), Vandell and Lane (1989).

[35] Fuerst *et al.* (2011) however did find a significantly positive price effect (17%) on their so-called 'signature architects': 63% of which comprised buildings designed by Skidmore, Owings, and Merrill: most of which would not be included in our measure of TAs because the principal architects who had won the relevant awards (Louis Skidmore (d.1962), Nathaniel Owings (d.1984), and Gordon Bunshaft (ret.1979): 1957, 1983 AIA Gold Medal, and 1988 Pritzker prize winners, respectively) were either dead or retired at the time the relevant buildings in Fuerst *et al.*'s sample were designed.

developers who hire TAs are able to flex London's regulatory regime to build taller could be regarded as just such an indirect subsidy, delivering more good architecture than would the market in the absence of regulation.

Whether this is welfare improving, however, is speculative and beyond the scope of this paper. We note that our evidence does not of itself show any external benefits associated with TAs' buildings. Rather it shows there is a possible premium paid per m^2 for office buildings with a greater density of Conservation Area and Listed buildings within a range of 300m. The statistical significance of both these variables disappears in our preferred specification, however: Model (5) – where we separate TAs into those building when height restrictions were not absolute and everywhere in London, and those building earlier – the 'Pre-Modern TAs'. Thus our data reveal no significant premium being paid by commercial purchasers of TA buildings, and at best ambiguous evidence for such a premium relating to a higher local density of Conservation Areas and Listed buildings. Consequently for the employment of TAs to be transparently adding to welfare at all, this value would have to be derived from the preferences and willingness to pay of tourists and the inhabitants of London. Here there appears to be some evidence suggesting that there may be such values, although compared to the costs we have estimated these are small (Ahlfeldt, 2013).

Certainly seeking and acquiring rents by employing a TA has costs, most of which (such as employing lawyers and planning specialists to pursue appeals against initial rejections) look like deadweight losses; and if there is a case for more high quality architecture than the market will deliver, this is almost certainly a suboptimal method of generating that increase. The current planning regime also delivers these rents more or less randomly to lucky developers and lucky TAs who succeed in flexing the regulations, and at a social cost for a single standard office building of at least £260m and likely orders of magnitude more for the land market as a whole.

TABLES

Table 1: Descriptive Statistics of Data used in Building Size Regressions

	N	Mean	Median	St. Dev.	Maximum	Minimum
TA Bldg	43	-	-	-	-	-
Modern TA	36	-	-	-	-	-
Pre-Modern TA	7	-	-	-	-	-
Modern TA Bldg Built outside Height Protected Area	15	-	-	-	-	-
Floorspace (m^2)	515	10,496	5,126	15,539	113,665	181
Above Ground Floors	515	8.06	7	6.52	87	2
Footprint (m^2)	515	1,683	1,031	1,711	10,689	61
Site area (m^2)	515	1,963	1,167	2,215	15,970	61
Floorspace/site area	515	4.85	4.54	2.80	26.20	0.35
Footprint/site area	515	0.93	1	0.15	1	0.09
Average Employment 600m	515	47,971	40,940	31,603	129,954	1,584
Located in Conservation Area	258	-	-	-	-	-
Built in Height Protected Area	118	-	-	-	-	-
Listed	70	-	-	-	-	-
Built Pre-1950s	167	-	-	-	-	-
Built 1950s	18	-	-	-	-	-
Built 1960s	31	-	-	-	-	-
Built 1970s	33	-	-	-	-	-
Built 1980s	83	-	-	-	-	-
Built 1990s	77	-	-	-	-	-
Built 2000s	98	-	-	-	-	-
Built 2010s	8	-	-	-	-	-
Local Planning Authority						
Camden	50	-	-	-	-	-
City of London	165	-	-	-	-	-
Westminster	188	-	-	-	-	-
Hackney	5	-	-	-	-	-
Hammersmith	11	-	-	-	-	-
Islington	32	-	-	-	-	-
Kensington	5	-	-	-	-	-
Lambeth	6	-	-	-	-	-
Southwark	26	-	-	-	-	-
Tower Hamlets	13	-	-	-	-	-
Docklands	14	-	-	-	-	-

Table 2: Descriptive Statistics of Data used in Hedonic Regressions

	N	Mean	Median	St. Dev.	Maximum	Minimum
TA Bldg	58	-	-	-	-	-
Modern TA	42	-	-	-	-	-
Pre-Modern TA	16	-	-	-	-	-
Modern TA Bldg Built outside Height Protected Area	16	-	-	-	-	-
Price (£m)–	625	72.03	34.50	113.88	1,111.90	1.45
Price (£)/ Floorspace (m^2)	625	7,012	6,485	3,263	25,477	1,608
Price (£)/ Site area (m^2)	625	34,219	28,549	25,899	258,718	1,768
Floorspace (m^2)	625	10,296	5,758	13,717	113,665	181
Above Ground Floors	625	7.88	7	5.11	45	3
Footprint (m^2)	625	1,749	1,200	1,611	9,128	66
Site area (m^2)	625	2,002	1,415	1,963	13,571	66
Floorspace/site area	625	4.82	4.60	2.58		
					26.20	0.35
	625	0.93	1	0.15	1	0.09
Footprint/site area						
Employment Density 600m	625	50,868	45,291	33,069	141,964	2,117
Within Conservation Area	349	-	-	-	-	-
Built in Conservation Area	143	-	-	-	-	-
Listed	79	-	-	-	-	-
Built Pre-1950s	196	-	-	-	-	-
Built 1950s	26	-	-	-	-	-
Built 1960s	32	-	-	-	-	-
Built 1970s	38	-	-	-	-	-
Built 1980s	103	-	-	-	-	-
Built 1990s	116	-	-	-	-	-
Built 2000s	112	-	-	-	-	-
Built 2010s	2	-	-	-	-	-
Local Planning Authority						
Camden	59	-	-	-	-	-
City of London	216	-	-	-	-	-
Westminster	217	-	-	-	-	-
Hackney	4	-	-	-	-	-
Hammersmith	16	-	-	-	-	-
Islington	37	-	-	-	-	-
Kensington	4	-	-	-	-	-
Lambeth	5	-	-	-	-	-
Southwark	33	-	-	-	-	-
Tower Hamlets	20	-	-	-	-	-
Docklands	14	-	-	-	-	-
Submarket						
City Core	188	-	-	-	-	-
City Fringe	51	-	-	-	-	-
Docklands	14	-	-	-	-	-
Midtown	99	-	-	-	-	-
North Central	13	-	-	-	-	-
South Central	13	-	-	-	-	-
Southern Fringe	25	-	-	-	-	-
West Central	20	-	-	-	-	-
West End	202	-	-	-	-	-
Year Sold						
1998	4	-	-	-	-	-
1999	9	-	-	-	-	-
2000	15	-	-	-	-	-
2001	30	-	-	-	-	-
2002	26	-	-	-	-	-
2003	38	-	-	-	-	-
2004	53	-	-	-	-	-
2005	57	-	-	-	-	-
2006	83	-	-	-	-	-
2007	95	-	-	-	-	-
2008	43	-	-	-	-	-
2009	63	-	-	-	-	-
2010	81	-	-	-	-	-
2011	28	-	-	-	-	-

Table 3: Conservation Areas in central London boroughs

	Number of areas	Percent of total area covered	First introduced
City of Westminster	55	75%	1967
Camden	39	50%	1968
Islington	40	50%	1968
City of London	26	33%	1971

Table 4: Can TAs Build Bigger? Dependent variable total floorspace/ site area

VARIABLES	(1) Floorspace/ Site area	(2) Floorspace/ Site area	(3) Floorspace/ Site area	(4) Floorspace/ Site area	(5) Floorspace/ Site area
Modern TA outside Height Protected Area		8.733***	8.098***	6.798***	6.626***
		(1.772)	(1.546)	(1.602)	(1.599)
TA	3.700***	0.624*	-0.134	-0.110	-0.137
	(0.908)	(0.367)	(0.361)	(0.376)	(0.376)
Built in Height Protected Area	-0.580**	-0.148	-0.753***	-0.592***	-0.666***
	(0.225)	(0.174)	(0.224)	(0.208)	(0.209)
Average Office Permission Refusal Rate	-10.27***	-10.16***	-8.405***	-11.73***	-11.25***
	(1.717)	(1.603)	(1.498)	(3.380)	(3.201)
Built 1950s			-0.000857	0.0276	0.115
			(0.367)	(0.370)	(0.358)
Built 1960s			0.553	0.612	0.743
			(0.527)	(0.517)	(0.523)
Built 1970s			0.580*	0.556*	0.675**
			(0.317)	(0.321)	(0.319)
Built 1980s			0.541	0.340	0.394
			(0.353)	(0.277)	(0.273)
Built 1990s			0.889***	0.714***	0.711***
			(0.249)	(0.253)	(0.252)
Built 2000s			1.761***	1.591***	1.666***
			(0.260)	(0.256)	(0.254)
Built 2010s			5.425***	5.688***	5.656***
			(1.646)	(1.818)	(1.857)
City of London				-0.377	-1.166**
				(0.449)	(0.512)
Docklands				3.380*	3.497**
				(1.766)	(1.748)
Average Employment 600m					1.56e-05***
					(5.02e-06)
Constant	5.549***	5.442***	4.806***	5.198***	4.643***
	(0.192)	(0.184)	(0.182)	(0.429)	(0.443)
Observations	515	515	515	515	515
R-squared	0.197	0.378	0.453	0.487	0.498

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Can TAs Build Taller? Dependent variable: No. of floors above ground level

VARIABLES	(1) Floors	(2) Floors	(3) Floors
Modern TA outside Height Protected Area	21.11***	18.93***	18.77***
	(3.956)	(4.585)	(4.669)
TA	0.397	0.424	0.400
	(0.868)	(0.888)	(0.887)
Built in Height Protected Area	-1.969***	-1.679***	-1.746***
	(0.424)	(0.395)	(0.402)
Average Office Permission Refusal Rate	-2.770	-5.988	-5.553
	(3.585)	(8.580)	(8.602)
Built 1950s	1.133***	1.151***	1.230***
	(0.376)	(0.388)	(0.373)
Built 1960s	4.802***	4.886***	5.005***
	(1.333)	(1.315)	(1.327)
Built 1970s	3.580***	3.509***	3.616***
	(0.858)	(0.879)	(0.892)
Built 1980s	1.501**	1.138**	1.187**
	(0.703)	(0.506)	(0.513)
Built 1990s	1.904***	1.571***	1.569***
	(0.452)	(0.481)	(0.481)
Built 2000s	3.144***	2.834***	2.902***
	(0.416)	(0.404)	(0.411)
Built 2010s	17.33***	17.74***	17.71***
	(6.485)	(6.738)	(6.804)
City of London		-0.316	-1.030
		(1.088)	(1.204)
Docklands		5.800	5.906
		(4.068)	(4.089)
Average Employment 600m			1.41e-05
			(1.23e-05)
Constant	6.151***	6.521***	6.019***
	(0.353)	(1.034)	(1.121)
Observations	515	515	515
R-squared	0.548	0.565	0.567

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Can TAs Get a Bigger Building Footprint?

VARIABLES	(1) Footprint/ Site area	(2) Footprint/ Site area	(3) Footprint/ Site area	(4) Footprint/ Site area
Modern TA outside Height Protected Area	0.0172	-0.0148	-0.0342	0.0202
	(0.0629)	(0.0699)	(0.0690)	(0.0668)
TA	-0.0613**	-0.0571**	-0.0601**	-0.0590**
	(0.0260)	(0.0274)	(0.0257)	(0.0262)
Built in Height Protected Area	0.0586***	0.0577***	0.0495***	0.0444***
	(0.0162)	(0.0171)	(0.0167)	(0.0171)
Average Office Permission Refusal Rate	-0.686***	-1.402***	-1.348***	-1.364***
	(0.119)	(0.406)	(0.372)	(0.369)
Built 1950s	-0.0336	-0.0250	-0.0153	-0.0117
	(0.0338)	(0.0323)	(0.0317)	(0.0320)
Built 1960s	-0.157***	-0.152***	-0.137***	-0.122***
	(0.0448)	(0.0443)	(0.0455)	(0.0439)
Built 1970s	-0.152***	-0.144***	-0.131***	-0.120***
	(0.0369)	(0.0365)	(0.0351)	(0.0353)
Built 1980s	-0.0818***	-0.0797***	-0.0737***	-0.0702***
	(0.0195)	(0.0204)	(0.0194)	(0.0197)
Built 1990s	-0.0739***	-0.0682***	-0.0686***	-0.0640***
	(0.0196)	(0.0217)	(0.0207)	(0.0212)
Built 2000s	-0.0473***	-0.0446**	-0.0362*	-0.0277
	(0.0180)	(0.0200)	(0.0200)	(0.0210)
Built 2010s	-0.0982**	-0.0839**	-0.0876*	-0.0362
	(0.0395)	(0.0394)	(0.0466)	(0.0566)
City of London		-0.0946**	-0.183***	-0.186***
		(0.0467)	(0.0512)	(0.0509)
Docklands		0.0512	0.0644	0.0815
		(0.0484)	(0.0475)	(0.0550)
Average Employment 600m			1.75e-06***	1.79e-06***
			(3.75e-07)	(3.72e-07)
Floors				-0.00290
				(0.00256)
Constant	1.034***	1.122***	1.059***	1.077***
	(0.0119)	(0.0456)	(0.0411)	(0.0445)
Observations	515	515	515	515
R-squared	0.173	0.191	0.236	0.243

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: What do TAs yield in price/m^2 of building? Dependent variable: ln(price/m^2)

VARIABLES	(1) Ln(Price/ Sqm)	(2) Ln(Price/ Sqm)	(3) Ln(Price/ Sqm)	(4) Ln(Price/ Sqm)	(5) Ln(Price/ Sqm)
TA	0.0469	-0.0522	0.0728	-0.0157	
	(0.0567)	(0.0562)	(0.0504)	(0.0501)	
Modern TA					0.0645
					(0.0615)
Pre-Modern TA					-0.168**
					(0.0846)
Within Conservation Area	0.0916**	0.0698*	0.0143	0.0128	0.00931
	(0.0361)	(0.0361)	(0.0326)	(0.0324)	(0.0324)
Listed	0.112**	0.102**	0.0569	0.0646	0.0770*
	(0.0483)	(0.0515)	(0.0428)	(0.0455)	(0.0457)
Ln(Office Permission Refusal Rate 9yr Moving Average)	0.0433***	0.0464***	0.0198	0.0232*	0.0240*
	(0.0130)	(0.0125)	(0.0143)	(0.0138)	(0.0137)
Ln(Employment 600m)	0.0891***	0.0721***	0.202***	0.186***	0.185***
	(0.0262)	(0.0254)	(0.0328)	(0.0316)	(0.0315)
Ln(Conservation Area Density 300m)	-0.0299*	-0.0281	0.00351	-0.000715	0.00244
	(0.0179)	(0.0176)	(0.0172)	(0.0168)	(0.0168)
Ln(Listed Building Density 300m)	0.0735***	0.0777***	0.0216	0.0277	0.0288
	(0.0182)	(0.0177)	(0.0195)	(0.0189)	(0.0188)
Ln(Park and Garden Density 300m)	0.0196***	0.0170***	0.0143***	0.0129***	0.0124***
	(0.00421)	(0.00409)	(0.00411)	(0.00397)	(0.00396)
Ln(Nearest Rail Station Distance)	0.0304	0.00749	-0.000238	-0.0170	-0.0185
	(0.0295)	(0.0287)	(0.0265)	(0.0258)	(0.0257)
Ln(Number of Above-Ground Floors)	0.152***	0.184***	0.0651	0.0915**	0.0782*
	(0.0491)	(0.0508)	(0.0442)	(0.0457)	(0.0460)
Ln(Depreciation Age)	-0.0180***	-0.00795	-0.0186***	-0.00856	-0.00957
	(0.00675)	(0.00691)	(0.00594)	(0.00606)	(0.00606)
Ln(Basements/Total Floors)	-0.00649	-0.0144*	-0.00967	-0.0160**	-0.0147**
	(0.00834)	(0.00817)	(0.00734)	(0.00721)	(0.00720)
A/C	0.292***	0.230***	0.200**	0.163**	0.176**
	(0.0875)	(0.0856)	(0.0776)	(0.0758)	(0.0758)
EG Office Grade A/B	0.0784*	0.0793*	0.0775*	0.0705*	0.0682*
	(0.0457)	(0.0459)	(0.0404)	(0.0404)	(0.0403)
EG Office Grade A	0.143***	0.0892**	0.145***	0.0906**	0.0893**
	(0.0407)	(0.0417)	(0.0361)	(0.0369)	(0.0368)
Ln(Percent Occupied)	0.0236***	0.0151*	0.0237***	0.0165**	0.0156**
	(0.00836)	(0.00812)	(0.00738)	(0.00716)	(0.00714)
Single Tenant	0.0532	0.0936***	0.0565*	0.0935***	0.0910***
	(0.0354)	(0.0348)	(0.0311)	(0.0306)	(0.0305)
Decade Built	NO	YES	NO	YES	YES
Submarket	NO	NO	YES	YES	YES
Year Sold	YES	YES	YES	YES	YES
Constant	5.882***	6.215***	5.060***	5.335***	5.306***
	(0.524)	(0.508)	(0.524)	(0.508)	(0.507)
Observations	625	625	625	625	625
R-squared	0.335	0.394	0.497	0.542	0.546

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: What Value does a TA add to a site? Dependent variable: ln(price/site area m^2)

VARIABLES	(1) Ln(Price/ Site area)	(2) Ln(Price/ Site area)	(3) Ln(Price/ Site area)	(4) Ln(Price/ Site area)
Modern TA outside Height Protected Area	0.759***	0.723***	0.730***	0.701***
	(0.222)	(0.209)	(0.201)	(0.193)
Modern TA	0.280***	0.0820	0.306***	0.135
	(0.0762)	(0.0803)	(0.0813)	(0.0842)
Pre-Modern TA	-0.165	-0.171	-0.269	-0.261
	(0.170)	(0.162)	(0.188)	(0.185)
Within Conservation Area	-0.0218	-0.0205	-0.116**	-0.111
	(0.0595)	(0.0800)	(0.0557)	(0.0749)
Built in Height Protected Area	-0.110*	-0.150*	-0.0326	-0.0596
	(0.0653)	(0.0893)	(0.0570)	(0.0834)
Listed	0.0417	0.0325	0.00597	-0.00913
	(0.0660)	(0.0681)	(0.0620)	(0.0658)
Ln(Office Permission Refusal Rate 9yr Moving Average)	0.0543***	0.0575***	0.0321*	0.0335*
	(0.0186)	(0.0182)	(0.0192)	(0.0182)
Ln(Employment 600m)	0.288***	0.273***	0.257***	0.243***
	(0.0469)	(0.0453)	(0.0546)	(0.0535)
Ln(Conservation Area Density 300m)	-0.101**	-0.113**	-0.0281	-0.0458
	(0.0475)	(0.0484)	(0.0339)	(0.0345)
Ln(Listed Building Density 300m)	0.115***	0.127***	0.0644*	0.0747**
	(0.0436)	(0.0448)	(0.0351)	(0.0366)
Ln(Park and Garden Density 300m)	0.0322***	0.0297***	0.0161***	0.0151***
	(0.00531)	(0.00535)	(0.00562)	(0.00566)
Ln(Nearest Rail Station Distance)	0.0217	-0.00655	-0.00173	-0.0241
	(0.0449)	(0.0467)	(0.0449)	(0.0466)
Ln(Depreciation Age)	-0.0262***	-0.0131	-0.0247***	-0.0120
	(0.00879)	(0.00911)	(0.00803)	(0.00852)
Ln(Basements/Total Floors)	0.00366	-0.00871	0.00415	-0.00729
	(0.0121)	(0.0117)	(0.0112)	(0.0106)
A/C	0.551***	0.510***	0.453***	0.435***
	(0.116)	(0.118)	(0.146)	(0.144)
EG Office Grade A/B	0.346***	0.349***	0.302***	0.306***
	(0.0596)	(0.0597)	(0.0563)	(0.0563)
EG Office Grade A	0.425***	0.365***	0.379***	0.331***
	(0.0569)	(0.0560)	(0.0537)	(0.0533)
Ln(Percent Occupied)	0.0340**	0.0251**	0.0326**	0.0251**
	(0.0140)	(0.0127)	(0.0131)	(0.0125)
Single Tenant	0.0158	0.0630	0.0198	0.0602
	(0.0473)	(0.0459)	(0.0442)	(0.0439)
Decade Built	NO	YES	NO	YES
Submarket	NO	NO	YES	YES
Year Sold	YES	YES	YES	YES
Constant	5.906***	6.408***	6.154***	6.636***
	(0.637)	(0.641)	(0.640)	(0.661)
Observations	625	625	625	625
R-squared	0.489	0.529	0.580	0.609

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: City of London means about assumed values

Variable	Values assumed floor bldg
Modern TA	e†
Within Conservation Area	1‡
Listed	1
Office Permission Refusal Rate	0.28%
Employment Density 600m	84,942
Conservation Area (100m^2) within 300m	1,209
Listed Buildings (100m^2) within 300m	362
Parks & Gardens (100m^2) within 300m	54
Distance to Nearest Station (m)	226
Above Ground Floors	8/27
Depreciation Age (yrs)	1
Basements	1
A/C	e
Office Space Grade A	e
Percent Occupied	88%
Single Tenant	e

†ln(e)=1, i.e. the dummy variable is indicated in log form.
‡ln(1)=0, i.e. the dummy variable is not indicated in log form.

Table 10: Development Profits and Rents

8F Standard Architect Profit	$\pi^8 + \Pi^8$	£56m
27F TA Profit	$\Pi^8 + \Pi^{27}$	£129m
TA Rents	$\Pi^{27} - \pi^8$	£73m
Potential Economic Rents / Gross Social Loss	$\pi^{27} + \Pi^{27} + \pi^{84} + \Pi^{84} + \pi^{90}$	£260m

Table 11: Planning Histories Building Size

Building	Address	TA	Initial Floors Proposed	Final Floors Accepted	Initial Floorspace m^2 Proposed	Final Floorspace m^2 Accepted	Percentage Floorspace Change
Clements House	20 Gresham Street	NO	8	8	32,396	32,022	-1%
Riverbank House	2 Swan Lane	NO	11	11	39,567	42,291	+7%
Premier Place	2-5 Devonshire Square	NO	9	9	27,000	23,226	-14%
Heron Tower	110 Bishopsgate	NO	34	46	32,516	42,873	+24%
'Gherkin'	30 St Mary Axe	YES	90	40	285,658	47,035	-84%
'Walkie-Talkie'	20 Fenchurch Street	NO	42	36	91,000	84,913	-7%

Table 12: Planning Histories Building Approval

Building	Address	Number of Applications Submitted	Number of Applications Approved	Average Time to Decision (Months)	First Application Time to Decision (Months)	Initial Application Consultation	Permission granted by Cabinet minister responsible
Clements House	20 Gresham Street	3	3	10.0	10	12/1997	NO
Riverbank House	2 Swan Lane	2	2	7.5	10	06/2002	NO
Premier Place	2-5 Devonshire Square	5	5	2.6†	4	02/1997	NO
Heron Tower	110 Bishopsgate	2	2	14.5	22	07/1999	YES
'Gherkin'	30 St Mary Axe	2	1	14.5	16+‡	02/1996	NO
'Walkie-Talkie'	20 Fenchurch Street	2	2	13.5	16	05/2005	NO

†Simultaneous applications were submitted and decided concurrently.
‡Application withdrawn after 16 months of deliberation.

Table 13: Planning History Lettings

Building	**Address**	**Bespoke Development**	**Construction Start†**	**Date First Tenant Signed**	**Months to First Tenant from Const. Start**	**Date Building Fully Let**	**Months to Full Occupation from Const. Start**
Clements House	20 Gresham Street	NO	06/2006	05/2008	23	06/2010	48
Riverbank House	2 Swan Lane	YES	09/2009	10/2006	-35	10/2006	-35
Premier Place	2-5 Devonshire Square	NO	07/1999	11/2000	16	11/2000	16
Heron Tower	110 Bishopsgate	NO	07/2007	10/2010	39	NOT YET	76+*
'Gherkin'	30 St Mary Axe	YES	07/1995	06/1998**	34	06/1998	34
'Walkie-Talkie'	20 Fenchurch Street	NO	07/2007	06/2012	59	NOT YET	76+***

†Construction is considered to have started once demolition of the previous building commenced.
* Completed 03/2011; only 45% let as of 02/2013; 63% let as of 09/2013.
**100% effectively let through purchase of scheme by Swiss RE on 06/1998 conditional on planning permission which was later granted 08/2000.
***Completion expected 01/2014: construction paused between 04/2009-02/2011; 57% pre-let as of 09/2013.

Table 14: Quantifiable costs of delay

	Total rents received until sale	**Extra financing cost**	**Net quantifiable costs of delay**
8-floor standard architect	£2m after 24months	£25m×10%×2 years= £5m	-
27-floor trophy architect	£10m after 48months	£68m×10%×4 years = £27m	-
Difference	+£8m	-£22m	**-£14m**

MAPS & FIGURES

Figure 1: The 546 postcode sectors and 515 office locations

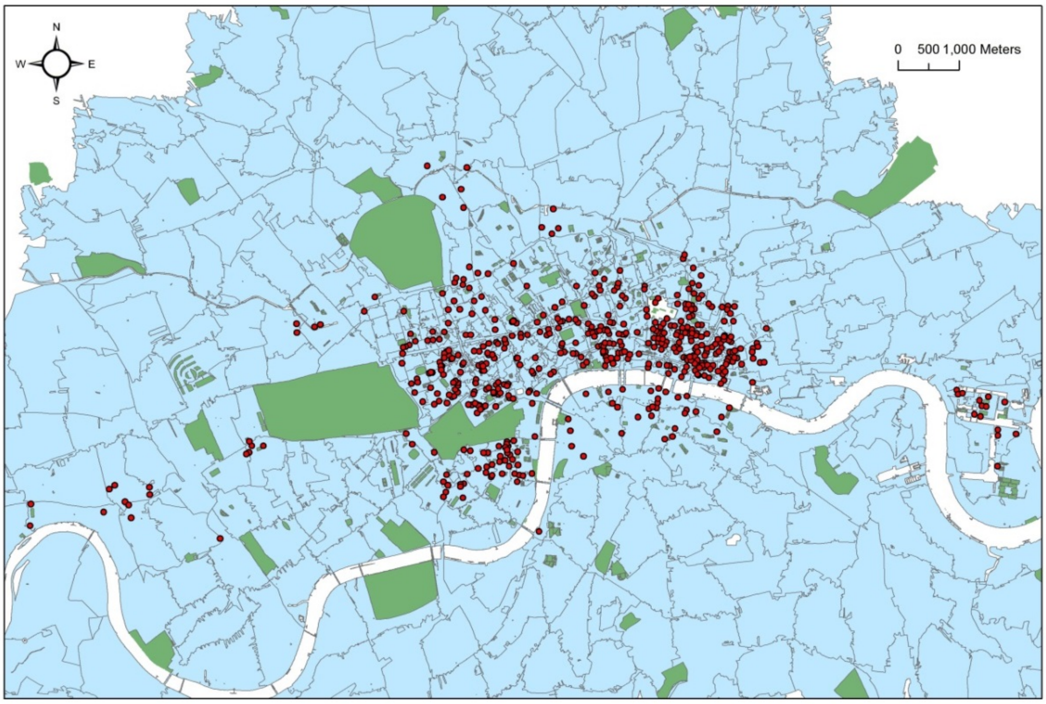


Figure 2: Height Protected Areas

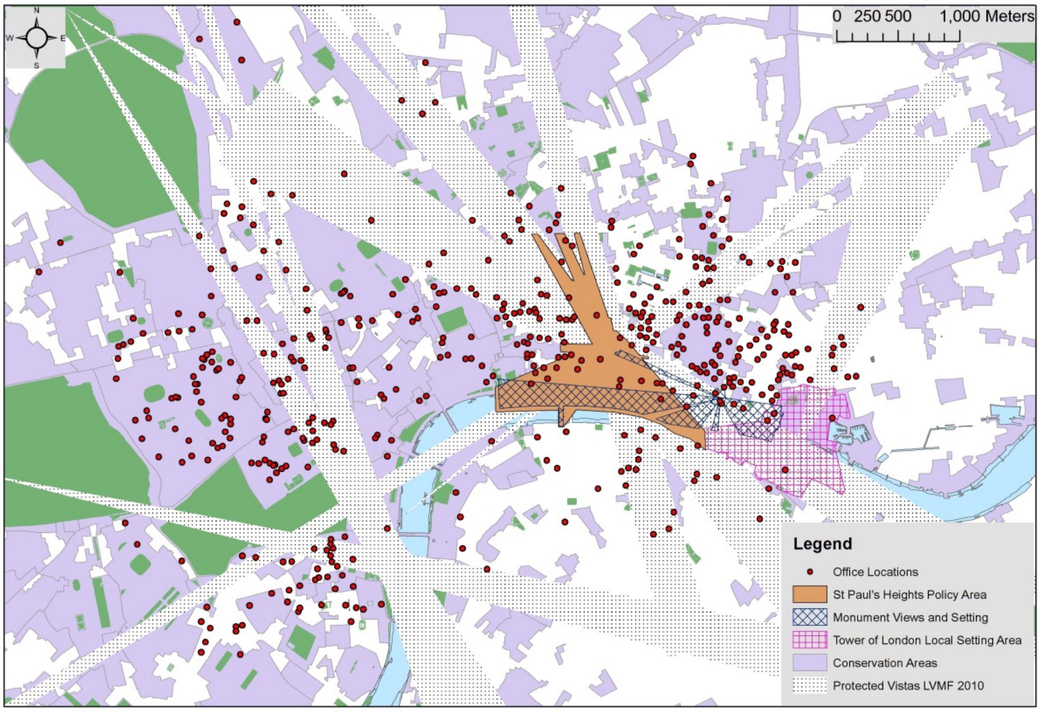


Figure 3: Construction costs per m² and net lettable to gross floorspace as a function of building height

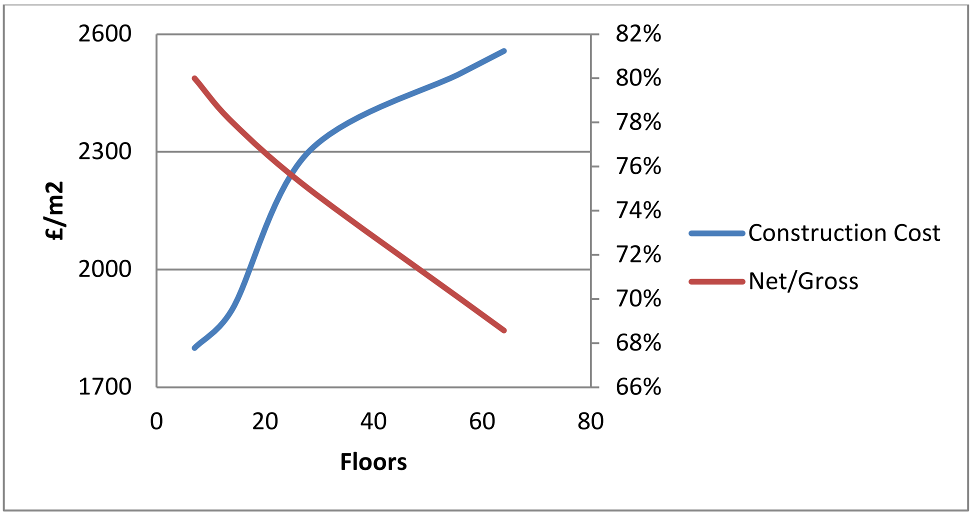
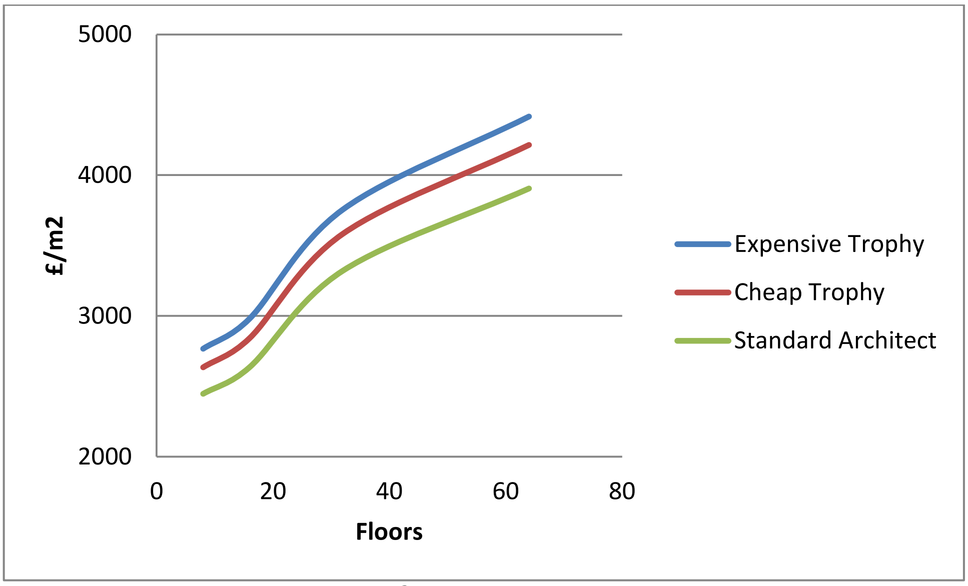


Figure 4: Estimated total land, construction and design costs per m² of building height by type of architect



Costs are for each lettable m², i.e. net of the net lettable-to-gross floorspace estimates.

Figure 5: Price per m² for mean characteristics TA building in City of London compared to building costs

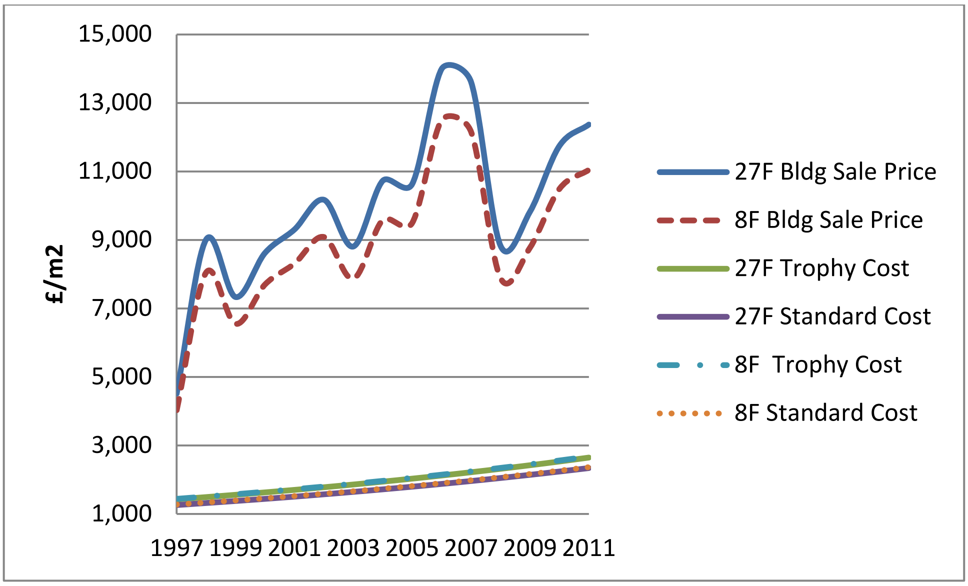
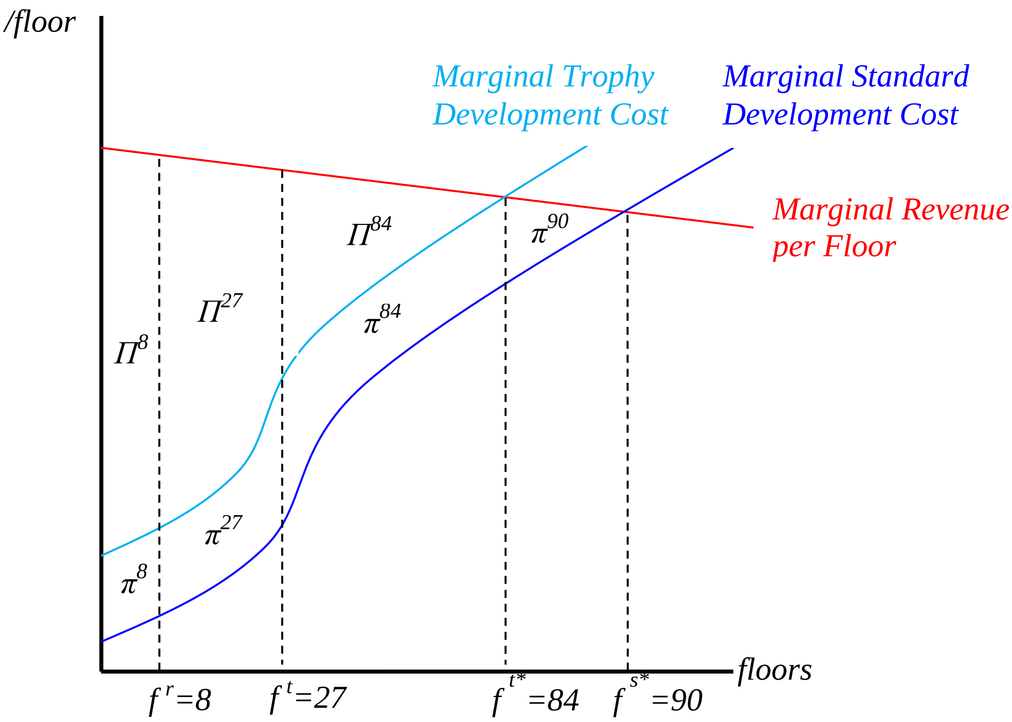


Figure 6: Rents, Deadweight losses, and Supernumerary costs associated with TAs and height restrictions



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Appendix 1: Dropping the tallest buildings from the sample

Table A1: Robustness: Omitting tallest TA buildings: dependent variable: floorspace/site m²

VARIABLES	(1) Floorspace/ Site Area Full Sample	(2) Floorspace/ Site Area Omit Greatest	(3) Floorspace/ Site Area Omit 2 Greatest	(4) Floorspace/ Site Area Omit 3 Greatest
Modern TA outside Height Protected Area	6.626***	6.089***	5.354***	4.149***
	(1.599)	(1.526)	(1.571)	(1.332)
TA	-0.137	-0.142	-0.0283	0.128
	(0.376)	(0.380)	(0.364)	(0.340)
Built in Height Protected Area	-0.666***	-0.688***	-0.670***	-0.643***
	(0.209)	(0.208)	(0.202)	(0.196)
Average Office Permission Refusal Rate	-11.25***	-11.30***	-11.23***	-10.88***
	(3.201)	(3.207)	(3.150)	(3.050)
Built 1950s	0.115	0.110	0.113	0.112
	(0.358)	(0.358)	(0.359)	(0.355)
Built 1960s	0.743	0.757	0.775	0.824
	(0.523)	(0.520)	(0.518)	(0.511)
Built 1970s	0.675**	0.679**	0.673**	0.671**
	(0.319)	(0.319)	(0.317)	(0.317)
Built 1980s	0.394	0.436	0.432	0.410
	(0.273)	(0.269)	(0.266)	(0.262)
Built 1990s	0.711***	0.772***	0.781***	0.760***
	(0.252)	(0.244)	(0.239)	(0.233)
Built 2000s	1.666***	1.637***	1.656***	1.667***
	(0.254)	(0.251)	(0.246)	(0.242)
Built 2010s	5.656***	5.800***	4.699**	2.891**
	(1.857)	(1.911)	(1.905)	(1.278)
City of London	-1.166**	-1.138**	-1.102**	-1.079**
	(0.512)	(0.514)	(0.493)	(0.463)
Docklands	3.497**	2.892*	3.118*	3.574**
	(1.748)	(1.693)	(1.704)	(1.684)
Average Employment 600m	1.56e-05***	1.52e-05***	1.42e-05***	1.60e-05***
	(5.02e-06)	(5.05e-06)	(4.89e-06)	(4.48e-06)
Constant	4.643***	4.661***	4.686***	4.562***
	(0.443)	(0.443)	(0.440)	(0.426)
Observations	515	514	513	512
R-squared	0.498	0.467	0.422	0.395

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1 successively removes the TA buildings with the greatest (Floorspace/Site Area) ratio in the sample. These are 8 Canada Square (26.02), 'The Cheesegrater' 122 Leadenhall (25.04), and 'The Shard' 32 London Bridge Street (23.62).

Table A2: Robustness: Omitting tallest TA buildings: Dependent variable: No. floors

VARIABLES	(1) Floors Full Sample	(2) Floors Omit Tallest	(3) Floors Omit 2 Tallest	(4) Floors Omit 3 Tallest
Modern TA outside Height Protected Area	18.77***	14.63***	13.05***	12.22***
	(4.669)	(3.238)	(3.215)	(3.140)
TA	0.400	0.929	1.170*	1.181*
	(0.887)	(0.663)	(0.652)	(0.652)
Built in Height Protected Area	-1.746***	-1.645***	-1.605***	-1.632***
	(0.402)	(0.343)	(0.334)	(0.332)
Average Office Permission Refusal Rate	-5.553	-4.138	-3.924	-3.961
	(8.602)	(8.073)	(7.932)	(7.910)
Built 1950s	1.230***	1.223***	1.228***	1.223***
	(0.373)	(0.346)	(0.346)	(0.346)
Built 1960s	5.005***	5.191***	5.235***	5.257***
	(1.327)	(1.310)	(1.311)	(1.313)
Built 1970s	3.616***	3.612***	3.601***	3.606***
	(0.892)	(0.889)	(0.888)	(0.887)
Built 1980s	1.187**	1.087**	1.070**	1.124**
	(0.513)	(0.471)	(0.460)	(0.451)
Built 1990s	1.569***	1.457***	1.463***	1.543***
	(0.481)	(0.433)	(0.421)	(0.409)
Built 2000s	2.902***	2.934***	2.971***	2.935***
	(0.411)	(0.377)	(0.367)	(0.359)
Built 2010s	17.71***	11.32***	8.888**	8.892**
	(6.804)	(4.288)	(4.330)	(4.326)
City of London	-1.030	-0.977	-0.910	-0.873
	(1.204)	(1.071)	(1.030)	(1.028)
Docklands	5.906	7.682**	8.248**	7.494*
	(4.089)	(3.835)	(3.875)	(3.897)
Average Employment 600m	1.41e-05	2.32e-05***	2.20e-05***	2.16e-05**
	(1.23e-05)	(8.70e-06)	(8.40e-06)	(8.43e-06)
Constant	6.019***	5.460***	5.466***	5.481***
	(1.121)	(0.984)	(0.969)	(0.966)
Observations	515	514	513	512
R-squared	0.567	0.550	0.516	0.479

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2 successively removes the TA buildings from the sample in order of most above ground floors. These are 'The Shard' 32 London Bridge Street (87F), 'The Cheesegrater' 122 Leadenhall Street (48F), and 25 Canada Square (45F).

Table A3: Robustness: Omitting greatest (Price/Site area) TA building sales: dependent variable ln(price/site m^2)

VARIABLES	(1) Ln(Price/ Site area) Full Sample	(2) Ln(Price/ Site area) Omit 8 Canada Square Sales	(3) Ln(Price/ Site area) Omit 25 Canada Square Sales	(4) Ln(Price/ Site area) Omit 51 Lime Street Sale
Modern TA outside Height Protected Area	0.701***	0.649***	0.549***	0.485***
	(0.193)	(0.176)	(0.152)	(0.146)
Modern TA	0.135	0.137	0.142*	0.143*
	(0.0842)	(0.0845)	(0.0844)	(0.0841)
Pre-Modern TA	-0.261	-0.268	-0.277	-0.278
	(0.185)	(0.184)	(0.182)	(0.181)
Within Conservation Area	-0.111	-0.119	-0.131*	-0.130*
	(0.0749)	(0.0754)	(0.0755)	(0.0756)
Built in Height Protected Area	-0.0596	-0.0602	-0.0619	-0.0613
	(0.0834)	(0.0836)	(0.0842)	(0.0842)
Listed	-0.00913	-0.0100	-0.0119	-0.0110
	(0.0658)	(0.0658)	(0.0657)	(0.0657)
Ln(Office Permission Refusal Rate 9yr Moving Average)	0.0335*	0.0305*	0.0281	0.0269
	(0.0182)	(0.0182)	(0.0181)	(0.0181)
Ln(Employment 600m)	0.243***	0.229***	0.215***	0.216***
	(0.0535)	(0.0527)	(0.0514)	(0.0513)
Ln(Conservation Area Density 300m)	-0.0458	-0.0315	-0.0109	-0.0120
	(0.0345)	(0.0351)	(0.0315)	(0.0319)
Ln(Listed Building Density 300m)	0.0747**	0.0794**	0.0878***	0.0855***
	(0.0366)	(0.0334)	(0.0287)	(0.0288)
Ln(Park and Garden Density 300m)	0.0151***	0.0150***	0.0147***	0.0152***
	(0.00566)	(0.00567)	(0.00564)	(0.00565)
Ln(Nearest Rail Station Distance)	-0.0241	-0.0304	-0.0257	-0.0274
	(0.0466)	(0.0464)	(0.0454)	(0.0453)
Ln(Depreciation Age)	-0.0120	-0.0133	-0.0152*	-0.0150*
	(0.00852)	(0.00867)	(0.00879)	(0.00881)
Ln(Basements/Total Floors)	-0.00729	-0.00829	-0.00987	-0.0107
	(0.0106)	(0.0106)	(0.0106)	(0.0106)
A/C	0.435***	0.432***	0.433***	0.432***
	(0.144)	(0.142)	(0.140)	(0.140)
EG Office Grade A/B	0.306***	0.308***	0.295***	0.294***
	(0.0563)	(0.0564)	(0.0562)	(0.0562)
EG Office Grade A	0.331***	0.326***	0.331***	0.331***
	(0.0533)	(0.0532)	(0.0528)	(0.0528)
Ln(Percent Occupied)	0.0251**	0.0244**	0.0234*	0.0231*
	(0.0125)	(0.0123)	(0.0122)	(0.0122)
Single Tenant	0.0602	0.0587	0.0497	0.0468
	(0.0439)	(0.0437)	(0.0434)	(0.0433)
Decade Built	YES	YES	YES	YES
Submarket	YES	YES	YES	YES
Year Sold	YES	YES	YES	YES
Constant	6.636***	6.688***	6.619***	6.638***
	(0.661)	(0.651)	(0.639)	(0.640)
Observations	625	622	620	619
R-squared	0.609	0.594	0.589	0.584

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3 successively removes all sales of each trophy architect building in the sample in order of greatest (Price/Site area) ratio. These are 8 Canada Square (Apr-07 £258,718/m^2, Nov-08 £214,872/m^2, Nov-09 £198,077/m^2), 25 Canada Square (Feb-04 £225,629/m^2, Nov-07 £211,163/m^2), and 'The Willis Building' 51 Lime Street (May-08 £186,829/m^2). Although present in the building-size sample, 'The Shard' 32 London Bridge Street and 'The Cheesegrater' 122 Leadenhall Street have never sold.

Appendix 2: Effect of TAs on Rent Free periods

Another way in which TA buildings might be able to influence developers' returns would be if their buildings systematically had shorter or longer rent-free periods. Many office buildings have such deals in order to attract first and new tenants.

Table A4: Rent-Free Period Regressions

VARIABLES	(1) Rent-Free Period (months)	(2) Rent-Free Period (months)	(3) Rent-Free Period (months)	(4) Rent-Free Period (months)
TA Building	5.203	1.115	-0.442	-0.913
	(3.440)	(3.052)	(3.033)	(3.013)
Lease Length (years)		1.467***	1.102***	1.178***
		(0.269)	(0.249)	(0.234)
Lease Floorspace m^2			0.000354	0.000368
			(0.000274)	(0.000276)
Building Depreciation				0.334
				(0.372)
Contract Start 2003	3.734	10.93*	13.24	12.72
	(4.174)	(6.328)	(8.593)	(8.700)
Contract Start 2004	-2.889	4.119	8.349	8.276
	(4.446)	(6.460)	(8.900)	(8.895)
Contract Start 2005	10.70**	16.13**	19.03**	18.68**
	(4.188)	(6.586)	(8.846)	(8.878)
Contract Start 2006	-2.438	3.140	5.909	5.947
	(3.975)	(6.123)	(8.643)	(8.648)
Contract Start 2007	-9.401	-0.215	0.780	0.210
	(5.807)	(7.151)	(8.963)	(9.034)
Contract Start 2008	-8.924	5.365	8.307	7.738
	(5.958)	(7.691)	(9.713)	(9.909)
Contract Start 2009	15.33	25.31**	24.70**	24.43**
	(11.05)	(10.74)	(10.98)	(10.98)
Contract Start 2010	2.714	13.84*	15.22	13.61
	(5.591)	(7.167)	(9.275)	(9.479)
Contract Start 2011	-6.540	9.913	11.45	9.985
	(4.245)	(6.892)	(9.070)	(9.512)
Contract Start 2012	-1.448	11.01	13.21	11.57
	(4.125)	(6.815)	(8.905)	(9.224)
Contract Start 2013	1.234	15.76**	17.47**	15.03
	(5.499)	(6.504)	(8.625)	(9.288)
Constant	17.27***	-9.729	-8.693	-9.913
	(3.463)	(7.561)	(9.113)	(9.054)
Observations	76	76	76	76
R-squared	0.287	0.567	0.598	0.603

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Building Depreciation = The number of years between the building construction date/most recent refurb and the lease start.

The analysis in Table A4 above consists of a sample of 17 leases from TA and 59 leases from standard buildings comprising 47 buildings altogether, and tests whether TA buildings yielded greater rent-free periods in a series of hierarchical regressions. All leases in the sample contained a positive rent-free period incentive. Robust standard errors are used as White tests reject homoskedasticity. The results above provide no evidence that tenants in TA buildings can demand exceptional rent-free concessions. If anything, rent-free periods in industry appear to incentivise greater lease length.

Appendix 3: Causal Interpretation of Relationship between TA Design and Additional Stories?

As discussed in Section 6 of the paper there are two potential objections to the causal interpretation we have put onto the strong relationship between whether a building is in a non-height restricted area and designed by a modern TA, on the one hand, and its additional height and resulting increased value of the site all else controlled for, on the other. The first of these objections is that companies wishing to make a landmark statement may tend to commission both taller buildings and TAs to be their designers. The second potential alternative interpretation we can think of is that designing tall buildings is particularly demanding of architectural skill so tall buildings are more likely to be designed by famous – or trophy – architects.

The crux of the first objection to our interpretation of causation is that bespoke developments cause *both* buildings to be tall *and* TAs to be chosen as their architect. If either one of these premises is false, then the bespoke status of developments cannot be a source of spurious causal inference of TAs on increased building height. In fact we find no evidence to support either such relationship. To address the first possible relationship, we take TA status as given[36] and determine whether bespoke status can influence building height. Table A5 shows that there have been 36 modern office buildings built by TAs in London. Of these 12 or 33% were commissioned to be built by a firm specifically for their own use. Following our earlier analyses, Table A6 shows a series of hierarchical regressions on the height of modern TA buildings depending on bespoke status and a number of controls. Under none of the specifications is the bespoke variable a statistically significant determinant of building height. Robust standard errors are shown because heteroskedasticity is identified in the data with a White test; homoskedastic standard errors yield the same result.

To address the second implicit assumption underpinning this possible criticism of causation we next take tall building status as given[37] and determine whether bespoke status influences the choice of a TA. Table A7 shows the 44 office buildings in London that have ever been built above 20 floors, 19 or 43% of these buildings were bespoke, 13 or 30% of them by TAs, and 6 or 46% of these TA buildings were also bespoke. A comparison of means test does not

[36] We do this to ensure the feasibility of data collection.
[37] For the same reason as footnote 36.

reject the null hypothesis that among London's tallest offices there is no difference between the probability that a bespoke development will chose a TA compared to non-TA (p = 0.80). Therefore bespoke developments do not appear to be either taller or to preferentially choose trophy architects. Either of these findings alone would be sufficient to invalidate the inference that bespoke status accounts for our observed relationship between TAs and building height, but together this conclusion is stronger still.

As a way of addressing the second potential criticism of our causal interpretation – that only TAs have the requisite skills to design tall buildings, Table A8 provides data on tall buildings from a selection of cities around the world. These cities are selected because they have comparatively flexible restrictions on building tall. They are: Chicago, Houston, Brussels, Benidorm (Spain), and Sao Paulo. Chicago and Houston are at the least restrictive end of the US spectrum of restrictiveness with respect to commercial buildings at least. Brussels was the office centre in Western Europe identified by Cheshire and Hilber (2008) as having the lowest estimated value of Regulatory Tax. Benidorm, especially when it was developed as a resort town during the 1970s and 1980s had both lax restriction and lax enforcement, and while Sao Paolo does have significant restrictions on very tall buildings it is quite unrestrictive with respect to buildings up to 100 metres. The sample of buildings in these cities consisted of those buildings above 100m: corresponding to roughly 25 floors.

We can see that only a small fraction (2.3%) of the tallest buildings in these five international cities was by a TA, and that this fraction is an order of magnitude lower than in London. There are also no TA buildings at all in Brussels or Benidorm – both cities with a far higher incidence of tall buildings per capita than London. A comparison of means test rejects with high confidence the probability that there is no difference between the incidence of tall TA buildings in London and the other cities. This result contradicts the idea that only TAs have the skills to build tall. It is also suggestive that there is a unique process at work in London which associates tall buildings with TAs: we argue that this process is rent-seeking in the face of a highly restrictive planning regime; not bespoke status or TAs' technical skill.

Table A5: Are bespoke buildings taller? Population of Modern TA buildings in London

Building Name	Address	TA	Award	Floors	Year Approved	Borough	Bespoke	Speculative	Conservation Area Built
'The Shard'	32 London Bridge Street	Renzo Piano	RIBA Gold 1989, AIA Gold 2008, Pritzker 1998	87	2003	Southwark	NO	YES	NO
'The Cheesegrater'	122 Leadenhall	Richard Rogers	RIBA Gold 1985, Pritzker 2007	50	2004	City of London	NO	YES	NO
	25 Canada Square	Cesar Pelli	AIA Gold 1995	45	1998	Tower Hamlets	YES	NO	NO
	8 Canada Square	Norman Foster	RIBA Gold 1983, Pritzker 1999	45	1997	Tower Hamlets	YES	NO	NO
	30 St Mary Axe	Norman Foster	RIBA Gold 1983, Pritzker 1999	40	1997	City of London	YES	NO	NO
	25 Bank Street	Cesar Pelli	AIA Gold 1995	33	2001	Tower Hamlets	NO	YES	NO
	40 Bank Street	Cesar Pelli	AIA Gold 1995	33	2001	Tower Hamlets	NO	YES	NO
Shell Centre	2 York Road	Howard Robertson	RIBA Gold 1949	26	1957	Lambeth	YES	NO	NO
Willis Building	51 Lime Street	Norman Foster	RIBA Gold 1983, Pritzker 1999	26	2002	City of London	YES	NO	NO
	33 Canada Square	Norman Foster	RIBA Gold 1983, Pritzker 1999	24	1996	Tower Hamlets	YES	NO	NO
	1 Cabot Square	Ieoh Ming Pei	RIBA Gold 2010, AIA Gold 1979, Pritzker 1983	21	1988	Tower Hamlets	NO	YES	NO
Moor House	120 London Wall	Norman Foster	RIBA Gold 1983, Pritzker 1999	19	1998	City of London	NO	YES	NO
	88 Wood Street	Richard Rogers	RIBA Gold 1985, Pritzker 2007	18	1995	City of London	NO	NO	NO
New Court	St Swithin's Lane	Rem Koolhas	RIBA Gold 2004, Pritzker 2000	16	2006	City of London	YES	NO	YES
Central St Giles	1-13 St Giles High Street	Renzo Piano	RIBA Gold 1989, AIA Gold 2008, Pritzker 1998	15	2005	Camden	NO	YES	NO
Lloyd's Register of Shipping	71 Fenchurch Street	Richard Rogers	RIBA Gold 1985, Pritzker 2007	14	1996	City of London	YES	NO	YES
	10 Bishop's Square	Norman Foster	RIBA Gold 1983, Pritzker 1999	13	2001	Tower Hamlets	NO	NO	NO
	1 London Wall	Norman Foster	RIBA Gold 1983, Pritzker 1999	13	2000	City of London	NO	YES	YES
Paddington	35 North Wharf	Richard Rogers	RIBA Gold 1985,	12	2001	Westminster	NO	YES	NO

Waterside	Road		Pritzker 2007						
Langbourne House	10 Fenchurch Street	Denys Lasdun	RIBA Gold 1977	11	1982	City of London	NO	YES	NO
	100 Wood Street	Norman Foster	RIBA Gold 1983, Pritzker 1999	11	1997	City of London	NO	YES	NO
Gibbs Building	215 Euston Road	Michael & Patricia Hopkins	RIBA Gold 1994	10	2000	Camden	YES	NO	YES
City Hall	110 The Queen's Walk	Norman Foster	RIBA Gold 1983, Pritzker 1999	10	1998	Southwark	YES	NO	YES
The Ark	201 Talgarth Road	Ralph Erskine	RIBA Gold 1987	10	1989	Hammersmith	NO	YES	NO
ITN Building	200 Gray's Inn Road	Norman Foster	RIBA Gold 1983, Pritzker 1999	10	1989	Camden	YES	NO	NO
Milton Gate	1 Moor Lane	Denys Lasdun	RIBA Gold 1977	9	1986	City of London	NO	YES	NO
Holborn Place	33 Holborn Circus	Norman Foster	RIBA Gold 1983, Pritzker 1999	9	1995	City of London	NO	YES	YES
One New Change	9-36 Cheapside	Jean Nouvel	RIBA Gold 2001, Pritzker 2008	8	2005	City of London	NO	YES	NO
	50 Finsbury Square	Norman Foster	RIBA Gold 1983, Pritzker 1999	8	1998	Islington	NO	YES	YES
	10 Gresham Street	Norman Foster	RIBA Gold 1983, Pritzker 1999	8	1997	City of London	NO	YES	YES
Tower Bridge House	St Katharine's Way	Richard Rogers	RIBA Gold 1985, Pritzker 2007	8	1999	Tower Hamlets	NO	NO	YES
	1 Poultry	James Stirling	Pritzker 1981	7	1986	City of London	NO	NO	YES
Stirling Square	5-7 Carlton Gardens	James Stirling	Pritzker 1981	7	1988	Westminster	NO	YES	YES
Tower Place West	Tower Hill	Norman Foster	RIBA Gold 1983, Pritzker 1999	7	1998	City of London	NO	YES	YES
Broadwick House	15-17 Broadwick Road	Richard Rogers	RIBA Gold 1985, Pritzker 2007	7	1998	Westminster	NO	YES	YES
Channel 4 Headquarters	124 Horseferry Road	Richard Rogers	RIBA Gold 1985, Pritzker 2007	5	1991	Westminster	YES	NO	NO

Table A6: Bespoke status on Modern TA building height

VARIABLES	(1) Floors	(2) Floors	(3) Floors	(4) Floors	(5) Floors
Bespoke	1.876	1.737	2.177	2.190	0.0470
	(4.605)	(4.357)	(4.066)	(4.127)	(4.443)
Built in Height Protected Area	-22.53***	-23.51***	-27.17**	-27.45**	-26.12**
	(5.826)	(5.451)	(10.19)	(11.01)	(11.54)
(Bespoke)×(Built outside Height Protected Area)					5.582
					(9.410)
Average Office Permission Refusal Rate	16.55	37.41	-55.33	-58.78	-57.18
	(39.33)	(40.86)	(57.58)	(61.60)	(61.76)
Permission Granted 1980s		0.663	8.164	8.865	12.29
		(5.280)	(10.76)	(12.58)	(14.22)
Permission Granted 1990s		9.755*	14.61	15.44	18.27
		(5.615)	(11.43)	(14.02)	(14.86)
Permission Granted 2000s		17.51**	22.25	23.25	26.71
		(7.902)	(13.85)	(16.82)	(18.44)
City of London			-14.43	-12.91	-11.89
			(10.94)	(8.660)	(8.843)
Docklands			-9.708	-9.860	-10.75
			(14.05)	(14.56)	(14.70)
Average Employment 600m				-3.32e-05	-5.18e-05
				(0.000126)	(0.000128)
Constant	30.63***	19.44***	30.95***	31.74***	28.29**
	(5.371)	(4.728)	(8.763)	(10.25)	(12.76)
Observations	36	36	36	36	36
R-squared	0.454	0.587	0.619	0.620	0.624

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Are bespoke buildings designed by TAs? Population of London office buildings >20-floors

Building Name	Address	Architect	TA	Bespoke Project	Floors†	Height	Year Built	Local Authority	Demolished
'The Shard'	32 London Bridge Street	Renzo Piano	YES	NO	87	310m	2012	Southwark	-
One Canada Square	1 Canada Square	Cesar Pelli	NO	NO	50	235m	1991	Tower Hamlets	-
'The Cheesegrater'	122 Leadenhall Street	Richard Rogers	YES	NO	48	225m	2014	City of London	-
Tower 42	25 Old Broad Street	Richard Seifert	NO	YES	47	183m	1980	City of London	-
Heron Tower	110 Bishopsgate	Kohn Pedersen Fox	NO	NO	46	203m	2011	City of London	-
HSBC Tower	8 Canada Square	Norman Foster	YES	YES	45	200m	2002	Tower Hamlets	-
-	25 Canada Square	Cesar Pelli	YES	YES	45	220m	2002	Tower Hamlets	-
'The Gherkin'	30 St Mary Axe	Norman Foster	YES	YES	40	180m	2003	City of London	-
'The Walkie-Talkie'	20 Fenchurch Street	Rafael Vinoli	NO	NO	36	160m	2014	City of London	-
Euston Tower	286 Euston Road	Sidney Kaye, Eric Firmin & Partners	NO	NO	36†	124m	1970	Camden	-
Britannic House	1 Ropemaker Street	F. Milton Cashmore & Niall D. Nelson	NO	YES	35‡	122m	1967	City of London	-
Broadgate Tower	201 Bishopsgate	Skidmore, Owings, and Merrill	NO	NO	33	164m	2009	City of London	-
-	25 Bank Street	Cesar Pelli	YES	NO	33	153m	2003	Tower Hamlets	-
-	40 Bank Street	Cesar Pelli	YES	NO	33	153m	2003	Tower Hamlets	-
Centre Point	103 New Oxford Street	Richard Seifert	NO	NO	33†	121m	1965	Camden	-
One Churchill Place	1 Churchill Place	HOK International	NO	YES	32	156m	2004	Tower Hamlets	-
Millbank Tower	21-24 Millbank	Ronald Ward & Partners	NO	YES	32	118m	1961	Westminster	-
-	10 Upper Bank Street	Kohn Pedersen Fox	NO	YES	31	151m	2003	Tower Hamlets	-
King's Reach Tower	Stamford Street	Richard Seifert	NO	NO	29‡	111m	1978	Southwark	-
Empress State Building	Empress Approach	Stone, Toms & Partners	NO	NO	28‡	100m	1961	Hammersmith	-
Portland House	Bressenden Place	Howard Fairbairn &	NO	NO	28	102m	1963	Westminster	-

		Partners							
The Willis Building	51 Lime Street	Norman Foster	YES	YES	28	125m	2007	City of London	-
Drapers Gardens	12 Throgmorton Street	Richard Seifert	NO	YES	28	99m	1967	City of London	2007
Commercial Union Tower	1 Undershaft	Gollins, Melvin, Ward	NO	YES	26	118m	1969	City of London	-
Shell Centre	2 York Road	Howard Robertson	YES	YES	26	107m	1962	Lambeth	-
Stock Exchange Tower	125 Old Broad Street	F. Milton Cashmore & Partners	NO	YES	26‡	99m	1969	City of London	-
Limebank House	168 Fenchurch Street	Richard Seifert	NO	YES	26	93m	1969	City of London	1998
Kleinwort Benson Building	20 Fenchurch Street	William H. Rogers	NO	YES	25	91m	1968	City of London	2008
New London Bridge House	25 London Bridge Street	Richard Seifert	NO	NO	25	94m	1967	Southwark	2010
-	99 Bishopsgate	Richard Seifert	NO	NO	25	104m	1976	City of London	-
The London Studios	58-72 Upper Ground	Elsom Pack & Roberts	NO	YES	25	82m	1973	Southwark	-
Southwark Towers	32 London Bridge Street	T.P. Bennett & Son	NO	NO	25	100m	1976	Southwark	2009
-	33 Canada Square	Norman Foster	YES	YES	24	105m	1999	Tower Hamlets	-
Marble Arch Tower	55 Bryanston Street	T.P. Bennett & Son	NO	NO	23	82m	1966	Westminster	-
Market Towers	1 Nine Elms Lane	GMW Architects	NO	YES	23	75m	1975	Lambeth	-
-	6-8 Bishopsgate	GMW Architects	NO	YES	23	88m	1981	City of London	-
Westminster City Hall	64 Victoria Street	Burnet, Tait and Partners	NO	NO	22	76m	1966	Westminster	-
Century House	100 Westminster Bridge Road	Devereux Architects	NO	NO	21	73m	1959	Lambeth	-
New Scotland Yard	10 Broadway	Chapman, Taylor and Partners	NO	NO	21	67m	1962	Westminster	-
City Tower	40 Basinghall Street	Burnet, Tait and Partners	NO	NO	21	69m	1957	City of London	-

Angel Court	1 Angel Court	Fitzroy Robinson and Partners	NO	NO	21	94m	1980	City of London	-
-	200 Aldersgate Street	Fitzroy Robinson and Partners	NO	NO	21	91m	1992	City of London	-
One Cabot Square	1 Cabot Square	Pei, Cobb, Freed & Partners	YES	NO	21	89m	1991	Tower Hamlets	-

†Building was allowed exceptional height as a concession for funding local roadworks.
‡Additional floor(s) added since construction. Data represents originally constructed floor count.
None of these buildings were built while inside a height protected area.

Table A8: Breakdown of buildings >100m and TAs by city

City	Bldgs >100m per million Population	Total Bldgs >100m	Office Bldgs	Residential Bldgs	Hotel Bldgs	Other Bldgs	TA Bldgs	TA Percentage
London	7	57	30	20	1	6	14	24.56%
Chicago	111	301	123	160	16	2	9	2.99%
Houston	40	88	60	19	3	6	5	5.68%
Brussels	15	17	15	2	0	0	0	0.00%
Benidorm	384	26	0	25	1	0	0	0.00%
Sao Paulo	20	231	75	142	9	5	1	0.43%
Total	**-**	**720**	**303**	**368**	**30**	**19**	**29**	**4.03%**

Appendix 4: Calculating Economic Rents: TA Size Increases and Profitability

In order to estimate how much extra floorspace TAs are able to stack on a given site we cannot simply add 19 floors as in Table 5. If this were the case then the additional floorspace/site area due to TAs estimated in Table 4 should equal close to 19[38]. Instead Table 4 says it equals 7. Clearly the average floorspace/site area ratio for TA buildings is less than 1 (in fact closer to .36). However we do not use this estimate as we wish to ensure that we compare the costs of TA buildings with the costs of standard architect buildings of the same footprint, and using the ratio of floorspace/site area for a given site area does not ensure that the building footprint remains comparable. Therefore we run a regression on floorspace/footprint in Table A9 and use the results to compute the ratio at which floorspace increases due to a TA for a given footprint (we find an additional $9m^2$ of floorspace per $1m^2$ footprint: for every 19 floors). These results are used to compute Table A10 which serves as the basis for our discussion of economic rents.

[38] The reason it would not be exactly 19 in this case is because the footprint/site area ratio is generally less than 1.

Table A9: Floorspace/Footprint

VARIABLES	(1) Floorspace/ Footprint
Modern TA outside Height Protected Area	9.043***
	(1.984)
TA	0.204
	(0.394)
Built in Height Protected Area	-1.009***
	(0.245)
Average Office Permission Refusal Rate	-5.150
	(4.409)
Built 1950s	0.162
	(0.348)
Built 1960s	2.563***
	(0.797)
Built 1970s	1.737***
	(0.422)
Built 1980s	0.838***
	(0.301)
Built 1990s	1.089***
	(0.273)
Built 2000s	1.985***
	(0.280)
Built 2010s	6.931***
	(2.257)
City of London	-0.400
	(0.679)
Docklands	2.186
	(1.809)
Average Employment 600m	9.82e-06
	(6.67e-06)
Constant	4.275***
	(0.564)
Observations	515
R-squared	0.506

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A10: Trophy and Standard Building Costs and Profits

	Floors	**Floorspace(m^2)**	**Cost (£m)**	**Sale Price (£m)**	**Profit (£m)**
Trophy Architect	*8*	*10,203*	*28*	*82*	*53*
Standard Architect	**8**	**10,203**	**25**	**82**	**56**
Trophy Architect	*27*	*24,672*	*68*	*197*	*129*
Standard Architect	**27**	**24,672**	**60**	**197**	**137**
Trophy Architect	*84*	*58,833*	*193*	*470*	*278*
Standard Architect	**84**	**58,833**	**167**	**470**	**303**
Standard Architect	**90**	**61,747**	**178**	**494**	**316**

Office sale-prices are estimated assuming £8,000/sqm and are invariant to architectural pedigree following empirical results.

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Llywodraeth Cymru
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Spatial Economics Research Centre (SERC)
London School of Economics
Houghton Street
London WC2A 2AE

Tel: 020 7852 3565
Fax: 020 7955 6848
Web: www.spatialeconomics.ac.uk

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