# Tearing Down Buildings in a City Hungry for Land

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**Abstract**

To tear down a building is not only an engineering matter, it involves also economic considerations. Previous studies suggest the possibility of a building being torn down to be not uniform across neighborhoods, and can reasonably be explained by a number of economic and social parameters. Moreover, pressure of land redevelopment is great in a city where demand significantly outstrips supply. In consequence, buildings in such a city are prone to be knocked down far ahead of the time when they are physically obsolete. We examine the building teardowns in Taipei, a city consistently ranked as one of the most crowded worldwide. Analysis of reliable official records allows us to present a number of evidence-supported findings. Firstly, demolished floor-areas by and large keep pace with market demands. In addition, not only those old neighborhoods with aged buildings but also the pricey neighborhoods have observed most activities of teardowns. Both physical and economic factors are at play to determine where to knock the buildings down. Despite its modern materials, buildings made of reinforced concrete tend to be replaced significantly earlier than its end of physical life. In contrast, a notable proportion of brick and wood buildings stand longer than their physical life. The parallel phenomena actually highlight the potential misallocation of land resources.

**Keywords**: teardowns; economic obsolescence; land supply

## When to Knock Down a Building

To tear down a building is not only an engineering matter, it involves also economic considerations. Barlev and May (1976) reason that buildings will be torn down when there are financial incentives to redevelop a site. They, through a case study of New York City, find that a heavier property tax, and a higher income level will hasten building demolition. In contrast, a higher interest rate, a larger building stock, a higher construction cost will prolong the time a building has stood. Weber et al. (2006) employ the Logit model to investigate the determinants of tearing down a building. They suggest that aged buildings tend to suffer from functional obsolescence. A building inflicted with incurable functional obsolescence is likely to be torn down earlier than others. The degree of building depreciation therefore represents the likelihood that a building will be torn down. Empirical evidence suggests a higher age, a lower floor-to-land ratio, a better access to public transportation and Chicago Lake will raise the possibility of a building to be knocked down sooner. Dye and McMillen (2007) also examines the Chicago metropolitan areas. They find the followings factors to be positively associated with the occurrence of building teardowns: better access to rapid transit line and Lake Michigan, a larger lot site, a higher floor-to-land ratio, among others. They also find the price of those properties that were demolished soon after their sales is irrelevant to building attributes (building materials, design style…). The price paid for those soon-to-be-demolished properties is for the land only.

These studies clearly suggest that demolition of a building, in particular in a major city, is largely an economic phenomenon. The possibility of a building being torn down is not uniform across neighborhoods, and can reasonably be explained by a number of economic and social parameters. In addition, the teardowns possibility is associated with the expected value of a new property on a redeveloped site, especially in a city with scarcity of land. Moreover, pressure of land redevelopment is great in a city where demand significantly outstrips supply. In consequence, buildings in such a city are prone to be knocked down far ahead of the time when they are physically obsolete. In the context of property valuation, the economic life of a building is shorter than its physical life. The timing of a building to be torn down is primarily explained by three groups of factors: the characteristics of building itself (materials, design…), accessibility to transport nodes and amenity (rapid transit line, lake…), as well as socio-economic conditions (income, land use zoning…).

## A City Hungry for Land

Taipei, consistently ranked as one of the most crowded cities (see Table 1), has long been hungry for land for (re)development. Despite lack of direct supporting evidence, it is safely assumed that the majority of buildings are demolished, before their physical obsolescence, to make way for new and high-density development.

**Table 1: Largest cities in the world ranked by population density**

| Rank | City / Urban area | Country | Population | Land area (in sqKm) | Density (people per sqKm) |
|---|---|---|---|---|---|
| 1 | Mumbai | India | 14,350,000 | 484 | 29,650 |
| 2 | Kolkata | India | 12,700,000 | 531 | 23,900 |
| 3 | Karachi | Pakistan | 9,800,000 | 518 | 18,900 |
| 4 | Lagos | Nigeria | 13,400,000 | 738 | 18,150 |
| 5 | Shenzhen | China | 8,000,000 | 466 | 17,150 |
| 6 | Seoul/Incheon | South Korea | 17,500,000 | 1,049 | 16,700 |
| 7 | Taipei | Taiwan | 5,700,000 | 376 | 15,200 |
| 8 | Chennai | India | 5,950,000 | 414 | 14,350 |
| 9 | Bogota | Colombia | 7,000,000 | 518 | 13,500 |
| 10 | Shanghai | China | 10,000,000 | 746 | 13,400 |

**http://www.citymayors.com/statistics/largest-cities-density-125.html**

We analyze the official record of building demolition permits kept by the Taipei City Government. It is obligatory to apply for a permit prior to the demolition of a building. Therefore, this data set is reliable and suitable to examine the building teardowns phenomenon. The data covers demolition of all residential buildings between January 2001 and September 2009. Table 2 provides the floor areas of demolished buildings for individual years. The demolished floor areas are on the rise from 2001 to 2007. This corresponds well with the housing market. The growing figure of mdemolished floor areas have reflected the rising demand.

**Table 2: Floor-areas of demolished buildings (2001.1-2009.9) by year**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Square-meters | 29,529 | 44,609 | 78,945 | 95,600 | 136,560 | 116,542 | 141,732 | 89,889 | 25,302 | 758,713 |

Table 3 further looks into the distribution of demolished floor areas among individual districts. Zhongzheng, Zhongshan, Datong, Wanhua and Daan are the five districts in which more floor areas, in percentage terms, are torn down than others. Datong and

Wanhua are districts developed earlier and with a higher number of aged building stock. These districts are identified by the government as the priority areas for urban regeneration. In this regard, the high percentage of buildings torn down there shall be seen as a positive sign. However, the other districts, Zhongzheng, Zhongshan and Daan, are areas that register the most expensive housing. Taking all these evidence together, the driving forces behind building demolition are both the physical obsolescence and market demands. Diagram 1 indicates the location of teardowns in the last 9 years. Apparently, by visual inspection, there exist clusters of demolished buildings. Agglomeration of demolished buildings suggests a spatial dimension in the determinants of tearing down a building.

**Table 3: Floor-areas of demolished buildings (2001.1-2009.9) by districts**

| Districts | Demolished floor areas ($m^2$) | Total floor areas in Taipei ($m^2$) | percentage |
|---|---|---|---|
| Shilin | 80,648 | 9018414 | 0.8943% |
| Datong | 69,018 | 3699407 | 1.8657% |
| Daan | 115,286 | 11309708 | 1.0194% |
| Zhongshan | 121,807 | 6093788 | 1.9989% |
| Zhongzheng | 110,518 | 4752476 | 2.3255% |
| Neihu | 18,783 | 7874538 | 0.2385% |
| Wenshan | 62,279 | 8323070 | 0.7483% |
| Beitou | 35,961 | 6891572 | 0.5218% |
| Songshan | 35,764 | 7360654 | 0.4859% |
| Xinyi | 28,457 | 6476765 | 0.4394% |
| Nangang | 10,714 | 3378085 | 0.3172% |
| Wanhua | 69,471 | 5154980 | 1.3477% |
| Total | 758,713 | 80333464 | 0.9445% |

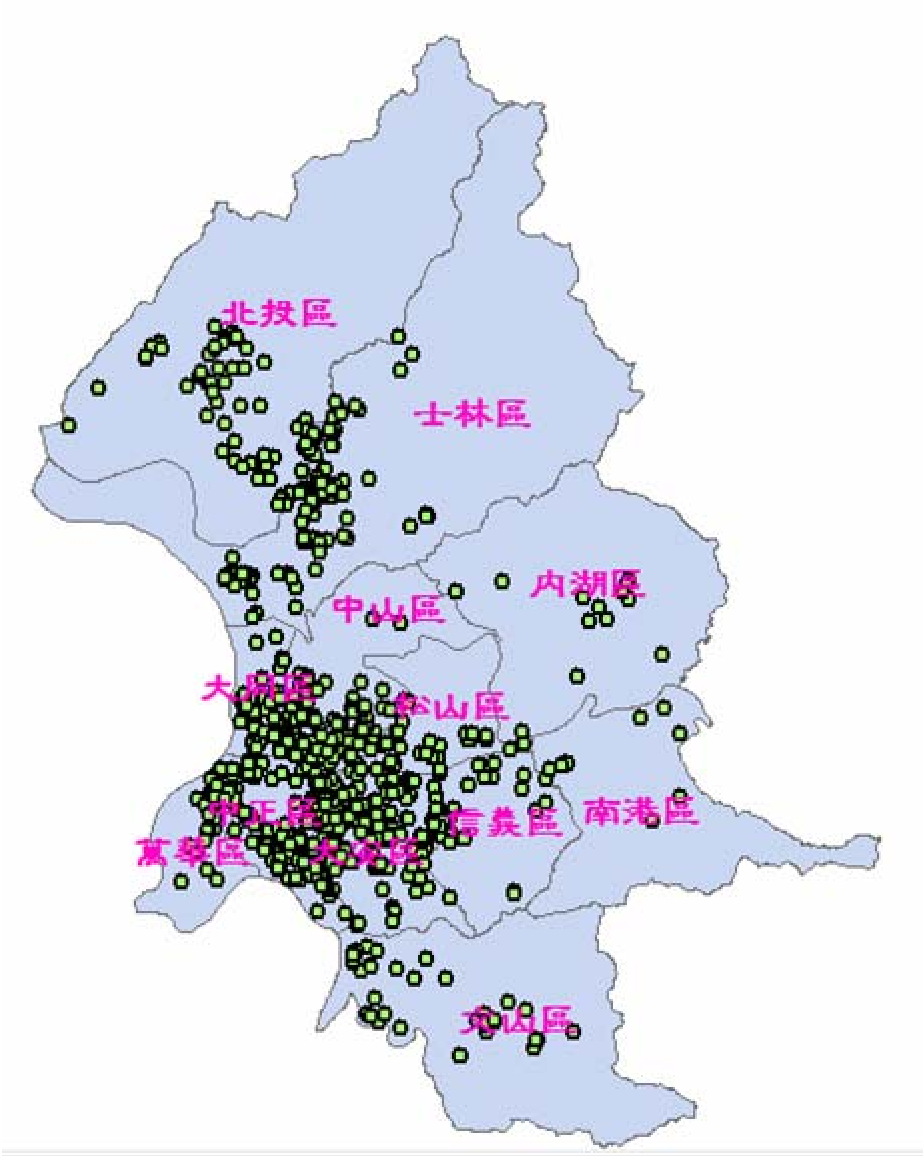


**Diagram 1: Location of Demolished Buildings**

As suggested at the outset, in a city such as Taipei, buildings are in most cases knocked down to make way for new development. However, it is difficult to conclude if a demolition rate is desirable. Wooden buildings are with little doubt to be judged as under-developed and expected to be replaced by high-rise buildings. The figures in Table 4 for them, however, suggest that more than 200 years will be needed for all the wooden buildings to disappear. It is believed that the legal, such as complex multi-ownership, and not economic obstacles have contributed to the delayed demolition. This will lead to an inefficient land use for sites are not allocated to a more economic purpose.

**Table 4: Floor-areas ($m^2$) of demolished buildings (2001.1-2009.9) by construction materials**

| | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Reinforced-concrete | 5222<br>0.005% | 20121<br>0.018% | 42353<br>0.036% | 53609<br>0.045% | 65236<br>0.054% | 75154<br>0.061% | 60469<br>0.046% | 47053<br>0.035% | 10298 | 379520<br>0.037% |
| Reinforced-brick | 18576<br>0.146% | 10765<br>0.084% | 24132<br>0.189% | 33461<br>0.260% | 56412<br>0.437% | 24233<br>0.190% | 44661<br>0.347% | 33054<br>0.255% | 9739 | 255037<br>0.239% |
| Brick | 1982<br>0.082% | 5523<br>0.229% | 8519<br>0.351% | 8453<br>0.350% | 11701<br>0.487% | 13852<br>0.571% | 34288<br>1.420% | 7543<br>0.305% | 4881 | 96748<br>0.474% |
| Wood | 3640<br>0.445% | 7431<br>0.920% | 3939<br>0.490% | 2137<br>0.272% | 3209<br>0.416% | 2879<br>0.414% | 2100<br>0.321% | 2160<br>0.318% | 382 | 27881<br>0.449% |
| Total | 29422 | 43841 | 78945 | 97662 | 136560 | 116119 | 141520 | 89813 | 25302 | 759187 |

We further select the 692 buildings with information of their age when knocked down. The distribution of building ages are shown in Table 5. In contrast to the law-specified building physical life (see Table 6). It is noted that all demolished reinforced-concrete buildings were knocked down before they reached their physical life. A small percentage of reinforced-brick buildings were over 52 years when torn down. In contrast, a relatively larger percentage of brick and wood buildings survive their physical life. Due to data constraints, we, however, are not aware if there are and how many buildings have outlived their physical life and remain in use. Those information are not included in the data analyzed.

**Table 5: Distribution of building ages when demolished**

| Year | 0-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | 36-40 | 41-45 | 46-50 | 51-55 | 56-60 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reinforced-concrete | 8 | 2 | 3 | 19 | 33 | 43 | 69 | 52 | 30 | 13 | 1 | 0 | 273 |
| Reinforced-brick | 6 | 2 | 0 | 1 | 5 | 18 | 32 | 96 | 88 | 63 | 18 | 1 | 330 |
| Brick | 1 | 1 | 0 | 2 | 8 | 10 | 2 | 18 | 16 | 11 | 3 | 0 | 72 |
| Wood | 1 | 0 | 0 | 1 | 2 | 6 | 2 | 1 | 2 | 2 | 0 | 0 | 17 |
| Total | 16 | 5 | 3 | 23 | 48 | 77 | 105 | 167 | 136 | 89 | 22 | 1 | 692 |

**Table 6: Law-specified annual depreciation, physical life and salvage value**

| Structure materials | Annual depreciation | Physical life (years) | Salvage value (%) |
|---|---|---|---|

| | (%) | | |
|---|---|---|---|
| Reinforced concrete | 1% | 60 | 40% |
| Reinforced brick | 1.2% | 52 | 37.6% |
| Brick | 1.4% | 46 | 35.6% |
| Wood | 2% | 35 | 30% |

The comparison of economic life and physical life suggests that a sizable proportion of reinforced-concrete buildings were knocked down far ahead of its physical life. As high as 40% of demolished reinforced-concrete buildings even did not reach half of their physical life. Even though it is necessary for buildings to be knocked down for future development, a too-early demolition also represents waste of resources and disjoint between urban plan and market reality. It also raises curiosity that a respective 19% and 29% of brick and wood buildings had passed their physical life when torn down. It is practically easier and economically sound to knock down such low-density buildings to accommodate expanding population and activities. But the figures suggest that redevelopment did not move as smoothly as normally expected. A delayed redevelopment on those desirable sites displays another policy puzzle to be explored.

Preliminary Findings and Some Further Thoughts

In a city with a severe scarcity of land, coupled with a world-class population density, Taipei's hunger for land needs no explanation. Analysis of reliable official records on building demolition allows us to present a number of evidence-supported findings. Firstly, demolished floor-areas by and large keep pace with market demands. In addition, not only those old neighborhoods with aged buildings but also the pricey neighborhoods have observed most activities of teardowns. Both physical and economic factors are operating in determining where to knock the buildings down. Despite its modern materials, buildings made of reinforced concrete tend to have stood substantially shorter than their physical duration. In contrast, a notable proportion of brick and wood buildings have sustained longer than their physical life. The parallel phenomena actually highlight the potential misallocation of land resources.

The next phase of our research is set to investigate the difference between economic and physical life of buildings and its determinants. Understanding what determines a building to be torn down ahead of the end of its physical life is important. Through that, we can comprehend more as to how a city might grow through recycling of land and where the government shall pour resources to in promotion of urban regeneration.

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