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Non-growth transition in the housing sector: Necessity, visions and challenges - A comparative study of Copenhagen and Hangzhou

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Abstract

This article examines the extents to which economic growth and housing stock growth has been decoupled from negative environmental impacts over the latest two decades in the metropolitan areas of Hangzhou (China) and Copenhagen (Denmark). Research results show that housing stock growth and economic growth has been, at best, weakly decoupled from environment impacts, implying that the goal of sustainable housing development has not been fulfilled by the decoupling strategies. The long-term incompatibility between housing stock growth and environmental sustainability suggests the necessity of non-growth in the housing sector in order to reduce the environmental impacts from housing consumption to be within the ecological capacity. On the basis of an analysis of drivers of housing stock growth, the visions for a non-growth housing stock in both city regions are imagined in terms of potential risks and countermeasures.

Keywords: decoupling, urban development, housing sustainable development, economic growth, non-growth

1. Introduction

Developing sustainable housing has been an important part of the endeavor to pursue environmentally sustainable development of the entire society. In the discourse on sustainable development, the dominant paradigm has been *decoupling* of economic growth from negative environmental impacts. In developing countries where the desirability of economic growth is usually taken for granted, decoupling has been emphasized as the key strategy for achieving environmental sustainability. In wealthy countries as well, maintaining economic growth through decoupling has been highlighted as a major goal on the political agenda, even though the affluence level is already very high. However, in recent years, the possibility of maintaining economic growth through decoupling has been questioned by critics arguing that decoupling alone is not sufficient to achieve environmental sustainability. Evidences so far have not shown convincing arguments that decoupling strategies will lead to an absolute decoupling between economic growth and its various environmental impacts (Azar et al., 2002; OECD, 2002; Tapio, 2005; Næss et al., 2011). Therefore, opponents of growth propose a reduction in the scale of the total economic output, i.e. degrowth to reduce the environmental impacts as much as is needed in order to stay within the biophysical limits of the planet.

Using the concrete examples from the field of housing and urban development, this paper argues that it is hard to combine continual growth in the housing stock and long-term environmental sustainability both in wealthy and poor countries. Non-growth in the housing sector appears to be needed to reach the requirements of an environmentally sustainable development. For the housing sector, decoupling means finding ways to accommodate the growth in the housing stock while reducing the negative environmental impacts resulted from this growth. The case studies are Copenhagen, the capital of Denmark, where living standard is among

the highest in the world and Hangzhou, the capital of Zhejiang province in China, where living conditions have not yet reached the same level.

First, trends of decoupling between economic growth, housing stock growth and environmental impacts in Hangzhou and Copenhagen are compared. The limits to decoupling as a major strategy for sustainable housing development suggest the necessity of a non-growing housing stock. Then, by analyzing the drivers of growth in the housing stock in these two cities, possibilities and visions are imagined of a non-growing housing sector not compromising the social aspect of sustainability. A comparison of two cities of different affluence levels, political traditions, institutional circumstances, and cultural backgrounds could provide a broader perspective on how decoupling strategies are implemented and their limitations for sustainable development.

2. Case cities and housing and urban growth

Hangzhou is the capital and the economic, cultural, scientific and educational center of the Zhejiang Province, a national historical and cultural city and an important destination for tourists. It is one of the central cities in the Yangtze River Delta and the transportation hub in southeastern China. The whole municipality covers an area of 3068 km^2 consisting of 8 districts: Shangcheng, Xiacheng, Jianggan, Xihu, Gongshu, Binjiang, Xiaoshan and Yuhang (Figure 1). The metropolitan area is planned as a hierarchic-polycentric structure, with one clear major center (the inner parts of the city), three second-order centers and six third-order centers (Figure 2). So far, the major center has the highest concentration of workplaces, stores and other service facilities compared to the lower-order centers, some of which have not been completely developed. Among others, Shangcheng, Xiacheng and part of Xihu and Gongshu are often referred to as the inner city where the major center is located. In 2001, in order to secure larger geographic space for urban development, the Xiaoshan and Yuhang districts were merged into Hangzhou metropolitan area where the third-order centers are mainly located.

Since the 1990s, with the rise of Yangtze River Delta region as an emerging global city region, Hangzhou has experienced rapid globalization and growth. The economy of Hangzhou developed fast from 1978 to 2008 with an average annual GDP growth rate of more than 11%. As a consequence of the national urban housing reform in the 1980s and 1990s, the industry of real estate has become an important driver of economic growth and the share of real estate in total regional GDP has been increasing. Hangzhou can be characterized as a forerunner among Chinese cities in the development of the residential sector. The metropolitan area has had an unprecedented growth in the housing stock, with an increase of 316% from 1991 to 2008. The growth in the number of urban residents has also been rapid, with 157% increase during the same period (Table 1). Residential buildings in Hangzhou Metropolitan Area are relatively new. Among the total residential building stock in 2008, 59% of the residential floor area was built between 1999 and 2008. Even after the global economic crisis in 2008, the construction of new dwellings has maintained a very high speed. There has also been considerable growth in the size of urbanized land, with an increase of 165% over the period 1991-2008.

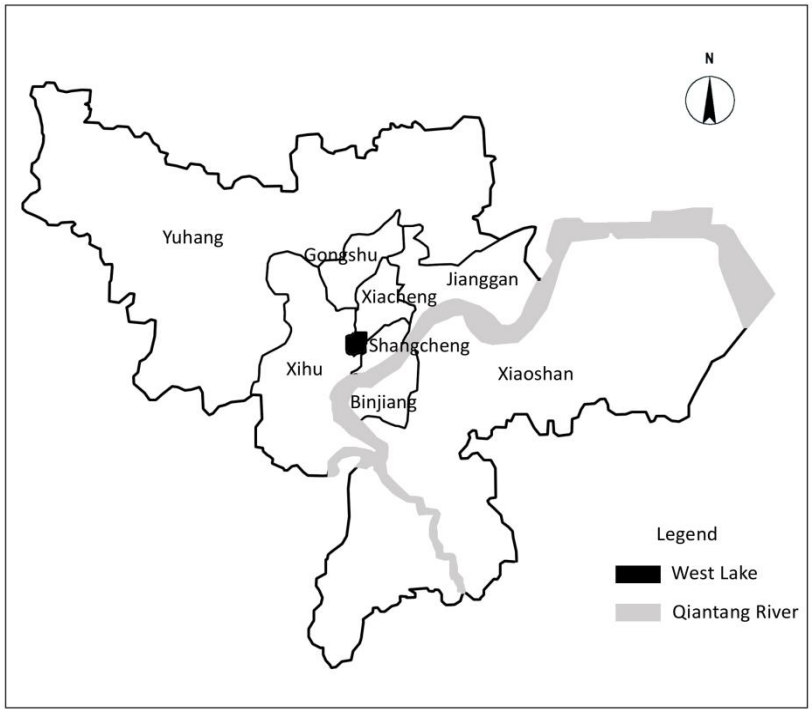


Figure 1: Geographical location of Hangzhou in China and eight districts comprising Hangzhou Metropolitan area.

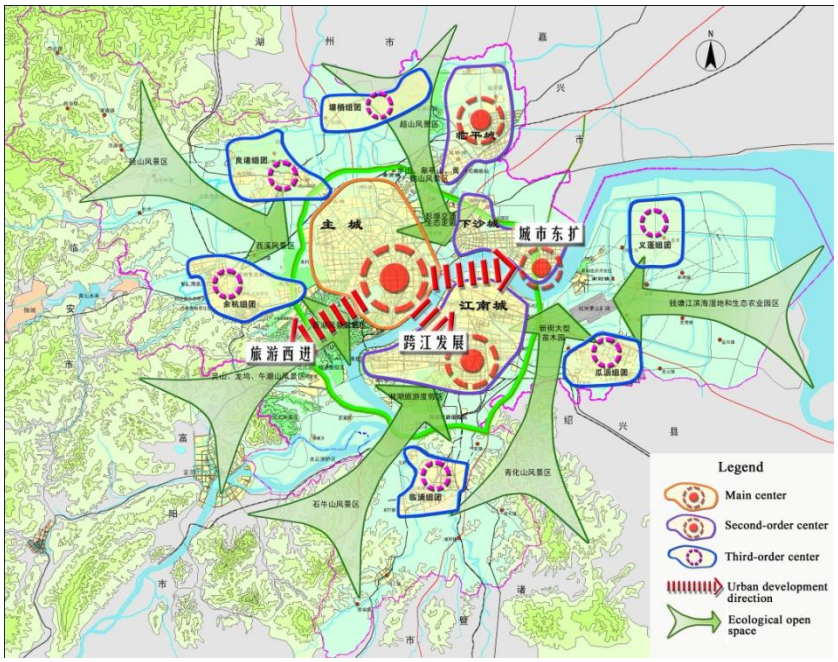


Figure 2: Centers of first, second and third order within Hangzhou Metropolitan Area (Hangzhou Urban Planning Bureau, 2007).

Table 1 Development of housing stock, demography and economy in Hangzhou from 1991-2008.

Metropolitan area	Hangzhou			Copenhagen		
Year	1991	1999	2008	1991	1999	2008
Housing stock (million m^2)	25.8	44.0	107.3	81.1	84.8	91.7
Urban population (million)	1.11	1.39	2.85	1.67	1.73	1.8
Average family size (persons)	3.40	3.11	2.75	2.10	2.08	2.09
Number of households (million)	0.43	0.55	1.26	0.82	0.86	0.89
Average floor area per capita (m^2/person)	10.8	14.6	22.4	48.6	49.1	51
GDP (index to 1991)	0.27	1	2.09		1	1.20
Urbanized land (km^2)	327	472	868		629	645
Population density (persons/hectare)	106.1	95.5	62.8		27.4	27.7

Copenhagen Metropolitan Area,[1] the capital of Denmark, covers an area of 3132 km^2. The center structure of Copenhagen Metropolitan Area could be characterized as hierarchic, with downtown Copenhagen as the main center. Nonetheless the central municipalities of Copenhagen and Frederiksberg make up only 3.4 % of the area of Copenhagen Metropolitan Area; they have an unchallenged status as the dominating center of the city region, having one third of the inhabitants and an even higher proportion of the workplaces. The central parts of five formerly independent towns now engulfed by the major conurbation form the second-order centers. Along with certain other concentrations of regionally oriented retail stores, and more local center formations in connection with, urban rail stations and smaller-size municipal centers are at a third level (Figure 3). Similar to many contemporary European cities, Copenhagen Metropolitan Area's trade and business is dominated by service and knowledge industries, with a rapid decline in the number of jobs in manufacturing industries since the 1970s, especially in the municipality of Copenhagen. From 1993 to 2006, the average annual economic growth in GDP was about 2%.

Whereas the development of housing sector in Hangzhou did not take off until the 1990s, when the centrally planned public housing provision and allocation was reformed into a regime of commercialized housing in an open market economy, rapid growth in the housing sector in Copenhagen Metropolitan Area already started after the World War II and peaked in the 1960s and 1970s. Since then, the construction of new dwellings has slowed down. Changes in the share of the housing sector in the total economy were consistent with the trajectory of dwelling construction. Compared to the fast growth in Hangzhou Metropolitan Area, growth in the housing stock, population and urbanized area have been moderate in Copenhagen Metropolitan Area. During the period 1991-2008, housing stock has grown by 13% and population by 7.8%. Over the period 1999-2008, the size of urban area has grown by 2.5% (Table 1). In contrast to Hangzhou, the housing stock is old in Copenhagen Metropolitan Area. In 2009, less than 10% of the total residential floor area was built in the years between 1991 and 2008.

[1] The Copenhagen Metropolitan Area as understood in this paper is equal to Greater Copenhagen as defined in the Danish Planning Act.

Figure 3: The continuous urban area of Copenhagen, based on a demarcation used in the MOLAND project (2010) initiated by the EU Commission. The continuous urbanized area of Copenhagen is shown in gray. Major transport arteries (black lines) are also shown.

The continuous growth in the housing stock has increased per capita floor area, especially in the case of Hangzhou. As shown in Table 1, in Hangzhou Metropolitan Area, per capita floor area in 2008 was more than twice of that in 1991. However, despite the higher growth rates in Hangzhou than Copenhagen, the housing standard is still much lower than that of Copenhagen.

Housing stock growth has several types of environmental impacts which could be generally summarized as consumption of raw material, energy, and undeveloped land. The consumption of raw material is accumulated in the housing stock, wherefore the degree of decoupling between housing stock and economic growth is calculated. Undeveloped land consumption for urban and residential development is another indicator to measure housing sustainability. Undeveloped land loss for urban and housing purpose results in encroachments on natural areas and agricultural land, which could have influences on biodiversity, food security, ecosystems, etc. In addition, growth in the urbanized area will entail the transportation needed for the residents to reach their workplaces and facilities for other daily-life activities. Depending on the location and density of residential areas, there is considerable variation in this energy consumption, where growth in floor area per capita tends, other things equal, to increase the spatial expansion of cities and hence their needs for motorized travel (Newman & Kenworthy, 1999; Næss, 2006). For these reasons, I consider the degree of decoupling between land consumption for urban development and economic growth to be another relevant indicator. Apart from these, the degree of decoupling of residential energy consumption from housing stock and economic growth has also been calculated.

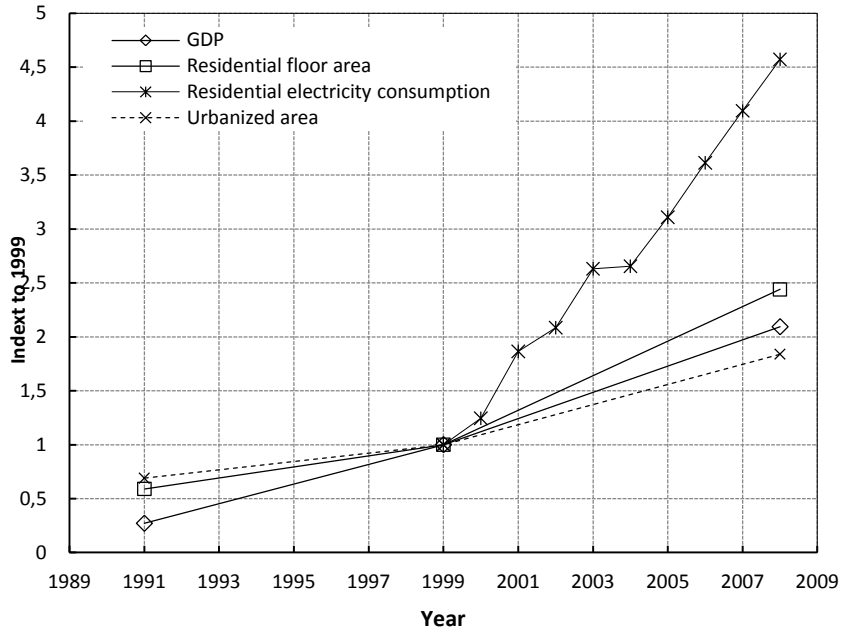
Tapio (2005) has proposed a theoretical framework for measuring different degrees of decoupling. On the premise of a growing GDP, logical possibilities can be strong decoupling, weak decoupling, coupling, or expansive negative decoupling. Strong decoupling occurs when GDP grows and environmental impacts (EI) keep stable or are reduced (%EI / %GDP $\leq$0). In weak decoupling, GDP and environmental impacts both increase but the growth rate of environmental impacts is at least 20% lower than GDP growth rate (0< %EI / %GDP $\leq$0.8). Coupling occurs when the growth in the environmental impact lies within the interval from 20% lower than the economic growth rate to 20% above this rate (0.8< %EI / %GDP $\leq$1.2). Expansive negative decoupling refers to situations where negative environmental impacts grow at a rate more than 20% above the economic growth rate (%EI / %GDP >1.2).

Due to data availability, the research covers the period 1991-2008, divided into two time horizons, i.e. 1991-1999 and 1999-2008. For some indicators, data only allow for a quantitative comparison of the two metropolitan areas in the second period.

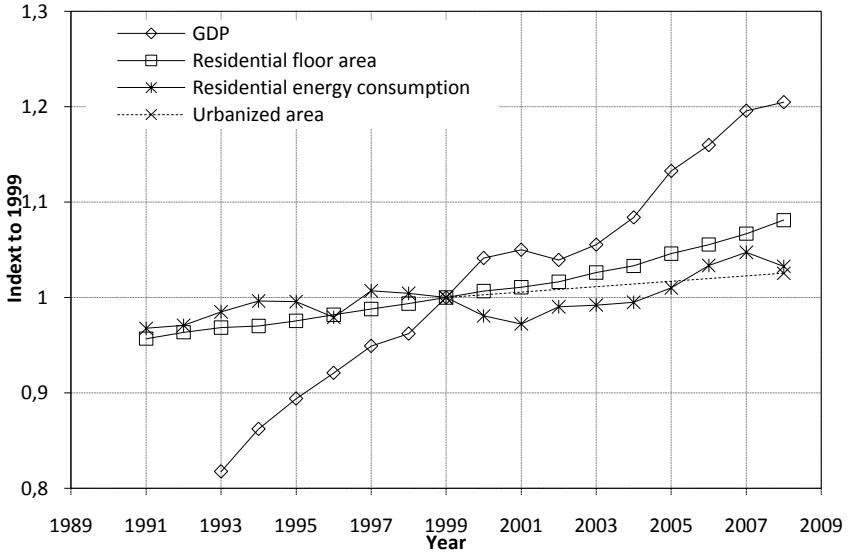
3. Decoupling trends in Hangzhou and Copenhagen Metropolitan Areas

Figure 4 shows how the GDP, residential floor area, residential energy consumption and urbanized area have developed since the 1990s in Hangzhou Metropolitan Area and Copenhagen Metropolitan Area (Figure 4).[2] In absolute terms, in both city regions, GDP, housing stock, residential consumption and the size of urbanized land have increased over the period investigated. In Hangzhou Metropolitan Area, housing stock and residential electricity consumption have grown at a pace higher than GDP growth. In Copenhagen Metropolitan Area, GDP has grown with a rate much higher than the housing stock and residential energy consumption. In both Hangzhou and Copenhagen, the size of urbanized land has increased at a lower rate than both housing stock and GDP.

[2] Due to data availability, the trend of residential energy consumption in Copenhagen Metropolitan Area is represented by Denmark as a whole. In Hangzhou, the major energy carrier for space heating/cooling, lighting and domestic appliances is electricity. Unfortunately, the data regarding electricity consumption do not allow for a quantitative investigation for the first period (1991-1999). Since electricity has gradually become the major energy carrier in household energy consumption by replacing coal in space heating/cooling in recent decade, the exclusion of the first period in the investigation makes sense.



Hangzhou Metropolitan Area



Copenhagen Metropolitan Area

Figure 4: Development of GDP, residential floor area, residential electricity consumption and urbanized area in Hangzhou Metropolitan Area (above) and Copenhagen Metropolitan Area (below) over the period 1991-2008 (Source: based on data provided by Hangzhou Statistic Yearbook, various years; Wang, et al., 2009; Statistic Denmark, various years; Aalborg University's Spatial Data Library, 2009).

Measured by decoupling degrees, Figure 5 indicates the changes in the growth rates of residential floor area, undeveloped land consumption for urban expansion, and residential energy consumption relative to GDP growth in both city regions.

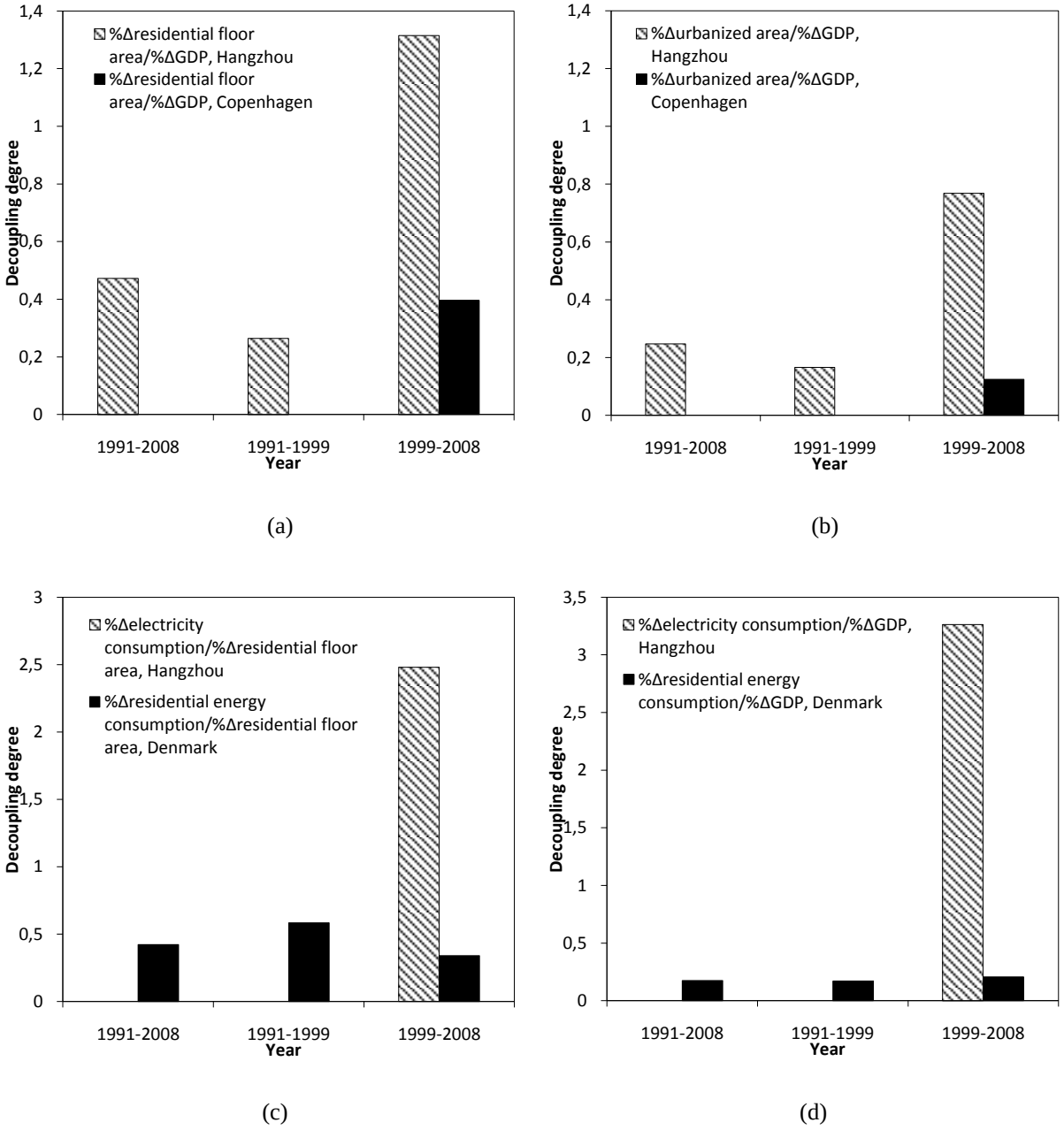


Figure 5: Decoupling rates between housing stock and GDP (a), size of urbanized area and GDP (b), residential energy consumption and housing stock (c), and residential energy consumption and GDP (d) in the metropolitan areas of Hangzhou and Copenhagen over the period 1991-2008.

Seen from Figure 5(a), in Hangzhou, the growth in the size of the housing stock has for the entire period 1991-2008 been weakly decoupled from economic growth. However, an important change has occurred during these years. In the first eight years (1991-1999), the residential building stock grew at a much lower rate than the economy, while during the period 1999-2008, the residential building stock increased considerably with a rate 30% higher than the economic growth. Hangzhou has thus moved from weak decoupling between housing stock growth and economic growth between 1991 and 1999 to expansive negative decoupling between 1999 and 2008. The substantial increase in the housing stock in Hangzhou in

the second period coincides with the period of housing reform, which emphasizes the perceived role of the housing sector from a drain to a driver of economic growth. The housing stock growth in Copenhagen has been slower than GDP growth over the period 1999-2008, representing weak decoupling between housing stock growth and economic growth. Housing construction in Copenhagen Metropolitan Area peaked in the 1980s and began to drop in the beginning of the 1990s and for the whole 1990s new construction of housing maintained a lower level, in spite of a growing population in the region. The average annual growth rate of housing stock was only 0.55% over this period. However, economic growth was relatively faster with an average annual growth rate of 3.51% from the period 1993-2000. This indicates a higher decoupling degree in the 1990s between housing stock growth and economic growth than that over the period 1999-2008. During the years after 2000, new construction of dwellings has steadily increased and peaked in 2006. In the light of a declined growth rate of GDP to 1.84% annually, the substantial increase in the housing construction was mainly resulting from high population growth. Even though the economic growth rate was still higher than that of the housing sector which was 1.1% annually during the period, the growth rate of the total housing stock was twice of that in the first period (1993-1999).

As shown in Figure 5(b), in both city regions, land consumption for urban development has been lower than the rate of economic growth over the investigated periods, in particular in Copenhagen Metropolitan Area. In Hangzhou, the growth rate of land consumption was 80% lower than the GDP growth rate in the period 1991-1999. Then it increased but was still lower than GDP growth rate in the period 1999-2008. Although the development in the two periods represents weak decoupling, the growth rate of land consumption was only 20% lower than GDP growth rate in the second period which, according to Tapio's definition, is barely within the range of weak decoupling. In Copenhagen Metropolitan Area, the decoupling degree between urbanized land growth and economic growth was 0.12 over the period 1999-2008, which means that the growth rate of the urbanized land was only 12% of GDP growth rate. The average annual growth rates of urbanized land and GDP were only 0.28% and 2.09%, respectively during this period. This tendency of decoupling also appeared in the previous period. Over the period 1993-2000, the average annual growth rate of GDP in Copenhagen Metropolitan Area was 3.5%, while according to EEA (2006), the annual growth rate of urbanized land was 0.8%. Therefore, relative decoupling between economic growth and growth in the urbanized land has already taken place in the 1990s, but the decoupling rate after 2000 is higher than that in the 1990s.

The higher decoupling degree between the urbanized land growth and GDP growth in Copenhagen Metropolitan Area does not indicate that the urban areas of Copenhagen are denser than Hangzhou. In contrast, Hangzhou has a considerable higher population density than that of Copenhagen. Copenhagen Metropolitan Area had experienced a higher growth rate of urbanized area than population growth since the mid-1950s. For the entire period from mid-1950s to late 1990s, population growth was about one third of the built-up area growth in the metropolitan area (EEA, 2006). This low density urban development pattern has been reversed in the 2000s. The low population density in the urbanized area provides opportunities for densification. In recent decade, urban development in Copenhagen Metropolitan Area has to a high extent taken the form of inner-city densification as well as suburban development close to urban rail stations.

Correspondingly, geographic development of new residences in Copenhagen Metropolitan Area has experienced a shift from decentralization to concentration or from suburbanization to reurbanization. According to Andersen and Jørgensen (1995), between 1940 and 1980, about 240,000 dwellings were constructed and nearly 350,000 people left the two core municipalities (municipality of Copenhagen and Frederikesberg) for new dwellings in the suburbs, which constituted a major element of urban expansion into the formerly rural areas in this period. In the 1970s, new dwellings were built at a distance from the city center of Copenhagen of on average 23 km (Hartoft-Nielsen, 2002). Meanwhile, economic restructuring has made old industrial factories close down or relocate from inner city and harbor areas to the broader periphery of the region and left the inner city with fragmented brownfields. The suburbanization of housing and the economic restructuring have made the Copenhagen Metropolitan Area sprawled and sparse.

Compared to the period 1940s-1980s, residential development in the metropolitan area during the latest decade has shown a trend of concentration. New dwellings in the 1990s were built on average 20 km from the city center of Copenhagen (Hartoft-Nielsen, 2002). Some brownfield areas in the inner city were redeveloped into residential areas. Even though the majority of the new dwellings have still been located in the rest of the metropolitan area, Copenhagen and Frederiksberg have shown a tendency of increasing their share of the total number of newly completed dwellings. On average, this share increased from 19.6% in the 1980s, 22.9% in the 1990s to 33.4% in the 2000s. This illustrates the densification in the inner city in the recent two decades even though there is still a sprawling trend in the outside part of the metropolitan areas. Another trend which is favorable from an environmental perspective is that, to some extent, residential development has taken place close to urban rail stations or other major public transport nodes. This trend is more pronounced in the central municipalities than in the outer areas. Due to densification strategies in Copenhagen Metropolitan Area, a stabilization in population density occurred in the late 1990s and the turn of the millennium.

To some extent, the pattern of urban and residential development in Hangzhou Metropolitan Area has been opposite to that of Copenhagen Metropolitan Area. The declined decoupling degree between the growth in the size of urbanized land and economic growth reflects the changes in the shift of spatial development pattern of the metropolitan area of Hangzhou from concentration and densification to decentralization and suburbanization. In the 1990s, urban development triggered by economic growth has to a high extent taken the form of renewal of existing urban areas, typically by replacing old built-up districts with new buildings at higher densities. As a result of land reform from free use of land to paid use in China, industries in the inner city moved out to the outskirts (Feng, 2002b). During this period, renovation of old urban districts was pointed out as the major residential development policy. Although new residential buildings were also constructed outside the inner city, clearance of old apartment buildings and construction of new ones at the same place was the major initiative on residential development. This is illustrated by the fact that the total floor area of clearance from 1986 to 1999 was 8.75 million square meter (Feng, 2002a), while the completed floor area over the same period was 17 million square meter (excluding Yuhang and Xiaoshan). According to Wang et al. (2009), the majority of expansion from 1991 to 1999 took place within the distance belts from 10 to 20 km from the city center of Hangzhou, with an increase of urbanized land of 145 km^2.

Along with the densification in the inner city, outward expansion also took place and gradually took the major role in urban development in the 2000s, which were characterized by a faster decline in the population density of Hangzhou. New built-up areas have mainly been constructed in the distance belts from 20 to 30 km from the city center. Urban expansion was relatively faster in this period than in the first one, with an increase of 396 km^2. The saturation of the inner city, where a considerable population densification has taken place (e.g. Shangcheng and Xiacheng, with a population density of 194 and 162 persons per hectare of built-up area in 1999), and the scarcity of land for further development, have led to the decentralization and suburbanization of dwellings. This development has been reinforced by the construction of transport infrastructure. Many recently developed residential districts have been located along 9 planned metro lines even though the majority of them have not yet been constructed. The decentralization of residential development in Hangzhou is likely to lead to increasing levels of motorized traffic between residences and workplaces and other city facilities (Næss, 2010). From a decoupling point of view, the evolution of such a city structure of Hangzhou is not efficient in reducing housing-related environmental impacts. Arguably, the increase of the growth rate of land consumption compared to GDP growth over 1999-2008 may be a signal of coupling in future.

Land use efficiency, in particular for residential areas, has been historically higher in Hangzhou Metropolitan Area than in Copenhagen Metropolitan Area. Due to a strong farmland protection policy, land available for urban development is quite limited in China. The typical type of residential buildings in Hangzhou has been middle-rise multi-family buildings of five to six stories, and the inhabitants have a tradition for dense living. Since 2000 or so, most of the newly constructed residential buildings are high-rise buildings and the plot ratios are higher in the areas in proximity of the city center. But in recent years, a steadily increasing number of low-rise houses like row houses and single family houses have been constructed on the outskirts. Distinct from Hangzhou, a preference for owner-occupied single-family houses in Denmark can be dated back nearly to the mid-19th century. Especially since the mid-20th century, the detached single-family house has been a preferred and ideal housing type in Denmark (Vestergaard, 2006). In the Copenhagen Metropolitan Area, the share of single-family dwellings in the total housing stock has remained fairly constant at about 25% since 1980. In contrast, the share of apartments which are relatively environmentally friendly has declined by 4 percentage points. This has reduced the environmental sustainability of housing. However, seen in a shorter and more recent period, the increased urban density since 1999 is mirrored by the fact that the share of detached single-family houses in the completed new residences has declined in Copenhagen Metropolitan Area compared to the latter half of the 1990s.

One point worth noticing is that not all environmental impacts will tend to increase at the same rate as GDP in the absence of particular decoupling efforts, as assumed by Tapio. When comparing GDP and the size of urbanized land, environmental impacts (measured as urban land growth) from economic activities taking place in a three-dimensional space is reduced to a two-dimensional land surface. Spatial environmental impacts resulting from economic activities could also go upward to the sky or downward into the ground, as urban growth takes place in a three-dimensional way. Therefore, land consumption on the surface of the planet only reflects part of the spatial impact of economic growth. This incomplete match implies that the growth rate of urbanized land could normally not be expected to be as high as that of GDP. A lower growth rate in land consumption than in GDP therefore does not necessarily indicate a ‘real’ weak decoupling of

urbanized land growth from economic growth. For those environmental impacts that have historically grown slower than the economy, caution is needed in order to make a legitimate assessment, especially when the decoupling indicators convey a positive message.

Unfortunately, data of residential energy consumption for the two city regions are not available. Since Copenhagen Metropolitan Area accounts for more than one third of the Danish population and GDP, the trends of decoupling of the residential energy consumption from housing stock growth and economic growth in Copenhagen could arguably be reflected roughly by measuring the indicator for Denmark as a whole. Denmark has substantially reduced its total final residential energy consumption since the oil crisis in1973. However, the decline in the residential energy consumption stopped in the beginning of 1980s and has since then almost been stabilized with small fluctuations. Even though strong decoupling has occurred between housing stock growth and residential energy consumption in Denmark since 1975, over the period 1991-2008, seen from Figure 5(c) and (d), residential energy consumption was only weakly decoupled from the housing stock growth and economic growth. This implies that the growth in household energy efficiency has declined, and the improvement of energy efficiency has been counteracted by growth in floor area and household machinery in recent two decades.

In strong contrast to Denmark, residential electricity consumption has been negatively decoupled from housing stock growth as well as economic growth in Hangzhou Metropolitan Area. Figure 5(c) and (d) show that residential electricity consumption has grown at rates of 2.5 and 3.3 times the growth rates of housing stock and GDP. In Hangzhou, the major energy carrier for space heating/cooling, lighting and domestic appliances is electricity. If other energy sources for household usage are included, the degrees of decoupling would be even lower. In spite of sharpened building regulations to conserve energy, the rate of increase in building energy efficiency is considerably slower than the increasing energy demand.

One common reason for growing residential energy consumption in Denmark and Hangzhou is the rapid increase of domestic appliances, which is due to bigger floor area and increased affluence level. However, securing of more comfortable indoor environment is a more pronounced factor contributing to energy consumption in Hangzhou than in Denmark, because residents in Hangzhou have for a long time suffered from harsh indoor environment and have not been able to adjust their indoor climates until the recent decade. The installation of heating and cooling equipment occurred during a period without any consideration of thermal performances of residential buildings in Hangzhou, yielding huge energy waste.

4. Towards non-growth in the housing sector

The trajectories followed by the two city regions in residential development, urban development and residential energy consumption since the beginning of the 1990s have shown more differences than similarities. Generally speaking, over the investigated period, Hangzhou Metropolitan Area has been experiencing an explosive growth in GDP, housing stock and energy consumption unprecedented in its modern history. However, Copenhagen Metropolitan Area, similar to most west European city regions, already passed its most rapid growth period in the two post-war decades and has experienced economic

recession and stagnation during the investigated period. Despite much faster growth in Hangzhou, per capita affluence level and consumption level including GDP, housing and residential energy consumption is still lower than that of Copenhagen, which had a high level of affluence at the beginning of the investigated period. Both countries have aimed at sustainable housing and urban development, with a longer history of this endeavor in Denmark than in China, which is at an earlier stage of its growth period compared to Denmark. The different stages of economic development have influenced the two countries' attempts in dealing with the environmental problems from housing and urban development.

The investigated decoupling trends between different variables in the two city regions have to some extent revealed the 'effectiveness' of the decoupling polices pursued by Copenhagen and Hangzhou for sustainable housing development, which is more significant in Copenhagen. However, economic growth has, at best, only been *weakly decoupled* from housing stock growth, land consumption and residential energy consumption, which implies that the goal of sustainable housing development has not been fulfilled by the decoupling strategies.

Long-term growth in housing stock is incompatible with environmental sustainability. Present environmental impact of the housing consumption is already higher than what would be desirable from a sustainability point of view. The footprint per capita in Denmark is already 3.4ha higher than its biocapacity in 2007 and Hangzhou overshot its biocapacity by 1.2ha in 2002 (WWWF, 2010; Zhang & Ye, 2004). So far, per capita ecological footprint in Hangzhou is only about one fourth of Denmark. An attainment of the Danish affluence level in Hangzhou would imply substantial biocapacity overshoot. Relative decoupling (as seen in the relatively slower growth in the residential energy consumption in Copenhagen and the size of urbanized areas in both city regions than GDP) still implies increasing environmental impacts and is therefore not sufficient to obtain a long-term ecologically sustainable development. If negative environmental impacts from the housing sector continue increasing, an attainment of an overall goal of decoupling economic growth from environmental impacts would require extensively strong decoupling within other economic sectors, which is also difficult.

Since long term growth in the housing stock is incompatible with environmental sustainability, a non-growth or even degrowth in the housing stock is necessary from an environmental perspective. Apart from being a considerable part of the GDP growth, housing has a social dimension associated with city sanitation, easing housing shortage, eliminating slums, improving living standards, etc. (Harris & Arku, 2007). The social aspect in poor countries is more significant because living conditions are obviously bad. Therefore, a proposal of non-growth in the housing stock from an environmental perspective should not compromise the need for a decent living which is an important part of the social sustainability. The analyses of the composition of the housing stock growth in Copenhagen and Hangzhou in the following section could help identify if a non-growth housing stock is plausible in both city regions.

Table 2 quantitatively measures the role of population growth and per capita floor area growth in driving housing stock growth. In Copenhagen, the factor of population growth is a more important driver of housing stock growth over the first period (1991-1999) than the second period. Even though population growth in the second period has been faster than the first one, a declining contribution to housing stock growth suggests

that growth in per capita floor area was much faster, whereas, in Hangzhou, the major driver of housing stock growth has shifted from growth in per capita floor area to population growth. Both urban population and per capita floor area have grown faster over the years 1999-2008 compared to the period 1991-1999 in Hangzhou. The large share of per capita floor area growth in the first period reflects the low living standard at the outset. However, given the fact that Chinese cities have gone into a rapid urbanization process, the dominant role of population growth in driving housing stock growth may be more prominent in the future years.

Table 2 Comparison of contributions of population growth and per capita floor area growth to housing stock growth in Hangzhou and Copenhagen.

Items contributing to housing stock growth	Copenhagen			Hangzhou		
	1991-1999	1999-2008	1991-2008	1991-1999	1999-2008	1991-2008
Contribution of population growth	78%	51%	61%	42%	66%	59%
Contribution of per capita floor area growth	22%	49%	39%	58%	34%	41%

It should be noticed that in the two decades prior to 1990s, the construction of new dwellings in Copenhagen Metropolitan Area was high while the population growth was negative. This had resulted in substantial growth in per capita floor area. After 1990s, even though the number of inhabitants began to increase in the metropolitan area, per capita floor area has also experienced an increase. In 2008, per capita floor area in Copenhagen was on average 51m^2, among the highest in the world. Then why is it still an implicit goal to continue increasing per capita floor space? From an environmental standpoint, growth of the housing stock both in absolute figures and in per capita floor area should not been seen as an unavoidable fact. In Copenhagen, a non-growth or even degrowth of the housing stock will arguably not influence negatively on the welfare that inhabitants are entitled to if proper policies are in place.

One important cause of a growing per capita floor area in Copenhagen is a declining family size which has increased the number of households and pushed up housing consumption. Such a trend not only impedes sustainable housing development as smaller household size tends to lower per capita resource efficiency (Gram-Hanssen et al., 2009), but also impedes the sustainability of a region because a declining household size imposes negative impacts on biodiversity conservation (Liu et al., 2003). Over the past three decades, the share of one-person household in Copenhagen Metropolitan Area has increased by 6 percentage points. Accommodating the growth in the number of households by simply increasing the number of housing units is apparently not an environmentally sustainable policy. Instead, co-housing for some of the one-person households could make their living not only environmentally sustainable but also social attractive. Therefore, housing policy for a non-growing housing stock can be adapted to the demographic change by converting it to more environmentally friendly lifestyles.

In a non-growing housing stock, every increase in floor area must be balanced by someone's loss. The poor are usually the losers in this situation because the limit of housing stock will induce housing scarcity and push up housing prices. To avoid social unsustainability, redistribution measures are in need. Housing is

traditionally an important part of social welfare in Denmark. Social housing can function as a redistributive measure to relieve the potential distributional conflicts.

In Hangzhou Metropolitan Area, even though the growth in the floor area per capita was high, growth in the housing stock has been to a larger extent attributed to population growth, reflecting the challenges of rapid urbanization of the metropolis. Even if we are cautious that sustainability on behalf of the future generation needs a non-growing housing stock, it would still be morally acceptable to grow housing stock because of the low living standard. A projected growing urban population combined with strong aspiration for larger floor area per capita would lead to a high housing consumption and impose substantial environmental pressure. However, whether the achievement of 'western living standard' is environmentally acceptable is critically questioned given the discussion above. In the long run, a halt to the growth in the housing stock is also necessary in order not to lead to collapse of the ecosystem. The point at which growth cannot continue should not be justified solely on the attainment of western standard of living. A proper living standard in terms of floor area per capita based on the balance of economic, social and environmental sustainability needs to be developed. Controlled growth guaranteeing a decent living standard for citizens should be facilitated within the ecological capacity. Without the former, growth containment on housing will hardly be accepted among the population.

Given the fact that growth in the housing stock has been fast in Hangzhou, the transition to such a non-growth period might arrive before long. Realizing that growth in the housing stock cannot be eternal ought to encourage government leaders and citizens in the metropolitan area to maximize well-being from the growth, and to strengthen decoupling strategies in order to conserve resources and reduce pollutions as much as possible. The present high growth pace in the housing stock should, from considerations of environmental sustainability, slow down. In Hangzhou, many new constructed dwellings are purchased for speculation and therefore are non-occupied. This probably shows that the current high growth rate in floor area may exceed the de facto need for dwellings to live in. Tightening the rules on non-occupied dwellings and speculation behaviors could cool down the overheating housing market and make housing affordable for the poor.

Similar to Copenhagen, declining growth in the housing sector and an imaginable non-growth in future are also likely to aggravate the unequal distribution of housing consumption, which has already been severe in Hangzhou. Housing policies should, from a perspective of social sustainability, give priority of growth in the housing consumption to the low-income population who are still living under poor conditions and increase their living standard.

5. Concluding remarks

Using the cases of Hangzhou and Copenhagen metropolitan areas, this article illustrates the constraints of decoupling strategies for housing sustainable development in different social, cultural and economic backgrounds. To obtain environmental sustainability, a halt to the growth in the total housing stock and floor area per capita seems to be urgent in Copenhagen and arguably needs to take place before long in Hangzhou.

Nevertheless, the initiatives of non-growth in the housing sector will tend to fail if they are not framed in a broader scheme of a zero-growth or degrowth economy.

In both cities, it can be imagined that a transition to non-growth in the housing sector will face challenges of contemporary institutions, most of which are framed to promote growth. Apart from the awareness of government leaders and policies, mobilizing citizens for an environmentally sustainable lifestyle is also essential. In Copenhagen, long-term economic stagnation in the 1970s and 1980s, combined with a new context of globalization, urged the state and local government to pursue growth stimulation policies in Copenhagen in order to keep Denmark's competitive position in Europe and the world. The growth stimulation policy embraces the housing policy as an instrument to attract an 'economically sustainable population' (upper socio-economic strata of the population instead of unemployed and welfare recipients) to reside in the Copenhagen Metropolitan Area (cf. Table 2) through new construction of spacious, expensive and luxury housing (Hansen et al., 2001). Contradictory to the desire of the Danish government that '(housing stock) growth and a sound environment should go hand in hand' (Danish Center for Urban Ecology, 2003, p.6), the case of Copenhagen tends to show the incompatibility between the pro-growth policy and environmental sustainability policy coexisting on the political agenda. When growth becomes the major goal, a sound environment could be sacrificed for it. Similar to the question put on the necessity of continual housing stock growth in Copenhagen, there is arguably also a need to question the necessity and possibility of continual economic growth, given the existence of environmental limits to growth and failures of more than half a century of continual economic growth in terms of social progress and environmental sustainability in developed countries.

In Hangzhou too, a slowing down of the housing stock growth would be in strong conflicts with the pursuit of overall economic growth. As some researchers have argued, currently, urban economy in most cities in China is property led (Wang, 2003). In Hangzhou, a local government-led growth coalition has been formed to promote urban development (Qian, 2007). Slower growth in the housing sector would lead to slow economic growth which is considered by the local government to be very undesirable. This makes us reflect beyond Hangzhou and the housing sector on the necessity and possibility of endless economic growth as a dominant development paradigm in China. Limited natural resources may not continuously support universal affluence at the current level of the rich countries, a level that China is likely to reach within a few decades. Against this background, priority for growth in China should therefore be given to the poor regions of the country to eliminate inequality, and future growth should be beneficial to social and environmental development. Of course, at this moment, since there is still large scope to improve eco-efficiency in China, the most urgent task to confront the challenge of sustainable development is to broaden and strengthen policies on decoupling and management.

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References

Andersen, H. T., Jørgensen, J., 1995. City profile: Copenhagen. *Cities*, vol. 1, pp. 13-22.

Azar, C., Holmberg, J., Karlsson, S., 2002. *Decoupling - past trends and prospects for the future*, Report of Environmental Advisory Council, Sweden.

Danish Center for Urban Ecology, 2003. D*enmark, State of the art: Architecture and Sustainability in Danish Housing*, p. 6.

EEA, 2006. *Urban sprawl in Europe*. Copenhagen: EEA

Feng, J., 2002a. Analyses on mechanisms of the development of suburbanization in Hangzhou (in Chinese). *Geography and Territorial Research*, vol. 18, No. 2, pp.88-92.

Feng, J., 2002b. Research on the industrial decentralization of Hangzhou city (in Chinese). *Urban Planning Review*, vol. 138, No. 2, pp. 42-47.

Gram-Hanssen, K., Scherg, R. H., Christensen, R. S., 2009. One-person households – a growing challenge for sustainability and housing policy. Paper presented at the ENHR 2009 conference in Prague.

Hangzhou Statistic Yearbook, 2010. Accessed May 2010 at http://www.hzstats.gov.cn/web/ShowNews.aspx?id=K7TYu2b6ZN4=

Hangzhou Urban Planning Bureau, 2007. *Hangzhou Master Plan.* Authorized by the State Council of China in 2007. Hangzhou: Municipality of Hangzhou.

Hansen, A. L., Andersen, H. T., Clark, E., 2001. Creative Copenhagen: globalization, urban governance and social change. *European Planning Studies*, vol. 9, No. 7, pp. 851-869.

Harris, R., Arku, G., 2007. The rise of housing in international development: The effects of economic discourse. *Habitat International*, vol. 31, No. 1, pp. 1-11.

Hartoft-Nielsen, P., 2002. Byudvikling i større byer- mulige konsekvenser for transporten (in Danish). *Byplan*, No.1, pp. 30-41.

Liu, J., Daily, G. C., Ehrlich, P. R., Luck, G. W., 2003. Effects of household dynamics on resource consumption and biodiversity. *Nature*, vol. 421, pp.530-533.

Næss, P., 2006. Accessibility, activity participation and location of activities: exploring the links between residential location and travel behaviour. *Urban studies*, vol. 43, No. 3, pp.627-652.

Næss, P., 2010. Residential location, travel and energy use: the case of Hangzhou Metropolitan Area. *Journal of Transport and Land Use*, vol. 3, pp. 27-59.

Næss, P., Strand, A., Næss, T., Nicolaisen, M., 2011. On their road to sustainability? The challenge of sustainable mobility in urban planning and development in two Scandinavian capital regions. *Town Planning Review*, vol. 82, No. 3, pp. 287-317.

Newman, P. W. G., Kenworthy, J. R., 1999. *Sustainability and Cities. Overcoming Automobile Dependence*. Washington DC/Covelo, California: Island Press.

OECD, 2002. *Indicators to measure decoupling of environmental pressure from economic growth*.

Qian, Z., 2007. Institutions and local growth coalitions in China's urban land reform: The case of Hangzhou High-Technology Zone. *Asia Pacific Viewpoint*, vol. 48, No. 2, pp. 219-233.

Statistics Denmark, 2010. Accessed March 2010 at http://www.statbank.dk/statbank5a/default.asp?w=1017

Tapio, P., 2005. Towards a theory of decoupling: degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001. *Transport Policy*, vol. 12, No. 2, pp. 137-151.

Vestergaard, H., 2006. Single-family detached housing: a branch of paradise or a problem? P. 86. In J. Doling & M. Elsinga (eds.) *Home ownership: Getting in, getting from, getting out, Part II*. Amsterdam: IOS Press.

Wang, W., Jin, J, Xiao, Z, and Shi, T., 2009. The characteristics of urban expansion and its driving forces analysis based on remote sensed data and GIS – a case of Hangzhou city from 1991 to 2008 (in Chinese). *Geographical Research*, vol. 28, No. 3, pp. 685-695.

Wang, Y. P., 2003. Progress and problems of urban housing reform. In Finer, C. J. (ed.) *Social policy reform in China: views from home and abroad*. England: Ashgate Publishing Limited

WWF, 2010. Living Planet Report, 2010.

Zhang, M., Ye, Y., 2004. Ecological footprint of Hangzhou city (in Chinese). *China Land Science*, vol. 18, No. 4, pp. 25-30.

Zhu, Y., Lin B., 2004. Sustainable housing and urban construction in China. *Energy and Buildings*, vol. 36, No. 12, pp. 1287-1297.