Fused Grid Planning in a Canadian City

A new approach for suburban master-planned communities.

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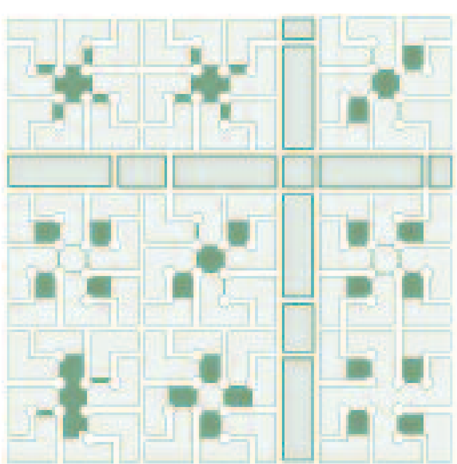
NEW URBANISM is an alternative planning approach for residential communities that promotes the building of compact neighborhoods and attempts to encourage social interaction in mixed-use town centers. The idea has been applied in master-planned communities such as Kentlands, Maryland and Celebration, Florida. There are a number of Canadian developments based on NU principles, including Cornell in Markham, Ontario and The Village in Niagara-on-the-Lake, Ontario. While the NU movement has acquired credibility among many architects and city planners, municipal officials have been less willing to embrace key elements of the NU approach. Public works departments, for example, have consistently raised concerns about the logistics and expense of snow removal and rear-alley garbage pickup. Critics question the costs of the approach relative to risks and its effectiveness in meeting consumer expectations.

The Canada Mortgage and Housing Corporation (CMHC), an agency of the Canadian federal government, researches community design that meets objectives such as low environmental impact and affordability. This research includes identifying principles that improve the suburban quality of life, creating a balance between pedestrian and automobile movement and developing opportunities for public open space. This has led to an investigation of residential development plans based on looped streets and cul-de-sacs organized in a modified-grid format design (see "Residential Street Pattern Design," *WRER* Fall 2001). The aim of this approach is to provide connectivity and a hierarchy of streets for traffic efficiency and ease of orientation, which are often missing in conventional, suburban, curvilinear streets. This kind of plan is called a fused grid.

The fused grid represents the synthesis of two traditional North American approaches to residential neighborhood planning: the traditional, 19th-century grid, and the curvilinear pattern of looped streets and cul-de-sacs of modern suburbia. The goal of the fused grid is to provide a balance between vehicular and pedestrian movement and to create safe, sociable streets and easy connectivity to community facilities. These attributes are achieved while retaining the land use and infrastructure advantages of conventional suburban plans, compared to the traditional grid advocated by New Urbanism.

The fused grid (Figure 1) consists of a large-scale grid of collector streets, carrying moderate- to high-speed car traffic. The blocks are roughly 40 acres in size (about 1,300 feet by 1,300 feet). Within each block, the layout of residential streets in the form of crescents and cul-de-sacs eliminates through-traffic. In addition, a continuous, open-space pedestrian path system provides direct access to parks, public transit, retail, and community facilities. Residents can cross a block on foot in approximately five minutes. The most intensive land uses such as schools, community facilities, high-density residential uses, and retail are located in the center of the plan, reached by twinned arterial roads. The plan provides efficient vehicular traffic without sacrificing safety and convenience for pedestrians.

Figure 1: The fused grid concept



A CASE STUDY

The first test of the fused grid has been in the City of Stratford, Ontario, famous for its Shakespearean summer festival. Since 1988, Stratford's population growth rate has been 1 percent a year, a rate expected to continue until 2013. The 2002 city population exceeded 30,000. Two years ago, the city began annexing land to accommodate future residential growth. A 300-acre area in the northeast section was chosen for a planning study. The planning team, in consultation with the municipal authorities and in response to the public participation process, developed three alternative plans for analysis and consideration by the city council.

The first alternative is a conventional suburban plan (Figure 2). The road pattern is curvilinear and provides a hierarchy between arterial, collector, and local streets. Road network efficiency is paramount in providing connectivity between places of residence, shopping, and employment, with limited pedestrian interconnectivity between residential neighborhoods. More intensive land uses and community-land uses are centered within the development at the intersection of arterial and collector roads. Parkland is dispersed throughout the community to provide walking-distance proximity to residents.

Figure 2: First alternative, conventional suburban plan

The second alternative applies the fused grid planning principles and incorporates a central corridor of twinned arterial roads and community facilities, including two school sites, public transit, and medium-density residential land uses (Figure 3). The balance of the developable land is divided into 40-acre blocks by a grid of collector roads that are linked to the regional arterial road network. Within

Figure 3: Second alternative, fused grid plan

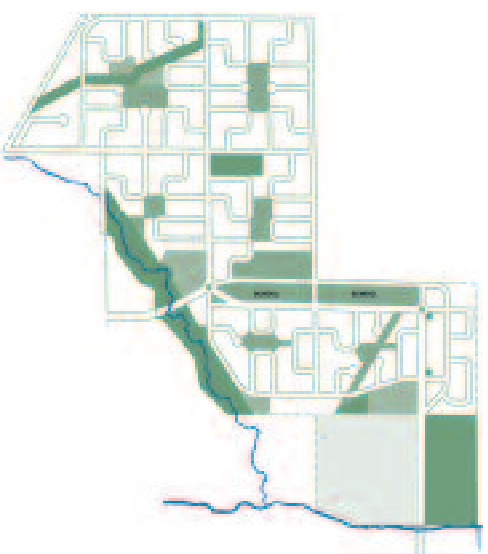
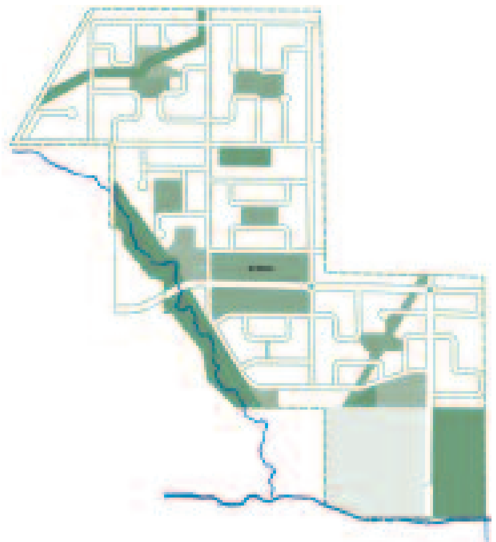


Figure 4: Third alternative, fused grid hybrid



these blocks, all local streets are either crescents or cul-de-sacs. In the center of each block is an area of pedestrian open space, accessible from each street within the block. This plan uses a standard subdivision block depth of 200 feet. (The other two alternatives use block depths varying from 220 to 270 feet, which are more in keeping with the small-town setting and with resident expectations.)

The third alternative is a hybrid of the first two (Figure 4). It is based on a grid pattern of streets and incorporates a central area of community uses. It also incorporates many fused grid principles, such as a grid pattern of minor collector streets at the periphery of 40-acre residential blocks, internal crescents, and cul-de-sacs, direct accessibility for pedestrians to open space, and centralized community facilities as a focal point and place of community interaction. The hybrid fused grid excludes the twinning roads through the "town center" and the enveloping of community and more intensive land uses between the road network.

A block depth of 220 to 270 feet determines the yard space that is available to each house; lots are generally larger in exurban and rural settings than in cities or fringe subdivisions. Lot depth influences the frequency of streets in a network and consequently the sum of their lengths, as well as the number of blocks and intersections and their impact on connectivity. Table I shows the differences that result from the depth of the block. About 25 percent more blocks are present in the "pure" fused grid than in the hybrid version, which is roughly proportional to the increase in the frequency of roads due to the block depth. Since the third alternative is an adaptation of the fused grid model, a comparison between the conventional suburban plan and the fused grid hybrid is more instructive.

Table I: Block characteristics

	Block depth (feet)	Street length (feet)	Number of blocks	Number of intersections
Conventional suburban plan	220-270	51,509	44	54
Fused grid	200	60,121	66	63
Fused grid hybrid	220-270	53,149	53	50

EVALUATION

Planners typically evaluate land-use alternatives from the points of view of the numerous stakeholders, including the municipality, real estate developers, and residents. Taking all those interests into account, 16 criteria were identified to assess the three alternatives. These criteria were based on efficiency, quality of life, and environmental impact. During the elaboration of the 16 criteria, it became obvious that indicators to measure the relative performance of each alternative were not readily available for every criterion, particularly those related to quality of life. Developing a new method was outside the scope of this work and, consequently, proxies were used instead.

Efficiency in the use of land, infrastructure, and services reflects developer and municipal perspectives and takes into account three land-use related quantities: net developable area; saleable frontage; and the percentage of land area used for roads. Efficiency affects municipal costs for road and service maintenance and replacement, including street cleaning and snow removal, which are directly proportional to the length of road lanes.

Road efficiency is also judged by matching projected traffic to the road type to ensure that roads can handle the anticipated capacity without under- or over-utilization. Also related to road efficiency is the number of opportunities for providing service extensions to future urban growth areas. These influence the traffic volume on individual roads, their functionality as traffic conveyors, and the property values along them; that is, the larger the number of planned extensions, the more efficient the system performance and the lower the likelihood that congestion will occur.

Transit service efficiency and walking distances to bus stops are a municipal pri-

Table II: Efficiency

	Net developable residential area (acres)	Net saleable frontage (feet)	Connections to future development	Transit-friendly (average distance to bus stop, feet)	Road length (feet)
Conventional suburban plan	205	58,100	0	951	51,509
Fused grid hybrid	200	60,300	5	700	53,150

ority. They relate to the transit route length, the number of necessary bus stops, and the expected ridership; all three together affect the economic viability and the quality of transit service. The differences in route length may be less important for transit viability than user convenience in reaching a bus stop. Beyond the five-minute-walk radius, ridership drops sharply, which in turn affects revenues. Thus, transit service efficiency was measured as the average distance to a bus stop.

Table II shows that the fused grid hybrid delivers about 4 percent more saleable frontage, even though it has a 2.5 percent less net developable area, accounted for by an increase in open space area and by slightly more road length. The fused grid also delivers greater convenience to transit users. Road length is important from several perspectives: economic, environmental, mobility, and quality of life. The balance point between excessive and insufficient road that respects all these perspectives equitably has not been determined and current research sheds little light on it. The fused grid offers a model for exploring this balance.

Quality of life takes into account neighborhood tranquility, measured by the number of crescents and cul-de-sacs, which are considered more desirable; restfulness, measured by the number of pedestrian intersections, defined as the number that enable residents to get from one street to another; connectivity, measured by the frequency of block sizes, where the larger the blocks the greater the road lengths and, consequently, the greater the car speed and the lower the safety for pedestrians; opportunities for direct views to open space; and the ease of accessibility to recreational parkland, measured as the shortest path to residential uses.

Current indicators and methods of measuring connectivity, which have emerged as an important criterion for new subdivision planning, are not found to be entirely satisfactory. Three indicators are used, all of which point to the increasing frequency of paths and choice of direction: block size and the number of vehicular and pedestrian (footpath) intersections.

Table III shows that on all five quality-of-life indicators the fused grid hybrid out-

Table III: Quality of life

	Tranquility (# of crescents and cul-de-sacs)	Connectivity (# of blocks [B], # of intersections [I])	Pedestrian intersections (# of non-vehicular intersections)	Access to parkland (average distance to parks in ft.)	Direct views of open space from streets (linear ft.)
Conventional suburban plan	13 6	B, 44/I, 54	14	1,509	10,571
Fused grid hybrid	15, 7	B, 53 / I, 50	27	623	12,553

Table IV: Neighborhood walkability

	<300	300-600	600-900	Subtotal	900-1,200	1,200-1,800	>1,800	Total
Conventional suburban plan	9%	32%	11%	52%	23%	18%	7%	100%
Fused grid hybrid	11%	34%	28%	73%	16%	9%	2%	100%

Table V: Car and pedestrian safety

	Total car intersections	Number of T-intersections	Percent of T-intersections	Number of cross-intersections	Percent of cross-intersections
Conventional suburban plan	54	50	92%	4	8%
Fused grid hybrid	50	42	84%	8	16%

performs the conventional suburban plan. A subsidiary, but important, indicator of connectivity is the frequency of block sizes. Table IV shows that the frequency of blocks within what is considered a walkable range (300 to 900 feet) is 73 percent and 52 percent for the fused grid and the conventional option, respectively.

Environmental impact takes into account minimizing adverse effects on the natural environment and minimizing the risk to residents: the preservation of the natural habitat (woodlots, watercourses, floodplains, and wildlife habitat); the impact of traffic noise along the arterial roads to noise-sensitive land uses; safety for cars, measured by the percentage of T-intersections (which are assumed to be safer); and safety for pedestrians, particularly children, measured by the number of road crossings needed to walk to community uses as an indicator of level of safety. Both plans preserve the same amount of sensitive natural areas.

Conventional suburban planning uses T-intersections extensively to improve neighborhood safety. T-intersections are also recommended by traffic engineering manuals for the same reason. The fused grid model uses T-intersections at the neighborhood level but uses cross-intersections at the district scale to promote good traffic flow. Based on this reasoning, the fused grid tries to optimize rather than maximize T-intersections. This approach balances neighborhood safety and district traffic flow.

The fused grid hybrid produces almost twice as many pedestrian intersections as the conventional (Table III) and average distances to the bus stops and parks are 0.75 and less than 0.5, respectively. When the two attributes are combined—shorter distances and more pedestrian paths—they produce a safer and more convenient neighborhood for pedestrians.

Based on the guiding principles of efficiency, quality of life, and environmental impact, and the foregoing results of the analysis with respect to the criteria developed for each principle, the land-use concept identified as best meeting the interests all the stakeholders' was the fused grid as adopted to the local physical and market context.

CONCLUSIONS

From this application of the fused grid hybrid to a small city fringe area, a number of observations and lessons can be derived, some about context and some about methods. First, the development dynamics of a given place constrain the unencumbered application of the model. For example, roadways at the site's boundary are not acceptable by neighboring jurisdictions, nor are they palatable to developers (single-loaded roads are judged uneconomic), even though they may be sensible from a transportation perspective. Also, creating a "center" in proximity to an existing town center in the midst of a rejuvenation effort is seen as counterproductive.

Current terms and methods for evaluating certain aspects of development are imprecise or unsuitable. For example, connectivity, tranquility, delight, and pedestrian safety have yet to be defined in commonly accepted terms and measured with generally agreed methods. Similarly, efficiency when applied to single items, for example, open space, misses the larger efficiencies of integration where open spaces can play the additional role of connectors, thus displacing asphalt and raising neighborhood quality. Such a "whole system" approach has yet to be clearly articulated.

The plan development, evaluation, and approval led to the production of a report to the Stratford city council. The report provided an overview of the urban development that will occur in the years to come as the northeast community becomes an integral part of the City of Stratford. It described the design principles of the fused grid, noting that the lands will generally be developed into 40-acre blocks, which will be divided internally by crescents and cul-de-sacs with direct pedestrian access to parkland. Community facilities would be centrally located, including the community park and proposed schools; natural areas would be preserved; and pedestrian linkages would be provided through community trails throughout the neighborhood and provide connectivity to destinations outside of the community.

The implementation of these principles will follow the Council's adoption of "Official Plan Amendment No. 11" to the Official Plan of the City of Stratford. Through subsequent subdivision and site planning processes and, ultimately, build-out, it will be possible to monitor the evolution of the urban development of this growth area and assess the attributes of the fused grid design and its influence on efficiency, quality, and impact.

celebrates its ongoing transformation into a world-class urban research university that is nourished by the neighborhood it helped to redevelop.

The next decade will see Penn spearheading development primarily to the east. Surface parking lots will be turned into student housing and recreational space. Abandoned industrial and commercial buildings will be converted into mixed-use facilities for teaching, scientific research, and technology transfer enterprises. There will be more shops, more green spaces, and more lively streets as University City links seamlessly with Center City. This time, however, it will all be done through partnerships between Penn and private developers.

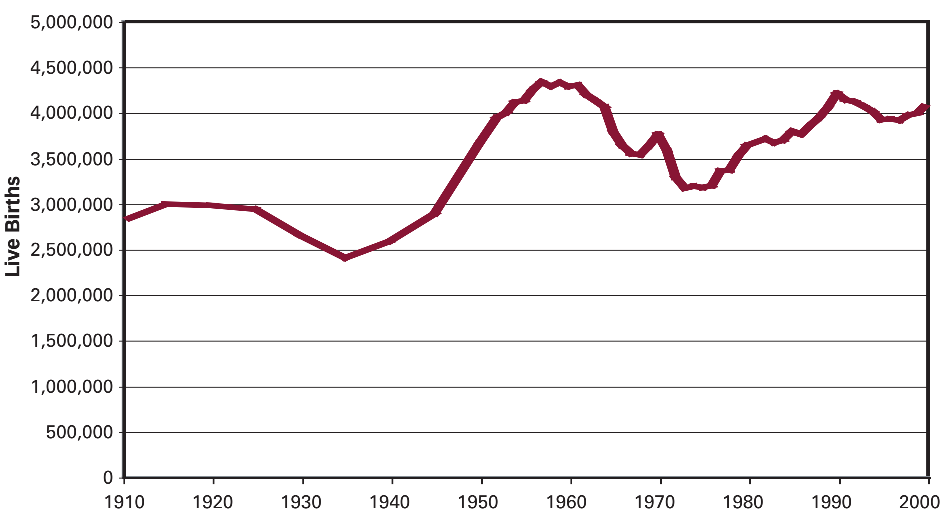
Penn is in the business of neighborhood transformation for the long haul.

Ten years ago, few thought Penn had the guts to stick its neck out for its neighbors. Today, we realize that by putting our money and reputation on the line to help revitalize University City, the neck we saved might well turn out to have been our own.

successfully. Future population size and characteristics are determined by the size of the current population and the changes due to births, deaths, and in- or out-migration. The current population size and its characteristics are known. Births and deaths (although problematic to predict into the future) have little effect on the size and characteristics of the national population who are of working age—20 to 65—for 20 years into the future. Therefore, the size and characteristics of the national working-age population can be predicted with substantially less error than most other variables that affect the economy. Because the size and composition of the working-age population is known relatively accurately for at least two decades in advance, it is tempting to use this knowledge to predict shifts in the stock market, housing, and commercial real estate.

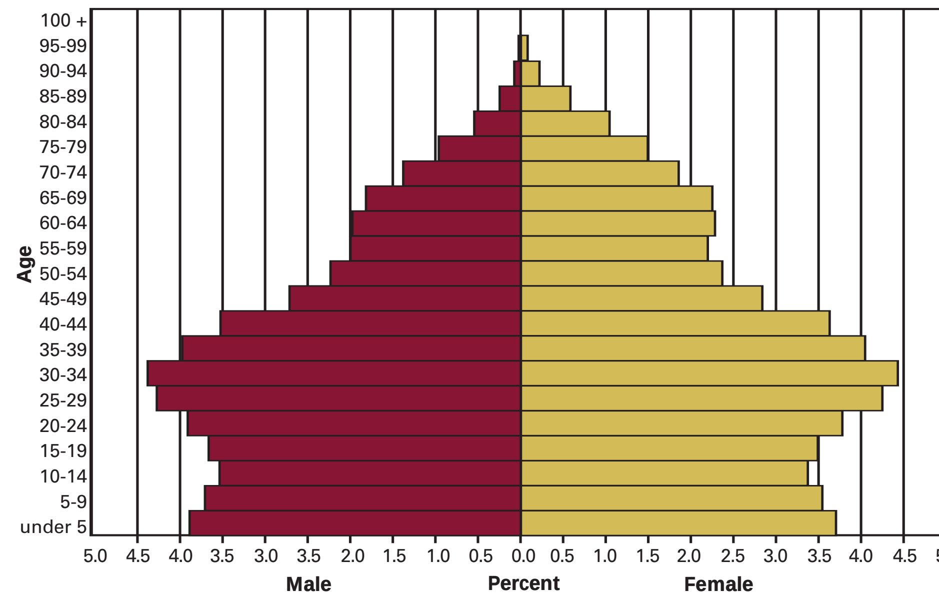
However, there are three concerns that arise when using population to predict economic outcomes. First, how accurate is the prediction of the future population size and characteristics? Second, how do population size and characteristics correlate with economic outcomes? And third, to the extent that population influences are foreseeable and their economic effects are predictable, will markets incorporate this information so as to mute the anticipated links, thus rendering predictions inaccurate?

Figure 1: Live births by year, 1910-2000



Source: Department of Health and Human Services, National Center for Health Statistics.

Figure 2: U.S. population by age and gender, 1990



PREDICTING POPULATION

Population predictions require data on current population, as well as predictions of births, deaths, and migration. Figure 1 illustrates the number of live births by year in the United States throughout the 20th century. The two peaks are periods when there were more than 4 million births per year; they include the 1946 to 1964 post-World War II baby boom and the baby "echo boom" that started in 1982. The two troughs include the Great Depression, when births fell below 2.5 million, and the 1964 to 1980 period, when births dropped below 3.2 million.

Figures 2, 3, and 4 display age pyramids for the U.S. population in 1990 and 2000, as well as the predicted population in 2025 (which is based on actual births for the age groups older than 25, and on predicted birth rates for those younger than 25). The left side of each chart shows the percentage of the male population in each age group for the year and the right side shows the percentage of the female population. Note that on Figure 2, the age pyramid for 1990, the "indentation" of the pyramid for the 10- to 14-year old group, reflecting the baby bust of birth years 1976 to 1980 in Figure 1, and the "bulges" for the 25- to 34-year-olds, reflecting mostly baby boomers born between 1956 and

Figure 3: U.S. population by age and gender, 2000

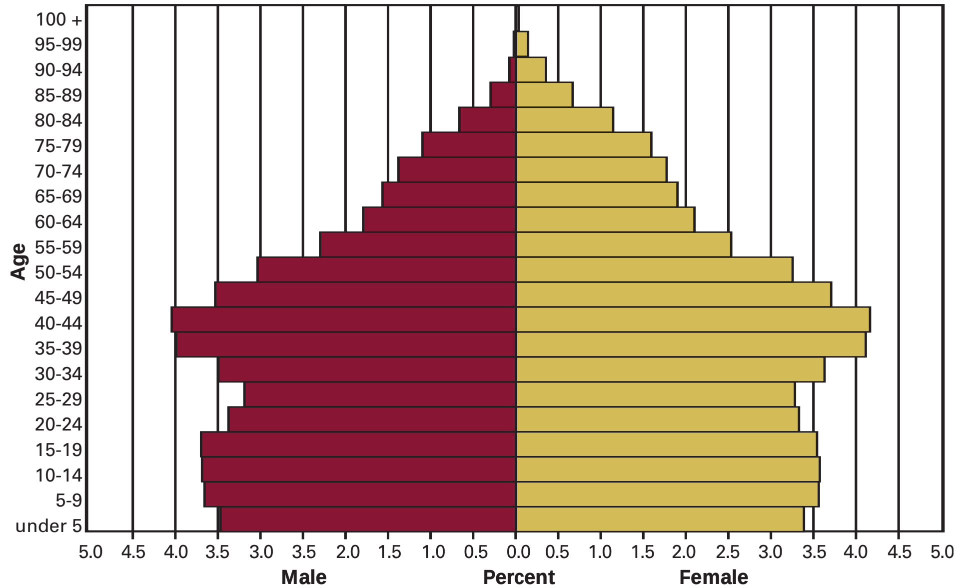
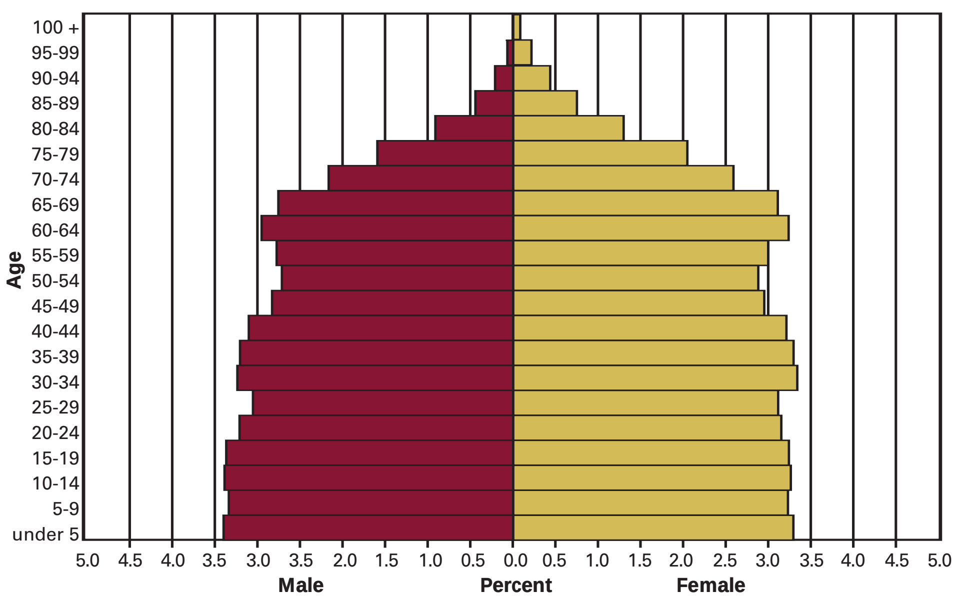
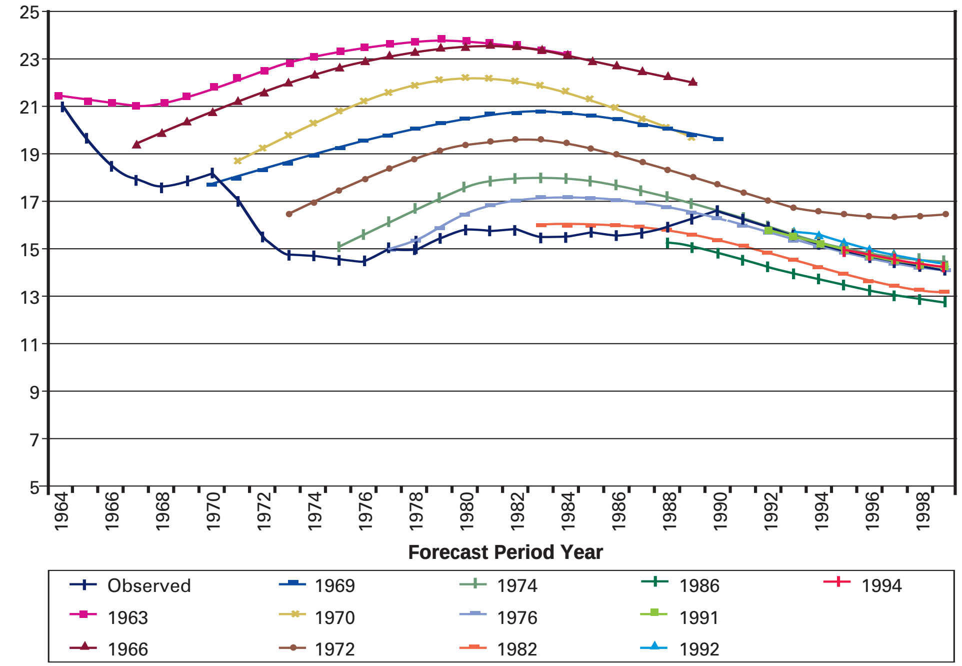


Figure 4: U.S. population by age and gender, 2025



Source: Figures 2, 3, and 4 were prepared by the U.S. Census and are available at http://www.census.gov/population/www/projections/natchart.html.

Figure 5: Observed and U.S. Census predicted crude birth rates, 1964-1999



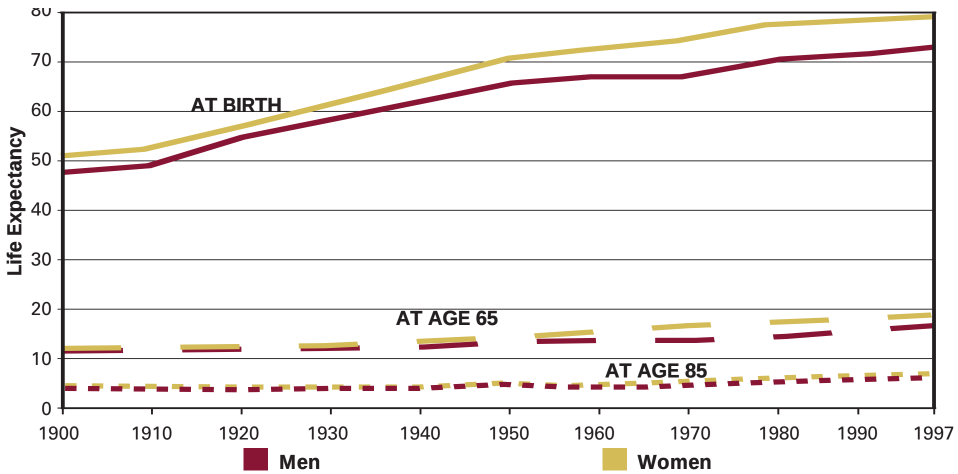
Source: Tammany J. Mulder, "Accuracy of the U.S. Census Bureau National Population Projections and Their Respective Components of Change," U.S. Census Population Division Working Paper Series No. 50, July 1, 2002.

1965. Figure 3, the age pyramid ten years later, shows a similar indentation for those 10- to 14-year-olds in 1990 who are now 20 to 24 and a bulge for those aged 35 to 44. For those age groups born before the date when the predictions are prepared, the predicted population proportions for each gender depend on known past birth rates and predictions of deaths and migration. The predicted "bulge" of the 2025 pyramid, shown in Figure 4, for the 60- to 69-year-olds reflects the known baby boom of 1956 to 1965 and the predicted "indentation" for the 50- to 54-year-olds reflects the known "baby bust" of 1971 to 1975.

It is important to understand that the track record on the accuracy of birth predictions, which is the critical component in predicting the size of the population in those ages not yet born, is not promising even for the best demographers. Figure 5 shows the crude birth rates (per 1,000 people) for 1964 to 1999 and the U.S. Census predictions for those birth rates.

Overall, the Census (an excellent group of demographers) tended to overpredict population based on its projections of birth rates. The predictions made from 1963 to 1974 (the start of the baby bust period), were far off the mark,

Figure 6: Life expectancy by age group and sex, in years, 1900-1997



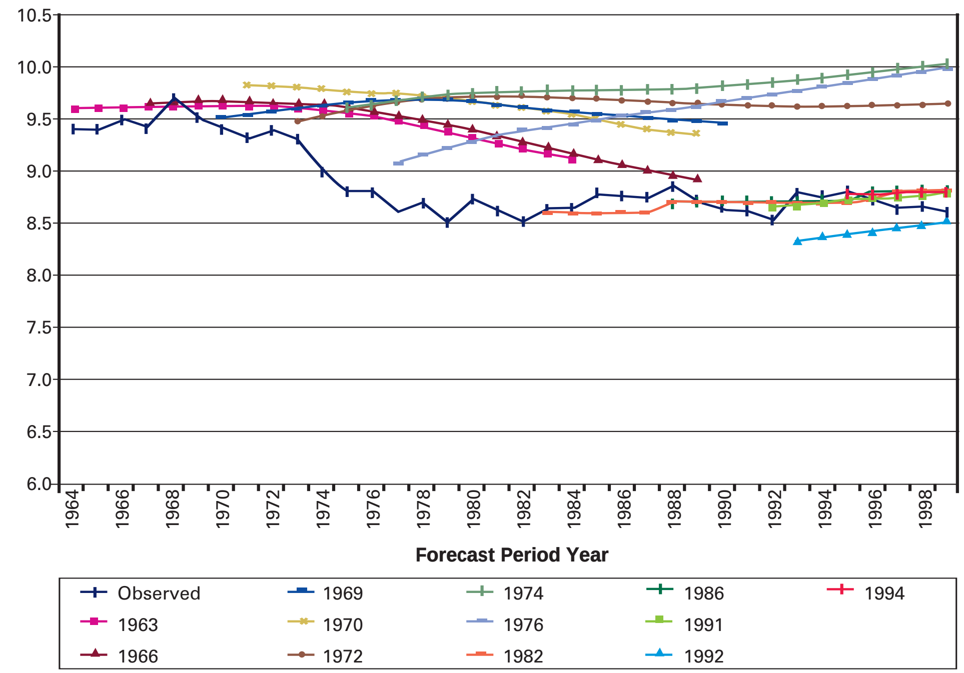
Reference population: These data refer to the resident population. Source: National Vital Statistics System.

consistently over-predicting births. Since 1974, when birth rates have fluctuated less, the predictions have been closer to the actual birth rates. What is obvious is that even the U.S. Census has not been able to accurately predict exactly *when* changes in birth rates will occur. For example, the decline in birth rates that started in 1964 was never predicted; neither was the trough of 1975-76, or the slight rise in birth rates between 1987 and 1990.

Figure 6 illustrates how life expectancy has changed in the 20th century. The chart includes changes in the life expectancy at birth, which increased from about age 50 in 1900 to about age 80 in 1997. The time path of the change in life expectancy is far less variable than the time path of the change in births. The largest rate of change on the figure is the increase that occurred roughly during the 1970s.

Predictions of death rates, while more accurate than predictions of birth rates, also have a poor track record. Figure 7 shows the crude death rates (per 1,000 people annually) for the 1964 to 1999 period, and the U.S. Census predictions for those death rates. Overall, the Census tended to over-predict death rates, resulting in an under-prediction of population. Census predictions appear to be amplifications of short-term trends. The relatively rapid drop in the death rates between 1969 and 1979 was not predicted by the Census, although the 1963, 1966 and 1970 predictions were for a less dramatic decrease in death rates. Interestingly, the 1969, 1972, and 1974 predictions were for mild increases in death rates. Since

Figure 7: Observed and U.S. Census predicted crude death rates, 1964-1999

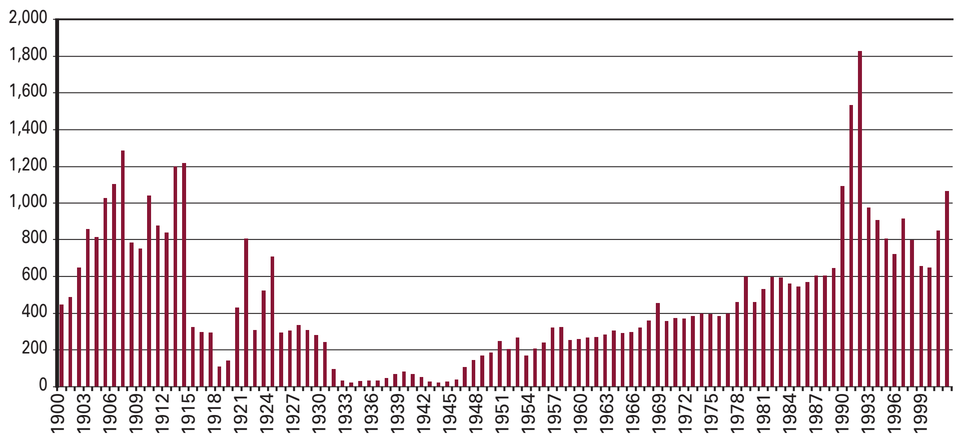


Source: Tammany J. Mulder, "Accuracy of the U.S. Census Bureau National Population Projections and Their Respective Components of Change," U.S. Census Population Division Working Paper Series No. 50, July 1, 2002.

1975, there has been little change in the actual death rate, as it moved between 8.5 per thousand and 8.8 per thousand in the population. However, the predictions did not reflect this stability until 1982. The inaccurate predictions of death rates have had less effect on overall population projections than did the inaccurate predictions of the birth rates. Although the over-prediction of death rates and the over-prediction of birth rates somewhat offset one another in terms of projected population size, they amplified errors in the prediction of age structure: errors in birth rate predictions over-predicted the sizes of younger populations, and errors in predictions of death rates under-predicted the size of older populations.

Figure 8 illustrates how legal migration into the United States has changed in the 20th century. Migration in the 1990s was large relative to any other time in our history and similar in magnitude to the flows early in the 20th century. Unfortunately, the U.S. Census's predictions of net migration rates are as problematic as its predictions of birth and

Figure 8: Immigrants to U.S. (in thousands) 1900-2001



Source: U.S. Citizen and Immigration Services.

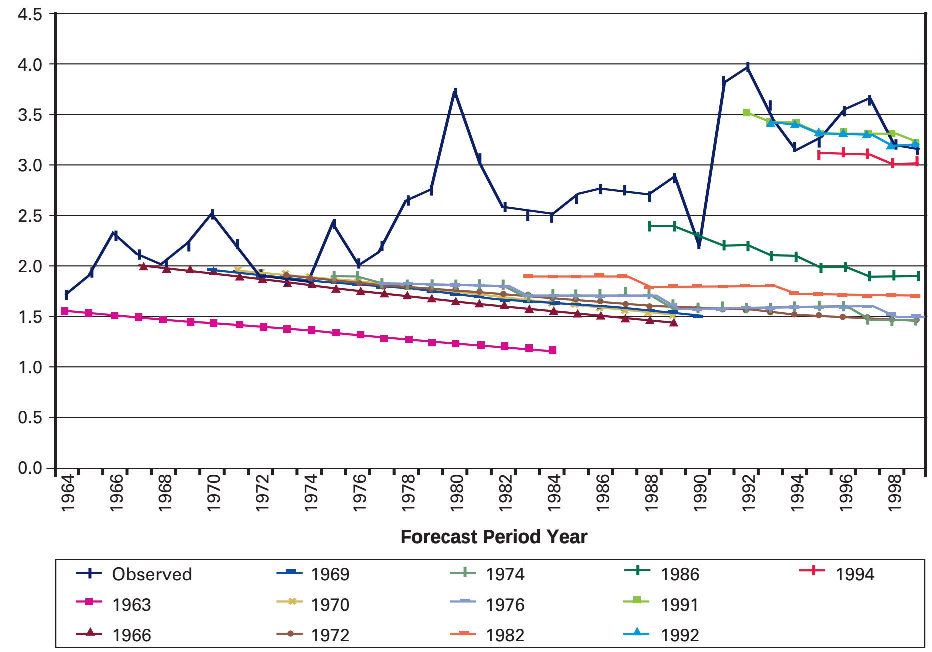
death rates. Figure 9 shows the actual net migration rates for 1964 to 1999 as well as the Census predictions for those rates made at various times. Overall, the Census tended to under-predict the net migration rate, and thus under-predict population. The relatively rapid increases in the net migration rates in the 1990s were also not predicted by the Census.

The 1986 prediction for 1991 was a little over half the actual rate. The 1991 prediction for 1992 (formed with knowledge of the 1991 increase) was much higher, but still a substantial under-prediction. The predictions made in 1992 and in 1994 for future years reflected the higher rates occurring in 1992 and 1994, but still under-predicted the actual rates.

Unlike births and deaths, migration levels strongly affect the size of populations in the 20- to 64-year-old groups. Figure 10 shows age pyramids for the foreign-born and native-born populations in the United States in 2002. The immigrant population includes substantially fewer persons not of working age, and substantially more persons of working age than the native-born population. Therefore, international migration has compensated for the "bulges" and "indentations" in the age pyramids for the native-born population. Furthermore, inaccurate prediction of migration resulted in under-predictions of the population aged 20 to 44.

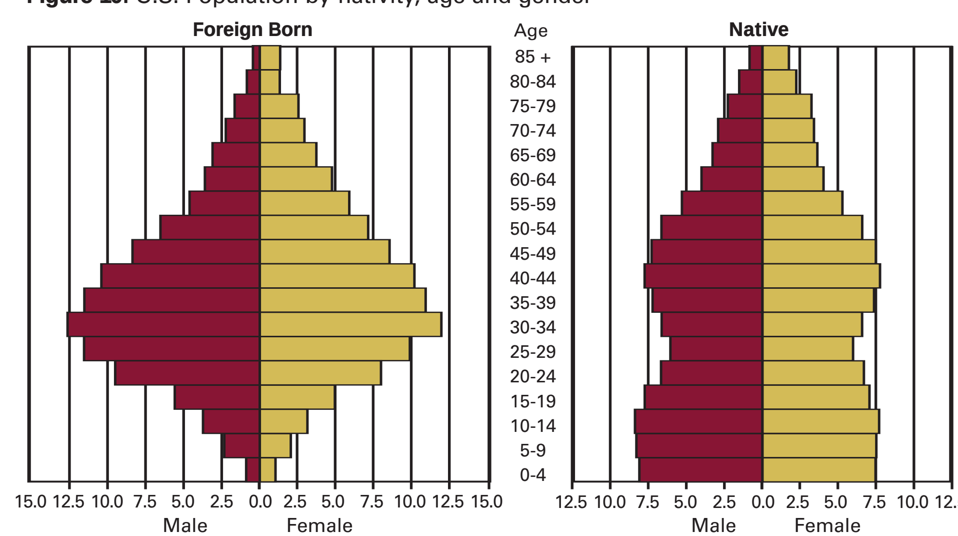
In summary, the track record for the accuracy of predictions of the components of population change—births, deaths, and migration—is poor. While the accuracy of predictions of the size of the working age population 20 years into the future is not

Figure 9: Observed and U.S. Census predicted net immigration rates, 1964-1999



Source: Tammany J. Mulder, "Accuracy of the U.S. Census Bureau National Population Projections and Their Respective Components of Change," U.S. Census Population Division Working Paper Series No. 50, July 1, 2002.

Figure 10: U.S. Population by nativity, age and gender



Source: Dianne Schmidley, "The Foreign-Born Population in the United States: March 2002," U.S. Census, Current Population Reports, pp. 20-539, February 2003.

strongly affected by inaccurate predictions of births and deaths, it is influenced by inaccurate predictions of migration. Even more problematic is the fact that migration can be a response to anticipated changes in the age composition of the population, as the government may admit more migrants in periods of labor shortages, and fewer in periods of unemployment. Also, since changes in populations at the margins affect economic outcomes, the errors in predicting births, deaths, and migration are problematic for anticipating the economic effects of demographic changes.

POPULATION AND ECONOMIC OUTCOMES

Microeconomics studies individuals and households, either at a point in time or as cohorts over time, and measures how the ages of individuals, or of household heads, have affected their income, their probabilities of retiring, their savings and investments, and their expenditures on housing, health, and other goods and services. Macroeconomics empirically examines how the size and structure of the population at different times correlate with the nation's aggregate income, savings, investments, and expenditures on housing, health, and other goods and services. Because the population age structure changes very slowly, the measurement problems are greater in macroeconomic studies than in microeconomic studies. There is not much variation by year in the composition of the nation's population to analyze. Furthermore, the correlation between the relative sizes of particular age groups for different time periods makes it difficult to isolate the effects of particular age groups accurately.

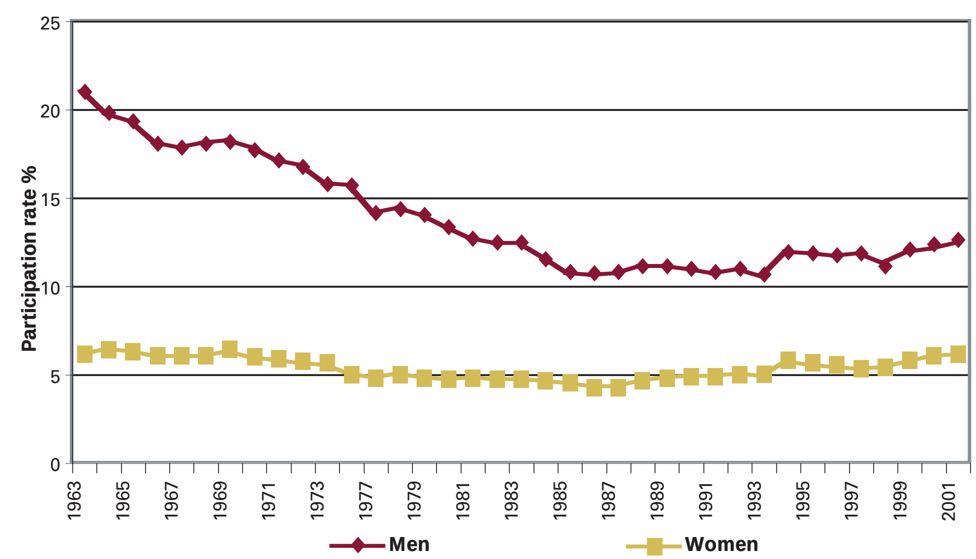
For the next two decades, as the baby boom generation reaches retirement age, and as the labor force participation of women levels out, all economists expect labor force growth to slow considerably. While there is debate about future growth in female labor force participation, rates of female labor force participation are now close enough to those for men that large increases seem impossible. Thus, future growth in the labor force will be primarily the result of the entry of the young and of migrants, or of delayed retirement by older workers. But migration is not easily predicted, and can even be manipulated by policymakers to increase labor force growth. The same is true of retirement.

Because both the incomes and health of older people have improved, microeconomic theory provides ambiguous predictions about changes in retirement age. On the one hand, as incomes rise, workers should retire earlier. On the other hand, as the health of older workers improves (or alternatively, as the physical requirements of jobs diminish), workers should retire later. Whether the income effect or the health/physical demands effect will be greater in determining retirement age in the future is unclear. For several decades, the income effect has dominated, causing the retirement age to decline. But in the last few years, there is evidence that the trend may be reversing, with the health effect dominating the income effect. Figure 11 displays labor force participation rates for men and women over 70, from 1963 to 2001. While the rates remain substantially lower than at the beginning of the period, they have increased slightly since the mid-1990s. Some researchers have attributed this rise to the changing age requirements for Social Security benefits. Because Social Security policies affect retirement ages, the rules for qualifying for Social Security are important (and difficult to predict) policy variables.

The oldest of the baby boom generation, born between 1946 and 1964, reached 58 this year. Those born in 1964 will reach 67 in 2031. By 2032, the baby boom generation will be almost entirely retired. But it is not clear exactly when most of the baby boomers will retire, although there is certainly no reason to expect anything other than a gradual movement of the generation into retirement.

Perhaps the most simplistic statement of microeconomic theory is the life-cycle theory of consumption, which holds that spending and savings decline after 65.

Figure 11: Labor force participation rates of men and women over age 70, 1963-2001



Source: Bureau of Labor Statistics data.

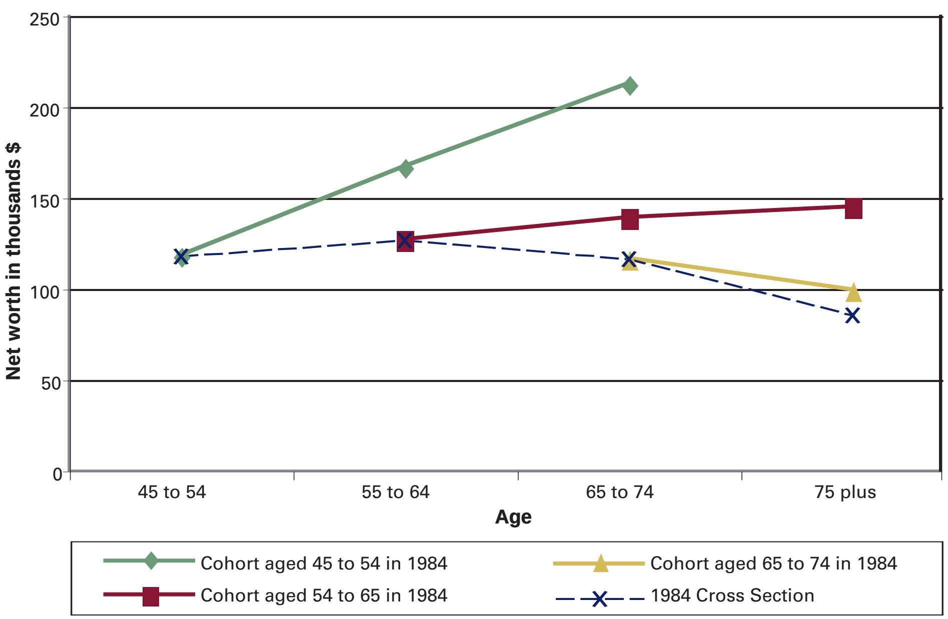
The expectation is that people spend more of a lower income when they retire. Between 20 and 65, people have higher incomes and savings. Extrapolating this life-cycle theory of individual behavior to the economy suggests that as the proportion of the population over 65 increases, aggregate spending and savings will decline. But this popular theory is supported neither by empirical studies of individual behavior nor by studies of aggregate market behavior.

Empirical studies of individual behavior have found that people over 65, at least those who hold most of the assets, continue to save. Although some studies suggest that retirees spend less and draw down their assets during retirement, the evidence is that the retirees who own the vast majority of assets held by the elderly population do not behave in the manner described by the life-cycle theory of consumption. Perhaps this is because they want to leave bequests or because they are risk-averse and seek to maintain high asset levels in order to maintain their lifestyle should they live to a very old age. In either case, they continue to spend their income and do not spend down their assets in their old age.

Past data on household spending and asset accumulation do not provide a good indicator of how baby boomers will save and spend as they age, since this generation is substantially wealthier than any previous generation. At any point in time, there will be a tendency in the data for older people to save less and spend less than younger people simply because they have had less overall income or wealth. Data on savings or income by age in any particular year include the effects of both age and the prior income history of the age group. Figure 12 illustrates the difference between measuring net worth by age at a point in time (1984) versus measuring the net worth of a cohort of the population as it ages. The figure shows the 1984 (cross-sectional) median net worth of households by age (in 2001 dollars). Figure 12 also displays the median net worth for households who were aged 45 to 54 in 1984 (again in 2001 dollars), the median net worth for these same households when they were aged 55 to 64 in 1994, and their median net worth (in 2001) when they reached ages 65 to 74. Because these households were wealthier than the households who were 55 to 64, or 65 to 74, in 1984, their net worth will be much higher when they reached these ages than was the case for previous generations. A similar pattern is observed for the cohorts who were 55 to 64 and 65 to 74 in 1984.

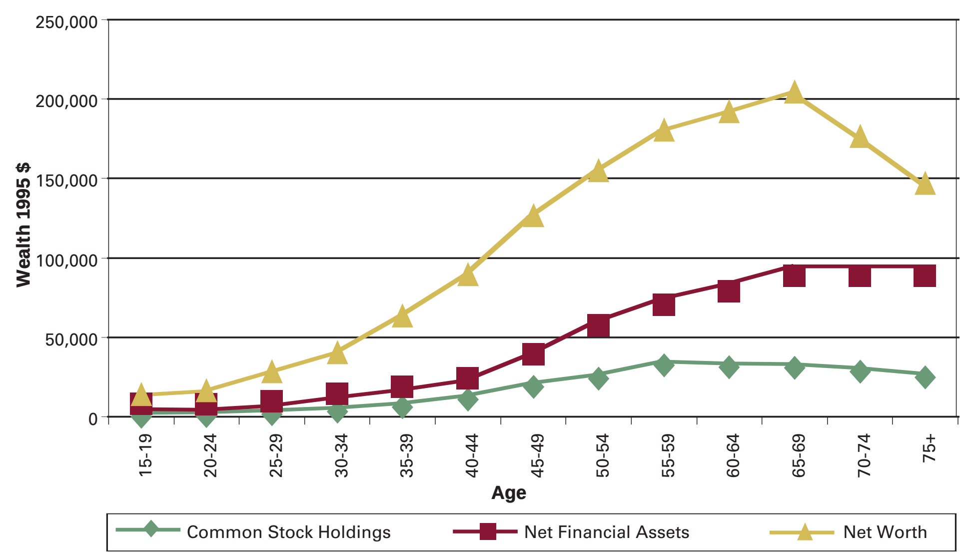
Figure 13 plots the results of a study of the relationships between age and assets

Figure 12: Median net worth by age: Cohort versus cross-section, 1984-2001



Source: Prepared by author from data reported in Federal Interagency Forum on Aging-Related Statistics, *Older Americans 2000: Key Indicators of Well-Being* (Washington, DC: Government Printing Office).

Figure 13: Age-wealth profile after adjusting cohort effects, 1983-1995

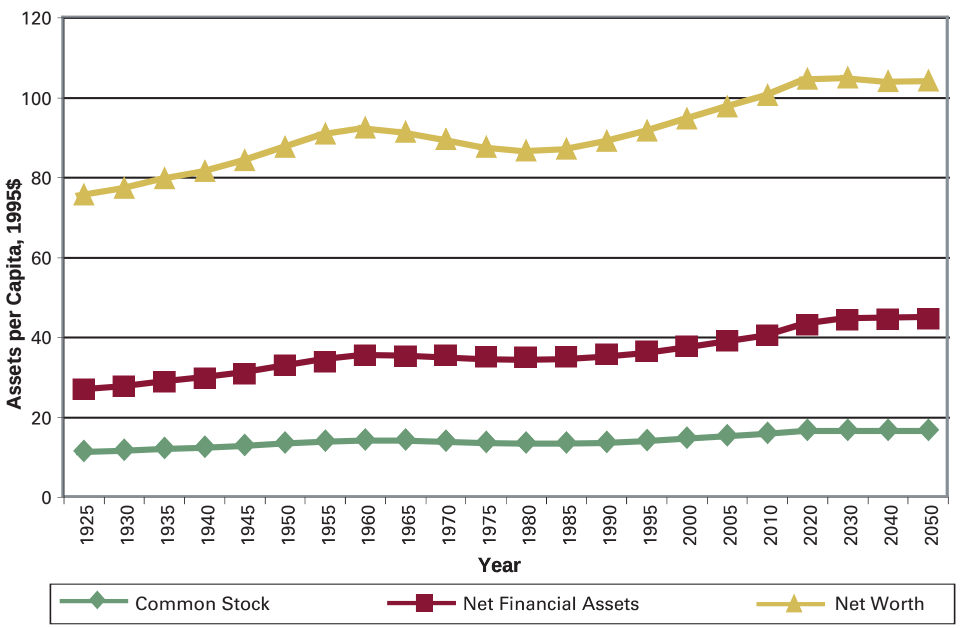


Source: Prepared by author from calculations made by James Poterba, "Demographic Structure and Asset Returns," *Review of Economics and Statistics*, vol. 83 (2001), Table 2, p. 570.

that adjusts the data to reflect the experiences of cohorts as they age. The figure shows cohort wealth over the life cycle for three asset categories. Average common stock holdings are defined as all common stocks including shares held through defined contribution pension accounts; net financial assets add assets other than common stocks (but subtract consumer and investment debt from gross financial assets); and net worth is the sum of net financial assets and the value of house net of mortgage, and holdings of other, non-financial, assets such as investment real estate net of any mortgages. The data reported in the figure are based on data collected between 1983 and 1995 by the Survey of Consumer Finance, and are expressed in 1995 dollars to capture how assets change over the life cycle for the same cohort of individuals.

Figure 13 reveals that, while age is associated with asset holdings even after considering the cohort effects described above, assets do not decline substantially during retirement. Younger adults (those under 40) have substantially lower asset holdings than those over 40. After 65, net financial assets and common stock holdings reach a plateau, moving neither up nor down with

Figure 14: Projected inflation-adjusted assets per capita, persons over age 15, based on asset by age patterns in Figure 13



Source: Prepared by author from calculations made by James Poterba, "Demographic Structure and Asset Returns," *Review of Economics and Statistics*, vol. 83 (2001), Table 5, p. 573.

age, while net worth decreases after 69. The decline in net worth during retirement, however, is less than the increase in middle age. (Note that persons over 75 hold more assets than persons under age 50.) Having more persons over 75 and fewer under 50 will not, therefore, lead to a decrease in aggregate asset demand.

The macroeconomic effects of the population's age composition on asset holdings and asset prices are difficult to measure. Figure 14 shows how aggregate asset demand shifts with the age composition of the population if the patterns of asset demand by age held in each year and age composition were the only determinant of asset demand that changed. Figure 14 shows that, if the patterns of demand for assets by age for recent cohorts persist into the first half of the 21st century and these are the only factors affecting asset demands, the aging of the American population will actually *increase* demand for assets.

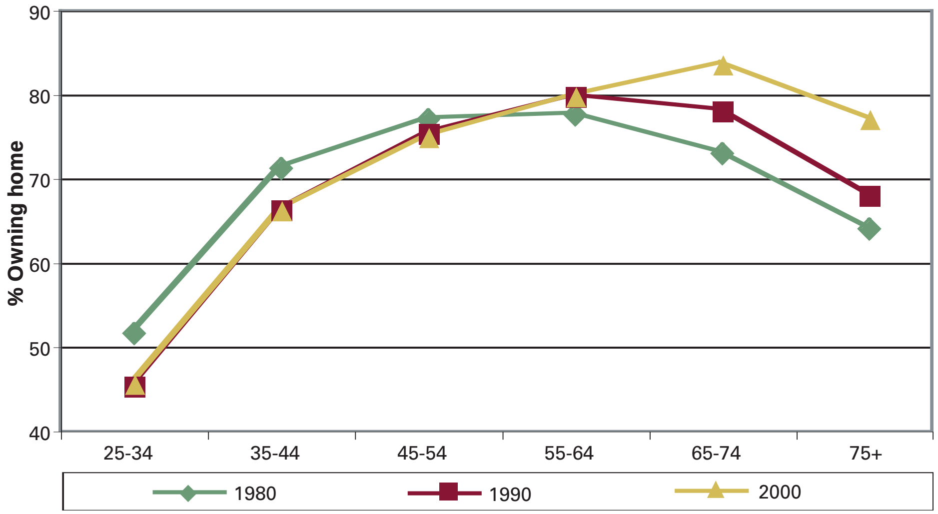
Studies that attempt to measure the correlation between the historic age composition of the population and demand for assets have generally found smaller effects than those implied by the "age-asset simulation" in Figure 14. The results differ across studies and are sensitive to the particular way that age effects are measured. The strongest evidence for age compositional effects on market outcomes is for returns on Treasury bills and long-term government bonds. There is weaker evidence that the ratio of the price of corporate equities relative to corporate dividends is correlated with age composition. However, none of these empirical findings support the view that asset returns will decline when the baby boomers retire.

There are at least three important reasons why the age structure of the population has been found to have so little effect on aggregate asset holding and prices. First, there is so much volatility in savings and spending across households and across time, that age effects are simply too small to be important. Second, since the age composition of the population changes very slowly, markets anticipate its effects. Finally, as markets are increasingly globally integrated, the demand for assets is less tied to the age composition of the U.S. population.

Will an aging population affect the aggregate demand for housing? At the individual or microeconomic level, the life-cycle theory of consumption holds that households are expected to occupy smaller housing units during retirement than during their child-raising years, decreasing the demand for housing.

Figure 15 shows the relationship between homeownership rates and age for each of the census years of 1980, 1990, and 2000. The pattern of homeownership by age in 1980 is consistent with the life-cycle consumption theory, as homeown-

Figure 15: Homeownership rates by age, 1980-2000

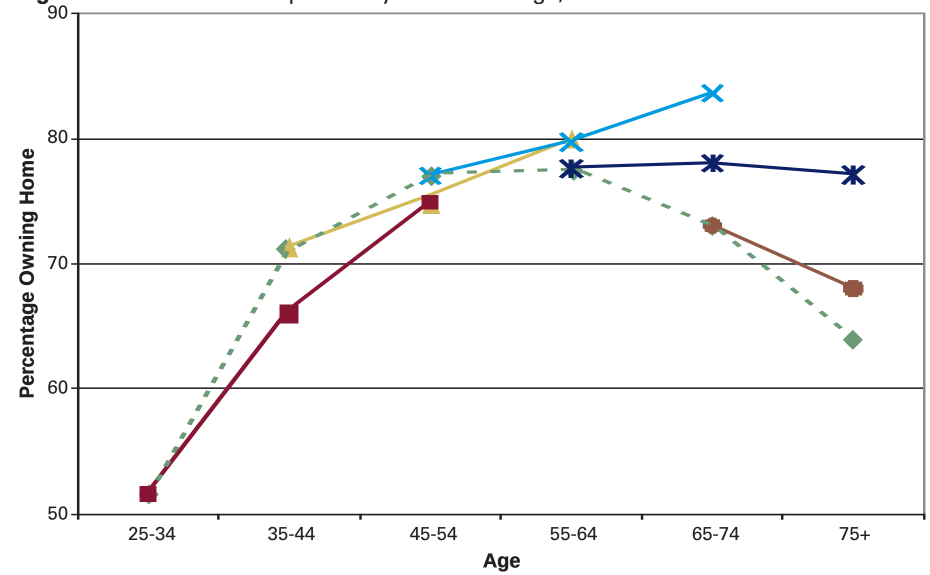


Source: Decennial Census data.

ership rates increase with age, peak for 45- to 54-year-olds, and then decline. But the patterns shift for 1990 and 2000. In fact, by 2000, the rate of homeownership is greatest for the 65- to 74-year-olds. The increases in homeownership rates between 1980 and 2000 are due to increased ownership rates among the over-55 population (which had more income and assets in 2000 than they did in 1980), with people of younger ages actually experiencing decreasing rates of ownership. As was the case for financial assets, the lower 1980 homeownership rates appear to be due to the elderly's lesser wealth, not their age.

Figure 16 displays the difference between the 1980 cross-sectional relationship linking age and homeownership rates, and the rates of homeownership experienced by each of the 1980 cohorts over the following 20 years. Consistent with Figure 15, the 25- to 34-year-olds in the 1980 cohort had lower rates of homeownership when they turned 35 to 44 in 1990 (or 45 to 54 in 2000) than did the cohort that was 35 to 44 (or 45 to 54) in 1980. The 45- to 54-year-olds in the 1980 cohort had much higher rates of homeownership at ages 55 to 64 in 1990, and at ages 65 to 74 in 2000, than did the cohorts who were the same ages in 1980. As was the case for financial assets, Figure 16 shows the rate of home ownership leveling out as people reached retirement ages. The plateau occurred because even though the elderly are less likely than younger cohorts to purchase homes, they typically occupy larger

Figure 16: Homeownership rates by cohort and age, 1980-2000

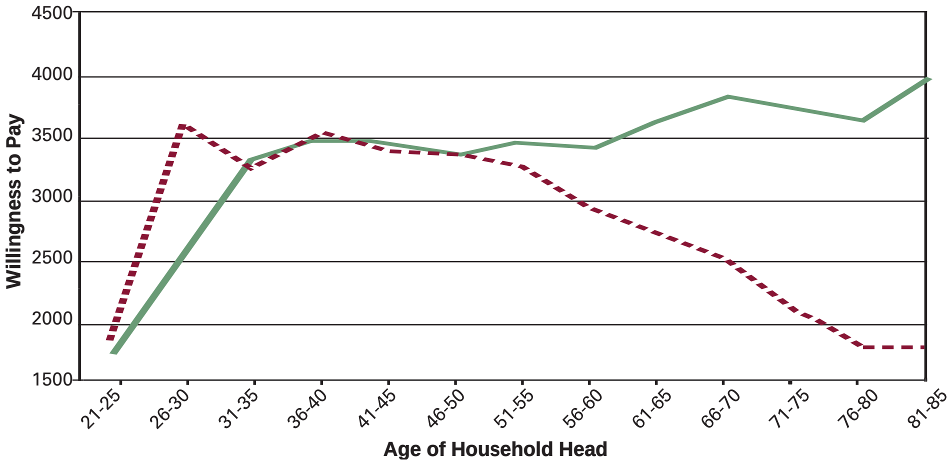


Source: Decennial Census data.

housing units. It is also clear that due to the greater incomes and wealth of baby boomers, their housing outcomes during retirement differed from those of earlier generations.

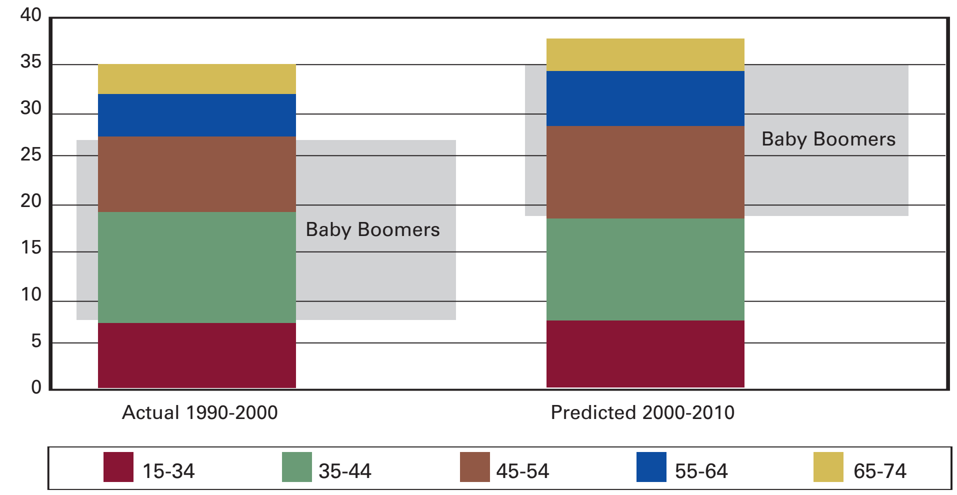
The willingness to pay for housing is a measure of housing demand, but it may also vary over the life cycle. One study first examined how the willingness to pay varies by age at a point in time, with no consideration of the effects of wealth and income, and then examined how age affected willingness to pay when only households with the same income and education were compared. Figure 17 shows the relationship between aging and willingness to pay for housing found in that study. The lower, dotted, line maps the willingness to pay for a given quality of house over age groups, with no consideration of other characteristics. The higher line isolates the true "age" effect of willingness to pay for housing by comparing people who differ by age, but who otherwise have the same income, education, household type, and race. The "isolated" age effect shows that the willingness to pay for a given quality of housing unit actually increases with age. The "uncontrolled" dotted line shows the opposite, because the elderly had less income than younger household heads. It was the lower income and education of older people that decreased their willingness to pay for housing, not their age. But because

Figure 17: Willingness to pay for housing unit by age



Source: Richard Green and Patric H. Hendershott, "Age, Housing Demand, and Real House Prices," *Regional Science and Urban Economics*, vol. 26 (1996), p. 475.

Figure 18: Millions of homeowners moving at least once in the decade, by age, 1990-2000 (Actual) and 2000-2010 (Predicted)



Source: Joint Center for Housing Studies of Harvard University, The State of the Nation's Housing 2003, Cambridge, Mass., p. 12.

baby boomers have more income and substantially greater wealth than previous generations, the "isolated" age effect line in Figure 17 is a more relevant indicator of post-retirement housing demand. The greater economic resources of baby boomers will increase their pre-retirement and post-retirement housing consumption far beyond that of previous generations.

Baby boomers are not yet over age 65, and will not be so for the next decade. They have continued to be active participants in the housing market. One measure of their demand for real estate is their numbers of repeat buyers. As Figure 18 shows, the older baby boomers, aged 45 to 54 in 2000, accounted for a substantial share of the homeowners who moved over the last decade. Half of the homeowners in this age group moved, with the majority moving to larger houses with more amenities. While the aging of the baby boomers means that they account for a smaller proportion of predicted movers in 2000 through 2010, their sheer numbers mean that they will continue to account for a sizeable share of repeat buyers.

There is more uncertainty about the echo baby boomers who will reach their mid-20s in 2010. Although there is no reason to believe that this group will not continue to postpone marriage and child-bearing into their late 20s and early 30s, it is hard to know how much the expectations of increased income and gifts from parents or bequests from grandparents might increase housing demand.

DEMOGRAPHY AND ECONOMIC OUTCOMES

Future population size and age structure are not known with certainty, but are more accurately predicted than are most other social and economic variables. Can these "relatively more accurate" predictions forecast economic outcomes? Determining the historic connections between demography and economic outcomes and using these connections to assess how predicted demography will predict future economic outcomes is very difficult because there are large feedback effects. Feedback occurs when household decisions about investments, savings, stock market participation, and housing depend on their needs (reflected in age and family size) as well as prices and income. Prices and incomes, in turn, change in reaction to current demographics and in anticipation of future price changes and demographics, muting the effects of population shifts, and complicating prediction. Government policies also change, as do tax structure, inflation rates, interest rates, overall levels of spending, the size and nature of immigration from abroad, and spending for particular age groups.

In 1989, on the basis of demographic theory, Gregory Mankiw, President George W. Bush's chair of the Council of Economic Advisors, and David Weil predicted a 47 percent decline in housing prices between 1987 and 2007. They attributed the 1970s increases in housing prices to the entry of the baby boomers into the housing market, and predicted that the entry of the 1965-81 baby bust generation would have the reverse effect. They forecast that demand would grow at a slower rate during the 1990s than at any time in the prior 40 years. Already, prior to their prediction, 47 of the largest 100 metropolitan areas had experienced a decrease in prices.

Of course, we know that home prices did not fall, and there were substantial increases in housing prices during the 1990s. Where did the predictions go wrong? In short, the approach was overly simplistic. One important problem was the failure to consider that the amount of housing produced responds to anticipated housing prices. In the real estate market, changes in demand are accommodated by reductions in quantity produced (development), and not only, or even principally, by changes in prices. When homebuilders anticipate a decrease in demand, current housing prices are lower, smoothing future price changes. Mankiw and Weil's predictions did not consider the effects of expectations on either current or future prices.

Attempts to predict prices are notoriously unreliable because many factors that influence price changes are either not considered or considered incorrectly. While the age structure of the nation's working-age population can be predicted with relative accuracy for a 20-year period, other important factors that serve to smooth the price effects of relatively slow, and easily anticipated, demographic changes cannot be predicted with accuracy. Productivity changes are critical to economic performance and to the flow of investments, but are basically impossible to predict. No empirically established connections between the rate of productivity increase and the age structure of population exist. While younger workers are, on average, more dynamic and flexible than are older workers, the productivity of older workers is higher than that of younger workers because of the effects of their greater experience, more specialized skills, lower supervisory costs and absenteeism, and better match between their skills and their job requirements. In short, the young have more energy, but less skill and judgment, and skill and judgment are highly productive.

Tax and regulatory changes are also critical to economic outcomes. Both the level and structure of Social Security benefits and of private pensions will influence when workers retire and their retirement behavior. Estate taxes affect the size and timing of bequests by the elderly. Bequests appear to be an important reason why the elderly continue to save in retirement, and also affect the savings behavior of heirs at a sufficient level to show up in aggregate savings. In addition, immigration policy determines the number of immigrants allowed into the country and their characteristics, including their age and skills. Any "shortages" of working-age people to support retirees can be resolved, at least in part, by more liberal immigration policies. Finally, the behavior of the population within any age group may change, undermining predictions based on the behavior remaining the same as the proportion of the age group changes. We have reviewed evidence that birth patterns, savings behavior, and home ownership by age has changed within the last 15 years, and that retirement age may be reversing its long-term decline. Also, asset allocation may change by age as baby boomers, who did not experience the Great Depression, replace the elderly, who did.

In sum, the relationships between the foreseeable future demographic composition of the population and future asset prices are impossible to predict. To the extent that the market anticipates demographic changes, prices, income, and behavior changes in response to that anticipation. If anticipated demographic changes are expected to lower prices in the future, then current prices—which include the expectation of future prices—are decreased because current prices fully reflect expectations of future change. Price changes over time are "smoothed" by market behavior. The bad news is that any prediction or forecast must credibly consider how expectations are created and acted upon. No one has been able to do this. The good news is that market processes themselves assure that market changes arising from anticipated changes in demography will occur smoothly.

Real Estate Crashes and Bank Lending

The role of non-recourse bank lending in generating boom and bust cycles in real estate.

ANDREY PAVLOV
SUSAN M. WACHTER

ALL NON-RECOURSE, asset-backed loans imply a put option on the underlying asset. If the value of the asset falls below the outstanding balance of the loan (less any transaction costs), then the borrower may simply "put" the asset to the lender and walk away from any future payments of principal or interest on the loan. While it might seem that the lender is "giving away" this put option, it's important to note that the lender is compensated for the imbedded option through a higher interest rate on the loan.

Completely rational lenders may choose to underprice the put option imbedded in a non-recourse loan. By doing so they would maximize their performance-based compensation, as long as the demand for the collateral assets was stable. Standard economic theory predicts that the losses following a market crash would preclude such underpricing behavior. However, due to agency issues, deposit insurance covering potential losses, and limited liability, the losses to the banks and their shareholders would be contained. Therefore, short-term lenders might find it rational to extend risky loans without an adequate interest rate spread with the potential consequence of a market crash.

The presence of short-term oriented lenders that underprice the put option makes it impossible for correctly pricing banks to compete, as other lenders are forced into underpricing, regardless of whether they are focused on short-term profits or on long-term performance. Ironically, under these circumstances the downside risk for banks, even in the event of a market crash, is limited. If all lenders face sudden large losses, both regulators and the public will likely blame the general economic conditions rather than underpricing behavior of the lenders.

Several outcomes are likely to accompany such systemic underpricing: first, a narrowing in the spread of lending over deposit rates; second, an increase in asset prices above fundamental levels; and finally, a decline in lenders' expected long-run profits. Of these effects, the increase in asset prices is perhaps the most troubling, because of the implications for macroeconomic stability. Inflated real estate prices induce a construction boom and an inefficient allocation of resources within the economy. Furthermore, a market with inflated asset prices is exceedingly vulnerable to negative demand shocks. When a "healthy" market is struck by a negative demand shock, asset prices decline to reflect the new supply and demand conditions. Inflated asset prices, however, magnify this decline as prices drop not only to adjust to the new demand but also to eliminate the inflated price.

With levered real estate, asset price declines beneath mortgage value will induce defaults. At the same time, the loss in asset value will decrease the value of bank collateral. Both effects have the potential to undermine the banking system's financial soundness, as has been shown repeatedly in numerous banking crises that have accompanied real estate crashes.

UNDERPRICING MODEL

For real estate, as for all assets, the fundamental asset price is the expected discounted value of the asset's returns over all possible future states of the economy. This is the price a rational investor would pay in the absence of lending or if lending is full recourse. For an investor, with full recourse, there are (in a simple world) two possible outcomes: a high payoff and a low payoff. The price the investor is willing to pay depends on the likelihood of the two outcomes and the discount rate. In the case of non-recourse lending, however, an investor who borrows to purchase the asset with zero equity either receives the high payoff (less the interest payments) when the good outcome occurs, or receives nothing if there is a bad outcome. With recourse, for example, a person who invests $100,000 may in the good outcome receive $120,000, or in the bad outcome receive $80,000, thereby losing $20,000. On the other hand, an investor who purchases the asset by borrowing using a non-recourse loan with zero equity either receives the price appreciation (minus the interest payment) in the good outcome or defaults and receives nothing in the bad outcome, without any losses. In the good outcome, the investor will receive $120,000 minus the principal and interest payment, say $105,000, for a return of $15,000, but in the bad outcome the investor will lose nothing.

Whether these two deals are equal in value depends on the interest rate and whether it is appropriately priced to cover the risk of the bad outcome. If there were no interest cost, then there is only upside to the investor, and the second deal is preferable. Similarly, a very low interest rate, too low for the risk, will be a better deal for investors than if investors were using their own money. In the example above, the interest charge should equal $20,000 for the prices with and without non-recourse borrowing to be the same. This is the total interest charge that compensates the lender for the default risk (although the investor/developer may still profit through entrepreneurial effort).

Moreover, if the loan is priced attractively, investors will pay more for the asset for which such loans are available. Thus the market price of the asset is driven above the fundamental price. This effect of underpricing is critical since it causes all investors to pay more for the asset, even rational full-recourse borrowers and equity investors.

Another market outcome of underpricing is that the premium of a bank's lending rate over the deposit rate declines. The deposit rate used by banks to pay for funds must be less than the lending rate for profits in the long run. The lending rate is higher than the deposit rate because it must cover the risk of the put option as well as the cost (net of fees) of making the loan. To the extent underpricing occurs, the premium declines.

What motivates banks to lend at rates that do not fully reflect the risk? To the extent that bank managers' salaries and bonuses are related to bank profits, managers will be motivated to maximize profits. Typically, bank managers' compensation is related to profits in order to optimally incentivize loan production. Moreover, shareholders may support incentivized compensation structures because they contain downside risk due to their protection through limited liability. Thus, the only actors who will be fully incentivized to monitor risk are depositors or large lenders. Because depositors are generally "small" and lack the resources or capacity to track bank lending behavior, demand deposit insurance is often provided, which exacerbates the problem.

The bank manager's compensation may be considered to have two components. If bank managers price the put option correctly, they receive the salary component regardless of the outcome. In the good outcome, the bank realizes positive profits and managers receive bonuses, which are an increasing function of profits. In the absence of underpricing, compensation contracts are designed to motivate lending officers and bank managers. The concern is that the very same compensation schemes may provide incentives for managers to underprice the put option. If they underprice the put option, they expand their market share and maximize their bonus for good outcomes.

Fundamentally, excess lending is due to managers' short time horizons, which cause them not to fully "price" the possibility of the future bad outcome. During a period of high profits and bonuses, underpricing will not be detected. In a bad outcome, on the other hand, banks will no longer be willing to make risky loans. Banks may close if too many risky loans were made, and managers may be fired. However, with short time horizons, bank managers may perceive that they have relatively little to lose when the underpricing is discovered some time in the future. Therefore, managers may decide to increase the immediate profits (and bonuses) and risk the small probability that a bad outcome will occur and their underpricing is discovered.

Due to limited liability, deposit insurance, and uninformed depositors, the above compensation scheme is consistent with maximizing shareholder value. Thus, shareholders with limited liability may not provide incentives for the managers to prevent underpricing. This possibility is strongest for shareholders who have little equity compared to the payoff from underpricing in the good state. This means that efficient markets alone will not be able to eliminate underpricing without effective regulatory intervention, which correctly and continuously adjusts the pricing of demand deposit insurance for the bank's risky lending.

This analysis yields a very worrisome implication: lenders that underprice steal market share from correctly pricing banks. Thus, correctly pricing banks have lower profits in the good state. However, correctly pricing banks may not even be able to get to break-even in a good outcome due to competitive pressure from the underpricers. Thus, competitive pressures push all lenders to underprice to maintain market share. This result holds even for bank managers who both correctly estimate the value of the put option and have a long-term horizon.

Such lender behavior has potential for devastating effects on property markets, since if banks are not correctly pricing risk, they are producing risk. This decapitalizes the banking system and may cause an economy-wide decline, which further undermines property markets.

THE ASIAN CASE

Real estate markets are vulnerable to waves of optimism—pricing above fundamental values—by lenders, investors, and borrowers. Optimists strongly influence asset prices and are also likely to remain in business so long as the upward trend in prices continues, even if their optimism is unfounded by an analysis of fundamental value. Optimists are likely to be able to borrow against their capital gains so long as lenders rely on market prices above the fundamental price when determining the value of real estate as collateral. The difficulty in selling real estate short means that optimists exert significant and asymmetric influence on the setting of real estate property prices.

But who provides the funds to finance the optimists' investments? As has been discussed, bank managers with short-term horizons are incentivized to provide funds to support exuberant borrowing. The magnitude of the resultant rise in real estate property will be greater—and the duration longer—so long as banks continue to lend. Lenders will attempt to maximize their short-run pay and will lend at rates that are too low given the expected risk.

While the divergence between market and fundamental value of real estate assets is not directly testable, if our model holds, the spread of the loan rate over the deposit rate can be used as a proxy for the extent of underpricing. This spread compensates the lender for providing the put option embedded in non-recourse loans. During a bubble that is due to widespread lender underpricing, lenders require little or no compensation for the put option. Thus, the spread of lending rates over deposit rates is narrowed and is correlated with higher prices of the underlying asset. At the same time, periods of widespread underpricing are associated with increased lending activity. In order for lenders to support the increased lending, they must increase deposit rates. This implies that deposit rates are positively correlated with asset prices. We can test this hypothesis and the conjecture that the spread of lending versus deposit rates is negatively correlated with asset prices.

In Asian markets in the 1990s, high deposit rates attracted capital inflows to banks, even as the spread between lending rates and deposit rates narrowed. Other research has tested our model using real estate and interest rate data from five South-Asian countries: Hong Kong, Indonesia, Malaysia, Singapore, and Thailand. The correlation between the spread of lending over deposit rates and real estate values was found to be highly negative for Thailand, Malaysia, and Indonesia, consistent with our hypothesis and symptomatic of underpricing behavior. Interestingly, relative to their peak, the real estate markets in Thailand, Malaysia, and Indonesia declined by a shocking 95 percent, 86 percent, and 81 percent, respectively.

The correlation coefficient between the spread of lending over deposit rates and real estate prices for Hong Kong and Singapore was either close to zero or positive. Both of these countries exercised strong government controls over the lending market before the crash. This evidence suggests that underpricing was limited or non-existent in these two countries. Consequently, while Hong Kong and Singapore also experienced a substantial negative real estate demand shock, the decline of property value in these two countries was much less: 33 percent and 38 percent, respectively.

According to our model, underpricing results in inflated asset prices above their fundamental level. After a crash, underpricing is eliminated and prices return to their fundamental level. Thus, underpricing compounds the effect of a negative demand shock and produces massive price declines. Therefore, countries that experience severe underpricing in the landing market, such as Thailand, Malaysia, and Indonesia, experience excessive price drops following a negative demand shock. Countries that prevent underpricing during periods of economic growth tend to experience relatively smaller price declines during economic stagnation.

CONCLUSION

Underpricing the put option imbedded in non-recourse mortgages leads to inflated asset prices even within efficient markets. Under certain economic conditions, rational lenders will choose to underprice the put option. Real estate and interest rate data from five Asian countries show widespread underpricing in Thailand, Malaysia, and Indonesia, and limited or no underpricing in Hong Kong and Singapore. Although Hong Kong and Singapore did experience real estate price declines, these resulted from crisis-induced declining demand. The three countries in which underpricing was strikingly evident experienced far greater losses in real estate values, with declines reaching levels of 80 percent or more in the aftermath of the financial market crisis.

We gratefully acknowledge financial support from the Social Sciences and Humanities Research Council of Canada.

What Should Stabilized Multifamily Cap Rates Be?

An examination of theoretical cap rates suggests that apartment pricing already reflects a substantial increase in long-term interest rates.

PETER LINNEMAN

IF A MULTIFAMILY property has achieved stabilized cash flow growth, intelligent application of the cap rate methodology will generate a valuation that is consistent with a detailed discounted cash flow (DCF) analysis. Absent long leases, and abnormal revenue or cost increases, the income stream from a stabilized property will grow at a roughly constant rate. Rather than conducting a DCF analysis that is largely an arithmetic exercise of growing current income at a constant growth rate, cap rate analysis greatly simplifies the valuation exercise without sacrificing accuracy. Apartments generally do not have long leases, nor do they have abnormal outlays associated with either tenant improvements or leasing commissions. As a result, in normal markets, multifamily properties are ideal candidates for cap rate analysis.

A property's cap rate is defined as its stabilized income, divided by its value. This immediately raises the question, "What measure of income?"—net operating income (NOI) or cash flow? The main difference between these alternative income metrics for apartment properties is recurring Cap Ex, while for other property types differences also arise due to tenant improvements and leasing commissions. Also, is it this year's or next year's income? To answer these questions, we visit the theoretical underpinnings of cap rate analysis.

THE GORDON MODEL

The Gordon Model states that the sum of discounted cash flows into perpetuity for a stabilized cash stream is represented by

$$V = \frac{C_1}{r-g},$$

where V is the property's value, C_1 is the cash flow derived from the property next year, r is the discount rate associated with the risk of the property's cash flows, and g is the annualized growth rate of the property's cash flow. From this it is obvious that the forward cash flow cap rate, CAP (C_1), is equal to

$$CAP(C_1) \equiv \frac{C_1}{V} = r - g.$$

That is, the forward cash flow cap rate equals the discount rate minus the annual cash flow growth rate.

The forward cash flow cap rate equation vividly demonstrates that a property's cap rate is a trade-off between its risk (r), and its cash flow growth potential (g). The higher a property's risk, the higher its cap rate is, while the greater the property's cash flow growth potential, the lower its cap rate. The Gordon Model of valuation applies only if the discount rate (r) is relatively large compared to the income growth rate. In fact, if the discount rate equals the growth rate, the valuation equation implies that the property's value is infinite. That is, the model explodes, because the discounted cash flow (DCF) model fails to yield a converging value. Intuitively, if the growth rate is higher than risk, eventually the property's cash flow becomes more than 100 percent of the economy. Clearly that is impossible.

The valuation equation demonstrates that the appropriate measure of income for cap rate analysis is next year's cash flow (C_1). If, instead, the property's current cash flow is used, an adjustment is required to reflect the cash flow growth that occurs between the current year and next year. For a stabilized property, next year's cash flow equals this year's cash flow (C_0) plus the growth associated with the stabilized growth rate (g),

$$C_1 = C_0(1+g).$$

Substitution of this formula into the valuation equation allows us to solve for the cap rate associated with current cash flow, CAP(C_0):

$$CAP(C_0) \equiv \frac{C_0}{V} = \frac{r-g}{1+g}.$$

That is, the cap rate based on current cash flow equals the forward cash flow cap rate divided by one plus the cash flow growth rate. Thus, if cash flow grows over time, the cash flow cap rate based on current cash streams is lower than that associated with future cash streams, by an amount reflective of the growth that occurs between today and tomorrow.

The Gordon Model can also be used to derive the appropriate NOI cap rate. If recurring Cap Ex requirements are stated as a percentage of NOI, then cash flow next period is expressed as

$$C_1 = N_1(1-d),$$

where N_1 is next year's NOI, and d is the ratio of recurring Cap Ex to NOI. This ratio will generally be 16 percent to 18 percent for institutional quality apartments, and higher for most other property types. For example, if next year's NOI is projected to be $10 million, and recurring Cap Ex is $1.7 million, then d equals 0.17. Manipulating the relationship between cash flow and NOI yields the forward NOI cap rate, CAP(N_1), as

$$CAP(N_1) = \frac{r-g}{1-d}.$$

Thus, if the forward cash flow cap rate is 7 percent, and recurring Cap Ex equals 17 percent of NOI (d=0.17), then the forward NOI cap rate equals 8.4 percent. We can also solve for the cap rate associated current NOI, CAP(N_0),

$$CAP(N_0) = \frac{r-g}{(1-d)(1+g)},$$

where N_0 is current year NOI.

Table I displays the NOI and cash flow cap rates for both this and next year income, when it is assumed that the discount rate is 8 percent, the annual cash flow growth rate is 2 percent, and the ratio of recurring Cap Ex to NOI equals 0.17. Note that the cap rate differences associated with using current-year income versus next-year income are relatively small, as long as the growth rate is small. However, the difference between cash flow cap rates and NOI cap rates is substantial, reflective of the fact that recurring Cap Ex drains significant cash.

Table I: Cap rates example*

On next year cash flow	6.00%
On this year cash flow	5.88%
On next year NOI	7.23%
On this year NOI	7.09%

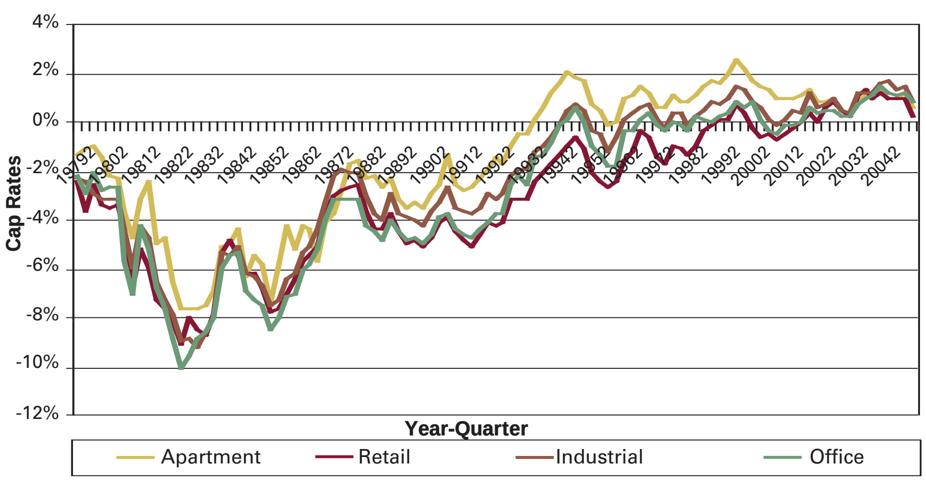
* For r = 0.08, g = 0.02, and = 0.17.

FORWARD CASH FLOW CAP RATE SPREADS

The spread between forward cash flow cap rates and the risk-free rate is a common way to describe cap rates. If we proxy the risk-free rate by the ten-year U.S. Treasury bond yield, this spread reflects the additional risk associated with the property relative to Treasuries, net of the perceived property income growth opportunity. We employ NCREIF's current year NOI cap rate data to obtain the "big picture" on how forward cash flow cap rate spreads have moved the last 25 years. Current year NOI cap rates are converted to next year cash flow (after recurring Cap Ex) by assuming that recurring Cap Ex as a percent of NOI is 17 percent for multifamily; 36 percent for retail; 31 percent for industrial; and 33 percent for office. These ratios are consistent with historical Cap Ex expenditures on NCREIF properties.

Figure 1 displays the history of forward cash flow cap rate spreads. In the early 1980s, when you bought real estate, you not only acquired its income growth potential and risk, but also accessed enormous tax benefits, as well as the option to massively leverage the property. As a result, the value of a property reflected the value of future operating income, plus the value of the tax benefits, plus the value of the option to leverage the property. During this period, forward cash flow cap rate spreads for all property types were negative, as their cash flow risk and potential were swamped by the value of the leveraging option and tax benefits. Forward cash flow cap rate spreads in the early 1980s were consistently 400 to 800 basis points lower than ten-year Treasuries, in spite of the fact that high (and rising) vacancy meant there was little hope for near-term cash flow growth. In this era, forward cash flow cap rate spreads were not about real estate, but rather about purchasing the option to overleverage and to access tax benefits.

Figure 1: Forward Cash Flow Cap Rate Spreads



When real estate's tax benefits were eliminated in 1986, forward cash flow cap rate spreads rose almost overnight by roughly 400 basis points for all property types. Nonetheless, forward cash flow cap rate spreads remained 200 to 400 basis points below Treasury yields, in spite of weak property fundamentals, due to the continued presence of the option to overleverage. That is, purchasing a property provided operating income risk and opportunity, as well as the option to receive grossly mispriced non-recourse debt. During this period, variations in spreads across product types grew, with retail and office cap rate spreads being roughly 200 basis points lower than for apartments. This gap reflected the greater perceived credit quality of retail and office tenants.

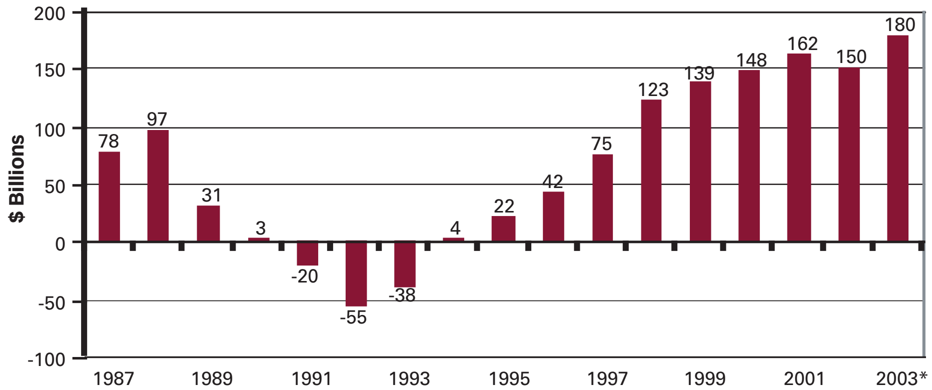
In the early 1990s, real estate debt evaporated, and real estate no longer included an option to overleverage. Instead, purchasing real estate included the requirement to underleverage. Thus, even as construction ceased and property fundamentals began modestly improving, forward cash flow cap rate spreads exploded, rising by nearly 400 basis points. Retail and office forward cash flow spreads remained the lowest, while spreads for apartments remained the largest, at nearly a 200 basis point spread over Treasury bonds.

By the mid-1990s, not only were real estate fundamentals improving, but real estate capital markets were returning to equilibrium due to capital flows to CMBS, REITs, and opportunity funds. As a result, the period from late 1994 through the August 1998 Russian ruble crisis saw forward cash flow cap rate spreads for apartments moderate to 50 to 100 basis points. Retail spreads remained the narrowest, at –100 basis points, while office and industrial spreads were roughly zero.

The late-1998 Russian ruble crisis, which had nothing to do with real estate, caused forward cash flow cap rate spreads to rise by 100 to 200 basis points, as real estate capital markets were now connected with broader global capital flows. Hence, as global capital fled to safety, it abandoned relatively risky assets, including real estate. This pattern continued even as global capital markets stabilized, as the tech bubble made cash flow seem passé.

When the tech bubble burst in 2001, forward cash flow cap rate spreads narrowed, falling by 50 to 75 basis points as cash flow became king. As property market fundamentals weak-

Figure 2: Commercial Mortgage Flows



Source: Federal Reserve Bank; *Mid-year seasonally adjusted annual rate.

ened following 9/11, forward cash flow cap rate spreads rose temporarily. Forward cash flow cap rate spreads have subsequently fallen by 100 to 150 basis points across the board since late 2002, in spite of weakening property fundamentals. This reflects the fact that although real estate fundamentals have eroded, they have eroded less than in other sectors. As a result, real estate has been a favored asset class. Narrowing spreads, combined with the roughly 100 basis-point decline in long-term Treasury rates, have caused nearly 300 basis point drops in forward cash flow cap rates.

SUSTAINABLE CAP RATES

So, what is the historic relationship between cap rates and long-term Treasuries? If we focus on the "modern" real estate era, when real estate capital markets are connected to global capital markets, and ignore both the Russian ruble crisis and the tech bubble, the answer appears to be that forward cash flow cap rate spreads for institutional quality multifamily properties are 50 to 100 basis points. But it is only these brief periods of the past 25 years that are reflective of true real estate pricing, as opposed to an option to overleverage, access to tax benefits, and abnormal capital markets. Thus, we expect forward cash flow cap rate spreads of approximately 50 to 100 basis points for stabilized portfolio of institutional-quality multifamily properties, as the greater risk of these properties relative to long-term Treasury bonds is roughly offset by their cash flow growth potential.

Another way to evaluate the appropriate forward cash flow cap rate is to note that the discount rate can be defined as the sum of the risk-free rate (FREE), plus a liquidity premium associated with the property relative to the risk-free asset (LIQ), plus the additional return required due to the operating and market risks of the property relative to the risk-free rate (RISK):

$$r \equiv FREE + LIQ + RISK.$$

The liquidity and operating risk dimensions of an A-quality multifamily property are best proxied by the risks associated with BB bonds, which historically carry a roughly 210 basis point spread over ten-year Treasuries. This is the general risk for pass-through credit card receivables, which, like stabilized multifamily cash streams, reflect unsecured credit claims on a broad base of consumers. For B-quality properties, the cash stream and liquidity risks are more equivalent to modestly lower credit bonds, BB-, which typically yield about 260 basis points over the risk-free rate. For C properties, with lower credit quality tenants and deteriorating competitive positions, the risks are roughly equivalent to B-rated bonds, which have spreads of roughly 350 basis points.

If the stabilized cash flow growth rate is approximately equal to inflation, or about 2 percent per annum, and recurring Cap Ex is approximately 17 percent of NOI, then the theoretically sustainable forward cap rates for A, B, and C-quality properties are displayed in Table II for two risk-free interest rate scenarios. Specifically, we analyze the environment where ten-year Treasuries remain at today's rate of approximately 4.2 percent, as well as the scenario where the ten-year Treasury yield rises to a more sustainable 5 percent. Note that the sustainable forward cash flow cap rates associated with a 5 percent interest rate environment are not substantially different than those that prevail today. That is, markets are currently pricing multifamily properties as if they believe that long-term interest rates are closer to 5 percent rather

Table II: Cap rates example*

	For A properties[2]		For B properties[3]		For C properties[4]	
	4.2% Treasury	5% Treasury	4.2% Treasury	5% Treasury	4.2% Treasury	5% Treasury
On forward cash flow	4.3%	5.1%	4.8%	5.6%	5.7%	6.5%
On current NOI[5]	5.1%	6.0%	5.7%	6.6%	6.7%	7.7%

1 All scenarios assume the stabilized cash flow growth (g) is 2% annually.
2 The risk premium for A properties is 210 basis points.
3 The risk premium for B properties is 260 basis points.
4 The risk premium for C properties is 350 basis points.
5 Recurring Cap Ex equals 17% of NOI.

than the current 4.2 percent. As a result, a 70 basis point increase in long rates should not appreciably change cap rates.

CONCLUSIONS

This analysis demonstrates that an internally consistent and disciplined approach exists for analyzing stabilized multifamily cap rates that focuses on the forward cash flow cap rate. While cash flow cap rates generally should rise with long-term interest rate rising, in view of current pricing they should remain in the range of 5 percent for A-quality properties, as the forward cash flow cap rate spread for A properties should be approximately 0. For B and C properties, the forward cash flow cap rate spreads should be approximately 60 and 150 basis points, respectively. These results are consistent with the forward cash flow cap rate spreads that have prevailed in normal markets for institutional quality multifamily properties.

Cash flow cap rates of roughly 5 percent to 5.5 percent are consistent with an unlevered total return expectation of roughly 7 percent to 7.5 percent for A-quality multifamily properties. Based on Jeremy Siegel's analysis of long-term stock returns, the anticipated return for the S&P 500 is approximately 7 percent plus inflation. Thus, the expected S&P 500 return is approximately 9 percent in a 5 percent ten-year Treasury bond yield environment, the CAPM model implies the beta for an unlevered, high-quality apartment portfolio is approximately 0.5. This compares to 0.2 to 0.4 betas found for the major apartment REITs. Thus, if anything, REIT betas suggest that apartment forward cash flow cap rates should perhaps be modestly lower than those shown in Table II. These low return requirements for top-quality multifamily properties reflect the fact that their cash flows have relatively low correlations with the market, as well as the fact that total return volatility for apartments is approximately 25 percent less than is the case for S&P 500.

Of course, in the short run, markets can deviate substantially from theoretical expectations. One need only recall the giddy days of the dot.com era. However, over the long run, pricing patterns tend to revert to those justified by fundamental risks and returns. Thus, we expect forward cash flow cap rates for multifamily properties that are approximately equal to the ten-year Treasury yield for A-quality apartments, and approximately 60 to 150 basis points higher for B and C properties, respectively.

Although the bond market is currently pricing ten-year Treasury yields at 4.2 percent, we expect cap rate reversion over the coming year due to ten-year Treasury yields rising towards 5 percent. The multifamily asset market is pricing as if this 80 basis point increase, a roughly 18 percent value exposure, has already occurred. Further, as cash flows rise over the next year, values will be nudged upwards.

Finally, it is important that the industry becomes more precise about whether it is referring to cash flow, or NOI, cap rates. Unfortunately, all too often these concepts are used interchangeably. They are greatly different. Such carelessness creates needless confusion. We strongly encourage the industry to adopt the more theoretically correct concept of forward cash flow cap rates when discussing cap rates.

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Creative Places

Certain urban areas are particularly attractive to knowledge-based workers.

WITOLD RYBCZYNSKI

IN *The Rise of the Creative Class*, Richard Florida argues for the power of place. People have always preferred nice places to live, of course, but the subject of Florida's research is a particular category of worker that he calls the "creative class." According to his extremely broad definition, this includes a range of knowledge-based workers, as diverse as scientists and engineers, people who work in media, education, and healthcare, as well as entrepreneurs, financial professionals, and upper management. This creative class comprises about 30 percent of the U.S. work force, but the distribution is far from even. In the Raleigh-Durham area, for example, with its concentration of research centers, high-tech forms, and universities, the creative class comprises almost 40 percent of the work force; in Las Vegas, on the other hand, with its preponderance of leisure industries employing service workers, the creative class is less than 18 percent.

"People balance a host of considerations in making decisions on where to work and live," Florida writes. "What they want today is different from what our parents wanted, and even from what many of us once thought we wanted." Since workers no longer expect to spend their whole career in the same job, they favor "thick" labor markets, that is, places with clusters of employment opportunities, whether they are high-tech firms, investment banks, media outlets, or research universities. Equally important to the creative class are places that offer attractive lifestyle

Table I: Top 50 urban regions ranked according to Florida's creativity index

Regions with populations 1 million +	Regions with populations 1/2 – 1 million	Regions with populations 1/4 – 1/2 million	Regions with populations < 1/4 million
1. Austin	11. Albuquerque, N.M.	8. Madison, Wisc.	4. Burlington, Vt.
2. San Francisco	26. Colorado Springs, Colo.	9. Boise, Idaho	15. Corvallis, Ore.
3. Seattle	32. Tucson, Ariz.	17. Fort Collins, Colo.	21. Iowa City, Iowa
5. Boston		18. Des Moines, Iowa	36. Champaign, Ill.
6. Raleigh-Durham		23. Santa Barbara, Calif.	39. San Luis Obispo, Calif.
7. Portland, Ore.		24. Lansing, Mich.	44. Portland, Maine
10. Minneapolis		25. Tallahassee, Fla.	45. Charlottesville, Va.
11. Washington-Baltimore		30. Provo, Utah	47. Cedar Rapids, Iowa
13. Sacramento		32. Lincoln, Neb.	49. College Station, Texas
14. Denver		41. Melbourne, Fla.	
15. Atlanta		50. Lexington, Ky.	
19. San Diego			
20. New York			
21. Dallas-Fort Worth			
27. Salt Lake City			
28. Phoenix			
31. Los Angeles			
32. Kansas City			
35. Philadelphia			
37. Houston			
38. Columbus, Ohio			
39. Chicago			
42. Nashville			
43. West Palm Beach, Fla.			
46. San Antonio			
48. Providence, R.I.			

Source: *The Rise of the Creative Class*, 2004 edition.

choices, opportunities for social interaction, identity (in the sense that creative people increasingly define themselves more by where they live than by where they work), authenticity (which often means history), and cultural diversity (that is, tolerance of a variety of lifestyle choices). "An attractive place doesn't have to be a big city," Florida writes, "but it has to be cosmopolitan."

Florida ranks urban regions according to what he calls a "creativity index." The index is a measure of four equally weighted factors: the proportion of creative workers in the work force; the degree of innovation, measured by patents per capita; the presence of high-tech industry; and social diversity, proxied by a "gay index." Table I shows the top 50 urban regions ranked according to Florida's index. The presence of a large number of college towns on the list, such as Champaign, Ill., Charlottesville, Va., Gainesville Fla., College Station, Texas, and Santa Barbara, Calif. skews his list to the lower end of population size. Nevertheless, more than half of the list consists of large urban regions with populations in excess of one million. When it comes to creativity, bigger may be better.

To assess the degree to which knowledge-based industries are attracted to regions with a high creativity score, I examined the location choices of one specific category of creative employers: large consulting firms that offer design services in the construction field. This category includes firms that provide some combination of engineering, architectural, and contracting services.

The locations of the 50 largest American design firms, ranked according to revenues, are presented in Table II. Sixty-eight percent are located in clusters of two or more firms. The New York City area has by far the largest cluster (9), followed by Los Angeles (5) and San Francisco (4).

Table II: Locations of 50 largest U.S. design firms

New York, N.Y.	9 firms
Los Angeles, Calif.	5 firms
San Francisco, Calif.	4 firms
Houston, Texas	3 firms
Denver, Colo.	3 firms
Kansas City, Kan.	3 firms
Philadelphia, Pa.	3 firms
Chicago, Ill.	2 firms
Harrisburg Pa.	2 firms
Boston, Mass.	1 firm
Omaha, Neb.	1 firm
Baton Rouge, La.	1 firm
Phoenix, Ariz.	1 firm
Miami, Fla.	1 firm
Atlanta, Ga.	1 firm
Boise, Idaho	1 firm
St. Louis, Mo.	1 firm
Dallas-Ft. Worth, Texas	1 firm
Hartford, Conn.	1 firm
Birmingham, Ala.	1 firm
Pittsburgh, Pa.	1 firm
Anchorage, Alaska	1 firm
Greenville-Spartanburg, S.C.	1 firm
Raleigh-Durham, N.C.	1 firm
Washington-Baltimore	1 firm

Source: *Engineering News-Record*, 2004.

Table II suggests that a high degree of clustering is taking place, since roughly half of the firms are located in five urban regions. Moreover, all five of these regions appear in Table I. In fact, the top eight regions in Table II, which account for 32 of the top 50 firms, are all places with good scores on the creativity index. In all, 39 of the top 50 firms are located in places that rank among the top 50 on the creativity index. Conversely, many of the urban regions with the highest creativity index scores, such as San Francisco, Denver, and New York, also attract clusters of the largest design firms.

While the information in Table II appears to support the creative clustering hypothesis, there are several important caveats. First is the overwhelming attraction of the New York City area, even though it ranks 20th in the creativity index ranking. Evidently, the size of the urban population matters, which is why the five largest urban areas in the country (New York, Los Angeles, Chicago, Houston, and Philadelphia) all attract clusters of the largest design firms. Second, Table II shows that the locations of the 50 largest design firms include metropolitan areas around "old" cities such as New York, San Francisco, Boston, and Chicago, as well as around "new" cities such as Los Angeles, Houston, Kansas City, and Denver. Dense, historical central cities do not appear to be significantly more attractive than the new, low-density, automobile-oriented suburban cities such as Raleigh-Durham and Dallas-Ft. Worth. Third, the location of firms in a metropolitan area should not be interpreted as signaling the attraction of the central city itself. The creativity index ranks urban regions, which include downtowns, suburbs, edge cities, and exurbs. The ability to offer a wide variety of locational options—suburban office parks as well as downtown lofts—may explain the attraction of large metropolitan areas such as New York and Los Angeles. In fact, only four of the nine "New York" firms are located in the city; the rest are located in suburban cities and towns in New Jersey, Long Island, and the outer suburbs. Firms in Los Angeles are scattered over the entire metropolitan region, including Pasadena, Ontario, and Orange County. The same pattern is evident in the other metropolitan locations. Of the three Philadelphia firms, one is located in the city and two are in outlying suburban towns. The Boston firm is actually in Cambridge. Lastly, some of the design firms are in urban regions such as Harrisburg, Pa., Miami, and St. Louis, which do not score high on the creativity index.

Design firms have business reasons, unrelated to place-characteristics, for operating out of a particular location, chief among them being access to potential clients, although design firms with an international clientele may have a greater degree of flexibility in this regard. The *Engineering News-Record* annually compiles a list of the 100 largest international design firms in the world, ranked by annual revenues from off-shore work. In 2004, 39 of these firms were American. Table III shows their locations.

Table III: Locations of 39 largest international U.S. design firms

San Francisco	6 firms
New York	6 firms
Los Angeles	4 firms
Houston	4 firms
Denver	2 firms
Philadelphia	2 firms
Washington-Baltimore	2 firms
Buffalo, N.Y.	2 firm
Phoenix	1 firm
Kansas City	1 firm
Baton Rouge, La.	1 firm
St. Louis	1 firm
Boston	1 firm
Anchorage, Alaska	1 firm
Greenville, S.C.	1 firm
Birmingham, Ala.	1 firm
Akron, Ohio	1 firm
Chicago	1 firm
Boise, Idaho	1 firm

Source: *Engineering News-Record*, 2004.

Note that there is a higher degree of clustering among the international firms—more than 70 percent are located in only eight urban areas, and almost half of these are concentrated in only two areas, San Francisco and New York. Both are metropolitan areas whose central cities have high-density urban centers. Both are considered vital, successful cities. Not coincidentally, both are coastal cities. Since New York is the world's financial center, and a so-called-global city, its attraction to internationally oriented design firms is understandable. But the presence of so many large design firms in the San Francisco area, which also ranks at the top of the creativity index, seems to strongly support the notion that knowledge-worker industries are drawn to dynamic, cosmopolitan urban surroundings.

Yet Table III also raises some interesting questions. Many of the cities that top the creativity index, such as Austin, Seattle, Raleigh-Durham, and Portland, Ore., are absent from the list of international design firms. It may be that the presence of high-tech industries or creativity measured by patents are poor indicators of what makes a place attractive to engineers and architects. That may be why the list of international design firm locations includes a large number of small, regional cities that do not rank highly in the creativity index: Buffalo, N.Y. (ranked 150th), Baton Rouge, La. (195th), or Greenville, S.C. (212th). These places do not fit the conventional profile of cosmopolitan urban "hot spots."

ARCHITECTURAL FIRMS

Architectural firms are a subset of design firms. They are generally smaller than the engineering firms (only 14 architectural firms appear in the list of the largest 100 design firms). Large architectural firms work both nationally and internationally. There is likewise a high degree of clustering: 100 of the 133 largest firms are located in clusters of two or more (Table IV), and more than half of the largest 100 firms are located in only six urban regions. The distribution of firms is not related to the size of the urban region. Small Boston has the same number as large New York; Atlanta and San Francisco have more than Houston or Philadelphia. Some urban regions, such as Raleigh-Durham, Austin, Denver, and Sacramento, rank high in the creativity index but have not attracted clusters of large architectural firms. Nevertheless, 84 percent of the firms in Table IV are located in regions that rank high on the creativity index—a strong correlation.

The clusters of the largest architectural firms occur exclusively in large cities. That may be because architectural firms appear to have a greater propensity than design firms to locate in the central city: 11 of the 12 New York firms are in Manhattan; one-third of the 12 Boston firms are downtown, one-third are in Cambridge; three-quarters of the Chicago firms are in the city; four of the five Philadelphia firms are in the city (on the other hand, of the 270 Philadelphia firms listed in the AIA directory, half are located in the city, while half are suburban).

Table IV: Locations of 100 largest American architectural firms

New York	12 firms
Boston	12 firms
Los Angeles	9 firms
Chicago	8 firms
Atlanta	6 firms
San Francisco	6 firms
Detroit	5 firms
Philadelphia	5 firms
Seattle	5 firms
Houston	5 firms
Minneapolis	4 firms
Washington-Baltimore	4 firms
St. Louis	3 firms
Dallas-Fort Worth	3 firms
Charlotte, N.C.	3 firms
Miami	3 firms
Columbus, Ohio	3 firms
Princeton, N.J.	2 firms
Portland, Ore.	2 firms

Source: *Engineering News-Record*, 2003.

There are a number of possible reasons for the decidedly urban clustering of architectural firms. Construction is cyclical, and thick labor markets are particularly important to architectural workers who move frequently between positions. Architects may be interested in a stimulating urban environment for professional reasons. A vibrant architectural culture feeds off urban universities, museums, art societies, and downtown professional groups, all of which are well represented in large cities.

Another measure of a lively architectural "scene" is the presence of firms with international reputations. One recognition of a firm's international design reputation is the extent to which it is invited to participate in closed international architectural competitions. (Participants in "closed" competitions are selected by the organizers, in contrast to competitions that are "open" to any qualified architect.) Two architectural journals, one American (*Architectural Record*) and one Spanish (*Arquitectura Viva*), were reviewed for the period 1994–2003. During these ten years, there were 71 international competitions documented, to which typically four to six prominent architectural firms were invited (40 percent of the invitations were issued to the same 11 architectural firms). Sixty-four firms were invited to compete in more than one competition. Of these, 47 were located in clusters of two or more. The geographic location of these clusters was highly concentrated in only 12 cities around the world. Table V ranks the cities according to the percentage of the invitations issued to firms in that city. Twenty-two of the 48 firms were located in American cities: New York (15), Boston (3), Los Angeles (2), and Chicago (2). The dominance of New York on the world architectural scene is obvious. There is also an unexpected concordance between the top-ranked cites in Table V—New York, London, Paris, and Tokyo—and the international financial centers that are usually referred to as "global cities."

Table V: Location of architectural firms with percent of invitations to international competitions, 1994–2003

New York (15 firms)	33 percent
London (5 firms)	13 percent
Paris (5 firms)	12 percent
Tokyo (5 firms)	10 percent
Amsterdam (2 firms)	9 percent
Los Angeles (2 firms)	7 percent
Boston (3 firms)	4 percent
Zurich (2 firms)	4 percent
Madrid (2 firms)	3 percent
Mexico City (2 firms)	3 percent
Chicago (2 firms)	2 percent
Toronto (2 firms)	2 percent

Source: *Architectural Record, Arquitectura Viva.*

Although there is almost no overlap between the list of largest architectural firms and the list of international competition invitees, the ranking of the American cities in Table V corresponds closely to the ranking in Table IV. This confirms that New York, Boston, Los Angeles, and Chicago are flourishing centers of architectural culture, in terms of both employment and skills.

CONCLUSION

It appears that certain places really are attractive to design firms. These places can be characterized as large urban areas. Generally speaking, New York remains dominant. Otherwise, it is hard to generalize, since the places with clusters of design firms include a wide variety of urban regions: Houston as well as San Francisco, Atlanta as well as Boston. The relationship between these creative clusters and urban regions with high creativity index rankings is far from conclusive. The largest clusters of the largest design firms are New York (ranked 20th in creativity), Los Angeles (ranked 31st), Houston (ranked 37th), Kansas City (ranked 32nd), and Washington-Baltimore (ranked 11th). Similarly, the urban areas that are centers of architectural culture—New York, Boston, Los Angeles, and Chicago—with the exception of Boston, do not rank at the top of the creativity index. It is possible that the factors that attract different categories of knowledge workers to different places are themselves different. For example, the presence of cultural institutions may be a bigger draw to architects than to high-tech industries. The architectural heritage of older cities will likewise play a different role for different groups. Nevertheless, the present study upholds the hypothesis that the power of place plays a role in attracting creative workers and knowledge-based industries.

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