The Economic Benefits of New York City's Public School Reforms, 2002-2013

Robert J. Shapiro and Kevin A. Hassett

December 2013

SONECON

Table of Contents

The Economic Benefits of the New York City's Public School Reforms, 2002-2013[1]

Robert J. Shapiro and Kevin A. Hassett

I. Introduction and Summary

Educational reforms are a regular feature of local politics in the United States. Given the economic and social benefits that are expected to follow when a city or county improves the quality of its school system, this interest is unsurprising. As the competition for well-paid jobs has intensified, sound academic skills and degrees have become minimum requirements for most of those jobs. Moreover, the "income premium" associated with completing high school or earning a college degree does not end with a person's first job, but rather is sustained throughout most people's working lives. Improvements in the graduation rates and test scores of a city's public school system also are associated, down the line, with lower crime rates, stronger local growth and higher property values. As a result, a city's businesses and residents, as well as its elected officials, have strong incentives to improve the quality and outcomes of public education.

This study estimates the economic benefits associated with the major public school reforms introduced in New York City (NYC) by Mayor Michael Bloomberg. Over the course of a decade, the Bloomberg administration undertook a series of significant changes to the operations of the New York City public school system, focused primarily on increasing the autonomy and accountability of a school's principal and teachers, and vastly expanding school choice and charter schools. We found that those reforms have been closely followed by substantial improvements in a number of key measures of student performance, including Math and English test scores, high school graduation rates, and college enrollment rates. We have analyzed the potential economic benefits of those improvements, and found:

Summary of Results

- **By numerous measures, student performance at NYC public schools improved markedly under the Bloomberg reforms:**
    - From 2006 to 2012, the mean scale score of NYC students on the English Language Arts test rose 2 percent, compared to a 1 percent gain across New York State;
    - From 2006 to 2012, the mean scale score of NYC students on the Mathematics test rose 4 percent, compared to a 3 percent gain across New York State;
    - From 2006 to 2012, the four-year graduation rate of NYC high school students increased from 49.1percent to 60.4 percent;
    - These graduation achievements were driven mainly by the progress of African-American and Hispanic students. From 2006 to 2012, graduation rates for African-American students increased from 42.9 percent to 55.0 percent. Similarly, the graduation rates of Hispanic students rose from 40.1 percent in 2005 to 52.7 percent in 2012.

[1] Support for this research was provided by the Fund for Public Schools. We also acknowledge the superb research provided by Doug Dowson, Matt Jensen and Regan Kuchan. The analysis and views are solely those of the authors.

- **The net present value of the additional lifetime income from earning a high school diploma compared to attending and dropping out of high school, is $218,000.**

    - Under the Bloomberg reforms from 2008 to 2012, 41,000 more NYC public high school students earned diplomas than would have occurred assuming the graduation rates for NYC students in 2006;
    - **The net present value of the additional income that these additional NYC high school graduates should earn over their lifetimes is $8.9 billion.**

- **The net present value of the additional lifetime income from enrolling in college, compared to ending one's education with a high school diploma, is $207,000.**

    - Under the Bloomberg reforms from 2008 to 2012, 30,900 more NYC public high school students enrolled in institutions of higher learning than would have occurred assuming the college enrollment rates of NYC students in 2006;
    - **The net present value of the additional income that these additional NYC college attendees should earn over their lifetimes is $6.4 billion.**

- ***All told, improvements in the performance of students graduating from 2008 to 2012 should produce lifetime income gains with a net present value of $15.3 billion.***

- **Rising high school graduation rates increase housing demand in the neighborhoods where those graduation rates rose, which in turn has led to increased residential property values.**

    - Under the Bloomberg reforms, the four-year graduation rates of NYC high school students increased 11.3 percentage points from 2006 to 2012.
    - We estimate that increasing NYC graduation rates by 1 percentage point in a zip code leads to an increase in residential property prices of 0.54 percent.
    - **On this basis, we would expect that NYC's rising graduation rates added as much as $37.1 billion to NYC residential housing prices or values.**

- **The expansion of charter schools can increase housing demand in the neighborhoods with new charter schools, leading to higher residential property values.**

    - The number of NYC charter schools climbed from 14 in 2001 to 183 in 2013, an average increase of 0.96 charter schools per zip code.
    - We estimate that adding one new NYC charter school in a zip code increased residential property prices there by 3.69 percent.
    - **On this basis, we would expect that the expansion of charter schools in NYC added as much as $22.45 billion to NYC residential property prices or values.**

II. The Bloomberg Reforms of Public Education

The New York City public school system is the country's largest, with an annual budget of $24 billion to cover the cost of 75,000 teachers for some 1.1 million students at nearly 1,800 schools.[2] The system faces many challenges beyond size. Nearly 40 percent of students live in households where a language other than English is spoken; and many Department of Education documents are printed in 13 languages in addition to English.[3] All told, Hispanic students make up 39.9 percent of NYC public school students, African Americans comprise 30.3 percent of students, Asian-Americans account for 15.0 percent of students, and non-Hispanic whites comprise the remaining 14.3 percent.

Michael Bloomberg's mayoralty brought about numerous changes in its operations and management. The Bloomberg agenda depended ultimately on Mayor Bloomberg's success in persuading the New York State legislature in 2002 to disband the NYC school board and transfer its authority to the Mayor.[4] From that time, the Mayor's office and the NYC Department of Education (DOE) carried out a series of major reforms. One set of changes addressed school governance and management, including creation of 10 regional districts under the Chancellor to replace 32 community school boards, new "autonomy zones" where schools gained broad discretion over staffing and spending, and more charter schools with similarly broad discretion.[5] The Mayor also secured new funding: Real funding ($2013) rose from $15.4 billion in 2002 to $24 billion in 2013. These increases supported 41 percent hikes in average teacher compensation and additional spending of nearly $5,000 per-pupil.[6] The Bloomberg strategy linked expanded discretion and funding to a new system of "performance management," granting schools and principals more autonomy and resources in exchange for more accountability for the results.[7]

The central goal of these reforms and additional resources has been to improve student outcomes. Since this goal cannot be divorced from the quality of teachers and their schools,[8] the reforms also include strategies and incentives for improving teacher recruitment, teacher assignments, teacher retention rates, and their working conditions.[9] The reform agenda also entailed phasing-out and closing more than 160 schools and opening nearly 660 new ones, and providing new paths to graduation for drop outs and those considered likely to leave before graduation.[10] The Bloomberg reforms also expanded school choice to all public school students and public high schools, from comprehensive high schools to small theme-based schools, and from charter schools and college preparatory schools to vocational schools. By 2008, incoming high school freshmen could choose from more than 700 schools, based on the proposition that different students prosper at different kinds of schools.[11]

---

[2] New York City Department of Education (2013). "About Us." http://schools.nyc.gov/AboutUs/default.htm
[3] Spanish, French, German, Chinese, Japanese, Urdu, Persian, Hindi, Russian, Bengali, Haitian, Korean, and Arabic.
[4] This transfer of authority did not affect federal and state requirements regarding the use of federal and state grants, financial reporting, collective bargaining, and educational services for students with disabilities.
[5] Paul Hill (2011).
[6] *Ibid.* This calculation of additional spending per-pupil excludes pass-through's for charter schools.
[7] Childress *et al.* (2011).
[8] O'Day and Bitter (2011).
[9] Goertz *et. al* (2011).
[10] Siskin (2011).
[11] Corcoran and Levin (2013).

Universal choice and budget resources tied in part to student enrollments have created much greater competition for students among schools, which in turn has forced many of those schools to undertake changes designed to attract more students and their accompanying funding. In 2008, some 88,000 eighth graders participated in the choice system for high school, designating an average of 7.1 schools of choice each. A major expansion of charter schools was also a basic element in this extensive system of choice, especially in the K-8 system. Under the Bloomberg reforms, the enrollments and numbers of charter schools increased from 1,800 students in 16 public charter schools in 2002 to nearly 30,000 students in 98 charter schools by 2009,[12] and some 60,000 students in 180 charter schools in 2013.[13] While two national studies reviewing charter schools across the country found that they did not outperform other public schools,[14] three recent studies of NYC charter schools concluded that students at those schools have performed better than students at other City public schools.[15] On that basis, the Bloomberg reforms include a goal of 225 charter schools serving 100,000 students in the near future.

Beyond the encouraging results for the NYC charter schools, the evaluation of the broader reforms remains controversial. New York City was awarded the prestigious Broad Prize for Urban Education in 2007 based on improvements in student achievement, enabling more African American and Hispanic students to achieve at high levels, and generally narrowing achievement gaps based on income and race.[16] Yet, some critics have claimed that the reforms and increased expenditures have produced only modest improvements in student achievement.[17] For example, one recent study by the Economic Policy Institute, as part of its "Broader, Bolder Approach to Education Initiative," claimed to find that educational reforms undertaken in Washington, D.C. and Chicago, as well as New York City, have produced few positive results.[18] Based on more objective criteria – including the New York State Regents Exams, assessments by the National Assessment of Educational Progress, and standardized citywide tests – the results have been mixed. The significance of these criteria, however, depends on how accurately their results actually capture meaningful improvements in students' abilities.

The most rigorous analysis of the reforms was conducted by James Kemple, executive director of the Research Alliance for New York City Schools. He endorsed the results of other evaluations which found large improvements in performance and graduation rates by NYC students attending the numerous small new schools of choice created under the reforms.[19] He also applied "comparative interrupted time series analysis" and found, "compelling evidence that the constellation of reforms being instated in NYC from 2003-2010 had a positive effect on ELA [English Language Arts] and math proficiency rates in the fourth and eighth grades, and on graduation rates, over and above the continuing effects of prior reforms or conditions shared by other districts."[20]

---

[12] *Op. cit*.
[13] New York City Charter School Center, http://www.nyccharterschools.org/.
[14] Center for Research on Educational Outcomes (CREDO) (2009). Zimmer, Gill, *et.al* (2009).
[15] Hoxby and Murarka (2009); Reardon (2009); Dobbie and Fryer (2009).
[16] Peter Meyer (2008).
[17] *Ibid*.
[18] Weiss and Long (2013).
[19] *Op. cit.*
[20] Kemple (2013).

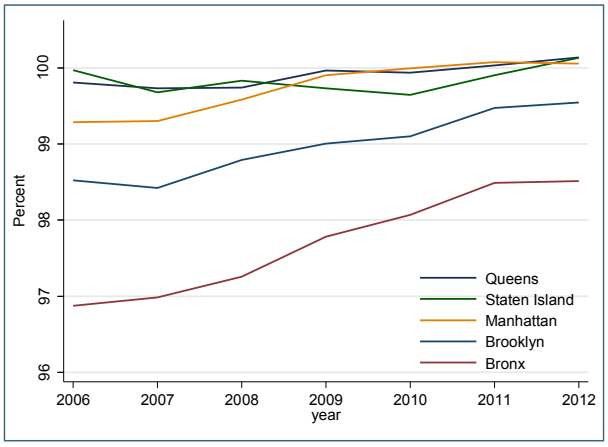
While we concur with Dr. Kemple's conclusions, this study does not try to link measures of student performance to particular reforms. Rather, we focus on three objective measures of achievement – high school dropout versus graduation rates, rates of subsequent college attendance, and statewide test scores by NYC public school students, compared to the entire state. We review the statewide test scores of NYC students from 2006 to 2012, both as measures of their achievement and to establish whether improvements in NYC graduation and college attendance rates might reflect any erosion in standards. Then, we track changes in their graduation and college attendance rates from 2008 to 2012, to establish whether student performance by these measures improved. We use 2006 as our baseline year for when most of the reforms were in place, and 2008 as the first year when those reforms could be expected to begin to show results. The data show that the high school graduation and college attendance rates of NYC public school students improved substantially over this period. Using these data, we estimate the economic benefits associated with these improvements in student performance, based on estimates of future lifetime earnings by NYC public school students and increases in property values in the neighborhoods where those improvements have occurred.

III. Measures of NYC Student Achievement, 2006-2012

Improvements in Statewide Test Scores by Students in NYC Public Schools, 2006-2012

As the Department of Education carried out the reforms, measures of student performance improved. From 2006 to 2012, mean ELA scale scores for students in grades three-through-eight increased 2 percent across the city, compared to 1 percent gains for all New York State public school students the same ages. While students from the Bronx and Brooklyn still lag state averages, unusually large shares of those students come from very disadvantaged households. Moreover, the largest improvements in ELA test scores occurred in public schools in the Bronx and Brooklyn, as well as Manhattan, with mean ELA scale scores up by 2.7 percent, 2.1 percent, and 1.8 percent, respectively. (Figure 1, below) As a result, the 2013 ELA test scores in four of the City's five boroughs are now on par with the state average.

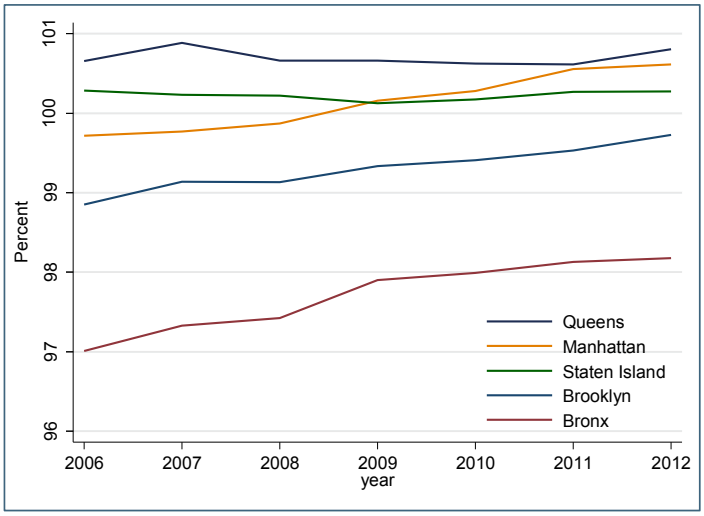
Figure 1: English Language Arts Test Scores by New York City Borough, Relative to New York State Averages, 2006-2012[21]



[21] Data, New York City Department of Education.

NYC public school students made even greater progress in their scores on New York State mathematics tests. From 2006 to 2012, the mean scale score for these NYC students rose 4 percent, compared to 3 percent gains for students at all New York State public schools. Again, students attending schools in the Bronx improved the most, with their scores increasing 4.5 percent, followed by students attending schools in Brooklyn and Manhattan, whose scores rose 4.2 percent. (Figure 2, below)

Figure 2: Mathematics Test Scores by Borough, Relative the New York State Averages, 2006-2012[22]



These improvements are especially striking given the large share of NYC public school students from low-income and minority backgrounds and/or who were considered to have only limited English proficiency, characteristics which place them at risk of low academic achievement. As noted earlier, this is particularly true for students from the Bronx and Brooklyn, which have much higher poverty rates than NYC overall. In 2012, 67 percent of all NYC public school students came from families whose incomes made them eligible for the free lunch program, compared to 43 percent statewide. Similarly, 69 percent of NYC public school students in 2012 were Hispanic or African-American, compared to 42 percent across the State. Finally, 15 percent were of NYC students were classified as "limited English proficient" (LEP), compared to 8 percent statewide.

The improvements in academic performance by NYC public school students from low income backgrounds during the years of the Bloomberg reforms are notable. Data from the New York State Education Department show that students in high-income school districts across the state – the 10 percent of districts with the smallest shares of students eligible for the free lunch program – scored an average of 86 percent on the State English Language Arts (ELA) tests and 88 percent on the State mathematics tests in the years 2006 to 2012. Over the same period, students in the lowest-income school districts statewide – the 10 percent of districts with the largest shares of students eligible for free lunches – scored an average of 83 percent on the ELA

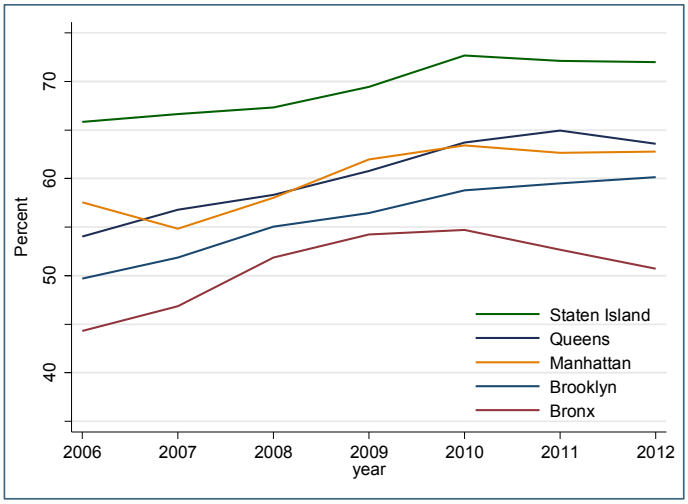
[22] Data, New York City Department of Education.

tests and 85 percent on the mathematics tests. Based on these averages and NYC's share of students from low-income backgrounds, students across New York City would have been expected to score about one percent below the statewide averages on both tests. By 2013, the actual gap between the averages for NYC students and students statewide was close to zero.

Improvements in the High School Graduation Rates of NYC Public School Students, 2006-2012

High school graduation rates provide another measure of student performance under the Bloomberg reforms. From 2006 to 2012, the four-year graduation rate for New York City public schools rose from 49.1 percent to 60.4 percent, or 11.4 percentage points.[23] The largest gains occurred in Brooklyn, where graduation rates increased 10.5 percentage points, and in Queens, where graduation rates rose 9.5 percentage points. (Figure 3, below) The increases in graduation rates since 2006 produced an additional 9,066 graduates in 2012. Moreover, these improvements coincided with increases in the requirements and standards for graduation, reflected in the number of Regents exams which students needed to pass in order to graduate. In addition, the share of NYC public high school students scoring passing grades on statewide Regents Examinations rose from 34 percent in 2006 to 58 percent in 2012.

Figure 3. Four-Year Graduation Rates by NYC Borough, 2006-2012[24]



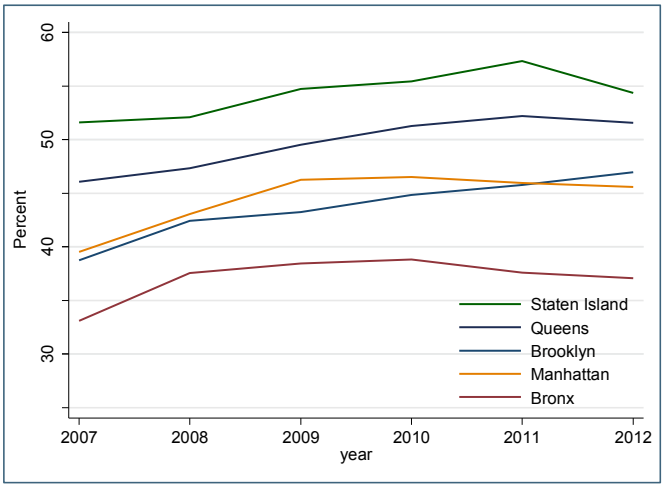
Improvements in College Enrollment Rates by NYC Public School Students, 2007-2012

Improvements in student performance under the Bloomberg reforms also are evident in rising rates of college enrollment by new graduates of NYC public schools. These data, provided mainly by the National Student Clearinghouse and CUNY, show that from 2007 to 2012, among students who began their ninth grade in NYC public schools, the percentage who enrolled in colleges after completing high school increased by nearly 6 percentage-points, from 40.5 percent to 46.4 percent. (Figure 4, below) Across the City, students from Brooklyn high schools made the most progress, with college enrollment rates up eight percentage points, from 38.8 percent in 2007 to 47.0 percent in 2012. College enrollment rates for public high schools in Manhattan rose

[23] These citywide data are not strictly comparable to data reported at the school or borough level due to the inclusion of alternative schools and out-of-district placement students.
[24] Data, New York City Department of Education.

6.1 percentage points, from 39.5 percent in 2007 to 45.6 percent in 2012. Citywide, increases in college enrollment since 2007 produced an additional 4,700 college enrollees in 2012.

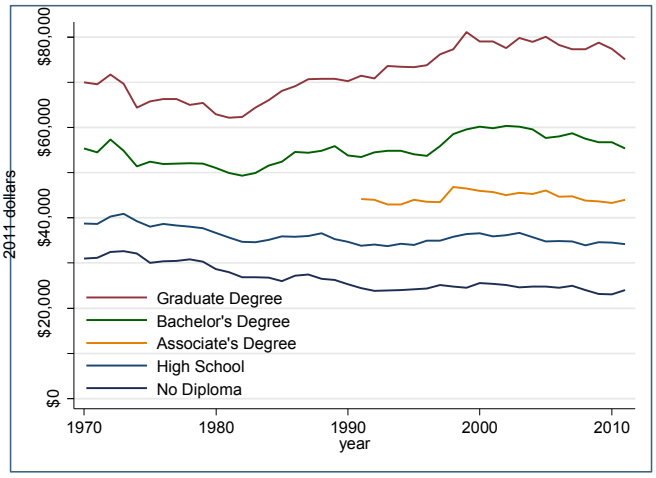
Figure 4: College Enrollment Rates by NYC Borough, 2007-2012[25]



IV. The Economic and Social Impact of Improved Student Performance

Over several decades, a large body of research has documented the relationship between educational attainment and socioeconomic outcomes, including wages and earnings, health status and criminal activity. Economists approach education as an investment in human capital: Individuals devote time and sometimes money, and government allocates funds, so that individuals can acquire skills and increase their productivity. The returns are measured by increased earnings.[26] Extensive analysis has shown that these returns are large: Better-educated workers earn substantially more than less-educated workers on a sustained basis. (Figure 5)

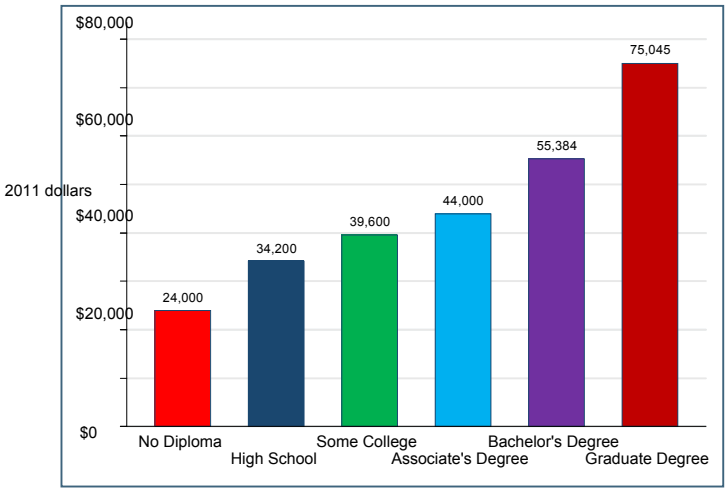
Figure 5. Median Personal Income by Education, 1970-2011 ($2011)



[25] Data, New York City Department of Education.
[26] The return also includes their incremental contribution to their employers' profits, which we ignore here.

According to 2011 data from the U.S. Census Bureau, the median annual income of a full-time worker without a high school degree was about $24,000, compared to some $34,000 for a full-time worker with a high school diploma and $55,000 for a full-time worker with a college degree. By these data, each additional year of education appears to boost median earnings by roughly 11 percent.

Figure 6: Median Personal Income by Education, 2011 ($ 2011)[27]



However, other factors such as family background and natural abilities also affect earnings; and some of those also independently affect educational achievement. For example, if people with greater ability tend to pursue more education than those with less ability, some of the correlation between education and earnings may simply reflect differences in ability rather than differences in education. Economists have developed a number of approaches to address this issue of "selection bias." For example, researchers have used data on identical twins to examine the impact of education on earnings.[28] The authors reason that identical twins with different levels of education are likely to closely resemble each other in native ability, family background and other variables that influence earnings. On this basis, they found that each additional year of education increased average earnings by 7 percent to 11 percent.

Other researchers use what economists call "instrumental variables" to measure the causal relationship between education and earnings. These "instruments" are variables which, in this case, are related to education, which here is the explanatory variable, but do not directly affect the relationship between education and income. For example, researchers observed that under compulsory schooling laws, students born late in the year stay in school longer, on average, than those born early in the year. Using the calendar quarter of birth as an instrumental variable for education, they found that each additional year of education increased earnings by 7 percent to 10 percent or nearly the same result found by researchers using data from identical twins.[29] In another study, the researcher posited that being raised near a college does not in itself affect earnings, but does increase a person's likelihood of attending college. Using proximity to

[27] Current Population Survey, U.S. Census Bureau.
[28] Ashenfelter and Krueger (1998)
[29] Angrist and Kreuger (1991).

a four-year college as an instrumental variable, the author also found that each additional year of education increased a person's earnings, on average, by 7 percent to 13 percent.[30]

In summary, economic researchers have found repeatedly a strong, positive relationship between education and earnings and estimate that each additional year of education raises a student's average earnings by 7 percent to 13 percent. This suggests that comparing the earnings of individuals at different levels of educational attainment can provide a reasonable approximation of the returns to education, which based on this literature is about 11 percent.[31]

The Social Returns to Education: The Impact on Crime Rates and Health Outcomes

The analyses described above, however, underestimate the total private returns to education, because they does not include or take account of the "external social returns" associated with education, which economists estimate can add an additional 1 percent to 3 percent.[32] These estimates are derived from a growing body of research which has shown that education, in addition to raising productivity and earnings, also produces other benefits by contributing to lower criminal behavior, improved health, and community development.

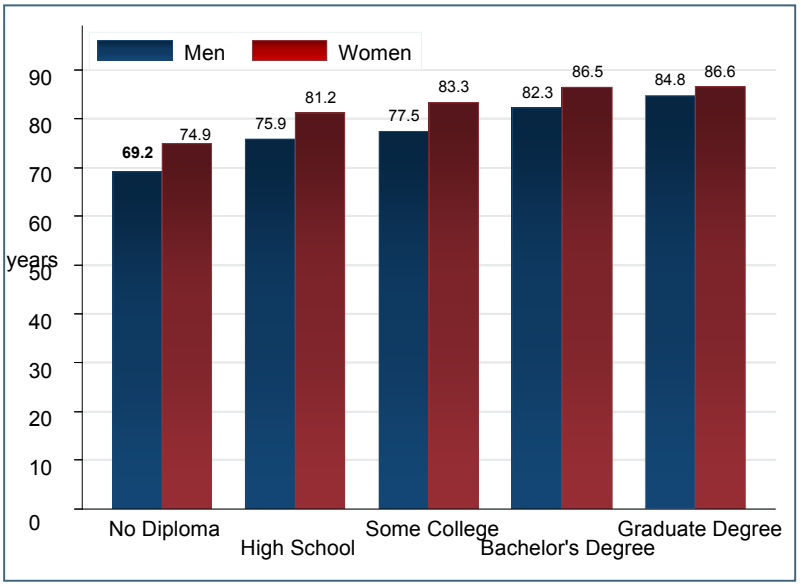
The relationship between crime and educational accomplishment, measured in years of education and graduation rates, is particularly robust. Economic theory suggests that people become less likely to engage in criminal activity as they acquire more education, because their education raises their returns from legitimate activities, which in turn increases both the opportunity costs of engaging in criminal behavior and the costs of getting caught. Improvements in education, therefore, should lead to less crime. The evidence confirms this insight: Improving educational outcomes is associated with lower crime. One leading study in this area found, for example, that a 10-percentage point increase in high school graduation rates was associated with a 6 percent to 7 percent reduction in arrests, an 8 percent decline in violent crimes, and 6 percent fewer property crimes.[33] The authors also found that graduating from high school reduces a person's probability of being incarcerated by three-to-four percentage points for young white men and by eight-to-nine percentage points for young African-American men.

Increased education is also strongly associated with positive health behaviors and outcomes. A recent study by the Centers for Disease Control reported that American adults with a high school diploma, on average, live six-to-seven years longer than those who drop out before graduation, and adults with a college degree live an average of five-to-six years longer than those with only a high school diploma. The researchers found that the difference in life expectancy between people who are highly educated and those with much lower levels of education can be as large as 15 years.[34] (Figure 7, below) Similarly, a recent study published in *Health Affairs* reported that between 1990 and 2008, the life expectancy of white Americans without a high

[30] Card (1995).
[31] In his review of the literature on the causal effect of education on earnings, Berkeley economist David Card (1993) concludes that such methods may produce a small upward bias on the order of about 10 percent.
[32] Acemoglu and Angrist (2000).
[33] Lochner and Moretti (2004).
[34] Rostron *et al*. (2010).

school diploma actually *fell,* from 72 years to 68.6 years for men (a 4.7 percent decline) and from 79.5 years to 74.2 for women (a 6.7 percent decline).[35]

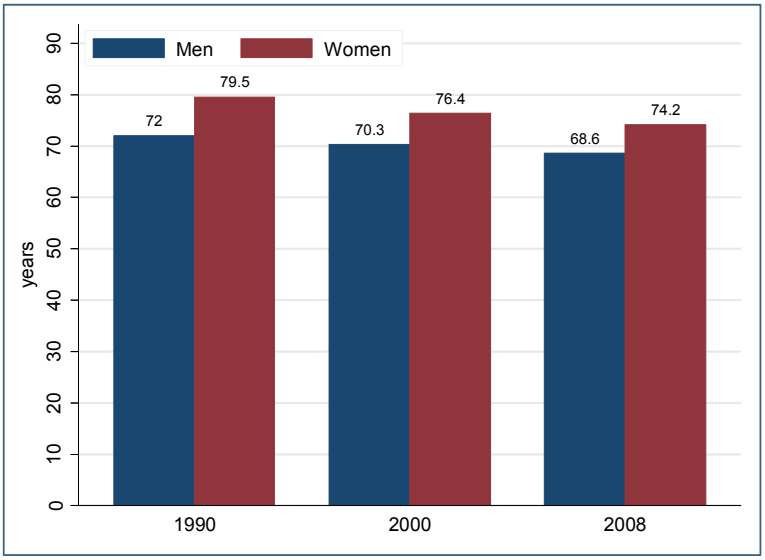
Figure 7: Life Expectancy of U.S. Adults at Age 25 by Educational Attainment, 2005[36]



Differences in health-related behaviors play an important role in determining these differences in life expectancy. For example, one recent study found that each additional year of education reduced the probability of a person smoking by two-to-four percentage points, the probability of a person becoming obese by one-to-1.4 percentage points, and the probability of a person being a heavy drinker by one-to-1.5 percentage points.[37] These associations persist even after controlling for income and a variety of other factors that can contribute to better health. The authors estimate that while income may account for some 20 percent of the relationship between education and health, as much as 30 percent of the relationship reflects cognitive capacities developed through education. In a similar vein, a recent study published in *Health Affairs* found that the life expectancy of white Americans without a high school diploma actually *fell* from 1990 to 2008, from 72 years to 68.6 years for men (a 4.7 percent decline) and from 79.5 years to 74.2 for women (a 6.7 percent decline).[38] (Figure 8, below)

[35] Olshansky *et al.* (2012).
[36] Rostron *et. al* (2010).
[37] Cutler and Lleras-Muney (2010).
[38] Olshansky *et al.* (2012).

Figure 8: Life Expectancy for U.S. Adults without a High School Diploma At Age 25, 1990, 2000 and 2008



V. The Impact of Improved Student Performance on NYC Graduating Seniors' Lifetime Incomes

In this section, we will estimate the lifetime income gains associated with the improvements in the high school graduation and college attendance rates of NYC public school students under the Bloomberg reforms. We start with data on median annual incomes by age and education for the years 2007 to 2011. The Census Bureau reports that in 2012, the median annual income for a full-time worker without a high school diploma was about $24,500 in 2011 dollars.[39] By comparison, the median income for a full-time worker with a high school diploma was about $34,000, and the median income for a full-time worker with a bachelor's degree was is about $55,400.[40]

These differences increase over time. (Table 1, below) Workers with high school diplomas initially earn about 23 percent more than those of the same age who dropped out of high school. By age 40, this gap widens to nearly 54 percent: A 40 year old full-time worker with a high school diploma earned about $35,852, compared to a full-time worker of the same age without a diploma, who earned $23,331 per year. By age 50, the median income of a full-time worker who graduated from high school is $37,921, an earnings premium of 43 percent over the $26,561 median income of high school drop outs at age 50. Similarly, college graduates initially earn nearly 58 percent more than high school graduates. By age 40, this earnings premium rises to 92.5 percent: A 40-year old full-time worker with at least a bachelor's degree typically earns $69,042 per year, while a full-time worker of the same age with a high school

[39] Current Population Survey, U.S. Census Bureau (2013).
[40] Bureau of Labor Statistics (2013).

diploma earns $35,852 per year.[41] By age 50, the wage premium for the median college graduate, compared to high school graduates, is 97.1 percent, at $74,757 compared to $37,921.

Table 1: Median Earnings by Age and Education, 2007-2011 Average, $ 2011[42]

Age	High School Dropout	High School Graduate	Some College	Associate's Degree	Bachelor Degree or More
25	$21,159	$26,058	$29,398	$32,308	$41,096
30	$21406	$30,091	$35,589	$37,308	$52,202
35	$22,331	$33,947	$40,246	$43,116	$62,719
40	$23,331	$35,852	$40,605	$43,116	$69,042
45	$24,762	$35,755	$44,037	$48,179	$72,807
50	$25,561	$37,921	$44,622	$51,866	$74,757
55	$26,773	$37,608	$46,481	$47,082	$72,909
60	$26,674	$37,370	$43,992	$48,825	$72,545
64	$28,519	$38,707	$47,472	$50,251	$75,117

To calculate the income benefits arising from the improvements in graduation and college attendance rates under the Bloomberg reforms, we start by estimating the present discounted value of the future earnings associated with each level of education. Following the academic literature, we adopt a discount rate of 3 percent and calculate that a high school dropout who works full-time from age 16 to 64 can expect future lifetime earnings valued today at $564,000.[43] Similarly, a high school graduate who works full-time from age 18 to 64 can expect future earnings valued today at about $782,000 or $218,000 more than a worker without a high school diploma. A student who completes high school, goes on to earn an associate's degree, and works full-time from age 21 to 64 can expect lifetime earnings valued today at $931,000, a premium of $149,000 over a high school graduate. Finally, a student earns at least a bachelor's degree and works full time from age 23 to 64 can expect future earnings valued today at about $1,275,000, a premium of $493,000 over a high school graduate.

Using these estimates, we calculate that based on expected future earnings, the present value of a high school diploma is $218,000, compared to the value of a high school education without a diploma. Similarly, the net present value of an associate's degree, after accounting for tuition, room and board, and other costs totaling $19,000, is about $130,000, compared to the value of a high school diploma. The additional net present value of completing at least a bachelor's degree, compared to the value of a high school diploma and after accounting for the estimated $67,000 cost of attending a four-year public college, is about $426,000.[44]

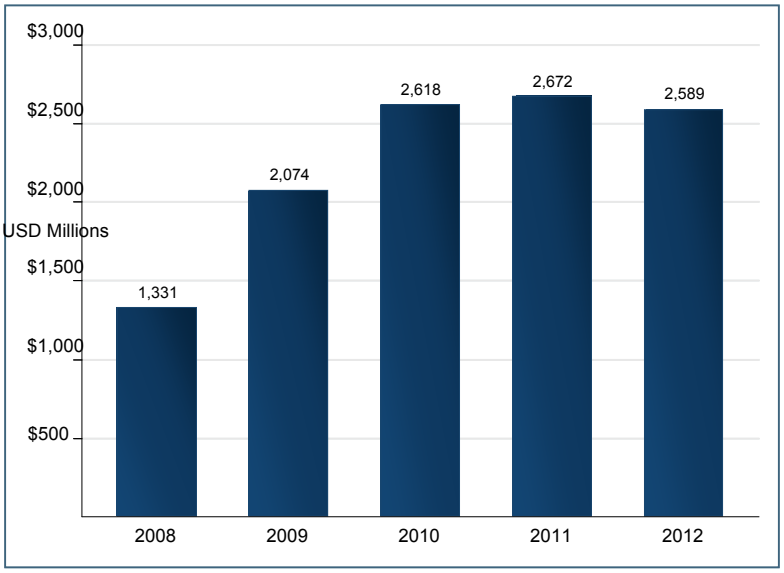
This analysis allows us to estimate the income benefits of improvements in student performance under the reforms implemented by Mayor Bloomberg. Between 2008 and 2012, the New York City public school system graduated more than 232,000 high school seniors or 41,000 more graduates than would have been expected assuming the graduation rates of 2006. The net

[41] Bureau of Labor Statistics (2013).
[42] US Census Bureau, Current Population Survey (2007-2011).
[43] Avery (2012).
[44] Our estimates of the cost of attending college are derived from Aud et al. (2013) which reported that in the 2010-2011 school year, first-time, full-time students paid an average net price of $16,820 at four-year institutions and $9,370 at two-year institutions.

present value of the additional income that these additional high school graduates should earn over their careers comes to $8.9 billion.

Similarly, from 2008 to 2012, roughly 177,500 graduating seniors from the New York City public school system went on to attend an institution of higher education, or 30,900 more college students than we would have expected based on rates of college enrollment for seniors graduating in 2006.[45] To estimate the additional income of these additional college enrollees, we also adjust the net present additional value of completing at least a bachelor's degree, $428,000, to reflect the share of new college students who attend and complete two-year and four-year institutions. The Bureau of Labor Statistics reports that in October 2012, 56.6 percent of high school graduates attending college were enrolled in four-year institutions and the remaining 43.4 percent were enrolled in two-year institutions.[46] Further, research has found that about 59 percent of full-time students attending four-year institutions earn their bachelor's degrees within six years, while the completion rate for students at two-year institutions is about 31 percent.[47] Using these findings, we estimate that 33.4 percent of new college attendees will go on to complete a bachelor's degree, 13.5 percent will complete an associate's degree, and the remaining 53.2 percent will obtain some higher education but fail to graduate. After applying these data to our earnings estimates, we find that the lifetime present value of enrolling in college is about $207,000. Thus, the net present value of the additional future earnings generated by the 30,900 additional NYC public school students who went on to enroll in college between 2008 and 2012 is approximately $6.4 billion.

Figure 9: Present Value of Additional Lifetime Earnings of NYC High School Graduates, By Year of Graduation, Based on Improved Student Performance Under the Bloomberg Reforms, ($ Millions)[48]



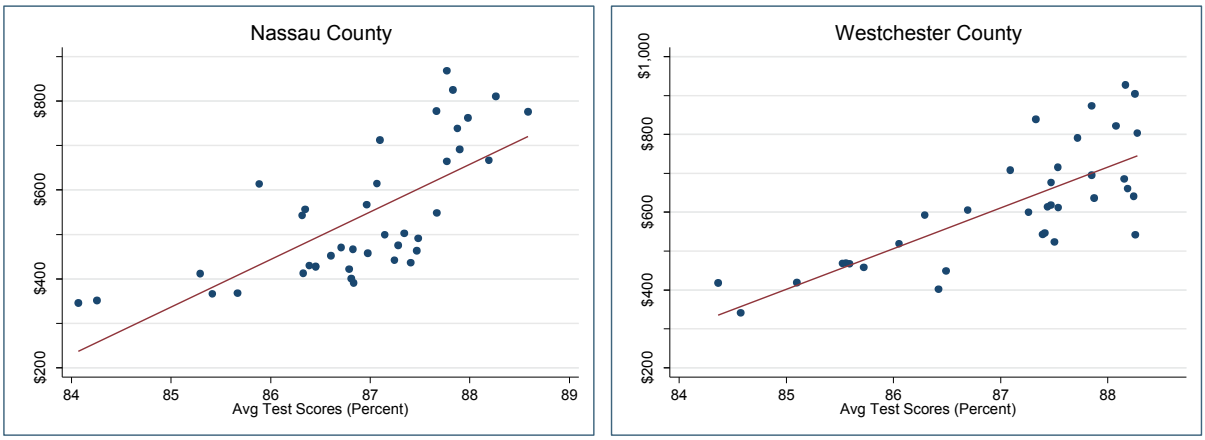
[45] College enrollment data by NYC public schools students are not available for 2006, so here we assume that graduating seniors in 2006 enrolled in college at the same rates as graduating seniors in 2007.
[46] BLS (2013).
[47] Aud *et al.* (2013)
[48] Authors' calculations.

All told, we find that the improvements in the graduation and college attendance rates of NYC public school students who finished high school in 2008 through 2012, under the Bloomberg reforms, will increase the net present value of their lifetime incomes by some $15.3 billion.

VI. The Impact of Improved Student Performance on NYC Property Values

The social returns to improved student performance are not limited to public safety and health. In addition, many families seek out neighborhoods with high-performing schools, and the increased demand for housing in those areas leads to rising property values. The relationship between school quality and housing prices is well established. Across the schools districts of Nassau County, New York, for example, we found that a one percent increase in a district's 2011 mean ELA and Mathematics test scores was associated with a 19.9 percent increase in housing prices in that district. (Figure 10A, below). Similarly, across the school districts of Westchester County, New York, a one percent increase in a school district's 2011 mean test scores was associated with an 18.2 percent gain in housing prices. (Figure 10B, below)

Figures 10A and 10B: Test Scores and Median Home Values by School District, Nassau County and Westchester County, 2011[49]



Research has shown that this relationship is not simply a correlation, but a causal link between school quality and nearby housing prices. In one influential study, researchers analyzed numerous school districts in Boston's suburbs to determine whether improvements in a district's state test scores in the years 1993 to 1995 influenced housing prices in the district.[50] To control for unobserved neighborhood characteristics that could be related to both school quality and housing, the author used a "regression discontinuity" design that compared housing prices on opposite sides of a school district's boundaries. The study found that an increase in test scores equal to one-standard deviation from median test scores was associated with a 2.1 percent increase in housing prices. Other researchers have produced similar findings. A 2004 study used data from several hundred Florida school districts on "letter grades" assigned to each public elementary school based on its students' test scores over the years 1999 to 2001, and found that

[49] New York State Department of Education; U.S. Census Bureau Community Survey.
[50] Black (1999).

schools with consistent "A" scores were associated with a housing premium of approximately 10 percent.[51] Similarly, a 2013 study analyzed data on test scores and housing prices in the United Kingdom from 2003 to 2006 and found that an improvement in test scores equal to one standard deviation was associated with a 3 percent increase in nearby housing values.[52] A review of the pertinent literature suggests that improving a school's student performance by one standard deviation generates nearby housing market returns on the order of 3 percent to 4 percent.

We continue this line of analysis by examining the relationship between improvements in the academic performance of NYC public school students and residential property values in the neighborhoods where those improvements occur. We approach this issue in two ways. First, we assess the extent to which rising high school graduation rates under the Bloomberg reforms have affected housing values. Second, we assess the extent to which NYC housing prices have been affected by the large increases in NYC charter schools and the students attending them.

Data and Methodology – Graduation Rates and Property Values

The first part of this assessment draws on data from the NYC Department of Education on annual graduation rates from NYC public high schools within four years by cohort from 2006 to 2012. We averaged the graduation rates of all public schools within each zip code after weighting each school by the size of its graduating cohort.[53] For housing prices or values, we used monthly median home sale prices by zip code as reported by DataQuick, a public-records database provider. DataQuick compiles these real estate data from public sources such as county assessors' offices and county recorders' offices, and provides monthly sale price information by zip code for new, existing, attached, and detached home sale transactions. The DataQuick monthly data cover the period from January 2004 to September 2013.

The graduation rates from NYC public schools increased gradually over the 2006-2012 period. The unweighted average across all NYC zip codes increased from 55.37 percent in 2006 to 59.6 percent in 2012. These numbers do not match the city-wide averages reported by New York State, because they are unweighted across zip codes and do not include alternative schools or students placed out-of-district.[54] A better measure of graduation rates across NYC zip codes weights each zip code for enrollment: By this measure, the graduation rate increased substantially more in this period, rising from 49.1 percent in 2006 to 60.4 percent in 2012. With regard to housing prices, as expected, the average median home sale price also generally increased over this period – although the effect of the financial and housing crisis is evident in the 2008 and 2009 data, when the median price dropped $45,166. Median prices rose again in 2011 and surpassed their pre-crisis levels in 2012.

A summary of the data is provided in Appendix A, including median home sale price, average graduation rates, and year-to-year changes in the annual averages of those variables. The Appendix presents the mean values across each zip code for each variable, the standard deviation, and the minimum and maximum values, all with regard to both the average for the

[51] Figlio *et al*. (2004).
[52] Gibbons et al (2013).
[53] We include only those schools that report graduation rates every year from 2006 to 2012. While this step alleviates reporting inconsistencies, it also removes schools that closed during this period.
[54] Officials may have access to reports from more schools than what we do.

entire period and for each year.[55] The sample for the graduation rate analysis covers 94 zip codes, and graduation rate and housing price data cover the years 2006 to 2012, with 84 periods covering each month of those years. Appendix A also provides a summary of the data for the charter school analysis, covering 198 zip codes, with 117 observations for each zip code for the months from January 2004 to September 2013.[56]

Our goal here is to test for any causal relationship between changes in the percentage of students graduating from NYC public schools and residential property values or prices. Later, we will also examine the impact of the large-scale increases in charter schools on property values, isolating those effects from the effects of overall graduation rates for all NYC public schools. One of the empirical challenges for this analysis involves identifying and excluding possible feedback effects. For example, a zip code's rising residential property prices might be associated with falling numbers of students from at-risk households, raising graduation rates. To isolate these effects and explore the causal relationship between only graduation rates and property values, we apply the "Granger causality test," a widely-used statistical regression model developed by Nobel Laureate Clive Granger. Granger's key insight was that one can test for the probability of a causal relationship between two related variables by using time series that incorporate lags for the dependent variable (here, housing prices).[57] Using this method, a time series for X (graduation rates) can be said to Granger-cause a time series for Y (housing prices), if the lagged values of X provide statistically-significant information about the future values of Y in a statistical analysis that also includes lagged values of Y as independent values.[58]

The main regression equation and its explication are provided in Appendix B. As noted, it includes a term for increases in the use of charter schools to segregate the effects of that variable.

Results – Graduation Rates and Property Values

The Granger analysis shows that raising the graduation rate of the public high schools in a NYC zip code by one percentage-point leads to, or Granger causes, an increase of 0.54 percent

[55] These measures will not match city-wide averages because our summary tables do not weight the zip codes.

[56] There are 68 zip codes where at least one charter school was located over the time period. DataQuick provided median home sale prices by month for 182 NYC zip codes. One was excluded for lack of adjacent observations.

[57] This insight in technical terms holds that recursive substitution of a dynamic system can reduce it to a bivariate system.

[58] While the analysis has many observations, given the large number of NYC public high schools, it also must rely on a panel with only eight years of annual data. Therefore, we also take steps to avoid "panel bias." Panel bias can occur because the lagged dependent variable is endogenous to the error term: If in period one, a zip code experiences a negative shock to the dependent variable that is not explicitly modeled, the error term will soak up the shock and the fixed effect for that geographical area will appear lower in every period. In period two, the lagged dependent variable and the fixed effect will both be lower, and so there will be a positive correlation between a regressor and the error, and the model is inconsistent. To account for this issue, we explore the Granger causality between public school graduation rates and property prices using the Arellano-Bover (1995) two-step generalized method of moments estimator, which is designed for dynamic panel analysis with few time periods but many individuals, or in this case, zip codes. See Arellano, M., and O. Bover (1995) and Arellano, M., and S. Bond (1991). We implement the Arellano-Bonds estimator using the Stata program xtabond2, developed by David Roodman and described in Roodman (2006).

in the residential property values of that zip code the following year.[59] The full specification of these results is also provided in Appendix B.

We estimate the magnitude of the the actual effects on NYC housing prices of improvements in the graduation rates observed over the seven year period, but we should note that these estimations require some assumptions. We assume, first, that the relationship between graduation rates and residential property prices is linear even as both measures increase over short periods of time. Since our residential price data come from sales of attached and detached single family homes, we also assume that the effects observed in those properties apply to all residential property designated by New York City as Class 1 and Class 2. Finally, we assume that positive effects in a zip code are not offset by negative effects in other zip codes.[60]

Based on the NYC 2013/2014 Tentative Assessment Roll, the full market value of all Class 1 and Class 2 residential properties across the City in early 2013 was $608.3 billion.[61] Earlier, we found that the overall high school graduation rate, based on the graduation rates of each high school weighted for its enrollment, increased from 49.1 percent in 2006 to 60.4 percent in 2012, a gain of 11.3 percentage-points. Based on the Granger causality analysis, we calculate that the 11.3 percentage-point increase in graduation rates would be expected to lead to a 6.1 percent increase in residential property values, compared to what those values would otherwise have been had graduation rates not improved.[62]

At current housing prices, we estimate that the improvements in high school graduation rates under the Bloomberg reforms would be expected to have added $37.1 billion to NYC residential property value.

Data and Methodology – Charter Schools and Property Values

The second part of this assessment also draws on data from the NYC Department of Education covering NYC charter schools by zip code location, district borough number, grades served, and the date when each school opened and, if applicable, closed.[63] For housing prices, we use the same data on monthly median home sale prices provided by DataQuick that we relied upon for the graduation rate analysis.

---

[59] This estimate is statistically significant at the 10 percent level; and if data from 2005 are included in the analysis, the result coefficient is nearly unchanged while the significance level improves to 5 percent. We did not include 2005 in the main specification to maintain consistency with the other analyses conducted for this study.

[60] The analysis also assumes that effects arising throughout the years would be the same if they occurred all at once.

[61] http://www.nyc.gov/html/dof/downloads/pdf/13pdf/ta_roll_summary_fy14.pdf

[62] 11.3 * 0.00544, or the percentage point increase in graduation rates times the effect of a one percentage point increase.

[63] To test the quality of our data we matched those data with public records of the NYCCSC. In addition to confirming the 183 charter schools currently operating in NYC, we drew data for nine additional schools that closed over the period from the NYCCSC. For their data see http://www.nyccharterschools.org/download-raw-data. There are some additional discrepancies between the two datasets. The NYCCSC provides the year each school opened, but only indicates the season that the school opened rather than the month—all schools are listed as opening in autumn. Those records do not always match our primary data, which specify the day, month and year of each charter school opening. One explanation may lie in the definition of the "opening date:" Each charter school sets its own application deadline, with many requiring submissions before April 1st. See http://www.nyccharterschools.org/enrollment-faq#9. Our primary data, therefore, may reflect when a school first accepted applications or when those applications were first due. The NYCCSC data, however, likely specifies the start of the school's first school year.

This analysis focuses on increases in the number of charter schools by zip code from 2004 to 2013, and explores whether these changes led to rising residential property values in the same zip code. Unlike the graduation rate analysis, we have monthly data available on the number of charter schools and exploit the additional variation this expanded dataset provides. While the number of charter schools citywide and the average number per zip code both increased steadily over this period, these data may underestimate the extent of charter school growth. For example, charter schools often begin with one grade level and grow by one additional grade level per-year in subsequent years.[64]

The empirical challenge is to test for any causal effects on residential property prices or values arising from the introduction and exit of charter schools in the same zip code. Once again, we have to isolate or exclude possible feedback or opposite effects. For example, residential property prices might lead to an increase in demand for non-traditional school choices, and thereby lead to new charter schools within the public school system, as distinct from increased numbers of charter schools leading to an increase in demand for housing nearby, which in turn leads to higher housing prices. Here again, we use the Granger causality test to identify any causal relationship between increases in charter schools and increases in nearby property prices. The linear panel regression equation with the specifications we used to test whether changes in the number of charter schools affected NYC residential property prices is provided in Appendix C.

The Granger analysis shows that much like graduation rates, the 12-month lagged value of changes in the number of charter schools can explain changes in residential property values with a high degree of statistical significance and confidence. The results show that adding one charter school in a NYC zip code, on average, will lead to or Granger cause a 3.84 percent increase in the value of residential properties in that zip code area over the following year.[65] The full specification of these results is also provided in Appendix C.

To estimate the actual effects of the expansion of NYC charter schools and their enrollments requires the same assumptions as our analysis of graduation rates. We assume here that the relationship between charter schools and residential property prices is linear, even as both measures increase over short periods of time. Once again, the residential price data come from sales of attached and detached single family homes, so we also assume again that the effects observed in those properties apply to all Class 1 and Class 2 residential property. And finally, we assume that positive effects in a zip code are not offset by negative effects in other zip codes.[66]

Once again, the full market value of all Class 1 and Class 2 residential properties across New York City in early 2013 came to $608.3 billion. The number of NYC charter schools climbed from 14 in 2001, just before the Bloomberg administration took office, to 183 in 2013. This constitutes an increase of 169 charter schools, or an average of or 0.96 schools per zip

[64] http://www.nyccharterschools.org/enrollment-faq

[65] This result is significant at the 5 percent level. The coefficient for the charter school analysis is somewhat higher here than in the graduation rate analysis, where this variable was included as a control. This could be due to the different sample length and inclusion of monthly variations.

[66] Here, again, we assume that changes occurring over several years would have the same effect if they occurred all at once.

code.[67] We estimate the value of that change by applying the coefficients from the regression analysis described above and specified in Appendix C. We find that the actual increase in the number of NYC charter schools would be expected to lead to or Granger cause a 3.69 percent increase in NYC residential property prices and values.[68] Based on early-2013 housing values, we estimate that the expansion of charter schools and their enrollments under the Bloomberg reforms would be expected to have added $22.45 billion to NYC residential property values.

Looking ahead, this analysis suggests that adding one charter school per zip code in the future could add roughly $23.36 billion to the value of residential property citywide, and each percentage-point increase in high school graduation rates could increase those property values by another $3.3 billion.

VII. Conclusions

Educational reform has been a major theme and focus of New York City Mayor Michael Bloomberg. In 2002, Bloomberg secured expanded authority over the City's public schools; and since then, he and the chancellors of the NYC school system put in place a series of substantial changes. These changes included expanded discretion for school administrators and teachers over the operations of their schools, supported by additional funding, in exchange for greater accountability for their success or failure in improving their students' academic performance. In this effort, many low-performing schools were closed and many more new schools were opened. The Bloomberg reforms also included a broad expansion of school choice for NYC public school students and their families, enhanced by the addition of nearly 200 new charter schools. This combination of greater accountability and enhanced choice increased the competition for students among schools, especially since funding followed the students.

This study examined, first, whether the academic performance of NYC public school students improved to a significant degree under these reforms; and second, whether those improvements have or can be expected to generate any significant economic benefits. The data and analysis show that the answer to both questions is yes.

We found, first, that student performance improved substantially under these reforms. The share of NYC public school students who graduated from high school within four years increased from 49.1 percent in 2006 to 60.4 percent in 2012. As a result, 41,000 more NYC students earned high school diplomas from 2008 to 2012 than would have occurred if high school graduation rates had remained at 2006 levels. In addition, the share of the NYC public school cohort who went on to attend college increased substantially: From 2008 to 2012, some 30,900 more NYC high school students enrolled in colleges and universities than would have occurred if the college enrollment rates of NYC students had remained at 2006 levels. Moreover, there is evidence that these improvements did not coincide with a decline in standards, as the scores of NYC public schools students on statewide English language and Mathematics tests improved at rates significantly greater than those for all students across New York State. The percentage of NYC public high school students who passed the statewide

[67] http://c4258751.r51.cf2.rackcdn.com/state-of-the-sector-2012.pdf

[68] 0.96*0.0384, or the average number of charter schools added by zip code, times effect of a new charter school in a zip code in about one year.

Regents Examinations also increased sharply over this period, rising from 34 percent in 2005 to 58 percent in 2012.

We further found that these improvements in the academic performance of NYC public school students under the Bloomberg reforms have produced, or can be expected to produce large economic benefits. It is well established that students who receive a high school diploma earn substantially more than those who drop out of high school. This income premium associated with earning a high school diploma has a lifetime net present value of $218,000. Based on this premium, the net present value of the additional income that the 41,000 additional NYC students who earned a diploma from 2008 to 2012 can expect to earn over their lifetimes totals $8.9 billion. Similarly, students who enroll in college earn substantially more than those who end their education with a high school diploma. The income premium associated with attending college has a lifetime net present value of $207,000. Based on this premium, the net present value of the additional income that the 30,900 additional NYC students who enrolled in college from 2008 to 2012 can expect to earn over their lifetimes totals another $6.4 billion.

All told, the improvements in the academic performance of NYC public school students graduating from 2008 to 2012 should produce additional lifetime income with a net present value of $15.3 billion.

These improvements in student performance under the Bloomberg reforms also have increased residential property values in the NYC zip codes where the greatest improvements occurred, as families began to favor neighborhoods with higher-performing schools. We found that each additional percentage-point increase in high school graduation rates across zip codes increased the overall value of NYC residential properties by $3.3 billion. We estimate that a change of the magnitude of the actual improvements in NYC high school graduation rates from 2008 to 2012, compared to 2006, would be expected to add about $37.1 billion to NYC residential property values. We further found that the expansion of charter schools also increased those property values, independent of their effect on high school graduation rates. We estimate that a change of the magnitude of the actual expansion of NYC charter schools would be expected to increase NYC residential property values by $22.45 billion.

This study demonstrates, therefore, that the academic performance of NYC public school students improved substantially under the Bloomberg reforms. The analysis further finds that those improvements have produced substantial increases in NYC residential property values and should be expected to produce substantial increases in the lifetime incomes of NYC public school students.

Appendix A

Summary Statistics

Table A-1, below, provides summary data for the variables used in the Granger causality regression analyses -- median home sale prices, average graduation rates, and numbers of charter schools. Table A-2 presents year-to-year changes of the annual average of the same variables. The entire sample covers 182 zip codes.[69] The graduation rate analysis draws on data for 94 zip codes and covers graduation rates from 2005 to 2012. For the charter school analysis, each zip code has 117 observations covering the months from January 2004 to September 2013.

Table A-1 presents the mean values across zip codes for each variable, the standard deviation, and minimum and maximum values, both for the average over the entire period and for each year included in the analysis.[70] Table A-2 presents changes in each variable by year.

The average median home sale price increased over the entire period. The effect of the housing crisis is clear between 2008 and 2009, when the median price dropped by $45,166. By 2011, median prices began to increase again, and they surpassed their pre-crisis levels in 2012. Public school graduation rates also increased steadily over the period, with the unweighted average across zip codes increasing from 56.14 percent in 2005 to 59.57 percent in 2012. These numbers do not precisely match the city-wide averages reported by New York State, since we report averages across zip codes rather than strictly citywide numbers, and we do not include alternative schools.[71] The citywide weighted average across zip codes, which takes account of differences across zip codes in total cohort size, showed an increase from 52.17 percent of high school seniors in 2005 to 60.43 percent of seniors in 2012. Finally, the average number of charter schools increased steadily over the period. As noted in the text, these numbers underestimate the extent of charter school growth, since charter schools often open with classes for only one grade and then expand by one grade per-year subsequently.[72]

Table A-1 and Table A-2 follow, below

[69] There are 68 zip codes with at least one charter school during the time period. There are median home sale prices for every zip code in NYC. One zip code is excluded in the regressions due to a lack of adjacent monthly observations.
[70] These measures will not match city-wide averages because our summary tables do not weight the zip codes.
[71] The official reports may also have access to reports from more schools than what we can access.
[72] http://www.nyccharterschools.org/enrollment-faq

Table A-1: Summary Statistics – Entire Period

Year	Observations	Mean	Std. Deviation	Minimum	Maximum
Median Home Sale Price ($)					
Average	2,021	$486,270.66	$510,551.05	$32,440.80	$13,061,723.50
2004	2,006	$403,302.10	$236,560.60	$42,626.00	$3,250,000.00
2005	2,092	$478.381.80	$1,782,378.00	$25,360.00	$70,800,000.00
2006	2,102	$480,546.10	$290,152.80	$50,000.00	$4,834,500.00
2007	2,096	$504.837.40	$286,744.40	$36,390.00	$2.975.835.00
2008	2,112	$509.823.90	$356,009.30	$29,000.00	$4,859,112.00
2009	2,048	$464.657.90	$351,379.80	$26,000.00	$5,720,288.00
2010	2,085	$462,924.40	$320,690.60	$26,762.00	$3,182,500.00
2011	2,091	$470,477.50	$339.537.90	$25,000.00	$2,750,000.00
2012	2,054	$521.760.20	$743,294.50	$33,000.00	$28,900,000.00
2013	1,523	$565,995.30	$398,732.60	$30,000.00	$3,345,000.00
Number of Charter Schools					
Average	2,317	0.45	1.00	0	5.80
2004	2,376	0.14	0.43	0	3.00
2005	2,376	0.20	0.57	0	4.00
2006	2,376	0.26	0.68	0	4.00
2007	2,376	0.30	0.72	0	4.00
2008	2,376	0.35	0.83	0	5.00
2009	2,376	0.45	1.01	0	6.00
2010	2,376	0.58	1.21	0	7.00
2011	2,376	0.66	1.34	0	7.00
2012	2,376	0.74	1.50	0	8.00
2013	1,782	0.84	1.67	0	10.00
Graduation Rate for Cohort					
Average	9.024	58.28	18.67	0.00	100.00
2005	1,128	56.14	19.43	0.00	100.00
2006	1,128	55.37	18.77	2.56	96.02
2007	1,128	56.45	18.33	8.96	97.25
2008	1,128	57.57	18.03	8.16	97.84
2009	1,128	59.94	18.16	11.11	96.54
2010	1,128	61.21	17.92	12.00	98.35
2011	1,128	59.98	18.45	12.26	98.67
2012	1,128	59.57	19.35	3.85	98.52

Table A-2: Changes in Median Home Sale Prices, Graduation Rates, and Charter Schools

Year	Mean	Change
Median Home Sale Price		
2004	$403.302.10	--
2005	$478,381.80	$75,079.70
2006	$480,546.10	$2,164.30
2007	$504,837.40	$24,291.30
2008	$509,823.90	$4,986.50
2009	$464,657.90	($45,166.00)
2010	$462,924.40	($1,734.00)
2011	$470,477.50	$7,553.10
2012	$521,760.20	$51,282.70
2013	$565,995.30	$44,235.10
Graduation Rate for Cohort		
2005	56.14	--
2006	55.37	- 0.77
2007	56.45	1.08
2008	57.57	1.12
2009	59.94	2.37
2010	61.12	1.27
2011	59.98	- 1.23
2012	59.57	- 0.41
Number of Charter Schools		
2004	0.14	--
2005	0.20	0.06
2006	0.26	0.06
2007	0.30	0.03
2008	0.35	0.05
2009	0.45	0.10
2010	0.58	0.13
2011	0.66	0.08
2012	0.74	0.09
2013	0.84	0.10

Appendix B

Granger Regression Equation and Explication for the Relationship between NYC Graduation Rates and NYC Property Values

(1) $\Delta(\log(\text{Residential Property Price}_{it})) = \beta_1 \bullet \Delta(\log(\text{Residential Property Price}_{i(t-1)})) + \beta_2 \bullet \Delta(\text{Charter Schools}_{i(t-1)}) + \beta_3 \bullet \Delta(\text{Graduation Rate}_{(t-1)}) + \gamma_t + \Delta\, \varepsilon_{it}$

The dependent variable in this specification is $\Delta(\log(\text{Median Residential Property Prices}_{it}))$, the log differences of residential property price for zip code *i* at time *t*. The independent variables are the lagged value of the dependent variable; the lagged values of $\Delta(\text{Graduation Rate}_{it})$, the differenced percent of four-year graduation rates by zip code and cohort; and the lagged values of $\Delta(\text{Charter Schools}_{i1})$, the average number of charter schools in a zip code by year. Time-specific fixed effects are captured by γ_t, however they are dropped in the regression tables.

The difference transformation eliminates fixed effects, but the independent variables are still potentially endogenous and so we draw instruments from within our dataset by using a system GMM specification. The year dummy variables are assumed to be strictly exogenous and included as IV style instruments, or in other words, we use the year dummy variables as their own instruments. Since we expect the first lag of differences to be correlated with the second lag of levels, we only include lags three deep and greater in our instrument matrix. We also employ small-sample adjustments and corrected standard errors.

Results for the Granger Regression Analysis of NYC Graduation Rates and Property Values

VARIABLES	$\Delta(\log(\text{Residential Property Price})_{it})$
$\Delta(\log(\text{Residential Property Price}_{i\,(t-1)}))$	0.7676***
	(0.16394)
$\Delta(\text{Graduation Rate}_{(t-1)})$	0.005267**
	(0.002516)
$\Delta(\text{Charter Schools}_{i\,(t-1)})$	.01956
	.01228
Observations	749
Number of zip codes	94
Number of instruments	89
AR(1)	0.039
AR(2)	0.050
Hansen	0.273
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Appendix C

Granger Regression Equation and Explication for the Relationship between NYC Charter Schools and Property Values

$$\Delta(\log(\text{Residential Property Prices}_{it})) = B_1 * \Delta(\log(\text{Residential Property Prices}_{i(t-2)}) + B_2 * \Delta(\text{Charter Schools}_{i(t-2)}) + y_t + \Delta e_{it}$$

In this Granger causality test, the dependent variable is Δ(log(Residential Property Prices$_{it}$)), the log 12-month difference of residential sales prices for zip code *i* at time *t*. The independent variables are the lagged log 12-month difference in residential property price for zip code i at time t-2, Δ(log(Residential Property Pricesi$_{(t-2)}$); the lagged 12-month difference in the number of charter schools for zip code i at time t-2, Δ(Charter Schools$_{i(t-2)}$). Differences are taken since the panel is non-stationary, and long differences are used to control for zip code fixed effects. This design takes into account the possibility that something unobserved about a given zip code leads to both increased property prices and increased numbers of charter schools. The semi-log specification allows us to identify the effect of discrete changes in the number of charter schools. Time-specific fixed effects are captured by γ_t to account for the extreme cyclicality of housing prices. Our specification also uses Eicker-Huber-White hetero-skedastic-consistent standard errors to account for the fact that charter schools do not have uniform effects across a zip code.

Results for the Granger Regression Analysis of NYC Charter Schools and Property Values

Variable	**Δ (log (Employment))**
Δ(log(Residential Property Prices$_{i(t-2)}$)	0.13833***
	(0.01823)
Δ(Charter Schools$_{i(t-2)}$)	0.0384***
	(0.01445)
Constant	0.1012
	(0.02661)
Observations	16799
R-Squared	0.0675
Robust Standard Errors in parenthesis	
*** p < 0.01; ** p< 0.56; * p < 0.1	

References

Acemoglu, Daron, and Joshua Angrist. "How Large Are Human-Capital Externalities? Evidence from Compulsory Schooling Laws." *NBER Macroeconomics Annual*, 15 (2000): pp. 9–59.

Avery, Christopher, and Sarah Turner. "Student Loans: Do College Students Borrow Too Much—Or Not Enough?" *Journal of Economic Perspectives*. 26.1 (Winter 2012): 165–192.

Angrist, Joshua D., and Alan B. Krueger. "Does Compulsory School Attendance Affect Schooling and Earnings?" *The Quarterly Journal of Economics*. 106.4 (Nov. 1991): 979–1014.

Arellano, M., and S. Bond, (1991). "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *Review of Economic Studies* 58: 277–97.

Arellano, M., and O. Bover, (1995). "Another look at the instrumental variables estimation of error components models." *Journal of Econometrics* 68: 29–51.

Ashenfelter, Orley, and Cecilia Rouse. "Income, Schooling, and Ability: Evidence from a New Sample of Identical Twins." *The Quarterly Journal of Economics*. 113. 1 (Feb. 1998): 253–284.

Aud, S., Wilkinson-Flicker, S., Kristapovich, P., Rathbun, A., Wang, X., and Zhang, J. *The Condition of Education 2013*. U.S. Department of Education, National Center for Education Statistics. Washington: 2013 (http://nces.ed.gov/pubs2013/2013037.pdf).

Black, Sandra E. "Do Better Schools Matter? Parental Valuation of Elementary Education." *The Quarterly Journal of Economics*. 114.2 (1999): 577–599.

Card, David. "Using Geographic Variation in College Proximity to Estimate the Return to Schooling." NBER Working Paper No. 4483, National Bureau of Economic Research, October 1993.

Card, David. "The Causal Effect of Education on Earnings." In Orley Ashenfelter and David Card, editors, *Handbook of Labor Economics* Volume 3A. Amsterdam: Elsevier, 1999.

Center for Research on Educatiuonal Outcomes (CREDO), (2009). "Multiple Choice: Charter School Performance in 16 states." Stanford University. Stanford, CA. http://credo.stanford.edu/reports/MULTIPLE_CHOICE_CREDO.pdf .

Childress, Stacey, Monica Higgins, Ann Ishimaru and Sola Takahashi (2011). "Managing for Results at the New York City Department of Education." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 87-109). Cambridge: Harvard University Press.

Corcoran, Sean and Henry Levin (2013). "School Choice and Competition in the New York City Schools." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 199-225). Cambridge: Harvard University Press

Cutler, David M., and Adriana Lleras-Muney. "Understanding Differences in Health Behaviors by Education." *Journal of Health Economics*. 29.1 (Jan. 2010): 1–28.

Dobbie, Will, and Roland Fryer, Jr., (2009). "Are High Quality Schools Enough to Close the Achievement Gap? Evidence from a Social Experiment in Harlem." NBER Working Paper No. 15473. http://www.nber.org/papers/w15473.

Figlio, David N., and Maurice E. Lucas. "What's in a Grade? School Report Cards and the Housing Market." *The American Economic Review*. 94.3 (Jun. 2004): 591–604.

Gibbons, Stephen, Stephen Machin, and Olmo Silva. "Valuing School Quality Using Boundary Discontinuities." *Journal of Urban Economics*. 75 (2013): 15–28.

Goertz, Margaret, Susanna Loeb and Jim Wyckoff (2011). "Recruiting, Evaluating and Retaining Teachers: The Children First Strategy to Improve New York City's Teachers." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 157-181). Cambridge: Harvard University Press

Hill, Paul T., (2011). "Leadership and Governance in New York City School Reform." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 17-33). Cambridge: Harvard University Press

Hoxby, Caroline M., and Sonali Murarka (2009). "Charter Schools in New York City: Who Enrolls and How They Affect Their Students' Achievement," NBER, Working Paper No. 14852. http://www.nber.org/papers/w14852.

Kemple, James J., (2013). "Children First and Student Outcomes: 2003-2010." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 288). Cambridge: Harvard University Press

Lochner, Lance. "Non-Production Benefits of Education: Crime, Health, and Good Citizenship." NBER Working Paper No. 16722, National Bureau of Economic Research, January 2011.

Meyer, Peter, (2008). "New York City's Education Battles: The mayor, the schools, and the "rinky-dink candy store." *Education Next*, Spring 2008, Vol. 8, No. 2. http://educationnext.org/new-york-citys-education-battles /.

Moretti, Enrico. "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data." *Journal of Econometrics*. 121 (2004): 175–212.

New York City Department of Education (2013). "About Us." http://schools.nyc.gov/AboutUs/default.htm .

New York City Charter School Center, http://www.nyccharterschools.org/.

O'Day, Jennifer A., and Catherine Bitter, (2011). "Improving Instruction in New York City: An Evolving Approach." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 109-131). Cambridge: Harvard University Press

Olshansky, S. Jay Toni Antonucci, Lisa Berkman, Robert H. Binstock, Axel Boersch-Supan, John T. Cacioppo, Bruce A. Carnes, Laura L. Carstensen, Linda P. Fried, Dana P. Goldman, James Jackson, Martin Kohli, John Rother, Yuhui Zheng and John Rowe. "Differences in Life Expectancy Due To Race and Educational Differences Are Widening, and Many May Not Catch Up." *Health Affairs*. 31.8 (2012):1803–1813.

Reardon, S.F. (2009). Review of "How New York City's Charter Schools Affect Achievement." Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit. http://epicpolicy.org/thinktank/review-How-New-York-City-Charter

Rostron BL, Boies JL, Arias E. Education Reporting and Classification on Death Certificates in the United States." National Center for Health Statistics. Vital and Health Statistics. 2.151 (2010).

Siskin, Leslie, (2011). "Changing Contexts and the Challenge of High School Reform in New York City." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 181-199). Cambridge: Harvard University Press.

Stiefel, Leanna and Schwartz, Ammy Ellen, (2011). ""Financing K-12 Education in the Bloomberg Years, 2002-2008." ." In O'Day, Jennifer A., et. al. (Eds.), *Education Reform in New York City: Ambitious Change in the Nation's Most Complex School System* (pp. 55-87). Cambridge: Harvard University Press.

U.S. Bureau of Labor Statistics. "College Enrollment and Work Activity of High School Graduates." Washington: 2013. (http://www.bls.gov/news.release/archives/hsgec_04172013.htm).

Weiss, Elaine and Don Long, (2013). "Market-oriented education reforms' rhetoric trumps reality." Economic Policy Institute. http://www.epi.org/files/2013/bba-rhetoric-trumps-reality.pdf.

Zimmer, Ron, Brian Gill, Kevin Booker, Stephane Lavertu, Tim Sass and John Witte (2009). "Charter Schools in Eight States." Rand Corporation. http://www.rand.org/content/dam/rand/pubs/monographs/2009/RAND_MG869.pdf

About the Authors

Robert J. Shapiro is the chairman of Sonecon, LLC, a private firm that advises U.S. and foreign businesses, governments, and non-profit organizations on market conditions, economic policy, and security-related issues and policies. He is also a Senior Fellow of the Georgetown University McDonough School of Business, an advisor to the International Monetary Fund, director of the NDN Globalization Initiative, and chairman of the U.S. Climate Task Force. From 1997 to 2001, Dr. Shapiro was Under Secretary of Commerce for Economic Affairs. Prior to that, he was co-founder and Vice President of the Progressive Policy Institute, and Legislative Director and Economic Counsel for Senator Daniel P. Moynihan. Dr. Shapiro holds a Ph.D. and M.A. from Harvard University, a M.Sc. from the London School of Economics and Political Science, and an A.B. from the University of Chicago.

Kevin A. Hassett is Director of Economic Policy Studies and Resident Scholar at the American Enterprise Institute (AEI). Before joining AEI, Dr. Hassett was a senior economist at the Board of Governors of the Federal Reserve System and an associate professor at the Graduate School of Business of Columbia University. He also served as a policy consultant to the U.S. Department of the Treasury during both the former Bush and Clinton administrations. Dr. Hassett is also a member of the Joint Committee on Taxation's Dynamic Scoring Advisory Panel, and an affiliate of Sonecon, LLC. He holds a B.A. from Swarthmore College and a Ph.D. from the University of Pennsylvania.