

# Projected Enrollments for the Springfield School District

June 15

# 2014

Grade progression ratios have been very stable the past five years and there is little evidence that the basic demography of the school district has changed. But there are many more children in the early elementary school grades, fueled by unprecedented increases in the size of the kindergarten. It is most likely that this results from higher participation rates among families already in the district, not a rejuvenation of the district's population. These points are elaborated in detail, and new projections are provided that take into account these greater rates of participation at the beginning of school. Eventual high school enrollments are further from their expected peak than are elementary and middle school enrollments; but the expansion in these high school enrollments will not occur for a number of years, until the current early elementary school enrollments have worked their way up through the system.

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Planning for future enrollments in the Springfield School District involves two inter-related issues:

- The demography of the school district
- The usefulness of the standard forecasting method

We will come to the demography of the school district by first considering the usefulness of the standard forecasting method. Although something has clearly changed with respect to enrollment in the Springfield School District — early elementary enrollments have surged — this does not appear to be related to the underlying demography of the area (*i.e.*, population size, migration, age distribution, fertility). If anything, the year-to-year predictability of enrollments from the existing school-age population is more stable than it has ever been in the district.

### The 2008 Projections: What Went Wrong (and What Went Right)

Table 1 shows the amount of error in predictions for the five academic years since the 2008 report, grade by grade; for elementary (K-4), middle (5-8), and high (9-12) school; and in total. Parenthesized numbers in red mean that the 2008 report *underestimated* the number of students.

**Table 1. Over (or Under) Estimates of Observed October Enrollments: 2009-10 to 2013-14**

Grade	Actual Error					Error if Kindergarten Entries Known				
	09-10	10-11	11-12	12-13	13-14	09-10	10-11	11-12	12-13	13-14
K	(7)	(37)	(59)	(48)	(64)	0	0	0	0	0
1	(10)	(31)	(42)	(47)	(33)	(10)	(19)	7	9	9
2	2	(4)	(34)	(43)	(53)	2	(4)	(21)	8	6
3	(2)	3	(2)	(31)	(33)	(2)	3	(2)	(18)	20
4	7	2	8	11	(22)	7	2	8	11	(8)
5	(3)	4	(4)	6	2	(3)	4	(4)	6	2
6	4	(5)	9	2	7	4	(5)	9	2	7
7	(6)	9	1	15	7	(6)	9	1	15	7
8	2	(2)	15	7	17	2	(2)	15	7	17
9	(17)	(12)	(5)	12	0	(17)	(12)	(5)	12	0
10	2	(14)	(2)	0	14	2	(14)	(2)	0	14
11	(1)	7	(12)	(12)	(2)	(1)	7	(12)	(12)	(2)
12	(0)	3	(2)	(28)	(14)	0	3	(2)	(28)	(14)
K-4	(11)	(67)	(128)	(157)	(205)	(4)	(18)	(7)	11	27
5-8	(2)	5	22	30	34	(2)	5	22	30	34
9-12	(16)	(17)	(21)	(28)	(2)	(16)	(17)	(21)	(28)	(2)
<b>TOTAL</b>	<b>(29)</b>	<b>(78)</b>	<b>(128)</b>	<b>(156)</b>	<b>(173)</b>	<b>(22)</b>	<b>(29)</b>	<b>(7)</b>	<b>13</b>	<b>59</b>

The totals at the bottom of the aqua-shaded, left-hand side of the table show that here are more students in the district (3907) than were predicted (3714)<sup>1</sup>, with the difference — 173 — representing an error of 4.6%. This is not good, and with the total error growing across the years, it appears that things have gone from bad to worse.

A closer look at these numbers shows that the standard forecasting method is actually working quite well, but that there is one area in which events have taken an extreme turn.

The projection method has two components:

- Children observed in the schools at a given time are “progressed forward” — *e.g.*, 2<sup>nd</sup> graders in 2008-09 are projected into 3<sup>rd</sup> graders in 2009-10, and into 4<sup>th</sup> graders in 2010-11, and so on. The *progression ratios* are determined from the recent historical record. From year to year there are always some families leaving the district and others coming in. Within the district, there are always some families who take the children out of the public school system and other families who put their children in it. Thus the grade progression ratios blend (a) age-specific net migration rates<sup>2</sup>; and (b) the net grade-specific tendency to join (or leave) the school system.
- New cohorts entering the school system, starting in kindergarten, are estimated from data on trends in births 5-6 years previous.

It is the latter that has been problematic. The first has actually been working very well.

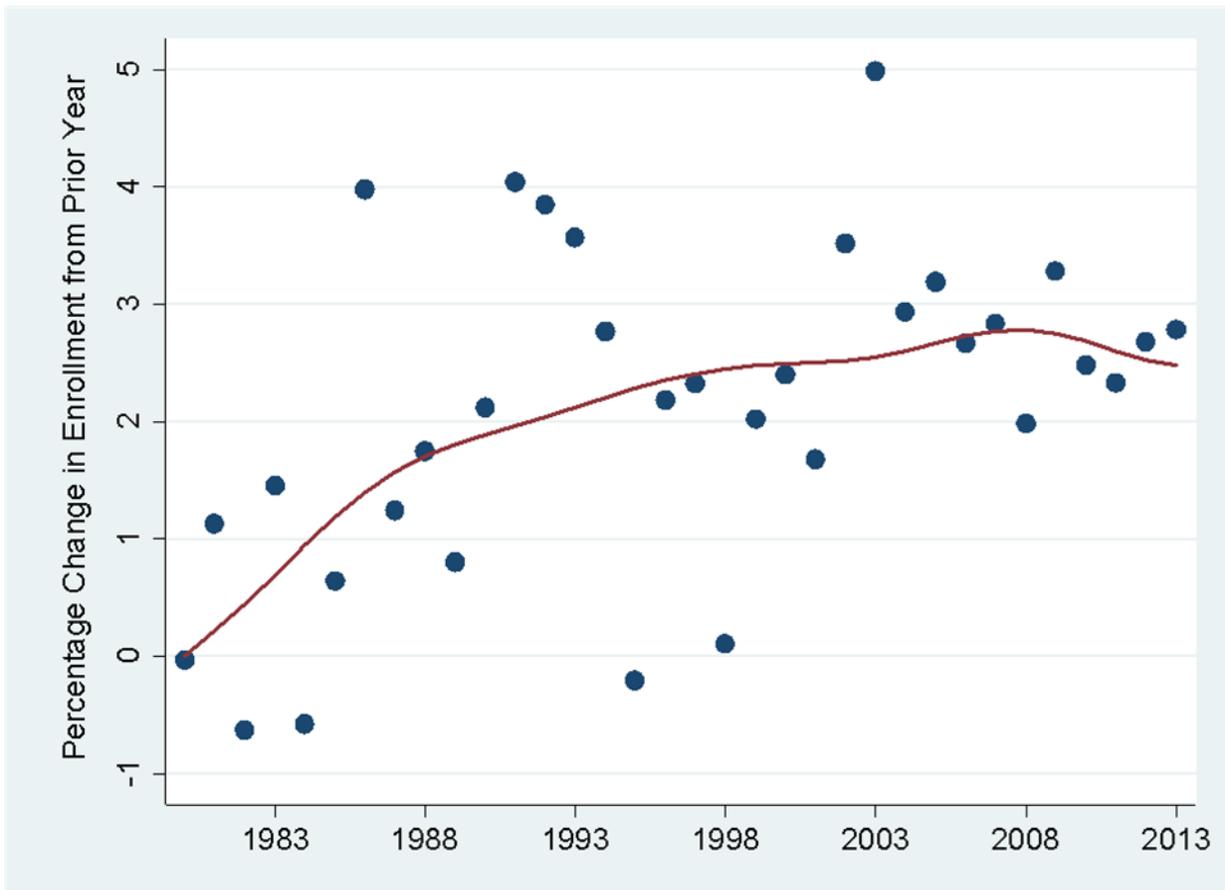
Consider the right-hand (light-green-colored) side of Table 1. It shows the same errors of prediction documented on the left-hand side of the table, with one exception: It was produced under the assumption that we had somehow known beforehand the number of annual entrants to kindergarten for the school years 2008-09, 2009-10, 2010-11, 2011-12, 2012-13, and 2013-14. This is why the first row is now a set of zeroes (0s) — it is as if there had been no errors in forecasting kindergarten enrollments. Aside from that, everything is calculated using the same methods and data available in 2008. This is why most of the numbers are the same on both sides of Table 1: Most grades for most years forecasted through 2013-14 — the current year, and the last one for which we can observe actual enrollments — come from cohorts that had already reached school age by Fall 2008, when the previous projections were done. As for the younger grades, who show up as a wave of red (under-projection of actual enrollments) in the upper-right corner of the left-hand (Actual Error) side of

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<sup>1</sup> Close readers of these reports will note that the actual prediction in the 2008 report was for 3711 students in 2013-14, not 3714. The difference here is that between 2008 and now, the School District made some very minor changes in its reports of enrollments for the 2007-08 and 2008-09 academic years. In calculating the error for the current report, I recalculated the 2008 projections using the now-updated enrollments for those two years. This was not to “re-write history.” Rather, in thinking about where the projection method is or is not working well, I did not want to add error from revisions of the earlier data to error resulting from the method. In any event, the changes are very, very few (and small), and have no bearing on the issues considered here.

<sup>2</sup> A *net migration rate* is the difference between the rate of in-migration and the rate of out-migration. By “age-specific,” we refer to such rates as calculated by the age of individuals. As we shall see in the discussion of the demography of Springfield Township and Morton Borough, there has long been a tendency for positive net rates of in-migration for children.

the table: It turns out that their progression (persistence, growth) during the years after they entered the school system in kindergarten was very much in line with what would have been expected. In the current year (2013-14), even the large entry cohort into kindergarten in 2009-10 would not have grown unexpectedly: The forecast for their fourth grade enrollment, *had we but known their size at entry to kindergarten*, would have been only 8 below this year’s enrollment. As for the other cohorts who have entered since then, and who have created the “tidal wave” of unexpected enrollment in early elementary school over the past 3-4 years: Their persistence post-kindergarten has actually been running at rates *lower* than in the past, to the point where — again, had we but known the kindergarten entries for each cohort — we would have been slightly *over*-predicting elementary school enrollment.



**Figure 1. Percentage Change in the Number of Students in Grades 2 through 12 Relative to Students in Grades 1 through 11 in the Previous Fall. The red line is the trend in the data.**

None of this changes what happened in fact. The forecasts of kindergarten enrollments were too low and this created a problem with respect to elementary school forecasts. But by removing this kindergarten-induced error we begin to separate the key issues for moving forward. The right-hand side of Table 1 shows that the errors due to the grade progression ratio component of the standard forecasting method are actually very low. The total high school size in 2013-14 differs by only 2 (!) students from the 2008 forecast. The middle school enrollments are too *high* by 34, a roughly 3%

overall error that was less in previous years. None of these errors are affected by the kindergarten “boom” and year-to-year, grade-by-grade examination of these data does not suggest real problems in forecasting. The elementary school enrollments, which are at the heart of the overall 4.6% error acknowledged earlier for 2013-14, would have contributed very little to the overall error *had we but anticipated the kindergarten boom*.

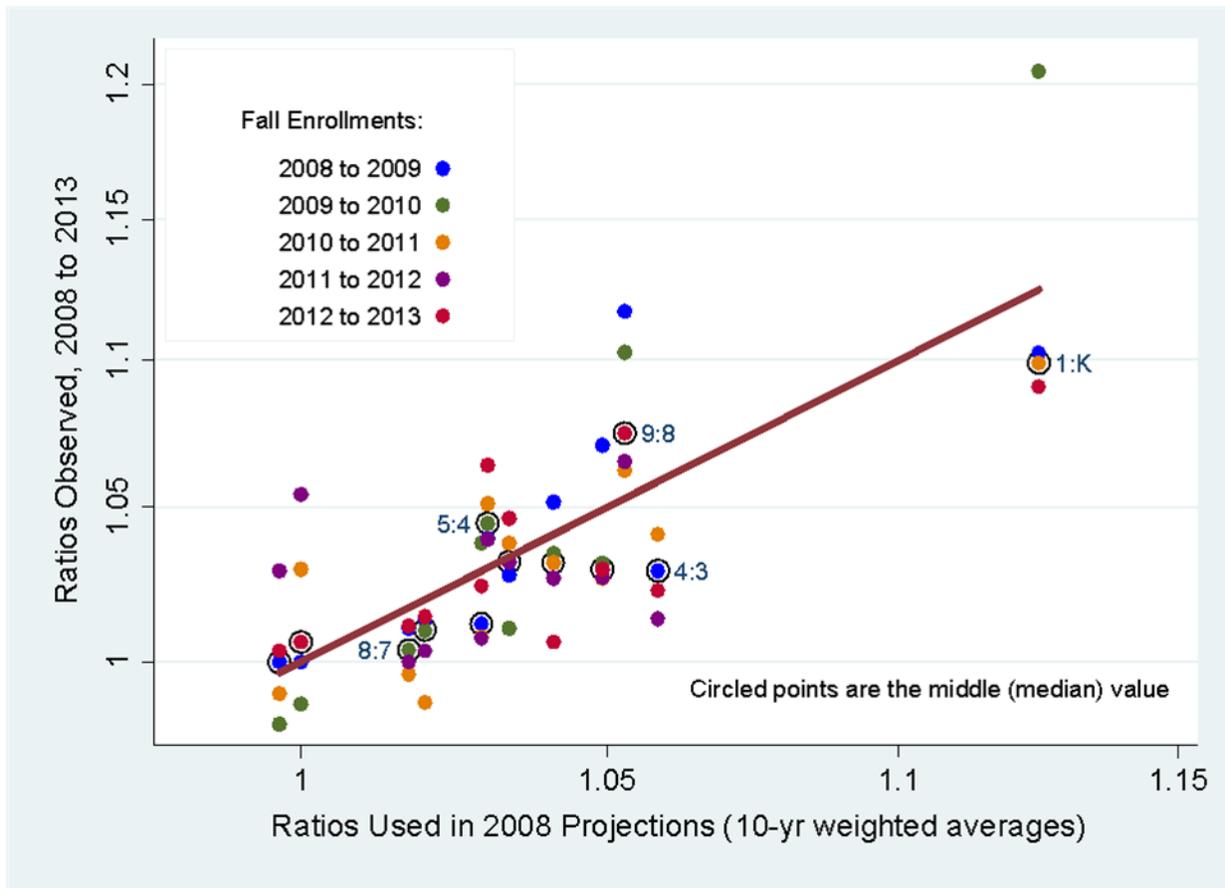
This is the great paradox of recent enrollments in the Springfield School District, since by every indicator available, the demography of the school district and the rhythms of school participation *have never been more stable*. Figure 1 is an update of a figure that has appeared in the previous two reports: the ratio of 2<sup>nd</sup> to 12<sup>th</sup> graders observed in a given school year to 1<sup>st</sup> through 11<sup>th</sup> graders observed in the prior school year. It is a measure of the annual growth in the size of the school system *among children who are already in the system*. Over the last ten years — everything that has happened since the unusual +5% rate of growth that occurred between Fall 2002 and Fall 2003 — enrollment growth within the system has been consistently between 2% and 3%. The last time it was even slightly over 3% was from Fall 2008 to Fall 2009. Figure 1 reveals that the past decade is far and away the period of the lowest annual variation in district-wide continuation or progression rates. It is *not* the picture of a district in which net in-migration among school-age children is increasing.

Our perspective on the stability of the situation (post-kindergarten) and the validity of the grade-progression-ratio forecasting method is reinforced when we look not just at the aggregate situation (as per Figure 1), but grade by grade: Figure 2 plots the specific grade progression ratios that were used in the 2008 report, which were based on the historical rates in ten years through 2008-09, where about half of the weight of these past rates pertained to the three most recent years.

Since 2008, there have been five new school-years, so there have been five observed grade progressions (from 2008-09 to 2009-10, from 2009-10 to 2010-11, from 2010-11 to 2011-12, from 2011-12 to 2012-13, and from 2012-13 to 2013-14). These are stacked vertically in Figure 2. The middle (median) of the five values is indicated by the circle. There are twelve sets of stacked points because there are twelve grade-specific progressions: from Kindergarten to 1<sup>st</sup> grade (1:K), from 1<sup>st</sup> grade to 2<sup>nd</sup> grade, ... , from 3<sup>rd</sup> grade to 4<sup>th</sup> grade (4:3), and so on until the transition from 11<sup>th</sup> to 12<sup>th</sup> grade. Only five of the grade-specific progressions are labeled in Figure 2, to reduce clutter. From Figure 1 we know that across eleven of these transitions (ignoring for the moment the first, from Kindergarten into 1<sup>st</sup> grade), the average has been between +2.3% and +3.3%, or ratios of 1.023 and 1.033. But there are differences across grades, so that the progression ratios used varied from just under 1.00 to around 1.06 (again, ignoring the transition from Kindergarten to 1<sup>st</sup> grade). These ratios appear on the x- (horizontal) axis of Figure 2.

Figure 2 confirms that the year-to-year progression rates have been very stable over the past years. They do vary somewhat from year-to-year, which is why forecasts are never perfect, but this almost has to be the case, since with ~300 students per grade, it only takes the idiosyncratic decisions of six families to change a ratio from, say, 1.02 to 1.04. A focus on the median value helps us see that on average the small differences that characterize different grade progressions within the Springfield School District have changed little this century. These median points lie very close to the red line in

Figure 2. The correlation between the progression ratios calculated in 2008 and these medians is 0.74 if we ignore the transition from Kindergarten into 1<sup>st</sup> grade (1:K) and 0.88 if we include it. A correlation of 1.00 is perfect, so these are strong correspondences.



**Figure 2. Grade Progression Ratios Observed Since 2008 Compared to Those Used in the 2008 Projections. The red line indicates what we would have observed if the future had been a perfect replica of the average recent past.**

There are only two grade progressions where the 2008 projection ratios under-estimated enrollment growth in all five subsequent years: These are the transitions from 4<sup>th</sup> to 5<sup>th</sup> grade (5:4) and from 8<sup>th</sup> to 9<sup>th</sup> grade (9:8). It may not be a coincidence that these are the entry points into, respectively, middle school and high school. If enrollment growth is being fueled not so much by new children coming to Springfield Township and Morton Borough, but rather by more families who are already in the district electing to send their kids to the public school system, then these are precisely the “opt-in” points where we would expect to see enrollment increases greater than in the recent past.

On the other hand, Figure 2 also indicates that two of the three instances in which the 2008 progression ratios were systematically *over*-estimating grade-to-grade enrollment growth were in the transitions immediately prior: from 3<sup>rd</sup> to 4<sup>th</sup> grade (4:3) and from 7<sup>th</sup> to 8<sup>th</sup> grade (8:7). I have no good story as to why this would be the case, but again caution that we are dealing with comparatively small

“bounces” (variations from year-to-year) and it could equally be the case that the higher rates on entry into middle and high school may simply be the “making up” of these idiosyncratic declines that were occurring in the grades just prior.

The final take-away point from Figure 2 pertains to the transition from kindergarten to 1<sup>st</sup> grade, a form of persistence, growth, and — possibly — in-migration that did *not* figure in the global growth ratios shown in Figure 2. Historically, the relationship between kindergarten enrollments and subsequent 1<sup>st</sup> grade enrollments has been a difficult one to predict, since the non-compulsory (and half-day) nature of kindergarten makes it especially subject to the vagaries of young family life. Yet as kindergarten enrollments have soared — as per Table 1 — the transition from kindergarten to 1<sup>st</sup> grade has become much more stable. True, from Fall 2009 to Fall 2010 there was a large jump (a ratio of 1.21, or a 21% increase in the number of 1<sup>st</sup> graders relative to the number of kindergarteners a year prior), but in the other four years the increase was stable at 1.09 to 1.10: Essentially a 10% increase, which is actually *below* the +12% (1.12 ratio) forecast based on years prior to 2008. This is why, if we return to Table 1 and examine the right-side columns, it is only for the Fall 2009 kindergarten cohort that underestimates would have persisted had we known the kindergarten enrollments to begin with; for all other cohorts we would be slightly *over*-estimating their size post-Kindergarten.

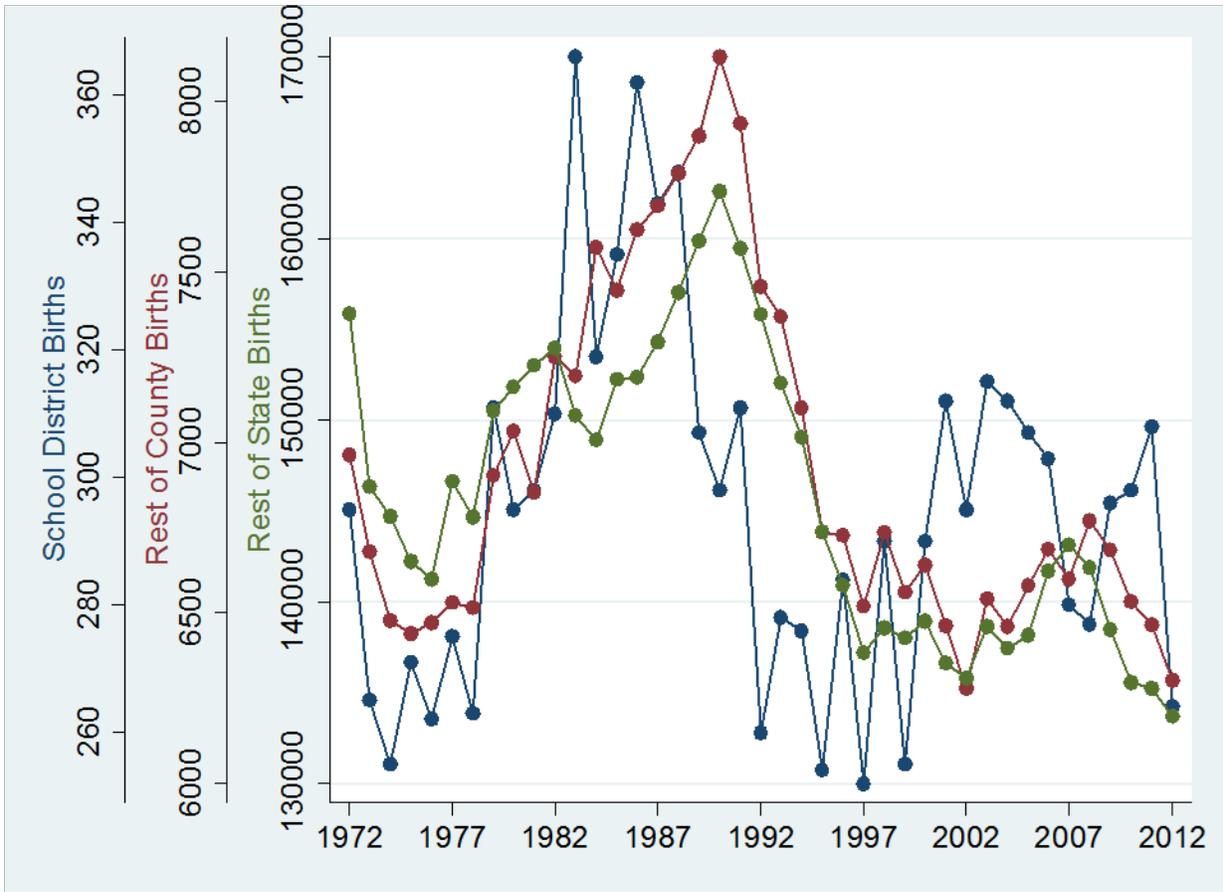
### **Where Are All the Kindergarteners Coming From?**

In the short- to medium-term, future kindergarteners (or first-graders, given the high volatility of kindergarten enrollments) are projected based on births occurring five to six years prior. These can be local births — those registered to residents of Springfield Township and Morton Borough — but they can also be based on regional birth series as well (county, state, even national), since (a) in a small area there is a lot of year-to-year bounce in the number of births; and (b) between birth and age 5 or 6, there can be a lot of migration. Young adults, and thus young children, move around a lot. Thus in past forecasts I have projected the number of kindergarteners and first-graders in part as a function of local births and in part as a function of birth trends in the state and county.

Figure 3 is an updated look at the correspondence between births to residents of the Springfield School District and births elsewhere in Delaware County and in the Commonwealth. The county and state births follow a familiar demography: Low births in the 1970s (the so-called “baby bust”); a rebound peaking around 1990 (the “echo” of the baby boom); and then a decline to a low level that has been fairly steady for the past 15 years. These ups and downs are very much the product of variation in the rates at which women bear children that occurred many years ago. Among women born in the last half of the 20<sup>th</sup> Century, rates of fertility have stabilized around two births per women.<sup>3</sup> So the number of births reflects changes in the number of women more than changes in their propensity to have children.

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<sup>3</sup> Hamilton BE and Cosgrove CM. Cohort Fertility Rates. Hyattsville, MD: National Center for Health Statistics. Available from: [/nchs/nvss/cohort\\_fertility\\_tables.htm](https://nchs.nvss.cohort_fertility_tables.htm). Released: June 30, 2010.

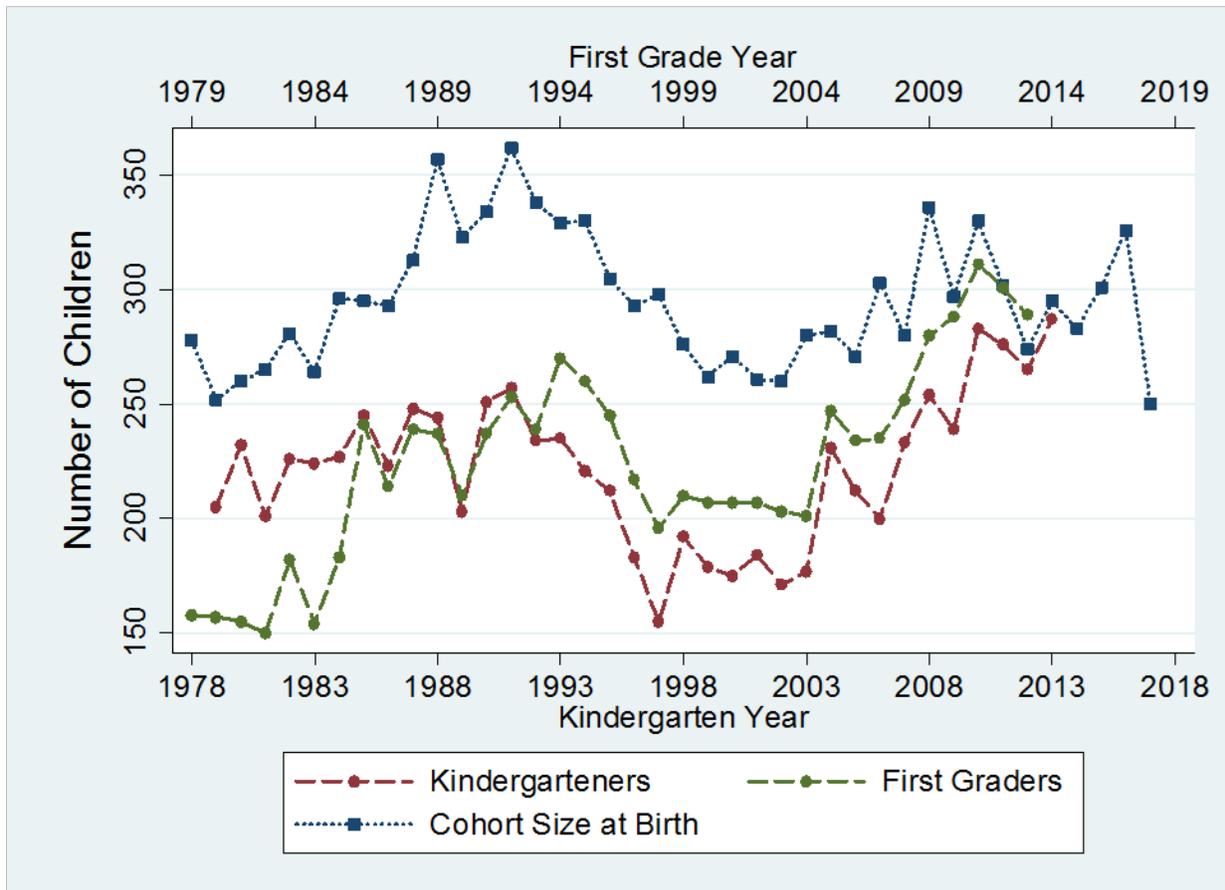


**Figure 3. Grade Progression Ratios Observed Since 2008 Compared to Those Used in the 2008 Projections. The red line indicates what we would have observed if past averages had perfectly predicted future grade progression ratios.**

In broad contour, births to the school district population have followed a similar course, although the echo of the baby boom came earlier and the drop back to 1970s-era numbers of births occurred sooner, starting in 1992. The comparatively small size of Springfield Township and Morton Borough make the year-to-year oscillation far greater than elsewhere in the county and in the state. On the other hand, the school district’s population did have a “rebound” not seen elsewhere: From the mid-1980s peaks of 360+ births in two years, the school district fell to 260 or below during several years in the 1990s. Then, in the first years of the 21<sup>st</sup> Century, births were averaging 310 or so per year—*i.e.*, a make-up of approximately half of the decline. In fact, the Springfield-Morton school district birth series has been moving around independently this century: It is uncorrelated with the births in the rest of the county and state. Were it not for the drastically low number of school district births for 2012, the most recent year for which local birth data are available, the series would actually show a strong *negative* correlation, with the school district births going down from 2003 while births in the rest of the county

were moving up, then rising again after 2008 — a time when county (and state) births have since been on the decline.<sup>4</sup>

Whether forecasts are based on local births alone, or in combination with other birth data, the key point is that the supply of potential kindergarteners is known for several upcoming years. It is only after that point that additional uncertainty is introduced by the need to make assumptions about future fertility.



**Figure 4. Births in the Springfield School District Relative to Enrollments in Kindergarten and in First Grade in the Fall of the Year These Children Reach the Corresponding School Age.**

<sup>4</sup> In 2012, the most recent year for which data are available, all three series are at low levels not seen for a decade or more. These data are from the Bureau of Health Statistics and Research, Pennsylvania Department of Health. The Department specifically disclaims responsibility for any analyses, interpretations or conclusions. These [2012 data](#), which have just been released, are *preliminary* and thus may at some point be revised (Pennsylvania Department of Health, Birth Statistics, Preliminary 2012 Data, accessed at <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=809799&mode=2>). This said, the data for the rest of the county and state are not out of line with their recent past trends, and a phone conversation with the person in charge of these data in Harrisburg revealed that the 2011 preliminary data — now confirmed — varied by only a two children too few (one each in Springfield Township and Morton Borough), and that otherwise the month by month preliminary counts were maintained in their entirety. Thus there is no reason to think that the 2012 figures will be revised upward in any serious measure.

Figures 1 and 2 have shown that the relationship between students in one year and students (in the next grade) one year hence has been very steady. Figure 4, which looks at the relationship between Springfield School District births and kindergarten enrollment five to six years following (and thus first-grade enrollment six to seven years following) has been anything but steady. Because birth data are available by month, we can map this relationship quite precisely. For example, the births occurring from September 2002 through August 2003 are children who would be kindergarten age in the 2008-09 school year — and thus as reported in the October 2008 enrollment counts. Reading from the lower x-axis, and finding the kindergarten year of 2008 (October count for 2008-09 academic year) we can see that there were 336 births between September 2002 and August 2003 (the blue line) and 254 kindergarteners (the red line). These same children were potential first-graders in October 2009 — this is denoted by the year 2009 on the upper x-axis of the figure — and the corresponding point on the green line indicates that there were 280 of them enrolled in the school district.

Fall 2008 corresponds to the time of the last forecasts, and even then we knew that births were at a recent high, since birth data for kindergarteners in the next succeeding years were already known. Indeed, since then births in the township have never attained similarly high levels, and yet the number of kindergarteners has trended steadily upwards to the point where — in Fall 2012 and Fall 2013 — the number of kindergarteners was almost exactly equal to the number of school district births five to six years prior. For first-graders, there were actually *more* children enrolled in the school system in Fall 2013 than there were children born in the school district six to seven years prior. This is extraordinary, since as Figure 4 shows, historically in the Springfield School District enrollments have always been substantially lower than corresponding births five and six years prior.

The children showing up in kindergarten and first grade are not necessarily all the same children born the corresponding year prior. The size of the cohort will be growing over time, as was first pointed out in the 2004 report; and there will be infants born in the district whose families move out, and others who come in to replace them. Still, it is uncanny how, since 2007, even as the ratio of school children to previous births has closed in on unity (*i.e.*, a one-to-one correspondence), the series have been moving together very closely: For kindergarteners, up from 2007 to 2008, a drop in 2009, then up again to 2010, then down through 2012 (which, in 2013, is where we last see the similarly-paced first-grade series), then up again to Fall 2013. We can follow subsequent births forward for four more years. If kindergarten enrollment stay on a par with prior births, then we might expect kindergarten enrollments at near comparable levels in Fall 2014 and Fall 2015, another enrollment increase in Fall 2016... and then a great collapse in Fall 2017, when the low 2012 birth cohort makes its appearance.<sup>5</sup>

If births were not increasing in the school district, then the increase in the number of kindergarteners since 2008 — and their persistence into subsequent elementary grades — must be due to increases in either:

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<sup>5</sup> This “2012 birth cohort” is actually births from September 2011 through August 2012, since these are the children who will be of kindergarten age in Fall 2017 (at least 5 but not yet 6 as of 1 September 2017). This is why this data point is slightly different from that shown for the 2012 (birth) year in Figure 3, which includes births during the 2012 calendar year. The four months of data for September-December 2011 are not subject to revision, which adds to the assurance that this really is an historically low birth cohort.

- the percentage of age-eligible residents (children) who are enrolled in the public schools; and/or
- the rate of net in-migration.

### *Enrollment Rates*

The 2008 report was written at a time when the economy had just collapsed and unemployment was increasing dramatically. As noted in that report, “Recent financial collapses are triggering an economic retrenchment of unusual proportions. Behavior seems to be changing in ways that would suggest greater use of a strong public school system.” Direct evidence for this is now available, thanks to the 2010 U.S. Census. The census provides us counts by single years of age for children in Springfield Township and Morton Borough, as of 1 April 2010. This was the Spring of the 2009-2010 academic year, so by allocating children proportionately by age to grade, we can compare Fall 2009 enrollments to the grade-eligible population as per the census occurring later in the school year.<sup>6</sup> The results appear in Figure 5, where these enrollment percentages (the maroon-colored bars) are compared to comparable enrollment percentages during the 1999-2000 academic year (the blue bars), a time of a much healthier economy. (The forest green bars, estimates for 2013, will be discussed shortly.)

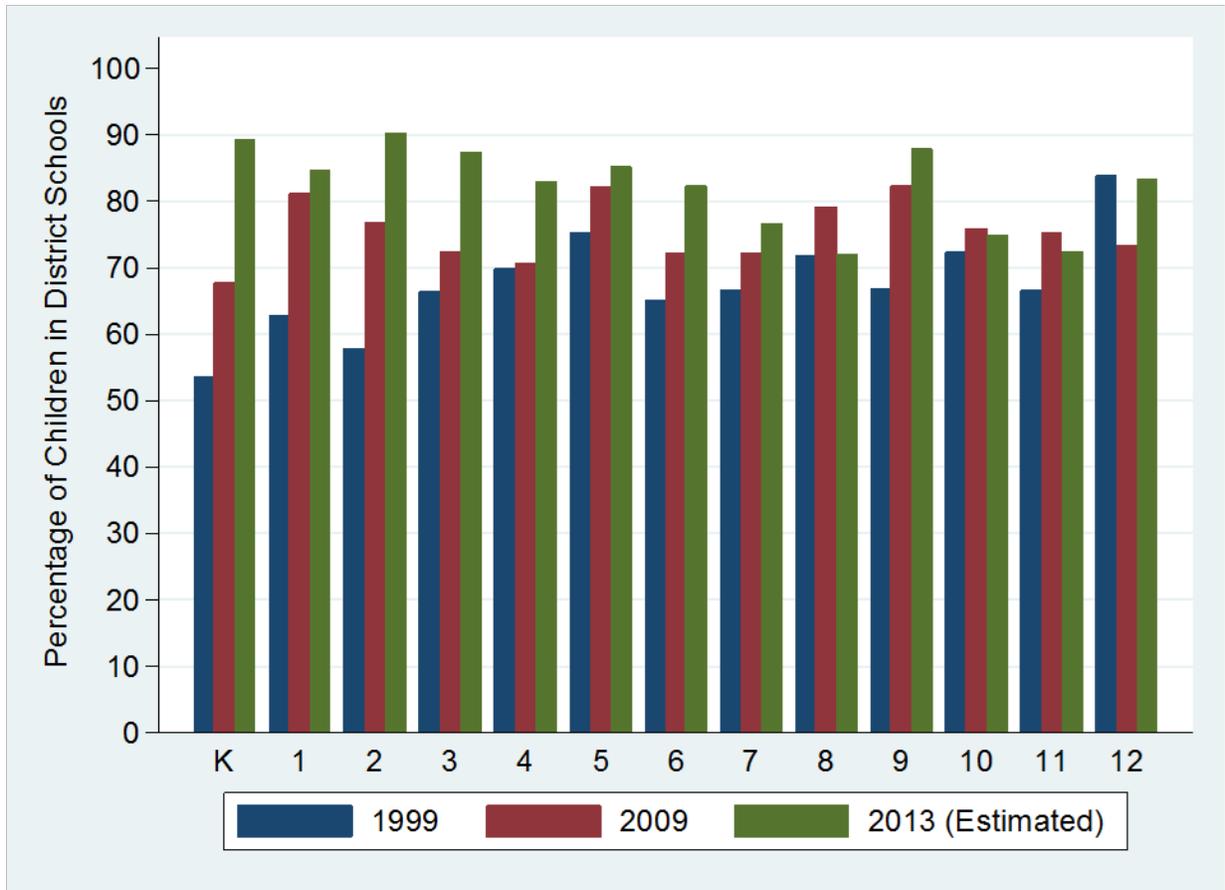
Not surprisingly, the percentage of school district children enrolled in the public school system was higher in the 2009-10 academic year than it had been in 1999-2000, especially in the early elementary grades. In kindergarten, the percentage enrolled increased from 54 to 68 percent; in first grade, from 63 to 81 percent; and in second grade from 58 to 77 percent. These are huge differences and a vivid reminder that, in a school district such as Springfield, where there have historically been alternatives to the public school system (Catholic and other religious schools, secular private schools), even without any *demographic* change, enrollments can increase due to greater demand.

This greater demand appears to have manifested itself in more families sending their children to the school district from the beginning of their school careers (kindergarten and first grade). There has also been a marked increase in the percentage of ninth-graders who are enrolled (from 67 to 82 percent). This fits with the elevated grade progression ratios from eighth to ninth grade that were noted previously in Figure 2, and the observation that the beginning of high school is another crucial decision point where an increase in demand for public over private schools would be expected to occur. All the other grades (save one) increased the percentage of the population that they were enrolling, by something around five or six points. Only for high school seniors — 12<sup>th</sup> graders — was there a reversal in participation: a decline from 84 to 73 percent.<sup>7</sup>

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<sup>6</sup> *E.g.*, seven year-olds in April 2010 will be spread on average 7/12ths in first grade and 5/12ths in second grade; similarly, 5/12ths of the six year-olds will be in second grade.

<sup>7</sup> The 84 percent participation in 1999-2000 would be the grade with the highest participation in this year. This seems anomalous. These percentages are calculated under the assumption that the eligible population are those children (or young adults) who are in the modal age for grade (5 and 6 years old for kindergarteners, 17 and 18 years old for 12<sup>th</sup> graders). By 12<sup>th</sup> grade, between students who had to repeat prior grades but are still in the school system, and students who have accelerated, it is possible that the denominator (eligible population) is no longer well-represented by the population at the modal ages. Also, there may have been differences between the 2000 and 2010 Censuses in the attribution of 18 year-olds to place of residence — their parents’ homes vs. college



**Figure 5. Percentage of Children in District Schools, by Grade: 1999-2000m 2009-10, and 2013-14 Academic Years. The population base for 1999-2000 and for 2009-10 is from the U.S. Census. The population for the 2013-14 academic year is an estimate.**

Since the 2009-10 academic year, enrollments have continued to surge, beginning from kindergarten (see again Table 1), so the question arises as to just how high rates of enrollment may now be in the school district. To answer this with any certainty would require data that do not exist — the current populations, by age, of Springfield Township and Morton Borough — but we can use the 2010 Census data to get an estimate of current enrollment rates. The forest-green-colored bars in Figure 5 represent the percentage of local children enrolled by grade in the current (2013-14) academic year, under the assumption that the number of children in 2010 who were four-years younger at the time than the standard age for a grade increased by 7.2%, or a growth rate of 1.75% per year.<sup>8</sup> This suggests

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dormitories — which could affect these rates, given that some proportion of the 18 year-olds are apportioned to the eligible 12<sup>th</sup> grade population (see prior footnote).

<sup>8</sup> *E.g.*, there were 286 one-year-olds and 310 two-year-olds in Springfield Township and Morton Borough in the 2010 Census. We assume that 5/12ths for the former and 7/12ths of the latter were one-year-old on 1 September 2009 and hence five-years-old on 1 September 2013 and thus eligible for Kindergarten in the current year. This would be 300 children, but their numbers will likely have grown by then. Assuming an additional 7.2%, we get an

that whereas traditionally in the Springfield School District, participation in the public school system was lower in the early elementary years than it was in middle school, that pattern may have reversed. The percentage of the population enrolled in kindergarten through third grade may be as high as 85-90%. Middle school enrollment percentages, which increased somewhat between 1999 and 2009, may have continued to increase in the four years since; whereas in high school — other than ninth-grade, where, again, we know enrollments have been increasing — it is hard to say that much has changed since 1999.

So one reading of Figure 5 is that the economic crisis that began in 2008 and which lingers in various forms to the present has really taken the “slack” out of the system: that families for whom paid schooling for younger children was once an affordable commodity now see it as a luxury, and that there are only so many more children in the district who could conceivably come into the public school system. This does not rule out the possibility that in future years the percentage of children of middle school and high school age who will be enrolled in the Springfield School District will continue to increase as the slew of children now in early elementary school move forward through the system. In fact, for this *not* to happen, the grade progression ratios observed in Figure 2 will have to decline, perhaps as parents who opted into the system for economic reasons opt out later, as the economy improves.

#### *Net in-migration*

In Figure 5, the rates of enrollment are reasonably certain for the 2009-10 school year. But it is possible that the percentages are exaggerated for 2013-14, especially if there has been an increase in net (entries versus exits) in-migration among school-age children in Springfield Township and Morton Borough. Such net in-migration is another way of talking about the “rejuvenation” of the population, as houses turn over and more young people come into the district.

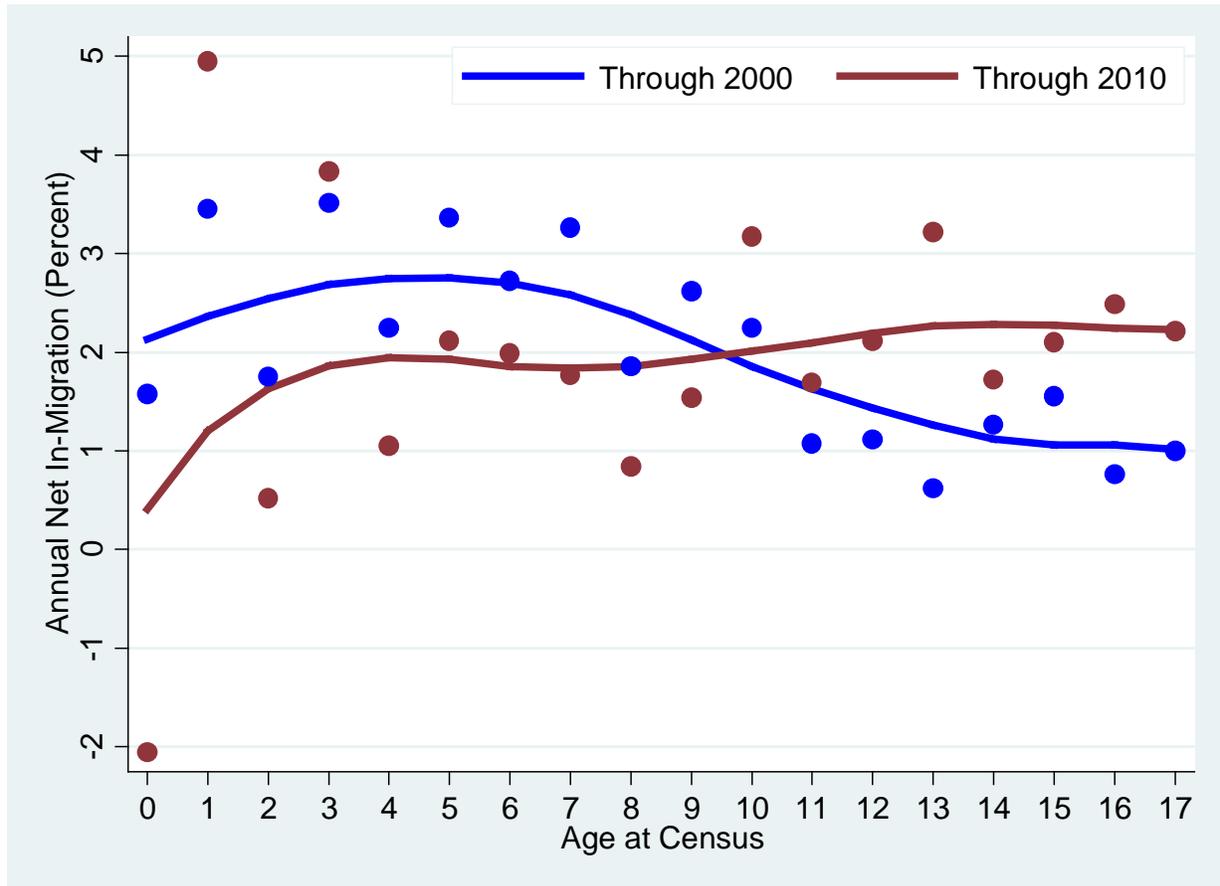
Although this appears plausible on the surface, comports with the observation that there are more young people afoot, and would help to explain the increase in enrollments observed since 2008, there is just not good evidence for it.

Consider what we know about net migration among children based on births to women residing in the school district and children tabulated in subsequent censuses. Children born from April 2009 through March 2010 will be counted as age 0 in the (April) 2010 U.S. Census; they will have lived on average  $\frac{1}{2}$  of a year. Children born from April 2008 through March 2009 will be counted as age 1 in the Census; they will have lived on average  $1\frac{1}{2}$  years. And so on through the young adults born April 1992 through March 1993, who would be counted as age 17 in the 2010 Census and who will have lived on average  $17\frac{1}{2}$  years. By comparing the ratio of persons at each age relative to births, and adjusting for the differences in time elapsed since birth, we can obtain as of 2010 the annualized net migration rates

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estimated five-year-old current population of 322. The actual number of kindergarteners counted in October 2013 was 287, or 89% of this estimated population.

of 18 birth cohorts.<sup>9</sup> These are the maroon dots in Figure 6. Because these are comparatively small-sized cohorts, there is some age-to-age “bounce” in the estimate of these annualized rates, especially for the younger ages where less time has elapsed. Thus Figure 6 includes a maroon line which marks the trend in these data. To give some perspective on these rates, which are under 2% per year for children under age 10, and somewhat over 2% per year for children over age 10, similar rates have been calculated as of the 2000 census.



**Figure 6. Annual Rates of Net In-Migration, as Observed for the Censuses of 2000 and 2010, by Age at Census (Birth Cohort). The lines are smoothed renderings of the trends across ages (birth cohorts).**

What Figure 6 shows is that in the run-up to the recent surge in early elementary school enrollments, there was no sign of increases in migration among young children. The migration of children of elementary age and below was running at lifetime rates lower than had prevailed ten years prior — a time not noted for high enrollments and or an unusual rejuvenation of the population — and

<sup>9</sup> Although we are fortunate to live in an era when infant and child mortality are quite low, they — alas — still exist. This calculation does not so much ignore the effect of mortality on the stock of births in these various cohorts as it apportions mortality to “out-migration.”

was also lower than the rates prevailing across the lifetime of older children in 2010.<sup>10</sup> Although rates as measured for the one- and three-year-olds look high, those surrounding them are comparatively low and the overall picture — as per the averaged trend line — is not one in which the steady increase in the supply of kindergarteners (see again Table 1 and Figure 4 is at all apparent.<sup>11</sup>

To which we can add other information from the 2010 Census: The school district's population continued to age through 2010: The median age rose from 41.9 to 43.2 in Springfield Township and from 37.5 to 39.5 in Morton Borough. The percentage of the population under age 18 dropped from 23.9% to 23.1%. The overall population size was essentially unchanged: 26,880 in 2010, versus 26,392 in 2000. Given the positive net in-migration among children and youth, as per Figure 6, this implies net out-migration among adults, through both moves and deaths. This is important to recognize, because this exchange of young (births, in-migration) for old (deaths, out-migration) is ever occurring. For the population to in some sense rejuvenate, the pace of this exchange must accelerate, and it is precisely the change in this pace for which we have no evidence.

The housing stock of the school district tells a similar story. There were 33 building permits issued between 2008 and 2011 — there had been only eight previously since 1999— but this hardly counters the tendency to tear down and to convert family housing to commercial and professional uses. Thus between the censuses of 2000 and 2010, the number of dwelling units declined by almost 6%, from 10,731 to 10,134.

But might not all of this just have been the calm before the storm, the storm being a frenetic in-migration of families with young children *since* the 2010 Census? This cannot be ruled out categorically, and the best evidence for it is new cohorts of kindergarteners that equal prior births in their school district cohorts (Figure 4) and are pressing up against the number of young children observed in the 2010 Census (Figure 5).

However, we do have evidence against it. The modal number of children per woman with a child is two, not one; and although some do have only one, some also have more than two. If there really is a surge post-2010 in families with elementary age children, where are the other kids? The subsequent rise in first-, second-, and now third- graders is completely explicable in terms of the already observed new kindergarteners (Table 1). They are the same children. Otherwise, the school system is showing no unusual accumulations of children (Figure 1) as would happen if there were increases in net in-migration; and even the one instance where continuation or progression rates have gone up since 2008 (from grade 8 to grade 9, as per Figure 2), this is (a) precisely where growth might be expected if more parents were putting children back into the school system at the beginning of high school; and (b)

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<sup>10</sup> These are almost two ways of saying the same thing, since, for example, the 15 year-olds in the 2010 Census are the same birth cohort as the 5 year-olds in the 2000 Census, and hence a third of their "migration careers" encapsulate the approximately 2.5% annual net migration rates experience during their first five years of existence.

<sup>11</sup> The average across ages of these annual rates is close to +1.75%, for both censuses. This was the figure used for projecting forward children observed at different ages in the 2010 Census, to create an estimate of the grade-specific school district population in the 2013-14 academic year, in Figure 5.

compensated by declines in rates at other ages. Nor do the kindergarteners seem to have younger siblings: Births were up a bit in 2011, but still not to the level of 2003, a level not seen since and a level not so great as to be responsible for especially large numbers of kindergarteners circa the 2008-09 academic year (Figure 4); and the preliminary data for 2012 suggest a dearth of fertility not seen in decades (Figure 3).

In contrast, observed numbers of public school children are not inconsistent with census counts and related estimates of the age-specific school district population, although this does mean that the percentage of district children who are attending the public schools, especially at the elementary grade levels, is at an historic high. These early grade rates probably will not go much higher, although rates at later grades will increase if grade progression rates do not change. An assumption here is that the available population data, especially from the Census, genuinely reflect the “facts on the ground.” This is less a concern that the Census is systematically under-counting children in Springfield Township and Morton Borough than it is a recognition that family life is changing. More children belong to what is functionally more than one household, yet the Census is supposed to count each of us in one place and one place alone. There are children with two parents living apart, or a parent and relatives living elsewhere. If the Springfield School District is more attractive than other school districts in the other places where a parent resides, then there may be children attending the Springfield public schools who are not technically counted by the Census as living in the Springfield School District population. This — in conjunction with the long-running economic downturn — could help explain these very high enrollment rates in the Springfield School District.

### **New Projections**

The new projections follow relatively straight-forwardly from what has already been discussed. They are shown, in blue, in Table 2 (p. 19), for the next academic year (2014-15) through 2029-30, with all of the enrollments observed since 1979-80 included as well, for historical perspective.

Grade progression ratios are used to move children already in school forward to the next grade in the next year. They are calculated as a weighted average of the last ten years’ grade progression ratios, with roughly half the weight coming from the past three years. As we know from Figures 1 and 2, these ratios have not changed much in the last decade, so the weighting scheme matters little. Using the last three years only, or the last five years, and/or giving equal weights to all years — all would give essentially the same projections.

What these projections do is “grow” the size of a school cohort as it moves from kindergarten through 12<sup>th</sup> grade. Consider (in Table 2) the historical record: the kindergarten cohort for 1997-98, for example, although almost any cohort would show the same pattern. It started out with only 155 kindergarteners, grew (following down the diagonal) to 196 first-graders in 1998-99, 204 second-graders in 1999-00, 210 third-graders in 2000-01, and so on, always increasing, except from 10<sup>th</sup> to 11<sup>th</sup> grade, where there was a decline of ten students (from 281 to 271); and then to 12<sup>th</sup> grade, where there was not change in enrollment. The same pattern is now recapitulated in the projections. Thus there are 269

current eighth-graders (in 2013-14). As per Figure 2 and Figure 5, ninth-grade is a growing point of entry to the school system, so we project 289 ninth-graders in the coming year. After that, enrollment grows little if at all in high school: This cohort should contribute 291 10<sup>th</sup> graders in 2014-15, also 291 11<sup>th</sup> graders in 2015-16, and 294 12<sup>th</sup> graders in 2016-17.

### *High School*

High school enrollment should therefore look fairly similar to what it has been for the past four years — around 1,200 students across four grades — for two more years, and then it will begin to grow: to near 1,300 in 2017-18 and then by almost 100 per year for the next two years. The rate of growth will slow down, but the high school should hit 1,600 by 2022-23 and peak at just about 1,700 in 2025-26. The seniors in that peak year are the kindergarteners of today, and thus this forecast of high school growth during the next dozen years involves mostly cohorts that are already in the school system. It has nothing to do with forecasts of future births.

These projections for high school enrollments in the near term are very consistent with those made five years ago since — as shown in Table 1 — total high school enrollments in 2013-14 were essentially identical to those projected in 2008. In fact, for the next four years total high school enrollments are now projected to *lag* slightly the projections done in 2008. They converge again in 2018-19 at just over 1,380 and it is not until 2019-20 — when this year's 3<sup>rd</sup> graders reach high school age — that the current forecast exceeds the previous projection and begins to “take off,” at least in comparison to what had been projected previously.

### *Middle School*

From Table 1 we know that overall middle school enrollments have actually been lagging to a small degree those projected in 2008. The forecast for next year (1,237 in 2014-15) is identical in Table 2 to what it was in the 2008 report (overall — there are differences by grade) and then it begins to grow, since in 2015-16 the current 3<sup>rd</sup> graders will be entering 5<sup>th</sup> grade. The growth is projected to peak in 2021-22 at 1,520, and then fall off again to a new trough, at 1,370 in 2025-26, before rising again into the 1,400s.

Unlike mid-horizon high school enrollments, middle school enrollments forecasts are affected by assumptions regarding the relationship between recent births and subsequent kindergarten enrollments, since the kindergarteners push up into middle school within five to eight years. The most unusual aspect of enrollments in Springfield School District since 2008 is that shown in Figure 4, where the longstanding gap between births to women in the school district and the number of kindergarten and first-graders who enroll five to seven years later has disappeared.<sup>12</sup> As previously discussed, the absence of any gap is unusual in that it has never been seen before. It is not totally unexpected,

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<sup>12</sup> The convergence in Figure 4 of births with subsequent enrollments does *not* imply that all children born in the school district are now attending the public kindergarten and first-grade. Between birth and school-age there is steady net in-migration (Figure 6), so the proportion of school-age children enrolled in the district schools is now very high, but less than 90% (Figure 5).

however: The 2008 report discussed how economic change could cause enrollments to increase even without demographic change, as more families opted to take advantage of public schools; and it is no coincidence that other school districts in the region that are already “built out” in terms of housing, but traditionally had low rates of public school enrollment, have also experienced rapid enrollment growth since 2008.<sup>13</sup> Past extrapolations of births into kindergarten- and first-grade enrollments were statistical exercises in modeling this gap. But the gap is gone, and for the last few years, the correspondence between the series (births and future enrollments) has been a tight one. Thus in Table 2 new kindergarteners for the years 2014-15, 2015-16, 2016-17, and 2017-18 have been set at 95% of the corresponding births shown in Figure 4 — a reflection of the very high ratios of students to births that we have seen in 2010-11 (86%), 2011-12 (91%), 2012-13 (97%), and 2013-14 (97%).

This may seem impractically high, and if it is, then middle school enrollments will turn out lower than those forecast in Table 2 — much lower if the ratio drops closer to the 60-70% that characterizes most of the history shown in Figure 4. Figure 4 also reveals that the only previous time when the number of kindergarteners approached the number of prior births was 1980-83, another occasion of economic distress (unemployment and inflation). In this sense, the assumption that near-term high early-elementary enrollments feeding mid-term expanding middle school enrollments is also an assumption of several more years of economic doldrums.

The predicted fall-off in middle school enrollments after 2021-22 coincides with the entry of the very small 2012 birth cohort. Even with high enrollment rates and expected net in-migration, there will be notably fewer students from this cohort.

### *Elementary School*

From Table 1 we know that elementary projections made in 2008 were too low, but that by “re-setting” kindergarten enrollments to what actually occurred during the past five years, the projections of elementary school students would have been fine. Students who have been entering the public school system in kindergarten have tended to stay in the system at the same rates that prevailed before kindergarten enrollments swelled (Figure 2). The projections in Table 2 assume that this state of affairs will continue.

Kindergarteners are expected to continue to show up at the high levels of recent years, with a peak in 2016-17. This is not because fertility has been high recently, but rather because we continue to assume that enrollment rates will remain high, as discussed just above. The low fertility cohort of 2012 makes its kindergarten entry in 2017-18 and should depress overall enrollments somewhat. Overall elementary school enrollments are not so far from their expected peak, and not much variation is predicted out into the future.

This is because elementary school enrollments in the middle- and long-term, far more than high school and even middle school enrollments, rely on assumptions about future births. As per the discussion surrounding Figure 3, most of the large movements in birth trends are a reflection of the

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<sup>13</sup> E.g., Lower Merion School District: <https://www.lmsd.org/enrollment-planning/index.aspx> and links therein.

Baby Boom and its aftermath — now long-ago events soon to be forgotten as those babies and their children fade as distinct reproductive elements. There is some year-to-year variation, especially in a small geographic area such as the Springfield School District, but nothing to model in an involved fashion, especially since there is also no evidence that the population dynamics of the district are changing (*cf.* Figure 6 and the accompanying discussion). The kindergarten enrollments in Table 2 are based on a time-series model fit to the Springfield School District birth data shown in Figure 4. They pick up — initially — a bit of the year-to-year pattern in variation, and then converge toward an average value.<sup>14</sup> Projected births were then multiplied by 0.95 — the high enrollment ratio alluded to earlier — to establish kindergarteners five years hence.

Whether a future in which something like 275 children per year enter the Springfield School District kindergartens is a realistic one depends on two things. If the economy improves substantially and/or the recent trend of huge majorities of eligible school district five- and six-year-olds reverses, then these numbers will be too high, and current elementary school enrollments will prove to be the peak. This could be mitigated, on the other hand, if births pick up substantially, as would occur if there were a demographic change in the direction of a more rapid pace in the turnover of housing from older to younger people.

### Conclusion

Not much appears to have changed in the past five years in the Springfield School District with respect to its demography (births, migration, population size, age structure). The propensity of school children to persist in the school system has also been steady — more so than at any time for which data are available. What has changed is the number of children showing up for kindergarten. There have been many more of them the last four or so years, and their persistence in the system presages growth not anticipated in the 2008 projections.

The argument in this report is that this change is more likely the result of the attractiveness of the school system in times of lingering economic distress and uncertainty — not that the demography of the district has changed in a way that prefigures massive changes in the school-eligible population. Uncertainty about the future is thus concentrated around the extent to which the recent history of very high early elementary school participation by the school district's families can be expected to continue.

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<sup>14</sup> The model has what is known in econometrics as an auto-regressive structure of lag 2.

**Table 2. Springfield Public School Enrollments: Observed, 1979-80 to 2013-14 and Projected, 2014-15 to 2029-30**

	K	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	K-4	5-8	9-12
1979-80	205	158	181	188	257	227	266	232	324	350	310	337	365	3400	989	1049	1362
1980-81	232	157	159	181	192	244	228	264	244	333	344	312	328	3218	921	980	1317
1981-82	201	155	159	170	183	192	242	250	275	245	327	332	313	3044	868	959	1217
1982-83	226	150	156	158	170	185	185	249	245	275	249	324	318	2890	860	864	1166
1983-84	224	182	147	165	159	178	193	203	251	272	273	234	305	2786	877	825	1084
1984-85	227	154	167	160	159	163	174	197	199	271	257	270	227	2625	867	733	1025
1985-86	245	183	158	180	162	161	171	187	195	200	268	248	255	2613	928	714	971
1986-87	223	241	178	167	202	171	179	178	187	211	206	263	255	2661	1011	715	935
1987-88	248	214	243	193	172	208	172	183	187	195	202	199	256	2672	1070	750	852
1988-89	244	239	209	241	200	191	215	174	185	191	193	211	196	2689	1133	765	791
1989-90	203	237	226	211	239	206	199	221	180	193	199	197	196	2707	1116	806	785
1990-91	251	210	233	240	224	241	213	206	220	188	205	199	188	2818	1158	880	780
1991-92	257	237	217	244	247	226	250	222	207	244	210	216	192	2969	1202	905	862
1992-93	234	253	240	232	253	253	235	252	235	250	240	218	209	3104	1212	975	917
1993-94	235	239	249	252	251	260	260	240	256	269	251	248	220	3230	1226	1016	988
1994-95	221	270	237	267	260	266	256	268	240	301	268	248	241	3343	1255	1030	1058
1995-96	212	260	261	226	262	266	256	256	279	257	303	266	243	3347	1221	1057	1069
1996-97	183	245	262	262	247	269	265	262	255	303	257	307	266	3383	1199	1051	1133
1997-98	155	217	252	269	254	254	274	280	271	278	302	261	307	3374	1147	1079	1148
1998-99	192	196	221	260	278	245	253	283	277	282	267	304	245	3303	1147	1058	1098
1999-00	179	210	204	244	268	291	253	255	291	271	287	265	295	3313	1105	1090	1118
2000-01	175	207	212	210	243	269	295	267	263	309	285	293	261	3289	1047	1094	1148
2001-02	184	207	220	214	217	244	266	302	266	290	308	282	292	3292	1042	1078	1172
2002-03	171	207	209	229	237	223	259	279	307	281	298	315	278	3293	1053	1068	1172
2003-04	177	203	222	217	249	256	244	274	279	319	299	308	319	3366	1068	1053	1245
2004-05	231	201	216	238	234	257	256	261	266	297	327	296	306	3386	1120	1040	1226
2005-06	212	247	207	240	251	241	262	273	268	268	298	326	306	3399	1157	1044	1198
2006-07	200	234	266	219	251	253	245	273	276	278	271	298	328	3392	1170	1047	1175
2007-08	233	235	238	267	235	251	267	255	283	295	281	271	302	3413	1208	1056	1149
2008-09	254	252	232	239	277	250	254	279	265	304	301	271	263	3441	1254	1048	1139
2009-10	239	280	259	244	246	288	253	272	282	296	308	301	271	3539	1268	1095	1176
2010-11	283	288	283	268	254	257	299	261	273	311	299	302	297	3675	1376	1090	1209
2011-12	276	311	299	292	279	267	259	307	260	290	307	296	311	3754	1457	1093	1204
2012-13	265	301	321	307	296	290	269	266	307	277	291	316	312	3818	1490	1132	1196
2013-14	287	289	315	323	314	315	297	277	269	330	281	292	318	3907	1528	1158	1221
2014-15	269	319	298	324	334	328	321	308	280	289	333	280	296	3979	1544	1237	1197
2015-16	286	299	329	306	336	349	334	333	312	301	291	332	284	4091	1556	1328	1207
2016-17	310	318	308	339	317	350	356	347	337	335	303	291	336	4246	1592	1390	1264
2017-18	238	345	328	317	351	331	357	369	350	362	337	302	294	4281	1578	1408	1296
2018-19	261	264	355	337	328	366	337	371	373	376	365	337	306	4377	1546	1447	1384
2019-20	271	291	272	365	349	343	373	350	375	401	379	364	341	4473	1548	1440	1485
2020-21	269	301	300	280	378	364	349	387	354	402	404	379	368	4536	1528	1455	1553
2021-22	272	299	310	308	290	395	371	363	391	380	405	403	383	4571	1479	1520	1572
2022-23	272	302	308	319	319	303	402	386	366	420	383	405	408	4593	1520	1457	1616
2023-24	273	303	311	317	331	333	309	418	390	394	423	382	409	4592	1534	1449	1609
2024-25	274	304	312	320	328	345	339	320	422	419	397	423	387	4589	1537	1427	1625
2025-26	274	304	313	321	332	342	352	352	324	453	422	396	428	4613	1544	1370	1699
2026-27	275	305	314	322	332	346	349	365	356	348	457	421	401	4590	1547	1416	1626
2027-28	275	306	314	323	333	346	353	362	369	383	350	456	426	4596	1551	1431	1615
2028-29	275	306	315	323	334	348	353	366	366	396	386	350	461	4580	1553	1433	1593
2029-30	276	306	315	324	335	349	355	367	370	393	399	385	354	4527	1556	1440	1531

### ***About the Author***

Herbert L. Smith is Professor of Sociology, Associate Chair of the Department of Sociology, and Director of the Population Studies Center of the University of Pennsylvania, where he has also served as Associate Dean for the Social Sciences for the School of Arts and Sciences. Prior to joining the faculty at Penn, he was a Visiting Research Fellow in the Population Sciences Division of The Rockefeller Foundation, and Assistant Professor of Sociology at Indiana University, Bloomington. He received his B.A., in History and Sociology, from Yale University, and his M.A. and Ph.D. in Sociology, from The University of Michigan, Ann Arbor. His Ph.D. thesis, on “Determinants of Higher Education Enrollment in the United States,” was the beginning of research interests in population forecasting and the demography of education. Professor Smith was on the organizing committee of the Social Science Research Council’s working group on Forecasting in the Natural and Social Sciences, and served on the National Research Council panel evaluating Department of Education-funded research on programs for teaching students with limited English proficiency. His work on the demography of education has appeared in the *American Journal of Sociology*, *American Demographics*, *Sociology of Education*, *Sociological Methodology*, and *Sociological Methods & Research*. A 2009 paper in the *Cahiers Québécois de Démographie* is a detailed summary of the statistical basis for projection methods such as those featured in this report. Professor Smith has previously served as an Associate Editor of *Sociological Methods & Research* and *Evaluation Review*, of *Sociological Methodology*, and of the *American Sociological Review*. He has served on the Board of Directors of the Population Association of America and has previously chaired the Panel on Demographic Research, a study section of the National Institute for Child Health and Human Development, of the National Institutes of Health; chaired the Section on the Sociology of Population of the American Sociological Association; chaired the Publications Committee of the Population Association of America; and served on the Sociology panel of the National Science Foundation. From 2009 through 2013 he was *Président* (Chair) of the *Commission d’Évaluation* (committee for evaluation, hiring, and promotion) of the *Institut National d’Études Démographiques* (INED, the French national institute for demography) — the first American or U.S.-based scholar to serve in this role. In addition to Springfield, he has prepared enrollment projections for four other Philadelphia suburban school districts.