Exhibit A
Demographic School Analysis: Population Projections for the Franklin Regional School District - Steward Demographics, LLC

Franklin Regional School District  District-Wide Facility Study
Demographic School Analysis:
Population Projections for the
Franklin Regional School District

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The present analysis will consist of four parts: (1) an initial analysis of demographic and economic processes impacting student enrollments, (2) the ten-year projections of students by grade and level, (3) the ten-year projections of student enrollment for the three elementary schools and (4) a summary.

To arrive at these projections, we take an in-depth look at shifts in births, levels of in-migration and rate of new housing construction. We examine the changes that have occurred, including whether there have been shifts in the last decade or longer, and for births, in particular, we probe into the processes and structures underlying these shifts, also revealing likely directions in the future. Migration is shown to be quite important. We examine net-migration of (i) families with preschool children, (ii) students at each educational level and (iii) the general population by age cohort. We also look at the change in the rate of new housing construction. A brief overview of the 4th three parts of the analysis is given below.

I. An initial analysis with four overall themes—

(1) Births

(i) We find decreases in the number of births over the last 20 years at each of the 5-year periods, from the peak in 1990-94 at 219, to 214 in 1995-99 to 210 in 2000-04 and then to 192 in 2005-09 to the current low of 181, a drop over the 2 decades of 37/year or 17%. The decreases in the last decade were also much more steep than those of the 1st 10 years (-29/yr. vs. -8/yr.)
(ii) A key question is “Should we expect the number of births to continue to decrease?” A straight black box extrapolation would say “Yes, births will continue to decrease.” But we will show that there are strong reasons to expect a turnaround, with births increasing. We can already see signals of this turnaround if we look at births by age cohort of the mothers. In which case, a follow-up question is “What will be the magnitude of the increase in births?”
(iii) The basis for the expected turnaround in number of births is the fundamental large shifts in the primary reproductive age cohorts in the United States, in Pennsylvania, in Allegheny and Westmoreland Counties and, indeed, in the Franklin Regional School District—which we will show. We label these shifts or population waves as the Baby Boom, the baby bust and the Echo Boom (Millenials). These population waves are particularly important given the relative constant fertility rates over the last 40 years of
white non-Hispanic women in the United States, which we will also show.

(2) Net Migration A 2nd fundamental population process is also in play—net migration into and out of the school district. These processes can be observed at multiple levels: preschool children, students in K to Grade 12 and in the adult residents as follows:

(i) In the last 5 years for which data is available, 2010-14, there has been a notable increase in preschoolers and their families moving into the district. The average inflow per year for ages 0-4 increased from about 30/year in 1995-99 and 2005-09 to 55/year per year of age, an increase of 25/year or 133 K students per 100 births in 2010-14. Consistent with this, the Birth-to-Kindergarten ratio has recently increased from 1.11 to 1.24. That is, instead of 111 K students showing up 5-6 years later per 100 births, more recently it is 124 K students per 100 births and in the last 2 years it is 1.33 or 133 K students per 100 births! Thus, in addition to the expected increase in number of births to district residents, there is already a net inflow of preschoolers moving in, adding to the expected increase in Kindergarten in the near term future.

(ii) In terms of the net migration of Franklin Regional students, we have developed a method to deduce such flows from time-series enrollment data. Initially assuming no migration, we calculate the difference between the exiting senior class in high school in the spring and the subsequent entering Kindergarten class in the fall—which we call the exit-entry exchange (E3). Then, algebraically, when we subtract the actual student enrollment change, we obtain the net migration (NM). Phrased differently, the 2 processes—E3 and NM, when added together equal the enrollment per year. In the last 5 years, 2010-2015, E3 was -468 and NM +188 and hence enrollment decreased by 280 students versus by over 450, which would have been the case with no migration. The net in-migration by students in K to grade 12 muted the decrease in student enrollment by 5%, from 12.4% with no migration to 7.5% with actual migration.

(iii) We can also deduce the net migration of 5-year age cohorts in the overall population of school district residents. As might be expected, there are strong outflows in age cohorts 15-19, 20-24 and 25-29, though none overpower the structural shifts in the population waves. There are also strong inflows in age cohorts 30-34, 35-39 and 40-44, though again, none overpower the structural shifts in the population waves. As we will show, the age cohorts 25-29, 30-34 and 35-39 are the key reproductive ages in the school district. We also observe net in-migration in the 50’s and outflows in the 60’s, 70’s and 80’s. Even in the face of these outflows by those ages 60 and above, there are still increases in all 5-year age cohorts at or above age 50.
Considerable new housing has been built in the school district over the last 20 years, with the peak of construction in 2001-05. The level of construction was also rather high in 1996-2000. In Murrysville Municipality, where over 90% of the new houses were built, an average of 93 new homes were built per year in 1996-2000 and an average of 109 new homes were built in 2001-05. In total, just over 1,000 (1,010) new homes were built in the 1996-2005 decade; and in the following most recent 10 years, 2006-2015, the number was less than 600 (582). With the onset and aftermath of both the housing and financial bubbles, new home construction dropped by 32% to an average 74/year in 2006-10, followed by another drop of 42% in 2011-2015, to an average of 43 new homes/year. All toll, the drop was 62% from the peak or from 109/year to 43/year. Looking at total housing construction in the Franklin Regional School District, including Delmont Borough, which had 100 new homes built in 1996-2005, but only 28 in 2006-2015, as well Export with a total of 10 new homes from 1996 to 2010 and none in 2011-2014, we have an average of 105 and 118 new homes built per year in 1996-2000 and 2001-2005, respectively. The total is 1,115 new homes. Also, in 2006, 122 new homes were built, so, in effect, 2006 marks the turning point in new home construction in the school district. For the 11 years from 1996-2006, 1,237 new homes were built (112/yr. ave.) and in the subsequent 9 years, the number was 494 (55/yr. ave.). In the last 5 years, this number has averaged 45/yr. The bottom line here is that there will be no additional direct impact from new housing construction beyond that already estimated in the retention ratios—which have indirect impacts from net migration to both existing housing stock and new homes. In fact, the results from the net migration analysis indicate considerable impacts via new residents more than just replacing those who move out, especially for families with preschool children.

Lastly, we will examine students residing in the school district who are home schooled, are enrolled in charter/cyber charter schools or are enrolled in private/parochial schools. Such students accounted for about 7% of the total student population residing in the school district in 2010 and about 8% in 2015. The number of students in alternative schooling was 250 in 2010 and 278 in 2015. The enrollments by level dropped by 5 (142→137) for the elementary level, and increased by 13 (62→75) at the middle school level and by 20 (46→66) at the high school level. For the elementary students, the drop was primarily due to a decrease of 23 in private/parochial students coupled with a gain of 14 home schooled students and 4 more charter/cyber charter students, for a net change of -5. At the middle school level, 12 of the additional students were home schooled, while at the high school level 11 of the 20 additional students were enrolled in charter/cyber charter schools, 6
were being home schooled and 3 additional students were in private/parochial schools. Overall, there was a doubling of home schooled students $32 \rightarrow 64$, an increase of 15 in charter/cyber charter enrollment $(41 \rightarrow 56)$, and a decrease of 19 students enrolled in private/parochial schools $(177 \rightarrow 158)$, for a net change of 28 additional students enrolled in alternative schooling $(250 \rightarrow 278)$.

The assessment of the above set of changes and processes is important in determining the nature of demographic modeling to use, in the selection of parameters for such models and in the interpretation of the underlying processes and the results.

II. Development and analysis of grade specific school district projections for the ten-year period, 2016-2025 (6 Scenarios).

All six projections use the most current four-year retention ratios. Five of the projections use the most current 4-year Birth to Kindergarten ratio; the other projection uses the most current 2-year Birth to Kindergarten ratio. Retention ratios in these scenarios have a baseline level of “growth” embedded in them, indirectly taking into account new housing, as well as any other basis for new student inflows into the school district. One of the alternative projections asks what level of births (or births plus net in-migration of preschoolers) would be necessary to maintain the current number of high school students, given the most current retention ratios. We mainly consider increases in births, but have one scenario in which births continue to decline; this case is considered an outlier, but serves to represent the lowest enrollment case. The cases with increased births are based on the population waves in the general population—Baby Boom, baby bust and Echo Boom—and in three instances also reflect the expected increase in births and the increased net in-migration of preschoolers.

III. Development and analysis of areal specific district student projections for the three elementary schools over the ten-year period, 2016-2025.

These projections use the most recent four-year retention ratios and Birth to Kindergarten ratios, as in Scenario III. In these projections, an attempt was made to take the specific elementary attendance area’s births into account but this was not effective and 2 scenarios were developed using the 2-yr. and. 6-yr. distribution of Kindergarten children across the 3 elementary schools. These disaggregate projections also map to the more aggregate projections in Section II.
I. Initial Analysis

Four (4) major demographic and economic processes are examined with respect to projecting the expected shifts in student population in the Franklin Regional School District (SD) over the next ten (10) years. The first major factor is the expected number of births per year—currently at about 181/year. We expect that this level or higher will hold for the remainder of the decade rather than continue to decrease. This assumption is based on our analysis of the shifting age structure for key reproductive age females; this will affect entering cohorts at the Kindergarten level, changing their current trajectory. The second major factor is the increase in the number of preschoolers moving into the district—276 over the most recent five-year period, equivalent to an increase in births of 55 per year. A third factor affecting the student population may be seen if we momentarily assume that migration is zero. In this case, any change in the student enrollment is due to the replacement of students who exit, by the students who enter—which we refer to in this analysis as the Exit-Entry Exchange (EEE or E3). This process, in conjunction with the net-migration of students, accounts for any changes in student enrollment. The fourth factor—potentially affecting the immigration of families with school age children—is new housing construction. The level of housing development has been considerable over the last twenty years, and for the 10-year period from 1996 to 2005, there were 1,115 new housing units built; of these, almost all were single family dwellings (SFDs).
However, due to the bursting of the financial and housing bubbles, new housing construction dropped rather steeply, as noted in the introduction. The continuation of such new housing construction, even at the lower current rate (45/year) remains important, however in another respect—in attracting families with preschool children. That is, even with lags between residency and enrollment in Kindergarten or Grade 1, the arrival of families with preschool children has yet to conclude in terms of additional students.

The analysis to follow, preceding the student population projections, is important both in terms of determining the nature of the demographic modeling to use and in the selection of parameters for such models. The analysis is also important in the interpretation of the underlying processes involved in the derived projected enrollment. We begin by taking an in-depth look at the demographic side of the process—fertility and migration.

**Fertility**

**An End to the Decrease in the Number of Births?**

Table 1 provides the number of births by year over the last twenty-five years. As shown in the lowest quadrant, per 5-year period, the initial decreases in births from 219/year to 214 and then 211 over the initial decade from 1990-94 to 2000-04 were rather small—a decrease of 8 fewer births, on average, per year (-4%). However, the next 10 years saw far stronger decreases per 5-year period—from 211/year in 2000-04 to 192/year in 2005-09 and then to 181/year in the most current period—2010 to 2014. The drop in the last 10 years averaged -18.6 in 2005-09 and then another -10.8 in
The total decrease of 29 fewer births per year in the last 10 years (-14%), when added to the rather slow decreases in the 1st 10 years, brings the 20-year drop to 37 fewer births per year or 17%. This raises two important questions “Should we expect the number of births to continue to decrease?” and (2) “Should we expect a comparable enrollment drop of -14% over the next 10 years?” Were we to simply take a black box approach to the 1st question and extrapolate the 20-year trajectory further into the future, the answer would be a definite “Yes the number of births/year will continue to fall”. But this approach implicitly assumes that the forces driving the decreases and their direction will continue unabated—without any insight into these forces and how they operate. In contrast to the initial black box answer given above, here we will show that there are strong reasons to expect a turnaround in the number of births/year—to increases versus decreases. The past is not the future, if we take into account the major shifts in the population age structure as well as delayed child bearing—from the predominance of births in the 20’s to the 30’s. The normal delay in childbearing is initially into the early 30’s and then into the late 30’s and early 40’s. This 2-phase shift is a rather significant behavioral change. On the other hand, the population waves that are moving through the age structure are quite pronounced and are fundamental to a more thorough understanding of why births continued to decrease over the last 20 years and why a turnaround should now be expected. More specifically, one of the main factors in the last 20 years has been the replacement of Baby Boom
2010-14. The total decrease of 29 fewer births per year in the last 10 years (-14%), when added to the rather slow decreases in the 1st 10 years, brings the 20-year drop to 37 fewer births per year or 17%. This raises two important questions “Should we expect the number of births to continue to decrease?” and (2) “Should we expect a comparable enrollment drop of -14% over the next 10 years?” Were we to simply take a black box approach to the 1st question and extrapolate the 20-year trajectory further into the future, the answer would be a definite “Yes the number of births/year will continue to fall”. But this approach implicitly assumes that the forces driving the decreases and their direction will continue unabated—without any insight into these forces and how they operate. In contrast to the initial black box answer given above, here we will show that there are strong reasons to expect a turn around in the number of births/year—to increases versus decreases. The past is not the future, if we take into account the major shifts in the population age structure as well as delayed child bearing—from the predominance of births in the 20’s to the 30’s. The normal delay in childbearing is initially into the early 30’s and then into the late 30’s and early 40’s. This 2-phase shift is a rather significant behavioral change. On the other hand, the population waves that are moving through the age structure are quite pronounced and are fundamental to a more thorough understanding of why births continued to decrease over the last 20 years and why a turnaround should now be expected. More specifically, one of the main factors in the last 20 years has been the replacement of Baby Boom
age cohorts with smaller “baby bust” age cohorts in their twenties and subsequently in their thirties—both being key reproductive age cohorts responsible for most of the births in the United States. As we will show in the analysis to follow, there are compelling reasons to expect a reversal from the prior decreases, with births beginning to increase. Thus, we will look more closely at the shifts in the number of births and the processes underlying these shifts.¹

**Relative Impact of the Different Age Cohorts: Delayed Childbearing**

Table 2 provides the births by age cohort of mother over the last 24 years, by municipality—Table 2A for Delmont, 2B for Export and 2C for Murrysville. Table 3 provides the same data for the entire school district and reveals part of the nature of the shift in births—delayed childbearing. Note that the “Total Birth” column (Σ) is the same as in Table 1. Table 3 now provides the number of births per age-cohort for 24 years. Here our concern is to address the relative impact of the different age cohorts. At the top of Table 3, in the early 1990s, one can already see the relative dominance, in terms of the number of births, of the age-cohort 30-34. (See the % of Σ row.) The remaining ordering is then as follows: the 25-29 cohort, the 35-39 and the 20-24 age cohort. By 1990, the shift to births in the early 30’s has already occurred, whereby the 25-29 age-cohort has been replaced and become a distant 2nd, in terms of number of births. Also, the 35-39 age-cohort begins to outpace the 25-29 age-cohort by 2000-04 and 2005-09. At

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¹ The answer to the 2nd question regarding large declines in enrollment will be addressed in the 2nd major section of this study—in the student projections.
the bookends, the 40-44 age-cohort has more births than that of teenagers and this gap, while small, is increasing. In all 5 multi-year periods, over ½ of all births occur after age 30. These numbers and relative share clearly indicate delayed childbearing—in the 30’s and early 40’s.

A different way to see the delayed child bearing is to look at the actual numerical changes in Murrysville between 1990-94 and 2000-04. They are as follows:

<table>
<thead>
<tr>
<th>Age Cohort</th>
<th>15-19</th>
<th>20-24</th>
<th>25-29</th>
<th>30-34</th>
<th>35-39</th>
<th>40-44</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Births in 1990-94</td>
<td>17</td>
<td>52</td>
<td>216</td>
<td>331</td>
<td>143</td>
<td>29</td>
<td>158</td>
</tr>
<tr>
<td>Births in 2000-04</td>
<td>9</td>
<td>42</td>
<td>151</td>
<td>348</td>
<td>207</td>
<td>49</td>
<td>161</td>
</tr>
<tr>
<td>Δ</td>
<td>-8</td>
<td>-20</td>
<td>-65</td>
<td>+17</td>
<td>+64</td>
<td>+20</td>
<td>+3</td>
</tr>
</tbody>
</table>

Unlike the overall school district where births dropped across all 5 year periods, here births are actually stable, with an extremely slight increase—but basically constant for these 2 periods. Quite noticeable in the above data is the age 30 breakpoint—all age cohorts below age 30 have decreases in births and all cohorts above age 30 have increased births. This is a fairly clear indication of delayed child bearing, especially given the virtual same number of overall births. The case is, of course, more complex than this given the population waves in the age structure, but this example is illustrative of the overall shift toward more and more of the births occurring after age 30.
Relative Size of the Different Age Cohorts: Baby Boom, Baby Bust and the Echo Boom

A second story emerges if we take a closer look into the nature of the shifts in the number of births by age in Tables 2 and 3. More specifically, can we identify the structures or processes underlying the shifts in the number of births in these tables? To begin to do so, we need to take into account the number of reproductive age women in different age cohorts, since the Baby Boom and baby bust periods have resulted in considerable oscillations in the number of women in the prime childbearing years. To be more concrete, at the peak of the Baby Boom (1957) the Total Fertility Rate\(^1\) was 3.8, while at the trough of the baby bust (1976) it was 1.7, less than 1/2 that of the Baby Boom peak. Thus, the number of reproductive age females is much larger if they were born in the Baby Boom years and reciprocally, much smaller if they were born in the baby bust years. If fertility rates of these cohorts of women were the same over time, then the number of expected births would vary considerably, with more births to Baby Boom mothers and fewer births to baby bust mothers. This is at least part of explanation for the shifts in births over time, in terms of where in the age distribution to expect increases or decreases in births. It is also pertinent for expectations regarding future levels of births since we are currently beginning to see Echo Boom cohorts, which are larger than the baby bust cohorts, take center stage in the key reproductive ages. We will explore these points in more depth below.

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\(^1\) The Total Fertility Rate (TFR) is the average expected total number of children that a woman will have under the current age-specific fertility rates.
To what extent are the shifts in births due to the shifting age structure of reproductive age females? We will initially address this question in two parts, examining the shifts in each case. We first compare the shifts in the female population age structure, paying particular attention to major decreases and increases per age cohort. We then juxtapose the shifts in the number of reproductive age females to the shifts in the number of births. In terms of percentage changes, enabling one to assess the extent to which the shifts in the number of reproductive females maps to the shifts in births.

Table 4 provides the data for the shifts in the female population in the Municipality of Murrysville by age cohort from 1990 to 2000 and from 2000 to 2010. The bottom quadrant of the table shows the percentage changes. From 1990 to 2000, there were major decreases in the number of women in the 20-24, 25-29 and 30-34 age cohorts. The decreases were 27%, 43% and 30%, respectively. Then from 2000 to 2010 there were reverses in the number of women in the 20-24 and 25-29 age cohorts, with gains of 12% and 35%, respectively. At the same time of these increases, the age cohorts 30-34, 35-39 and 40-44 experienced major decreases in the number of women, with both cohorts in their 30’s decreasing by around 30% and the age 40-44 cohort declining by 22%.1 To what extent are the changes in the number of women in Table 4 comparable to changes in the number of births?

Table 5 juxtaposes the shifts in the number of reproductive age females (NRAF) and the shifts in the number of births by age cohort in Murrysville.

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1 Note that the age 30-34 cohort experienced major decreases of about 30% in both 1990-94 and 2000-2004. The actual numbers are shown at the top of the table: 696→489→351.
Column A gives the percentage changes in the number of births by age, column B shows the percentage changes in NRAF. Column C provides the effects of other factors on the shift in births—particularly of the behavioral changes in fertility, and column D gives the relative impacts on the shifts by NRAF and the behavioral changes. The sum of columns B and C yields the shift observed in the number of births in column A.

The upper quadrant of Table 5 shows the shifts from 1990 to 2000. We see major decreases in the NRAF in the 20’s AND major decreases in the number of births. To size up the relative contributions NRAF and the changes in fertility by age we take the sum of columns B and C and use the absolute values of the numbers in columns B and C as the denominator to obtain the relative share of the population shift (column B) and the behavioral change (column C) shown in column D. For both the 20-24 and 25-29 age cohorts, just over 75% of the decrease in births is due to decreases in the NRAF. About 25% of the shift in births is due to increased fertility since the drop in births was not as steep as the drop in NRAF.\(^1\) For the 30-34 age cohort, on the other hand, the NRAF decreased by 30% and the number of births increased modestly by 5%. This is due to the large effect of delayed child bearing (+35%) and the concomitant large effect of the decreases in NRAF (-30%) i.e. +35% -30% = +5%. The effect of delayed child bearing is even stronger for the 35-39 age cohort, with a decrease in the NRAF of 8%, but an increase of 45% in the number of births—a 12%/88% split with the major

\(^1\)Additionally, if one looks at column C there is a monotonic increase in fertility with increasing age from 15-19 through 40-44. This column when examined from top to bottom clearly indicates delayed child bearing.
age cohorts with smaller “baby bust” age cohorts in their twenties and subsequently in their thirties—both being key reproductive age cohorts responsible for most of the births in the United States. As we will show in the analysis to follow, there are compelling reasons to expect a reversal from the prior decreases, with births beginning to increase. Thus, we will look more closely at the shifts in the number of births and the processes underlying these shifts.¹

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\(^{1}\) The Total Fertility Rate (TFR) is the average expected total number of children that a woman will have under the current age-specific fertility rates.
To what extent are the shifts in births due to the shifting age structure of reproductive age females? We will initially address this question in two parts, examining the shifts in each case. We first compare the shifts in the female population age structure, paying particular attention to major decreases and increases per age cohort. We then juxtapose the shifts in the number of reproductive age females to the shifts in the number of births. In terms of percentage changes, enabling one to assess the extent to which the shifts in the number of reproductive females maps to the shifts in births.

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Table 5 juxtaposes the shifts in the number of reproductive age females (NRAF) and the shifts in the number of births by age cohort in Murrysville.

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1 Note that the age 30-34 cohort experienced major decreases of about 30% in both 1990-94 and 2000-2004. The actual numbers are shown at the top of the table: 696 → 489 → 351.
Column A gives the percentage changes in the number of births by age, column B shows the percentage changes in NRAF. Column C provides the effects of other factors on the shift in births—particularly of the behavioral changes in fertility, and column D gives the relative impacts on the shifts by NRAF and the behavioral changes. The sum of columns B and C yields the shift observed in the number of births in column A.

The upper quadrant of Table 5 shows the shifts from 1990 to 2000. We see major decreases in the NRAF in the 20’s AND major decreases in the number of births. To size up the relative contributions NRAF and the changes in fertility by age we take the sum of columns B and C and use the absolute values of the numbers in columns B and C as the denominator to obtain the relative share of the population shift (column B) and the behavioral change (column C) shown in column D. For both the 20-24 and 25-29 age cohorts, just over 75% of the decrease in births is due to decreases in the NRAF. About 25% of the shift in births is due to increased fertility since the drop in births was not as steep as the drop in NRAF.\(^1\) For the 30-34 age cohort, on the other hand, the NRAF decreased by 30% and the number of births increased modestly by 5%. This is due to the large effect of delayed child bearing (+35%) and the concomitant large effect of the decreases in NRAF (-30%) i.e. \(+35\% -30\% = +5\%\). The effect of delayed child bearing is even stronger for the 35-39 age cohort, with a decrease in the NRAF of 8%, but an increase of 45% in the number of births—a 12%/88% split with the major

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\(^1\)Additionally, if one looks at column C there is a monotonic increase in fertility with increasing age from 15-19 through 40-44. This column when examined from top to bottom clearly indicates delayed child bearing.
effect from delayed childbearing. In general we see the decreases in births in the teens and twenties and increases in births in the thirties and early forties, consistent with the above finding on delayed child bearing. However, there is much more operative here, as we will now show.

The lower quadrant of Table 5 provides the age structure and the shifts by age cohort between 2000 and 2010 for Murrysville. We can see increases in NRAF at ages 15-19 and the 20’s (especially 25-29) and decreases in NRAF in the 30’s and early 40’s. At ages 30-34, 35-39 and 40-44, the decreases in the number of births are closely related to the decreases in NRAF. Column D shows that from 75% to 96% of the drop in births in these age cohorts is due to decreases in NRAF. In contrast, in ages 15-19 and 20-24, the increases in NRAF are overpowered by large decreases in fertility—accounting for about 70%-80% of the decline in births. At ages 25-29, on the other hand, the large increase in NRAF is met with only a modest 6% increase in births, suggesting comparable impacts from NRAF (45%) and delayed child bearing (55%), with the latter largely muting the increase in NRAF.

In regard to Table 5, the following point is quite important. The large decreases in NRAF in the upper quadrant for ages 20-24, 25-29 and 30-34 are paralleled a decade later by large decreases in the 30-34, 35-39 and 40-44 age cohorts. In fact, these are the same age cohorts in 1990-2000 who have now aged 10 years in 2000-2010, thus essentially decreasing the number of births for 2 decades. In 1990-2000, the baby bust and the
relatively smaller Transition cohort between the Baby Boom and the baby bust occupy the 20-24, 25-29 and 30-34 age bands. In 2000-2010, this same population + net migration now occupies the 30-34, 35-39 and 40-44 age cohorts. To simplify, by looking at the 1\textsuperscript{st} 2 cohorts per decade, this is basically a phase shift in which baby bust 1\textsuperscript{st} replaces the Baby Boom in the 20’s in the 1\textsuperscript{st} phase or decade, and then, due to aging, they also replace the Baby Boom cohorts in the 30’s in the next decade or 2\textsuperscript{nd} phase—having major implications for the size of the NRAF inside the age distribution. The baby bust’s tandem shifts, replacing larger Baby Boom cohorts at these key reproductive ages, and in the middle of the Baby Boom and Echo Boom, are important in producing a wave-form of reduced births in both 1990-2000 and 2000-2010.

Tables 6 and 7 provide information on the NRAFs and births for the entire school district for 2000-2010. As may be seen in Table 6 there are increases in NRAF for all age cohorts less than age 30 and major increases for both cohorts in their 20’s (+16-\%-+24\%). These two 20-24 and 25-29 age cohorts mark the start of the entry of the Echo Boom cohorts and they are replacing the baby bust cohorts (in the 20’s) as the latter age and move into the 30-34 and 35-39 ages. It is not coincidence that the cohorts above age 30 in the 2000-2010 decade have experienced major decreases in NRAFs of 24\% to 26\%. Table 7 show the shifts in births alongside the shifts in NRAF, as well as the behavioral fertility shifts and relative shares of effects on births (column D)—as has already been examined for Murrysville in Table 5. The
shifts in births and shifts in NRAF for ages 30-34 and 35-39 (-23% and -25%) are extremely close, accounting for 90%-96% of the decreases in births at these ages, respectively. For the early 40’s cohort, the NRAF effect is also high, accounting for 73% of the shift in births. Especially important, is that now the cohorts in their 20’s are experiencing increases in births, reversing the downward trajectory seen earlier for these cohorts in the Murraysville case for 1990-2000 (Table 5, upper quadrant, ages 20-24 and 25-29 where the NRAF decreased by 27% and 43%, respectively and births also were decreasing by 19% and 30%, respectively). In short, in 1990-2000, the 2 cohorts in their 20’s had major NRAF decreases and major decreases in births, while in 2000-2010 there has been a turnaround with these larger replacement cohorts experiencing both an increase in NRAFs and in births. The increases in births of 6% and 15% are muted somewhat due to delayed childbearing (showing up in Table 7 as negative for all cohorts under age 30). Two things are important regarding these observations. First, of course, is that the shifts in the number of births has turned around for women in the district in their 20’s and are now increasing, at the same time that the NRAFs for these age groups are increasing. Second, these increases in NRAFs are due to Echo Boom women replacing baby bust females who have now aged into their 30’s. The good news is that there are more Echo Boom cohorts to follow and that in the 2010-2020 decade they will also replace the baby bust women now in their 30’s, further increasing the likelihood of increases in births in the future.
Overall, we conclude that both processes that we have been examining are operative—there are large drops or increases in the number of women, which in many cases account for most of the change in the number of births by these women. There is also delayed childbearing, including the second wave, into the late thirties and early forties. Here we also note (1) that the Baby Bust cohorts are important in both the 1990s and thereafter in that in their aftermath there are major decreases in the NRAF and (2) that this wave phenomena when adding in the Echo Boom cohorts and which reverses the decreases, extends over several decades, including into the forthcoming decade and in the most recent decade. We will now look more closely at the shifting age structure and how it relates to the discussion above and to likely shifts in births in the future.

**Baby Boom, Baby Bust and the Echo Boom: United States, Pennsylvania, Allegheny County, Westmoreland County and the Franklin Regional School District**

Before continuing, we will offer somewhat more context for the changes in the number of reproductive women. What is going on? Are the oscillations in terms of drops and then increases in the population of the key reproductive age cohorts seen here specific to the Franklin Regional School District? To Pennsylvania in general? Or is this a more general phenomenon in the United States? Table 8 provides data for the United States, Pennsylvania and Allegheny County for five-year age cohorts from ages 0 to 44. In the top panel of Table 8, the numbers in bold type indicate the Baby Boom and the shaded numbers indicate the baby bust. We refer to a medium sized
cohort born between the Baby Boom and the baby bust (1966-1970) as the Transition cohort. The Echo Boom cohorts immediately trail the baby bust cohorts and cover at least 2 decades, as did the Baby Boom. The data for Table 8 extend from 1990 to 2010. At all three levels—in the United States, Pennsylvania and Allegheny County, there are decreases in the 20-24, 25-29 and 30-34 female age cohorts between 1990 and 2000 AND decreases in the 30-34, 35-39 and 40-44 age cohorts between 2000 and 2010. (See the shaded age cohorts in the Change by Age Cohort Across Time, the second panel—lower quadrant of Table 8, page 1). One has to think in terms of generational change, where the births of daughters in one generation become the mothers of the next generation. Thus, the shifts in the 20-24, 25-29 and 30-34 age cohorts of females in 1990-2000 represent a more tidal shift from the Baby Boom to the baby bust due to changes in fertility levels as noted earlier—from total fertility rates, where on average, their mothers had 3.8 children in 1957 to 1.7 children in 1976. The low fertility rates in the 1970s are referred to as the baby bust. To illustrate, there were 21.3 million children born between 1956 and 1960, at the height of the Baby Boom and 16.3 million births between 1971 and 1975 the onset of the baby bust, a decrease of 5.0 million births and a drop of 23%. Also, these same cohorts – aged 10 years by 2010—and now 30-34, 35-39 and 40-44 are again experiencing decreases in the number of women. Equally important, in 1990, the four five-year Baby Boom cohorts (born in 1946-1965) occupied three of the key reproductive age cohorts (25-29, 30-34 and 35-39, as well as
the oldest reproductive cohort (40-44). In contrast, by 2000, the Baby Boom occupied only the two older reproductive cohorts and the two five-year baby bust cohorts (born in 1971-1980) were beginning to take center stage, occupying both key twenty-year-old cohorts. (See the shaded age cohorts in the upper panel of Table 8 to view their aging from the teens to the 20’s to the 30’s.) A third key reproductive cohort, age 30-34 in 2000, was held by the Transition cohort. Thus, in 2000, three of the key reproductive age cohorts (20-24, 25-29 and 30-34) were smaller than their predecessors in 1990, as clearly shown in the upper panel of Table 8. [Look to the left in the same row.] Look also in the lower panel where the size of the change across the decades is given, as well as the percentage change. From 1990 to 2000, the largest decrease was in the 25-29 age cohort and between 2000 and 2010, the largest decrease was in the 35-39 age cohort. In both cases, this is the 1st baby bust cohort. By examining the shaded age cohorts in the lower panel of Table 8, one can see that they travel in tandem and are decreasing in both decades at all levels—national, state and county. These cohorts are the two baby bust cohorts and the Transition cohort, the latter of which led the declines once the Baby Boom was over. If one looks at the size of the Echo Boom cohorts which follow the baby bust cohorts, they reverse the age cohort declines and are increasing in both the United States and Pennsylvania in both decades for at least the 1st three Echo Boom cohorts. At the national level the increases range from 14% to 20% in 1990 to 2000 and from 9% to 14% in the 2nd decade, 2000 to 2010. The increases
are generally more modest in Pennsylvania—from 4% to 14% in 1990-2000 and 6% to 16% in 2000-2010. In Allegheny County, the story is more mixed with increases in only the 2nd Echo Boom cohort between 1990 and 2000 and for the 1st and 2nd Echo Boom cohorts in 2000 to 2010.\footnote{The smaller the geographical unit being examined, the greater the potential impact of migration.}

Comparable data for 2000 to 2010 in Westmoreland County is given in Table 8A, with one exception—the data are for the total population, not just females as in Table 8. In 2000, the baby bust cohorts occupy the 20-24 and 25-29 age bands, while the Transition cohort is 30-34. These 3 age cohorts are considerably smaller than the cohorts on either side—older (Baby Boom) or younger (Echo Boom). If one then shifts their attention to the 2010 column—with the focus on the same baby bust and Transition cohorts, now 10 years older—the baby bust cohorts remain considerably smaller. The change in magnitude and percentages is shown in the last column. To identify the baby bust cohorts, look at the column to the right of the “Birth Years” column and to ascertain the shifts look at the last column. We see decreases for the 30-34, 35-39 and 40-44 age cohorts of 20% to 26%. In 2 of the 1st three Echo Boom cohorts there are increases, though not in the 1st Echo Boom cohort.

Finally, we turn to the Franklin Regional School District resident population. Table 9 provides the data for the total population by age cohort for 2000 and 2010. Once again, we may readily identify the Baby Boom, baby bust and Echo Boom age cohorts by their relative size, as well as their
sequential ordering. The shifts in this decade, seen in the prior analysis regarding NRAF and births, are quite evident—with decreases of 21%-26% in the age cohorts 30-34, 35-39 and 40-44 (baby bust 2, baby bust 1 and transition cohorts, respectively) and increases in the cohorts 20-24 and 25-29 (Echo Boom 2 and Echo Boom 1 cohorts) of 23%-27%. In sum, the population waves analyzed in the prior section are occurring throughout the United States at all levels and they will continue to have impacts for at least the next 2 to 3 decades and possibly for the next half century.¹

Since the age cohorts that we have been discussing have a very clear time of birth identification, we can specify their location across time in 5-year sequences—including the future. We do this in Table 10, mapping the shifting of the key Baby Boom, baby bust and Echo Boom cohorts from 1990 to 2020 for 5-year periods from 1990 to 2020. The distinct cohorts include the 4 Baby Boom cohorts, the Transition cohort, the 2 baby bust cohorts and 3 Echo boom cohorts. In 1990, the Baby Boom cohorts occupied all age bands 25 and older, including 3 key reproductive age cohorts—25-29, 30-34 and 35-39. By 2000, we can see that the baby bust cohorts are in their 20’s and occupy the 20-24 and 25-29 age bands. The Transition cohort also occupies the 30-34 age band. So, it follows that the baby bust cohorts will also occupy the 30-34 and 35-39 age bands in 2010, while the 1st two Echo Boom cohorts take over the two twenty age cohorts. Currently (2015), Echo Boom cohorts occupy 3 key age bands—20-24, 25-29 and 30-34.

¹ As, for instance an echo bust and a 2nd Echo Boom, etc. until these population waves eventually dampen until they are exhausted.
The two most important features in Table 10, regarding the future, pertain to the replacement of the baby bust cohorts by the Echo Boom cohorts in 3 of the 4 key reproductive cohorts by 2015 and the continuation of the Echo boom cohorts in the key reproductive ages beyond 2020 as well. With multiple Echo Boom cohorts moving into all key reproductive ages, the bottom line is that births should increase. This would involve Echo Boomers both moving up (in age) and moving in (the 2000→2010 analog). These Echo Boomers will be replacing the baby bust cohorts as this oscillatory process continues well into the 21st century. And, these shifts in demographic age structure are part of a national, as well as a regional and local, set of shifts tied to at least one familiar term—Baby Boom—and now, by two less familiar terms—baby bust and Echo Boom (Millennials). All municipalities and schools in the United States are embedded in these demographic processes. The distinctions revolve around the extent to which migration modifies these basic population distributions at the particular geographical level.

**Total Fertility Rate**

Before pursuing migration, we will briefly take a look at the Total Fertility Rate (TFR) in the United States. We do so for two reasons. First, the shifts in these TFRs have been largely responsible for the oscillations in the population age structure that we have just discussed. Second, for white and, more recently for white, non-Hispanic women, the TFRs have been remarkably stable for the past 42 years. Such stability then enables one to