September 2019 Enrollment Projections

Progress Report of the Ad Hoc Enrollment Working Group

16 September 2014

Challenges Facing Lexington

- Enrollments are approaching capacity limits
                    for current LPS use patterns

- Recurrent enrollment forecast surprise

➡ Need to gain confidence for educational and resource planning

"Prediction is very difficult,

especially about the future"

- Yogi Berra

- Samuel Goldwyn

- Niels Bohr

Outline

- **Projections from the report**

- **Addressing net in-migration**

- **Next Steps**

- **Conclusions**

Bottom Line Up Front

Projected 2019 Enrollment

Grade Group	Total Enrollment	Growth over 2013
Elementary K-5	3196	268 (+/- 114)
Middle School 6-8	1819	160*
High School 9-12	2265	244*
Total System	7280	672 (+/- 114)*

* Projection methodology for Middle School and High School does not provide
confidence intervals. Expected total system interval is expected to be somewhat larger

Methodology

- **Used two models**
  - **Cohort Survival Model**
  - **Linear Extrapolation Method**

- **Identified each model's weakness and blended**

- **Developing Housing Unit Model to better account for in-migration and "August Surprise"**

# Per-Model 2013-2019 Enrollment Growth Projections

Growth in Enrollment	Cohort Survival Method		Linear Extrapolation Method 90% Confidence Interval	
	Forecast	High est./Low est.	Forecast	Upper CL/Lower CL
Total system	505	601/409	555*	707/404
Elementary	101	197/5	268	382/153
Middle	160		165	299/32
High	244		136	261/11

* Total system projection forecast over total student population rather than as sum of Elementary, Middle, and High School enrollments for Linear Extrapolation Method

Cohort Survival Model

- Model used nationally for mature communities

- Babies are born and progress forward year by year
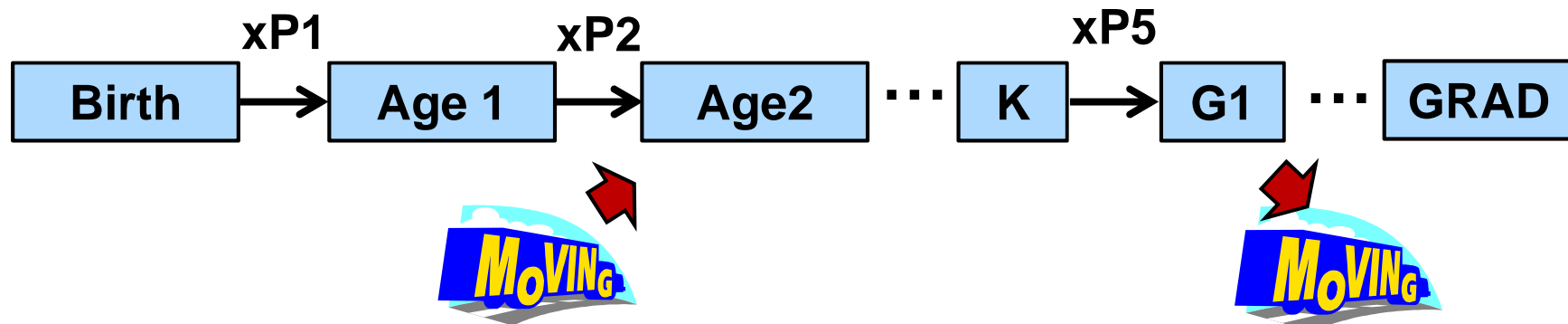
- Students also arrive and leave
    - # of 2-year-olds next year = P2 x # 1-year-olds now
    - P2 = 1.05 predicts a 5% increase in 2-year-olds by next year

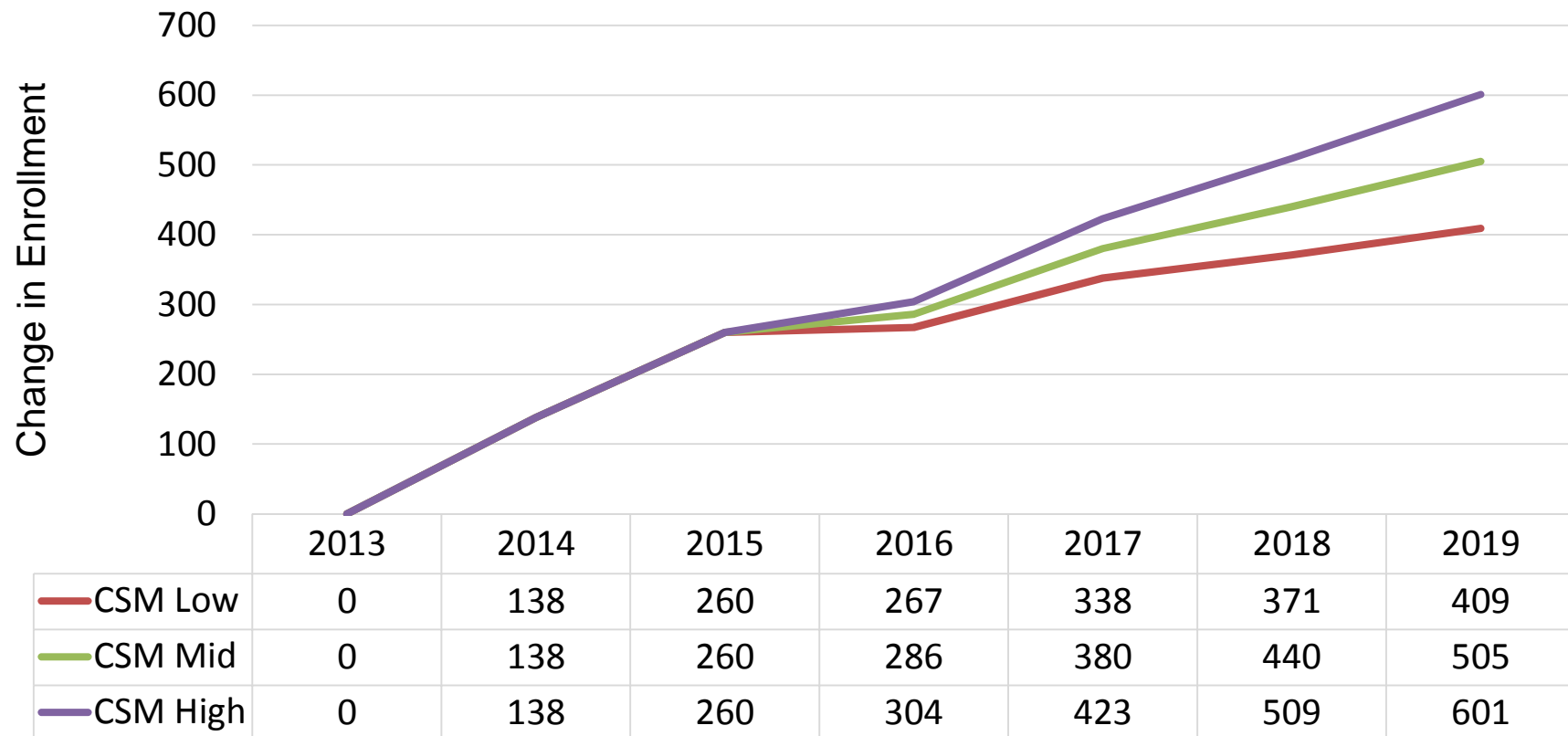**Lexington has used this "Cohort Survival Model"**

LPS Cohort Survival Model

- **Three projections are provided: Low, Mid, and High**

- **Variation in projection based on choice of Birth->Kindergarten Progression Factor**

  Low B->K: 1.85

  Mid B->K: 1.95

  High B->K: 2.05

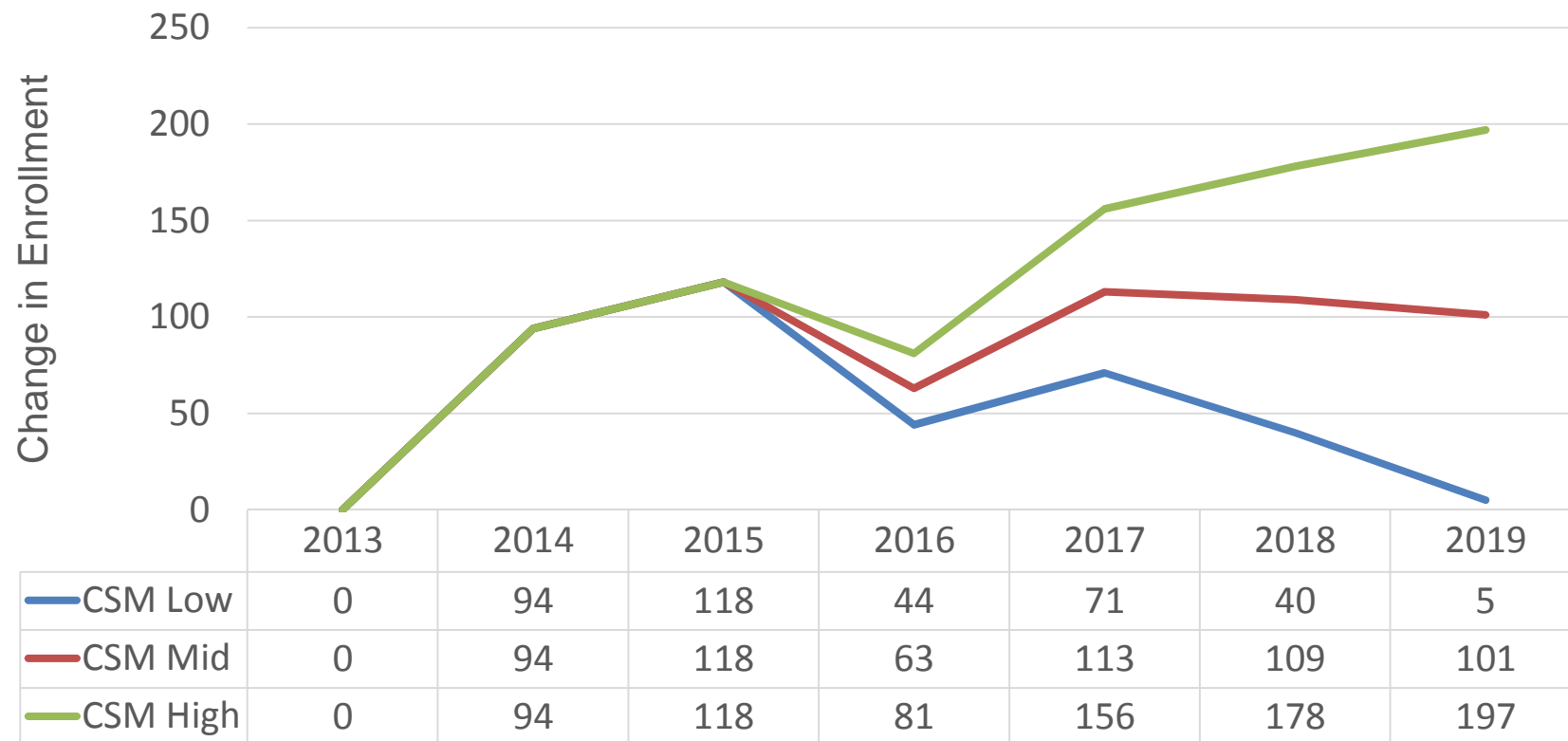- **Variations only manifest in Elementary School projections in the 5-year horizon**

Cohort Survival Model
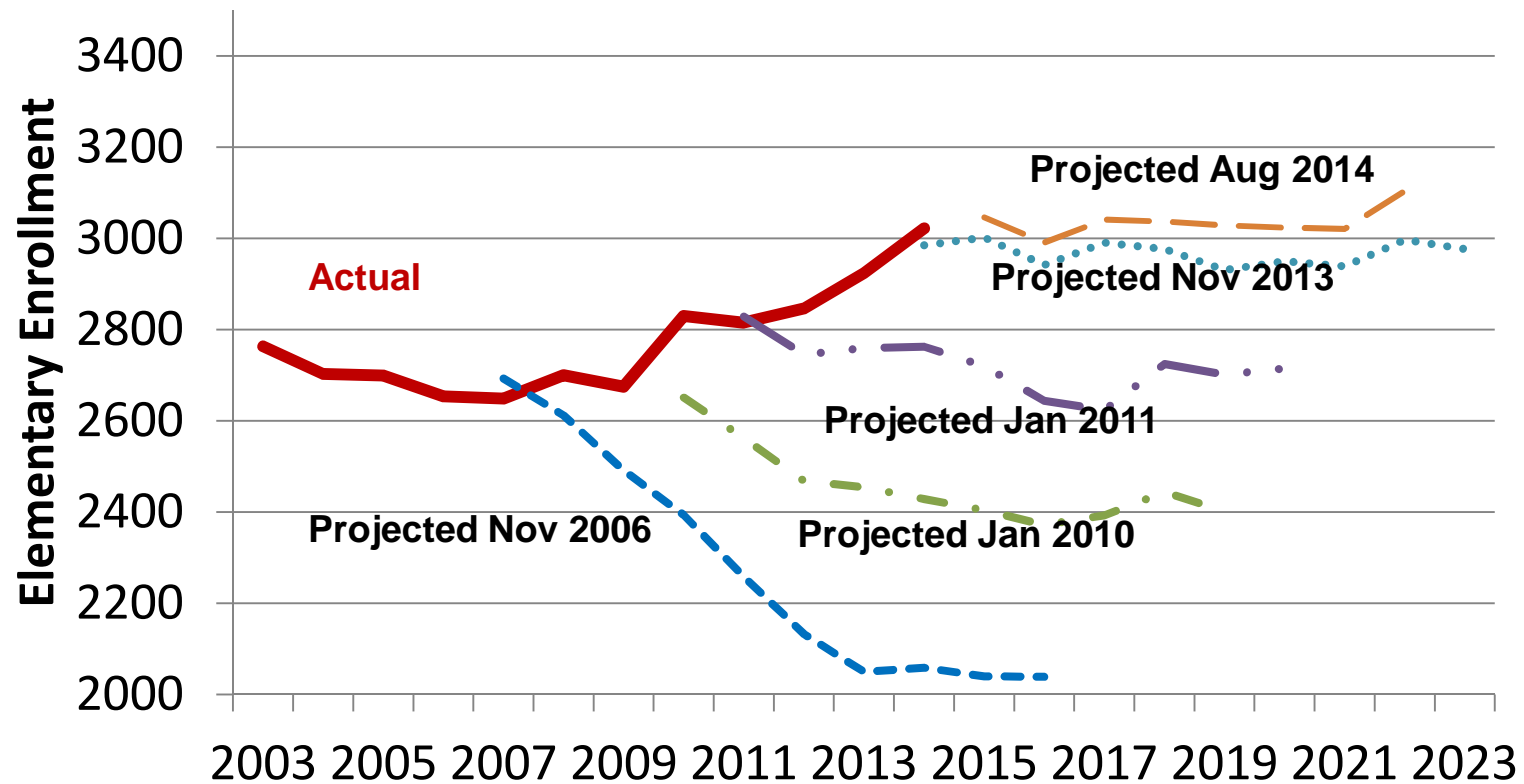# Projected System-wide Growth 2013-2019

Change in Enrollment

	2013	2014	2015	2016	2017	2018	2019
CSM Low	0	138	260	267	338	371	409
CSM Mid	0	138	260	286	380	440	505
CSM High	0	138	260	304	423	509	601

Cohort Survival Model
Projected Elementary Growth 2013-2019

	2013	2014	2015	2016	2017	2018	2019
CSM Low	0	94	118	44	71	40	5
CSM Mid	0	94	118	63	113	109	101
CSM High	0	94	118	81	156	178	197

CSM Elementary School Projection History
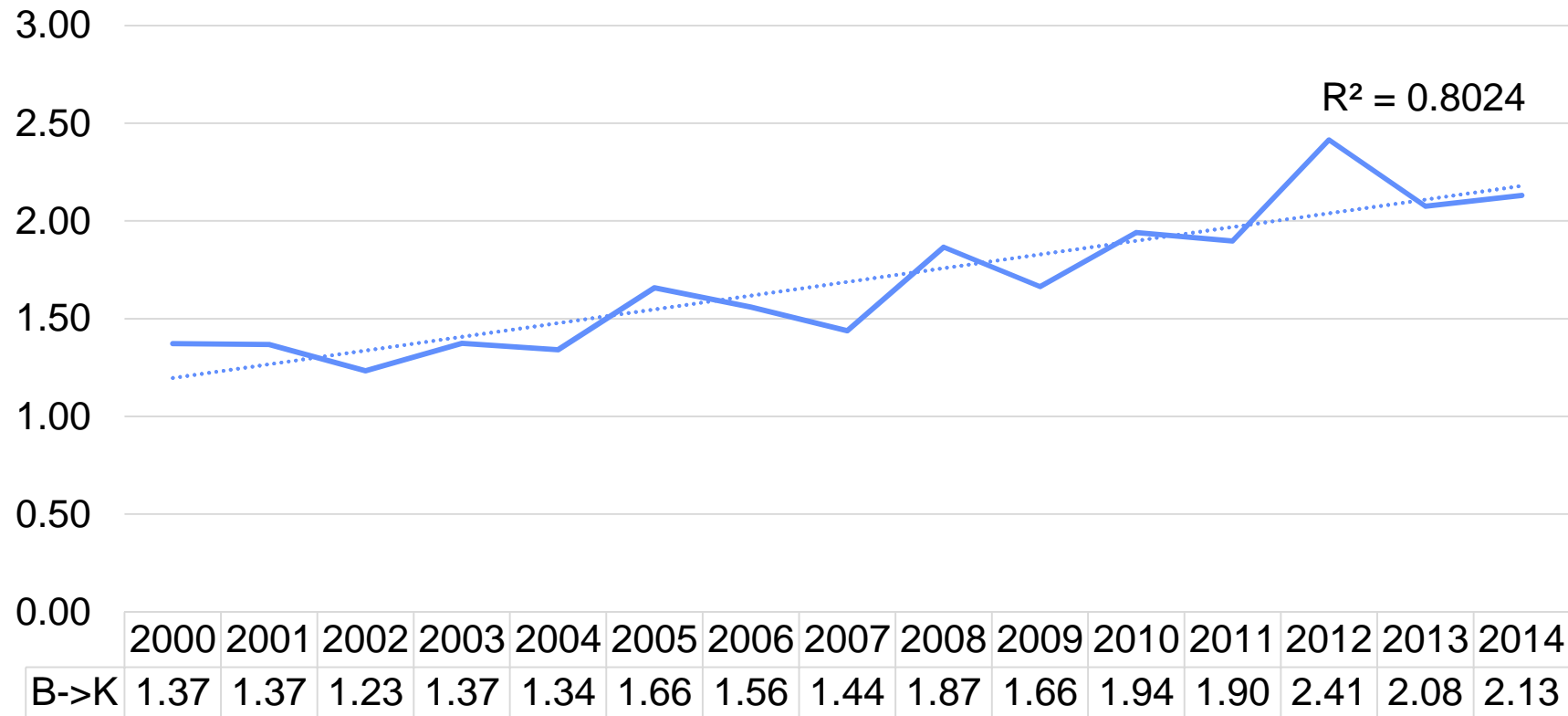
CSM Limitations

Births Compared with Kindergartern Enrollment 5-years later

Births (1994-2008)
Enrollment (2000-2014)
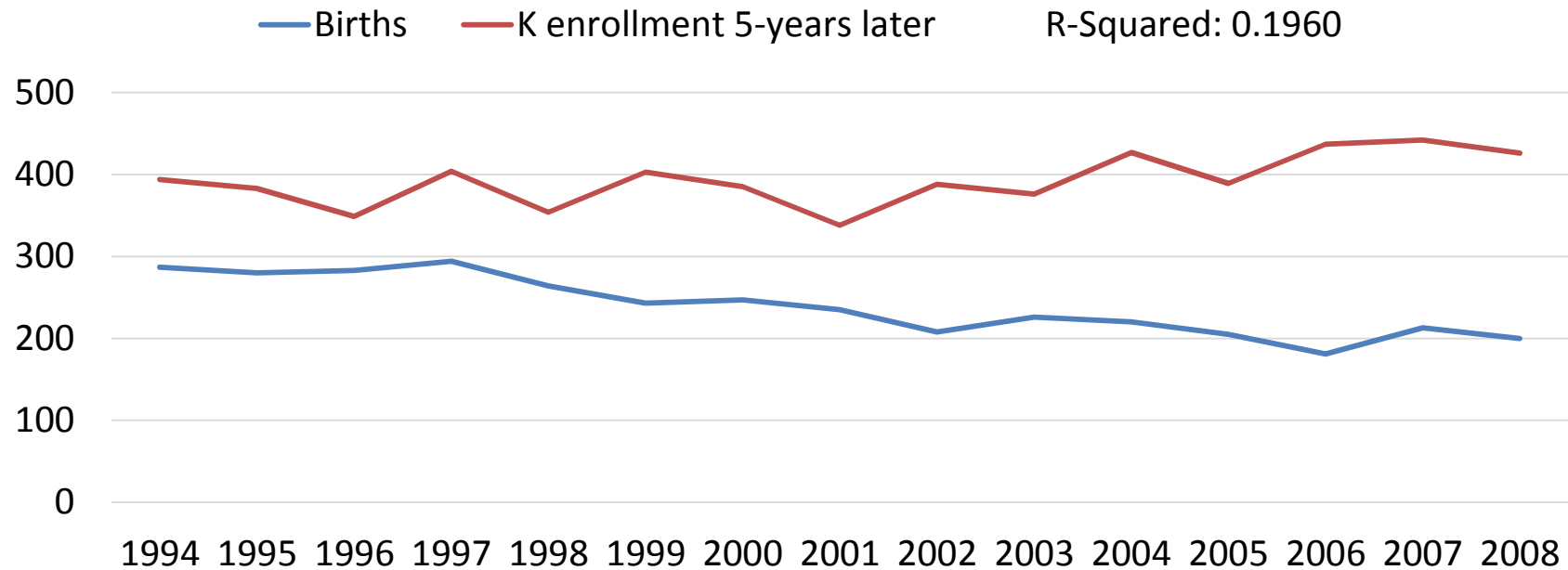
Birth to Kindergarten Progression Rates (2000-2014)

R² = 0.8024

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
B->K	1.37	1.37	1.23	1.37	1.34	1.66	1.56	1.44	1.87	1.66	1.94	1.90	2.41	2.08	2.13

CSM Limitations

- **Little correlation between births and subsequent enrollment**

- **Uses a fixed multiplier for progression rate while in-migration has been growing**

Linear Extrapolation Method

- Simple regression over recent enrollment history
- Captures linear trends

- Does not directly model underlying factors
- Does not anticipate change
- Does not capture enrollment "waves" or "bulges"

Defining Base Period for Regressions

- **2008-2014 is base period used in regressions**

- **Changes begin around 2008:**
  - **(2008) 387 unit increase in rental housing at Avalon Bay**
  - **(2008) Birth to Kindergarten progression jumps to 1.87**
  - **(2009) Enrollment increases begin**
  - **(2009) Average number of new housing unit per year increases from 18 to 32**
  - **(2010) Percentage of housing units occupied by students begins to increase**

Elementary School Enrollment
Linear Extrapolation Method

Recommended Model Blending

- **Elementary: Linear Extrapolation Method**

- **Middle: Cohort Survival Model**

- **High School: Cohort Survival Model**

- **LEM better captures recent trends of in-migration**

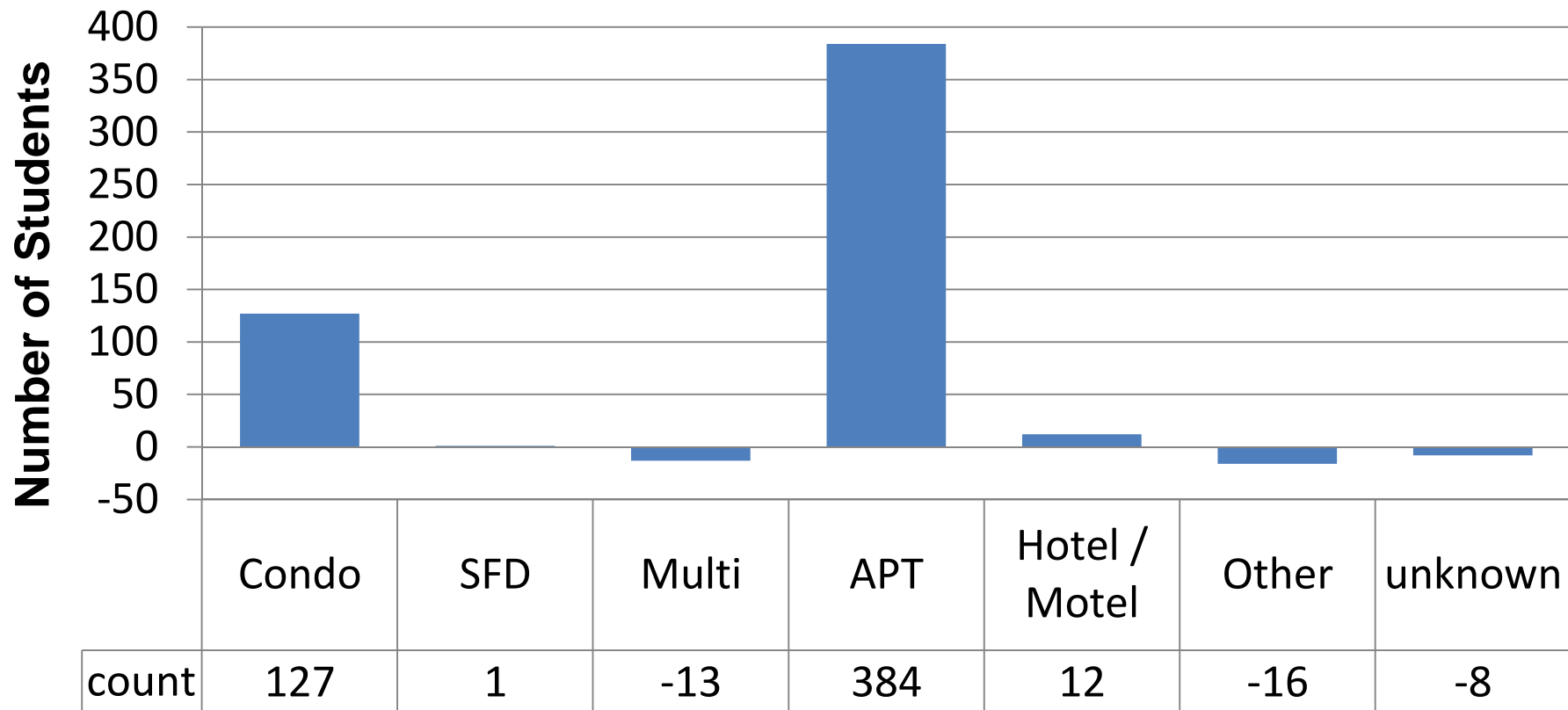- **CSM better captures enrollment waves in upper grades**

# Addressing In-Migration Explicitly

Building a Better Model

Change in Number of LPS Students by Residence Type (2003-2013)

	Condo	SFD	Multi	APT	Hotel / Motel	Other	unknown
count	127	1	-13	384	12	-16	-8

105% of net growth attributable to condos and apartments

Change in Number of Families by Residence Type (2003-2013)

	Condo	SFD	Multi	APT	Other	unknown
count	99	34	5	323	9	32

Y-axis: Number of Families (0 to 350)
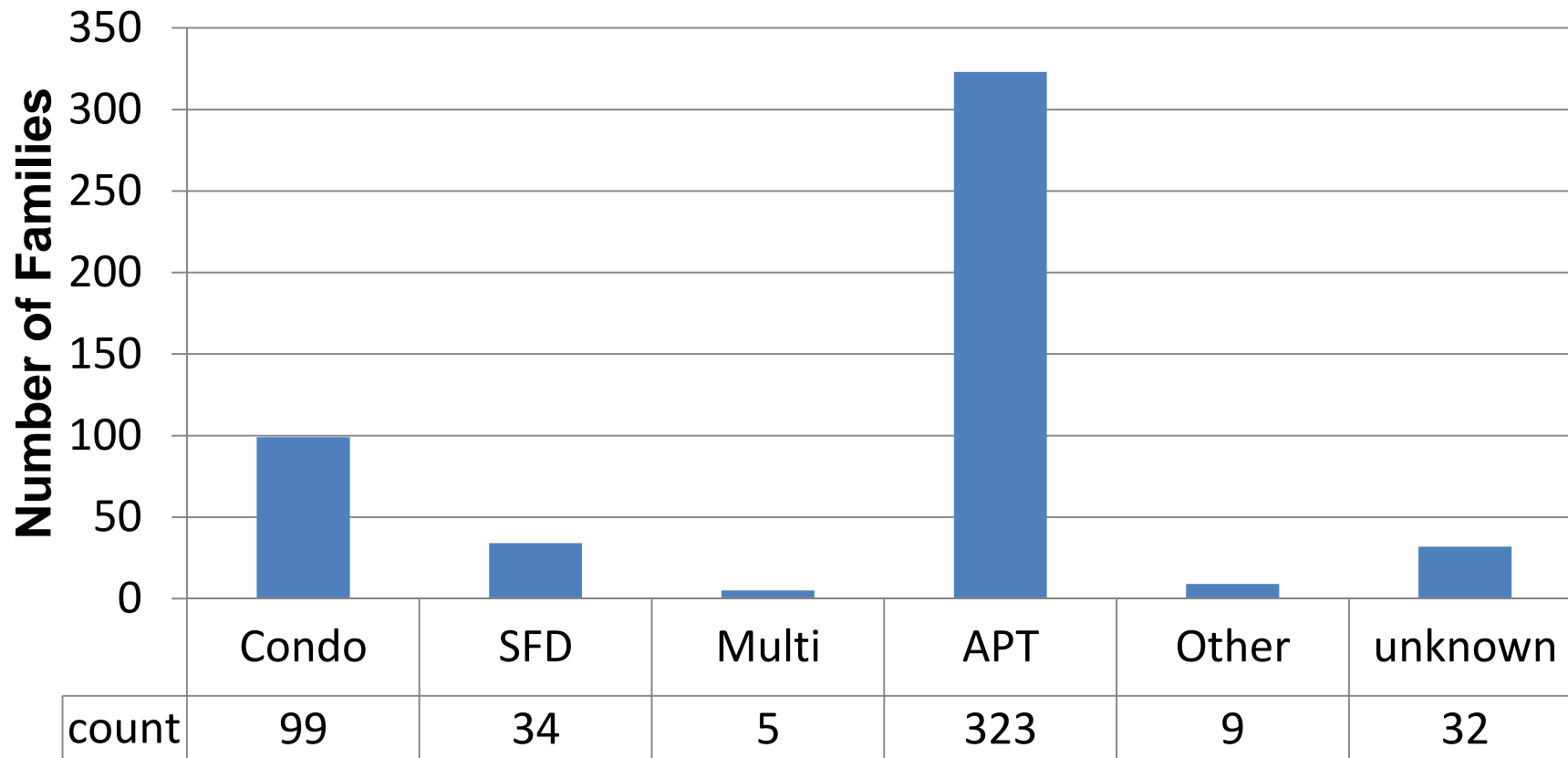
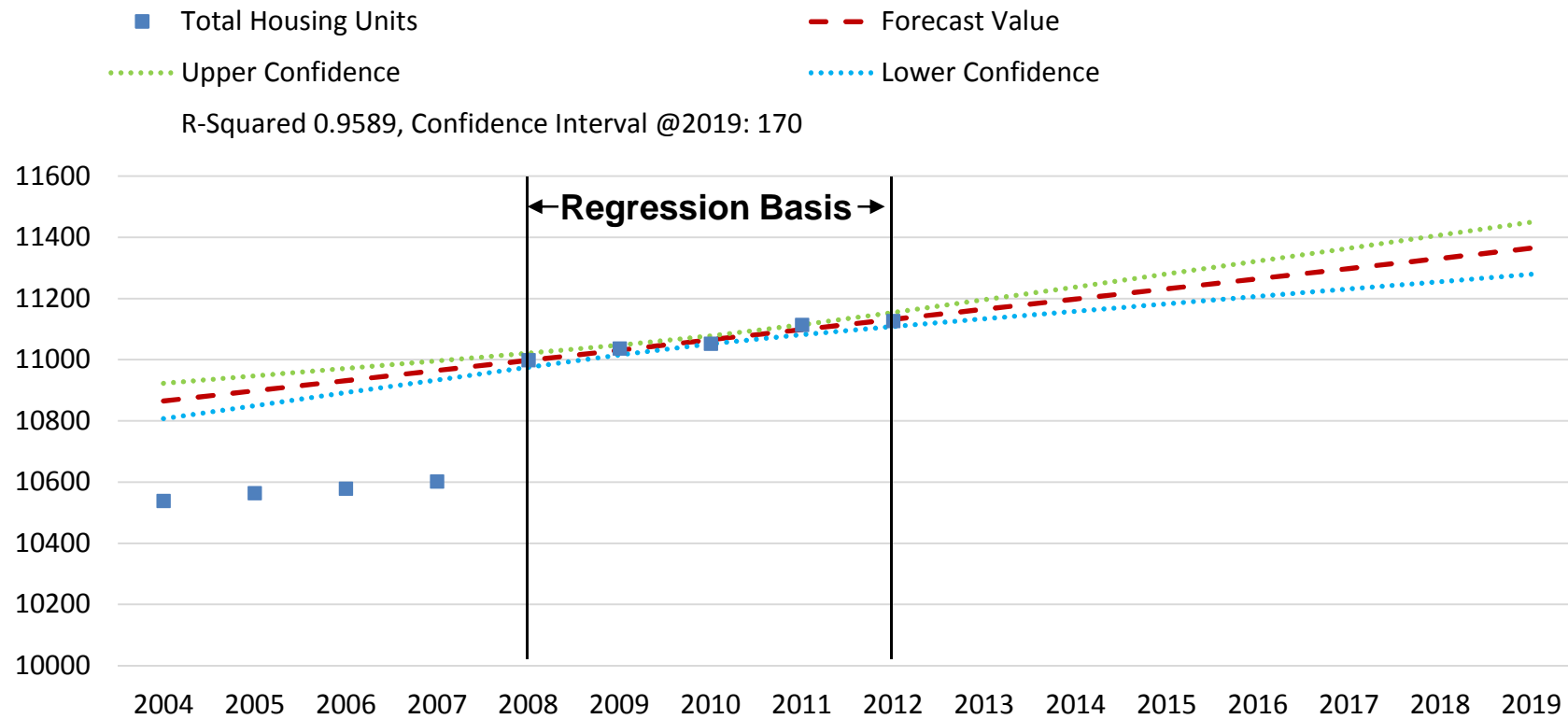**Number of families has increased by about 500**

Observable Factors

- **Number of Housing Units (NHU)**

- **Percentage of Housing units sheltering students (PH)**

- **Student Density (SD) – average number of students in a residence when students are present**

Housing Unit Model:

$$\text{Enrollment} = NHU * PH * SD$$

Number of Housing Units
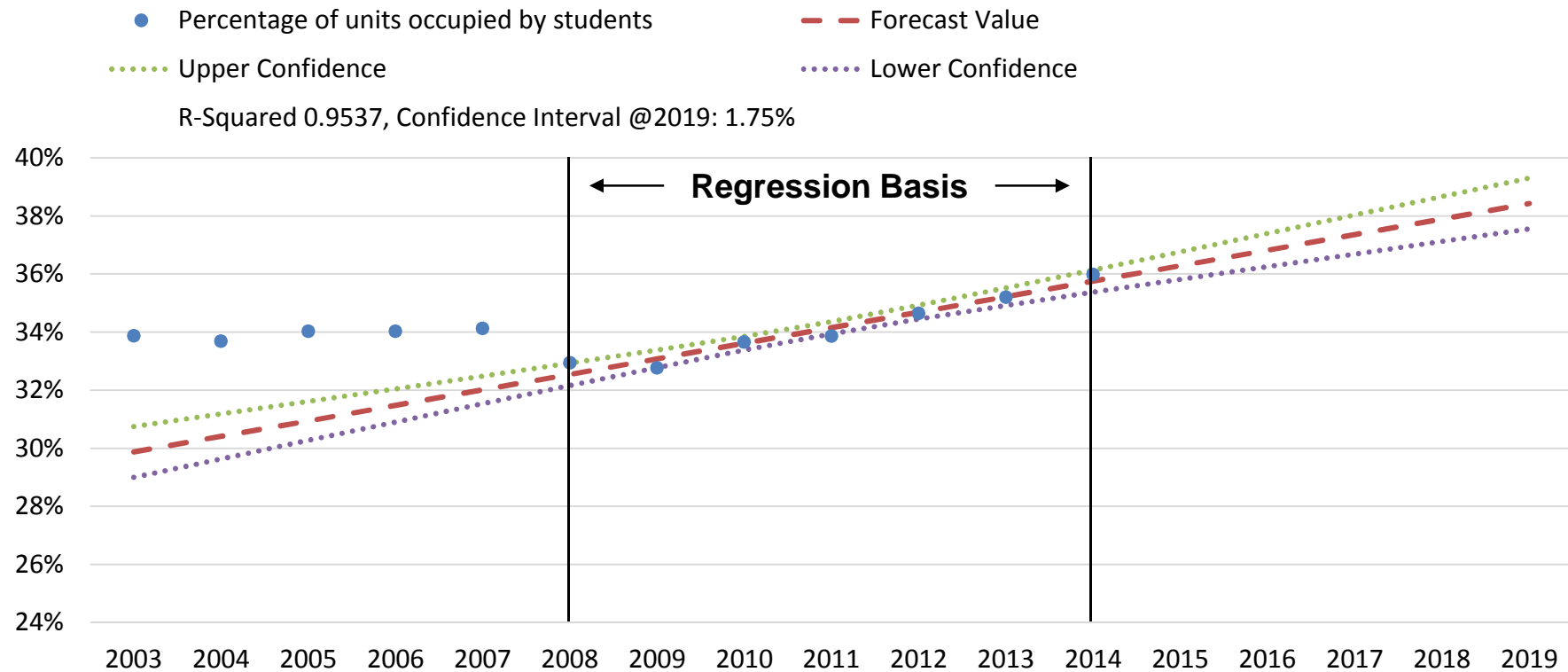

- ■ Total Housing Units
- ┅ ┅ Forecast Value
- ···· Upper Confidence
- ···· Lower Confidence

R-Squared 0.9589, Confidence Interval @2019: 170

←**Regression Basis**→

Percentage of Housing Units Sheltering Students

- Percentage of units occupied by students
- Forecast Value
- Upper Confidence
- Lower Confidence

R-Squared 0.9537, Confidence Interval @2019: 1.75%

← Regression Basis →

Average Number of Students per Dwelling when Present
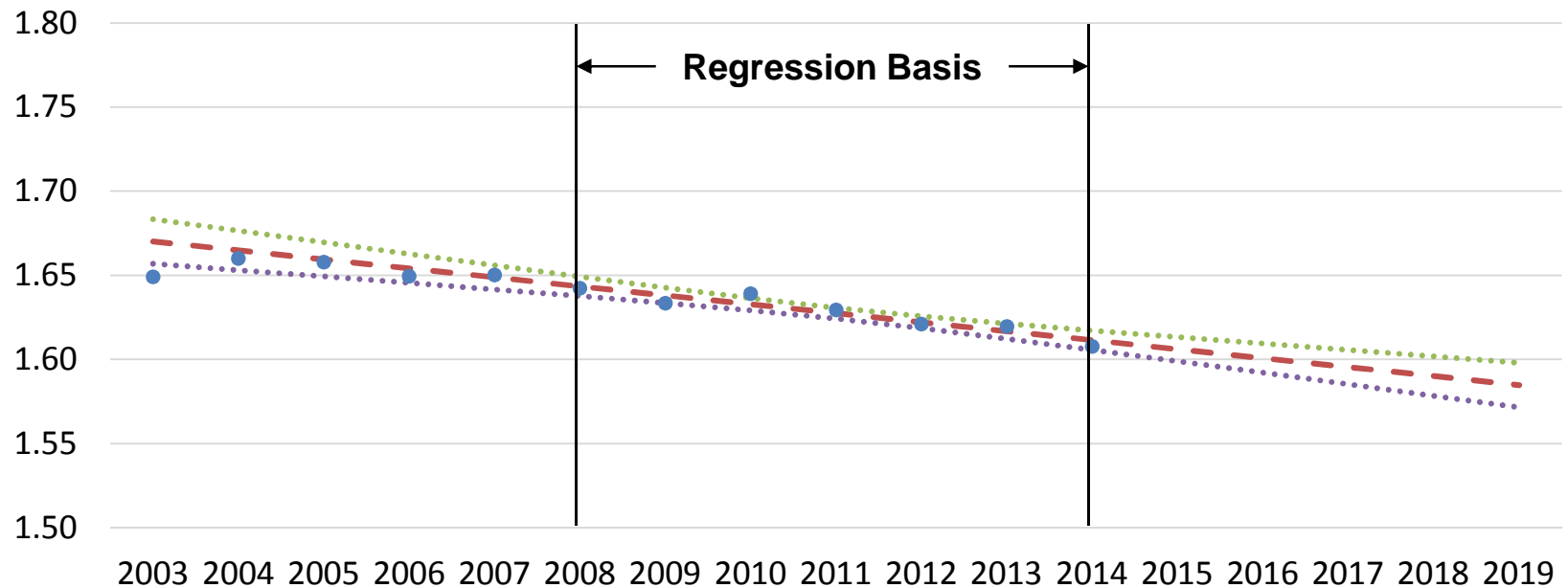
Growth Capacity Remains
Single Family Dwellings (SFD)

Percentage of SFD occupied by students

$$y = 0.003x + 0.3339$$
$$R^2 = 0.8288$$

Legend: all configs ◆, Linear (all configs) --------
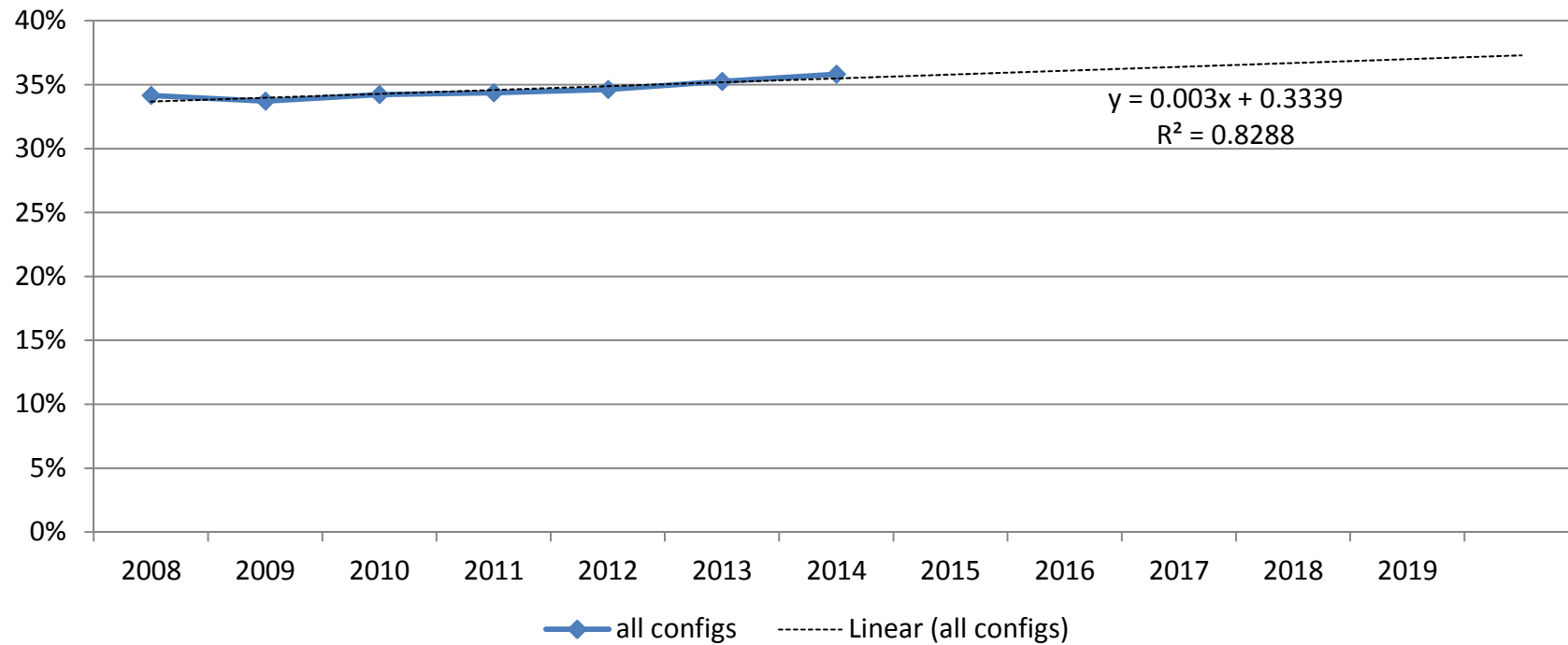
Growth Capacity Remains - Condos

Percentage of condo units occupied by students

$y = 0.0105x + 0.1333$
$R^2 = 0.9471$

Legend: all configs — Linear (all configs)
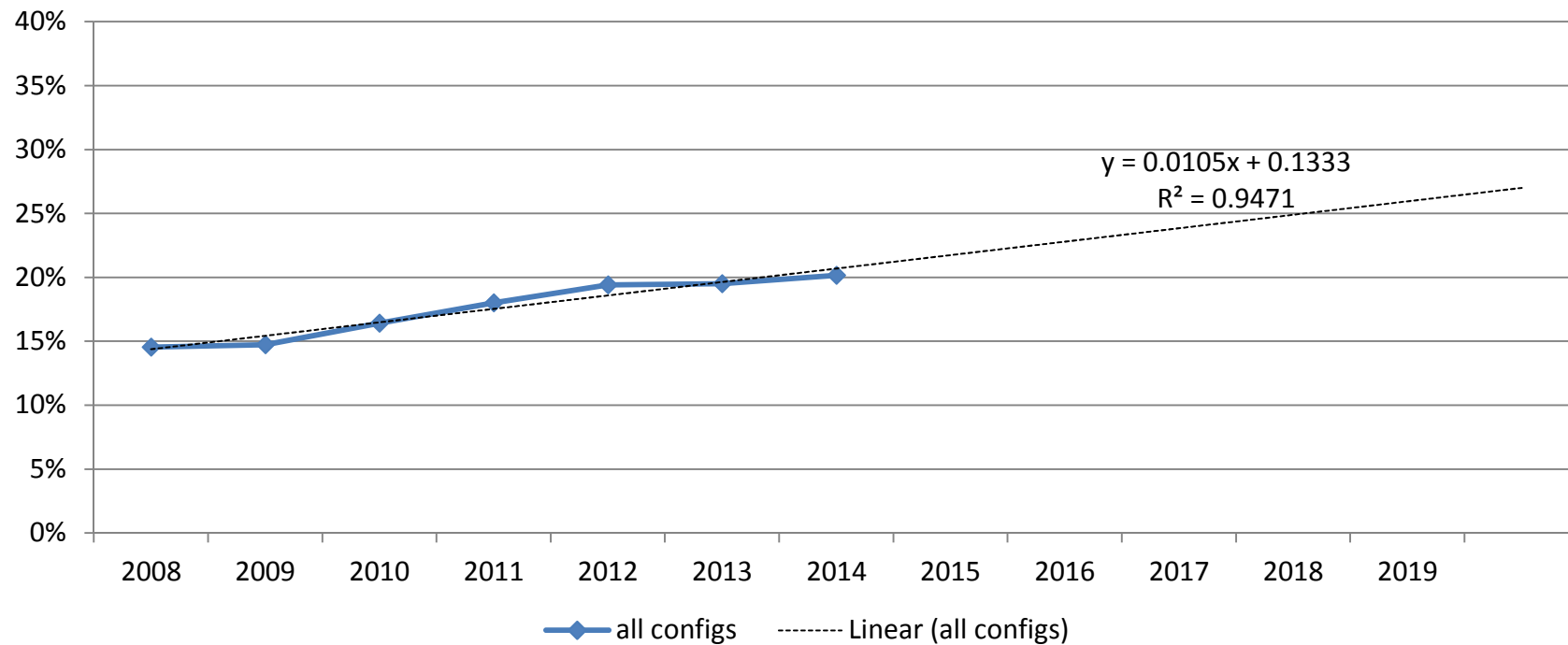
Growth Capacity Remains - Apartments

Percentage of units occupied by students

$y = 0.0353x + 0.3653$
$R^2 = 0.8149$

$y = 0.0318x + 0.283$
$R^2 = 0.9315$

$y = 0.0254x + 0.2332$
$R^2 = 0.9747$

$y = 0.0087x + 0.0396$
$R^2 = 0.6642$

- 1 bedroom
- 2 bedrooms
- 3 bedrooms
- all configs

------- Linear (1 bedroom) -------- Linear (2 bedrooms) -------- Linear (3 bedrooms) •••• Linear (all configs)
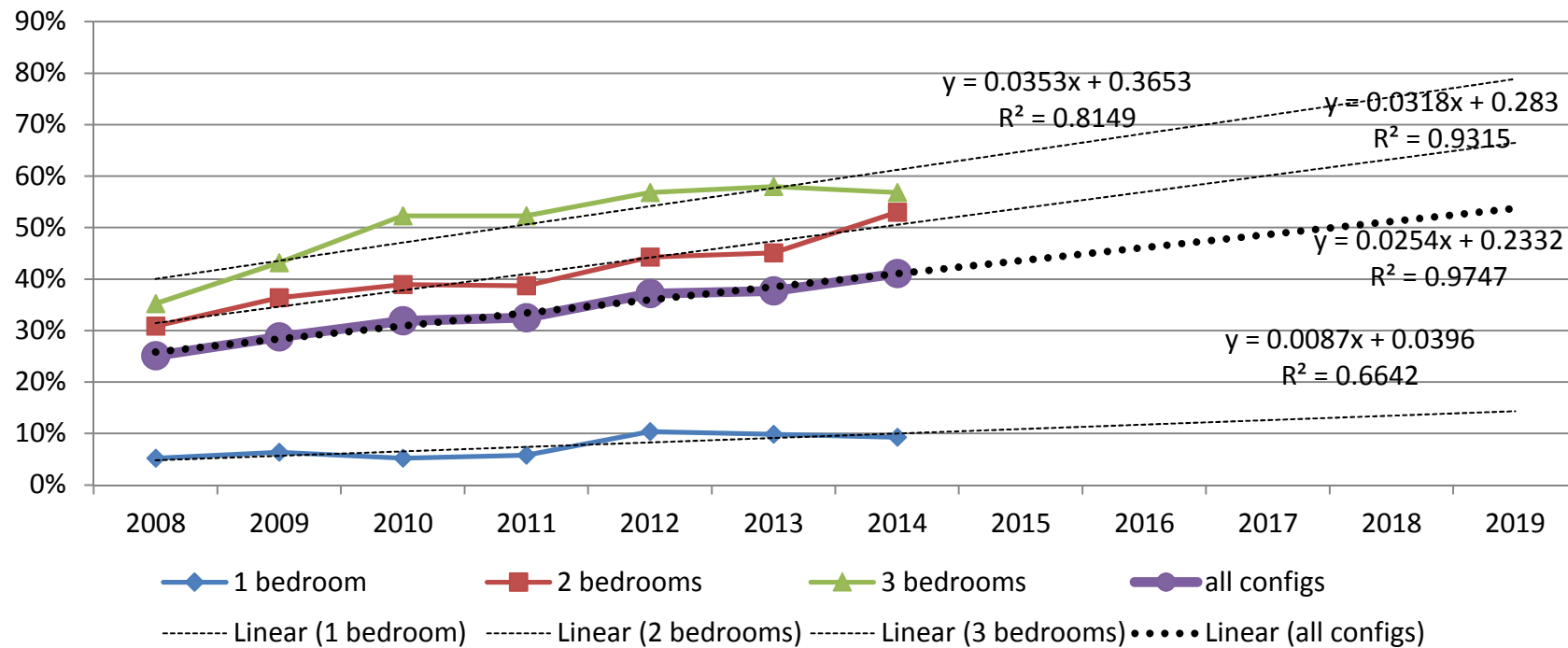
Causes for Concern

- **Housing Market has heated up – does this presage a greater turnover and in-migration?**

- **Does dropping student density (still a small factor) indicate more younger siblings?**

- **August surprise continues high – 60 additional students system-wide between 8/15 EWG data extract and 8/26 CSM data**

Next Steps

- **Continued refinement**

- **Improved data collection**

- **Creation of repeatable process and transition to staff**

Conclusions

1) Projected 2019 Enrollments

Grade Group	Total Enrollment	Growth over 2013
Elementary K-5	3196	268 (+/- 114)
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2) Capacity for continued growth exists in all housing types

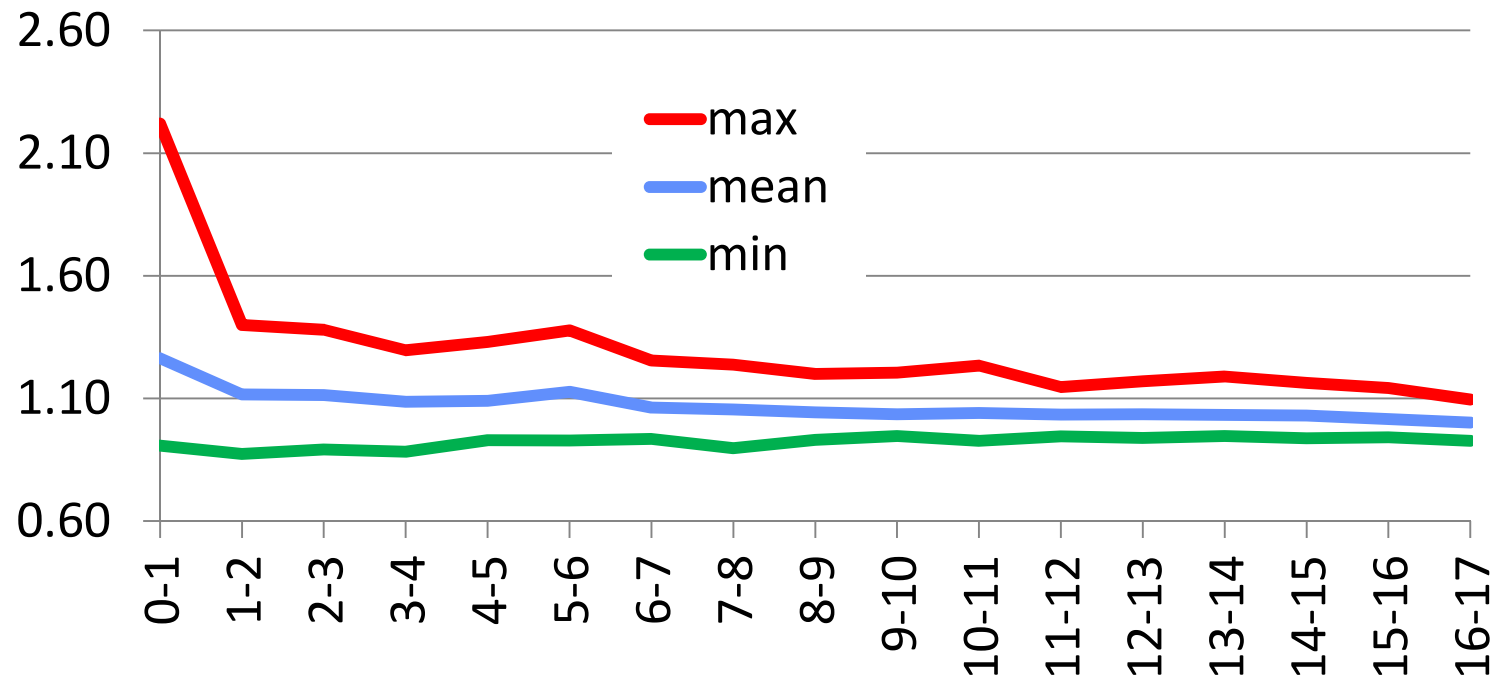# Discussion

Backup

Data Sets Used by EWG

Data sets:

- LPS Student Rolls: 2000 – 2014

- Town Census: 2000 – 2014 (complete, archival)

- Town Assessors data: 2007 – 2014

- Town Permit Database: 2004 – 2014

- Federal Census: 2000, 2010

Progression ratios (2001-2013)

Age Progression Rates

Large and variable progression ratios for early years contribute to failure of cohort survival method for ES

Progression ratios (2001-2013)

Standard Deviation in Age Pr. Rates