

Two analyses on productivity in the Danish educational system

WORKSHOP WITH NATIONAL PRODUCTIVITY
BOARDS

Brussels November 14, 2019

Jesper Linaa

Today's agenda

Two analyses on productivity in the educational sector in Denmark

- Both analyses were published in the most recent productivity report of the Chairmanship of the Danish Economic Councils – the National Productivity Board
- **A new measure of productivity in primary school (1st-9th grade)**
Nicolai Kaarsen (2019): Et mål for produktivitet i grundskolen (første udkast). *Documentation note* (in Danish only), www.dors.dk
- **Productivity and resources in high schools (10th-12th grade)**
Nicolai Kaarsen & Amra Rizvanovic (2019). “More Money, Better Students? – Evidence from a Funding Reform of Danish High Schools”. *Working Paper 2019:01*, www.dors.dk

A NEW MEASURE OF PRODUCTIVITY IN PRIMARY SCHOOL

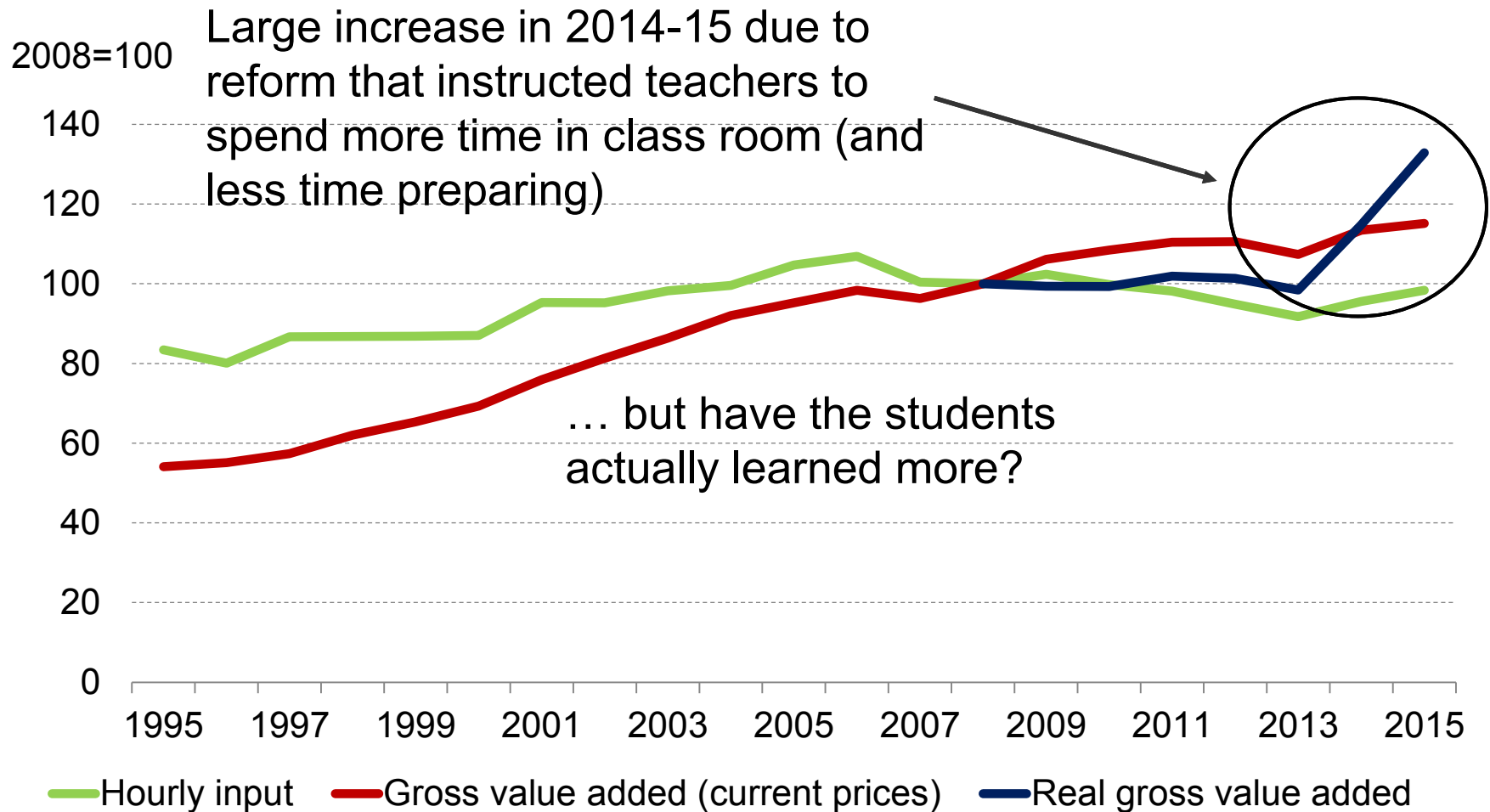
A new measure of productivity in primary school

Problems with measuring productivity in the public sector

- Lots of problems with measuring productivity in the public sector; no market prices \Rightarrow no productivity levels comparable across sectors and difficulties doing quality adjustments
- Prior to 2007: The “input approach”
- After 2007: The “output approach” for some areas; health services, culture, social services, education
- The output method counts the number of services, e.g. the number of knee surgeries, number of visitors to museums, number of elderly in nursing homes, ...
- Regarding primary school, the number of students are used from 2007-2010 and from 2010 onwards the number of student hours are used

Gross value added and hourly input

According to official statistics



The productivity measure

How we want to measure productivity

- We want to develop a quality-adjusted measure of teaching per hour
- By “quality-adjusted” we really mean “learning-adjusted”, so important to emphasize: Although school is certainly about learning it is most certainly also about many other things such as democracy understanding, personality traits, ...
- But basically we want to develop a standard measure of hourly productivity like

$$\text{hourly productivity} = \frac{\overbrace{\text{real gross value added}}{\text{real production} - \text{materials}}}{\text{hours worked}},$$

where we perform a quality adjustment of real production

PISA scores

Converting PISA scores into learning years

- We convert PISA test scores into learning years. Real production is given by

$$Y_t = p \cdot n_t \cdot q_t,$$

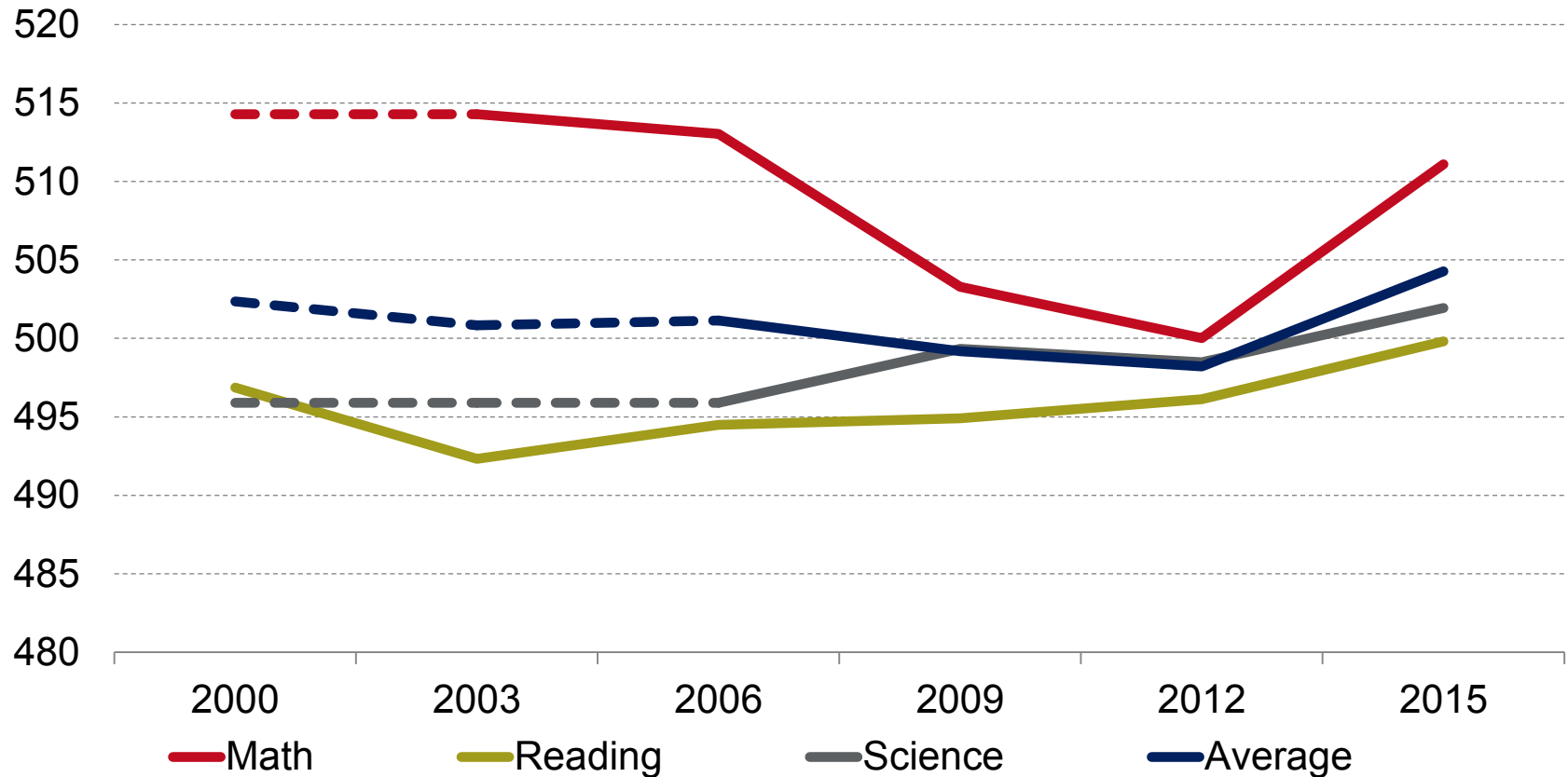
where n_t is the numbers of students in year t , q_t is the quality factor (indexed to 1 in 1995), and p is price in the base year (1995). Value added is achieved after deduction of consumption in production

- Each PISA point corresponds to 1/30 learning year, cf. OECD (2016, Box I.2.1) OECD (2016). “PISA 2015 Results (Volume 1): Excellence and Equity in Education PISA”
 - I.e. a 15 point increase in the PISA score translates into 1/2 year increase in schooling or a 5 percent increase in real production
- Regarding the conversion of PISA scores, you only got the very short version, but you will find the details in Kaarsen (2019)

Danish PISA scores

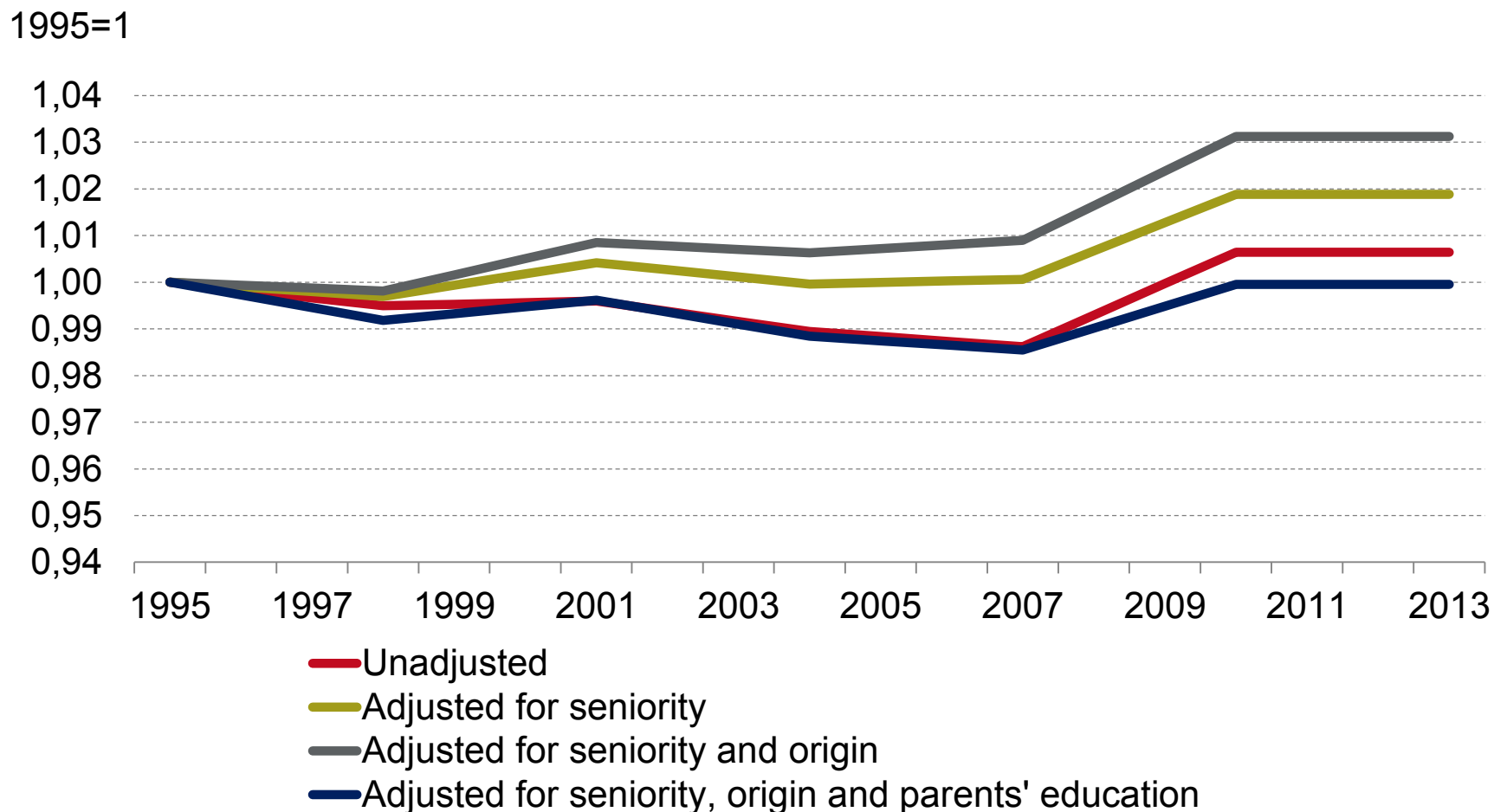
Little increase in the average PISA score from 2000-2015

PISA score



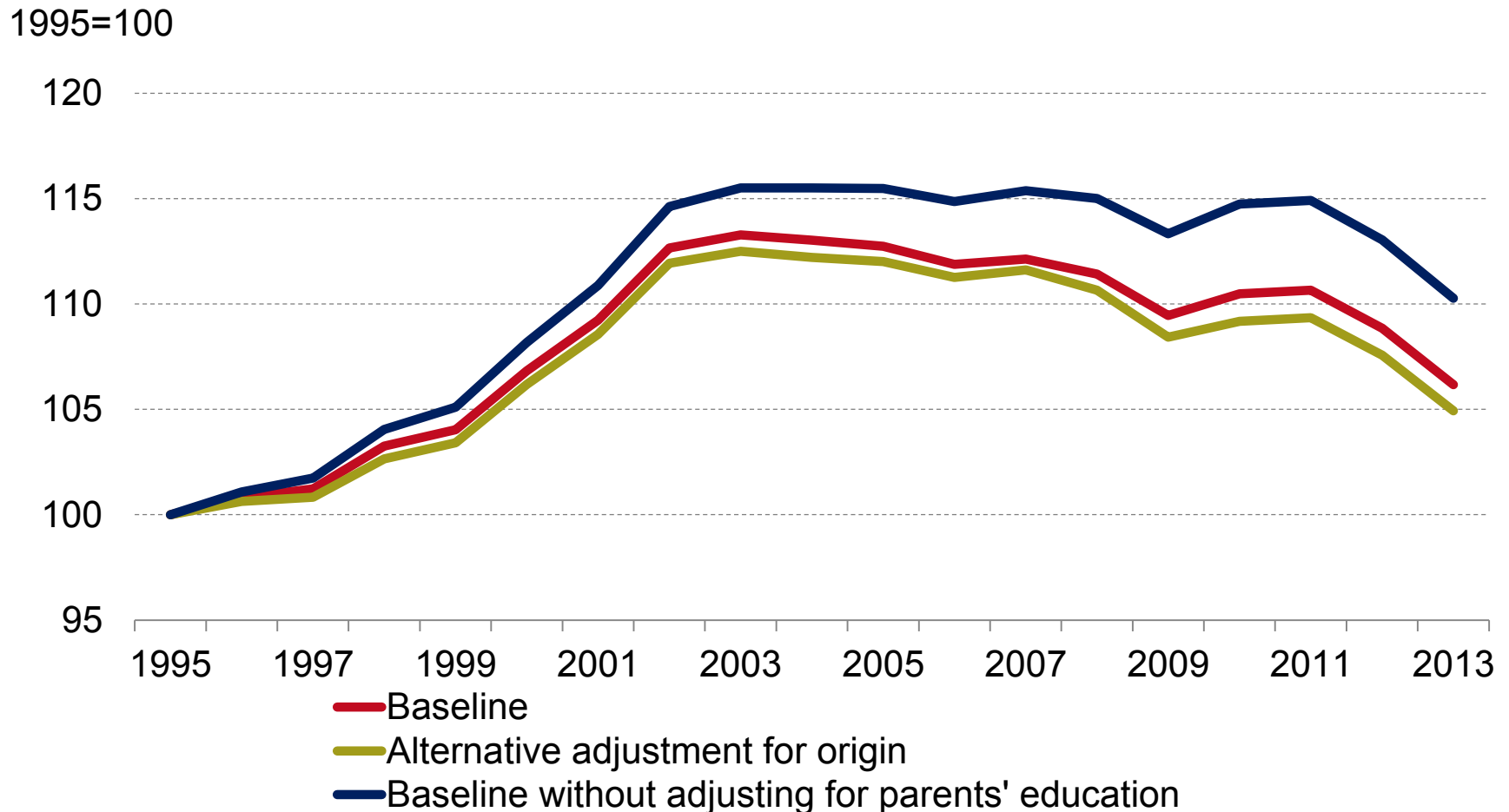
Quality in primary school

Almost no changes in quality when based on PISA scores



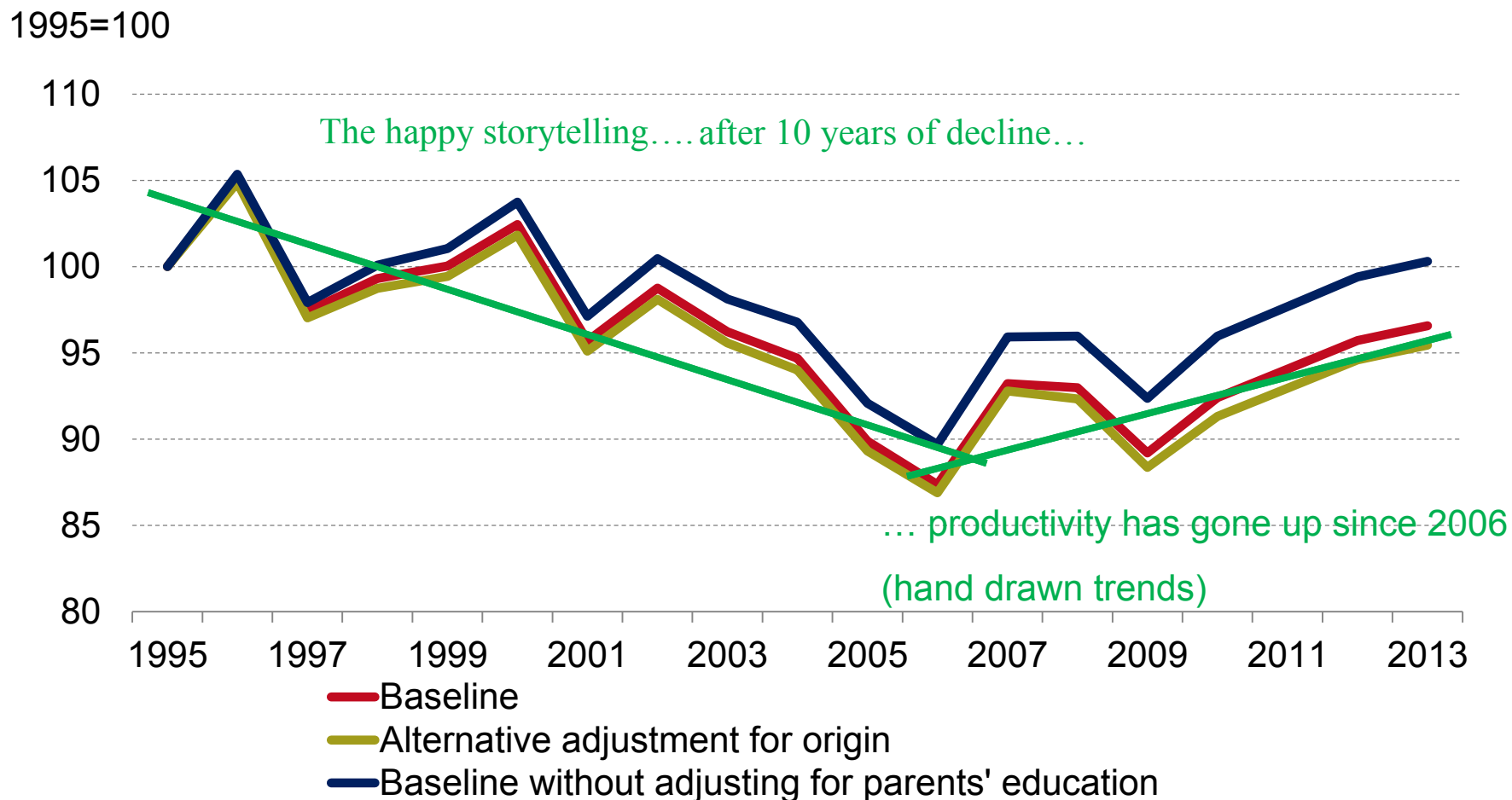
Quality-adjusted gross value added

Quality-adjusted gross value added has increased from 1995-2013



Quality-adjusted productivity

Quality-adjusted productivity almost constant from 1995-2013



Conclusion

A new measure of productivity indicates sluggish development

- We proposed a new metric for measuring quality-adjusted productivity in primary schools
 - We used PISA scores. Other scores can be used. The important thing to note is that productivity measures should and can be improved
- Quality in primary school is about more than just core courses like math, reading and science. Improved productivity measures should take this into account, but we need to have quantitative inputs for this
- Using the metric here proposed it seems like productivity in primary school have been more or less constant over the 1995-2013 period

PRODUCTIVITY AND RESOURCES IN DANISH HIGH SCHOOLS

Productivity and resources in Danish high schools

Research question and identification strategy

- **Question**

How do changes in the size of government subsidies to high schools affect the performance in terms of the students' grades, their probability of graduating and their propensity to continue education beyond high school?

- **Problem: (At least) two possible selection biases**

1. Subsidies directed to schools with many low-achieving students
2. High-achievers move to schools with high levels of funding

- **Solution**

We seek to handle the second problem by controlling for background information on the students. The first problem is handled by using a reform that exogenously redistributes funding

Productivity and resources in Danish high schools

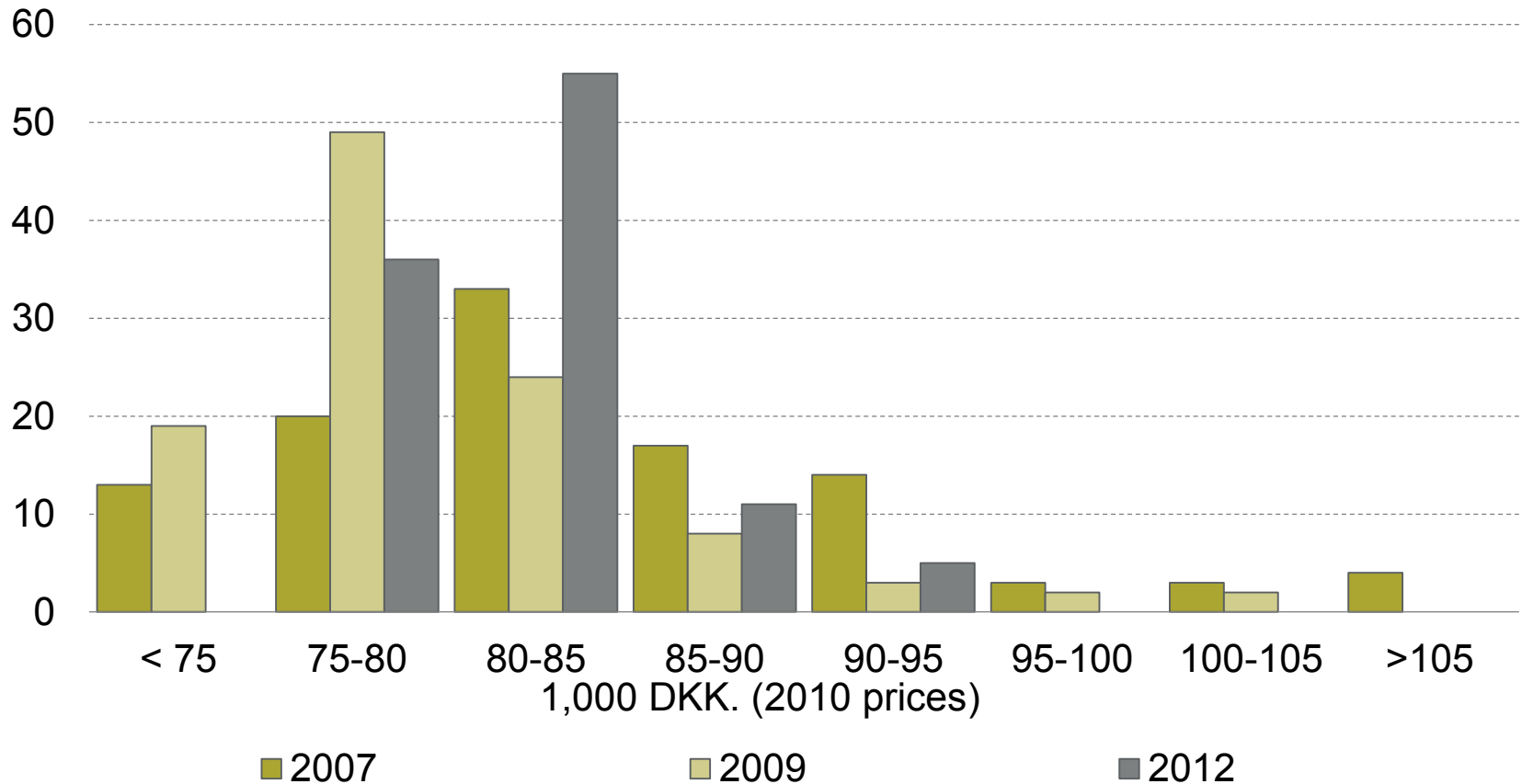
Identification strategy

- We use exogenous variation from a reform that standardized government subsidies from 2008 and onward – prior to the reform funding per student varied substantially amongst high schools
- This standardization led to a rapid convergence that eliminated much of the variation
- To deal with student selection we use register data to control for a large number of factors
 - Gender, origin, GPA, GPA Danish, GPA Math, missing parents, mother's, father's, parents' income, parents' employment status, parents education, ...
- Now let's take a look at the reform

The distribution of funding per student

Most even distribution in 2012

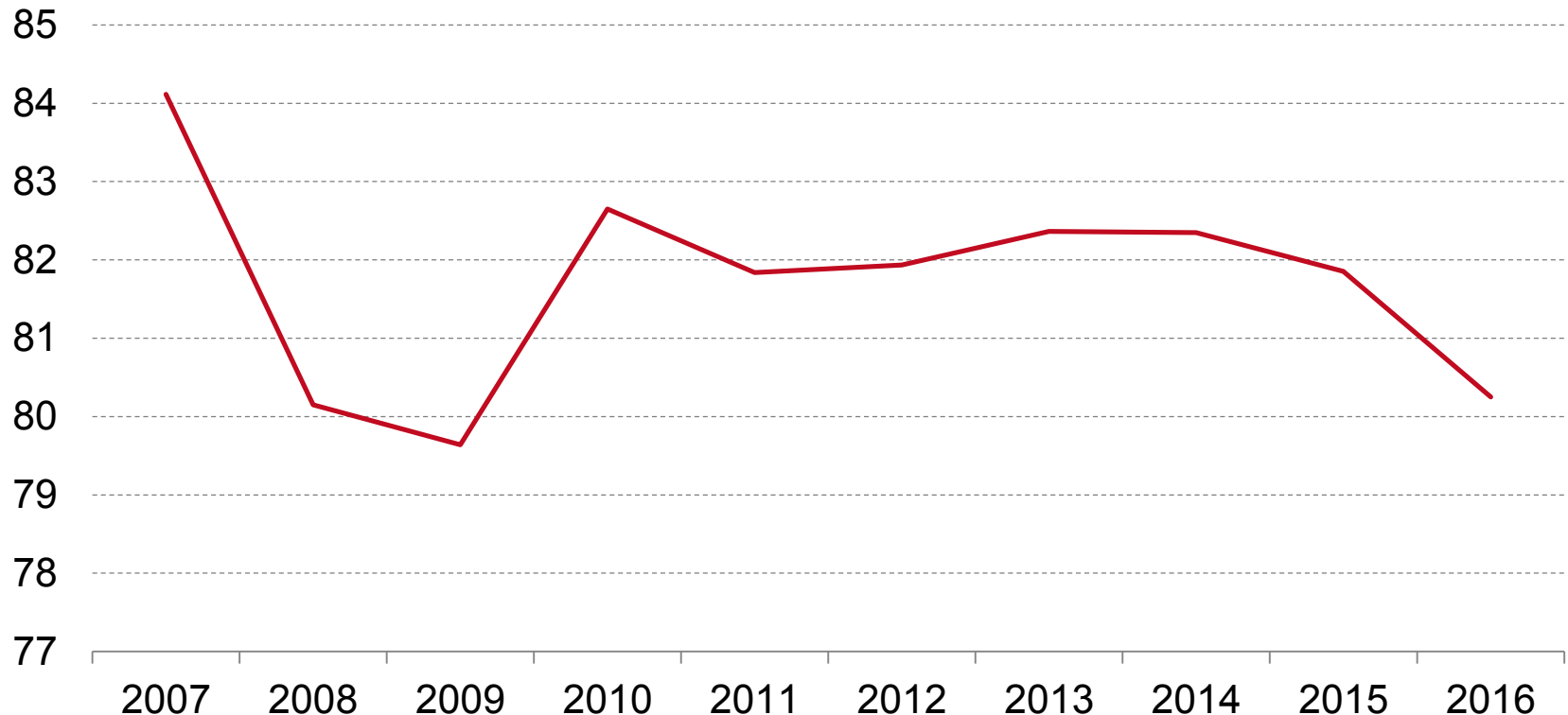
Number of high schools



Subsidy per student

Mean funding stable in estimation period, though declining from 2014

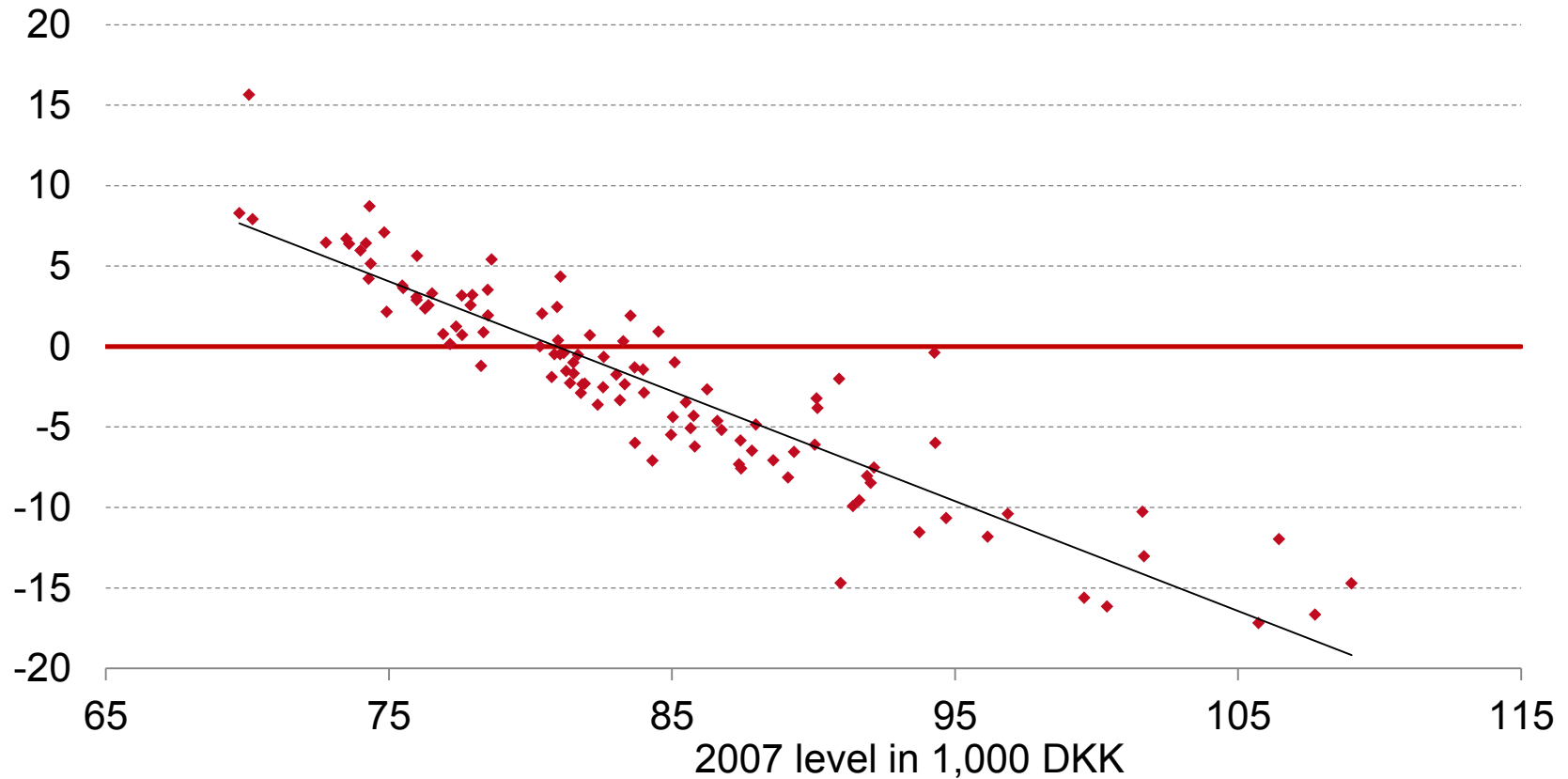
1,000 DKK (2010 prices)



Change in subsidy per student, 2007-2012

Redistribution from schools with high subsidies to schools with low

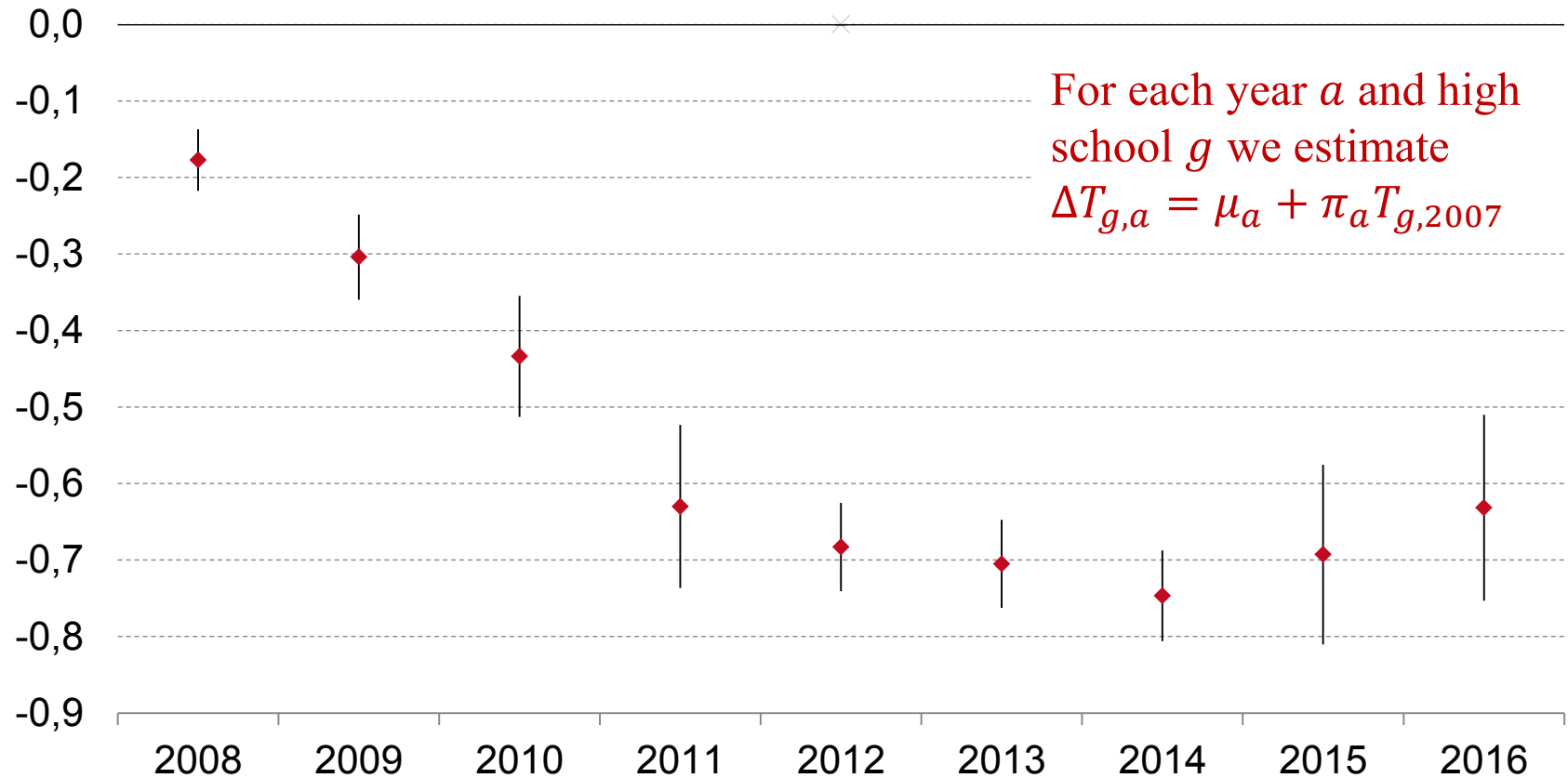
Changes in 1,000 DKK



Convergence coefficients from 2008-16

Convergence is reached from around 2012

Effect on changes in funding, DKK



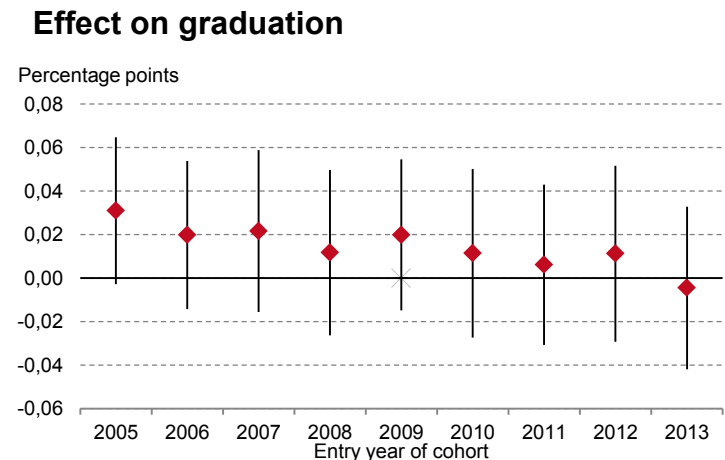
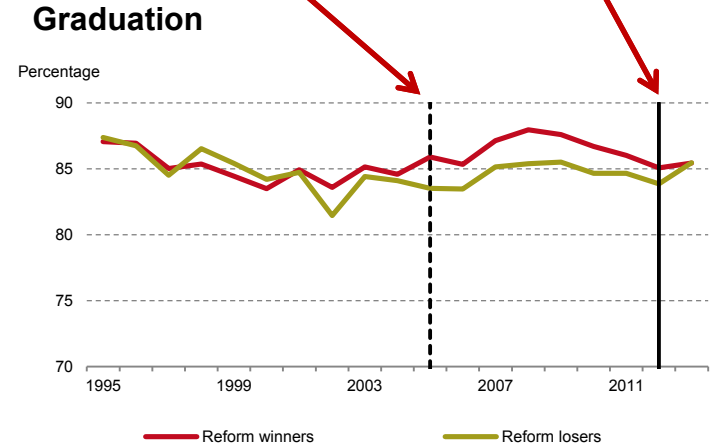
Graduation

No significant effect on graduation rates

- Upper panel shows graduation rates among students from reform-winnings high schools vs. graduations rates among students from reform-losing high schools
- Lower panel shows accumulated difference between the two since 2004 after controlling for a large number of characteristics. Red dots are point estimates – lines are 95 percentage confidence bands
- Hence, no significant effect in any year

First cohort affected by the reform (for half a year)

First cohort after reform was fully phased in



Grade Point Average

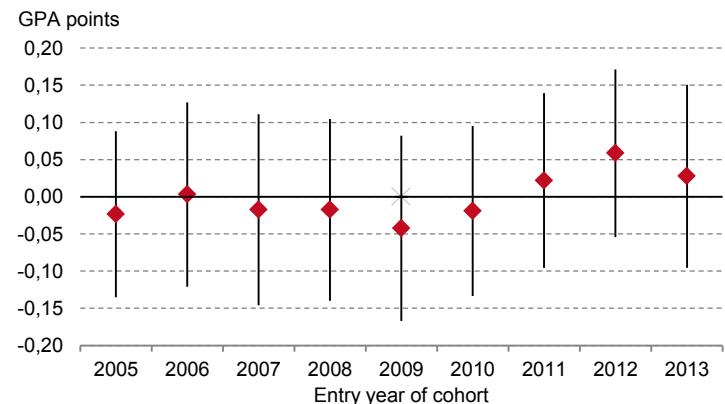
No significant effect on grades either

- Upper panel: Grade point average on the Danish “12 scale” among students from reform-winnings high schools vs. graduations rates among students from reform-losing high schools
- Lower panel: Accumulated difference between the two since 2004 after controlling for a large number of characteristics. Red dots are point estimates – lines are 95 percentage confidence bands
- No significant effect here either

Grade point average



Effect on grade point average

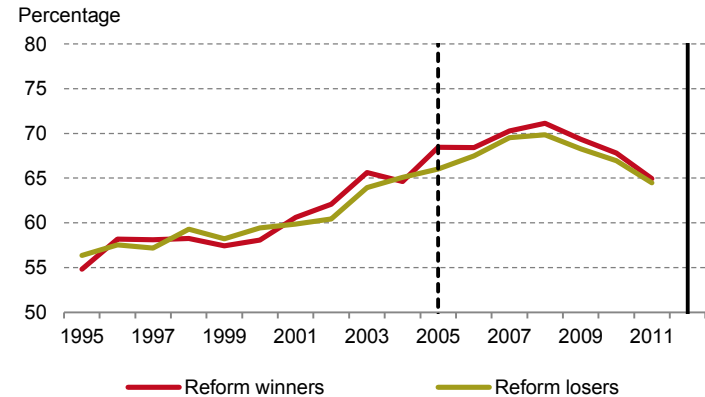


Continued education

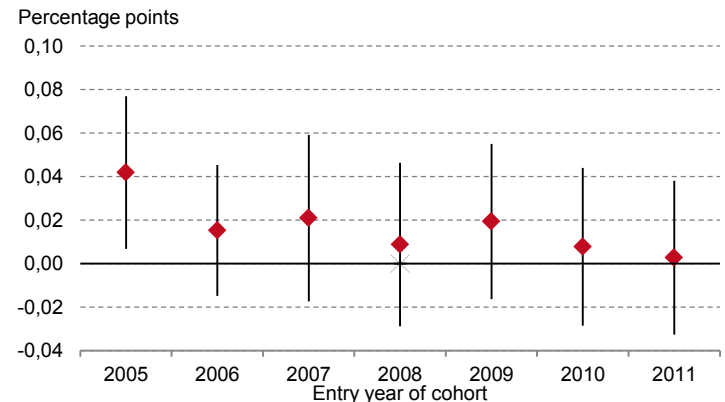
No significant effect on continued education

- Upper panel: The share of students that end up studying after high school, e.g. at the university
- Lower panel: Accumulated difference between the two since 2004 after controlling for a large number of characteristics. Red dots are point estimates – lines are 95 percentage confidence bands
- No significant effect here

Continued education



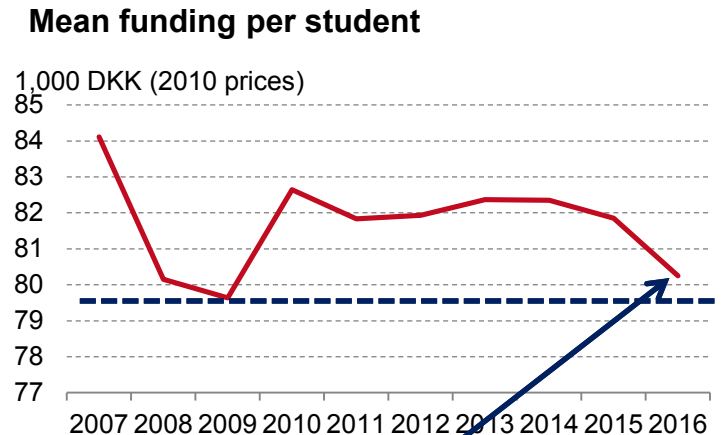
Effect on continued education



Conclusion

No sign of impact from reform on three central indicators

- No significant impact from reform on grades, graduation rates nor the share of students that continue education
- This indicates that the “reform-losing high schools” have improved their productivity
- However, it cannot be concluded that further reductions in funding are likely to improve productivity further
- Remember the “mean funding per student” graph
 - further reduction will send mean funding outside estimation region



Danish Economic Councils

Web: www.dors.dk

Mail: dors@dors.dk

Twitter: [@DORsSekretariat](https://twitter.com/DORsSekretariat)

LinkedIn: [dk.linkedin.com/company/
the-secretariat-of-the-danish-economic-councils](https://dk.linkedin.com/company/the-secretariat-of-the-danish-economic-councils)