CPB Discussion Paper

No

Competition and quality in Dutch primary schools

Joëlle Noailly, Sunčica Vujić, Ali Aouragh

Preliminary concept - Do not cite or circulate

Abstract in English

We investigate the impact of competition between primary schools on the quality of education. Do schools facing more competition in their neighbourhood perform better than schools facing less competition? As a main measure of school quality, we look at the performance of pupils at the Cito-test. Due to potential endogenous school location and pupil sorting, we adopt an instrumental variable strategy (IV) in the spirit of Gibbons et al. (2008). Using a large range of data on pupil, school and market characteristics, our results suggest that school competition has a positive effect on pupil achievement measured by the Cito-test.

Key words: Education, competition, primary schools, pupil achievement.

JEL code: I20, H70, R5.

Abstract in Dutch

Steekwoorden:

Contents

Summary

1 Introduction[1]

In recent years, many countries have shown interest in public policies aiming to increase competition in education. These policies are motivated by the standard economic argument that more competition would provide an incentive for schools to improve quality. To the extent that parents choose for the best quality schools and that schools benefit from an increase in enrolment - for instance through higher funding - schools will attempt to improve quality in order to retain and attract pupils. There is a very extensive literature on the effects of school competition on educational outcomes, mainly in the US and more recently in the UK (Hoxby, 2003; Belfield and Levin, 2003, Gibbons et al., 2008).

The objective of the current paper is to investigate the impact of school competition on the quality of Dutch primary schools. The Netherlands stands out as one of the few countries with a very large freedom of school choice. Freedom of education is even laid down in the Dutch Constitution (Art. 23). In contrast with the US and most European education markets, parents in the Netherlands can send their children to all public or private schools of their choice without financial penalty or geographical restrictions. In addition, there is a trend in recent years towards more accountability and transparency on the quality of Dutch schools. Since a few years the Inspectorate of Education publishes quality assessments for all Dutch primary schools on its website. Nevertheless, despite free school choice and increasing transparency, little is known about the effect of school competition on the quality of education in the Netherlands. In parallel, there are recent concerns that the development of very large school boards in primary education might deter competition and thus reduce gains on pupil achievements.

In this paper we investigate the evidence of school competition on the quality of schools in the Netherlands, measured by educational outcomes. Our research question is: do schools facing high level of competition in their neighbourhood perform better than schools facing less competition? To answer this question, we estimate the effect of school competition on pupil performance measured by standardized test-scores at the end of primary school (the so-called Cito test). We obtained data on the Cito test for all pupils in the Netherlands over the 1999-2003 period from the Cito organization, the company in charge of educational assessments in the Netherlands. In addition, we also collected data on a large range of pupil, school and neighbourhood characteristics.

One of the most important issues when measuring the effect of school competition on quality is the endogeneity problem. Parents choose to live close to high-quality schools and these schools will in general attract most pupils. As high-quality schools grow larger, they may appear more and more monopolistic in the market. As a result, the level of competition in the

[1] We thank Maarten Cornet (Ministry of Finance), André de Moor, Geert de Boer (Ministry of Education, Culture and Science), Judith Post (Ministry of Economic Affairs), Ib Watterreus (Education Council of the Netherlands), Pierre Koning, and Dinand Webbink (CPB) for valuable comments.

market is endogenously related to the quality of schools. In order to address this issue we follow an instrumental variable strategy in the spirit of Gibbons et al. (2008). The intuition of Gibbons et al. (2008) is that schools located inside the educational market[2] are accessible to a larger number of parents and face therefore more competition than schools located at the boundary of the educational market. They use therefore the distance between the school and the boundary of the educational market as an instrument for competition. We follow their methodology and apply a related instrument to the Dutch situation, namely the distance between the school and the town centre. The intuition is that schools located close to the town centre face more competition than schools located at the boundary of the town. Assessing the performance of our IV strategy reveals that this distance measure is a good instrument for the level of competition in the market.

Our empirical results suggest that pupils enrolled in schools facing more competition in their neighbourhood perform better than pupils in schools facing less competition. We find evidence for a small positive link between competition and pupil achievement both in an OLS and IV framework, although the estimates are larger in the IV approach. A one standard deviation increase in competition increases the standard deviation of the Cito score by about 10% (1.5 point).

The paper is organised as follows. Section 2 gives an overview of previous research on the impact of competition on school performance. Section 3 describes the education system in the Netherlands. Section 4 presents the main methodological issues and our empirical strategy. Section 5 describes the data and sample construction. Section 6 presents our main results on the effects of competition on the standardized Cito scores and some robustness checks. Section 7 discusses the results and draws implication for policy. Section 8 concludes.

2 Literature

There is an extensive literature studying the link between school choice and school competition and educational achievements. Overall, the results from the literature are mixed. While some studies find a positive link between competition and educational outcomes, estimates in many other studies lack statistical significance.

On methodological grounds, the literature is generally divided between two strands. One strand of the literature evaluates policies aiming to extend school choice and the impact of these reforms on educational outcomes. The effects are then compared with a control group or counterfactual not affected by the policy. Since choice extension may not be randomly assigned across markets, the main issue in these studies is to correct for potential endogeneous location of the new schools. Since these policy reforms are very localised, it is often difficult to generalise these results to other educational markets. Holmes et al. (2003) investigate how the

[2] In the UK educational markets are defined within the boundaries of a Local Education Authority (LEA). A LEA is a local council which is responsible for education within a certain geographical domain.

introduction of school choice in North Carolina, via an increase in the number of charter[3] schools both temporally and geographically, affects the performance of traditional public schools on standard performance tests. Performance is measured through elementary and middle school test scores on math, reading, and writing. Distance from the traditional school to the nearest charter school is measured in: (a) number of kilometres, (b) whether the traditional school lies within 5, 10, 15, 20 or 25 km of the nearest charter school, and (c) using an indicator for whether a charter school is located in the county that year. Estimation results are produced using three types of models: (a) cross-sectional models by year; (b) dynamic panel data models using Arellano-Bond IV estimation approach; and (c) dynamic panel data models using semi-parametric ML estimator. The paper finds that traditional school achievement gains from charter school competition across a wide set of models. The results of the paper imply an approximate one percent increase in achievement when a traditional school faces competition from a charter school. The increase represents approximately one quarter of the mean standard deviation of observed gains, suggesting a considerable return to school choice.

Hsieh and Urquiola (2003) analyze the effect of the school reform in Chile in 1981 on educational outcomes. By providing vouchers to any student wishing to attend private schools, Chile expanded school choice of prospective pupils. Using OLS and IV estimation approaches, the authors find no evidence that choice improved average educational outcomes. However, they do find evidence that the reform led to increased sorting (cream-skimming), as the 'best' public school students left for the private sector. They use as instruments the urbanization rate and the population of a commune in 1982 - these should capture the effect of market size on the extent of private entry. OLS estimation results suggest that test scores experience a decline in communities where the private sector grew by more, while repetition rates experience a relative increase. They find a positive effect on repetition rates, i.e. the number of times pupils have to repeat a class: a one standard deviation increase in the 1982-88 private enrolment growth increases the observed change in repetition by a quarter of a standard deviation. By contrast, they find a negative effect on math scores. A one-standard deviation increase in the private enrolment rate lowers the relative math score of public schools by about 40 percent of a standard deviation. IV estimation results continue to suggest that greater private growth resulted in lower achievement. Interpretation goes along the lines that public schools have not experienced significant incentives to compete (few schools have been forced to close). On the other hand, private schools interpreted the competitive pressures of a voucher programme not by raising their productivity, but rather by choosing better students (cream-skimming). They also conclude that school choice might have improved parents' utility even if it does not improve academic achievement. Schools may be using the money for something else than educational outcomes that parents value (e.g., fresh painted walls).

[3] In the United States, charter schools are publicly funded schools permitted to operate autonomously and free from many of the regulations other public schools must follow. In return for this flexibility, the school is accountable for achieving certain goals, notably regarding pupil achievement.

The second strand in the literature looks at the effects of implicit variation in the level of school competition in a cross-section of markets and relates the level of competition in the market to pupil outcomes. The main challenge of these studies is to establish a causal link - net of other effects - between pupil achievement and school competition, i.e. to circumvent the problem of reverse causality between competition and educational performance. Typically, estimation techniques using instrumental variables are preferred over ordinary least-squares estimations as being more 'methodologically sound ' since they explicitly address the issue of endogenous competition. In turn, however, the quality of IV estimates highly depend on the quality of the instrument. Belfied and Levin (2003) review the cross-sectional research evidence on the effects of competition on education outcomes. Looking at 41 empirical studies in the US, they find that a majority of the studies show positive statistically significant impacts of competition on educational outcomes. Although negative correlations are rare, a large number of estimates lack statistical significance. Overall, they conclude that, if any, the gains from competition tend to be very modest: a one standard deviation increase in competition measured by the Herfindhal index or the enrolment rate at an alternative school increases test scores by approximately 10% of a standard deviation. Within the cross-sectional studies mentioned by Belfield and Levin (2003) a large range of US studies look at whether competition by private schools lead to an increase in educational attainment within public schools. Most of these studies also rely on IV estimation techniques using the share of Catholics in the population as an instrument for local private enrolment (Hoxby, 1994; Dee, 1998; Sander, 1999, Jepsen, 2002)

An influential paper using US data that has often been cited in the literature is the paper by Hoxby (2000). Hoxby (2000) analyses the effect of the level of choice (Tiebout choice) available in different school markets, on schools' productivity and sorting of students. The Tiebout choice (TC) is defined as 'voting with your feet' and it takes place when households make residential choices among local school districts. Using an instrumental variable approach, where instruments are derived from the natural boundaries (rivers and streams), she concludes that "metropolitan areas with greater TC have more productive public schools and less private schooling". On one hand, OLS estimates of Hoxby (2000) show no evidence that increased Tiebout choice affects pupil's performance. She interprets this result by the fact that successful school districts attract households that have school-aged children, thereby increasing their market share and reducing the observed degree of choice. Hoxby concludes that OLS results are biased due to endogeneity of choice and omitted variables. On the other hand, IV estimation results show that student achievement is higher when there is more choice among districts. An increase from 0 to 1 in the index of Tiebout choice generates reading scores that are 3.8 to 5.8 points higher and math scores that are 2.7 to 3.1 points higher. It means that test scores rise by one-quarter to one-half of a standard deviation. Additionally, such an increase in choice generates educational attainment that is 1.4 grades higher and income

at age 32 that is about 15 percent higher. These are big effects if one compares school market areas at opposite ends of choice spectrums, such as Miami and Boston.

Rothstein (2007) criticized the results of Hoxby on the grounds that her approach to measuring rivers and streams is very imprecise. The large significant effects of choice on students' achievement in Hoxby's paper are only obtained with Hoxby's particular streams variables. When Rothstein applies alternative constructions of the same variables, he obtains smaller estimates that are never significant. Instead, Rothstein suggests that the more precise OLS estimate of zero choice effect on test scores should be preferred to less precise IV estimates, since the instrument that Hoxby uses is weak.

Card et al. (2008) analyse the effects of competition in the dual school system in Ontario (Canada), with public (secular) and separate (Catholic) schools, both publicly funded. They test whether the schools that face greater cross-system competition have better performance, as measured by reading, math and writing test score gains between 3rd and 6th grade. Increased cross-system competition points to significant, but relatively small effect on test score gains. Comparing markets where only 20 percent of children have choice to markets where 60 percent of children can exercise choice, the authors estimate that reading and math scores in 6th grade are 2-5% of a standard deviation higher, relative to 3rd grade score. The effects on writing test scores are smaller and mostly insignificant.

Looking at data for England, Gibbons et al. (2008) empirically analyse the causality between school choice and school competition on the performance of schools, focusing on the gain in pupil's educational attainment on reading, English, and mathematics test scores from age 6/7 to age 10/11. On one hand, index of school choice is derived from a property of residential location, and is defined as the number of schools accessible to a pupil. On the other hand, the competition index is derived from a property of school location, and is defined as the average number of schools accessible to pupils in the school. The authors apply OLS and IV estimation approaches, where they generate instruments for choice and competition in terms of distance from the educational market boundary. OLS estimates show that pupils in schools facing more competition seem to do marginally better, but the impact of pupil's choice availability is more varied. IV estimates show no evidence of either pupil's choice availability or more competition among schools improving pupil's attainment. They also find that it is only in 'majority controlled' schools, i.e. schools owned by a foundation or charitable institution which has majority representation in the school governing body, that competition is causally linked to school performance. For these schools is the effect relatively large: one extra school increases the value added by 20% of a standard deviation. According to Gibbons et al. (2008) this could be explained by the fact that these schools have more freedom and flexibility in their management practices and teaching methods.

So far, evidence for the Netherlands is lacking. The only other available study using the Dutch data is the paper by Dijkgraaf et al. (2008) which looks at the effects of competition

on quality of education in secondary education.[4] They use OLS approach and measure competition via the Herfindahl index on the 10, 7.5 and 5 kilometres markets drawn around one school. As a measure of quality, they use average scores at the final written exam, the percentage of students who successfully pass the exam, and the percentage of students who go directly from the third year to the diploma. The authors conclude that schools that face higher competition have worse pupils' performance than schools that face lower competition. The main limit of this paper, however, is that it does not allow us to compare these results with estimates obtained using an IV approach.

3 School choice and competition in Dutch primary schools

There are about 7000 of primary schools in the Netherlands. Education is compulsory at age 5 and older, but most parents send their children to school at age 4. Primary education consists of mainstream primary education (BAO), special primary education (SBAO) and (advanced) special education (SO) for children with learning and behavioural difficulties and children with learning disabilities. In the remainder of this study, we only focus on mainstream primary education.

The Dutch education distinguishes two systems: the public schools and the publicly-funded private schools. Private schools are inspired by a religion or a philosophy. In private education a distinction is made between Protestant, Roman Catholic schools and other private institutions. The shares of each type of schools into Dutch primary education is given in Table 3.1. This last category includes schools with a specific educational concept (anthroposophist, Montessori, "Free Schools," etc.), as well as some special religious schools (Jewish, Islamic). All religious groups and other groups representing certain philosophies of life - called 'denomination' - are free to start a special school and are, up to minimum standards, free to decide about didactics of the school. If there are a sufficient number of parents in a community who want to send their children to a public school, they can force the local government to start one.

Table 3.1 General education: institutions 2004/2005

Primary education		
	# of schools	%
Total denomination	6986	100,0
Public	2317	33,2
Protestant	2092	29,9
Roman Catholic	2072	29,7
Other private education	505	7,2

Source: Statistics Netherlands

[4] HAVO/VWO

In the Netherlands, the difference between public and private schools is nowadays flawed. All public and private schools are equally financed by the government based on the number and distribution of pupils. Schools with a majority of pupils considered to be the ones who need more attention, get higher funding. Pupils are weighted on the basis of a certain number of criteria. Up to 2006 which is the period relevant for our empirical analysis, the weighting arrangements were as follows: (1) children from a Dutch cultural background whose parents have low level of education: a weighting of 0.25; (2) children of barge-operators: 0.40; (3) children of caravan dwellers and gypsies: 0.70; (4) children from a non-Dutch cultural background whose parents have a low level of education and low-skilled occupations: 0.90; (5) all other children: no weighting.[5] In addition, schools receive extra personnel and other resources on the basis of these weightings.[6] In order to qualify for extra funding under the weighting system, a school must meet a number of additional criteria, such as the minimum percentage of pupils with a certain weighting. No additional funds are allocated if the school fails to meet these minimum requirements.

Primary education is free since schools which are funded are not allowed to require extra payment from the parents, although they can ask voluntary contributions to cover the costs of extra activities (such as school trips and cultural events). Public schools are not allowed to refuse children who want to come to the school unless they are already full. Officially, private schools are allowed to refuse children on the basis of their identity (denomination). This means that they may require that parents, pupils, and teachers accept the principles on which the school is founded. This requirement is in most cases a purely procedural process.

Many public schools offer religious classes and a growing number of 'religious' schools are open to 'non-religious' children. Additionally, the difference between teaching methods tends to become less visible. The private and 'new' schools with alternative teaching methods have had a large influence upon public schools. Alternative teaching curriculum can, nowadays, be found in many public schools. This was also due to the Education Act from 1985, which stated that schools had to adapt their teaching methods to the individual child.

Parents have in principle the complete freedom of choice of a school, since all public and private schools are free of charge and there are no geographical restrictions on school choice.[7] Several reports have looked at the motives of parents in their choice of school in

[5] Changes to the system were introduced on 1 August 2006 and will be completed over a four-year period. In the new system, the weightings are as follows: (1) a weighting of 0.3 if both parents' highest level of education is junior secondary vocational education (LBO/VBO), (2) a weighting of 1.2 if one parent's highest level of education is primary education and the other parent's is LBO/VBO and (3) a weighting of 0 for other pupils. The new weighting system will run parallel with the old one up to 2009.

[6] Next to this main funding scheme, there is a range of other special funding schemes targeted for special purposes, such as the small classes scheme (Groepsgrootte en kwaliteit) or the scheme for disadvantaged pupils (Onderwijsachterstanden).

[7] In practice, the freedom of choice might be limited by different factors. In certain areas in Amsterdam, for instance, primary schools adopt a postcode policy: only children living in the same postcode as the school can register at the school. Also, schools might refuse children due to capacity constraints (when schools are full). Schools and municipalities might also recommend parents to choose for another school (for instance if the municipality has implemented a policy against seggregation).

primary education (Karsten et al., 2002; Herweijer and Vogels, 2004). Survey results indicate that parents state the 'quality of education' as the most important determinant of a school choice. However, parents interpret the quality of education as a very broad concept. To get an idea of the quality of a school, parents look at a wide range of indicators: the Cito-test, the reputation of the school, the number of pupils that continues into higher secondary education, the quality assessments of the Inspectorate of Education, etc. Remarkably, parents from a Dutch background also tend to put a high weight on the level of segregation in the school (Karsten et al, 2002, p104.), with higher quality coinciding with less pupils from a non-Dutch background.[8] In the surveys, this comes out under the labelling 'matching between school and home' ('our type of people'), 'atmosphere at school' and 'identification with the school' .

After quality, another important determinant of school choice is the distance to school. Most parents choose for a school in their neighbourhood. A survey on the travel behaviour from home to school of children in primary education, finds that the average distance that children travel is of 1.26 km (van der Houwen et al, 2004).[9] Finally, parents' choice is often irrespective of denomination. In 1990, 7% of the parents had no preference for the denomination of the school. In 2000, this share increased to 20% (Herweijer and Vogels, 2004). In 1999, 40% of the parents sent their children to a school whose denomination did not match with the parents' religious background (Ledoux et al, 2003).[10]

Webbink and Burger (2006) discuss how the current Dutch financing system provides incentives to schools to improve their performance. Firstly, given the current financing scheme based on the number of pupils, schools have incentives to attract more pupils in order to receive more funding.[11] Secondly, with more pupils the chance that public financing is stopped because the school is too small (the so-called 'closing-down' norm) decreases. Finally, the salary scale of school directors also depends on the size of the school.[12] According to this financing scheme, pupils are thus valuable assets for schools and its management.

According to standard efficiency arguments from economic theory, competition between schools in order to attract and retain pupil will force schools to improve the quality of education (e.g. educational outcomes) so as to keep up with their competitors. This theoretical argument rests, however, on several assumptions: 1) parents are informed about quality of schools, 2) parents are free to choose the school they prefer, 3) school resources increase with the number of pupils 4) schools have some autonomy and flexibility in their teaching methods,

[8] This is coined as the 'white schools' versus 'black schools' issue.

[9] Unfortunately, the report does not mention other statistics such as standard deviation or maximum distance traveled by pupils.

[10] Nevertheless, in certain regions in the Netherlands denomination is still likely to be important (e.g., Bijbelbelt regions).

[11] Another conclusion of Webbink and Burger (2006) is that there may be potential tensions between incentives to increase quality and incentives to integrate pupils from a low socio-economic background. Regarding the composition of the school population, it is not clear in which direction the incentives go. Even though schools receive more funding for disadvantaged students from a non-Dutch background, these pupils are more costly for the school as they require more teaching resources and effort.

[12] Even though teachers are not paid according to the size of the school, having more pupils can also be beneficial for teachers as they then have more resources for teaching (so it decreases teaching's effort).

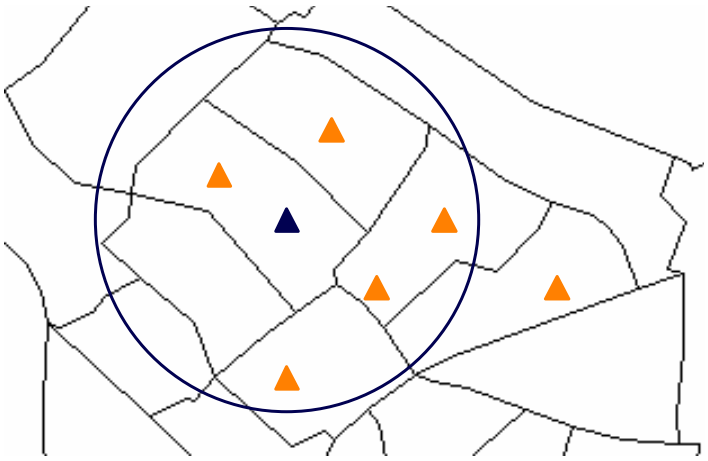
5) schools are allowed to expand in order to accommodate for extra demand. As discussed previously, to a large extent these assumptions hold true in the Dutch context. . Therefore, we expect to find a positive effect of competition on the quality of schools.

4 Empirical approach

4.1 Defining school competition

In this paper we define the concept of school competition in a spatial context. We assume that a school competes with alternative schools located within a circle of 3km around the school.[13] This is illustrated in Figure 4.1.[14] Unfortunately, we do not know where pupils attending a given school live, so that we cannot trace how far pupils are actually travelling to go to school. Given that we look at primary schools for children aged 4-11, parents are not likely to make long journeys. Although our choice of 3km is arbitrary, it is in line with the evidence that the average distance home-school in the Netherlands is rather small, about 1.26km according to data from van der Houwen et al. (2004). In their analysis of UK school markets, Gibbons et al. (2008) can construct travel zones for all pupils. They find that in the Great London area the median travel distance of primary schools pupils is 0.743 km (with a maximum of 6km).

Figure 4.1 School market as a circle of 3km around each school



In this example, the school in black competes with 5 other schools (in grey). The map describes 4-digits postcode areas.

[13] Given the way we construct our markets, in the case of connected towns, the number of competing schools also includes school which are located in adjacent towns.

[14] In our robustness analysis we will also consider larger markets of 5km around a school.

Nevertheless, we face several shortcomings with our definition of school competition. Firstly, we cannot look at the distinction between school competition and school choice as Gibbons et al. (2008).[15] This means that we only look at how many alternative schools are available to pupils in the school ('school competition') and not at how many schools are effectively accessible to a pupil ('school choice'). Since we do not have data containing information on school location and pupil residential location we cannot assess how much pupils are willing to travel to attend a school, and therefore how many schools on average are accessible in their neighbourhood.[16]

Secondly, due to data constraints, we can only measure distances between the centres of 4-digits postcode areas. This implies that we have to deal with potential measurement errors in our empirical analysis. More precise distance data (for instance between two schools or between two centres of 6-digits postcode areas) were not available. As a consequence, our circles of 3km are in fact circles around the centre of the 4-digit postcode area in which the school is located. If the centre of another 4-digit postcode falls (does not fall) within this circle, all schools located in this postcode area will also (will not) be included in our market.[17]

Thirdly, our definition of school competition as a 3km circle is likely to be affected by other factors such as town size and urbanization. Highly urbanized markets will have a higher density of schools than less urbanized markets. We will correct for these factors in our analysis.

4.2 Measuring school quality

When choosing a school, parents compare the quality of the different schools in their neighbourhood. As a measure of school quality, we look at the performance of pupils attending the school in a standardized test score, namely the so-called Cito-test. About 80% of Dutch pupils participate in a nationwide standardized Cito test in their final year of primary school. The objective of the Cito is to test the skills acquired by students over the years in the primary school on four areas:

1. language (spelling, writing, reading and vocabulary)
2. arithmetic (understanding of numbers, mental arithmetic, percentages, fractions, dealing with measures, weights, money and time).
3. information processing (use of texts and other information sources, reading and understanding of tables, graphs and maps)

[15] By making the distinction between school choice and school competition, Gibbons et al. (2008) aim to disentangle whether the benefits from school provision based on parental choice are due to a better allocation of pupils among schools ('better matching') or due to increased competitive pressure faced by schools.

[16] In that case, the circle is drawn around each pupil.

[17] On average, our 3km school markets are composed of 3.5 postcode areas (with a maximum of 10 postcode areas).

4. world orientation (optional):[18] applying knowledge in the fields of geography, history, biology, science and form of government.

The complete test consists of over 200 multiple-choice questions. Pupils have incentives to perform well since pupils' scores are one of the acceptance criteria into different levels of secondary education. Averages scores of schools' pupils are used by the Inspectorate of Education to evaluate the quality of primary schools. The Inspectorate publishes an assessment of whether a school performs above or below the average of schools with a comparable student population. Average Cito scores are in principle public information and are often available on folders and websites published by the schools. Parents then may use this information to select a school for their children.

Yet, we may question whether the Cito-test truly reflects the quality of a school. As stated earlier, parents may value the quality of schools on other aspects which are less easily quantifiable such as reputation, atmosphere, building maintenance, extra activities, etc. Another problem when using standardized test scores is that they may be sensitive to strategic behaviour by schools. This can occur whenever schools choose for instance to publish test-scores after excluding low-performing students (see Chorny and Webbink (forthcoming) for a study of this issue on Amsterdam schools). Our data are, however, exempt from this problem since we obtained the Cito-scores directly from the Cito-organization and not from the schools. Still, our data might be affected by the so-called *teaching-to-the-test* behavior. This would mean that the Cito might be overrated as schools train pupils on skills specific to the Cito at the expense of other topics.

Despite these shortcomings, the Cito test scores data present the advantage to be readily accessible. In addition, the Cito-scores are generally correlated with other aspects that matter to parents, such as the level of segregation[19] or the percentage of pupils that continue into secondary education. Finally, many international studies show that parents are not indifferent to standardized tests scores. Evidence using house prices show that parents do take average pupil achievement at schools in consideration in choosing their residential location. (Black, 1999; Kane, Staiger and Reigg, 2005). Using UK data, Gibbons and Silva (2008) show that parental perception of educational excellence is also related to standardized test scores. Even though we cannot directly generalize these results to the Netherlands, this gives some support to our choice of measuring school quality through standardized test scores. Finally, in order to measure the impact of school competition on the added-value of a school, we will adjust the Cito scores to correct for the distribution of pupils within the school. Indeed, average Cito tests of a school are not indicative of the added-value of the school, but instead mainly reflects the distribution of the pupil population within the school. Schools with a high percentage of pupils from a low socio-economic background are likely to score low on Cito.

At last, we also considered looking at another measure of school quality next to Cito scores, namely the assessments of school quality by the Inspectorate of Education (the so-called 'quality cards'). Since the 1999/2000 school year, the Inspectorate of Education assesses all primary schools

[18] In our empirical analysis, we abstract from looking at scores on world-orientation.

[19] In our data, we find a positive correlation of 0.6 between the percentage of Dutch pupils and pupils Cito-scores.

on a regular basis on four aspects: 1: school performance, 2. didactic performance, 3. learning material, 4. support and guidance for pupils. The main advantage of the quality cards is that they might reflect other aspects of quality, such as guidance of pupils, materials, etc, which are not captured by the Cito test but that are very relevant for parents. Since the information on quality cards is obtained directly from the schools, they could however be sensitive to strategic behavior by school. Unfortunately, the quality of these data proved to be insufficient to perform our analysis. The number of observations is relatively limited and the data show too little variation.[20]

We estimate the effect of competition on the quality of schools, in a simple regression analysis framework (OLS/IV), correcting for school and neighbourhood characteristics. The following specification sketches our empirical approach:

$$performance_{ism} = \alpha\, comp_{m} + x'_{ism}\,\beta + \varepsilon_{ism} \qquad (1)$$

where $performance_{ism}$ is the Cito test score for pupil *i*, attending school *s*, located in market *m*; $comp_{sm}$ is a competition index for school *s* in market *m*; x'_{ism} is a vector of pupil, school, and neighbourhood characteristics (such as demographic and wealth characteristics of the neighbourhood).

4.3 IV strategy

One of the main issues when measuring the effects of competition on school quality is that the level of competition observed in a market may be endogenous in the quality performance of schools. Indeed, families may consider the quality of schools when deciding in which neighbourhood to live. As a result, such residential sorting might lead to families crowding around high-quality schools, so that high-quality schools tend to be larger than low-quality schools. As high-quality schools grow larger this reduces the apparent level of competition in the market. In a similar way, schools of lower quality might find it difficult to retain pupils and may even exit the market, reducing competition in the neighbourhood. Simple descriptive statistics in our dataset show that indeed schools exiting the market tend to have low average Cito scores and that schools with high average Cito have the largest enrolment shares in the market. In short, the problem is that the market structure we observe is actually related to the quality of schools.

The implications of endogenous competition are that estimates in a simple OLS regression analysis will be biased. Instead, we will adopt an IV strategy in which we use a reliable instrument for our competition variable. This instrument should be correlated with the level of competition in the market but not with the quality of schools.

[20] In the dataset we obtained from the Inspectorate of Education, the assessments were reported as a binary variable (sufficient/insufficient).

Our IV strategy follows closely the approach of Gibbons et al. (2008). Their intuition is that families living at the boundary of the educational market are more likely to go to the nearest schools than families living inside the school market (in case of England, this is the Local Educational Authority - LEA). This is because families living at the boundary face longer journeys and thus higher travel costs to go to a school other than the nearest. As a consequence, schools located close to the market boundary face less competition than schools located at the centre of the market.

Gibbons et al. (2008) use therefore the distance to the LEA boundary as a instrument for competition. In the same spirit, we will use the distance between the school and the town centre: the closer (further away) schools are from the town centre, the more (less) competition they face. This IV strategy rests on several assumptions. Firstly, school choice should decrease with respect to the distance to the town centre. In other words, there should not be more schools at the periphery of the town than in the centre. This could occur for instance if several towns were connected to one another. Also, schools and population should not be more densely populated around the town periphery than in the centre. Finally, after correcting for observable characteristics, the distance school-town centre should not be correlated with the quality of schools. In the end, these are empirical issues that will be addressed when we test the power of our instrument in Section 6.

Another additional limit is due to the lack of precision of our distance measures. As noted earlier, we only measure distances between the centres of two 4-digits postcode area. In our dataset, all schools located in the same postcode area will therefore be at equal distance from the town centre wherever their actual location.[21] Our instrument will thus be measured with errors. In practice, this does not need to affect our estimates as long as we have a good instrument.

5 Data and sample construction

We obtained Cito scores at the pupil level from the Cito organisation for the period 1999-2003. The dataset includes the standardized total Cito test score[22] as well as the component scores. We excluded the bottom and top 1% of the pupils to avoid potential outliers. The only additional information that we have at the pupil level is the gender.

Next to pupil data, we obtained several datasets from the Inspectorate of Education with information on the Dutch primary schools. We have a dataset with the addresses of all primary schools in mainstream education in the Netherlands, a dataset with the composition and size of the pupil population of each school and finally a dataset reporting the number of

[21] In small towns composed of only one 4-digit postcode our instrumented school-town centre distance will then be set to 0km for all schools.

[22] The total Cito score and its components are standardized with mean 0 and standard deviation 1.

teachers[23], and the average Cito-test results at the school level. We have also obtained a dataset from the CFI organization[24] including the composition of school boards over the same period. Regarding school denominations, we make a distinction between four groups: public schools, Catholic schools, Protestant schools and other private schools (mainly interconfessional schools and free schools). We dropped a group of specific private schools: namely, orthodox Protestant schools (reformed and evangelistic), Islamite, Hindu and Jewish schools as these schools constitute very specific markets and we cannot reasonably assume that these schools are competing with the other group of public and private schools.

In our dataset, about 15% of schools have more than one dependence. Unfortunately, our data on school performance and school characteristics are not available at the dependence level. We assume therefore that school performance is equal across dependences. Further, we divide the total number of pupils of a school equally across its dependences, since we do not have detailed data on the number of pupil per school building. To test whether this would significantly affect our results, we also conducted our empirical analysis on the sample of markets with schools with only one dependence. We find similar results as when we include markets with schools with several dependences. Finally, when we build our competition variables, we assume that when a school has several dependences within the same market (see Section 4.1 on our definition of markets) these dependences are not competing with one another. This is a realistic assumption since within a same market school dependences are often located very close to one another (often in the same street in an adjacent building).

In total, we construct about 6000 school competition markets (defined as a 3km radius around every school) distributed over 3000 4-digits postcode areas in about 1600 towns. We obtained demographic data at the 4-digit postcode area and town level from Statistics Netherlands (CBS). The dataset includes information about number of inhabitants, average income per inhabitant, average house prices, population composition, etc. To correct for market characteristics, we include demographic variables of the 4-digit postcode area in which the school is located. We also control for the size and urbanization at the town level. This is mainly to correct for a scale effect in our instrument variable (the larger the city, the larger the distance to the city centre). We obtained geocoded data from the Geotran company on administrative towns and 4-digit postcode areas. This allowed us to compute all our distance variables (between two centres of 4-digit postcodes and between the centre of a 4-digit postcode and the town centre) using a Geographical Information System software. Within each 3km market, we constructed the "competitors" variables as the number of alternative schools within our 3km markets[25] and the inverted Herfindhal index[26] as follows:

[23] Data on teachers are missing for the years 1999 and 2003, so we excluded them from our analysis. We conducted the analysis on the 2000-2002 sample and on the 1999-2003 sample excluding data on teachers. This did not affect our estimates on the effects of competiiton. In addition, the number of teachers is highly correlated with the total number of pupils in a school and with the percentage of non-Dutch pupils.

[24] CFI (Central Funding of Institutions) is an agency of the Ministry of Education, Culture and Science in charge of the funding of Dutch education institutions.

[25] Therefore, monopoly markets have 0 alternative competing schools within a 3km radius.

$$HHI_m = 1 - \sum_i^n s_{i,m}{}^2 \,, \tag{2}$$

where s_i is the market share of a school i in a market m. A high level of competition in the market is thus reflected by a high value of the Herfindhal index.

Finally, we restrict our sample to towns of more than 20000 inhabitants. In small rural towns with low school density our competition indices are very highly correlated with urbanization and town sizes variables, leading to multicollinearity problems.[27] In larger markets, however, competition is only partly related to town size and urbanization and we find more mixed patterns of competition, town size and urbanization levels. An additional problem with small rural towns is that there is not much variation in our instrument variable. Since we measure our distance data between centres of 4-digit postcode areas, for most of these small towns composed of only 1 postcode area the distance school-town centre is set to zero. We are left with a sample covering about 50% of all primary schools in the Netherlands and 60% of all pupils. Figure 5.1 (in Appendix) plots the distribution of the number of alternative schools within 3 km.

Since we restrict our sample to large towns, we are not able to estimate the impact of school competition on educational outcomes in small rural towns. Nevertheless, in towns with more than 20000 inhabitants, we find a large diversity of market structures, ranging from monopoly to highly competitive markets as plotted in Figure 5.1. In theory, however, there are no reasons to believe that competition works differently between large and small towns. A monopoly school in a small rural town will lack incentives to improve performance just as a monopoly school within a large urban town. The question is whether the intensity of competition across oligopoly markets in small and large towns is likely to differ. It could for instance be that school denomination plays a greater role in small towns than in large ones.[28] In that case, schools would be offering differentiated products and competition incentives would be weaker in small towns. Another potential differences between oligopoly markets across small and large towns, is that in large towns we will have a lot of overlapping school markets (defined as a 3km radius around each school). This would for instance imply that in a large town, even if a school has only one competitor within 3km, this competitor may itself have a large range of competitors within a 3km circle, and thus the intensity of competition might be higher in a duopoly market in a large town than in a small town, where the number of overlapping markets is by definition limited. Given the difficulty of extrapolating our results to small towns, we will therefore abstract from this issue. Table 5.1 gives the descriptive statistics

[26] To ease interpretation of the results, we invert the Herfindhal index such that a lower (higher) value indicates lower (higher) competition. A value of 0 indicates thus a monopoly market.

[27] Descriptives statistics of small towns of less than 20000 inhabitants and correlation indices can be found in Appendix.

[28] As an illustration, Catholic (public) schools tend to be overrepresented (underrepresented) in small towns. In towns of less than 20000 inhabitants, 46% (25%) of the schools are Catholic (public), against 33% (33%) in larger towns.

of our sample dataset. On average, there are about 6 alternative schools within a 3km radius (standard deviation is 5 schools) around each school (15 within a 5km radius).

Table 5.1 Descriptive statistics, 1999-2003, Towns of 20000+ inhabitants

Label	Mean	Std. Dev.	Min	Max	Obs
Pupil characteristics					
Cito (std)	0	1	-2,5	1,6	358767
gender	0,50	0,50	0	1	358767
School characteristics					
average Cito test score	534	5	511	547	280061
number of pupils	324	143	20	1238	358767
% pupils subsidy 1.90	0,20	0,26	0	1	358767
public schools (dummy)	0,33	0,47	0	1	358767
catholic schools (dummy)	0,33	0,47	0	1	358767
protestant schools (dummy)	0,25	0,43	0	1	358767
other schools (dummy)	0,09	0,28	0	1	358767
Market characteristics					
Postcode level variables					
average house prices (in 1,000 euros)	136	48	48	451	358767
%population with high income	0,36	0,06	0,09	0,59	358767
%population with low income	0,45	0,06	0,29	0,72	358767
% population 0-14 years	0,18	0,04	0,02	0,31	358767
% population 65 years +	0,13	0,06	0,02	0,75	358767
Town level variables					
Total inhabitants (in 1000)	157	191	21	656	358767
Urbanization (quartiles of number of addresses per km^2)	3,2	0,7	2,0	4,0	358767
Competition variables (3km)					
distance to town centre	2,6	2,1	0	23	358241
number of alternative schools	6,5	4,8	0	27,0	358767
Herfindhal index (inverted)	0,78	0,16	0	0,96	358767
number of alternative public schools	2.4	2.7	0	13	118208
number of alternative catholic schools	1.8	1.6	0	8	101274
number of alternative protestant schools	2.0	1.9	0	12	88764
number of alternative schools belonging to a different school board	3.1	2.1	0	14	117491
Competition variables (5km)					
number of alternative schools	14,7	10,1	0	62	362090
Herfindhal index (inverted)	0,89	0,10	0	0,98	362090

6 Results

6.1 First-stage results

As stated in Section 4.3, we instrument our competition variables with the logarithm of the distance between the centre of the postcode of the school and the town centre. The intuition is that the larger the distance (being further away from the town centre), the lower the level of competition in the market, since parents living further away from the town centre are more likely to enrol their children into the school around the corner. In order to assess the choice of our IV strategy, we look at the results of the first stages estimates of the IV regressions. In the first stage of the regression, we estimate the effect of the logarithm of the distance school-town centre on the level of competition in the 3km circle around the school. We expect a significant negative effect. Table 6.1 gives the results of our first-stage estimates in which we regress the effect of logarithm of the distance to the town centre on the level of competition in the market.

Table 6.1 **First stage estimates, Dependent variables = (1) number of competing schools within 3 km (2) inverted Herfindhal index within 3 km.**

	(1) Number of competiing schools	(2) HHI
Competition		
log(distance to town centre)	-0.367***	-0.236***
	(0.015)	(0.010)
Pupils		
gender (0=male, 1= female)	0.001	0.000
	(0.003)	(0.002)
School characteristics		
Total number of pupils	-0.000***	-0.000***
	(0.000)	(0.000)
Percentage of pupil weight 1.90	0.556***	-0.019
	(0.056)	(0.027)
Size of school board (quartiles)	0.017***	-0.001
	(0.003)	(0.002)
Dummy for catholic schools	-0.091***	-0.095***
	(0.021)	(0.014)
Dummy for protestant schools	0.117***	0.039***
	(0.023)	(0.013)
Dummy for other schools	-0.071**	-0.031
	(0.032)	(0.020)
Market characteristics		
City size (in 1,000 inhabitants)	0.003***	0.001***
	(0.000)	(0.000)
Urbanization city (1=very low, 4= very high)	0.219***	0.171***
	(0.011)	(0.010)
% of high incomes	-0.385*	0.712***
	(0.205)	(0.111)
% of low incomes	1.285***	-0.362**
	(0.257)	(0.155)
Average house prices (in 1000 euros)	-0.001**	-0.003***
	(0.000)	(0.000)
% population aged 0-14	-1.565***	0.196
	(0.334)	(0.169)
% population aged 65+	-3.653***	-0.466***
	(0.209)	(0.116)
Observations	358241	358241
R-squared	0.45	0.23
F-test on excluded instrument	637	544
Partial R2 on excluded instrument	0.05	0.05

We find that the distance instrument is always very powerful in explaining competition. Areas with less school competition are located on average further away from the town centre than areas with more school competition. A 10% increase in the distance between the school and the town centre reduces the number of alternative competing schools by 3.67% of a standard deviation, so the set of competing schools is reduced by 0.2 (=5*0.0367). This corresponds to 2% of the mean (=0.2/6.5 as there are 6.5 competing schools on average in a 3km circle).[29] The F-test for excluded instruments is always high (Staiger and Stock, 1997) and lie always way above 10, the reference threshold for strong instruments. Since our first stage results report a lower explanatory power (R^2) when instrumenting the Herfindahl index (0.18) compared to the number of competing schools (0.45), we might expect that our instrument works better when instrumenting number of schools variable. The strong link between competition and our distance measure also suggests that potential measurement errors in our distance measures are not likely to affect our results.

The fact that on a large sample of Dutch towns we find a strong negative coefficient suggests that 'on average' school competition tends to decrease with the distance to the town centre. Yet, according to anecdotal evidence, in the city of The Hague a large number of schools tend to be located far away from the town centre. School choice should thus increase with the distance to the town centre. A quick look at our data shows that this holds true. We find a positive correlation between the number of schools in a 3km market and distance to the town centre. Nevertheless, for towns of comparable sizes such as Amsterdam, Rotterdam and Utrecht, we find a negative correlation between distance to centre and school choice as suggested by our empirical strategy.

An important assumption in our IV strategy is that distance to the town centre is not correlated with other unobserved characteristics of pupils, schools and neighbourhoods that we are not controlling for, but that still may affect pupil achievement. In other words, the question is whether our distance variable still captures other features of pupils, schools and neighbourhood close to town centre, which may a direct influence on educational outcomes. For instance, pupils in the town centre may be more motivated and value test results more than pupils at the boundary of the town. Parents living close to the town centre may be more involved into their children's education than parents living at the boundary of the town. In addition, schools close to the town centre may also have better management practices than schools at the periphery.

We attempt to minimize the concerns about potential correlation between school quality and the distance measure by controlling for a large set of covariates, especially regarding neighbourhood characteristics, in our baseline estimation. By definition, however, it is not possible to directly test for a potential correlation with unobservable characteristics. We do not have data on the intrinsic motivation of pupils for instance. Regarding schools, the only additional data available are on the yearly outflow of teachers. We did not use these data in our

[29] Gibbons et al. (2008) find similar effect of distance on the number of competing schools.

baseline specification due to missing values. Distance to the town centre could be correlated with the ouflow of teachers if for instance schools at the periphery had different working conditions (or working 'atmosphere') and management practices than schools in the town centre. Regressing our distance measure on the outflow of teachers and our covariates show, however, no significant correlation between these two variables. This finding is encouraging, but we cannot of course completely rule out the fact that our distance measure may be correlated with other unobservables we cannot measure

6.2 Basic specification

Before we turn to the effects of competition on pupil achievement, we first look at the other factors that explain the performance of pupils. Table 6.2 shows IV estimates of equation (1) including the coefficients of all our control variables on pupil, school and neighbourhood characteristics. We clustered standard errors on school and year, so that we assume that there is some intra-correlation between all pupils of a same school passing the Cito exam in a given year.

The results show that male pupils perform on average better than females. Large schools perform better than small schools, all other things being equal. Pupils in schools with a large share of non-Dutch pupils perform worse than pupils in schools with more Dutch pupils. The effect is large: Cito-scores of pupils decrease by 9% of a standard deviation (so about 1 point) for each 10% increase in the percentage of pupils with a non-Dutch background. The results also show that schools in larger school board tend to perform worse than schools in smaller school boards. This could be explained by the fact that incentives are weaker when there are many schools in the school board simply due to higher monitoring costs. It could also be that schools in larger boards have lower incentives to compete (if schools in the same board are not competing with one another). Finally, catholic schools perform better than public and protestant schools. Pupils in schools located in wealthy neighbourhood have higher Cito scores than pupils going to schools in less wealthy areas.

Table 6.2 IV estimations, Basic specification, Dependent Variable = CITO per pupil

Competition	
Number of competing schools within 3km	0.065***
	(0.015)
Pupils	
gender (0=female, 1= male)	0.039***
	(0.003)
School characteristics	
Total number of pupils	0.000***
	(0.000)
Percentage of pupil weight 1.90	-0.862***
	(0.022)
Size of school board (quartiles)	-0.006***
	(0.001)
Dummy for catholic schools	0.048***
	(0.008)
Dummy for protestant schools	-0.008
	(0.008)
Dummy for other schools	0.120***
	(0.012)
Market characteristics	
Town size (in 1,000 inhabitants)	-0.000
	(0.000)
Town level of urbanization (quartiles of address density)	-0.046***
	(0.006)
% of high incomes	0.333***
	(0.061)
% of low incomes	-0.150*
	(0.078)
Average house prices (in 1000 euros)	0.002***
	(0.000)
% population aged 0-14	-0.886***
	(0.107)
% population aged 65+	0.156*
	(0.091)
Observations	358137
R-squared	0.09

The number of competing schools is standardized with mean 0 and standard deviation 1.
Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.10
Robust standard errors, clustered at the school level per year.

Table 6.3 summarizes the effects of competition on pupil achievement, i.e. the coefficients of interest in this study. The first panel of Table 6.3 gives the results of IV estimations on the total

Cito-score of each pupil and on each of its component: language, arithmetic and information processing. The results are presented for both competition variables: the number of competing schools within 3km and the (inverted) Herfindhal index. We find evidence for a small positive link between school competition and educational outcomes. Pupils in schools facing more competition in their neighborhood perform better on average than pupils in schools facing less competition. The gains from competition are in the range of 5-10% of a standard deviation in pupil achievement. Said in another way, an increase in one standard deviation in competition leads to an increase of 5-10% of a standard deviation in the Cito-score[30], so about 1 to 1.5 point. At first sight, this effect seems modest since increasing the level of competition in the market by one standard deviation is comparable to an additional five schools within a 3km radius. A large increase in competition is needed to raise the level of pupil achievement by one extra point. Looking at the different components of the Cito-score, the largest effect of competition is found on the language part.

The second panel of Table 6.3 reports the results of the first-stage estimations and present the coefficient of the distance measure on the competition variable as in Table X. All these coefficients are negative and statistically significant at the 1% level.

Finally, the third panel of Table 6.3 gives the results of OLS estimations. In this specification, the effects of endogenous competition and residential sorting are not corrected for. In an OLS framework the effects of competition on the Cito-scores are much lower. They fall in the range of 0-2.5% of a standard deviation. A small positive link is found for some specifications, while other lack statistical significance.

[30] The standard deviation of the Cito-score is of 15 points.

Table 6.3 Estimation results for different specifications

	Dependent variables							
	total Cito	total Cito	Cito language	Cito arithmetic	Cito information	Cito language	Cito arithmetic	Cito information
Base IV estimation								
competitors	0.064***		0.071***	0.040**	0.062***			
	(0.020)		(0.015)	(0.016)	(0.014)			
HHI		0.099***				0.107***	0.060**	0.093***
		(0.020)				(0.023)	(0.024)	(0.021)
First-stage results								
First stage coefficient								
ln(distance)	-0.367***	0.236***	-0.366***	-0.366***	-0.366***	-0.242***	-0.242***	-0.242***
	(0.015)	(0.010)	(0.014)	(0.014)	(0.014)	(0.010)	(0.010)	(0.010)
F-test for excluded instruments	637	544	638	638	638	562	562	562
Partial R-squared	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Base OLS estimation								
competitors	0.007*		0.012***	0.003	0.005			
	(0.004)		(0.003)	(0.004)	(0.003)			
HHI		0.019***				0.027***	0.006	0.019***
		(0.005)				(0.005)	(0.005)	(0.005)

Note: We control for all variables as in the base specification shown in the previous table. The competition variables are standardized with mean 0 and standard deviation 1. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.10
Robust standard errors, clustered at the school level per year. In IV estimations, the number of observations is N=358241 in columns (1) and(2), N= 362911 in columns (3) to (8). In OLS estimations, the number of observations is N=358767 in columns (1) and (2) and N=363437 in columns (3) to (8).

6.3 Robustness checks

We tried a large range of specifications using robust estimation of standard errors. Year dummies were never significant so we do not mention them. Including dummies for the 4 largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague and Utrecht), we found that pupils in Amsterdam and Rotterdam had higher Cito scores than pupils in other smaller cities in the country, all other things being equal. Excluding all markets in these 4 large cities tended to reduce slightly the effect of competition on quality. Finally, we also included non-linear terms for our competition variables, which were never significant both with OLS and IV.

In this section, we provide some additional results and check the robustness of our estimations by experimenting with different definitions of school competition. Table 6.4 gives the IV results for different town size samples. The effects of competition on the Cito score tend to be more important in larger towns. As explained earlier, this could be potentially explained by the fact that the intensity of competition might be higher in large towns given a certain number of competitors (more overlapping markets), or simply because parents give more importance to school denominations in smaller markets.

Table 6.4 IV results, dependent variable=CITO per pupil, effects of competition, different samples.

Dependent Variable = CITO per pupil	(1)		(2)		(3)		(4)	
	20000+	20000+	40000+	40000+	70000+	70000+	100000+	100000+
competitors	0.064***		0.082***		0.124***		0.100***	
	(0.02)		(0.021)		(0.031)		(0.030)	
HHI		0.099***		0.165***		0.268***		0.211***
		(0.02)		(0.043)		(0.070)		(0.064)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.09	0.09	0.10	0.10	0.11	0.11	0.13	0.13
Obs	358241	358241	244698	244698	183584	183584	142266	142266
First stage coefficient								
ln(distance)	-0.367***	-0.236***	-0.353***	-0.175***	-0.293***	-0.135***	-0.368***	-0.174***
	(0.015)	(0.010)	(0.021)	(0.012)	(0.026)	(0.013)	(0.035)	(0.016)
F-test for excluded instruments	637	545	275	219	127	105	113	113
Partial R-squared	0.05	0.05	0.03	0.02	0.02	0.02	0.02	0.02

The competition variables are standardized with mean 0 and standard deviation 1.
Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.10
Robust standard errors, clustered at the school level per year.

We then make different assumptions on the way schools compete with one another, as suggested by Dutch policymakers. We only present these results as robustness tests and we do not attempt to discuss how realistic these assumptions are and to interpret the results. In column (1) in Table 6.5 we assume that public schools are only competing with other public schools within a 3km radius. In columns (2) and (3) similarly we assume that Catholic and Protestant schools are only competing with other Catholic and Protestant schools, respectively. We only find a significant positive effect of competition on pupil outcomes in the case of Catholic

schools. In the literature, higher incentives for Catholic schools are often attributed to better governance and religious fervour. In column (4) of Table 6.5 we assume that schools are only competing with schools falling under a different school board. By definition, this implies that public schools are not competing with one another since all public schools in a town fall under the responsibility of the municipality. Since this may be seen as a far-stretched assumption, in column (5) we assume that each public schools behave as an independent school board. Using the school board definition of school competition, estimates of the effects of competition are larger than in our baseline specification, suggesting that schools might indeed have more incentives to compete with schools from a different school board. Finally, in column (6) we assume that schools compete with all other schools located within a 5 km radius around each school. The overall picture of Table 6.5 is that we find a positive link between competition and the Cito-score in many specifications.

Table 6.5 IV estimations, robustness checks, different definitions of school competition

	(1) public	(2) catholic	(3) protestant	(4) school board	(5) schoolboard	(6) 5km
competitors	0.03	0.060***	-0.023	0.079***	0.062***	0.096***
	-0.041	(0.017)	(0.027)	(0.02)	(0.02)	(0.02)
HHI	0.03	0.084***	-0.026	0.14***	0.12***	0.13***
	-0.038	(0.024)	(0.031)	(0.04)	(0.04)	(0.03)
Observations	117805	117374	88766	361564	361564	358241

Competition variables are standardized with mean 0 and standard deviation 1.Robust standard errors, clustered at the school level per year. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.10. We control for the same variables as in our baseline specification. First-stage results always show a strong negative link between distance to town and competition. Columns (4) and (5) assumes that schools are competing with all other schools within 3 km falling under a different school board. In column (4), we count all public schools as one school board (since all public schools are administrated by the local municipality). In column (5), we count all public schools as one independent school board.

7 Discussion and policy implications

The key result of this study is that competition raises educational outcomes in Dutch primary schools. Pupils in schools facing more competition in their neighbourhood perform better than pupils in schools facing less competition. The magnitude of the effect is small: one standard deviation increase in competition raises the Cito-scores by 5 to 10% of a standard deviation on average.

At first sight, such gains on pupil achievement might seem very modest. Yet, according to Hanushek (2006) even small increases in pupil achievement can have important impacts in the long-term. Several studies show for instance that an increase in pupil

achievement may have a large impact on future earnings of pupils (Mulligan, 1999; Murnane et al., 2003; Lazear, 2003). These studies suggest that one standard deviation increase in math performance at the end of high school translates into 12% higher annual earnings, implying that a one standard deviation increase in performance would boost their earnings by $3600 for each year of work life. In addition, there is large evidence that students who do better on standardized achievement tests, tend to have lower drop-out rates (Murnane et al, 2003). Finally, Hanushek & Kimko (2000) also establish the causal effect between higher test scores and economic growth and conclude that one standard deviation difference on test performance is related to 1 percent difference in annual growth rates of GDP per capita. Hanushek (2006) simulates the effects of a policy introduced in 2005 leading to an improvement of scores of graduates of one-half standard deviation by the end of a decade. He argues that such a policy would not have an immediate effect on the economy, because new graduates are a small portion of the labour force, but the effect would mount over time. If past relationship between quality and growth holds, GDP in the US would end up 2% higher by 2025 and 5% higher by 2035.

This evidence gives therefore support to policies aiming to increase competition in educational markets. However, increasing competition by one standard deviation may require substantial reforms. The question is whether such policies are feasible and cost-effective. Obviously building new schools in the market may be a very costly way to increase competition. A less costly alternative would be to increase the amount of information available to parents. While newspapers publish school ranking for secondary schools in the Netherlands, such tables are not available in primary education. Instead, parents gather information on the performance of schools in their neighbourhood through schools websites and visits. Since 2003, quality assessments of primary schools (‘quality cards’) have been published on the website of the Inspectorate of Education. Yet, it is not clear how many parents actually use this information when choosing a school.

An option to increase transparency is to publish meaningful indicators of school performance. The main advantage of value-added performance measures is that they provide an indication of school performance corrected for the ability of the pupil population. Another advantage of these measures is that they lower the incentives for creaming strategies by schools (i.e schools may try to improve their ranking by cream-skimming the pupils with highest ability). Since 2006, a new indicator of school performance has been introduced in league tables in the UK, namely the contextual value added (CVA). The idea of CVA measures is that value-added measures of pupil performance are also corrected for pupil characteristics, such as gender, low-income and ethnicity.

Finally, the benefits of policies aiming to increase competition in school markets should also be weighed against other potential costs associated with an increase in competition, such as for instance an increase in segregation. The potential effects of competition on segregation in Dutch schools are, however, out of the scope of this study.

8 Conclusions

In this paper we look at the causal links between competition and pupil achievement in Dutch primary schools. Our research question was: Do schools that face more competition in their neighbourhood perform better in terms of standardized test scores than schools facing less competition? In order to answer this question, we constructed the relevant markets for primary school competition as a zone of 3km radius around every school. We then computed different competition indices within these markets. We estimated the effect of school competition on the Cito-test results at the pupil level using an instrumental variable approach. In the spirit of Gibbons et al. (2008), we use the intuition that schools located at the periphery of a town are likely to face less competition than schools located close to the town centre. This is because parents living at the town periphery face higher travel costs to bring their children to a school in the centre and are therefore more likely to go to the nearest school in their neighbourhood. We use therefore the distance between the school and the town centre as an instrument for competition. This instrument appears to be very powerful in our all specifications.

In an OLS framework, we find a small positive relationship between school competition and standardized test results. When we control for endogeneity issues using our IV strategy, we find a larger effect of competition on pupil achievements. Yet, the effects remain very small. A one standard deviation increase in competition increases Cito-scores on average by 5-10% of a standard deviation, so about 1 to 1.5 point. Although at first sight, the gains from competition may seem modest, there is some evidence in the literature that even small increases in pupil achievement may mount to important benefits in the long-run in terms of earnings and economic growth. A possible option to increase competition among schools is to increase the level of transparency in the market, mainly by improving the information available to parents about school performance.

This study opens many opportunities for further research. Firstly, the IV approach used in this paper could be reproduced for schools in secondary education. This could provide a useful comparison with the OLS results provided by Dijkgraaf et al. (2008). Secondly, on methodological grounds, the recent introduction of a postcode policy in the city of Amsterdam could provide a useful natural experiment to measure the impact of a restriction in competition on the Cito-scores. Nevertheless, the effects of this policy on test performance will only be effective in a few years. Finally, more research is needed to grasp how parents actually choose a school in the Dutch market. Data on the travelling behaviour of pupils would greatly improve this type of analysis.

9 References

Atkinson, A., Burgess, S., B. Croxson, P. Gregg, C. Propper, H. Slater and D. Wilson (2007) "Evaluating the impact of performance-related pay for teachers in England", mimeo, University of Bristol.

Belfield, C. R., and Levin, H. M. (2003), "The Effects of Competition on Educational Outcomes: A Review for the United States," Occasional Paper No. 35, Columbia University, New York, NY. National Center for the Study of Privatization in Education.

Besley, T. and S. Machin (2008) "Are public sector CEOs different? Leadership Wages and Performances in Schools", mimeo, London Schools of Economics.

Black, S. (1999) "Do better schools matter? Parental valuation of elementary education" Quarterly Journal of Economics, 114(2), pp. 577-599.

Dee, T. S. (1998), "Competition and quality of public schools," Economics of Education review, Volume 17, p. 419-427.

Dijkgraaf E., S. A. van der Geest, and J. M. de Jong (2008), "Effect van concurrentie op de kwaliteit van het HAVO en VWO," SEOR-ECRi report.

Hsieh, C. T., and Urquiola, M. (2003), "When Schools Compete, How Do They Compete? An Assessment of Chile's Nationwide School Voucher Programme," NBER Working Paper, WP 10008.

Gibbons, S., Machin, S., and Silva, O. (2008), "Choice, Competition and Pupil Achievement", forthcoming in *Journal of the European Economic Association*, (IZA Discussion Paper 2214).

Gibbons, S. and O. Silva (2008) "School quality, child wellbeing and parents' satisfaction", mimeo, London School of Economics.

Hanushek, E., J. Kain, D. O'Brien and S. Rivkin (2005) "The Market For Teacher Quality", NBER WP 11154.

Hanushek, E., J. Kain and S.G. Rivkin (2003) "Why Public Schools Lose Teachers", *Journal of Human Resources*, forthcoming.

Herweijer, L., and Vogels, R. (2004), "Ouders over opvoeding en onderwijs," Sociaal en Cultureel Planbureau, Den Haag, scp-publicatie 2004/20.

Holmes, G. M., DeSimone, J., and Rupp, N. G. (2003), "Does School Choice Increase School Quality?," NBER Working Paper, WP 9683.

Hoxby, C. M. (1994), "Do Private Schools Provide Competition for Public Schools?," NBER Working Papers, WP 4978.

Hoxby, Caroline M. (2000), "Does Competition among Public Schools Benefit Students and Taxpayers?," *American Economic Review*, Vol. 90, No. 5, p. 1209-1238.

Jepsen, C. (2002), "The role of aggregation in estimating the effects of private school competition on student achievement,"Journal of Urban Economics, Volume 52, p. 477-500.

Kane, T., D. Staiger and S. Reigg (2005) "School quality, neighborhoods and housing prices: The impacts of school desegregation", NBER WP 11347.

Karsten, S., J. Roeleveld, G. Ledoux, C. Felix en D. Elshof (2002), "Schoolkeuze in een multi-etnische samenleving, SCO-Kohnstamm Instituut, Amsterdam.

Leuven, E., Lindhal, M., Oosterbeek, H., and Webbink, D. (2003), "The Effect of Extra Funding for Disadvantaged Students and Achievement," Working Paper.

Rothstein, Jesse (2007), "Does Competition among Public Schools Benefit Students and Taxpayers? A Comment on Hoxby (2000)," *American Economic Review*, Volume 97, No. 5, p. 2026-2037.

Sander, W. (1999), "Private schools and public schools achievement," Journal of Human Resources, Volume 34, p. 697-709.

Steiger D. and Stock J. H. (1997) 'Instrumental Variables Regression with Weak Instruments', *Econometrica* 65(3): 557–586.

Wooldrige, J. (2002), "Econometric Analysis of Cross Section and Panel Data," MIT Press.

van der Houwen, K., Goossen, J. and I. Veling (2004) "Reisgedrag kinderen basisscholen", Traffic Test bv, Report TT02-95 in opdracht voor het Fietsberaad, Veenendaal.

Appendix

Table 0.1 Descriptives statistics, towns of 20000- inhabitants

Label	Mean	Std. Dev.	Min	Max	Obs
pupil performance					
average Cito (std)	0	1	-2.5	1.6	253528
School characteristics					
number of pupil	245	116	2	786	253528
% pupils subsidy 1.90	0.04	0.07	0	0.85	253528
public schools (dummy)	0.25	0.43	0	1	253528
catholic schools (dummy)	0.46	0.50	0	1	253528
protestant schools (dummy)	0.26	0.44	0	1	253528
other schools (dummy)	0.03	0.17	0	1	253528
Postcode level variables					
average house prices (in 1,000 euros)	164	38	69	583	253528
%population with high income	0.33	0.06	0.12	0.64	253528
%population with low income	0.46	0.04	0.29	0.60	253528
% population 0-14 years	0.20	0.03	0.09	0.36	253528
% population 65 years +	0.14	0.04	0.02	0.29	253528
Town level variables					
Total inhabitants (in 1000)	8.4	5	0	20	253528
Urbanization (quartiles of number of addresses per km^2)	1.5	0.6	1.0	4.0	253528
Competition variables (3km)					
distance to town centre	0.3	0.8	0	6	253528
number of alternative schools	2.6	2.1	0	11.0	253528
Herfindhal index (inverted)	0.5	0.3	0	0.9	253528
number of alternative public schools	0.53	0.80	0	4	63218
number of alternative catholic schools	0.90	1.1	0	4	114697
number of alternative protestant schools	1.19	1.64	0	8	65515

Table 0.2 Correlation matrix, competition indices and town characteristics

	competitors	HHI
Sample of towns 20000- inhabitants		
Town population	0.72	-0.68
Town urbanization	0.60	-0.59
Sample of towns 20000+ inhabitants		
Towns population	0.50	-0.28
Town urbanization	0.35	-0.27

Figure 0.1 Distribution of the number of alternative schools within 3 km, Towns of 20000+inhabitants