School discipline, investment, competitiveness and mediating educational performance

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Abstract

Purpose – The purpose of this paper is to combine seemingly unrelated factors to explain global competitiveness. The study argues that school discipline and education investment affect competitiveness with the association being mediated by educational performance. Crucially, diachronic effects of discipline on performance are tested to demonstrate effects over time.

Design/methodology/approach – Partial least square (PLS) modelling is used to analyse the Organization for Economic Co-operation and Development's Programme for International Student Assessment (PISA) data. The study further draws from World Bank data on Government Expenditure and World Economic Forum data on competitiveness. Five PISA dimensions of school discipline (students listening well, noise levels, teacher waiting time, students working well, class start time) are hypothesised to affect academic performance in reading, math and science, and to ultimately impact competitiveness.

Findings – Findings confirm the relative importance of school discipline (88 per cent) in comparison to education investment (12 per cent) on educational performance, with both variables also being found to be significantly associated with competitiveness directly.

Originality/value – This study demonstrates the time effects of discipline, more specifically that discipline dimensions (students listen well in 2003 and students work well in 2009) are associated with competitiveness in 2012. Implications for school policy and further research are discussed.

Keywords Mediating effect, PISA, Competitiveness, Education investment, Educational performance, School discipline

Paper type Research paper

Introduction

Educational performance, school discipline and competitiveness are all issues discussed regularly in the global press (Banchero, 2013; Donnelly, 2013; Mullich, 2013). This study proposes to combine these seemingly unrelated "real world" issues to gain better understanding of how educational policy could be reformed and how changes could be made to the way schools are run in order to achieve the best possible academic performance. Could increasing discipline lead to increasing educational outcomes as well as helping nations to become more competitive?

Contribution of the study

The purpose of this study is to examine the links between everyday school operations that result in various levels of school discipline, national financial investment in education, academic performance measured every three years globally by the Organization for Economic Co-operation and Development (OECD)'s Programme for International Student Assessment (PISA) assessment, and national competitiveness levels. The study is structured to reveal how

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the various dimensions of school discipline – namely students listening well, noise levels, teacher waiting time, students working well and class start time – and PISA academic performance in reading, math and science all relate to competitiveness. If a nation would change its school operations in such a manner as to increase one of the five school discipline dimensions, would educational performance improve and, in turn, would the country's competitiveness increase? Could it be that educational performance should be viewed as a mediating factor for global competitiveness levels? Understanding how the mechanics work and how various dimensions are linked is very important for the future as it is the responsibility of every nation to ensure that young generations are work ready, and that nations remain competitive.

This study is designed to answer a couple of very specific questions:

(1) Does school discipline affect competitiveness via educational performance?

(2) Does education investment affect competitiveness via educational performance?

The importance of this study is three-fold. First, it attempts to confirm that, for schools to improve academic performance, it is necessary to reconsider the most appropriate approach to education, with perhaps stricter discipline being adopted in classrooms. Second, it attempts to contribute to the ever-growing discussion in the academic literature as well as popular press about what policy changes might be necessary to improve scores in internationally comparable assessments of educational performance. Finally, it further attempts to refocus research away from how much funding is allocated to education to the arguably more important issue of how the funds are spent and how classrooms are run.

Literature review

School discipline

There is a rich body of literature relating to school discipline in many fields, namely in child development and behaviour (Dodge *et al.*, 1994; Loeber, 1982; Patterson and Stouthamer-Loeber, 1984), adolescent behaviour (Ary *et al.*, 1999; Conger *et al.*, 1992; Dodge and Pettit, 2003), punishment (Gershoff, 2002; Maag, 2001; Straus, 1991), school uniforms and school violence (McCarthy, 2001; Starr, 2000; Wilson, 1999) and physical discipline (Deater-Deckard *et al.*, 1996; Lansford *et al.*, 2005; Straus, 1991; Han, 2011; Kwon, 2004; Wilson, 2002). Slightly more recent research deals with how discipline in classroom is perceived by various parties involved with school discipline such as students, parents and teachers and how it is used to manage the classroom. According to Bechuke and Debeila (2012, p. 242), "school discipline can be described as all activities that are implemented to control learner behaviour, to enforce compliance and maintain order" with Cameron (2006, p. 219) adding further that school discipline relates to "teachers' methods of managing students' actions in class".

Research has confirmed the association between parenting styles and academic achievement (Dornbusch *et al.*, 1987; Leung *et al.*, 1998; Spera, 2005). Generally, authoritative parenting has been associated with children's and adolescents' higher level of performance (Aunola *et al.*, 2000) – i.e. being both demanding and responsive but not controlling. Linking various school discipline types with parenting discipline preferences was further developed by Pellerin (2005a), who found that "schools in which students remain engaged combine high standards for academics and behaviour"-with responsiveness to-"demonstrate the appropriateness of applying parenting theory to school". Pellerin based her classification of various school disciplines on an influential parenting typology developed in the 1960s known as Baumrind's Parenting Typology (Baumrind, 1966), which originally classified parenting styles as authoritative, authoritarian and permissive. Pellerin focussed on establishing what kind of school climate and what level of discipline achieves the best outcomes. Her work supports the notion of authoritative socialisation – i.e. adults being both demanding and responsive – achieves the best results both at school and at home. This line

of reasoning supports the hypothesis in this study about an association between school discipline and academic performance, and this study argues that a school's approach to discipline, either being very focussed on discipline or providing a less disciplined climate, leads to different academic outcomes.

The topics of school discipline (or the lack thereof) and the perceived relatively low academic performance of western countries have also been discussed in the popular press on numerous occasions (Donnelly, 2013; Lipman, 2013). This study argues that discipline in classrooms should be increased to give students the opportunity to perform better and to achieve higher academic results. Times of viewing discipline solely as a punitive measure (Skiba and Peterson, 2000) are truly in the past and schools need to move towards teaching students to embrace discipline and see it as beneficial to their development. This study argues that the higher the level of discipline in a school, the higher the academic performance of the schools' students, and that schools can certainly influence how disciplined their classrooms can get.

Education investment

According to the World Bank (1993, p. 45), "a common, though imperfect measure of educational quality is expenditures per pupil" and researchers have been investigating the association between investment in education and academic performance for decades. For example, Keller (2006b, p. 18) recommended "raising enrolment rates and prioritising public expenditure towards lower education stages", which led to much discussion about whether investment in human capital should be increased (Annabi *et al.*, 2011). Keller (2006a, p. 38) also found statistically significant results that "the faster-growing countries in Asia have spent more public resources on primary education, notably also per student in primary school".

On the one hand, there certainly is evidence that some best performing PISA countries increased their funding per student at primary level by significant amounts. For example, funding in South Korea increased from 1970 to 1989 by 355 per cent (World Bank, 1993) but, on the other hand, there is evidence that investing more in education does not always lead to effective increases in educational attainment. Leigh and Ryan (2011) found that while there has been a statistically significant drop in numeracy between 1964 and 2003 in Australia, school expenditure per child increased, which would indicate a decline in school productivity. Siddiqi *et al.* (2012) confirmed a surprising fact that increased educational spending failed to increase adolescent reading literacy in their study of over 100,000 students from OECD countries.

When investigating the cost of education, the focus in the past has also been on teacher ratios, as employee related expenses are the main costs of education (Keller, 2006b). While it is widely believed that quality of education can be improved by decreasing the pupil-teacher ratio (Keller, 2006a), some question the impact a reduction in class sizes might have on academic achievement. In fact Hoxby (2000, p. 1280) established "that class size reductions have little or no effect on achievement". This was further supported by Hanushek (2003, p. 92) who questioned government policy of "funding or mandating smaller class sizes", which while popular is also proving to be "an expensive and generally unproductive policy".

Another measure of effectiveness of education is the impact on student learning. Jensen *et al.* (2011) raise an interesting point about what actually drives the increased investment if better results are not being achieved. In effect, how cost effective are investments in education? Is funding perhaps being used inefficiently, especially on higher education (Keller, 2006a)? The author also raised a point that the highest test scores across the world achieved by East Asia's students might indicate that "East Asian nations have generally spent [an] efficient amount per student" (p. 24). It is a known fact that the longer a teacher has been teaching, the more experienced they are perceived to be and the more "expensive" they become. Perhaps more spending should be dedicated to increasing the quality of teachers' education with more performance-related pay schemes adopted (Woessmann, 2011).

Educational performance

Since 2000, every three years the OECD conducts Programme of International Student Assessment (PISA) testing that has been designed to "offer policy makers a lens through which to monitor students outcomes over time and to assess the strengths and weaknesses of their own systems in the light of other countries" performance' (OECD, 2003, p. 3). These surveys are now not only administered in the OECD countries but also in partner countries, in order to compare the performance of 15-year olds in reading, math, science and problem solving. The aim is to measure how well secondary schools prepare students to meet the challenges of today's societies. Over 500,000 students participated in the 2012 PISA, with the number of participating students in each country varying between 293 in Liechtenstein to 38,142 in Italy; the average number of participants being almost 8,000 (OECD, 2013).

The importance of education for countries is well researched and discussed in the literature. Some of the factors found to influence academic performance include the role of homework in improving academic achievement (Cooper *et al.*, 2006), the difficulty schools have in attracting and retaining teachers (Hanushek *et al.*, 2004), the lack of impact of a master's degree on improving teachers skills (Rivkin *et al.*, 2005), the relationship of emotional intelligence with academic success (Yeo and Carter, 2011), funding issues (Jensen *et al.*, 2011) or the role played by students' perceptions of the quality of educational institutions in their choice of international university (Carter and Yeo, 2009).

Previous studies into PISA data[1] have predominately used a case study approach, with a number of studies focussing in detail on one or two particular countries. Examples are the investigation of classroom practices in Israel and Finland as relatively low and high performing countries, respectively (Cohen *et al.*, 2009), Italy as the focus of investigation of effective educational policies design (Vergolini and Zanini, 2013), comparison of Canada with the USA in a study about how a reading skills deficit in the USA can be traced to early childhood, even before formal schooling could make any impact (Merry, 2013) or a study into performance and inequality across the UK nations (Machin *et al.*, 2013).

Surprising only a few studies attempted to include a larger number of the countries that participate in the OECD PISA. For example, BenDavid-Hadar (2013) used 34 countries participating in the 2009 PISA assessment in her study into social cohesiveness and competitiveness, Chiu and Chow (2011) investigated 41 countries for impact of school, economic and cultural differences on classroom discipline, and Baumann and Winzar (2016) included a majority of the PISA countries in a study about how a country's competitiveness could be predicted by a change in educational achievement. This study picks up on such work, and on a recommendation by Cohen *et al.* (2009) that more of the PISA participating countries should be examined and, in particular, the authors' suggestion to look at countries with high scores such as Korea and Japan. Following Cohen and his colleagues, this study investigates the maximum number of PISA countries that offer data on performance and discipline, two of the focus areas of this research.

Competitiveness

For a country to succeed, and the extent to which that may occur, depends on how talented its people are and what education they choose to pursue. Porter (1990), who is known for linking competitive advantage to innovation, also noted that when governments seek to redesign their educational policies to increase a nation's competitiveness, the process of creating a competitive advantage in an industry might take longer than a decade, and the consequences of any changes will not become visible for many years to come. Research on using education to increase competitiveness has been continued by influential Harvard scholars (e.g. Barro, 1991; Barro and McCleary, 2003) who focussed on how countries that are poorly developed economically use education to "succeed" or "catch up" with more

economically advanced and developed countries especially, and, more specifically, how important human capital is to economic growth.

Further studies into economic growth have investigated how educational attainment is linked to economic performance (Barro and Lee, 1993), or how various levels of education affect per capita growth (Keller, 2006b). While each educational stage, be it primary, secondary or tertiary education, leads to increases in productivity (Keller, 2006b), each nation needs to decide what their focus should be. Does a country wish to increase the pool of workers able to use computer technology (through increases in secondary education) or is a country looking to innovation and invention of new technologies and, in turn, to increase competitiveness (through tertiary education)? Hanushek and Woessmann (2010) continued to probe the role of education quality in economic growth by investigating the OECD PISA data with respect to the long-term economic impact of improving PISA outcomes. They confirmed the economic costs of low educational achievement, and a correlation between education and economic indicators; in other words, education is essential for a country to succeed.

Theory development and hypotheses formulation

Over recent decades, various mechanisms have been used to find links between education and economic growth, and to model economic growth theoretically. Solow (1956) proposed in his first Growth Model that output of economy is a direct function of the labour and capital in an economy. The role of education in the production function was discussed in The Technological Diffusion Theories, which dealt with growth through adoption of new technologies (Nelson and Phelps, 1966) and The Endogenous Growth Theories focussed on the role of education and on creating new ideas and technologies in order to increase innovation in an economy (Lucas, 1988). Subsequently, Neoclassical Theories of Growth expanded the analysis of economic growth by adding education into the equation (Mankiw *et al.*, 1990). What all these approaches have in common is that they believe in education having a positive effect on economic growth.

It has long been argued that societies need to start regarding education as an investment in the nation and, therefore, treat it as a form of capital (Schultz, 1960). Education can help to improve the capabilities of a nation's citizens and, therefore, lead to their increased future earnings at both macro and micro level (Schultz, 1971). The 1992 Nobel Prize Winner in Economics, Gary Becker, discussed as early as in 1975 the benefits of investment in human capital and the potential rates of return (Becker, 2009). Further research followed into links between education and economic growth (Hanushek and Woessmann, 2010), indicating that even the smallest improvements in a nation's workforce skills can translate to a large impact on national growth in the future.

The level of discipline instilled in classrooms will have an impact on future workforces' work ethic (Baumann *et al.*, 2016) with Baumann and his colleagues offering two different lenses on the future of education: students as learners, and students as customers (Carter and Yeo, 2016). In a study into school failure and school success, Glasser (1997) in his work on Choice Theory advocated that societies should focus on nurturing the warm, supportive relations that can help students to succeed at school and to work hard. He argued that individuals can control their own behaviour and, therefore, young generations can become more self-disciplined and subsequently learn more. Parents, schools and a society as a whole have the responsibility to ensure that young generations are well prepared to enter the workforce and for instilling the right attitudes and beliefs in them for years to come, making them job ready. If a society can help students to be more disciplined, ready to learn more and aim to achieve more, nations might become more competitive as a result.

This study argues that a key factor for investigation is the way in which schools are run, as there appears to be a "natural" ceiling for the effect of increased funding; just spending

money might lead, for example, to establishing unproductive programs. Furthermore, it has been suggested that more resources might actually "harm achievement" (Hanushek, 1997, p. 301), and investigation of "how well schools are using their resources" in order to find out "what works" was recommended (p. 303), as different schools have been found to have different effects on achievement of students. It might not all be about how much money is spent in order to decrease class sizes and increase quality of education.

Accumulation of human capital is influenced by government public policies (Barro, 2013), and it has long been acknowledged that making changes to educational policies is difficult but doing better is certainly possible. Countries like Poland or Germany in Europe or Japan in East Asia all improved their mean PISA results over the nine years between 2003 and 2012 (Poland by 25 points, Germany by 16 points and Japan by 13 points); proof that making things better for the younger generation is possible. Therefore, choosing not to introduce changes aimed at improving educational outcomes would mean that nations "choose" to forego future economic growth gains (Hanushek and Woessmann, 2010).

Cohen *et al.* (2009, p. 29) put forward their Preliminary Theory stating that "teachers and schools systems that are simultaneously demanding and supportive of all students achieve the best and most equal results", in contrast to "teachers and schools" […] [that are] […] not demanding much academically and have poor results with a wide gap between the strong and weak students'. This study builds on his foundation and argues that it is more relevant to focus on what happens in the classrooms, on the discipline climate at school rather than on how much is spent on education. If discipline in classrooms is increased to enable students to concentrate more and subsequently learn more, better academic results will also be achieved, which in turn will increase the nation's competitiveness levels. Furthermore, this study argues that the impact of school discipline is greater than the impact of how much is spent on the education.

Based on the review of the literature, we propose the following hypotheses split into two main categories: overarching hypotheses and diachronic hypotheses. The latter being split into three subcategories: hypotheses relating to effect of school discipline over time, of education investment over time and educational performance over time.

Overarching hypotheses

HM1. Discipline has a significant impact on competitiveness mediated by educational performance.

HM2. Education investment as government expenditure on education, as a percentage of gross domestic product (GDP), has a significant impact on competitiveness mediated by educational performance.

Diachronic perspective

School discipline

HD1. School discipline in 2003 had significant impact on competitiveness in 2012.

HD2. School discipline in 2009 had significant impact on competitiveness in 2012.

Education investment

HI1. Education investment as government expenditure on education, as a percentage of GDP, in 2003 had significant impact on competitiveness in 2012.

HI2. Education investment as government expenditure on education, as a percentage of GDP, in 2009 had significant impact on competitiveness in 2012.

Educational performance

HP1. How well students performed in 2003 PISA Math assessment had significant impact on competitiveness in 2012.

HP2. How well students performed in 2003 PISA Science assessment had significant impact on competitiveness in 2012.

HP3. How well students performed in 2003 PISA Reading assessment had significant impact on competitiveness in 2012.

HP4. How well students performed in 2009 PISA Math assessment had significant impact on competitiveness in 2012.

HP5. How well students performed in 2009 PISA Science assessment had significant impact on competitiveness in 2012.

HP6. How well students performed in 2009 PISA Reading assessment had significant impact on competitiveness in 2012.

Model and data sources

School discipline data

The first area of investigation of this study focusses on "School Discipline". The secondary data used in the analysis were collected during the OECD' PISA academic performance assessments for years 2003, 2009 and 2012. No data about discipline were collected in 2006. The disappearance of the disciplinary variable from 2006 data set raised some questions within the general population as well as among researchers and is discussed, for example, in Salinas and Santín (2011, p. 176). Subsequently, the five dimensions of school discipline were reintroduced back into PISA survey in 2009. Apart from academic achievement data, various reports compiled by the OECD include student information about "themselves, their homes and their school and their learning experience" (OECD, 2013, p. 3). The OECD's report *What makes schools successful?* provides a summary about what students perceive as "conducive" to learning in classrooms, with disciplinary climate being found "consistently related to higher average performance at the school level […] even after accounting for the socio-economic status and demographic background of students" (OECD, 2013, p. 64).

The publicly available data set used in this study, as a proxy measure for classroom discipline, breaks down school discipline into five areas with the marks for all five constructs ranging between 1 and 100 (with most starting around 50). The constructs were measured as a percentage of students who reported that the investigated phenomena occur:

- "in every or most lessons" for 2003; and
- "never or hardly ever" or "in some lessons" for 2009 and 2012.

Appendix 1 provides an overview of the PISA discipline dimensions and Appendix 2 provides a summary of the source documents accessed for the purposes of this study.

To enable the analysis of effects over time, the extraction method of principal factor analysis was used to create 2003, 2009 and 2012 discipline constructs, which were subsequently used in the correlation and regression analyses. For years 2003 and 2009, a decision was made to exclude the discipline construct "Students work well", because it had the lowest values. A deliberate decision was made to include all the five discipline dimensions for 2012, in order to keep the 2012 Discipline construct comparable with the construct utilised in partial least square (PLS) analysis, which was also created by using all five discipline dimensions for 2012 (see Appendix 6 for PLS Descriptive Statistics).

To ensure that required reliability has been achieved in the model, Cronbach's α reliability score was also computed as it is viewed as "the most common measure of scale reliability", with a value of 0.7 being acceptable (Field, 2013, p. 708). The constructed discipline variables for 2003 and 2012, as constructed during the factor analysis, and later utilised in the correlation analysis, are summarised in Appendix 7.

Education investment data

The second area of investigation of this study examines "Education Investment". The secondary data used in this study uses data publicly available on the website of World Bank, as data on education inputs and outputs, efficiency of education and also on participation rates are compiled there. The data are based on responses to surveys from official education authorities in each country, and compiled by the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics. The EdStats Query – Education Expenditure section on the World Bank website provides information about education investment as a percentage of GDP and the data set sample size of countries with data available for 2012 used in this study was sufficiently large to meet the required minimum sample size of being "ten times the maximum number of arrowheads pointing at any latent variable anywhere in the PLS path model" (Hair *et al.*, 2013, p. 20).

Educational performance data

The third area of investigation of this study focusses on "Educational Performance". The secondary data used in this study were obtained by accessing the OECD's PISA publicly available results. The underlying question of the triennial survey is "What is important for citizens to know and be able to do?" (OECD, 2013, p. 21), with the focus of the survey being on assessing the level of knowledge and skills students have gained in the areas of reading, mathematics, science and problem solving. The standardised PISA data set allows us to compare results for all OECD countries as well as for OECD partners, and the programme offers baseline indictors of knowledge and skills or student performance trends. Appendix 3 provides a summary of the varying results achieved in each PISA category in the four PISA assessments discussed in this study. Appendix 2 provides a summary of the source documents accessed for the purpose of this study.

Competitiveness data

The dependant variable in this study is "Competitiveness" and it is the final area of this investigation. The secondary data used in this analysis were obtained by accessing *The Global Competitiveness Reports* produced annually by World Economic Forum (WEF), which provide a comprehensive assessment of the productive potential of countries worldwide (Schwab, 2010). The Global Competitiveness Index (GCI) has been at the centre of the annual competitiveness analysis conducted by WEF as the index is viewed as "a comprehensive tool that measures the microeconomic and macroeconomic foundations of national competitiveness" (Schwab and Sala-i-Martín, 2013, p. 4).

The WEF attempts to identify key factors behind economic growth in order to enhance understanding about why some countries are more successful than others. The WEF started to report on three subgroups only, as in 2003, and gradually increased the details provided, from nine pillars in 2006 to 12 pillars and three subgroups in 2009 and 2012. This study used the three subgroups for the analysis of 2012 global competitiveness through PLS-PM analysis. Appendix 4 provides a summary of information available in the reports relevant to this study and Appendix 2 provides a summary of the source documents accessed for the purposes of this study.

Data harmonisation

The data harmonisation process was crucial for this study due to the fact that there were three different data sources, and the data set had to be validated for completeness, accuracy and consistency of data entry to ensure that the most complete data set was obtained in order to later conduct the subsequent analysis. The analysis in this study was based on the final 2012 list of 65 PISA study participants, and therefore some data for the previous three years of testing might have been missing, as smaller number of countries participated in each round.

It is also important to note that the focus of both PISA 2003 and 2012 was on mathematics (OECD, 2013) making those two years comparable, while mathematics was only a minor domain of the PISA assessment in 2009, with the focus then being on reading (OECD, 2010). It is therefore not possible to compare 2009 discipline data with 2003 or 2012 PISA discipline data. In other words, discipline 2009 results are not comparable with results from 2003 or 2012, as students in math classes behave very differently from students in reading classes. To uncover trends, only 2003 and 2012 disciplinary climate data were compared in this study. To ensure that both years were directly comparable, reversed scores had to be calculated for 2003 discipline, as each of the five constructs in 2003 were measured as a percentage of students who reported that the investigated phenomena occurred "in every or most lessons" as opposed to "never or hardly ever" or "in some lessons" in 2012.

Lastly, to utilise an adequate sample size for the analyses, a decision was made to use data from 2011 for both constructs of education investment, as 2012 UNESCO expenditure on education data were only available for 25 countries and the OECD data for 2012 annual expenditure per student will only become available in late 2015. Appendix 5 provides a summary of publically available data on participating countries. Figure 1 presents the overall model developed for this study, including data sources.

Methodology

This study focusses on combining four variables, namely school discipline, education investment, educational performance and competitiveness, into one model as a result of

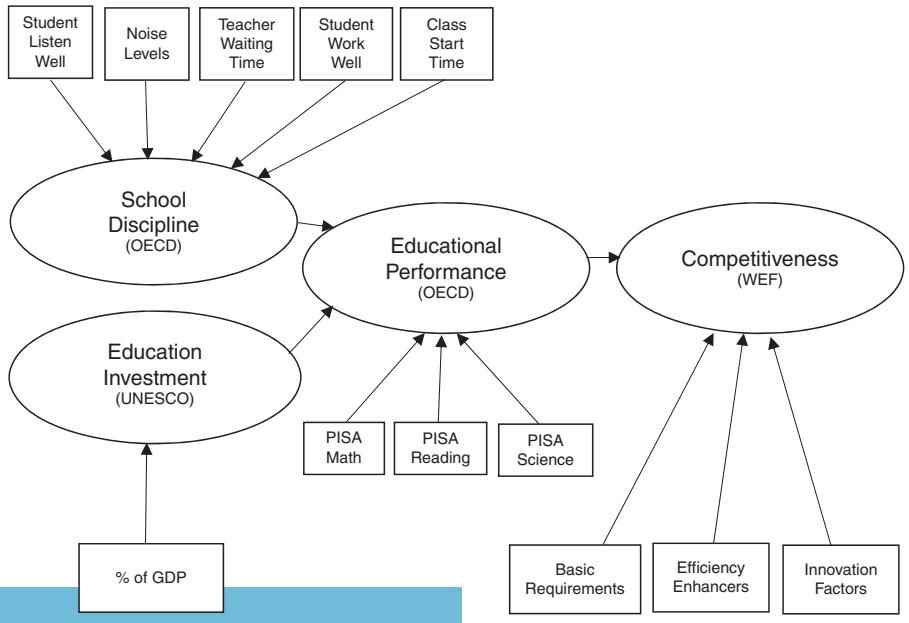

Figure 1.
Model and construct specification

identifying a gap in the literature that called for developing a combined conceptual framework. The study draws on publicly available data in PISA discipline dimensions, PISA scores for math, science and reading, as well as educational expenditure and countries' competitiveness levels. The data used for this research are cross-sectional secondary data and, for the purposes of this study, the strategy was to use a quantitative technique to analyse the data.

Partial least squares-structural equation modelling (PLS-SEM) was deemed to be the appropriate technique for the analysis of the gathered data for a number of reasons. First, according to Hair *et al.* (2011, p. 139), "PLS-SEM is a causal modelling approach aimed at maximising the explained variance of the dependent latent constructs". It meets the requirements of this testing, as the purpose of this study is to examine multiple relationships between dependent and independent variables, and the possible mediating effect. Second, as "the research objective is prediction rather than confirmation of structural relationships, then variance-based PLS-SEM is the preferred method" (Hair *et al.*, 2011, p. 139). The key advantage of using the PLS tool stems from its ability to analyse relationships between latent variables, especially the more complex ones, and for studies with small samples (Henseler and Sarstedt, 2013). The PLS approach was also selected as "PLS-SEM has been increasingly applied in business disciplines" (Hair *et al.*, 2011, p. 139).

PLS analysis

To test the assumptions of the overall model and to confirm that the model "works" overall, PLS analysis was conducted. This study focusses on testing of the relative importance of school discipline and education investment and the mediating effect of educational performance on competitiveness. PLS technique was used to investigate these relationships, as PLS is "a statistical approach for modelling complex multivariable relationships among observed and latent variables" (Vinzi *et al.*, 2010, p. 2), with Chin (2010, p. 84) adding further that "PLS path modelling is a component based methodology that provides determinate construct scores for predictive purposes". In other words, PLS is used to look for patterns in data when there is only little known about how the variables might be related (Hair *et al.*, 2013) and, in this study, the focus is also on establishing which independent variable will be better at predicting the dependent variable.

While Hair *et al.* (2013, p. 4) indicated that PLS is "primarily used to develop theories in exploratory research", "PLS is also typically recommended in situations in which the sample size is small" (Haenlein and Kaplan, 2004, p. 295), as is the case of this study. According to Hair *et al.* (2013, p. 20), "the minimum sample size should be ten times the maximum number of arrowheads pointing at a latent variable anywhere in the PLS path model". The complete sample size of countries participating in 2012 PISA assessment is sixty five. However, data on the amount the OECD spent on education per student initially considered to be used in the PLS analysis was not available for a sufficient number of countries to meet the minimum sample size requirement. Another data set of education investment data were therefore compiled using UNESCO government expenditure on education as percentage of GDP data.

The baseline model for the 2012 data was assessed for appropriateness of the model fit. According to Hair *et al.* (2011, p. 141), "a structural equation model with latent constructs has two components". The first, the inner model (also called the structural model), deals with relationships between the model constructs (also called latent variables), or concepts that are abstract and cannot be directly observed, while the second component, the outer model (also called measurement model), deals with relationships between indicators (also called manifest variables) and latent variables (Hair *et al.*, 2013).When evaluating the model, the fit indices were examined to determine how well the inner and outer models are suited for making predictions. Using goodness-of-fit indices has increasingly become popular in judging the overall model fit (Henseler and Sarstedt, 2013), as the indices (summarised

in Table I) indicate how well the model fits the data in a study. As there was no indication of lack of fit in both instances, and the fit indices are on par with similar modelling approaches (Baumann and Hamin, 2011), the overall model was deemed robust and valid. This conclusion was supported by high Cronbach's α figures achieved in the PLS model, namely 0.931 for school discipline, 0.990 for educational performance and 0.980 for competitiveness.

Results

The purpose of this study is to examine the relative importance of the effects of school discipline in comparison to education investment on global competitiveness, as mediated by educational performance. First, results of the baseline model for the 2012 data are discussed to confirm if the assumptions in this study work overall; second, results of the longitudinal analyses are provided. The first set of analyses, the PLS model, demonstrates the relative importance of school discipline and education investment in the formation of educational performance and global competitiveness. The longitudinal analyses demonstrate the impact of levels of school discipline, education investment and educational performance in the past, namely in 2003 and 2009, on competitiveness in 2012. The section concludes with a summary of both the supported and unsupported hypotheses.

Baseline model

This section provides the results obtained by running the baseline model for 2012 data. The model was examined using the PLS approach and the model fit was determined to be acceptable (see Table I), as supported by high Cronbach's α figures achieved in the model, namely 0.931 for school discipline, 0.990 for educational performance and 0.980 for competitiveness. Thus the results of explanatory power of individual constructs are presented next. The explanatory power of the two predictors of a country's educational performance is summarised in Table II. The results indicate that school discipline and education investment are significantly associated with educational performance. School discipline, in fact, explains over 88 per cent of educational performance while education investment explains approximately 11.80 per cent. The strongest impact on educational performance was found in discipline (coefficient = 0.389), followed by education investment (coefficient = 0.142). Further, Figure 2 provides details of β coefficients for discipline and education investment indicating that the strength of the association with educational performance is three times stronger for discipline ($\beta = 0.328$) than it is for education investment ($\beta = 0.115$).

Goodness of fit			
Absolute	0.447	Outer model	0.975
Relative	0.688	Inner model	0.706

Table I. Goodness-of-fit indices

	Discipline	Education investment
Correlation	0.351	0.128
Path coefficient	0.389	0.142
Correlation × path coefficient	0.137	0.018
Contribution to R^2 (%)	88.20	11.80
Cumulative R^2 (%)	88.20	100.00

Table II. The explanatory power of two predictors in explaining educational performance

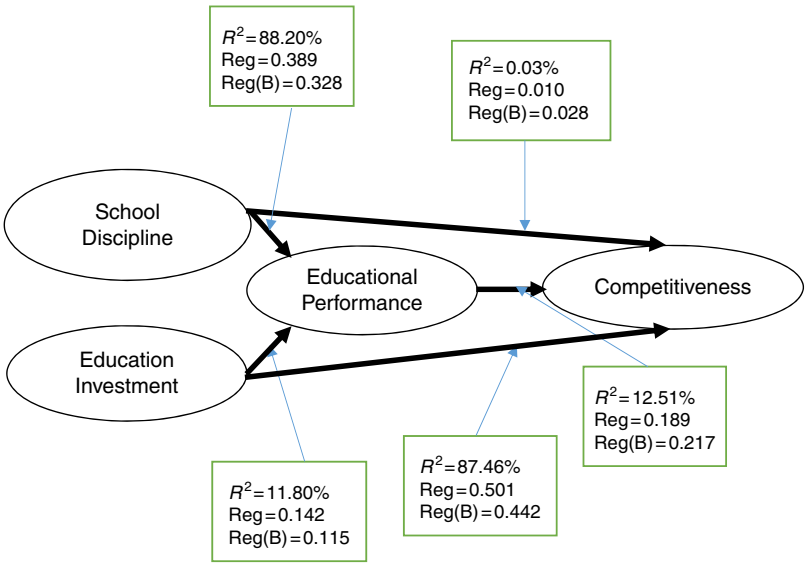

Figure 2.
The relative importance of discipline and education investment on competitiveness

Notes: $n=48$. All associations significant at $p \leqslant 0.05$

Next, the explanatory power of the three predictors of a country's competitiveness is summarised in Table III. The variable with the greatest predictive power of competitiveness is education investment. Measured as R^2, it explains over 87 per cent of competitiveness. Educational performance and discipline follow at a lower predictive power, educational performance explaining over 12 per cent and discipline explaining just under 1 per cent of competitiveness. In other words, the results of this study confirm that competitiveness is significantly associated with education investment and school discipline. The strongest impact on competitiveness was found in education investment (coefficient = 0.501), followed by education performance (coefficient = 0.189), and discipline (coefficient = 0.010).

Table IV summarises the model assessment of R^2, showing to what extent the developed model explains competiveness. The model explains 31 per cent ($R^2 = 0.311$, adjusted $R^2 = 0.280$) of competitiveness. The study also uncovered that educational performance is

Table III.
The explanatory power of three predictors in explaining competitiveness

	Education investment	Educational performance	Discipline
Correlation	0.543	0.205	0.011
Path coefficient	0.501	0.189	0.010
Correlation × path coefficient	0.272	0.039	0.000
Contribution to R^2 (%)	87.46	12.51	0.03
Cumulative R^2 (%)	87.46	99.97	100.00

Table IV.
Model assessment of R^2

Latent variable	Type	R^2	Adjusted R^2
Educational performance	Endogenous	0.155	0.137
Competitiveness	Endogenous	0.311	0.280
Mean		0.233	

explained by over 15 per cent ($R^2 = 0.155$, adjusted $R^2 = 0.137$). Overall, the model's explanatory power is more than 23 per cent ($R^2 = 0.233$).

Figure 2 provides a graphical summary of the strength of relationships within the tested model with associations between all constructs being found significant at $p \leqslant 0.05$. This model highlights the relative importance of discipline in comparison to education investment on competitiveness mediated by educational performance, and also how discipline has a direct effect on educational performance and an indirect effect on competitiveness.

Diachronic perspective

The previous section provides results of testing of the baseline model for the 2012 data, while this section discusses the results of testing for time dimension effects. Results of multiple regression analyses, which examined the time effects of school discipline, education investment and educational performance on competitiveness in 2012, will be provided.

Similar to other studies into academic performance, multiple regressions were run for various scenarios (Lang *et al.*, 2015; Ricketts and Rudd, 2005). A process of elimination was used to remove any potential explanatory variables that did not have a statistically significant association with the dependent variable. Predictor variables were removed based on their p value until, at the conclusion of this process, the remaining variables were significant at least at $p \leqslant 0.1$. In other words, only significant and meaningful predictors of competitiveness were identified to explain competitiveness in 2012. The results of the multiple regressions are summarised in Table V.

The first testing focussed on the impact of school discipline and the findings confirm that the variables students listen well in 2003 and students work well in 2009 are both significantly associated with global competitiveness in 2012. Students listen well in the 2003 dimension explains 4.3 per cent of competitiveness in 2012 and students work well in 2009 dimension explains almost 14 per cent of competitiveness in 2012. While the β coefficient of students listen well in 2003 is 0.385 and only a trend was found (0.084), the β coefficient of students work well in 2009 is very strong at 0.705, with the association being found significant at $p \leqslant 0.05$ level.

In regards to educational performance, 2003 PISA Reading and PISA Math dimensions both in 2006 and 2009 were all found significantly associated with competitiveness in 2012 at $p \leqslant 0.001$ level. The β coefficient of 2003 PISA Reading variable was 0.684, with the variable being found to explain over 45 per cent of competitiveness in 2012. 2006 PISA Math variable ($\beta = 0.571$) and 2009 PISA Math variable ($\beta = 0.621$) were found to explain over 31 per cent and over 37 per cent of competitiveness in 2012, respectively.

Lastly, the testing focussed on education investment and OECD annual expenditure per student in the years investigated in this study, namely 2003, 2006 and 2009, were also found statistically significant (at $p \leqslant 0.001$ level) in relation to competitiveness in 2012. 2003 OECD annual expenditure per student was found to explain over 41 per cent of competitiveness in 2012 with the β coefficient being 0.657. 2006 OECD annual expenditure per student ($\beta = 0.667$) and 2009 OECD annual expenditure per student ($\beta = 0.693$) were found to explain almost 43 per cent and over 46 per cent of competitiveness in 2012, respectively.

Discussion

The purpose of this study was to examine the relative importance of the effects of school discipline in comparison to education investment on global competitiveness. Educational performance was modelled as the mediator between school discipline, education investment and competitiveness. Importantly, the study was also designed to test for effects of education dimensions on competitiveness over time.

Predictor	Unstandardised coefficients	SE	Standardised coefficients (β)	T	p
Discipline dimension					
Discipline 2003					
2003 – D1 – students listen well	0.040	0.022	0.385	1.788	0.084*
$R^2 = 0.176$, adjusted $R^2 = 0.043$					
Discipline 2009					
2009 – D4 – students work well	0.062	0.023	0.705	2.689	0.011**
$R^2 = 0.247$, adjusted $R^2 = 0.136$					
Educational performance					
Educational performance 2003					
2003 PISA Reading	0.009	0.002	0.684	5.547	0.000***
$R^2 = 0.468$, adjusted $R^2 = 0.453$					
Educational performance 2006					
2006 PISA Math	0.006	0.001	0.571	4.872	0.000***
$R^2 = 0.326$, adjusted $R^2 = 0.313$					
Educational performance 2009					
2009 PISA Math	0.006	0.001	0.621	5.922	0.000***
$R^2 = 0.385$, adjusted $R^2 = 0.374$					
Education investment					
2003 OECD – annual expenditure per student	0.000	0.000	0.657	4.933	0.000***
$R^2 = 0.432$, adjusted $R^2 = 0.414$					
2006 OECD – annual expenditure per student	0.000	0.000	0.667	5.147	0.000***
$R^2 = 0.445$, adjusted $R^2 = 0.428$					
2009 OECD – annual expenditure per student	0.000	0.000	0.693	5.611	0.000***
$R^2 = 0.481$, adjusted $R^2 = 0.465$					

Notes: ***,**,*Significant at $p \leqslant 0.001$; $p \leqslant 0.05$; $p \leqslant 0.1$

Table V.
Diachronic effects of education on competitiveness (2012)

Relative importance of school discipline

One of the key focus areas of the study was to explore the impact of school discipline, in comparison to education investment. In terms of explanatory power, school discipline was the much stronger factor to explain performance. Eighty eight per cent of educational performance is explained by discipline, which contrasts with only twelve per cent explained by education investment. The literature had some indication that discipline would be an important factor to explain education performance, but such strong explanatory power is remarkable. In other words, discipline has a greater impact on educational performance than education investment. Discussion, by both politicians and the media, on education policy often centres on funding, but this study now establishes that a much more effective "tool" to improve education performance and ultimately competitiveness of a nation, is indeed to focus on school discipline. Better disciplined students learn more and perform and ultimately contribute to a more competitive workforce and economy. Indeed, the results of this study are in line with recent research on the role of discipline in the formation of a work ethic (Baumann *et al.*, 2016) that established how strict discipline and a focus on academic performance significantly contribute to a work ethic. This study also indicates that academic performance is more closely linked with how schools are run and with how well expectations and goals are set for students (McInerney, 2005) than with how much money is spent on schools (Jensen *et al.*, 2011).

Ultimately, this study is aligned with previous studies confirming that, for example, "students and schools tend to perform better in a climate characterised by discipline and

high levels of student morale and commitment" (Schleicher, 2007, p. 355). East Asian countries like South Korea and Japan, for example, have strict discipline in schools and also peak perform in international student competitions, whereas western countries generally have lower levels of discipline, but also lower academic performance (Baumann and Winzar, 2016; Baumann *et al.*, 2016). For countries that cannot afford additional education investment, the findings of this study provide a practical and cost effective solution, as changing school policy is, more or less, cost neutral, but good (or better) discipline appears most effective in driving academic performance. Crucially, good school discipline ultimately also links to competitiveness.

Mediating effect of educational performance

In this study, one of the focus areas has been on investigating the relative importance of discipline and education investment on competitiveness mediated by educational performance. One of the objectives of the PLS method is to predict, meaning the higher the R^2 of endogenous constructs, the higher the prediction in the PLS path model (Hair *et al.*, 2013). This study has demonstrated mediating effect of educational performance on competitiveness, linking school discipline and education investment. The overall model explains 23 per cent of competitiveness based on three explanators, meaning that educational dimensions together explain roughly a quarter of competitiveness. The variable with stronger explanatory power is education investment. Naturally, many other variables come into play when forming competitiveness, but both discipline and education investment significantly link to competitiveness, mediated by educational performance.

The way competitiveness and education relate to one another has been researched with prior studies probing two angles – how competitiveness explains academic performance (Baumann and Hamin, 2011) and also, reversely, how education explains competitiveness (Baumann and Winzar, 2016). This study builds on the previous research of education impacting on economy by adding a new perspective of the contributing factors to global competitiveness. This study demonstrates that school discipline has the potential to influence a country's competitiveness as well as educational performance. While investment in education clearly has an effect on educational performance and on competitiveness, this study suggests that the stronger leverage is school discipline. This study has shown that discipline is a key factor in both increasing educational performance and also increasing a nation's competitiveness levels.

Linking discipline, performance and investment dimensions to competitiveness

To gain further understanding of competitiveness, diachronic testing was applied to ascertain how school discipline and education investment link to competitiveness over time. While such an analysis is crucial to comprehend the dynamics of the dimensions under investigation since time lag effects are anticipated, the literature has previously assumed a cross-sectional approach, perhaps with the exception of Baumann and Winzar (2016) who started exploring the effect of education on competitiveness (and vice versa) over time. One of the key findings of this study is that discipline dimensions, namely students listen well in 2003 (adjusted $R^2 = 0.043$) and students work well in 2009 (adjusted $R^2 = 0.136$) were significantly associated with competitiveness in 2012, and the time effect becomes stronger the closer the tested year was to the year 2012. In other words, if students pay attention and listen during classes, such behaviour in classes will influence competitiveness in the longer term, meaning that discipline has an effect over time. This study also found that education investments made in both 2003 and 2009 impacted significantly on 2012 competitiveness.

This study has demonstrated temporal effects of the discipline dimension, educational performance dimension and education investment on competitiveness in 2012. As pointed out by Porter (1990), there is always a time lag effect. It might take longer than a decade for

any educational policy change to impact competitiveness and, while competitiveness could be increased by simply ensuring that students listen well, the impact might not directly be visible instantly.

More disciplined students achieve better educational results (Cohen and Romi, 2010; Pellerin, 2005b) with the issue at play in undisciplined classrooms relating to distraction combined with a lack of respect for teachers and education. If it takes time for teachers to get students' attention, time is wasted rather than spent on learning. Education is among the most important services provided by governments, and the findings in this study support the argument that how schools and classrooms are run need to be reconsidered, and perhaps the expectations a society places on students need to be increased. It might not be about how much the schools receive in funding, or how many students are in a class but, rather, how well students listen and how well students work in the classrooms.

Teachers need to be empowered to achieve greater discipline in classrooms. For countries with already a high level of discipline with equally high educational performance (e.g. in East Asia), the recommended strategy is to maintain good levels of discipline in the classroom in order to keep up strong academic performance. In contrast, countries with low levels of discipline and low performance may consider changing school policy to a stricter regime in order to lift academic performance and competitiveness without increasing education investment. It is necessary for schools to put in place strategies for managing school misbehaviour or "any behaviour that threatens the flow of academic performance" (Türnüklü and Galton, 2001, p. 291), in order to create a discipline climate conducive to high achievement with the aim of influencing global competitiveness in years to come.

Future research directions

This study has put forward a new conceptual framework combining school discipline, education investment, educational performance and competitiveness into one model for the first time, and the subsequent testing of the overall model has provided empirical support for the proposition that school discipline has indirect impact on competitiveness. What remains to be investigated are likely differences in levels of discipline between geographic regions, as different geographic regions were found in prior research to have differing attitudes towards school discipline (Baumann *et al.*, 2012) and educational achievement (Baumann and Winzar, 2016). Future PISA data should also be included in subsequent research to further verify our findings, especially with a focus to broaden the time horizon of the analysis.

Other suggestions for future research include expanding on the findings from this study, which drew on publically available secondary data, by using a survey instrument to focus on examining the links between school discipline and academic achievement at a more granular level. The OECD's PISA data set provides access to information about school discipline at the aggregated national level, and surveys could be used to investigate the various discipline approaches used at individual schools, as information about the PISA assessment participating schools could possibly be obtained from the administrators of PISA surveys in individual countries. And, lastly, future studies could also investigate further the diachronic perspective of this research. This study has made an attempt to explain competitiveness in absolute terms but future studies should focus on investigating changes in competitiveness.

Limitations

No study is without limitations and this study is no exception. In the latest PISA assessment, for example, 790 schools and 17,800 students participated in Australia, 200 schools and 6,100 students in the USA, 550 schools and 12,600 students in the UK and 150 schools and 5,000 students participating in South Korea (OECD, 2013). Due to the sheer

number of PISA participants and the variance in the number of schools, students in participating countries, limitations of the PISA assessment, such as socio-economic inequality, will be inherent in findings of this study; and, thus, cross-country differences in the quality of educational systems and other influences such as family background cannot be neglected (Hanushek and Woessmann, 2010).

Conclusion

This study makes unique contributions in three distinct ways. First, the study demonstrates the substantially higher explanatory power (roughly 88 per cent) of school discipline in explaining educational performance in comparison to education investment with only 12 per cent. Second, this study demonstrates the mediating effect of educational performance on competitiveness, linking school discipline and education investment. The overall model explains 23 per cent of competitiveness based on three explanators. Third, diachronic testing was applied to better comprehend how school discipline and education investment link to competitiveness. It was demonstrated that school discipline indeed is associated with competitiveness over time, specifically a nine-year effect for the students listen well dimension, and a three-year effect for students working well, explaining a remarkable 4-14 per cent of competitiveness in 2012. Time effects were also found for educational performance ranging from 31-45 per cent, with reading demonstrating a nine-year effect and math a six as well as a three effect. The results of this study support the previously established temporal effects shown by Baumann and Winzar (2016), i.e. education really boosts competitiveness.

In all, 12 hypotheses in total were developed for this study and Table VI, which follows, provides a summary of the eight hypotheses that are supported by the research findings.

Panel A: baseline model	
HM1: Discipline has significant impact on competitiveness mediated by educational performance	Supported
HM2: Education investment as a percentage of GDP has significant impact on competitiveness mediated by educational performance	Supported
Panel B: Diachronic perspective	
School discipline	
HD1: School discipline in 2003 had significant impact on 2012 competitiveness	Supported
HD2: School discipline in 2009 had significant impact on 2012 competitiveness	Supported
Education investment	
HI1: Education investment as government expenditure on education as a percentage of GDP in 2003 had significant impact on competitiveness in 2012	Supported
HI2: Education investment as government expenditure on education as a percentage of GDP in 2009 had significant impact on competitiveness in 2012	Supported
Educational performance	
HP1: How well students performed in 2003 PISA Math assessment had significant impact on competitiveness in 2012	Not supported
HP2: How well students performed in 2003 PISA Science assessment had significant impact on competitiveness in 2012	Not supported
HP3: How well students performed in 2003 PISA Reading assessment had significant impact on competitiveness in 2012	Supported
HP4: How well students performed in 2009 PISA Math assessment had significant impact on competitiveness in 2012	Supported
HP5: How well students performed in 2009 PISA Science assessment had significant impact on competitiveness in 2012	Not supported
HP6: How well students performed in 2009 PISA Reading assessment had significant impact on competitiveness in 2012	Not supported

Notes: *HM* denotes hypotheses regarding mediating effects; *HD* denotes hypotheses regarding discipline; *HI* denotes hypotheses regarding education investment; HP denotes hypotheses regarding educational performance

Table VI.
Summary overview of hypotheses

The results in this study support the overarching hypothesis about discipline climate in classrooms having an impact on both educational performance of countries as well as on country competitiveness.

For academics, the study provides useful input to better model competitiveness and its drivers, namely by incorporating educational dimensions such as school discipline, education investment and educational performance. Future research should aspire to explain geographic differences in diverging approaches to school discipline with equally diverging academic performance. Baumann and Krskova (2016) demonstrate such effects for low, medium and high performing students, with differences in school discipline across five geographic regions. Future research could probe the relative importance of school discipline and education investment on competitiveness with the established mediating role of education performance with Baumann and Krskova's lens of the following five regions: Europe, Americas, Fast East Asia, Rest of Asia and Anglo-Saxon.

For education policy, the study points towards the importance of school discipline with the now demonstrated effects on educational performance and competitiveness, both cross-sectional and also over time. This study suggests that education investment alone is not sufficient to boost educational performance as well as global competitiveness. Quite possibly, often additional investment is used for central policy development and other administrative mechanisms that may add to bureaucracy, but as our study shows, have little impact on educational performance and subsequent competitiveness. The more cost effective approach, based on this study's findings, is to focus on school policy where improving school discipline is cost neutral, but it appears very effective on desirable outcomes such as performance and competitiveness. Teachers need effective tools to discipline students in order to create an atmosphere where students listen well, noise levels are low, teacher waiting time is also low, students work well, and class starts on time. After all, students need to "learn in their schools and universities to love learning" (Sahlberg, 2006, p. 284).

Not surprisingly, political agendas of countries around the globe are now also focussing on competitiveness, with "the need for greater economic competitiveness" being "used to justify educational reforms" (Sabadie and Johansen, 2010, p. 237), "as human capital is an essential component of national economic competitiveness" (p. 253). Interestingly, though, very limited attention so far has been paid to explaining how various levels of classroom practices lead to differing results in PISA assessment (Cohen *et al.*, 2009), and which, in turn, leads to increased competitiveness. Our study is designed to contribute to this debate with the empirically demonstrated importance of school discipline in driving both, educational performance as well as competiveness.

Note

1. For a helpful overview of empirical studies on educational efficiency based on PISA data please refer to Table 2 in Salinas and Santin (2011).

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Appendix 1

Table AI.
PISA discipline dimensions

Queries raised during PISA testing	Variable label used in this study
Students do not listen to what the teachers says	D1 – Students listen well
There is noise and disorder	D2 – Noise level
Teacher has to wait a long time for students to quiet down	D3 – Teacher wait time
Students cannot work well	D4 – Students work well
Students do not start working for a long time after the lesson begins	D5 – Class start time

Appendix 2

Year	Source	Date accessed
Discipline		
2003	www.oecd.org/education/school/programmeforinternationalstudentassessmentpisa/34002216.pdf	8/3/2015
2006	Data not collected in 2006	21/3/2015
2009	www.oecd.org/pisa/pisaproducts/48852742.pdf	21/3/2015
2012	www.oecd.org/pisa/keyfindings/pisa-2012-results-volume-IV.pdf	8/3/2015
Education investment – OECD		
2003	Skills beyond school 2006 www.oecd.org/edu/skills-beyond-school/37344658.xls	14/3/2015
2006	Education at a Glance 2009: OECD Indicators www.oecd.org/education/skills-beyond-school/43636332.pdf	14/3/2015
2009	Education at a Glance 2012: OECD Indicators www.oecd.org/edu/EAG%202012_e-book_EN_200912.pdf	9/8/2015
2011	Education at a Glance 2014: OECD Indicators www.oecd.org/edu/EAG2014-Indicator%20B1%20(eng).pdf	9/8/2015
UNESCO – Expenditure on education as % of GDP (from government sources)		
2003	http://data.uis.unesco.org/Index.aspx?queryid=184	26/8/2015
2006	http://data.uis.unesco.org/Index.aspx?queryid=184	26/8/2015
2009	http://data.uis.unesco.org/Index.aspx?queryid=184	26/8/2015
2011	http://data.uis.unesco.org/Index.aspx?queryid=184	26/8/2015
Educational Performance		
2003	www.oecd.org/newsroom/34011082.xls	7/3/2015
2006	www.oecd.org/pisa/pisaproducts/39725224.pdf	15/3/2015
2009	www.oecd.org/pisa/pisaproducts/46619703.pdf	1/3/2015
2012	www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf	1/3/2015
Competitiveness		1/3/2015 (no longer accessible)
2003	www.weforum.org/pdf/Gcr/GCR_2003_2004/GCI_Chapter.pdf	
2006	www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2006-07.pdf	1/3/2015
2009	www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2009-10.pdf	4/8/2015
2012	www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf	1/3/2015

Notes: This study uses data publically available from the EdStats Query section on the World Bank website, which is maintained by UNESCO Institute for Statistics, and which provides information about education investment as a percentage of Gross Domestic Product (GDP). Using education spent information as a percentage addresses the issue of comparability, or purchasing power parity, making the analysis much more robust.

Table AII.
Summary of data sources accessed

Appendix 3

Table AIII. Summary of PISA triennial highest and lowest results

PISA category	*n*	Min.	Max.
PISA 2003			
PISA Math	40	356	550
PISA Science	40	385	548
PISA Reading	40	375	543
PISA 2006			
PISA Math	55	318	549
PISA Science	55	349	563
PISA Reading	54	312	556
PISA 2009			
PISA Math	61	365	600
PISA Science	61	369	575
PISA Reading	61	370	556
PISA 2012			
PISA Math	65	368	613
PISA Science	65	373	580
PISA Reading	65	384	570

Appendix 4

	Construct	Details
2003	Total GCI figure per country	*3 subgroups* 1. Public Institutions Index 2. Macroeconomic Environment Index 3. Technology Index
2006	Total GCI figure per country	*9 Pillars* 1. Institutions 2. Infrastructure 3. Macroeconomy 4. Health and primary education 5 Higher education and Training 6. Market efficiency 7. Technological readiness 8. Business Sophistication 9. Innovation
2009	Total GCI figure per country	*3 subindices* 1. Basic requirements 2. Efficiency enhancers 3. Innovation and sophistication factors *12 Pillars* 1. Institutions 2. Infrastructure 3. Macroeconomic stability 4. Health and primary education 5. Higher education and training 6. Goods market efficiency 7. Labour market efficiency 8. Financial market sophistication 9. Technological readiness 10. Market size 11. Business sophistication 12. Innovation
2012	Total GCI figure per country	*3 subindices* 1. Basic requirements 2. Efficiency enhancers 3. Innovation and sophistication factors *12 Pillars* 1. Institutions 2. Infrastructure 3. Macroeconomic stability 4. Health and primary education 5. Higher education and training 6. Goods market efficiency 7. Labour market efficiency 8. Financial market sophistication 9. Technological readiness 10. Market size 11. Business sophistication 12. Innovation

Table AIV.
Summary of information available in WEF's global competitiveness reports

Appendix 5

Source	Number of countries participating 2003	2006	2009	2012
PISA results – discipline	40	Not available	41	64
UNESCO government expenditure on education	53	48	49	49[a]
PISA results – education	40	55	61	65
Global competitiveness Index	55	62	63	62
OECD – annual expenditure per student	34	35	36	38[b]

Notes: [a]As at the end of September 2015, 2012 UNESCO Government Expenditure on Education data were available only for 25 countries. To increase the sample size for the analysis, 2011 data were used instead, as the data was available for 49 countries; [b]2012 OECD annual expenditure per student will only become available in late 2015. Again, to increase the sample size for the analysis, 2011 data were used in this study instead

Table AV.
Summary of available data per year

Appendix 6

Variable	*n*	Min.	Max.	Mean	SD
Panel A – discipline					
D1 – Students listen well	64	51.00	93.00	68.64	9.13
D2 – Noise level		49.00	90.00	69.78	9.20
D3 – Teacher wait time		55.00	93.00	73.19	8.18
D4 – Students work well		59.00	90.00	77.39	6.62
D5 – Class start time		50.00	90.00	73.72	9.10
Panel B – education investment					
OECD Expenses per student	38	522.00	16,182.00	8,282.90	3,944.00
UNESCO Government Expenditure on Education	49	2.56	8.55	5.00	1.27
Panel C – educational performance					
PISA Math	65	368.00	613.00	473.35	55.50
PISA Science		373.00	580.00	478.57	50.68
PISA Reading		384.00	570.00	473.97	47.09
Panel D – competitiveness					
C1 – institutions	62	2.85	6.07	4.50	0.88
C2 – infrastructure		3.22	6.72	4.93	0.94
C3 – macroeconomic stability		2.42	6.66	5.04	0.90
C4 – health and primary education		5.37	6.82	6.09	0.37
C5 – higher education and training		3.69	6.18	4.96	0.60
C6 – goods market efficiency		3.18	5.60	4.60	0.51
C7 – labour market efficiency		3.29	5.90	4.56	0.56
C8 – financial market sophistication		3.13	5.89	4.44	0.70
C9 – technological readiness		3.33	6.29	4.92	0.86
C10 – market size		2.08	6.93	4.50	1.02
C11 – business sophistication		3.11	5.80	4.53	0.71
C12 – innovation		2.63	5.78	4.05	0.94

Table AVI.
PLS descriptive statistics (2012)

Appendix 7

2003[a]

Variable name	Factor loadings (initial CFA)	Factor loadings (optimised CFA)	Min.	Max.	Mean	SD
D1 – Students listen well	0.720	0.771	61	82	70.54	5.139
D2 – Noise level	0.871	0.910	52	100	67.12	10.303
D3 – Teacher wait time	0.927	0.916	57	86	69.04	6.703
D4 – Students work well	0.613	Excluded	61	82	76.35	4.624
D5 – Class start time	0.799	0.775	37	85	70.40	9.045

2009[b]

Variable name	Factor loadings (initial CFA)	Factor loadings (optimised CFA)	Min.	Max.	Mean	SD
D1 – Students listen well	0.931	0.923	55	92	74.06	9.125
D2 – Noise level	0.909	0.944	52	90	70.83	10.109
D3 – Teacher wait time	0.973	0.979	62	93	74.25	8.381
D4 – Students work well	0.810	Excluded	56	91	81.82	6.116
D5 – Class start time	0.932	0.934	56	91	76.63	8.535

2012[c]

Variable name	Factor loadings (optimised CFA)	Min.	Max.	Mean	SD
D1 – Students listen well	0.860	51	93	68.64	9.129
D2 – Noise level	0.911	49	90	69.78	9.202
D3 – Teacher wait time	0.958	55	93	73.19	8.190
D4 – Students work well	0.883	59	90	77.39	6.620
D5 – Class start time	0.920	50	90	73.72	9.102

Notes: [a]$n = 40$, optimised Cronbach's $\alpha = 0.845$; [b]$n = 41$, optimised Cronbach's $\alpha = 0.958$; [c]$n = 64$, optimised Cronbach's $\alpha = 0.942$

Table AVII.
Factor score analysis – discipline

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