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# THE DEMOGRAPHIC COST
# BIRTH RATES AND ACHIEVEMENT ON INTERNATIONAL TESTS

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# המחיר הדמוגרפי
# שיעורי הילודה והישגים במבחנים בינלאומיים

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נייר מדיניות מס׳ 2011.10

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# *The Demographic Cost*
## *Birth Rates and Achievement in International Tests*

Yariv Feniger and Yossi Shavit*

***Abstract***

*The birth rate in Israel is high compared to other developed countries. As a result, Israeli families are larger and classrooms are more crowded. Research has shown that these two variables, family size and class size, adversely affect academic achievement. International studies show that pupils' achievements are lower in Israel than in other developed countries. An analysis of PISA 2000 and PISA 2006 data shows that the relative size of Israel's young population which is related to high birth rates explains most of the gap between the average score of Israeli pupils and the international average. The influence of the size of the young population on pupil test scores is correlated to family size and classroom crowding. Whereas, other studies have sought the explanation for low achievement in features of the education system itself, the current study shows the significant contribution of the broader demographic context to the comparatively low achievements of Israeli pupils.***

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** A more comprehensive paper on the findings of this study is forthcoming in the journal *Israeli Sociology*.

International achievement tests from the last two decades have shown that, on average, Israeli pupils' scores are below those of their counterparts in other developed countries. These findings have been consistent across all PISA studies (which measure achievement in reading comprehension, mathematics, and science) and TIMSS studies (which measure achievement in mathematics and science). Though these results have received widespread media exposure and sparked public and political debate, no detailed research attempt has been made to explain Israel's low standing relative to the other participating countries. The current study aims to analyze PISA 2000 and PISA 2006 data in order to understand why Israeli pupils achieve below their counterparts from countries at a similar level of economic development. The study's findings are then used to suggest policy measures which may improve the achievements of Israeli pupils in international tests.

Yogev, Livneh, and Feniger's (2009) analysis of the PISA 2000 data has shown that varying academic achievements in different countries are closely correlated with (1) the level of economic development and (2) the relative size of the school-age population in those countries. Their study further shows that these two variables predict most (approximately 80 percent) of the variance in average scores across countries.

Taking the findings of Yogev et al. as the starting point, this study aims to offer a more detailed explanation of Israeli pupils' achievements in the international tests. In particular, the analysis of the results goes beyond the aggregate national level. The methodology makes it possible to examine statistically the effect of multiple variables on multiple levels of analysis. Variables are tested on the individual pupil- and family-level (micro-level variables) as well as on the national or country-level (macro-level variables). (For further elaboration, see the Spotlight section.)

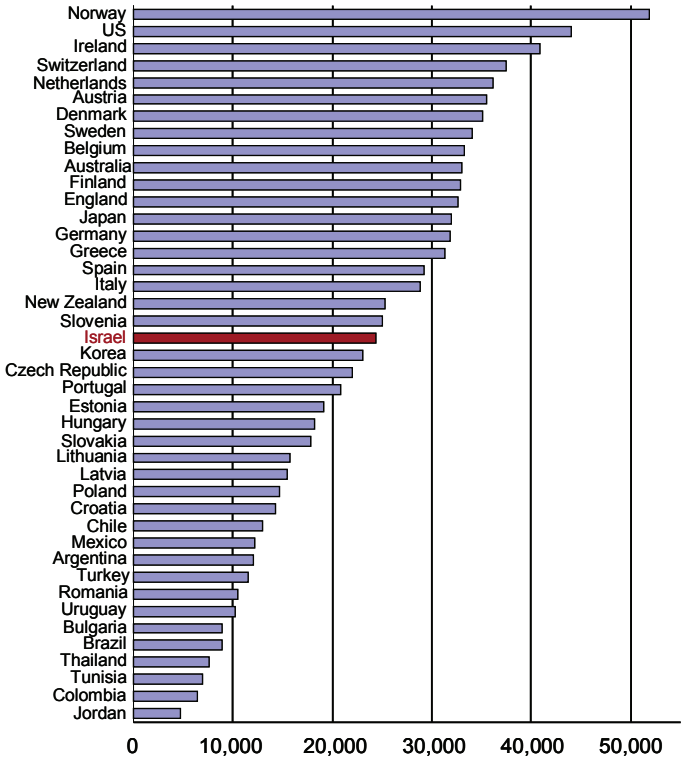
A country's level of economic development, typically measured by gross domestic product (GDP) per capita, affects its ability to finance education costs and to invest in achievement-enhancing educational resources. Figure 1 compares Israel's GDP per capita in 2006 (standardized for purchasing power) with the GDP per capita of the other

participant countries in PISA 2006 (data are from the United Nations Development Programme [UNDP] website). Figure 2 shows expenditures per pupil on secondary education as a share of the GDP per capita in Israel and in the other participant countries in PISA 2006 (data are from the UNESCO website). As the two figures indicate, Israel is not among the wealthiest participant countries, and its level of expenditure per pupil is not particularly high by international standards.

Figure 1

**GDP per capita**

PPP adjusted dollars, 2006

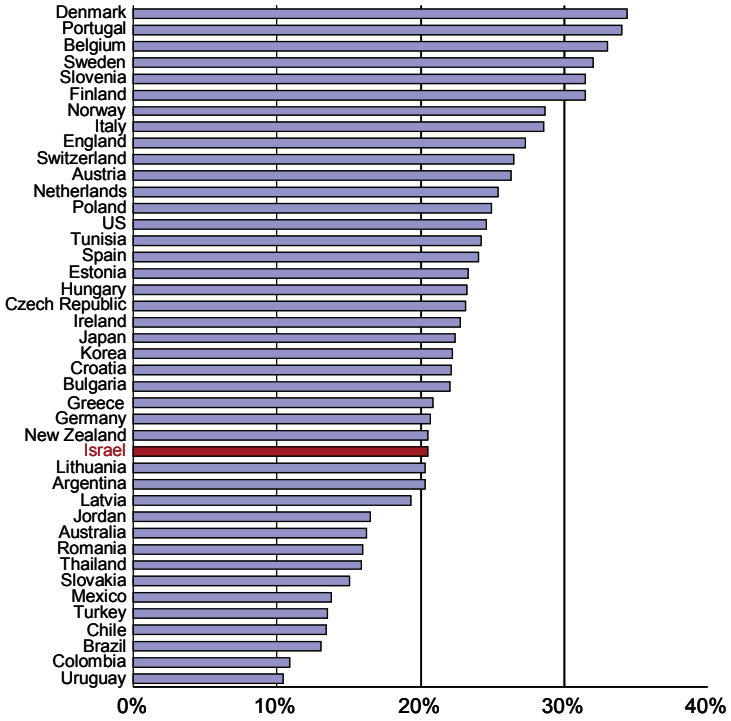



**Source**: United Nations Development Programme.

Figure 2

**Annual per pupil expenditure on secondary education**

as a percent of GDP per capita, 2006




**Source**: UNESCO.

Educational expenditure per pupil is affected by the demographic structure of a country's population. In countries with high fertility rates, school-age children constitute a large share of the population and national education expenditures required are relatively high. Israel's fertility rate is higher than the world average and especially high relative to fertility rates in developed countries. This finds expression in the total fertility

rate, which measures the average number of children a woman is likely to bear in her lifetime. In 2009, this rate in Israel was 2.96, compared with the world average of 2.58, the European Union average of 1.51, and the United States figure of 2.0. Even compared with its neighboring countries, Israel has a high total fertility rate. The figures for Lebanon, Jordan, and Egypt are 1.85, 2.39, and 2.66, respectively. Only neighboring Syria, at 3.14, has a higher rate than Israel's. (All data are from the United States Central Intelligence Agency website.) School-age children thus constitute a large share of Israel's population: about 28 percent of the Israeli population is aged 0-14, compared with 15.4 percent in the European Union and 20 percent in the United States (see Figure 3).

These figures underscore not only the methodological importance of standardizing educational expenditure for the number of pupils in the education system, but also the dynamic nature of a country's demographic structure. Education systems must budget not only for current, but also for future pupils. Governments must plan and build educational facilities, recruit and train new teachers, and so forth. In Israel, with its young demographics, the forecasted number of future pupils imposes further budgetary burdens on the education system.

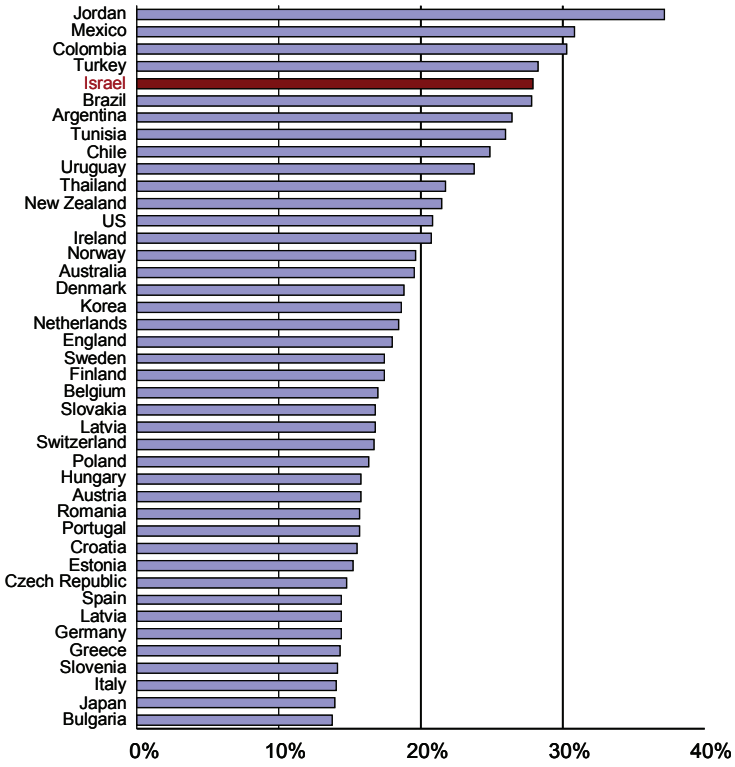
Birth rates can affect academic achievements in ways other than through public expenditures per pupil. Many studies show that the number of siblings in a family is inversely related to their cognitive development and academic achievements. The resource dilution hypothesis states that children raised in small families enjoy a larger share of the family's resources, including parental attention, which enhances their cognitive development (Blake, 1989). Resource dilution within the pupils' families may thus explain lower academic achievements in countries with high birth rates. The share of the young population in a country's total population may further affect academic achievement through its effect on class size. Class size is determined not only by the demographic burden on the education system, but also by education policy. In the United States, for example, the last two decades have witnessed a marked reduction of class size, with many resources

allocated to this goal (Loveless and Hess, 2007). Proponents of such reduction argue (among other things) that smaller classes enable teachers to devote more time to each pupil, to improve the learning atmosphere in the class, and to respond more adequately to the needs of pupils with either special needs or high aptitude. Studies disagree, however, on the exact effect of class size on academic achievement.

Figure 3

**Percent of 0-15 year-olds in the population**

2006




**Source**: United Nations Development Programme.

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Analysis of PISA data, which is detailed in the Spotlight, indicates a correlation between the share of the young population in Israel and the relatively low achievements of Israeli pupils, with the negative effect of the former on the latter largely explained by two further variables, family size and class size.

### *Spotlight:* Study Description

The analysis is based on data drawn from PISA 2000 and PISA 2006. PISA surveys focus on pupils aged 15, most of whom are in the tenth grade. All pupils participating in PISA 2000 were tested in reading comprehension, with sub-samples tested in mathematics and science. PISA 2006 tested all pupils in all three subjects. Scores were reported on a standardized scale in which the mean was set at 500, with a standard deviation of 100. The current study focuses on reading comprehension only; note, however, that the scores in all three subjects are closely correlated. All pupils tested by PISA filled out a detailed questionnaire with questions on family and school background: these questionnaires served as the source for the pupils' background variables. Variables drawn from the PISA data have been supplemented by macro-level (country-level) variables drawn from international databases.

Several statistical models were used to examine the effect of both individual- and country-level variables on pupils' achievements in general and on the achievements of Israeli pupils in particular. The models were estimated for 34 countries with PISA 2000 data and for 41 countries with PISA 2006 data. Figure 4 shows the gap between the achievements of Israeli pupils and the international average based on PISA 2000 data. (Only PISA 2000 data are shown here, since PISA 2006 data provide no information on family size and class size. The other models yielded very similar results for both PISA databases.)

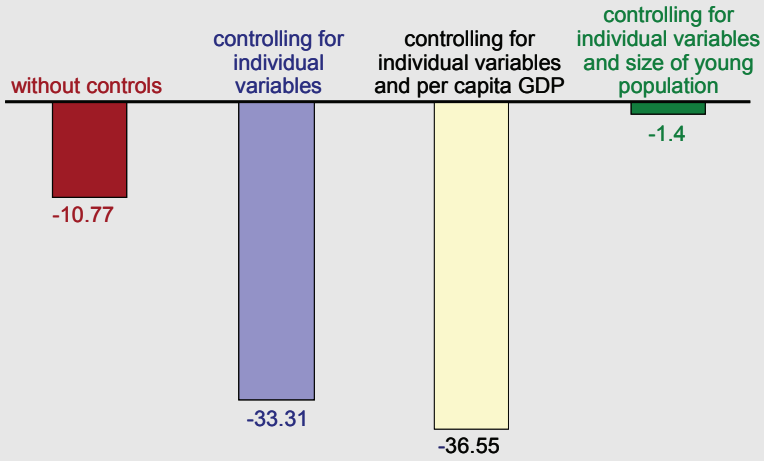
The first model estimated the achievement gap between Israeli pupils and pupils from other countries without controlling for other variables, making it possible to isolate the effect of each variable. The average score for Israeli pupils was found to be about eleven points lower than the international average.

The second model controlled for the following individual variables: pupil's age, gender, parental education, parental occupation, and number of books at home. This model increased the gap between Israeli pupils and the international average by more than 20 points. That is, for pupils with similar background characteristics, residing in Israel predicted a score about 30 points lower than the international average. In particular, Israeli pupils scored lower, on average, than non-Israeli pupils with similar family background.

Figure 4

**The achievement gap**

the gap in scores between Israel and the OECD countries*
controlling for individual and country variables, 2006




* OECD countries that participated in the PISA 2006 tests.

**Source**: Feniger (Taub Center and Ben-Gurion University) and Shavit (Taub Center and Tel-Aviv University).

The third model controlled for GDP per capita. This slightly increased the gap between Israeli and non-Israeli pupils. In other words, the achievements of Israeli pupils were lower than those predicted by the country's level of economic development. This indicates that the level of economic development is not the main cause of Israel's relatively low academic achievements. The next stage examined whether the share of children aged 0-15 in the total population can be an explanation for Israel's relatively low academic achievements. This fourth model shows that after controlling for this variable (alongside all other individual variables), the gap between Israeli pupils and the international average disappeared almost entirely.

In light of this finding, the next aim of the research was to explain which mechanisms might mediate between the share of the young population and the pupils' achievements. Several hierarchical models were used to test the hypotheses that investment per pupil, class size, or the number of siblings might be the mediating factors. The analyses found that while investment per pupil did not explain the influence of the size of the young population on pupils' achievement, each of the other two variables, class size and the number of siblings, did.

In summary, the analysis of the data indicates a correlation between the share of the young population in Israel and the relatively low achievements of Israeli pupils, with the negative effect of the former on the latter largely explained by two further variables, family size and class size.

Policy-oriented studies typically seek the causal variable for low achievement in features of the education system itself, such as teacher quality or curricula. Such studies tend to underestimate the importance of the social context within which the education system operates. The current study focuses on Israel's unique social structure, particularly on the country's demographic structure and its implications for pupils' achievements. The study highlights a fundamental constraint of the education system, namely the very rapid growth of the pupil population.

Government policy aiming to change the fertility rate is unlikely to have much influence on the majority of the population; changes in Israel's fertility rate are not to be expected in the short or medium term. Public attention should instead be focused on significantly reducing class size. Classes in Israel are very large by international standards: PISA 2006 reported 32 pupils per class in Israel, compared with 25 in the United States, 23 in Italy, and 21 in Finland (the latter topping PISA's international rankings on this measure). Such a step will incur great costs (Blass, 2008) but is not impossible to achieve.

Class size in Israel is in large part a consequence of the education system's inconsistent budgetary policy. Data on class size in Israel reveal that certain population groups with particularly high fertility rates nevertheless enjoy relatively small classes: these groups include ultra-Orthodox Jews, whose children attend independent (recognized and unofficial or exempt) schools, and modern Orthodox Jews whose children attend State-religious schools. Average class size is smaller in each of these education sectors than in Israel's State (secular) schools (Weissblau, 2005).

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UNESCO – http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx

CIA – http://www.cia.gov/library/publications/he-world-factbook/fields/2127.html