TIMSS TRENDS FROM 1995 TO 2007:
A FOCUS ON ITALY

Ina V. S. Mullis
Michael O. Martin
TIMSS & PIRLS International Study Center

ABSTRACT

This paper focuses on TIMSS trends in students’ educational achievement in Italy since 1995. With data on mathematics and science achievement at fourth and eighth grades and mathematics and physics for advanced students at the final year of secondary schooling, TIMSS is a unique source of information for examining the results of countries efforts to improve student outcomes over the past 15 years. This paper describes the trends in Italy in comparison to those in a number of other countries that have participated since 1995, including several top-achieving Asian countries, several European countries, and the United States.

Keywords: TIMSS trends – Italian trends – TIMSS achievement

ESTRATTO

Questo articolo si concentra sulle tendenze osservate nel rendimento alla prova TIMSS degli studenti italiani a partire dal 1995. Con i dati su matematica e scienze per il quarto e l’ottavo grado di scolarizzazione e su matematica e fisica per gli studenti dell’ultimo anno di scuola secondaria di primo grado, TIMSS è una fonte di informazioni preziosa per esaminare l’impegno dei sistemi educativi dei Paesi partecipanti nel migliorare i risultati dei loro alunni nel corso degli ultimi 15 anni. Questo articolo descrive le linee di tendenza italiane confrontate con un certo numero di altri Paesi che hanno partecipato all’indagine, a partire dal 1995. Tra questi sono presenti alcuni tra i meglio classificati Paesi asiatici, diversi Paesi europei e gli Stati Uniti.

Parole chiave: Tendenze TIMSS – Tendenze italiane – Risultati TIMSS
1. Overview of TIMSS

TIMSS (Trends in International Mathematics and Science Study) is a large and innovative international assessment that has been conducted every four years since 1995, with TIMSS 2011 currently under way in about 70 countries. TIMSS Advanced, which assesses advanced mathematics and physics at the senior secondary level, was conducted in 1995 and 2008, with the next assessment planned for 2015. The goal of TIMSS is to provide comparative information about educational achievement across countries to improve teaching and learning in mathematics and science. TIMSS measures trends in mathematics and science achievement at the fourth and eighth grades, as well as monitoring curricular implementation and identifying promising instructional practices from around the world. TIMSS is a project of the IEA (International Association for the Evaluation of Educational Achievement), an independent international cooperative of national research institutions and government agencies that has been conducting studies of cross-national achievement in a wide range of subjects since 1959. Because country participation in any IEA study is voluntary, the decision is made by each member country according to its data needs and resources, and then coordinated through the IEA Secretariat in Amsterdam.

1.1. Availability of TIMSS trend data

TIMSS trend data are available across four assessment cycles: 1995, 1999, 2003, and 2007. The initial and extremely ambitious TIMSS assessment in 1995 encompassed participation at five grade levels, including students in the fourth and eighth grades and in the final year of secondary school. However, subsequent assessments have not covered as many grades, with the 1999 assessment only at the eighth grade, and then the TIMSS 2003 and 2007 assessments beginning the current practice of including both fourth and eighth grades. The number of countries has grown across the assessment cycles, with TIMSS 1995 involving 40 countries and TIMSS 2007 involving 59 countries and approximately 425,000 students. The TIMSS trends from 1995 through 2007 have been described in two companion reports, the [TIMSS 2007 International Mathematics Report: Findings from IEA’s Trends in International Mathematics and Science Study at the Fourth and Eighth Grades (Mullis, Martin, & Foy, 2008)] and the TIMSS International Science Report: Findings from IEA’s Trends in International Mathematics Science Study at the Fourth and Eighth Grades (Martin, Mullis, & Foy, 2008). The TIMSS Advanced 2008 assessments of mathematics and physics at the senior secondary school level involved 10 countries, including changes in students’ achievement between 1995 and 2008 in five countries. The details of the TIMSS Advanced 2008 assessments were presented in the TIMSS Advanced 2008 International Report: Findings from IEA’s Study of Achievement in Advanced Mathematics and Physics in the Final Year of Secondary School (Mullis, Martin, Robitaille, & Foy, 2009).

2. Fourth grade trends in mathematics

The TIMSS & PIRLS International Study Center at Boston College published the trends in mathematics achievement from 1995 through 2007 in the TIMSS 2007 International Mathematics Report. At the fourth grade, 16 countries had trend data for the 1995 and 2007 assessments: Australia, Austria, the Czech Republic, England, Hong Kong SAR, Hungary, Iran, Japan, Latvia, the Netherlands, New Zealand, Norway, Scotland, Singapore, Slovenia, and the United States. As documented in the 2007 international reports, generally, and even in the same countries for mathematics and science, between 1995 and 2007 there was a tendency toward more improvement than declines at the fourth grade.

More specifically, in mathematics at the fourth grade, eight of the countries showed improvement between 1995 and 2007: Australia, England, Hong Kong SAR, Iran, Latvia, New Zealand, Slovenia, and the United States. Of the remaining countries, four—Singapore, Japan,
Scotland, and Norway — showed essentially no change in achievement, and four—Austria, the Netherlands, Hungary, and the Czech Republic — showed declines. Keeping in mind there was no assessment in 1999 at the fourth grade, it also is interesting to consider more recent results. These findings also are positive for mathematics, showing that average achievement between 2003 and 2007, either increased (nine countries) or stayed the same (10 countries), with only two countries having decreases.

Figure 1 presents TIMSS trend results in average mathematics achievement for selected countries, keeping in mind there was no fourth grade assessment in 1999. For Italy, the trends between 1995 and 2003, shown by the dotted line, have been computed to be comparable between assessments. In 1995, four Italian Regions did not participate — Piemonte, Toscana, Lazio, and Sicilia — so the 2003 were recomputed without these four Regions. The results between the 2003 and 2007 assessments are based on participation by all Regions, and match the results presented in the TIMSS 2007 International Mathematics Report. The Italian results are shown in comparison to the trends for nine other countries from 1995 to 2007, selected from countries with complete data sets (1995, 2003, and 2007) to represent several of the high-performing Asian countries, a variety of European countries, and also include the United States.

As shown in Figure 1, mathematics achievement showed little change in Italy between 1995 and 2007 at the fourth grade. Because a number of Asian countries consistently have been the top-achieving countries in TIMSS, the first row in Figure 1 shows the results for three of these countries — Singapore, Japan, and Hong Kong SAR. In 2007, for fourth grade mathematics, Hong Kong SAR, Singapore, and Japan were among the top-performing countries. Of these high-achieving Asian countries, Hong Kong SAR showed significant improvement from 1995 together with significant improvement from 2003 to 2007, suggesting a sustained improvement over the 12-year period from 1995 to 2007. There was little change between 1995 and 2007 in Singapore or Japan.

The other countries in Figure 1 span a range of mathematics achievement. On average, Hungary, the Netherlands, England (since 2003), and the United States performed above the TIMSS scale average; while Slovenia performed about at the TIMSS scale average and Norway below it. These countries also showed a variety of trend patterns. For example, Slovenia and England were the two other countries in addition to Hong Kong SAR to show a pattern of sustained improvement from 1995 to 2007. For the United States, the improvement since 1995 largely reflected improvement between 2003 and 2007. Norway declined significantly between 1995 and 2003, but rebounded in 2007 almost back to the original level. Finally, the Netherlands and Hungary had decreased achievement in 2007.

Figure 2 presents brief descriptions of the TIMSS 2007 International Benchmarks in mathematics, and trends in the percentages of fourth grade students scoring at each of the benchmarks. The benchmarks represent the range of performance shown by students internationally. TIMSS conducted a detailed scale anchoring analysis to describe TIMSS 2007 mathematics performance at four different points on the TIMSS mathematics scales: Advanced is 625, High is 550, Intermediate is 475, and Low is 400. The results revealed substantial variation in performance between students achieving at the high end and the low end of the scale. At the fourth grade, students at the Advanced International Benchmark applied mathematical understanding and knowledge in a variety of relatively complex problem situations and were able to explain their reasoning, whereas those at the Low International Benchmark demonstrated some basic mathematical knowledge and were able to compute with whole numbers, recognize some geometric shapes, and read simple graphs and tables.

In general, the higher a country’s average achievement, the higher the percentages of students reaching the high and advanced benchmarks. In 2007, 6 percent of the Italian fourth grade students reached the advanced benchmark in mathematics and 29 reached the High benchmark, with these figures the same as in
There was no fourth-grade assessment in 1999.
The scale interval is 10 points for each country.
* Indicates significant difference from 1995.
Trends between 1995 and 2003 for Italy are based on data that did not include four regions: Piemonte, Toscana, Lazio, and Sicilia.

Fig. 1 TIMSS Trends in Average Mathematics Achievement – Fourth Grade.
2003. However, in 2007 more Italian students reached the Intermediate and Low levels, indicating progress in the lower regions of the scale. Because of the difference in the 1995 Italian sample (not including four Regions), the 1995 Italian results are not included.

<table>
<thead>
<tr>
<th>Country</th>
<th>Advanced</th>
<th>High</th>
<th>Intermediate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>6 6</td>
<td>29 29</td>
<td>65 67</td>
<td>89 91</td>
</tr>
</tbody>
</table>

**TIMSS International Benchmarks (Points on the TIMSS Scale)**

- **Advanced (625)**: Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning.
- **High (550)**: Students can apply their knowledge and understanding to solve problems.
- **Intermediate (475)**: Students can apply basic mathematical knowledge in straightforward situations.
- **Low (400)**: Students have some basic mathematical knowledge.

---

**Fig. 2** Trends in Percentages of Students Reaching TIMSS International Benchmarks in Mathematics – Fourth Grade.
Looking at the Asian countries, the results show that 40 to 41 percent of the fourth grade students in Singapore and Hong Kong SAR reached the Advanced benchmark and 74 to 81 percent reached the high benchmark. For Hong Kong SAR, this represented a considerable increase from 2003. The percentages were not quite as high in Japan, but it is clear that substantial percentages of fourth grade students in these Asian countries demonstrated high to advanced levels of achievement.

As for the other countries, Slovenia and England had relatively steady increases across the achievement distribution, and the United States had improvement at the lower end of the distribution. For the countries with declines in achievement between 1995 and 2008, Hungary had lower percentages of students reaching the lower benchmarks, and the Netherlands had lower percentages reaching the higher benchmarks.

3. Fourth grade trends in science

The TIMSS trends in science achievement for the 1995, 1999, 2003, and 2007 assessments can be found in the TIMSS 2007 International Science Report. Comparing across the 12 years between 1995 and 2007 at the fourth grade, 16 countries had achievement data available. The overall patterns are more positive than for mathematics, with seven countries showing increases, four with similar achievement, and five with decreases.

Figure 3 presents the trends in average science achievement at the fourth grade for the same countries as shown for mathematics in Figure 1. For Italy, the trends between 1995 and 2003 (without the four Regions of Piemonte, Toscana, Lazio, and Sicilia) were stable, but there was a significant improvement between 2003 and 2007. Also, looking at three of the high-performing Asian countries, Singapore and Hong Kong SAR showed substantial improvement between 1995 and 2007, while achievement in Japan remained at about the same level. As for the other countries, fourth grade students in Hungary and Slovenia showed significant improvement in science achievement, while those in the Netherlands, England, and the United States remained at about the same levels. In Norway, there was a decline in science achievement at the fourth grade.

Figure 4 presents the results for the TIMSS 2007 International Benchmarks in science for the fourth grade. Looking at the brief descriptions of the benchmarks, it can be seen that students at the Advanced International Benchmark applied knowledge and understanding of scientific processes and relationships in beginning scientific inquiry whereas those at the Low International Benchmark displayed some elementary knowledge of life science and physical science. In Italy, significantly higher percentages of students in 2007 than in 2003 reached the three top benchmarks.

The improvement between 2003 and 2007 in Italy was similar to that shown in Singapore and Hong Kong SAR, with little change between 1995 and 2003, but considerable progress between 2003 and 2007. However, it can be noted that whereas 36 percent of the Singaporean students reached the advanced benchmark in 2007, only 12 to 14 percent of the students did in Italy, Japan, and Hong Kong SAR. The pattern of improved performance in 2007 at three or four benchmarks also was evidenced in Hungary, England, and Slovenia, although relatively fewer Slovenian students reached the high and advanced benchmarks. In comparison, the Netherlands and the United States showed stability across assessments, with a decrease at the advanced level compared with 1995. Also compared with 1995, the Norwegian fourth grade students demonstrated decreases across the entire achievement distribution.

4. Eighth grade trends in mathematics

Across the TIMSS countries, the trends in mathematics achievement between 1995 and 2007 were not as encouraging at eighth grade as they were at fourth grade. At eighth grade, 20 countries had data in both 1995 and 2007: including the Australia, Bulgaria, Colombia,
No fourth-grade assessment in 1999.
The scale interval is 10 points for each country.
* Indicates significant difference from 1995 (2003 for Italy).
Trends between 1995 and 2003 for Italy are based on data that did not include four Regions: Piemonte, Toscana, Lazio, and Sicilia.

Fig. 3 TIMSS Trends in Average Science Achievement – Fourth Grade.
Cyprus, Czech Republic, England, Hong Kong SAR, Hungary, Iran, Japan, Korea, Lithuania, Norway, Romania, the Russian Federation, Scotland, Singapore, Slovenia, Sweden, and the United States. Of the 20 countries, five had increased average achievement in 2007 compared
with 1995, five similar had achievement, and 10 decreased achievement.

Figure 5 presents the eighth grade trend results in mathematics for Italy and nine other countries, most of which are the same as those shown at the fourth grade. The 1995 sample did not include four Regions in Italy, so had reduced coverage. In 1999, there was full sample coverage, and that became the basis for trends into the future. However, to link 1999 back to 1995, a second achievement estimate was computed not including the four Regions. That difference is shown by the dotted line between 1995 and 1999. As shown in Figure 5, including the trends from 1995 to 1999 on a slightly reduced sample, achievement in Italy was relatively constant from assessment to assessment across the four cycles. In the context of more declines across TIMSS countries than improvements, the fact that achievement in Italy remained at a steady level could be considered as relatively good news.

Of all the countries with comparable samples across all four assessments at the eighth grade, only four did not have any declines between assessments — England and the United States (shown in Figure 5) as well as Korea and Lithuania. For the three Asian countries included in Figure 5, both Singapore and Japan lost ground over the 12 years. Hong Kong SAR had increases, but then declined between 2003 and 2007 to the extent that achievement essentially returned to the same level as in 1995. After no change between 1995 and 2003, Slovenia improved between 2003 and 2007. Hungary and the Russian Federation had some ups and downs, but ended up with lower achievement in 2007 than in 1995. The Swedish eighth grade students showed steady declines in achievement between 1995 and 2003, and particularly between 2003 and 2007.

Figure 6 shows the trends in percentages of eighth grade students reaching the TIMSS International Benchmarks. Students at the High International Benchmark demonstrated an excellent grasp of the mathematics in the assessment, including the ability to solve a variety of non-routine problems. In comparison, those at the Low benchmark demonstrated some knowledge of whole number and decimals, operations, and basic graphs.

For Italy, data are not available for 1995 due to the reduced sample coverage (missing four Regions) compared with the other assessments. However, similar to the trends in average achievement, there was consistency from assessment to assessment with the exception of a steady decline in the percentage of students reaching the High benchmark. This same trend pattern, but even more pronounced, was observed in Singapore and Japan. In both Asian countries, in addition to fewer students reaching the high level in 2007 than in 1995, fewer reached the intermediate and low levels. A similar pattern was observed in Hungary, with decreased percentages of students reaching the two lowest benchmarks. In Sweden, decreased percentages reached all four benchmarks. Between 1995 and 2007, the percentages reaching benchmarks decreased from 12 to 2 percent for Advanced, from 46 to 20 percent for High, from 81 to 60 for Intermediate, and from 96 to 90 for Low, indicating more severe declines at the upper regions of the achievement distribution. Slovenia and the Russian Federation had little, if any, changes. Finally, England improved in the middle of the achievement distribution, and the United States, in all levels except the advanced benchmark.

5. Eighth grade trends in science

At the eighth grade, of the 19 countries with 1995 data, 5 had increased achievement in 2007, 11 had similar achievement, and only three had decreases. Thus, the trend results between 1995 and 2007 for eighth grade science show stability in average achievement, in general, for the TIMSS countries over the 12-year period.

Figure 7 presents the science trend results for Italy and for the same set of countries as shown for mathematics at the eighth grade. It can be seen that the Italian results are consistent with the prevailing pattern across TIMSS countries, in that average achievement in science was re-
The scale interval is 10 points for each country.

* Indicates significant difference from 1995.

Trends between 1995 and 1999 for Italy are based on data that did not include four Regions: Piemonte, Toscana, Lazio, and Sicilia.

Fig. 5 TIMSS Trends in Average Mathematics Achievement – Eighth Grade.
Relatively stable from assessment to assessment (including between 1995 and 1999, not including four Regions). Also, most of the other countries in Figure 7 did not show changes in average science achievement between 1995 and 2007, including Singapore, Japan, Hungary, the

**Fig. 6** Trends in Percentages of Students Reaching TIMSS International Benchmarks in Mathematics – Eighth Grade.
The scale interval is 10 points for each country.
* Indicates significant difference from 1995.
Trends between 1995 and 1999 for Italy are based on data that did not include four regions: Piemonte, Toscana, Lazio, and Sicilia.

Fig. 7 TIMSS Trends in Average Science Achievement – Eighth Grade.
Russian Federation, England, and the United States. Hong Kong SAR showed considerable improvement between 1995 and 2003, and then a significant decline in 2007, but average achievement in 2007 was still above the original 1995 level. Slovenia did not participate in 1999, but has showed steady improvement since then. In contrast, Sweden showed considerable declines, particularly between 2003 and 2007.

Figure 8 presents the trends in percentages of eighth grade students reaching the science benchmarks. At the eighth grade, students at the Advanced International Benchmark demonstrated a grasp of some complex and abstract concepts in biology, chemistry, physics, and earth science. In comparison, those at the Low International Benchmark simply recognized some basic facts from the life and physical sciences. In Italy, achievement related to the science benchmarks has remained essentially unchanged since 1999, except a slight decline at the advanced benchmark. (The 1995 data are not shown since they were not comparable, because four Regions were not included.) The pattern of consistency from assessment to assessment is reflected in the similarity across assessments for the benchmark results. Japan, Hungary, the Russian Federation, and England had no significant changes, and the United States changed only slightly at the low benchmark. Despite having about one-third, by far the largest proportion, of students reaching the advanced benchmark, Singapore had significant decreases at the two lowest levels. Sweden had substantial decreases at all four levels, including from 19 to 7 percent at the advanced level and from 52 to 32 percent at the high level. Of the countries shown in Figure 8, only Slovenia showed progress across the entire achievement distribution.

6. TIMSS advanced mathematics

Although the initial 1995 TIMSS assessment examined the teaching and learning of mathematics and science for students in their last year of secondary school, that component was not reassessed until 2008. Ten relatively diverse countries participated in TIMSS Advanced 2008: Armenia, Iran, Italy, Lebanon, the Netherlands, Norway, the Philippines, the Russian Federation, Slovenia, and Sweden. Detailed results were published in the TIMSS Advanced 2008 International Report.

Italy was one of the original participants in the 1995 advanced mathematics assessment that also participated in the replication of that assessment in 2008. TIMSS Advanced 2008 focused once again on students who were enrolled in the last year of secondary school, and who were specializing in advanced mathematics or physics as part of an academic program. Although Italy participated in both the mathematics and physics portions of TIMSS Advanced 2008, because its 1995 participation was only in the mathematics portion, that is where trend data are available.

Taking part in an international study comparing and contrasting the achievement of senior secondary students enrolled in the most advanced programs in mathematics and science that their countries have to offer provides information about the quality and quantity of well-educated citizens graduating from their secondary schools, particularly those with strong background and career interests in fields related to mathematics, science, engineering, and technology. On the other hand, it is the case that the additional sources of variation across countries by the final year of secondary school complicate the interpretation of the results. By the final year, countries have provided different opportunities for students in the rigor and length of their advanced programs, and students also have had opportunities for choices.

In shaping educational policy, every country confronts the challenge of providing a high level of education for all students. It may be a goal to offer a highly enriched program in advanced mathematics to a significant percentage of the students, and have those students achieve at internationally high levels. However, there are issues of practicality and feasibility. Also, decisions about what constitutes a high level of education or a specialized program, differ considerably across countries, as do ideas about
how many students should or can participate in advanced courses or receive specialist training. Thus, TIMSS Advanced developed a coverage index as a means of comparing the relative sizes of the populations included in the study in these countries.

Fig. 8 Trends in Percentages of Students Reaching TIMSS International Benchmarks in Science – Eighth Grade.
Figure 9 presents trend results for the four countries that participated in TIMSS Advanced mathematics in both 1995 and 2008 — Italy, the Russian Federation, Slovenia, and Sweden. Figure 9 also includes the results of the TIMSS Advanced Mathematics Coverage Index. The coverage index for a particular country is an estimate of the percentage of the entire national age cohort covered by the TIMSS Advanced target population. The components of the TIMSS Advanced Mathematics Coverage Index are fully documented in the TIMSS Advanced 2008 International Report.

It may be helpful to consider the TIMSS Advanced coverage index as a fraction, expressed as a percentage. The denominator of the fraction is the estimate of the size of the entire national population for the same age cohort as the students tested for TIMSS Advanced. For example, the students in Italy, Slovenia, and Sweden all were 19 years old, on average, whereas those in the Russian Federation were 17 years old. The four trend countries vary widely in terms of the overall size of their age cohorts (which depend on the size of their national populations). In the Russian Federation, the estimated size of the age group from which the TIMSS Advanced 2008 population was selected was greater than 1.5 million. At the opposite extreme, the size of the comparable age cohort in Slovenia was about 22,000, Italy’s age cohort was about 606,000, and Sweden’s about 126,000. The numerator of the fraction is the estimated size of the target population assessed by TIMSS Advanced derived from the TIMSS Advanced student sample. In Italy, the students were in the Liceo Scientifico (general schools with scientific focus), Liceo Scientifico Tecnologico (general schools with focus on technology), or Istituti Tecnici (vocational full-time training). In the Russian Federation, the students assessed by TIMSS Advanced were those who had 6 hours or more per week instruction in advanced mathematics, and were found in Lyceums, Gymnasiums, Special Schools for Mathematics and Physics, and some General Secondary Schools that had mathematics profiles. The Slovenian students were in the fourth year of the General Gymnasia. The Swedish students were in the natural science program and had taken the mathematics D course (the fourth in the mathematics progression), and may have taken the even more advanced optional E course.

In summary, the TIMSS Advanced Mathematics Coverage Index expresses the number of students enrolled in the advanced mathematics program or track assessed by TIMSS Advanced as a percentage of all students of the same age who could potentially have been in the advanced program or track (if they had all continued their schooling to the final year, wanted to be in the program, and had been accepted). The data show that the 2008 coverage index varies considerably, extending from a low of 1.4 percent in the Russian Federation, to about 12.8 percent in Sweden, to nearly 19.7 percent in Italy, and to 40.5 percent in Slovenia. It can be seen that the Russian Federation assessed a very elite population of students. Because all students in Russia study mathematics and physics every year in lower and upper secondary school, for the 1995 assessment the Russian Federation elected to assess the population that took the most mathematics, and then replicated that approach in 2008. At the other extreme, Solvenia has only two programs — vocational and general gymnasia — with only the latter offering the possibility of university admission.

The Italian coverage data shown in Figure 9 is about the same amount in 2008 as in 1995. In comparison, coverage dropped slightly in the Russian Federation (from 2.0 to 1.4 percent) and from 16.2 to 12.8 percent in Sweden. Coverage was considerably less in 2008 for Slovenia than it was in 1995, decreasing from 75.4 to 40.5 percent. Although Slovenia had a relatively high percentage of students taking advanced mathematics courses in 2008, this percentage represented a substantial drop from 1995.

In Italy, as well as in Slovenia and Sweden, average achievement in advanced mathematics declined significantly between the two assessments. Sweden showed the greatest average decline — almost 90 points. In the Russian Federation, average achievement in 2008
showed some signs of improvement but was not significantly different from that in 1995. Although data are available for only four countries, it can be noted that the pattern of overall declines is consistent with the pattern of overall declines across the TIMSS countries at eighth grade. Because of the many cultural and educational factors involved, such as shifts in population, curriculum, school organization, and even students’ attitudes, explaining changes in achievement over time is very difficult. A further complication may be that the reasons for declines at the upper secondary level can be found at earlier grades. For example, although the trends in mathematics achievement were relatively stable at the eighth grade in Italy and Slovenia, there was a decline in Sweden.

Figure 10 shows trends in the percentages of students who have taken advanced mathematics courses that reached the TIMSS Advanced 2008 International Benchmarks. In TIMSS 2008, students performing at the advanced benchmark demonstrated their understanding of concepts, mastery of procedures, and mathematical reasoning skills in algebra, trigonometry, geometry, and differential and integral calculus to solve problems in complex contexts. They were able to answer most of the questions in the assessment with a high degree of success. In the middle of the achievement continuum, those reaching the intermediate benchmark demonstrated knowledge of concepts and procedures in algebra, calculus, and geometry, but had some difficulty in solving a range of complex problems.

In Italy, the decline in achievement between 1995 and 2008 was concentrated primarily at the lower range of the achievement distribution. There were somewhat smaller percentages of students reaching the high and advanced levels, but significantly smaller percentages of students demonstrated a grasp of the concepts necessary to solve algebra, calculus, and geometry pro-
problems. This pattern of decline in achievement between 1995 and 2008 was nearly identical to that shown in Slovenia. As might be anticipated for the Russian Federation and Sweden, the trends at the benchmarks corresponded to the trends, on average. That is, the Russian Federation held steady across the achievement distribution showing slight upward, but statistically non-significant, changes at all three benchmarks. In Sweden, consistent with the substantial decline in average achievement, students evidenced declines across the achievement distribution. However, similar the results in Italy and Slovenia, the declines were more severe at the intermediate level, falling from 64 percent of the Swedish students reaching that level in 1995 to only 29 percent in 2008.

7. Summary

In general, Italy’s trends in mathematics and science achievement over time seem generally consistent with those of other TIMSS countries. The stable levels of average achievement at grade four in mathematics perhaps were not as positive as the more prevalent upward shift evidenced in many countries, but Italy’s upward trends in science achievement match the pattern across TIMSS countries. At the eighth grade, the stable levels in average achievement in mathematics are perhaps more positive than the more prevalent downward trends seen in many TIMSS countries, the stability in average science achievement corresponded to the pattern in many countries. Finally, compared with
the four countries with trend data in advanced mathematics for students in their final year of upper secondary, Italy’s decline was not unusual. Three of the four countries, also including Slovenia and Sweden as well as Italy, had decreased average achievement. In comparison, the Russian Federation showed little, if any, change. Interestingly, the three countries with declines in advanced mathematics had the most change at the intermediate rather than the high and advanced levels of the achievement distribution. That is, smaller percentages of students demonstrated knowledge of concepts and procedures in algebra, calculus, and geometry.

REFERENCES

