TIMSS & PISA INTERNATIONAL TESTING USING HIGH ABILITY MATHEMATICS SUB-SCORE DATA

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ECHA 2012 CONFERENCE

Munster, Germany

September 12 – 15, 2012

Presentation: Friday, September 14, 11:45 – 12:45

ADVANCED ACHIEVEMENT FACTORS - MATHEMATICS

- **Number of Tests – TIMSS, PISA (**Some Only PISA)
- **Years of Participation in Testing**
- **Country Comparisons – Europe 50 – EU 27**
- **CONTENT Domain - Number, Algebra, Geometry, Data**
- **COGNITIVE Domain: Knowing, Applying, Reasoning**
- **Grade 4, Grade 8, Age 15 (Application)**
- **Gender, 90+ Percentile, Advanced Benchmarks**
- **Levels of Proficiency (1 – 6)**
- **Trends over Multiple Years of Testing**

- **RANK 1-20**

	TIMSS 4 2007	TIMSS 8 2007	PISA 15 2009
MATH Mean Range	500- 607	474- 598	501-600

TIMSS/07 Trends in International TM4-8 TS4-8 Math & Science Study

- 1995 1999 2003 **2007** 2011 (Pub. Feb. 2013)
- 2007 – 58 Countries
- Grades 4 & 8 (Age Variable)
- 150+ Schools
- 4,000 – 4,500 Students
- MATH & SCIENCE
- 90+% Percentile Score
- International Benchmarks % Advanced (625) High (550)
- IEA Intl. Assn. for Evaluation of Educational Achievement

- Multiple Choice 50-54%
- Constructed Response 46-50%
- CONTENT & COGNITIVE Domains
- Grade 8 – Math (Includes Algebra)
- GENDER Comparison
- Race/Ethnicity
  Asian, White, Hispanic, Black
- School POVERTY Level
  Related to Achievement
- TRENDS (Cohort 2007 Gr. 4, 2011 Gr. 8)
- TIMSS & PIRLS International Study Center
  Lynch School of Educ. Boston College

http://timss.bc.edu/TIMSS2007/intl_reports.html

PISA

Program for International Student Assessment

2000 Reading **2009**

2003 **Math** **2012**

2006 Science 2015

2009 – 65 Countries/ Jurisdictions

34 OECD & 31 Non-OECD Groups

OECD - Organization for Economic Cooperation & Development

- **15 Year-Olds**
- http://www.pisa.oecd.org

- Functional Skills At **End** of Mandatory Schooling
- **APPLICATION** of Capabilities to problems with real-life context.
- Scores: Combined & **SUB-SCALES**
- **90th** Percentile Scores
- **PROFICIENCY LEVELS** 1 – 6
- **GENDER** Differences
- Race/Ethnicity
- **PISA "Effect"** Indirect but Influential Tool of Education

COMPARING TIMSS & PISA

Results not always consistent. (Wu, 2009)
Identify factors contributing to discrepancies in results.
Differing Aims & Difference in Survey Designs.
PREDICTORS: Years of Schooling & Content Balance of 2 Tests
2 Factors = 93% of Variation
Two Rankings can be reconciled to reasonable degree of accuracy.

TIMSS 4 & TIMSS 8

- Aim to improve teaching and learning of mathematics
- Provide data about achievement in relation to different types of curricula, instructional practices, school environments.
- **GRADE-BASED** – better aligned in years of schooling.
- Different ages due to when students started school.
- **MATH CONTENT** close to school

PISA – Age 15

- Aim to assess how well 15-year-olds are prepared for life's challenges. – More application.
- Ability to use knowledge and skills to meet real-life challenges rather than specific school curriculum.
- **AGE-BASED** – similar in age
- Can be in different grades due to when students started school.
- **CONTENT BALANCE** differs from TIMSS (particularly Algebra, Data

Interpreting International Comparisons Some Essential "Cautions" (Koretz, 2009)

- Comparisons with a "slippery international average" are nearly meaningless.
- Compare with performance of other countries that provide an informative contrast.
- International assessments measure very broad domains of achievement using a relatively small number of test items to estimate mastery of domain.
- Rankings could be modified by changing emphasis on content.
- Inconsistencies Do Exist -
  No reason to put international comparisons aside.
  Be careful in interpreting results.
- Ignore small differences even when they are statistically significant.
- Finding in more than one assessment - more confidence result is not due to test.
- Performance of students at end of high school is difficult to compare - portion of cohort leaving school early varies.

RECOMMENDATIONS (Wu 2009)
In Comparing TIMSS and PISA

- Look beyond simple **ranks** of countries.
- Examine performances by **sub-domains** in context of population being tested.
- Realize how test **content** & population definition have significant impact on results.
- Trends over **test cycles** - Check whether **curriculum contents** have shifted.
- If **math topic** is not **emphasized** in curriculum, not likely students will perform as well as if emphasized.
- Test that is inclusive of wide range of **content domains** and items is more likely to product stable and reliable results.
- **Matrix sampling** design of items in PISA & TIMSS allows inclusion of items from **different content domains**.
- Student achievements closely related to **what students are actually taught**.
- Students with **more years of schooling** do better.
- Designers need to pay close attention to **sub-content weights and population** definition.
- Test results can be useful and relevant in review of **curriculum and pedagogy**

CONTENT DOMAINS
MATH Sub-Score Data

	TIMSS4	TIMSS8
NUMBER	50%	30%
ALGEBRA		30%
GEOMETRY/MEAS.	35%	20%
DATA/PROB.	15%	20%

- **CONTENT DOMAIN %** on test items can be a resource to **BALANCE** distribution in Standards.

PISA (Wu 2009)

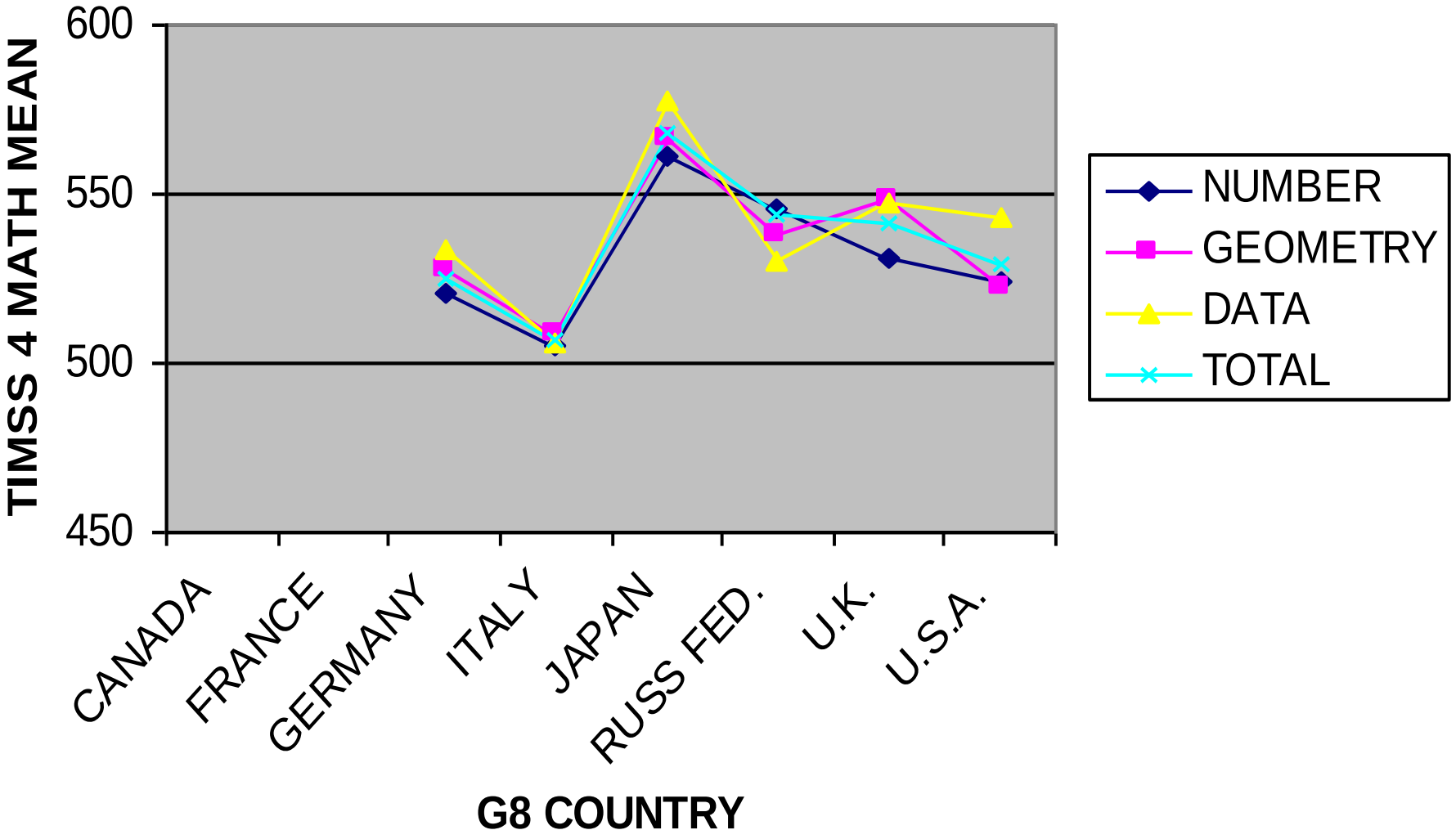
Number	38%	
Algebra	8%	(Lower)
Measurement	9%	
Geometry	14%	
Data	31%	(Higher)

- **CONTENT BALANCE %** outlined in a Country's Curriculum Standards in Grades 4 and 8 may not correlate with **% of Content used in test items.**

TIMSS Gr. 4 - 2007 - G-8 COUNTRIES
MATH CONTENT AREA SUB-SCORES

G8 COUNTRY Pop. Million Age 5-19 2008		NUMBER 50%	GEOM/MEAS. 35%	DATA 15%	TOTAL	Rank
Canada	6.8					
France	11.8					
Germany	12.5	521	528	534	525	12
Italy	8.2	505	509	506	507	16
Japan	18.2	561	566	578	568	4
Russ. Fed.	22.7	546	538	530	544	6
U.K.	11.1	531	548	547	541	7
U.S.A.	61.9	524	522	543	529	11

TIMSS GR. 4 MATH CONTENT SUBSCORES

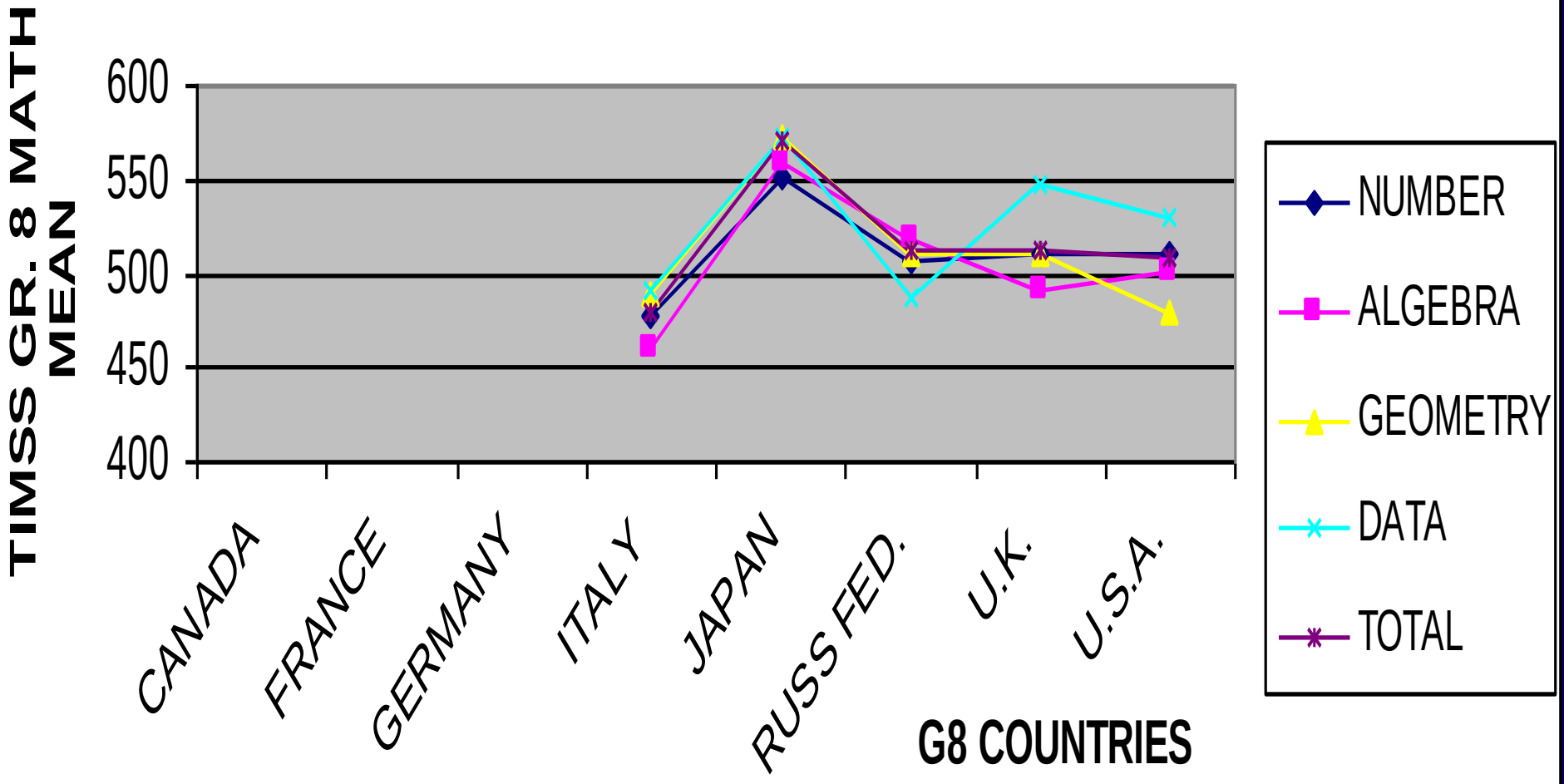


Note: Content variance in Russian Fed., U.K. and U.S.

TIMSS Gr. 8 - 2007 – G-8 COUNTRIES
MATH CONTENT AREA SUB-SCORES

	NUMBER 38%	ALGEBRA 8%	GEOM/Meas 23%	DATA 31%	TOTAL (Rank)
Canada					
France					
Germany					
Italy	478	**460**	**490**	**491**	**480** **(19)**
Japan	**551**	559	**573**	**573**	**570** **(5)**
Russ. Fed.	507	**518**	510	**487**	512 **(8)**
U.K.	510	**492**	510	**547**	513 **(7)**
U.S.A.	510	501	**480**	**531**	508 **(9)**

G8 TIMSS GR. 8 MATH CONTENT SUBSCORES

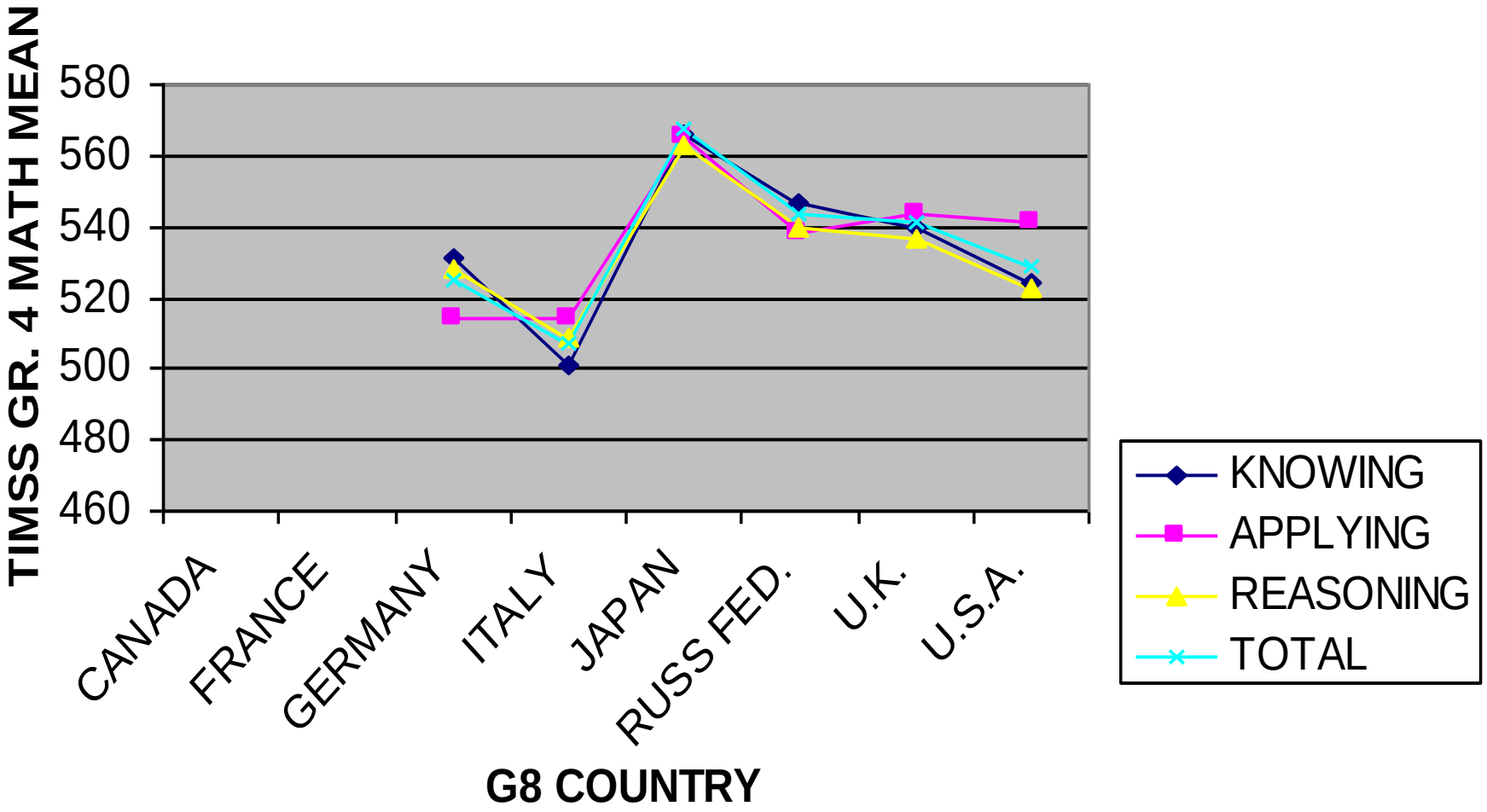


Note: Variance in U.K. (Data) and U.S. (Data, Geometry)

TIMSS Gr.4 - 2007 – G-8 COUNTRIES
MATH COGNITIVE AREA SUB-SCORES

G8 COUNTRY	KNOWING	APPLYING	REASONING	TOTAL	RANK
Canada					
France					
Germany	531	514	528	525	12
Italy	501	514	509	507	16
Japan	566	565	563	568	4
Russ. Fed.	547	538	540	544	6
U.K.	540	544	537	541	7
U.S.A.	524	541	523	529	11

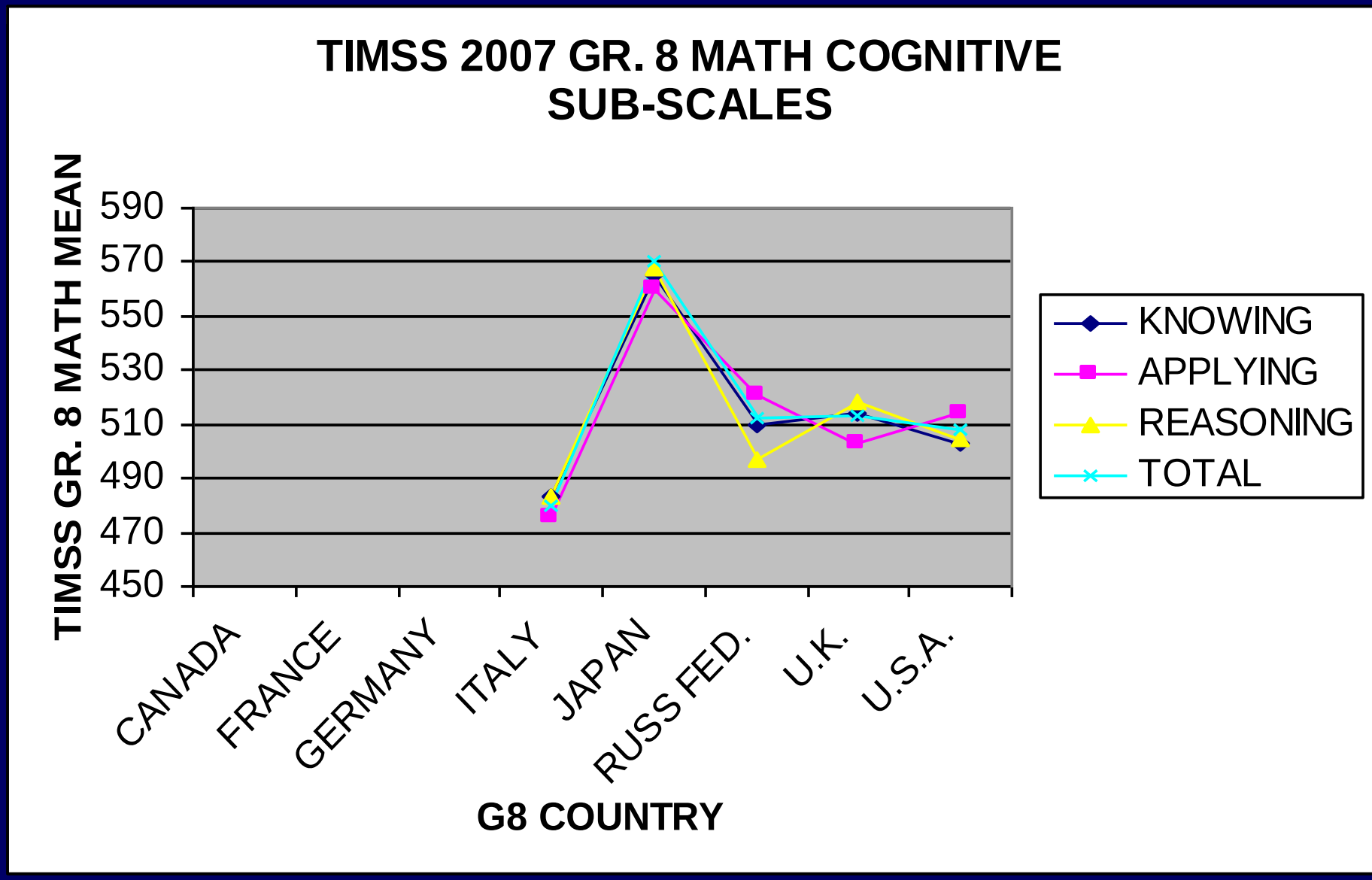
TIMSS 2007 GR. 4 MATH COGNITIVE SUB-SCALES



Note: Variance in Applying: Germany, U.K., U.S.

TIMSS Gr. 8 - 2007 – G-8 COUNTRIES
MATH COGNITIVE AREA SUB-SCORES

G8 COUNTRY	KNOWING	APPLYING	REASONING	TOTAL	RANK
Canada					
France					
Germany					
Italy	483	476	483	480	19
Japan	565	560	568	570	5
Russ. Fed.	510	521	497	512	8
U.K.	514	503	518	513	7
U.S.A.	503	514	505	508	9

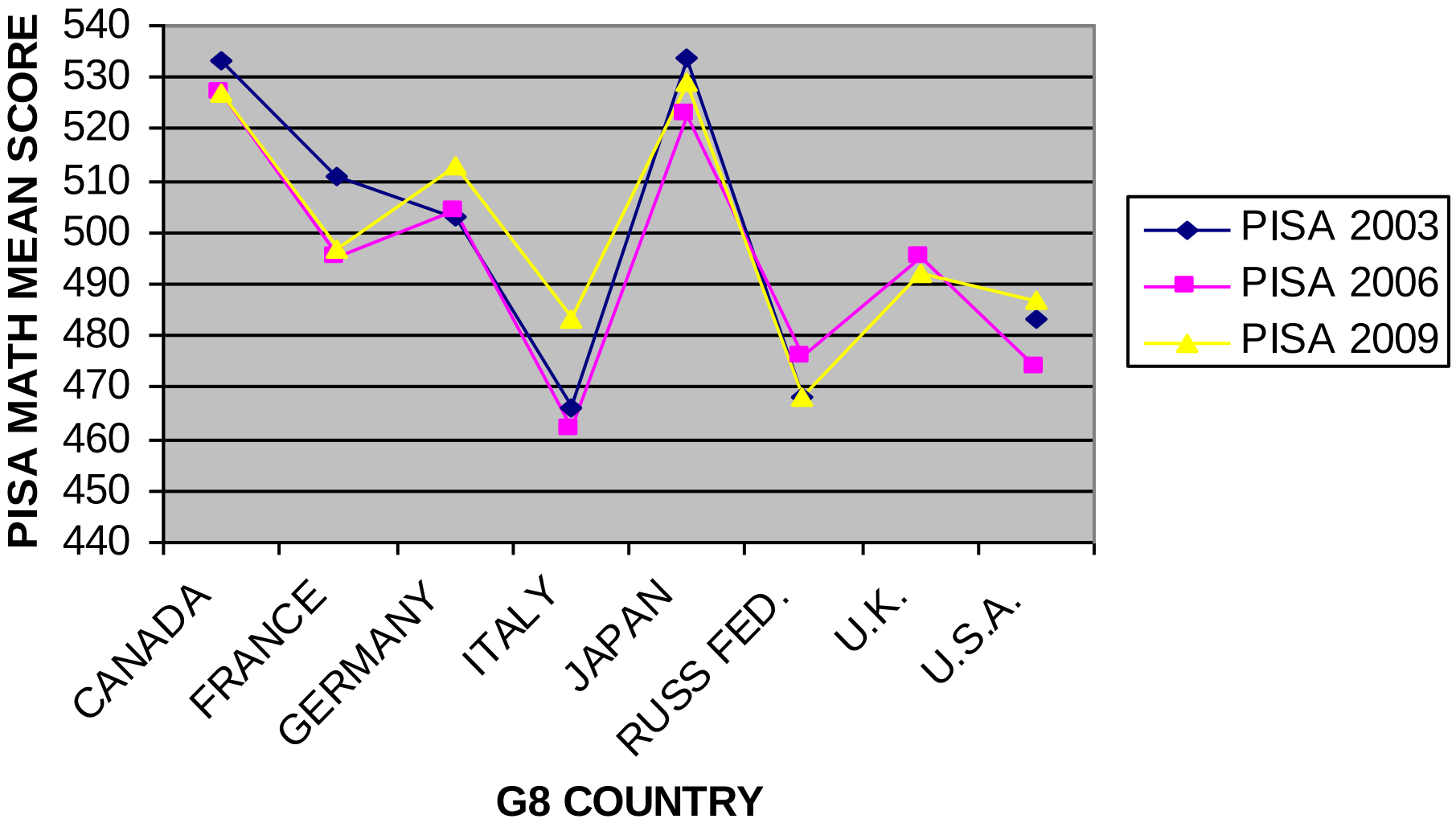


Variance in Applying & Reasoning: Russian Fed., U.K., U.S.

PISA – MATH – 3 TEST Sample G8 COUNTRY COMPARISON

G8 Country	2003	Rank	2006	Rank	2009	Rank
Canada	533	7	527	7	527	10
France	511	16	495	23	497	22
Germany	503	19	504	19	513	16
Italy	466	30	462	36	483	34
Japan	534	6	523	10	529	9
Russ. Fed.	468	29	476	33	468	38
U.K.	-	-	495	23	492	28
U.S.A.	483	27	474	35	487	31

PISA MATH TREND - 3 TEST CYCLES

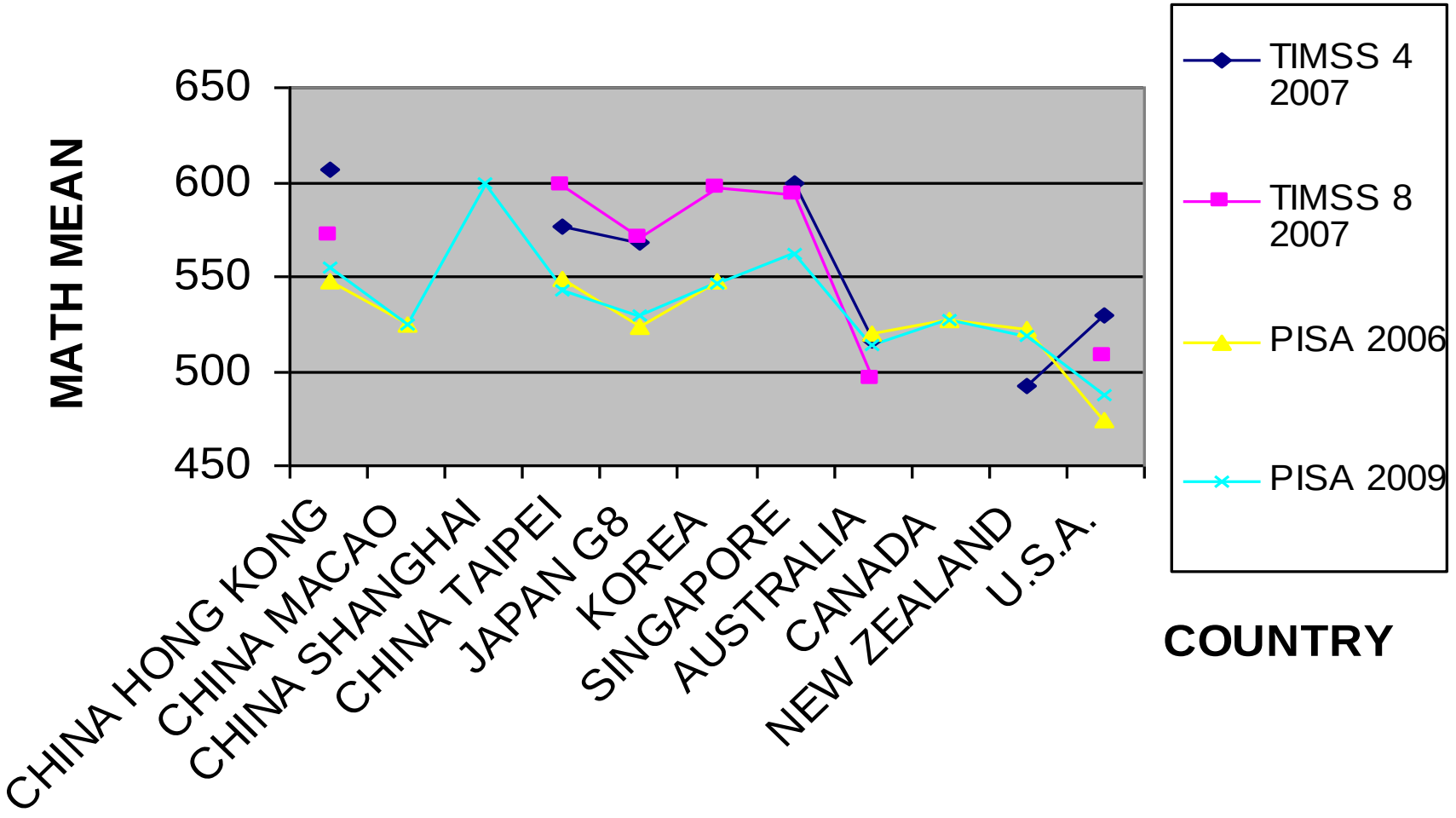


Higher Mean 2009 = 5 Lower Rank 2009 = 7

NON-EUROPE SAMPLE

ASIA * OECD	TM4 2007	RK	TM8 2007	RK	PISA 15 2006	RK	PISA 15 2009	RK	TM4 90% 2007	TM8 90% 2007	PISA 90% 2006	PISA 90% 2009	TM4 625 2007	TM8 625 2007
China Hong Kong	607	1	572	4	547	3	555	3	691	681	665	673	40%	31%
China Macao					525	8	525	12			632	634		
China Shanghai							600	1				726		
China Taipei	576	3	598	1	549	1	543	5	663	721	677	675	24%	45%
JAPAN G8 *	568	4	570	5	523	10	529	9	663	677	638	648	23%	26%
Korea, Rep.*			597	2	547	3	546	4		711	664	659		40%
Singapore	599	2	593	3			562	2	702	706		693	41%	40%
ADDITIONAL														
Australia	516	14	496	14	520	12	514	15	620	600	633	634	9%	6%
Canada					527	7	527	10			635	638		
New Zealand	492	23			522	11	519	13	598		643	642	5%	
U.S.A.	529	11	508	9	474	35	487	31	625	607	593	607	10%	6%

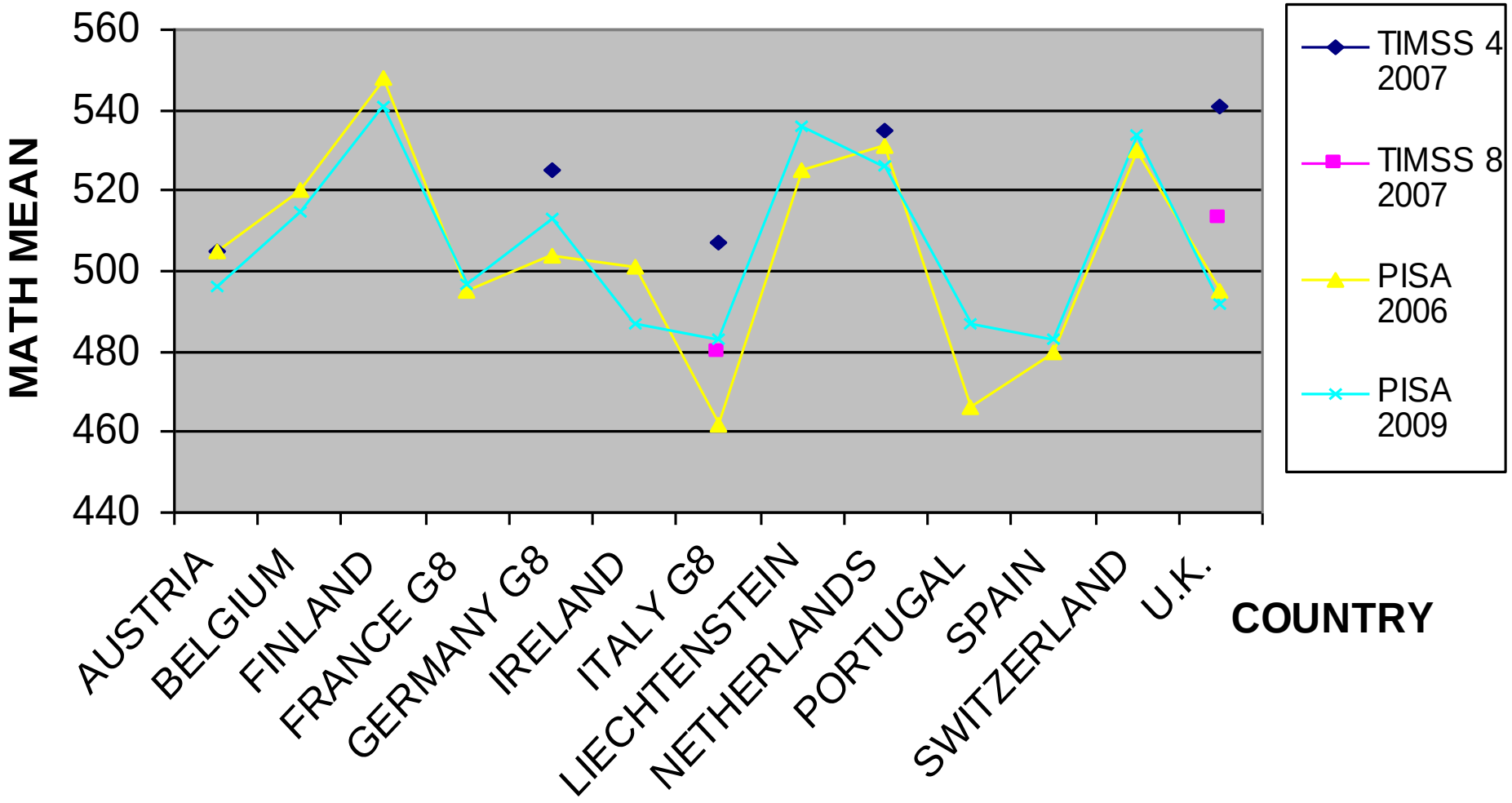
HIGH RANKING MATH - NON-EUROPE



WESTERN EUROPE SAMPLE

W. EUROPE OECD = All	TM4 2007	RK	TM8 2007	RK	PISA 15 2006	RK	PISA 15 2009	RK	TM4 90% 2007	TM8 90% 2007	PISA 90% 2006	PISA 90% 2009	TM4 625 2007	TM8 625 2007
Austria	505	17			505	18	496	24	590		630	620	3%	
Belgium					520	12	515	14			650	646		
Finland					548	2	541	6			652	644		
France G8					495	23	497	22			617	622		
Germany G8	525	12			504	19	513	16	607		632	638	6%	
Ireland					501	22	487	31			608	591		
Italy G8	507	16	480	19	462	36	483	34	601	574	584	602	6%	3%
Liechtenstein					525	8	536	7			643	637		
Netherlands	535	9			531	5	526	11	612		645	640	7%	
Portugal					466	37	487	31			611	605		
Spain					480	32	483	34			593	597		
Switzerland					530	6	534	8			652	658		
United Kingdom	541	7	513	7	495	23	492	28	647	618	612	606	16%	8%

WESTERN EUROPE MATH TRENDS

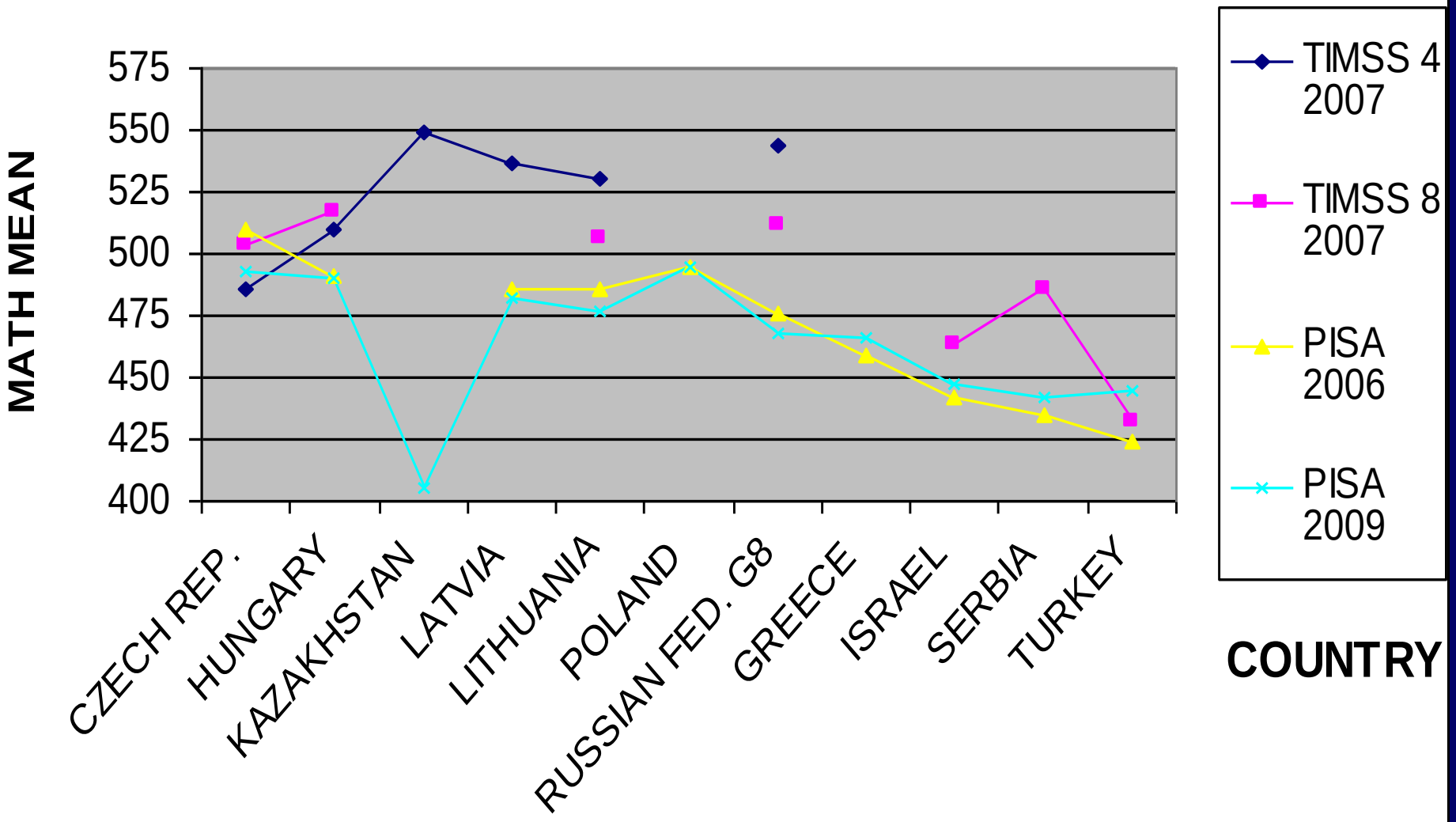


HIGHEST: Finland, Liechtenstein, Netherlands, Switzerland

EASTERN EUROPE SAMPLE

E. EUROPE * OECD	TM4 2007	RK	TM8 2007	RK	PISA 15 2006	RK	PISA 15 2009	RK	TM4 90% 2007	TM8 90% 2007	PISA 90% 2006	PISA 90% 2009	TM4 625 2007	TM8 625 2007
Czech Rep. *	486	24	504	11	510	16	493	27	578	599	644	615	2%	6%
Hungary *	510	15	517	6	491	27	490	29	620	624	609	608	9%	10%
Kazakhstan	549	5					405	53	653			514	19%	
Latvia	537	8			486	30	482	36	628		590	584	11%	
Lithuania	530	10	506	10	486	30	477	37	624	609	602	590	10%	6%
Poland					495	23	495	25			610	609		
Russian Fed. G8	544	6	512	8	476	33	468	38	647	617	592	576	16%	8%
ADDITIONAL														
Greece					459	39	466	39			575	580		
Israel			463	24	442	40	447	42		584	581	581		4
Serbia			486	18	435	41	442	43		587	553	560		5
Turkey			432	31	424	43	445	43		581	550	574		5

EAST EUROPE MATH TRENDS

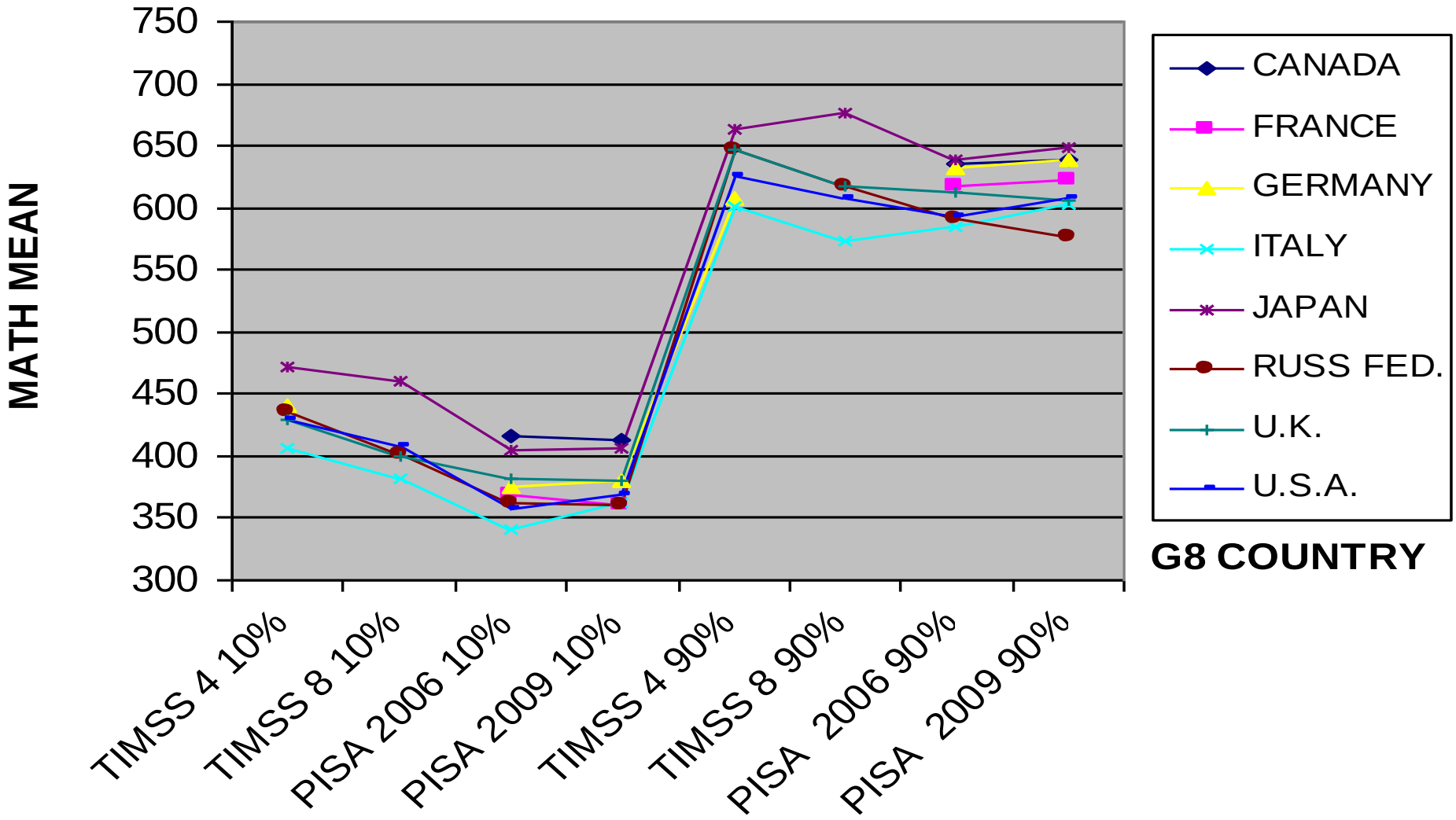


TIMSS HIGHER THAN PISA – PISA 2009 Most Complete

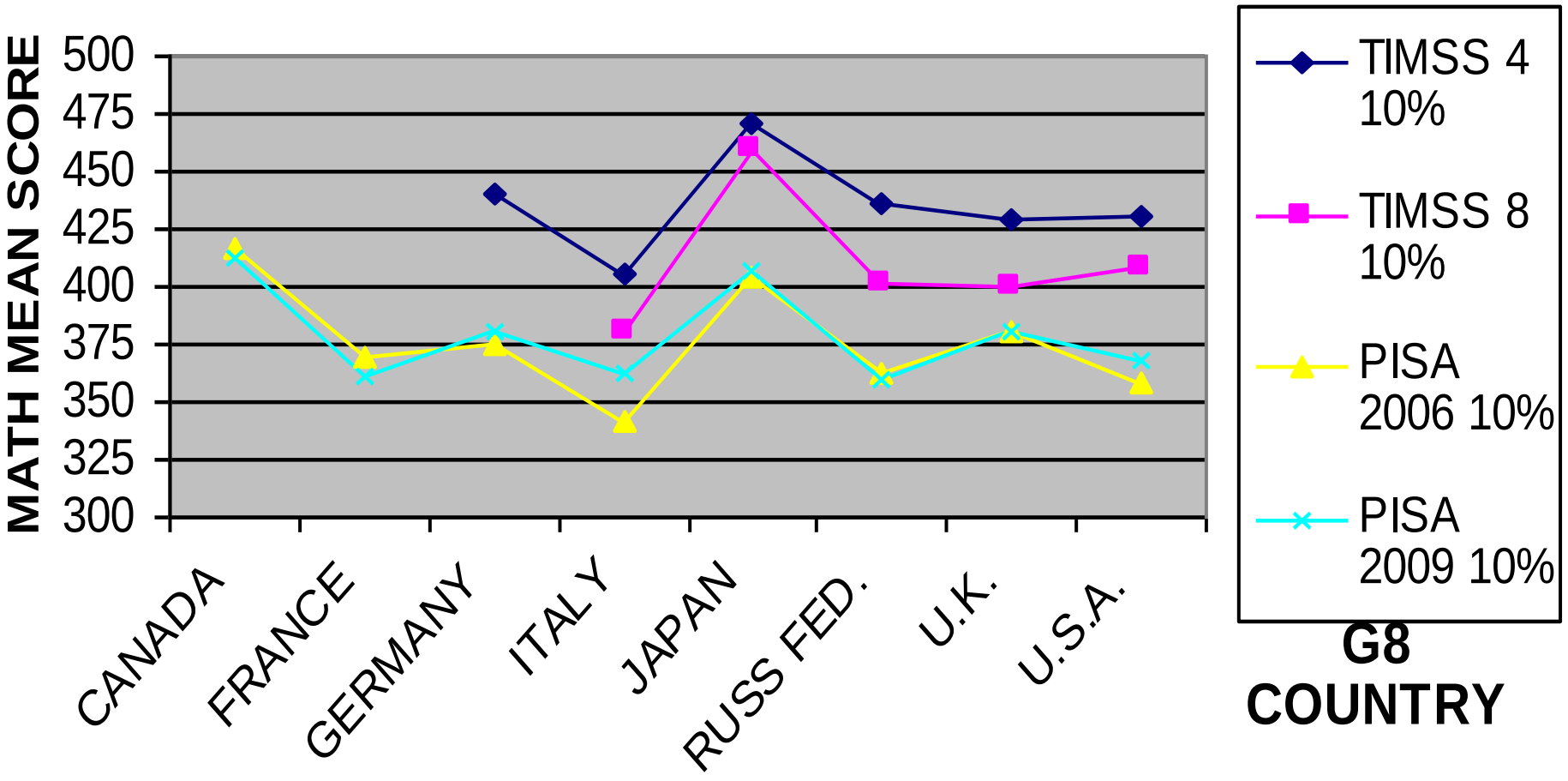
TIMSS 2007 – PISA 2006
10th & 90th PERCENTILES

G8 COUNTRY	TIMSS 2007 4 10 %	TIMSS 2007 8 10 %	PISA 2006 10 %	PISA 2009 10 %	TIMSS 2007 4 90 %	TIMSS 2007 8 90 %	PISA 2006 90 %	PISA 2009 90 %
Canada			416	413			635	638
France			369	361			617	622
Germany	440		375	380	607		632	638
Italy	406	381	341	363	601	574	584	602
Japan	471	460	404	407	663	677	638	648
Russ. Fed.	436	402	363	360	647	617	592	576
U.K.	429	400	381	380	647	618	612	606
U.S.A.	430	408	358	368	625	607	593	607

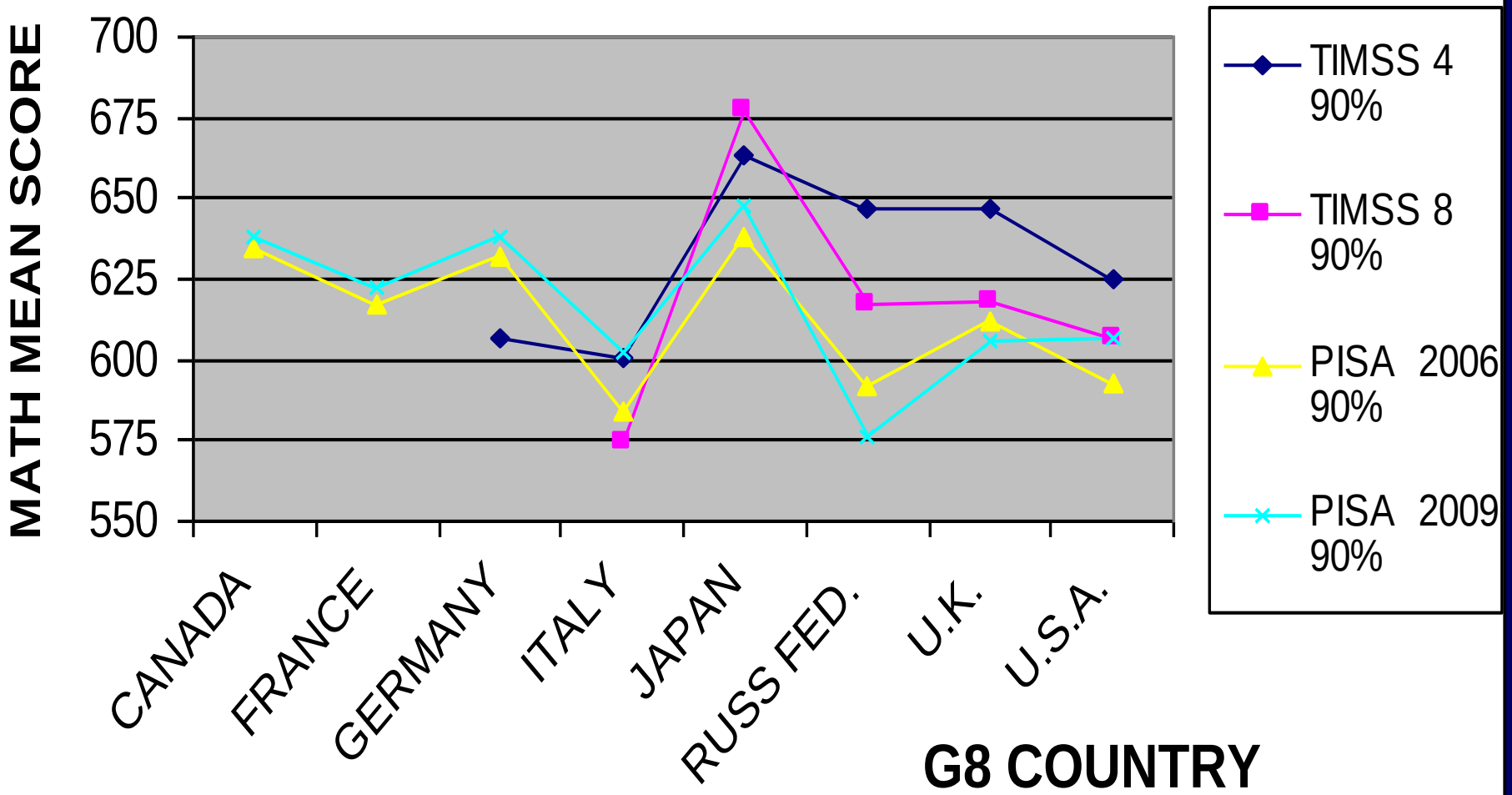
TIMSS 2007 - PISA 2006, 2009 - 10TH & 90TH PERCENTILES



TIMSS 2007 - PISA 2006, 2009
10TH PERCENTILE - G8 Countries



TIMSS 2007 - PISA 2006, 2009
90TH PERCENTILE - G8



90TH PERCENTILE - PISA MATH 2009
90% = Significant G/T Policy Evidence

ASIA – NON-EUROPE

- **CHINA-SHANGHAI 726**
- **SINGAPORE 693**
- **JAPAN 648**
- **U.S. 607**

WESTERN EUROPE

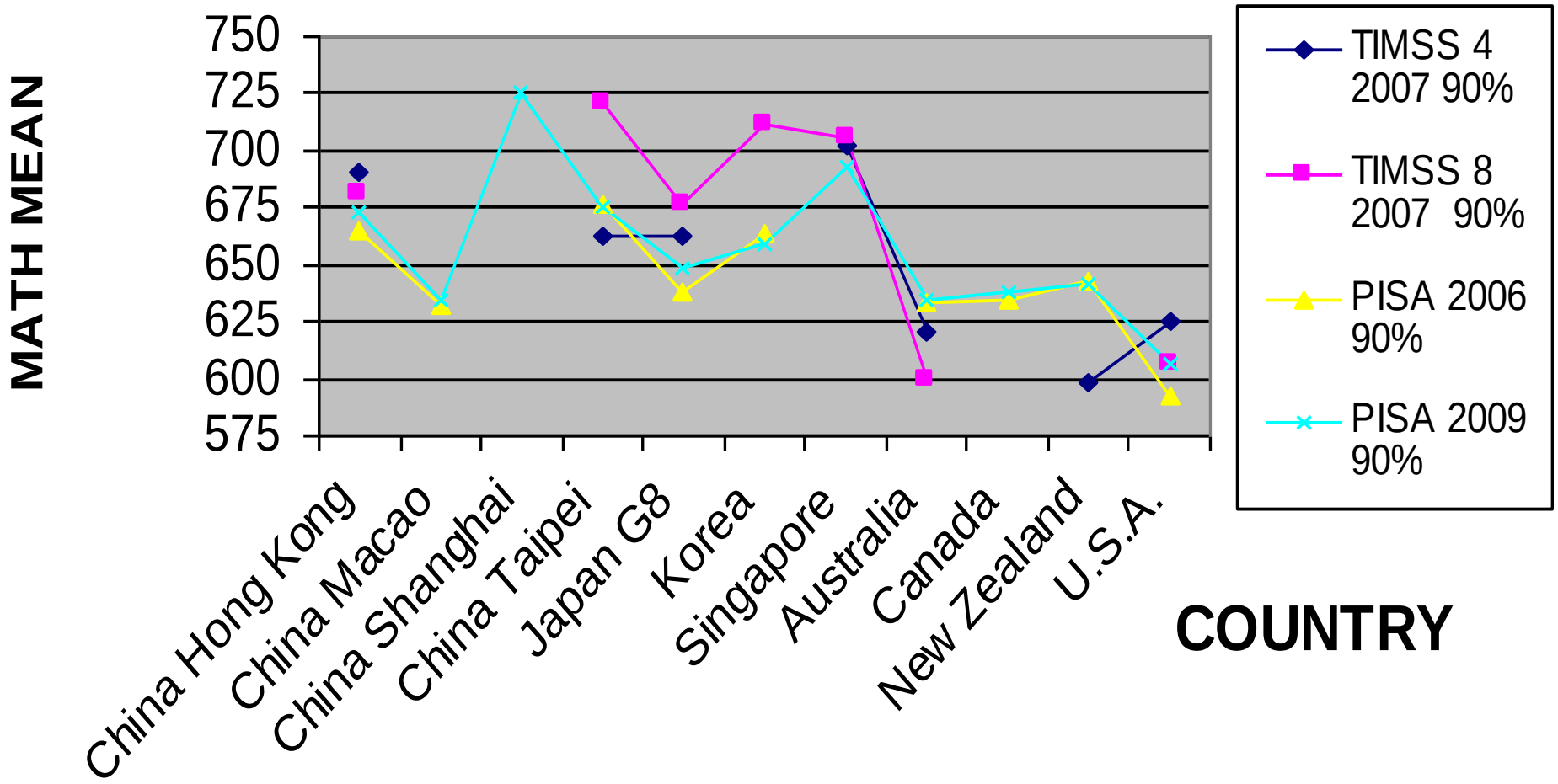
- **SWITZERLAND 658**
- **BELGIUM 646**
- **FINLAND 644**
- **U.K. 606**

EASTERN EUROPE

- **CZECH REP. 615**
- **POLAND 609**

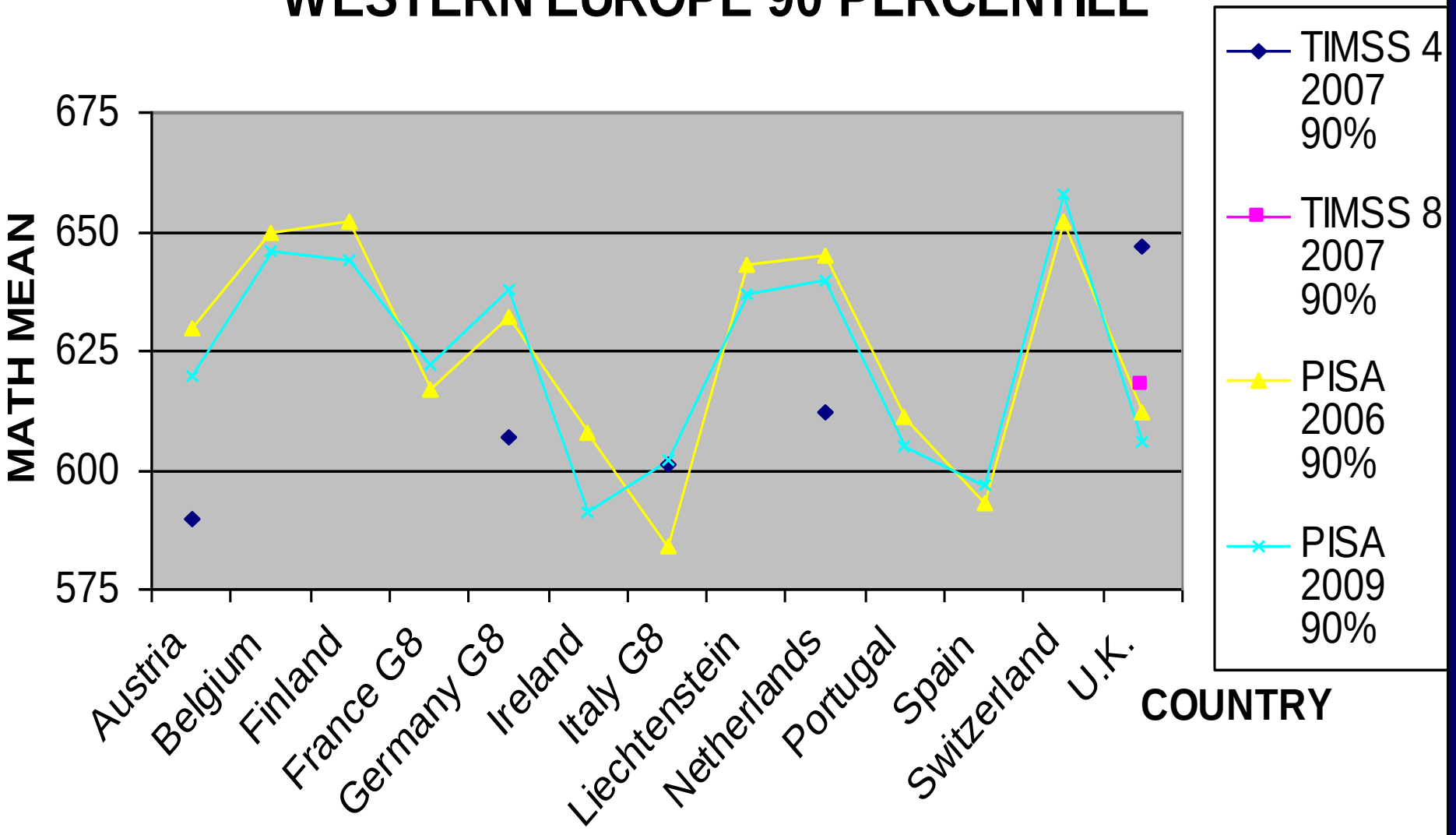
- 90% Score can be used as DATA to support G/T Programming and Advanced MATH Curriculum.
- Increase in 90% MATH Score can be a strong factor in raising the mean score for the country.
- 90% MATH Score comparisons can be used as support for policy for Advanced MATH and CONTENT BALANCE in curriculum development.

NON-EUROPE MATH 90 PERCENTILE



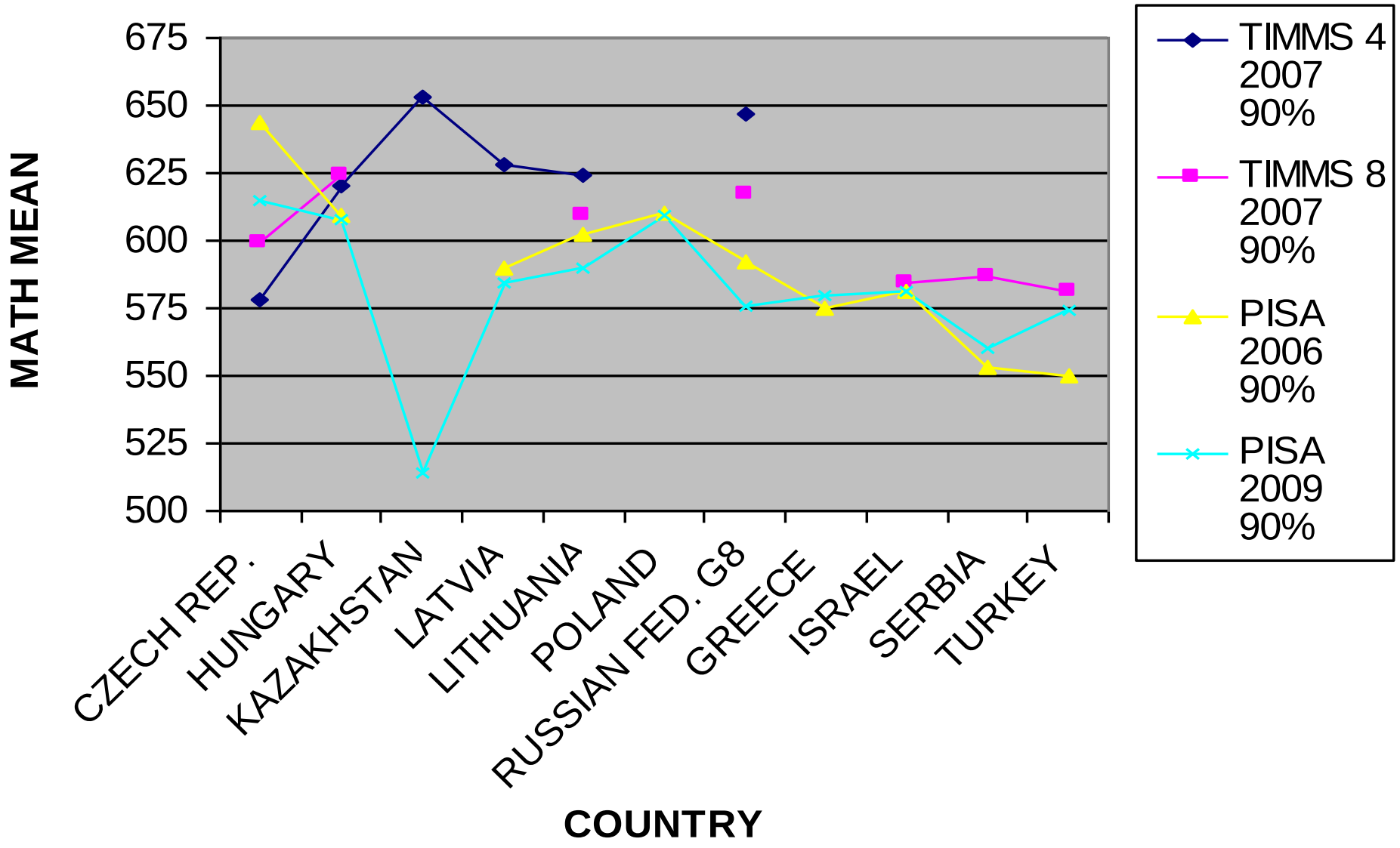
NOTE: Higher East Asia Scores – China Shanghai Highest

WESTERN EUROPE 90 PERCENTILE



HIGHEST: Finland, Switzerland, Belgium, Netherlands, Liechtenstein

EAST EUROPE MATH 90 PERCENTILE



MOST COMPLETE: **Czech Rep., Hungary, Lithuania, Russian Rep.**

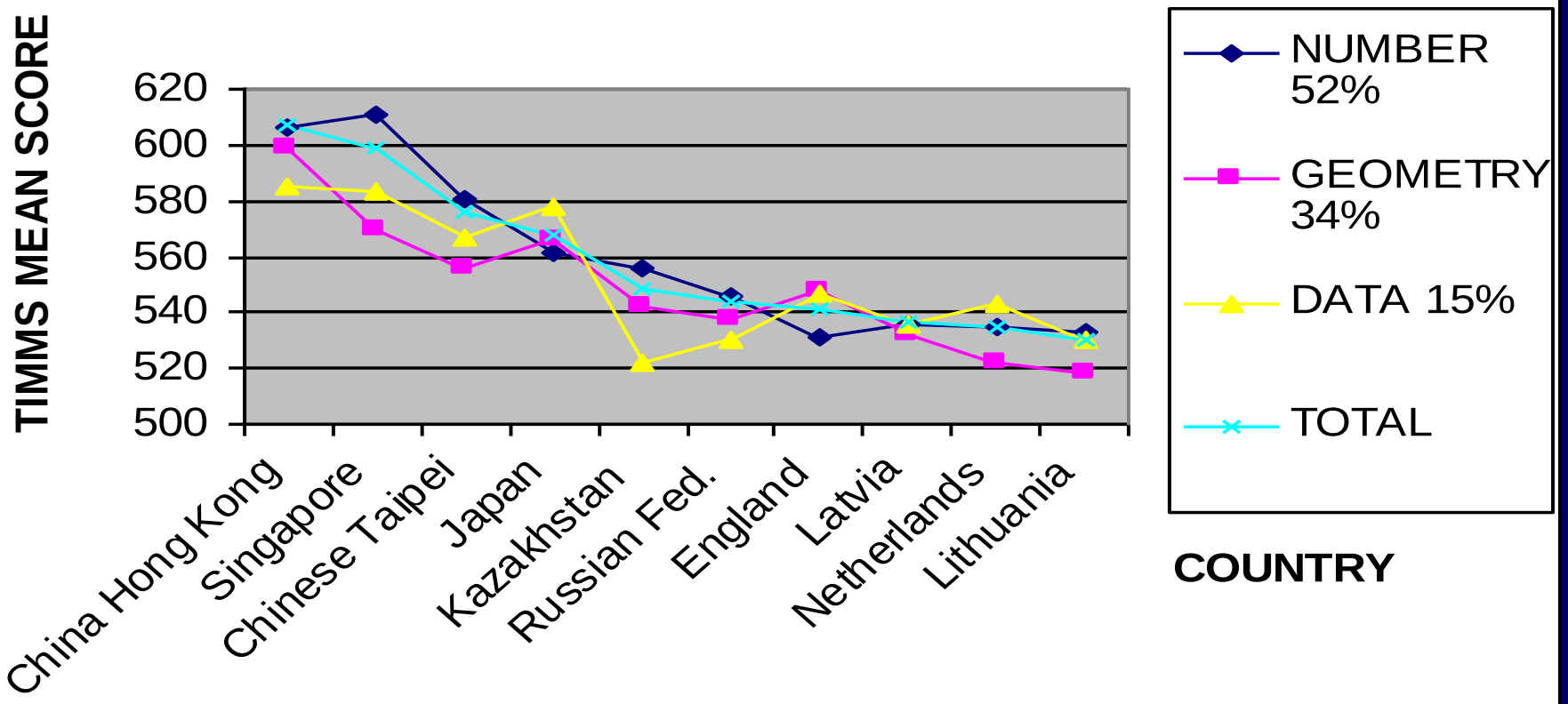
TIMSS MATH – Grade 4 - Rank 1-10

90% Highest Singapore (702) China Hong Kong (691)
Highest Sub-Score: Number (7/10), Geometry (1/10), Data (3/10)
Lowest Sub-Score: Number (2/10), Geometry (5/10), Data (3/10)
Number: (Range 533 - 611) +78 Highest Low & High Score
Geometry: (Range 518 - 599) +81 Lowest Score- Higher Variance
Data: (Range 522 - 585) +63 Mid-Range Distribution
COG DOM Highest Sub-Score: Know 5/10, Apply 5/10, Reasoning 0/10

Rank	COUNTRY	TOT	90 %	NUMB 52%	GEOM 34%	DATA 15%	KNOW 39%	APPLY 41%	REAS 21%
1	China Hong Kong	607	691	606	599	585	599	617	589
2	Singapore	599	702	611	570	583	590	620	578
3	Chinese Taipei	576	663	581	556	567	569	534	566
4	JAPAN G8	568	663	561	566	578	566	565	563
5	Kazakhstan	549	653	556	542	522	547	559	539
6	RUSSIAN Fed G8	544	647	546	538	530	547	538	540
7	ENGLAND G8	541	647	531	548	547	540	544	537
8	Latvia	537	628	536	532	536	540	530	537
9	Netherlands	535	612	535	522	543	540	525	534
10	Lithuania	530	624	533	518	530	539	520	526

Highest Sub-Score: Number (7/10), Geometry (1/10), Data (3/10)
Lowest Sub-Score: Number (2/10), Geometry (5/10), Data (3/10)
Number: (Range 533 - 611) +78 Highest Low & High Score
Geometry: (Range 518 - 599) +81 Lowest Score- Higher Variance
Data: (Range 522 - 585) +63 Mid-Range Distribution

TIMSS GR. 4 - MATH RANK 1-10
CONTENT SUB-SCORES



TIMSS MATH – Grade 8

Rank 1-10

90% 700+: Chinese Taipei, Korea, Singapore

Highest Sub-Score: Number (1/10), Algebra & Geo. (2/10), Data (5/10)

Number: (Range 506 - 597) + 91 Highest Low Score, Lowest Range

Algebra: (Range 483 - 617) +134 Greatest Range – (Significant)

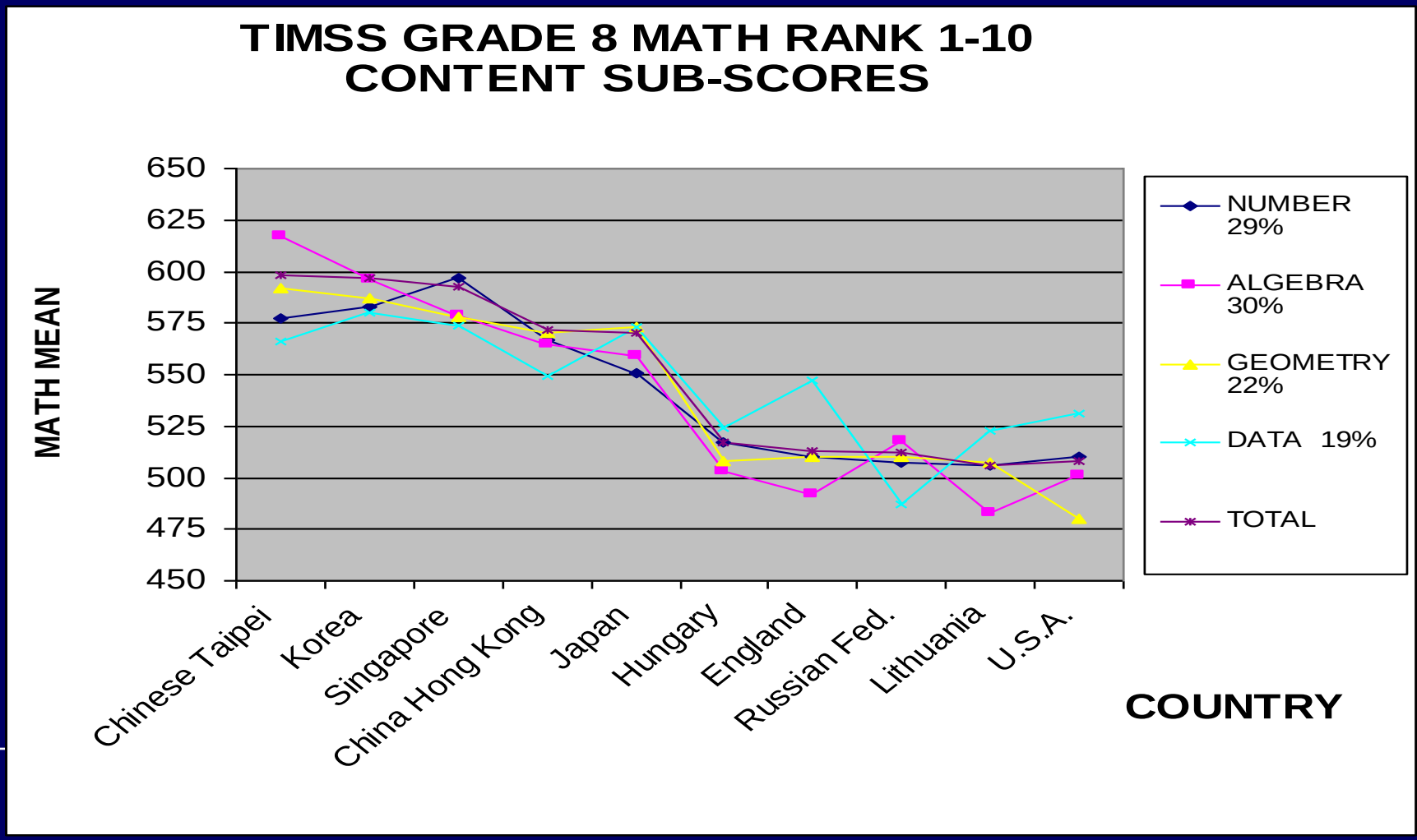
Geometry: (Range 480 - 592) +112 Greater Range

Data: (Range 487 - 580) + 93 Mid-Range

COG DOM: (Range 486- 596) +110 KNOW 2/10, APPLY 6/10, REAS 2/10

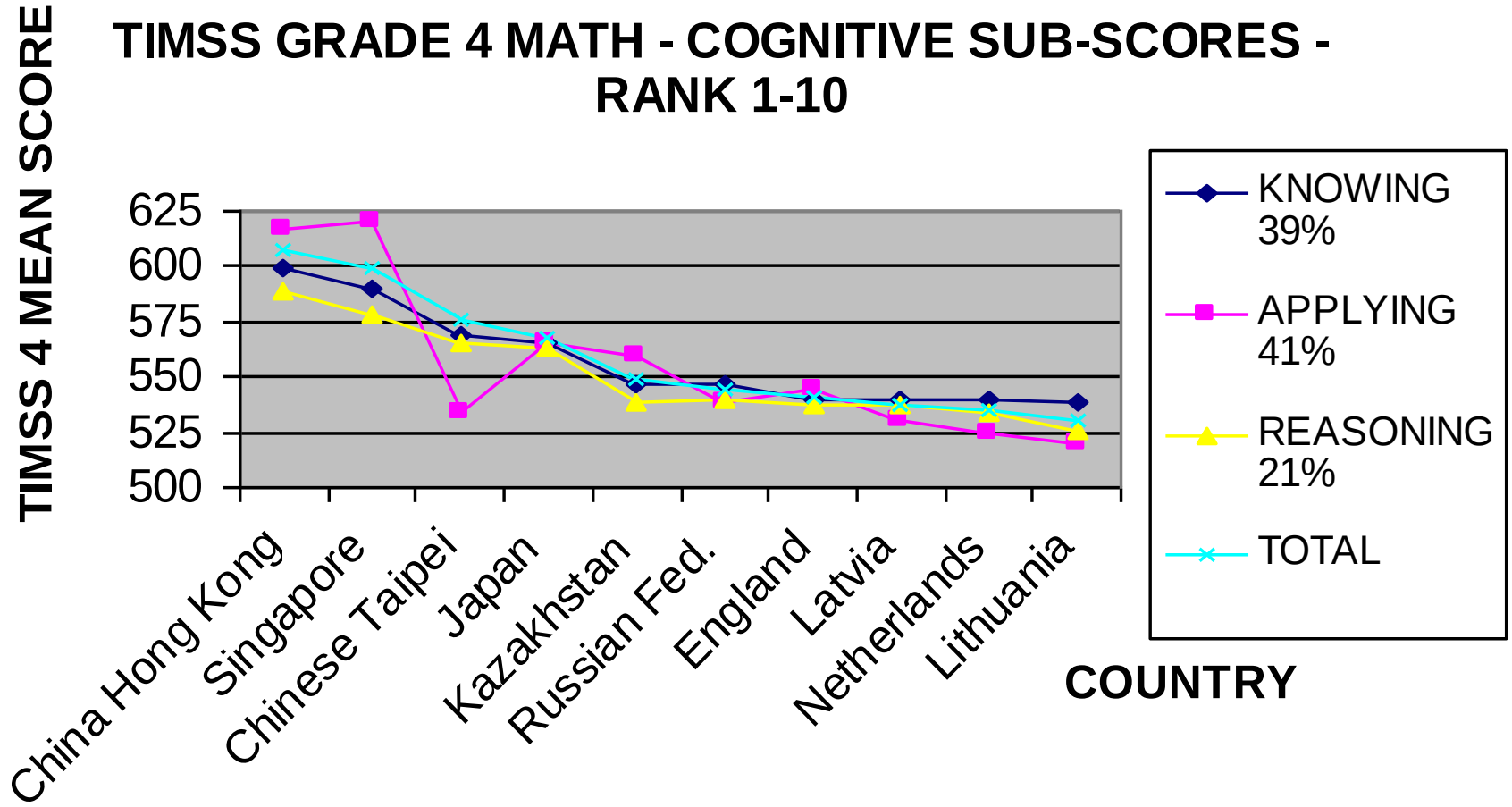
Rank	COUNTRY	TOT	90%	NUM 29%	ALG 30%	GEO 22%	DATA 19%	KNOW 39%	APPLY 41%	REAS 21%
1	Chinese Taipei	598	721	577	617	592	566	592	594	591
2	Korea, Rep.	597	711	583	596	587	580	595	596	579
3	Singapore	593	706	597	579	578	574	593	581	579
4	China Hong Kong	572	681	567	565	570	549	569	574	557
5	Japan	570	677	551	559	573	573	565	560	568
6	Hungary	517	624	517	503	508	524	513	518	513
7	England	513	618	510	492	510	547	514	503	518
8	Russian Fed.	512	617	507	518	510	487	510	521	497
9	Lithuania	506	609	506	483	507	523	511	508	486
10	U.S.A.	508	607	510	501	480	531	503	514	505

Highest Sub-Score: Number (1/10), Algebra & Geo. (2/10), Data (5/10)
Number: (Range 506 - 597) + 91 Highest Low Score, Lowest Range
Algebra: (Range 483 - 617) +134 Greatest Range – (Significant)
Geometry: (Range 480 - 592) +112 Greater Range
Data: (Range 487 - 580) + 93 Mid-Range



Highest Sub-Score: **COGNITIVE DOMAIN**

Knowing	5/10	
Applying	5/10	
Reasoning	0/10	Low

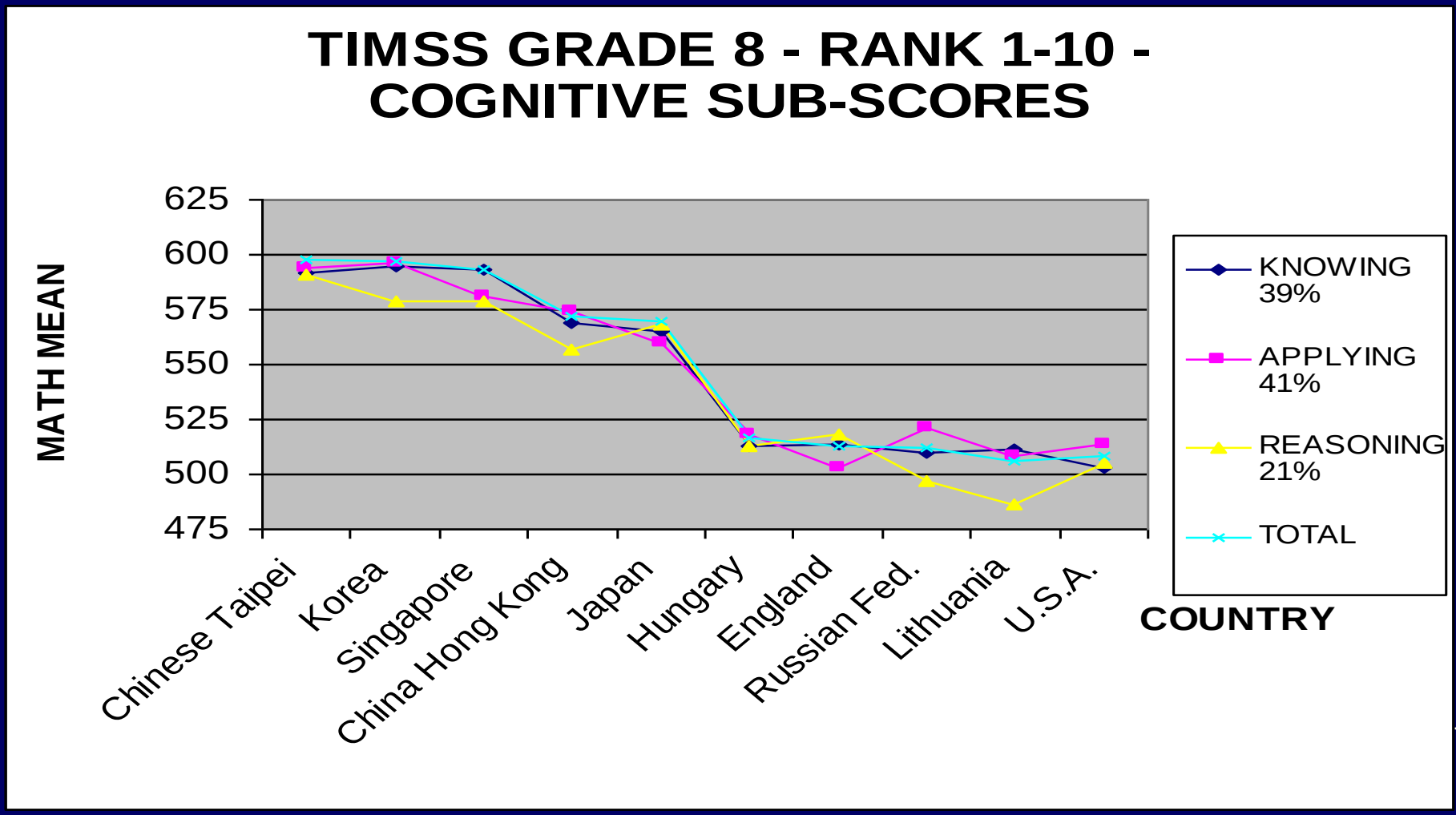


COGNITIVE DOMAIN (Range 486- 596) +110

KNOWING 2/10

APPLYING 6/10 High

REASONING 2/10



TIMSS INTERNATIONAL BENCHMARKS

MATH 4

NUMBER, GEOMETRY, DATA

- LOW (400) **"DEMONSTRATE"**
- INTERMEDIATE (475) **"EXTEND"**
- **HIGH (550)** **"SOLVE, INTERPRET, USE"**

APPLY knowledge and understanding to solve problems.

- **ADVANCED (625)** **"ORGANIZE"**

APPLY understanding & knowledge in variety of relatively complex situations & explain reasoning.

MATH 8

NUMBER, ALGEBRA, GEOMETRY, DATA

- LOW (400) **" SOME KNOWLEDGE"**
- INTERMEDIATE (475) **"DEMONSTRATE"**
- **HIGH (550)** **"APPLY, WORK, USE, SOLVE"**

APPLY understanding & knowledge in variety of relatively complex situations.

- **ADVANCED (625)** **"APPLY, SOLVE"**

Organize & draw conclusions from information, make generalizations, & SOLVE non-routine problems

PISA MATH TRENDS 2003 – 2009

(OECD 2010)

IMPROVED 8 Countries	UNCHANGED 22 Countries	DECLINED 9 OECD Countries
☐Improved in 8 ☐7 of 8 countries showing better performance still well below OECD Average Italy, Portugal, Greece Mexico, Turkey, Brazil, Tunisia ☐Mexico (+33), Brazil (+30) largest improvement ☐Significant improvement among lowest-performing students: Mexico, Turkey	☐Mean remained unchanged across 28 OECD countries. NOTE: PISA 2003 provides results in MATH that were measured with more precision than PISA 2006 and PISA 2009, since the PISA 2003 MATH focus devoted more testing time to Mathematics. Changes are reported where they are statistically significant.	☐8 of 9 who declined had been at or above 2003 OECD average ☐Netherlands: Drop of 12 points but remains among highest-scoring countries. ☐Drop in score but still above OECD average: Australia, Belgium, Denmark, Iceland ☐Drop from above-average to OECD average: Czech Rep., France, Sweden
☐Germany improved to above-average levels.		☐Ireland: Drop from OECD Average to below average.

MATH - PISA PROFICIENCY LEVELS

PROFLEV	SCORE RANGE	TASK DESCRIPTIONS
1	358 – 419	☐ Answers questions involving familiar contexts where all relevant information is present & questions are clearly defined. Uses routine procedures with direct instruction.
2	420 – 481	☐ Interpret & recognize situations in contexts that require no more than direct inference. Can employ basic algorithms, formula, procedures or conventions, with direct reasoning
3	482 – 544	☐ Executes clearly described procedures, including sequential decisions. Select, apply simple problem-solving strategies. Interpret & use representations & reason from them.
4	545 – 606	☐ Works with explicit models for complex concrete situations. Selects & integrates symbolic representations, linking to real-world. Utilize well-developed skills & reasoning
5	607 – 668	☐ Develop & work with models for complex situations. Select, compare, evaluate using problem-solving strategies for complex problems. Well-developed thinking & reasoning skills, appropriate representations, symbolic & formal characterizations, with insight.
6	669 +	☐ Conceptualize, generalize, and utilize information based on investigations & modeling of complex problem situations. Link different sources & flexibly translate between them. ☐Capable of advanced mathematical thinking & reasoning. Apply insight & understanding along with mastery of symbolic & formal math operations/relationships.

PISA Proficiency Levels 5 & 6

NON-EUROPE	%	WESTERN EUROPE	%	EASTERN EUROPE	%
China Hong Kong	30.7	Austria	12.9	Czech Rep. *	11.7
China Macao	17.1	Belgium	20.4	Hungary *	10.1
China Shanghai	50.4	Finland	21.6	Kazakhstan	1.2
China Taipei	28.5	France G8	13.7	Latvia	5.7
JAPAN G8 *	20.9	Germany G8	17.8	Lithuania	7.0
Korea, Rep.*	25.5	Ireland	6.7	Poland	10.4
Singapore	35.6	Italy G8	9.0	Russian Fed. G8	5.3
		Liechtenstein	18.0		
OTHER		Netherlands	19.8	OTHER	
Australia	16.4	Portugal	9.6	Greece	5.7
Canada	18.3	Spain	8.0	Israel	5.9
New Zealand	18.9	Switzerland	24.1	Serbia	3.5
U.S.A.	9.9	United Kingdom	9.9	Turkey	5.7

PISA MATH - Age 15 2006 Rank 1-26

Asia (5) – English Lang. (5) - W. Europe (11) - E. Europe (5)

Rank 1-20: RANGE: TOT (492-549) - 90% (608-677) VAR. (+110)

Rank	COUNTRY	TOT	90%	DIF
1	Chinese Taipei	549	677	128
2	Finland	548	652	104
3	China Hong Kong	547	665	118
3	Korea, Republic	547	664	117
5	Netherlands	531	645	114
6	Switzerland	530	652	122
7	Canada G8	527	635	108
8	China Macao	525	632	107
8	Liechtenstein	525	643	118
10	Japan G8	523	638	115
11	New Zealand	522	643	121
12	Australia	520	633	113
12	Belgium	520	650	130

Rank	COUNTRY	TOT	90%	DIF
14	Estonia	515	618	103
15	Denmark	513	621	108
16	Czech Republic	510	644	134
17	Iceland	506	618	106
18	Austria	505	630	125
19	Germany G8	504	632	128
19	Slovenia	504	623	119
21	Sweden	502	617	115
22	Ireland	501	608	107
23	France G8	495	617	122
23	Poland		610	115
23	U. K. G8		612	117
26	Slovak Republic	492	611	119

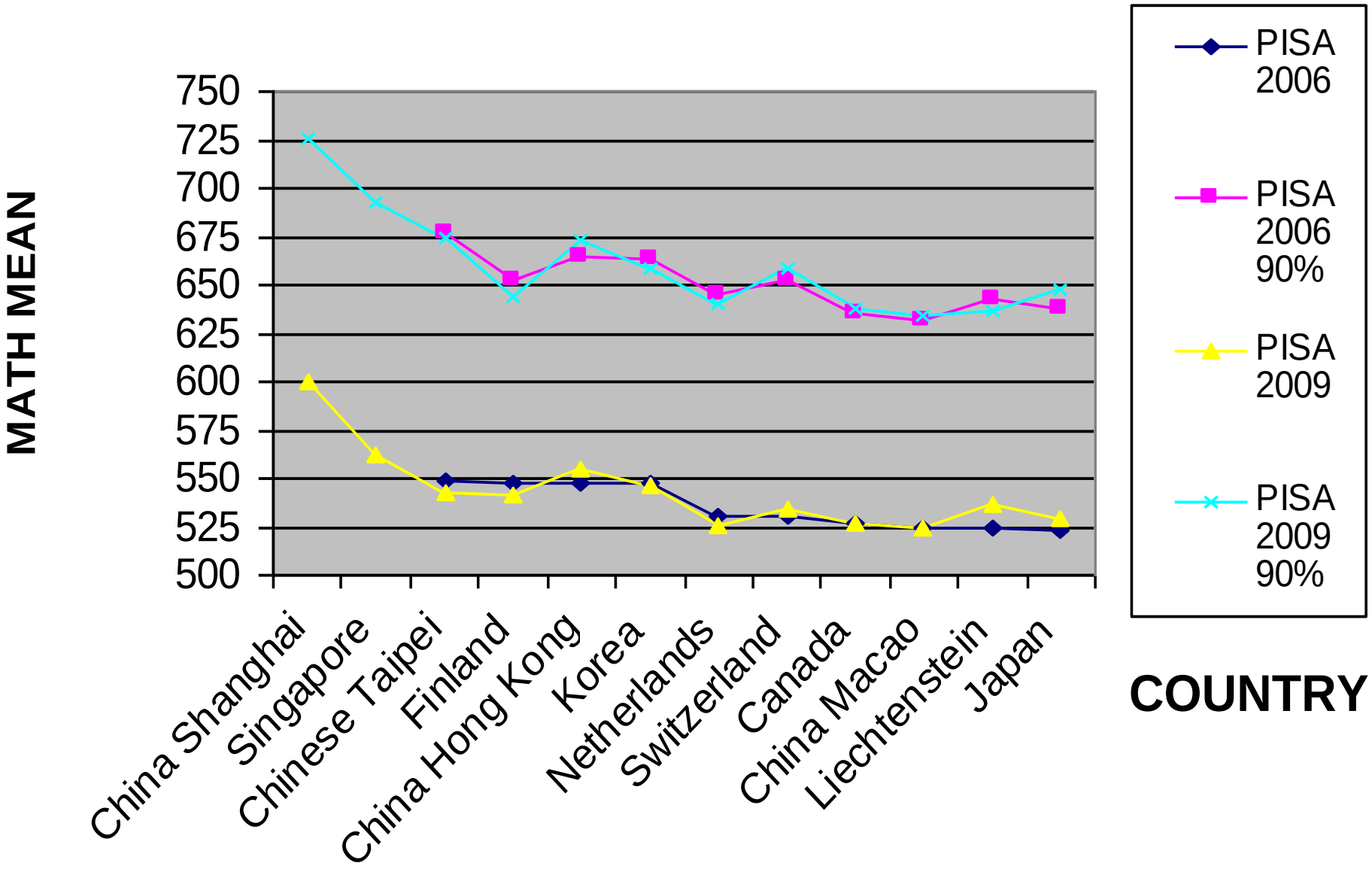
PISA MATH - Age 15 2009 Rank 1-20

Asia (7) – English Lang. (3) - W. Europe (8) - E. Europe (2)

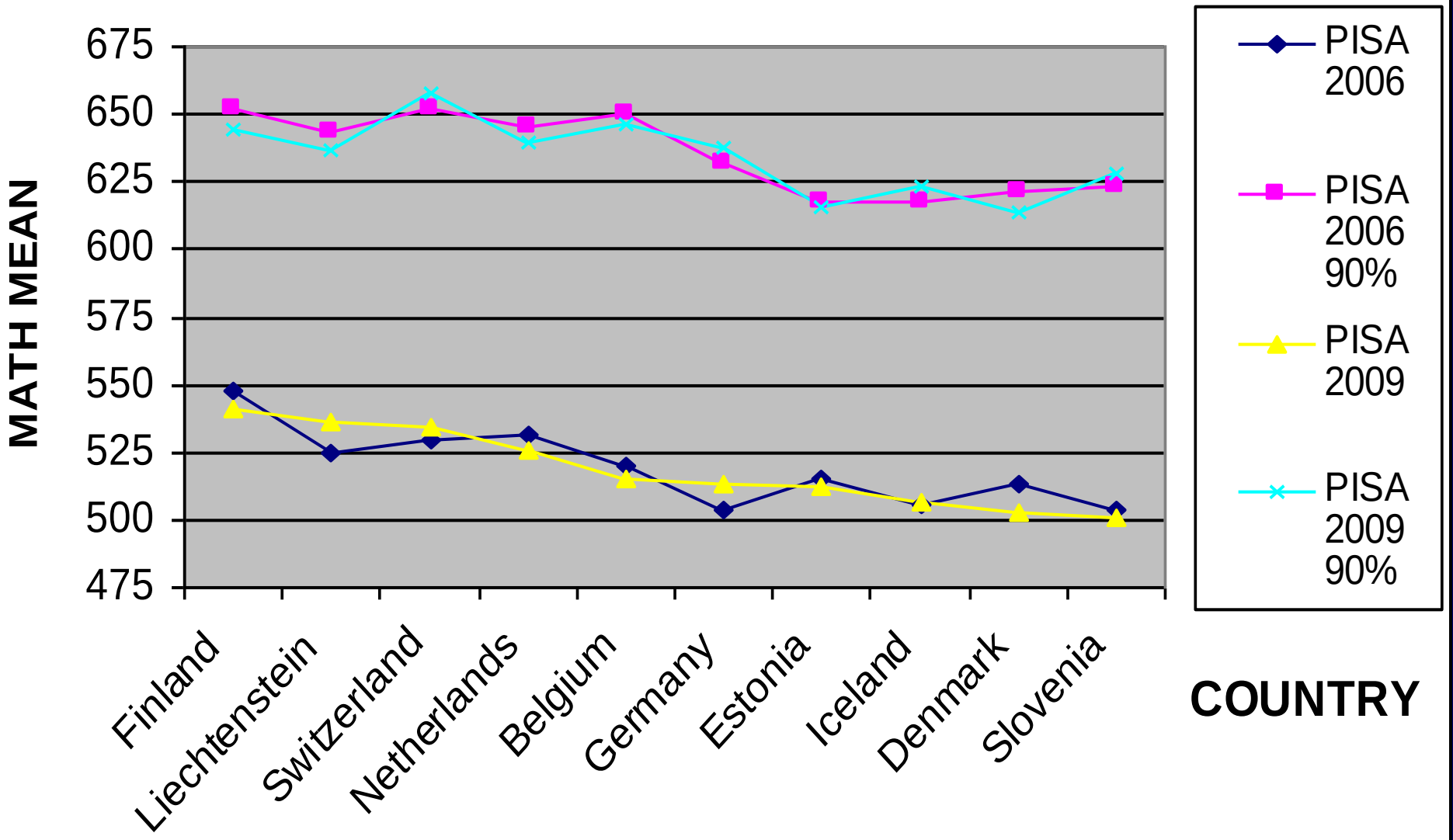
Rank 1-20: RANGE: TOT (501 - 600)

Rank	COUNTRY	TOT	90%	Differ -ence	Rank	COUNTRY	TOT	90%	Differ -ence
1	China-Shanghai	600	726	126	11	Netherlands	526	640	114
2	Singapore	562	693	131	12	China-Macao	525	634	109
3	China-Hong Kong	555	673	118	13	New Zealand	519	642	123
4	Korea, Republic	546	659	113	14	Belgium	515	646	131
5	China-Taipei	543	675	132	15	Australia	514	634	120
6	Finland	541	644	103	16	Germany G8	513	638	125
7	Liechtenstein	536	637	101	17	Estonia	512	616	104
8	Switzerland	534	658	124	18	Iceland	507	623	116
9	Japan G8	529	648	119	19	Denmark	503	614	111
10	Canada G8	527	638	111	20	Slovenia	501	628	127

PISA MATH TOP SCORE PROFILES



PISA 2009 MATH EUROPE RANK 1-20



GENDER DIFFERENCES – MATH
TIMSS 2007 – 35 Countries

GRADE 4

- 20/35 Countries -Significant difference in average MATH scores of MALES and FEMALES.
- MALE Higher – 12 Countries
- FEMALE Higher – 8 Countries
- Difference in Average scores - MALE / FEMALE:
  - Kuwait – FEMALE +37
  - Colombia – MALE +17
  - U.S. – MALE +6 (Number Only)

GRADE 8

- 24/47 Countries – Show significant difference in average MATH scores of MALES and FEMALES.
- MALE Higher – 8 Countries
- FEMALE Higher – 16 Countries
- Difference in Average scores - MALE / FEMALE:
  - Oman – FEMALE +54
  - Colombia – MALE +32
  - U.S. – NO Measurable Difference

MALES Higher in: Number, Geometry, Data & Chance

SOURCE: IEA (TIMSS) 2007

MATH - GENDER DIFFERENCES

PISA 2009 REPORT
How do girls compare to boys in mathematics skills?

- In 35 out of 65 countries, boys score significantly higher in math than girls.
- Boys have substantial score advantage of 20-33 Points:
  Belgium, Chile, Switzerland, U.K.
  USA, Colombia, Liechtenstein.
- 4 out of 6 Highest Countries - Little or no gender difference in math.
- Girls – Level 6 At least 10%
  Chinese Taipei, Singapore,
  China Shanghai

(OECD 2010)

POLICY CONSIDERATIONS

- Increase Motivation & Accelerated MATH Opportunities for FEMALES
- Decrease in GENDER variance may increase MATH test scores.
- FEMALE or MALE MATH score differences support evidence for realistic goal of GENDER EQUITY.
- Evidence that Females have Math ability equal to math achievement of Males.

PISA MATH 2009 FINDINGS

(OECD 2010)

How do countries perform in Mathematics overall?	What can students do in Mathematics? *OECD
☐China Shanghai and Singapore much higher ☐OECD Average: ½ – 1 Proficiency Level above: **Canada, Finland, Japan, Korea, Netherlands, Switzerland, Hong Kong Chinese Taipei, Macao China, Liechtenstein** ☐**Wider range of scores in math than reading.** ☐**East Asian show largest advantage over others.**	**Proficiency Levels 5 & 6** ☐OECD Avg. 1 in 8 13% ☐Korea* **(OECD High)** 26% ☐Chinese Taipei 29% ☐Hong Kong 31% ☐Singapore 36% **Proficiency Level 6** ☐OECD Avg. 3% ☐Korea* 8% ☐Switzerland* 8% ☐Singapore 16% ☐Shanghai China 27%

PISA 2009 REPORTING (OECD 2011)

STRONG PERFORMERS

FINLAND

- Slow and Steady Reform for Consistently High Results
- Exceptional Teacher Quality

GERMANY

- Once Weak International Standing Prompts Strong Nationwide Reforms for Rapid Improvement
- Reduce influence of socio-economic background on student achievement

SUCCESSFUL REFORMERS

VIGNETTES ON EDUCATION REFORMS

ENGLAND

- Tackling Teacher Shortages
- Encouraging Science & Math Teachers

POLAND

- Secondary Education Reform
- Structural reforms of late 90's

Remarkable Turnaround

The **FINLAND** Phenomenon

(Takayama 2010)

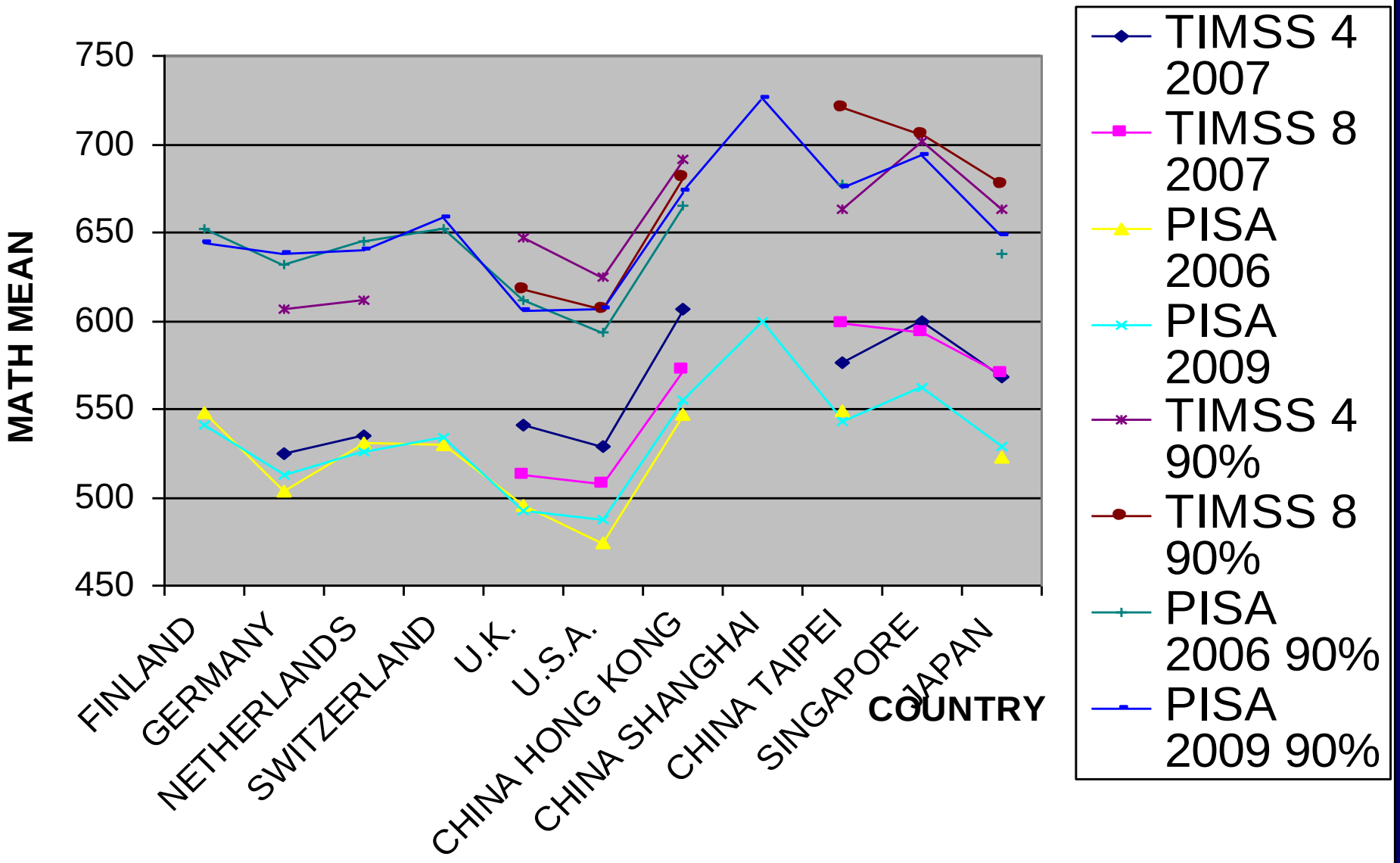
- High Quality Teacher Education Programs
- High Social Status of Teachers
- High Certification Requirements
- Extensive Library System
- High Cultural Value on Reading
- Start School at Age 7
- Systematic Effort to Avoid leaving any children behind
- Egalitarian principles & measures
- Elimination of Ability Grouping
- Free Provision of Education
- Constructivist Pedagogical Approach aligns with PISA curricular logic
- Local Control over Curriculum & Administration.
- Less is More Core Standards

NOTE: Higher Engagement Supports Cognitive Neuroscience Research **(Abadzi 2006)**

CHINA-SHANGHAI - PISA 2009 Noteworthy Achievement (Dillon 2010)

- **Math 600** **Singapore 562**
- **Reading 556** **Korea 539**
- **Science 575** **Finland 554**
- Industrial Powerhouse
- China's Rapid Modernization
- 20 Million Residents
- "Chinese relentless at accomplishing goals."
- "Accuracy of results unassailable."
- Modern Universities
- Magnet for best students.
- Shanghai huge migration hub.
- Stellar students stay in city.
- Taking Education very seriously
- Important Curricular Reforms
- Work Ethic "amazingly strong"
- Chinese History competitive exams.
- Value of Exams in Core Subjects
- Teacher Training Emphasis
- Teaching – Preferred Occupation
- Teachers Salaries Have Risen
- Educators Freedom to Experiment
- Students Able to Extrapolate & Apply
- More time spent on studying
- School hours long every day
- Work extends into weekends
- Less time on extracurricular activities like music, athletics.

FINLAND - SHANGHAI COMPARISONS



MATH G/T POLICY - Data Evidence

TIMSS

TIMSS

1995 **1999 2003 2007 2011**

- Results of **TIMSS 2011** testing will provide significant analyses in Math. Released Dec. 2012
- 90th PERCENTILE Data
- ADVANCED INTERNATIONAL BENCHMARKS Data
- CONTENT Domains
- COGNITIVE Domains
- GENDER – Sub-Scales in each test cycle provide data as evidence for MATH differences.

PISA

PISA 2000R 2003M 2006S 2009R 2012M

- MATH Sub-Scale Data
- PISA **2003** and **2012** are test cycles with special focus & in-depth analyses in MATH.
- Results of **PISA 2012** testing will provide extensive analyses in MATH.
- GENDER –

  PISA Math Sub-Scales provide data supporting MATH differences.
- PROFICIENCY LEVELS 1-6 can be reviewed in future MATH curriculum development for high achievement.

PISA 2009 – ADDITIONAL DATA

PISA 2009 – READING Focus – **PISA 2012 – MATH FOCUS**

OVERCOMING SOCIAL BACKGROUND

- Socio-economic Background
- Can Disadvantaged student defy odds?
- Single-Parent Families
- Immigrant Background
- Where Student Lives
- Equitable School Resources

LEARNING TO LEARN

- Enjoyment of Reading
- Kinds of Reading
- Reading Habit by Gender
- Learning Strategies that help students perform better

WHAT MAKES A SCHOOL SUCCESSFUL?

- Selecting & Grouping Students
- How systems select and group students
- Effect of School Governance
- School Governance in Different Countries
- Allocation of Educational Resources
- Performance in more disciplined schools.
- Learning Climate

(OECD 2010)

U.S. COMMON CORE STANDARD DEVELOPMENT (Carmichael, et al 2009) (Ravitch 2009)

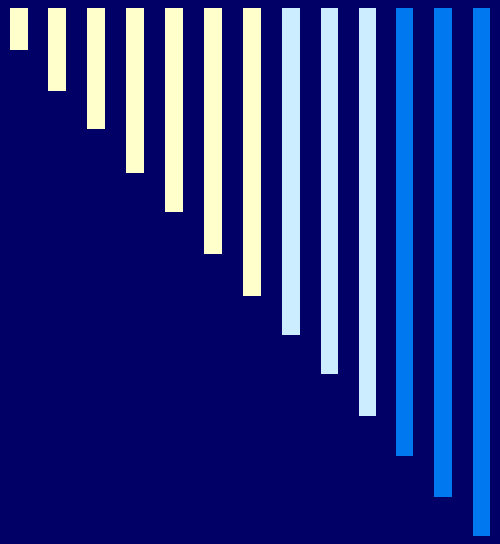
	Common Core	NAEP National Assessment of Educational Progress	TIMSS	PISA
Content & Rigor 0 - 7	5 10 Content Areas Simple, clearly understood	5 Excessive Number of Standards (300) All equal status.	6 Measurable, very little jargon. Covers all content	4 Problem Solving. Does not cover grade level content.
Clarity & Specificity 0 - 3	3 Not explicit enough. Do not set priorities. All equal status.	1 Unnecessary verbiage, poor focus No clear guidance on importance.	3 Clear, coherent, well organized. Little ambiguity.	0 Unbalanced, overemphasis on data display. Poor in standards use.
GRADE	8 B	6 C	9 A	4 D

CONCLUSIONS

- There are a number of **VARIABLES** that can be used in analysis of International Test Scores
- Most comparisons of international test scores relate to **AVERAGE** scores of the country's test sample. Analysis of **Sub-Scores** provides excellent data relating to **ADVANCED** achievement.
- **GENDER** comparisons can provide support for policy and equal opportunity for advanced curriculum for males and females.
- PISA **PROFICIENCY LEVELS 1-6** are useful guides in development of curriculum for advanced students.
- **90 Percentile –** Important data for analyzing achievement of top 10%.
- **CONTENT DOMAIN** sub-scores support CONTENT BALANCE as significant variable related to high achievement in Mathematics.
- **COGNITIVE DOMAIN** Sub-Scores provide valuable data related to higher order **REASONING**.
- **ADVANCED INTERNATIONAL BENCHMARKS** are an excellent resource for curriculum development for high ability.
- **YEARS OF SCHOOLING & PRE- PRIMARY EDUCATION** are variables related to achievement that support early advanced opportunities
- "Shadow Education" provides undocumented additional instruction.

I.N.S.T.E.A.D. International

International Network Supporting Transnational Education & Advanced Development



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INTERNATIONAL TESTING COMPARISON DATA – PAGE 1 of 3

(Stone 2012)

CONTINENT	COUNTRY	OECD/PART/TM	TIMSS GR 4 MATH 2007	RANK	TIMSS GR 8 MATH 2007	RANK	PISA MATH 2006	RANK	PISA MATH 2009	RANK	TIMSS 4 MATH 90%	RANK	TIMSS 8 MATH 90%	RANK	PISA MATH 2006 90%	RANK	PISA MATH 2009 90%	RANK
AS	China Shanghai	P							600	1							726	1
AS	Singapore	P	599	2	593	3			562	2	702	1	706	3			693	2
AS	China HongKong	P	607	1	572	4	547	3	555	3	691	2	681	4	665	2	673	4
AS	Korea, Rep.	O			597	2	547	3	546	4			711	2	664	3	659	5
AS	Chinese Taipei	P	576	3	598	1	549	1	543	5	663	3	721	1	677	1	675	3
WE	Finland	O					548	2	541	6					652	4	644	9
WE	Liechtenstein	P					525	8	536	7					643	9	637	14
WE	Switzerland	O					530	6	534	8					652	5	658	6
AS	Japan G8	O	568	4	570	5	523	10	529	9	663	3	677	5	638	11	648	7
NA	Canada G8	O					527	7	527	10					635	12	638	12
WE	Netherlands	O	535	9			531	5	526	11	612	14			645	7	640	11
AS	China Macao	P					525	8	525	12					632	14	634	15
OC	New Zealand	O	492	23			522	11	519	13	598	18			643	9	642	10
WE	Belgium	O					520	12	515	14					650	6	646	8
OC	Australia	O	516	14	496	14	520	12	514	15	620	11	600	12	633	13	634	15
WE	Germany G8	O	525	12			504	19	513	16	607	16			632	14	638	12
EE	Estonia	O					515	14	512	17					618	19	616	22
WE	Iceland	O					506	17	507	18					618	19	623	18
WE	Denmark	O	523	13			513	15	503	19	611	15			621	18	614	24
EE	Slovenia	O	502	19	501	12	504	19	501	20	589	22	594	15	623	17	628	17
WE	Norway	O	473	25	469	21	490	28	498	21	566	26	552	29	609	28	608	28
EE	Slovak Rep.	O	496	21			492	26	497	22	597	19			611	24	621	20
WE	France G8	O					495	23	497	22					617	21	622	19
WE	Austria	O	505	17			505	18	496	24	590	21			630	16	620	21
EE	Poland	O					495	23	495	25					610	26	609	27
WE	Sweden	O	503	18	491	15	502	21	494	26	586	23	582	21	617	21	613	25
EE	Czech Rep.	O	486	24	504	11	510	16	493	27	578	24	599	13	644	8	615	23
WE	U.K./England G8	O	541	7	513	7	495	23	492	28	647	6	618	7	612	23	606	31
EE	Hungary	O	510	15	517	6	491	27	490	29	620	11	624	6	609	28	608	28
WE	Luxembourg	O					490	28	489	30					610	26	613	25
NA	U.S.A. G8	O	529	11	508	9	474	35	487	31	625	9	607	10	593	32	607	30

INTERNATIONAL TESTING COMPARISON DATA – PAGE 2 of 3

(Stone 2012)

CONTINENT	COUNTRY	OECD/PART/TM	TIMSS GR 4 MATH 2007	RANK	TIMSS GR 8 MATH 2007	RANK	PISA MATH 2006	RANK	PISA MATH 2009	RANK	TIMSS 4 MATH 90%	RANK	TIMSS 8 MATH 90%	RANK	PISA MATH 2006 90%	RANK	PISA MATH 2009 90%	RANK
WE	Portugal	O					466	37	487	31					611	24	605	32
WE	Ireland	O					501	22	487	31					608	30	591	35
WE	Italy G8	O	507	16	480	19	462	38	483	34	601	17	574	25	584	36	602	33
WE	Spain	O					480	32	483	34					593	32	597	34
EE	Latvia	P	537	8			486	30	482	36	628	8			590	35	584	37
EE	Lithuania	P	530	10	506	10	486	30	477	37	624	10	609	9	602	31	590	36
EE	Russian Fed. G8	P	544	6	512	8	476	33	468	38	647	6	617	8	592	34	576	41
EE	Greece	O					459	39	466	39					575	38	580	40
EE	Croatia	P					467	36	460	40							574	42
ME	Dubai (UAE)	P							453	41							584	37
ME	Israel	O			463	24	442	40	447	42			584	20	581	37	581	39
EE	Turkey	O			432	31	424	43	445	43			581	22	550	40	574	42
EE	Serbia	P			486	18	435	41	442	43			587	17	553	39	560	44
EE	Azerbaijan	P					476	33	431	45							512	53
EE	Bulgaria	P			464	23	413	46	428	46			586	19	543	41	555	45
EE	Romania	P			461	27	415	45	427	47			587	17			530	48
LA	Uruguay	P					427	42	427	47							546	46
LA	Chile	O					411	47	421	49							527	49
AS	Thailand	P			441	30	417	44	419	50			562	27	524	42	522	50
LA	Mexico	O							419	50							520	51
LA	Trinidad/Tobago	P							414	52							546	46
EE	Kazakhstan	P	549	5					405	53	653	5					514	52
EE	Montenegro	P					399	48	403	54							509	54
LA	Argentina	P					381	51	388	55							509	54
ME	Jordan	P			427	32	384	50	387	56			556	28	489	43	490	59
LA	Brazil	P					370	52	386	57							493	57
LA	Colombia	P	355	31	380	41	370	52	381	58	470	30	477	41			479	61
EE	Albania	P							377	59							493	57
AF	Tunisia	P	327	34	420	33	365	54	371	60	469	31	508	36			471	62
AS	Indonesia	P			397	37	391	49	371	60			509	35			462	64
ME	Qatar	P	296	36	307	49	318	55	368	62	413	35	427	48			506	56

INTERNATIONAL TESTING COMPARISON DATA – PAGE 3 of 3

(Stone 2012)

CONTINENT	COUNTRY	OECD/PART/TM	TIMSS GR 4 MATH 2007	RANK	TIMSS GR 8 MATH 2007	RANK	PISA MATH 2006	RANK	PISA MATH 2009	RANK	TIMSS 4 MATH 90%	RANK	TIMSS 8 MATH 90%	RANK	PISA MATH 2006 90%	RANK	PISA MATH 2009 90%	RANK
LA	Peru	P							365	63							480	60
LA	Panama	P							360	64							466	63
EE	Kyrgyzstan	P					311	56	331	65							436	65
AF	Egypt	T			391	39							521	33				
AF	Algeria	T	378	30	387	40					493	29	465	42				
AF	Botswana	T			364	44							460	43				
AF	Ghana	T			309	48							428	47				
AF	Morocco	T	341	32							466	32						
AS	Malaysia	P			474	20							578	23				
EE	Armenia	P	500	20	499	13					617	13	601	11				
EE	Malta	P			488	16							597	14				
EE	Ukraine	P	469	26	462	25					573	25	572	26				
EE	Bosnia/Herzegov	T			456	28							552	29				
EE	Georgia	T	438	28	410	34					549	27	532	32				
LA	El Salvador	T	330	33	340	46					448	33	433	45				
ME	Cyprus	T			465	22							575	24				
ME	Lebanon	T			449	29							549	31				
ME	Iran, Islamic Rep	T	402	29	403	35					508	28	516	34				
ME	Bahrain	T			398	36							505	37				
ME	Syrian Arab Rep	T			395	38							502	38				
ME	Oman	T			372	42							492	40				
ME	Palestinian Natl.	T			367	43							498	39				
ME	Kuwait	T	316	35	354	45					443	34	455	44				
ME	Saudia Arabia	T			329	47							429	46				
ME	Yemen	T	224	37							371	36						
WE	U.K./Scotland	O	494	22	487	17					592	20	590	16				

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PRESENTATION:
ECHA Conference – MUNSTER, GERMANY – September 14, 2012
"TIMSS & PISA INTERNATIONAL TESTING - USING HIGH ABILITY MATHEMATICS SUB-SCORE DATA"