



# The Global Digital Divide and the Effects of Technology Use on Educational Outcomes

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## Outline

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- Cross-country differences in computer and Internet use
- Causes of the Global Digital Divide
- Disparities in computer and Internet use by race and income in the United States
- Causes of the U.S. Digital Divide
- Consequences of the Digital Divide
- Educational impacts

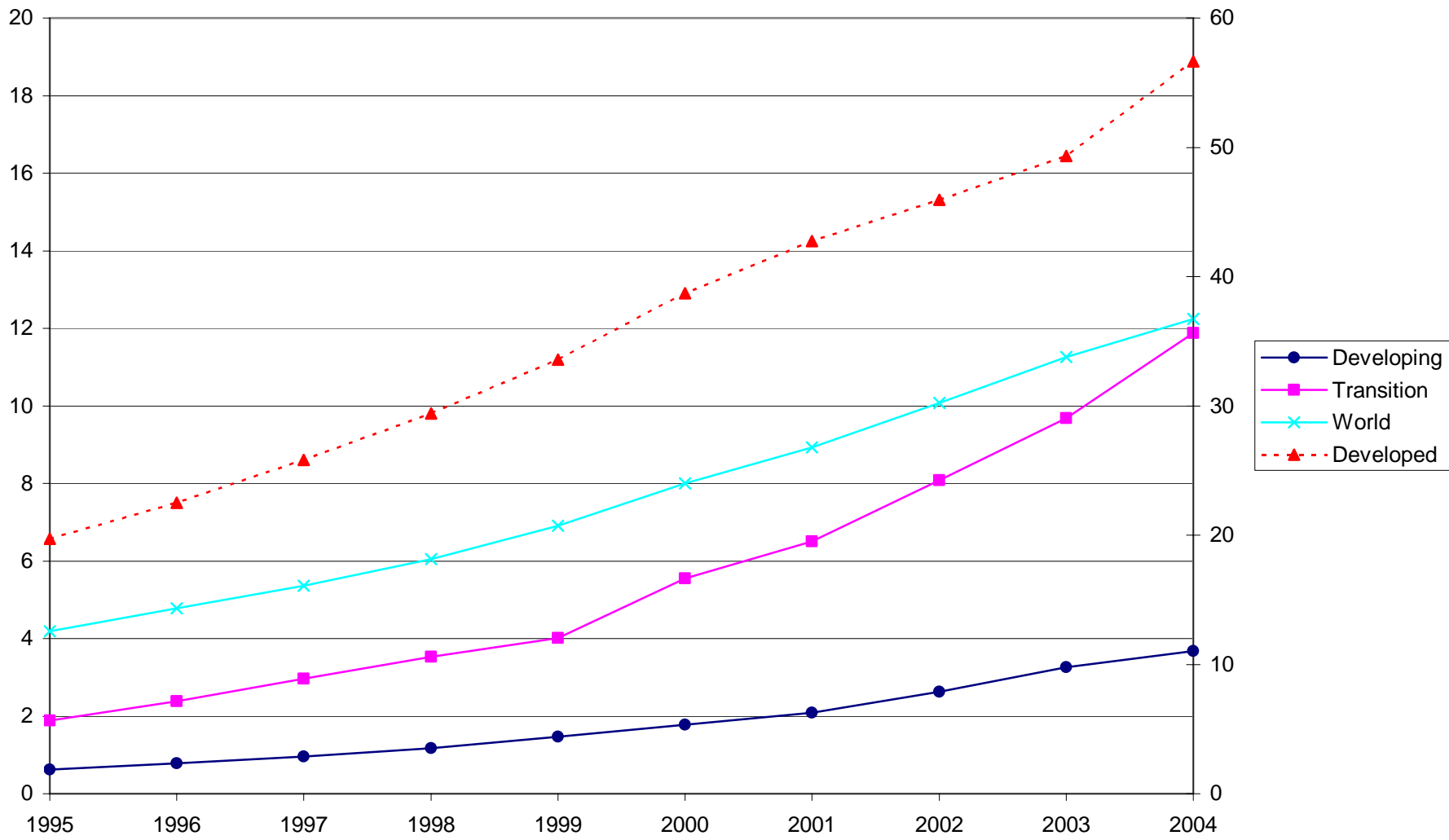


## The Global Digital Divide

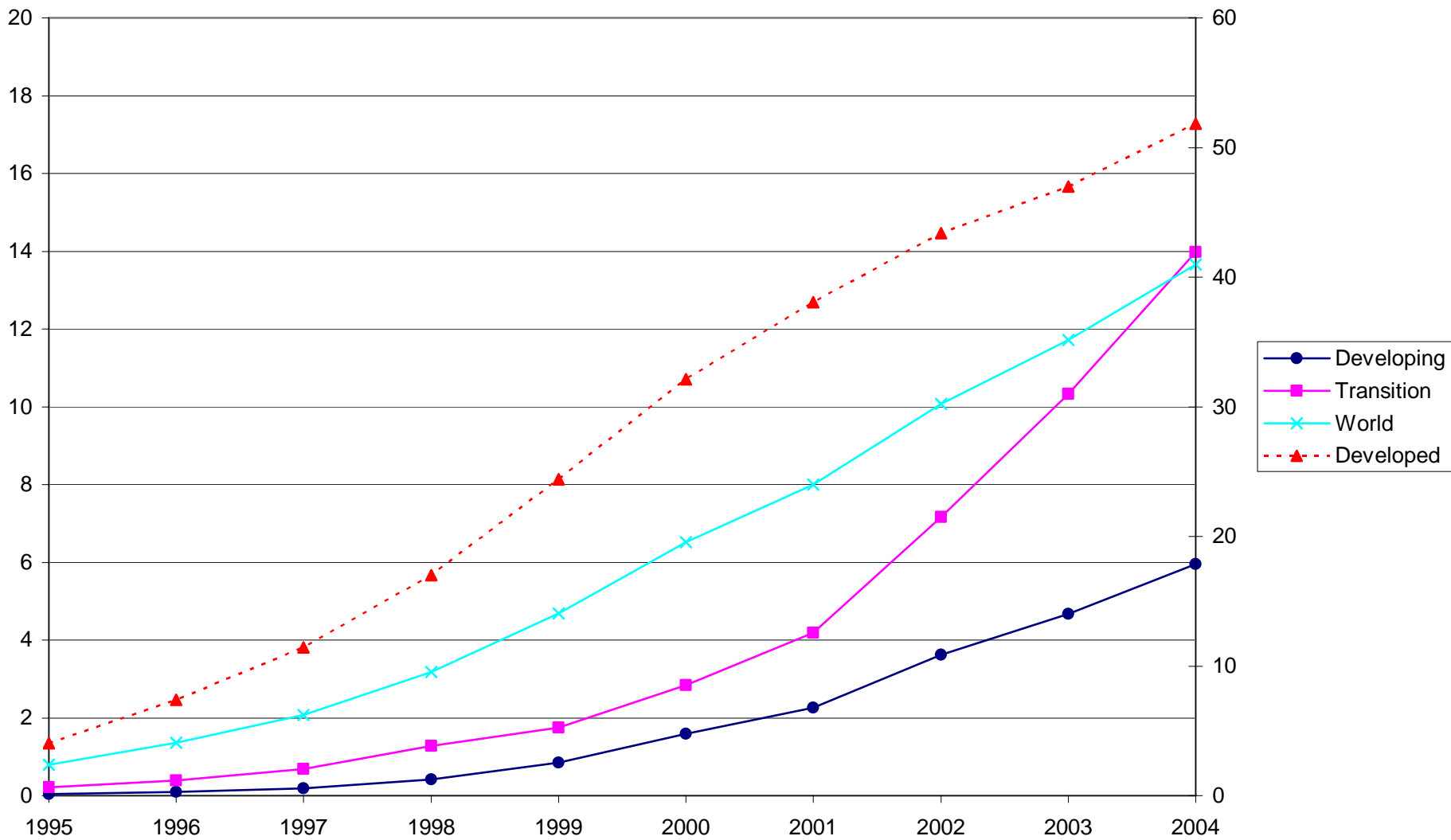
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- Cross-country differences in Computer and Internet Use
- International Telecommunications Union data
- Large disparities across countries

**Figure 1**  
**Computer Penetration Rates by Country Type (ITU 1995-2004)**



**Figure 2**  
**Internet Penetration Rates by Country Type (ITU 1995-2004)**





## Causes of the Global Digital Divide

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- “ICT Use in the Developing World An Analysis of Differences in Computer and Internet Penetration” (with Menzie D. Chinn)
- Regression and decomposition analysis

Table 5  
Computer Penetration Rate Decompositions Relative to Developed Country Total (2002-2004)

	Developing Total	Brazil	China	Indonesia	India	Mexico	Nigeria
Computer penetration rate gap	47.3	41.5	46.9	49.2	49.5	40.9	49.8
Contribution from:							
Main telephone lines per 100 people	16.1	11.7	12.8	18.4	18.4	14.1	22.2
Monthly telephone subscription charge	-0.1	0.1	-0.1	-0.1	0.0	0.1	0.2
Cost of three minute local call	0.3	0.2	0.2	0.0	0.1	0.6	1.2
Electric power consumption (kwh per capita)	-4.5	-3.6	-4.2	-4.9	-4.9	-3.7	-5.2
Population ages 0-14 (% of total)	-8.4	-5.8	-3.3	-7.2	-9.0	-8.9	-12.9
Population ages 65 and above (% of total)	-7.9	-7.8	-6.3	-8.3	-8.1	-8.0	-12.3
Urban population (% of total)	-2.1	0.3	-2.3	-1.9	-2.8	-0.2	-1.0
Gross national income per capita (000s)	43.7	37.7	42.1	45.1	45.8	35.1	50.7
Years of schooling	6.1	6.7	4.9	6.5	6.4	3.7	
Rule of law	5.3	4.8	5.2	6.6	4.1	4.9	9.3
Trade in goods (% of GDP)	-0.1	0.3	-0.4	-0.1	0.4	-0.3	-0.1
Financial openness	-0.3	-0.2	-0.3	-0.1	-0.3	-0.2	0.4
Private credit by banks and oth. fin. insts. / GDP	0.4	0.4		0.4	0.4	0.4	0.5

Notes: (1) The dependent variable is the number of personal computers per 100 people. (2) Coefficient estimates are reported in Table 3 Specification 2. (3) All contribution estimates are relative to the developed country total.

Table 6  
Internet Penetration Rate Decompositions Relative to Developed Country Total (2002-2004)

	Developing Total	Brazil	China	Indonesia	India	Mexico	Nigeria
Internet penetration rate gap	42.7	37.2	41.4	43.3	45.2	35.4	46.6
Contribution from:							
Main telephone lines per 100 people	4.3	3.2	4.3	5.0	5.0	3.8	6.6
Monthly telephone subscription charge	0.1	-0.2	0.3	0.2	0.0	-0.1	0.5
Cost of three minute local call	0.2	0.1	0.1	0.0	0.0	0.4	0.8
Electric power consumption (kwh per capita)	4.5	3.6	4.2	4.9	4.9	3.7	5.2
Population ages 0-14 (% of total)	-7.7	-5.3	-2.7	-6.6	-8.2	-8.1	-12.4
Population ages 65 and above (% of total)	1.6	1.6	-0.6	1.7	1.7	1.7	0.9
Urban population (% of total)	2.1	-0.3	1.5	1.9	2.8	0.2	2.6
Gross national income per capita (000s)	20.6	17.8	24.3	21.3	21.6	16.6	24.3
Years of schooling	4.6	5.0	3.8	4.9	4.7	2.8	
Rule of law	9.7	8.8	11.2	12.1	7.5	8.9	16.1
Trade in goods (% of GDP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial openness	-1.2	-1.0	-1.5	-0.5	-1.4	-0.8	-0.8
Private credit by banks and oth. fin. insts. / GDP	6.3	6.0		6.9	6.2	7.1	7.2

Notes: (1) The dependent variable is the number of Internet users per 100 people. (2) Coefficient estimates are reported in Table 3 Specification 2. (3) All contribution estimates are relative to the developed country total.





## Summary

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- Income, human capital, the youth dependency ratio, telephone density, legal quality and banking sector development are associated with technology penetration rates.
- Overall, the factors associated with computer and Internet penetration do not differ substantially between developed and developing countries.
- Estimates from Blinder-Oaxaca decompositions reveal that the main factors responsible for low rates of technology penetration rates in developing countries are disparities in income, telephone density, legal quality and human capital.

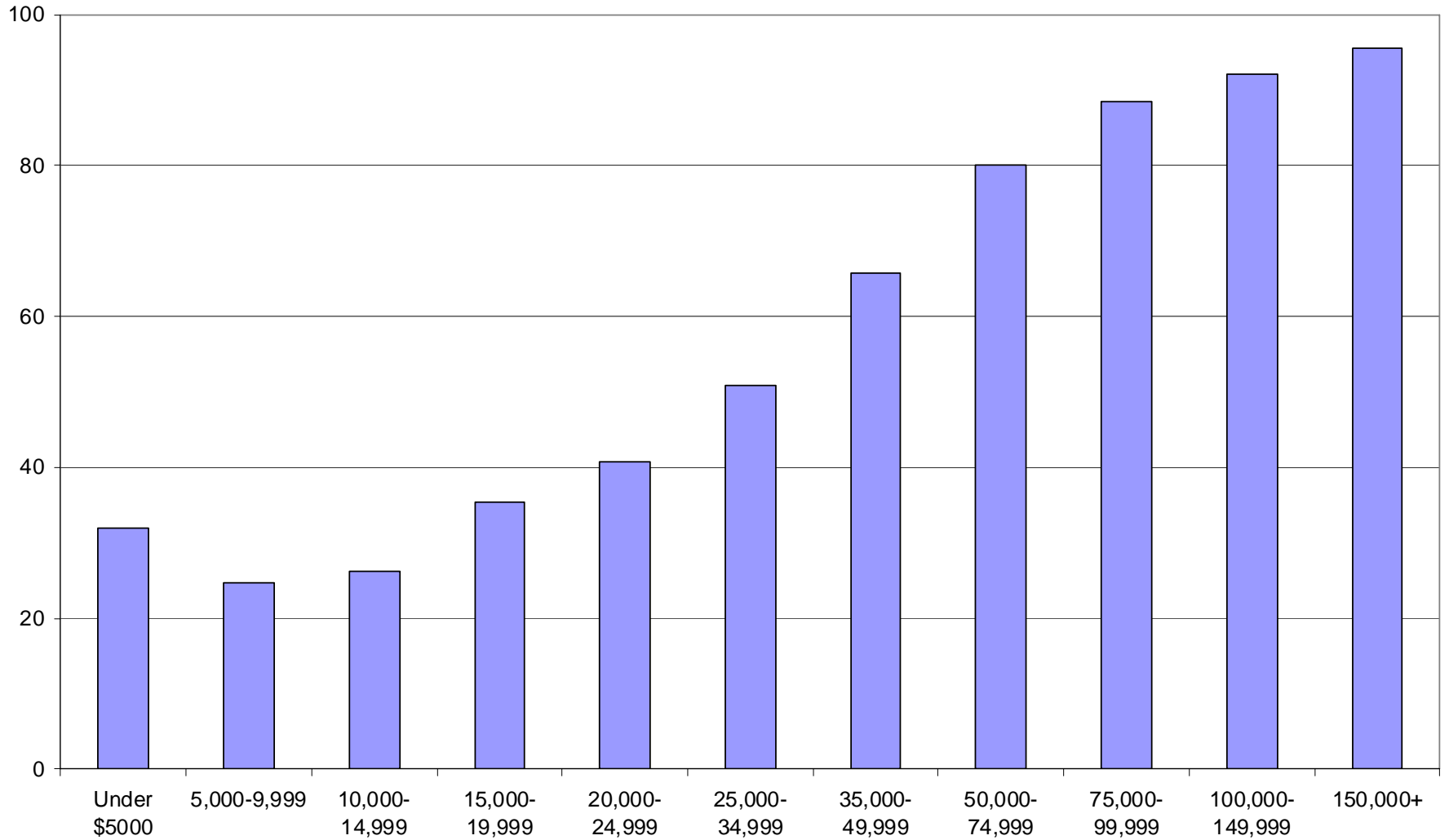


## U.S. Digital Divide

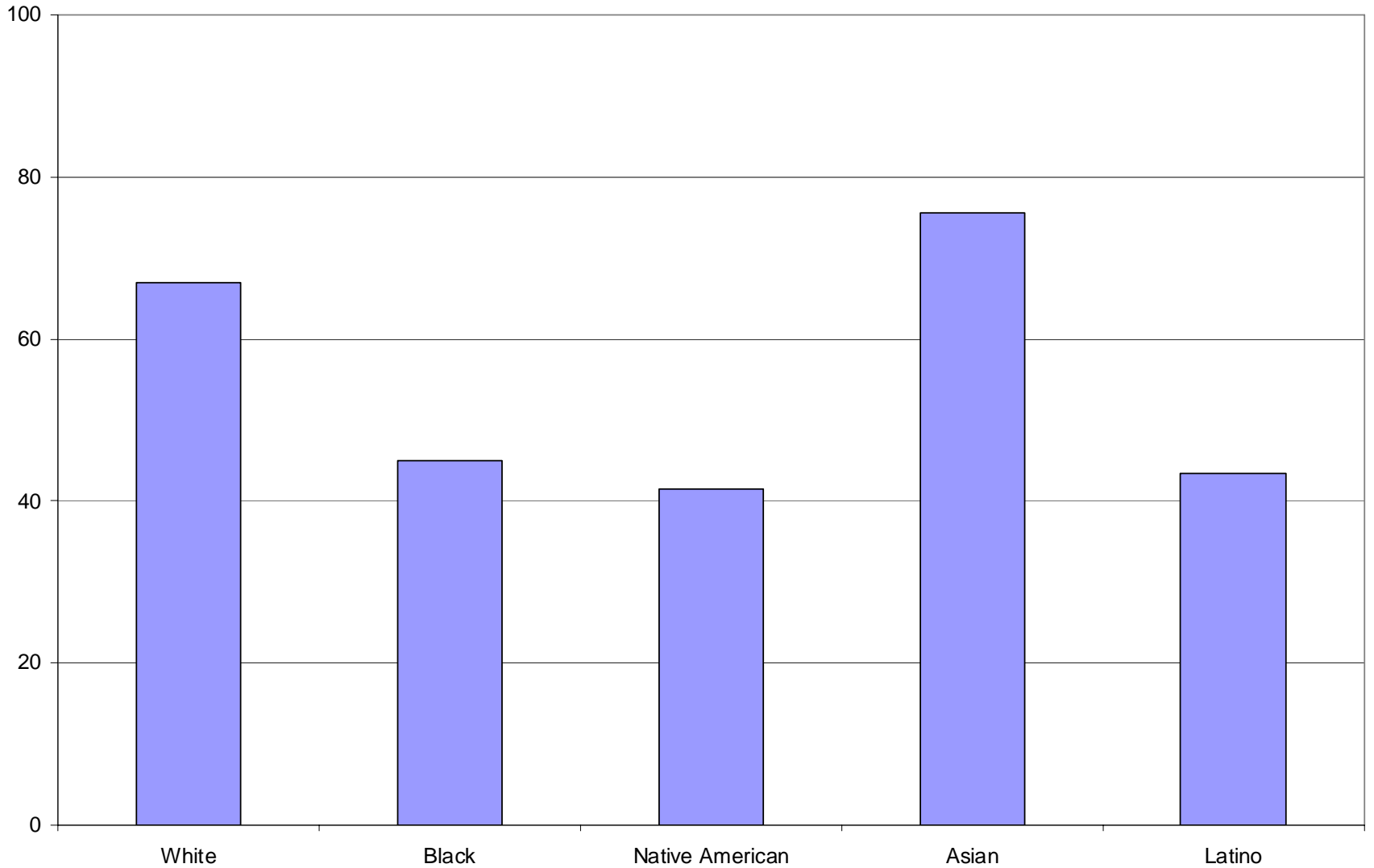
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- The United States has one of the highest computer and Internet penetration rates in the world,
- But, nearly 30 percent of children in the United States do not have access to the Internet in their homes.
- Large disparities in access to technology by race and income
- Disparities will not disappear soon

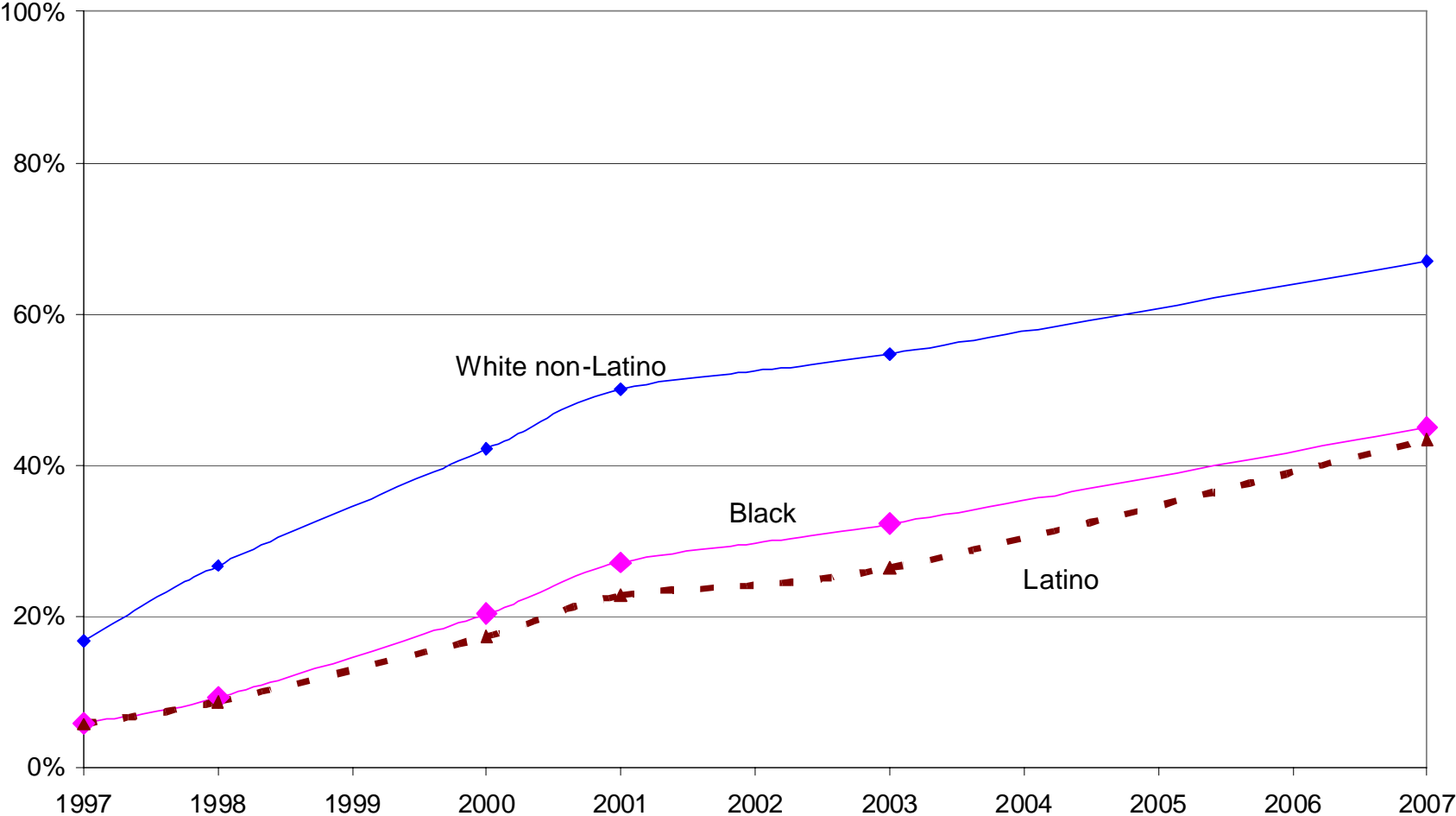
Home Internet Use by Income Level  
Current Population Survey, 2007



Home Internet Use by Race  
Current Population Survey, 2007



Percent of the Population (Ages 18+) Who Use the Internet at Home by Race/Ethnicity  
Current Population Survey, 1997-2007





## Causes of U.S. Digital Divide

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- “Explaining Differences in Access to Home Computers and the Internet: A Comparison of Latino Groups to Other Ethnic and Racial Groups”
- Current Population Survey, Computer and Internet Use Supplement
- Decomposition analysis

Table 6  
Decomposition of Racial/Ethnic Gaps in Home Computer Rates  
Current Population Survey, October 2003

	Black	Latino	Mexican	Cuban	Puerto Rican	Central/ South Amer.	Native Amer.
White/minority gap in home computer rate	0.225	0.247	0.302	0.178	0.145	0.200	0.270
Contributions from racial differences in:							
Sex and age	-0.010 -4.3%	-0.026 -10.7%	-0.031 -10.4%	0.019 10.6%	-0.021 -14.5%	-0.032 -15.8%	-0.016 -6.0%
Marital status and children	0.022 9.6%	0.000 0.2%	-0.005 -1.5%	0.009 5.0%	0.016 10.8%	0.004 2.0%	0.016 6.0%
Education	0.024 10.7%	0.053 21.6%	0.062 20.6%	0.033 18.4%	0.035 24.4%	0.050 25.1%	0.039 14.3%
Income	0.060 26.8%	0.058 23.3%	0.064 21.1%	0.043 24.1%	0.048 33.4%	0.058 28.9%	0.088 32.7%
Region	0.010 4.5%	-0.009 -3.7%	-0.011 -3.8%	0.005 2.8%	0.000 -0.1%	-0.008 -4.2%	-0.012 -4.3%
Central city status	0.002 0.9%	0.000 0.0%	0.000 0.0%	-0.004 -2.4%	0.000 0.3%	0.000 0.0%	0.007 2.5%
Employment / Occupation	0.004 1.9%	0.015 6.1%	0.019 6.4%	0.005 3.0%	0.002 1.6%	0.016 8.0%	0.008 2.9%
All included variables	0.113 50.0%	0.091 36.8%	0.098 32.5%	0.109 61.6%	0.081 55.8%	0.088 44.0%	0.130 48.2%

Notes: (1) The sample consists of adults ages 25 and over (2) Contribution estimates are mean values of the decomposition using 1000 subsamples of whites. See text for more details



## Summary of Explanations

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- Differences in income and education are largest factors, but explain only part of the ethnic and racial disparities in home computer and Internet access.
- Language is also found to be an important determinant of home computer and Internet access even after controlling for education, family income and immigrant status.
- Concerns over privacy on the Internet do not appear to contribute substantially to racial disparities in home Internet access.





# Why Do We Care? Potential Consequences of the Digital Divide

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- Education
- Labor Market
- Communications
- Politics
- Consumers
- Health Information
- Community Involvement
- Government
- Emergency Information



## Educational Consequences

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- Computer and Internet use in the nation's schools is ubiquitous.
  - Nearly all instructional classrooms in U.S. public schools have computers with Internet access, with an average of roughly 4 computers per classroom.
- E-rate program provides discounts to schools and libraries for the costs of telecommunications services and equipment (\$2 billion per year)
- Several state, local government and private programs provide laptop computers to schoolchildren (e.g. Maine, \$40 million)
- Extensive literature focuses on the effects of computer use in classrooms
- The increasing reliance on computers and the Internet for classroom instruction, delivering educational content, and completing homework assignments suggests that disparities in home access to technology or the so-called Digital Divide may have implications for educational inequality.



## Educational Consequences

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- “Home Computers and Educational Outcomes: Evidence from the NLSY97 and CPS,” (with Daniel Beltran and Kuntal Das)



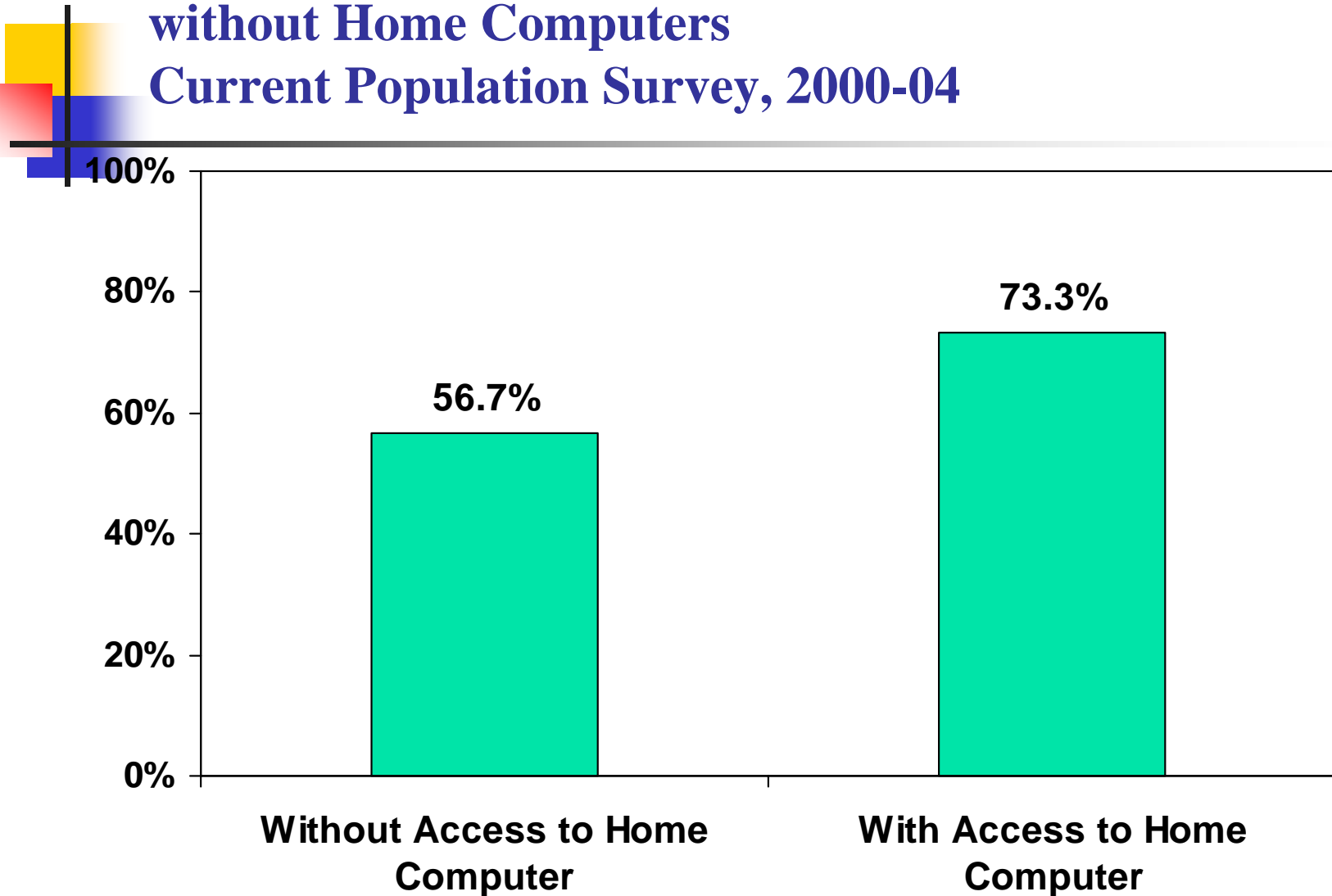
## Goals of Study

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- Examine whether home computers improve educational outcomes among teenagers
  - Home computers may improve educational outcomes by making it easier to complete school assignments and "open doors to learning," but could create a distraction from playing video games and using the Internet.
- Methods:
  - Compare children who do not have home computers to children who have home computers
  - Use regression models to control for differences in family income, parental education and household characteristics
  - Use two national datasets (Matched CPS and NLSY9)

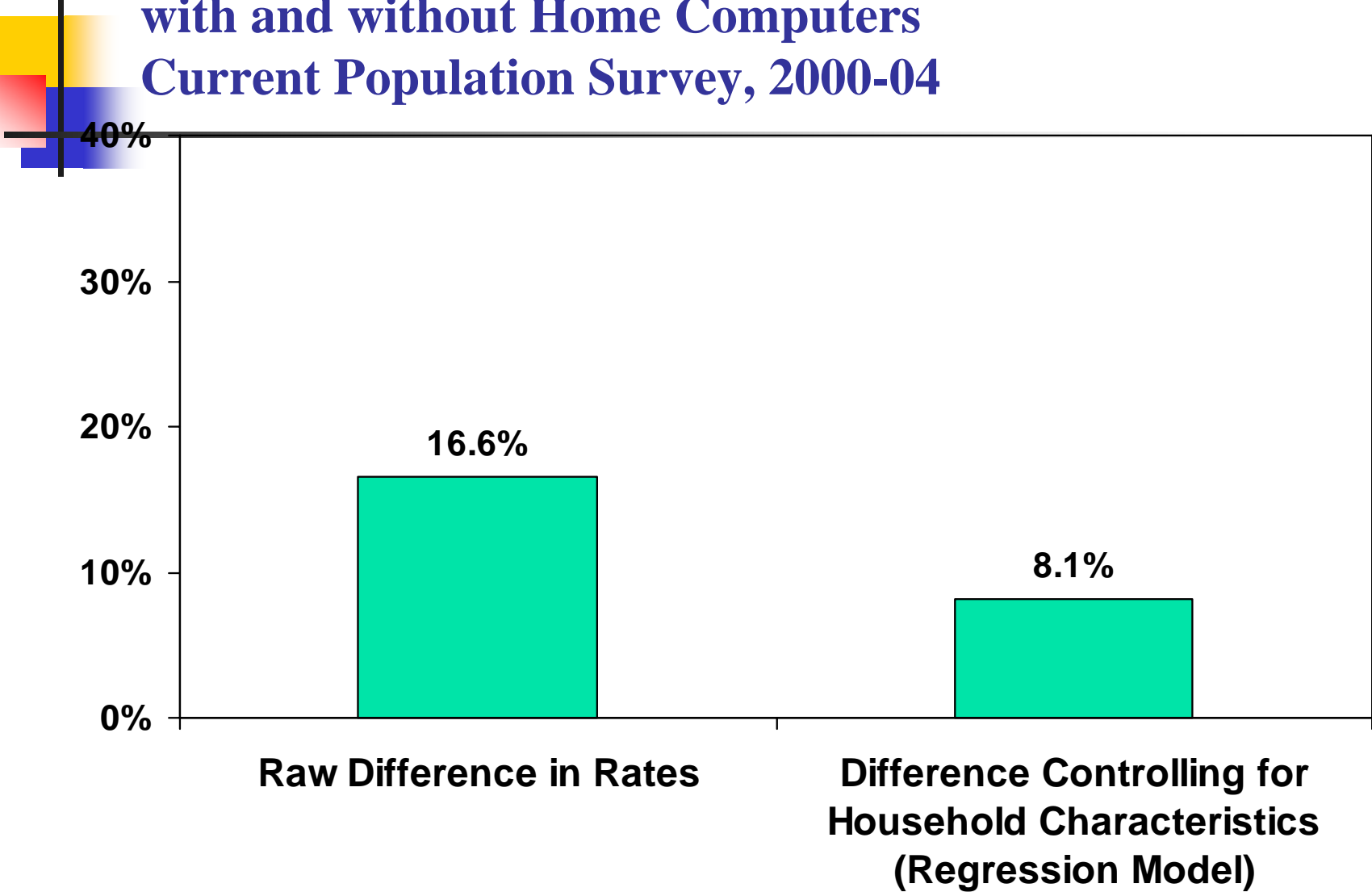
# High School Graduation Rates for 11th Graders with and without Home Computers

## Current Population Survey, 2000-04



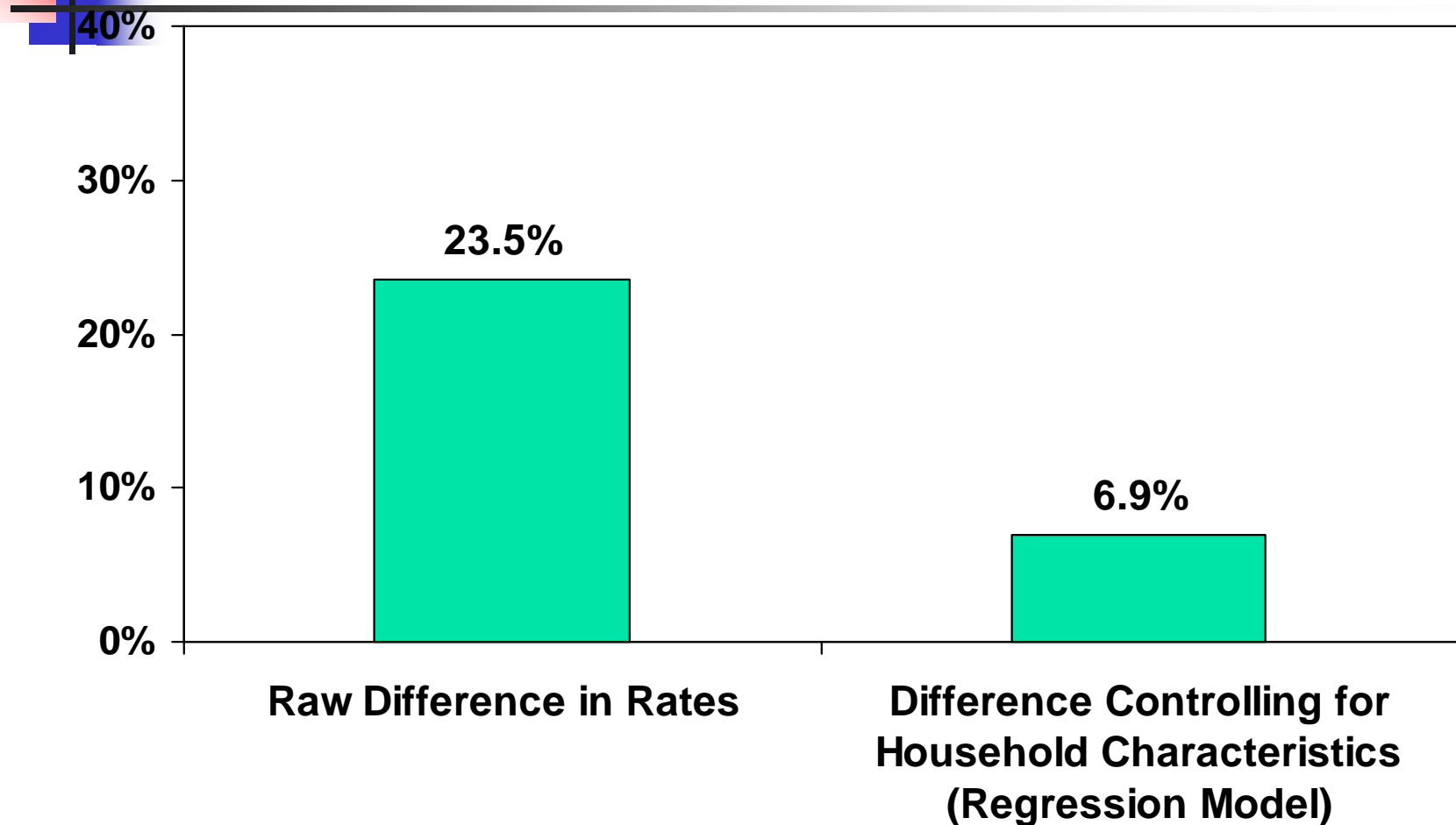
# Difference in High School Graduation Rates for Children with and without Home Computers

## Current Population Survey, 2000-04



# Difference in High School Graduation Rates for Children with and without Home Computers

## National Longitudinal Survey of Youth, 1997-02





## Additional Methods and Youth Outcomes

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- Instrumental variables, individual fixed effects
- Having a home computer:
  - Increases grade point average by 0.2 points (4.0 scale)
  - Decreases school suspension rate by 25 percent
  - Some evidence that computers decrease criminal activities
- Validity test: other similar products have no effects
  - Cable television
  - Dictionary at home
  - Future computer





## New Research

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- Random experiment using free computer giveaway
  - Community College in Northern California
  - Study impact on grades, retention and graduation
- Maine laptop program
  - Examine impact on test scores and attendance rates



## Policy Implications

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- Policies should address financial, informational and technical constraints to purchasing and using computers among disadvantaged families
  - Tax breaks, IDAs or loans for educational computer purchases, training programs, and computer donations.
  - Laptop programs allowing for home use
- Increase funding for technology-related programs affecting disadvantaged groups, such as community technology centers
- Home computers may become more important in the educational process as schools are increasingly digitizing content and there is growing momentum for replacing textbooks with CD ROMs or Internet-based materials