**X Seminario Latino-Iberoamericano de Gestión Tecnológica ALTEC 2003**
**"Conocimiento, Innovación y Competitividad: Los Desafíos de la Globalización"**

# Are Borders Behind?
# Computer Technology Benchmarking on the U.S.-Mexico Border

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## Abstract

The issue of computer and related technology use has become an indicator of quality of life and economic well-being. To better understand how policies should be developed to meet the needs of computer related technology, communities must develop some baseline measures. In the border region of the United States and Mexico, benchmarking is extremely important inasmuch as the digital divide is believed to be significant. This study provides a computer related technology baseline and examines through multivariate approaches how their use can be measured and how previous studies that have concluded some ethnic groups lag in computer related technology use does not hold true in the border region.

**Key Words**: Technology-Use; Ethnicity; Border Region, Topic: Social, economic and environmental impacts from innovation.

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## Introduction

The issue of computer and related information technology (IT) use has grown from one of relative scant discussion related primarily to efficiency in industrial and service processes, to a dominant theme in business and government. Discussions of computers and related IT and the role they plays in community development have also become high level agenda items (Intelligent Community Forum, 2001), even more so in communities that were left behind during the "dot.com" period of the 1990s. No where is this more evident than in the historically poor border communities of the United States-Mexico border, where the effects of the IT boom were slow to develop as a result of low incomes, low education levels (Fullerton, 2001:1-10), and the absence of community-based leadership that drove a technology-based economic development strategy.

Of particular importance in the border region is the absence of IT characteristics including: 1) few fast growth companies based in technology; 2) a clear strategy to transform the regional economies; and, 3) a lack of proto-type strategies to begin the transition (Intelligent Community Forum, 2001). In the border region spanning the southern United States and the northern frontier of Mexico, these characteristics began to emerge in the late 1990s. Economic development organizations, for example, pointed to the availability of fiber optic lines and the potential to develop call centers for a variety of service sectors (i.e., credit card companies, insurance claims, and catalog sales) as evidence of an IT base for a new economy. More critical thinkers, however, likened these developments to replacements for the declining garment industry in that they were not proto-types that would result in fast growing firms. In addition, comprehensive strategies to transform the economic base were left undeveloped as the maquiladora industry and the benefits from NAFTA provided generally short term relief. From another perspective, the service sector expanded in border communities such as El Paso, but remained dependent on their relationship to maquiladoras and, thus, forces of globalization (Canas, 2002). One result of this series of events was recognition in El Paso of the need to benchmark current IT and related use and how it impacts the community at a variety of levels. Put simply, benchmarking can serve as the process by which practices can be analyzed in order to determine what needs to be done to improve

performance. Benchmarking enables strategy because it provides a starting point from which data based planning activities can proceed.

In El Paso, a community similar in many respects to most border communities, but one that is slightly more prosperous by border standards (Brenner, et al., 2001), a variety of groups have been interested in a county-wide IT usage and access survey in order to obtain the first benchmark of home and individual adoption. This interest was generated by the original *Digital Divide* study conducted by the National Telecommunications and Information Administration (NTIA) in 1995. This first study, *Falling through the Net: A Survey of the "Have Nots" in Rural and Urban America*, showed how African Americans, Hispanics, and—at the time—women trailed behind their white, male, more affluent counterparts in terms of computer and Internet access and use. Subsequent NTIA studies released in 1998, 2000, and 2002 showed substantial gains among minorities and low-income groups in terms of improved access, but concluded that nationally they still trailed well behind. More importantly, the limited data available suggests that as an underserved community, El Paso and other border communities may be at an even greater risk as IT becomes a cornerstone of the modern education and workplace environments. With a first goal of benchmarking, the study also provides data that suggest many previous conclusions about IT use among ethnic groups, in this case Hispanics who make up over 75 percent of the border residents, may not hold true at the regional level.

**Information Technology Change and Benchmarking**

The business world long ago accepted change as the dominant theme that guides planning and development. To survive, the private sector understands that they must be able to adapt to consumer desires, restructure to fend off competition, and refine production processes to keep costs low. Joseph Schumpeter's classic works suggested that a vibrant economy would breed "creative destruction" (Schumpeter, 1975: 82-85). This process sees business innovation lead to the elimination of old technologies or processes on a continuing basis. Along the same line, Lester Thurow proposed that "disequilibrium" was a key force that required businesses to eliminate the "old" even though it may have value because of the added-value of new technology (Thurow, 1999: 57-69). Without adapting new technology at

a rapid pace, a business, in conceptual terms of Thurow and Schumpeter, would be eliminated in a technology-driven Darwinian process of survival of the current.

Within the border region, Thomas Friedman's (1999) *The Lexus and the Olive Tree* provides more insight, suggesting that if your business, your country, or your culture, for whatever reasons, do not stay abreast of fast moving markets and the forces of creative destruction you will simply be left behind. Given the economics of the border region after the 1990s, is it safe to ask if these forces were at work. Did "creative destruction" occur in the region? Is the IT gap too large to bridge in the short-term? Regardless, is there a strategy that can be taken by communities to close the gap?

A first step in developing a strategy is to determine where you are. Benchmarking at one point in time is not only important for determining the strategies that may be required but for knowing how much effort will be needed. At the governmental level, the private sector is looked to as a model for innovation, leading different levels of government to institute—sometimes ill-fated—programs ranging from Total Quality Management to the Senior Executive Service, the latter of which was designed to create 'corporate level' government positions that could compete with private sector salaries and prestige. One of the most successful innovations of late, if used properly, is benchmarking (Jarrar and Zairi, 2001: 906-912).

While similar efforts by governmental organizations do exist (Zairi, 1996), the void that remains in benchmarking community needs has yet to be addressed in any organized fashion. The best effort of its kind that is currently being carried out by the Urban Institute (UI) is its National Neighborhood Indicators program. While not specifically termed benchmarking, the data sets recommended by UI are, in effect, point in time snapshots of the consumers of government (Tatian, 2000). The purpose of the UI program is to train communities to use data to affect policy, although current programs are centered in large, often prosperous, cities ranging from Milwaukee and Denver to Oakland and New York.

Noticeably absent from the recommended UI data sets, however, are any measures of overall community IT use, as are any advanced methods of data analysis. A worthwhile effort in this arena was funded by the City of San Diego (Godbe Research and Analysis, 2000). What made this particular study interesting was not only its attempt to capture the state of IT use in the city at the time, but its understanding of the link between overall IT use and the

potential for economic growth. However, what was missing was a reliable scale by which other cities, or even different groups within a city, could judge themselves beyond simple frequencies. Thus, a goal of our study was to gather an accurate assessment of the state of IT use in the county of El Paso, Texas. The final survey instrument was developed such that the data collected could be used to compare groups within El Paso, and by extension El Paso to other cities. As part of this effort, a set of questions included on the survey instrument designed as an IT use and proficiency benchmark for the city.

**The Setting: El Paso, Texas**

El Paso, Texas is located in West Texas along the United States–Mexico border and sits across the Rio Grande from Ciudad Juárez, Chihuahua México. In 2001, just fewer than 690,000 people lived in El Paso. From 1990 through about 1994, El Paso experienced relatively strong growth both in terms of birth rates and in-migration. After 1994, however, El Paso actually had a negative migration rate. Explanations for the exodus abound, but many point to higher salaries in other metropolitan areas and El Paso's relatively high unemployment rate, which typically hovers two to three points above the national and state rates. As of December 2002, El Paso's unemployment rate climbed above nine percent (9.1 %, seasonally adjusted), well above the state rate of 6.5 percent.

El Paso's weak economy was brought about by a variety of factors. During the 1970s and 1980s, the city hinged its future on the low wage garment industry, and when companies like Levi Strauss finally moved on in search of even lower wages in South America, very few business groups were prepared to develop a new economic base. The recovery has been slow, but as of yet the 13 percent unemployment rates of 1996 have yet to return.

Most important is El Paso's educational attainment rate. Aside from the strong correlation between education and income along the U.S. Mexico border (Fullerton, 2001: 1-10), a well-educated population ensures that industries that do locate to an area can find trained employees. Thus far, fixing the educational pipeline locally has met with mixed results. As of 2000, El Paso trailed both the state and nation in the percentage of the population with high school degrees. Only 65.8 percent had graduated from high school, compared to 75.7 percent and 80.4 percent at the state and national level, respectively. The same trend is evident for those with bachelor's degrees or higher. In 2000, only 16.6 percent

of El Paso residents had four year college degrees, far less than state (23.2 %) and national (24.4 %) averages.

Not surprisingly, the above challenges have led to lower overall income rates and higher poverty rates. El Paso's median household income in 1999 was $31,051, 77 and 74 percent of the state ($39,927) and national ($41,994) totals, respectively. Per capita income figures are even more disturbing, as El Paso's per capita income level is only 62 percent of the national amount. Poverty figures tell a similar story; in the 2000 Census, 23.8 percent of El Paso residents fell below the federal poverty limit. Texas had only 15.4 percent of its population below the poverty level, while the U.S. average was even lower at 12.4 percent.

Thus, when the original NTIA study was released in 1995, few questioned that El Paso had a long way to go to match state and national IT use levels. What was more important was the fact that a changing economy was going to need an entirely different kind of employee than was required by the garment industry.

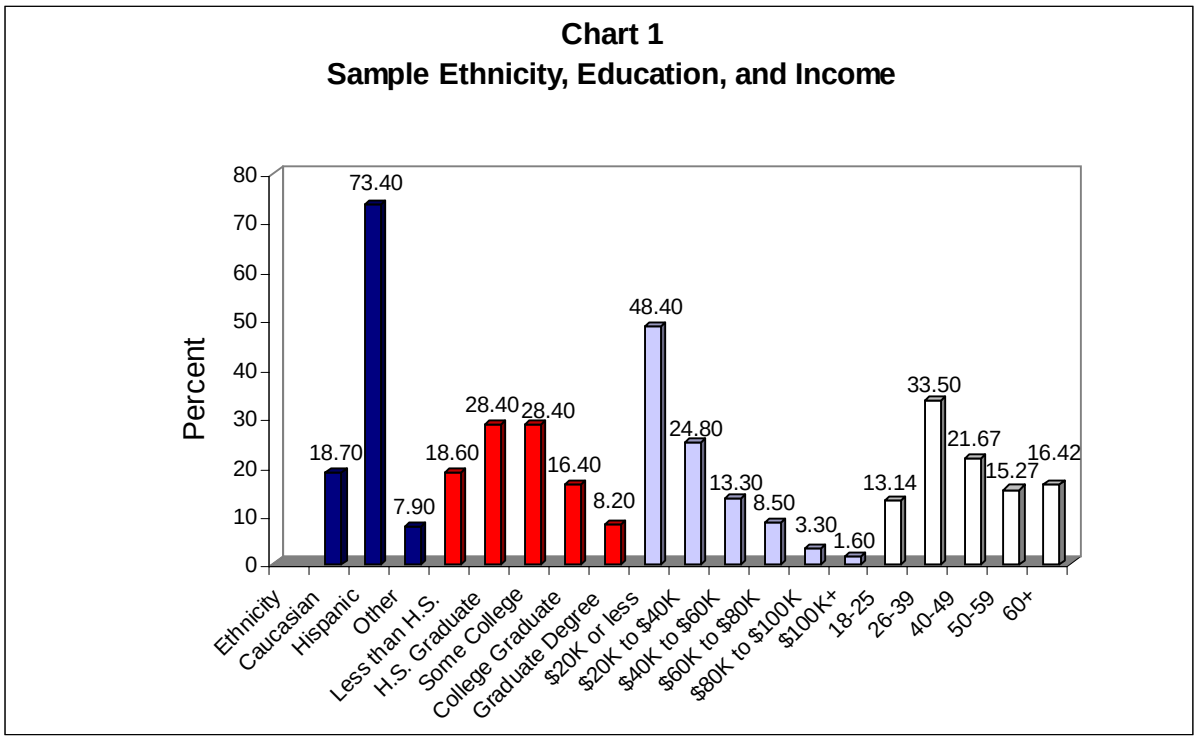
**Method**

The survey was conducted in September 2002, using a Random Digit Dialing (RDD) sample of El Paso County phone numbers that was pre-tested for disconnects and fax machines. With RDD, every household with a working phone has an equal probability of being selected, as the numbers are generated *at random* based only on the working prefixes for a selected area. In total, 609 surveys were completed. At the 95 percent confidence level, a county-wide sample of 609 provides an accuracy level of plus or minus 4 percent of the mean.

**Findings**

Participants generally mirrored the demographic and socioeconomic composition of El Paso County in the 2000 Census (Chart 1). Over 73 percent (73.4) of the sample were Hispanic, followed by Whites, who composed 18.7 percent of the sample. The remainder was made up of 7.9 percent self-identifying as "Other." The largest income group reported a total household income of $20,000 or less (48.4 percent) reflecting the low income status of the region. Twenty-five percent (24.8) had household incomes between $20,000 and $40,000; 13.3 percent earned between $40,000 and $60,000; 8.5 percent earned between $60,000 and

$80,000; 3.3 percent earned between $80,000 and $100,000; and, 1.6 percent earned above $100,000. The majority of the sample also fell into lower education categories. Nearly a fifth

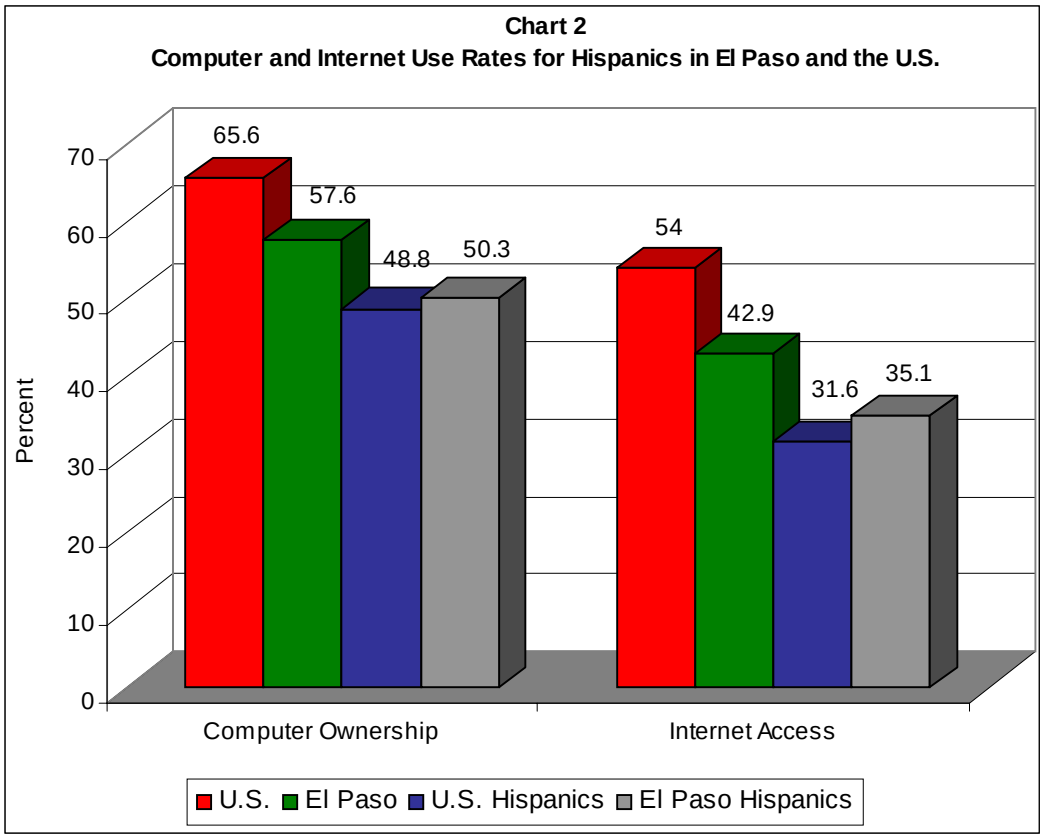



(18.6 %) had less than a high school education, and 28.4 percent graduated from high school which includes the GED. More than a quarter (28.4 %) had some college (includes technical school training), followed by 16.4 percent who held a bachelor's degree. Over eight percent (8.2 %) of the sample hold a graduate degree. Age distribution indicates that nearly one-third (33.5 %) of the respondents to the survey were between 26 and 39 years of age, and a group we anticipate will become or already are technology users. The second largest sample subset is made up of 40 to 49 olds (21.7 %), a group that has experienced the IT and computer boom in their adult years. The sample above 50 years of age (31.7 %) is receiving IT and computer in increments, albeit somewhat quickly, after they reached adulthood. At the other extreme, 18 to 25 year olds who have experienced considerable IT exposure throughout their life comprise 13.1 percent of the respondents to the survey. Overall these characteristics are consistent with the regions demographics and provide a representative sample for drawing conclusions and accurately benchmarking the community.

**How El Paso Compares**

Although the most recent NTIA study is over a year old, comparisons to the recently collected El Paso data shed light on a number of areas. As Chart 2 shows, nationwide in 2001, 65.6 percent of households owned computers, compared to 57.6 percent of households in El Paso. Hispanics in El Paso actually fared better than their U.S counterparts, with 50.3 percent reporting that they owned computers, although this figure is well within the margin of error for this study. The same general trend holds true for Internet access. Across the nation, 54 percent of homes had Internet access in 2002, compared to 42.9 percent for El Paso. El Paso Hispanics also had somewhat higher Internet use rates (35.1 %) than Hispanics nationally (31.6 %). Neither of the findings is surprising, however, given that El Paso's Hispanic community is largely heterogeneous, as would be expected in any county where the largest ethnic group makes up 78 percent of the total population (U.S. Census, 2000).

These data, however, we believe only provide limited information in that real differences between ethnic and other groups cannot be detected. The real question that should influence policy is: How much of the variability in computer and related IT use is explained by ethnicity or other factors, such as income, education, and age? Moreover, are these differences between groups statistically significant in the sense that one group differs in its overall mean score from others? It would be useful if the NTIA provided such data, but no real comparisons between groups are made, aside from a binary logistic regression approach adopted for the 1999 NTIA study. Even then, only Internet use and access to computers are evaluated; and, as IT alternatives continue to evolve, these measures hardly describe IT use as a key component of a skilled workforce or as part of civic culture (Norris, 2001). To respond to this problem, the El Paso study incorporated a number of items that were intended to measure both tools, such as computers, and uses of related IT, such as Internet banking.




**IT Scale**

The first step in detecting differences between groups is building a reliable scale. For the study here, 18 binary items (0 = no, 1 = yes) were summed to create a composite score (ranging from 0 to 18) of computer and related IT proficiency. The data collected suggest that the scale as constructed is reliable (Cronbach $\alpha$=.842 or internally consistent) well above the normally accepted minimum of $\alpha$=.7. While some caution should be taken when using binary items in items in summed scales because of a violation of the linearity assumption for individual items (McDonald, 1999), the use of Chronbach's Alpha is still useful in that it represents a *lower-bound* of reliability. The items included in the scale are as follows:

Do you have access to the following device in your home or use any of the following?

| | | |
|---|---|---|
| Television | Regular cable TV | Digital cable or satellite cable |
| Cellular phone | Pager | Personal digital assistant (PDA) |
| Fax | Web TV | Digital camera |
| ATMs | Debit cards | Banking by phone |

Shopping by phone Wireless Internet Internet banking

Internet shopping Do you currently have a computer at home?

Do you currently have Internet access at home?

The distributions of responses for the scale are provided in Table 1. These data show that the majority of the respondents fell into the low computer IT use category, 58.62 percent we call

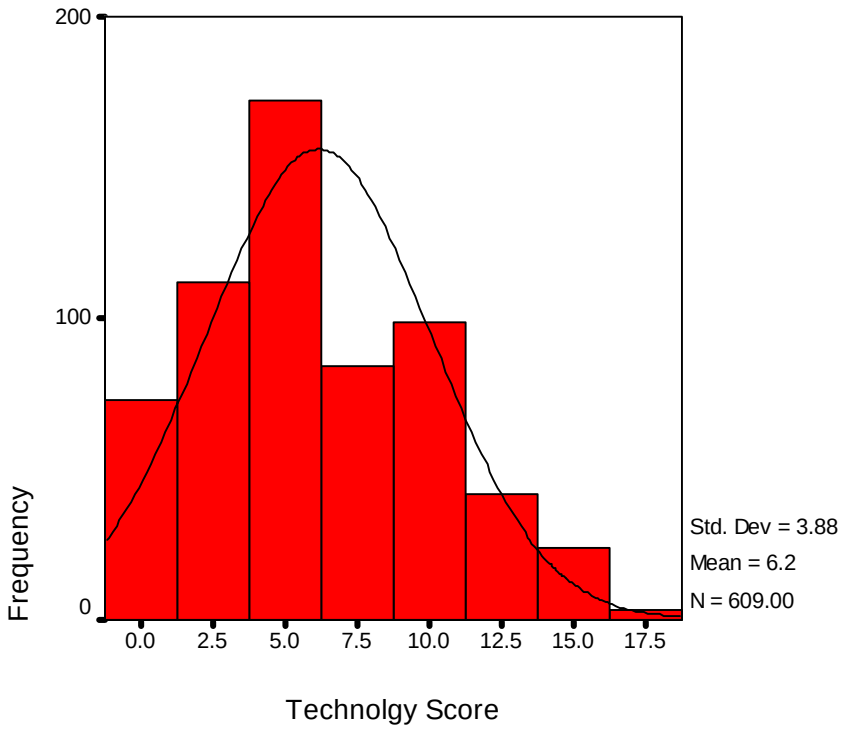
**Table 1**
**Distributions of Technology Use Index Scores**

| Index Score | Frequency | Percent | General Categories |
|---|---|---|---|
| .00 | 4 | .7 | |
| 1.00 | 69 | 11.3 | *Low* |
| | | | ***(Learners)*** |
| .00 | 52 | 8.5 | *Scores 0 to 6* |
| 3.00 | 60 | 9.9 | *357* |
| 4.00 | 55 | 9.0 | *58.62%* |
| 5.00 | 63 | 10.3 | |
| 6.00 | 54 | 8.9 | |
| 7.00 | 43 | 7.1 | |
| 8.00 | 41 | 6.7 | *Medium* |
| | | | ***(Adapters)*** |
| 9.00 | 33 | 5.4 | *Scores 7 to 12* |
| 10.00 | 35 | 5.7 | *207* |
| 11.00 | 31 | 5.1 | *33.99%* |
| 12.00 | 24 | 3.9 | |
| 13.00 | 18 | 3.0 | |
| 14.00 | 16 | 2.6 | |
| 15.00 | 7 | 1.1 | *High* |
| | | | ***(Technologists)*** |
| 16.00 | 1 | .2 | *Scores 13 to 18* |
| 17.00 | 2 | .3 | *45* |
| 18.00 | 1 | .2 | *7.39%* |
| Total | 609 | 100.0 | |

"learners," suggesting that overall the community may have a generally low rate of adoption of computer and IT-related services. Over one-third (33.99 percent) fall into the medium use category, or "adapters" indicating a mix of uses and a proclivity for adoption of a mix of applications that in many ways have become a daily part of life. For example, television, cell phones, and ATMs are rather routine for many people and are not exotic or exclusive, as they were ten years ago. Those who fall into the high use category, our "technologists," are less

than 10 percent of the total (7.39 %) and use a broad range of applications and services, making inclusion of computers and related IT a routine and inclusive part of their lives. Chart 3 provides a graphic of this distribution. The normal curve indicates that the mean of 6.2 equates with the "learners" level, which, based on the discussion of intelligent communities (Intelligent Community Forum, 2001) would seem not to be a positive indicator in economic development terms.

**Chart 3**
**Distribution of Technology Use Scale**




Given that the IT use scale is internally consistent, as discussed above, additional statistical tests become available. For the purposes here, an analysis of variance (ANOVA) approach is appropriate for detecting overall differences between groups. To detect differences between individual groups and to control for increases in the family-wise error rate, a Tukey Honestly Significant Difference (HSD) post-hoc test is used. Inasmuch as statistical significance is a function of sample size in such tests (Carver, 1978), more weight will be placed on the discussion of $R^2$ values. In addition, a traditional linear regression approach will be used to test how each of the variables discussed above explain variability in the summed technology use and proficiency scale. What this leads to is asking what differentiates the "learners" from the "adapters" and the "technologists.

**Analysis of Variance**

Not surprisingly, particularly given the sample size for this study, the result for every one-way ANOVA was statistically significant at the $p = .000$ level or better as shown in Table 2. Unfortunately, this provides little information beyond what one can glean from each of the NTIA studies, namely that there are differences across ethnic groups and income and education levels in terms of overall computer and related IT use. Income did far better than each of the other independent variables, explaining 32.6 percent of the variability in use patterns. Education, although not as strong in its explanatory power, also did well, explaining 21.4 percent of the variability in IT and computer use. Given previous NTIA research, one would expect ethnicity to explain a high degree of computer and related IT use. Ethnicity explained a relatively small amount of variability in the dependent variable. The $R^2$ value of .081 suggests that only slightly more than 8 percent (8.1 %) of the variability in the scale is explained by a person's ethnicity, raising questions about earlier discussions that saw a strong link to ethnicity. Age was the weakest of all of the variables tested, explaining only 5 percent (5.1 %) of the variability in the scale.

**Table 2**
**Technology Use Summed Scale (DV)**

| *IV* | *df* | *df error* | *F* | *Significance* | $R^2$ |
|---|---|---|---|---|---|
| Income* | 5 | 603 | 58.415 | .000 | .326 |
| Education* | 4 | 604 | 41.030 | .000 | .214 |
| Ethnicity* | 2 | 606 | 26.668 | .000 | .081 |
| Age* | 4 | 604 | 14.414 | .000 | .051 |

* Equals statistical significance at $\alpha = .05$ or better

The Tukey HSD post-hoc tests (data available on request) provide further insight about the differences between the groups included within each of the independent variables. Income behaves just as one would expect from NTIA research. Respondents making under $20,000 ($m = 4.217$, $sd = 3.068$ ) and $20,000 to $40,000 ($m = 6.404$, $sd = 3.223$ ) had statistically lower mean scores than each of the higher income groups, while the $20,000 to $40,000 group mean score was also statistically higher than the under $20,000 group. Findings for the education variable follow along the same general path. Those with less than a high school education ($m = 3.336$, $sd = 2.582$ ) and those who had completed only high school

(*m* = 5.127, *sd* = 3.31 ) had statistically lower mean scores than each of the higher education groups. This is borne out by the fact that once a person has some college education, many of the statistical differences disappear until at least a graduate degree is obtained. The results for the age variable are intriguing. Higher levels of income and education are often associated with age, which one would suppose would lead at least middle age groups to be more proficient in computer and related IT use than at least some of the lower age groups. This is not the case, as the only statistical difference is between those 60 and above (*m* = 4.222, *sd* = 3.888) and each of the other education groups, and the difference is a negative one in that the oldest age group has a lower overall mean score than each of the other groups. Based on NTIA research, ethnicity also behaves as expected. Hispanics (*m* = 5.497, *sd* = 3.825) had a lower mean score than both Whites (*mean* = 8.166, *sd* = 3.402) and those self reporting as "other" (*m* = 7.500, *sd* = 3.531). Based on these analyses the findings are consistent for income, education, and age, but we have some indications that ethnicity may not follow the trend of previous research.

**Linear (OLS) Regression**

The above ANOVA analyses would suggest that each of the variables, with the possible exception of age, behaves as expected (Table 3). The real question is whether differences between ethnic and age groups still exist after controlling for income and education, both of which explained the highest degree of variability in the dependent variable above. Linear regression allows a formal test of each of these variables when combined in one model. The examination below was conducted in four stages, with one variable being added at each step. Model one includes only income, while models two through four include, in succession, education, age, and then ethnicity.

The most surprising finding of the results is not that income again was the strongest of the variables included, but the degree to which the variables combined to explain variability in the technology score. The *t* and *F* statistics provided are well below the *p* = .05 level for all but model four, where ethnicity is not statistically significant. The implications for these findings are twofold. Most important is the fact that even without ethnicity, the remaining variables still explains 40 percent of the variability in overall technology use, while income

and education alone explain more than 36 percent. Further consideration of the ethnicity variable clearly suggests that the role of ethnicity explains less than at the national level. The

**Table 3**
**Technology Scale Model Summaries**

| Model | Independent Variables | B | *T* | Sig. | *F* | Sig. | $R^2$ |
|---|---|---|---|---|---|---|---|
| $\hat{TS} = \beta_0 + \beta_1(income)$ | Constant<br>Income | 2.664<br>1.760 | 10.775<br>16.586 | .000<br>.000 | 275.091 | .000 | .312 |
| $\hat{TS} = \beta_0 + \beta_1(income) + \beta_2(education)$ | Constant<br>Income<br>Education | 1.138<br>1.405<br>.817 | 3.681<br>12.275<br>6.886 | .000<br>.000<br>.000 | 171.775 | .000 | .362 |
| $\hat{TS} = \beta_0 + \beta_1(income) + \beta_2(education) + \beta_3(age)$ | Constant<br>Income<br>Education<br>Age | 3.342<br>1.424<br>.816<br>-.588 | 7.165<br>12.813<br>7.082<br>-6.186 | .000<br>.000<br>.000<br>.000 | 134.314 | .000 | .400 |
| $\hat{TS} = \beta_0 + \beta_1(income) + \beta_2(education) + \beta_3(age) + \beta_4(ethnicity)$ | Constant<br>Income<br>Education<br>Age<br>Ethnicity | .3508<br>1.424<br>.817<br>-.588<br>-.0036 | 6.7<br>12.802<br>7.068<br>-6.186<br>-.359 | .000<br>.000<br>.000<br>.000<br>.720 | 100.623 | .000 | .400 |

fact that a large Hispanic population makes up the border region no doubt explains part of this finding. Perhaps what is more important is that Hispanics have begun to move from being "learners" to becoming "adapters." Computers and related IT use are less and less limited to those with high incomes and/or higher education levels, it is becoming a mainstream phenomenon that will continue to expand. However, income is a limiting factor and computers and related IT are consumed after many other needs are met for low income families. In this regard, evidence that Hispanics are becoming adapters in the border region, contrary to some indications of the opposite at the national level, may bode well in transforming communities and economies in the region.

**Discussion**

Clearly, the results presented paint seemingly different pictures. There are measurable differences between income, education, age, and ethnic groups in overall computer and related IT use. What is important, however, is how much of the variability is explained simply by group membership. For age and ethnicity, only 5 and 8 percent, respectively, of the overall variability is explained. While this seems somewhat high, income and education clearly play far more important roles. Moreover, once controlling for income, education, and age, the effects of ethnicity are *negated.*

In a practical sense, these findings are surprising when compared to anecdotal national evidence, but should come as no surprise to local policy makers or those who follow development in the border region. El Paso's Hispanic population is a large and heterogeneous one, composed of individuals from vastly different education and income levels. As local efforts are mounted to address computer and the growing list of IT issues, these and other findings should be considered to the extent that differences do exist between groups; but, to make significant change, income and education gaps should guide existing and new program implementation and policy.

The above results should also serve as a benchmark such that future replications of this study should show smaller and smaller amounts of explained variability based on income and education. Not only would future replications be important as measures of a key component of El Paso's growth, like all benchmarking data they could also serve as a tool for continuous program improvement in a variety of domains (Jarrar and Zairi, 2001: 906-912). At the high end, a comprehensive strategy to boost computers and related IT use and its value as a tool in the economy of the region is required. This strategy must view them as an enabling component across existing, as well as emerging sectors. Given that El Paso is a larger and more prosperous town within the border, it is likely that other communities may fall behind these findings. In addition, this strategy is required to also have an international component which was not addressed here, but is an inescapable part of the border. Using computer and related IT in the bi-national sphere will help develop "good governance" and, overall, goals to improving the region's quality of life (Johnston, 2001: 193-199). Regardless, these findings do show that the ethnicity variable may not play as critical of a role in explaining why computers and related IT have not been adapted than studies done at the

national level have concluded. Further examination of this issue clearly should follow and the "benchmark" provided here will, hopefully, serve as a model to follow in other areas of the border region.

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