# Economic Performance in a Cross-Section of U.S. Native American Economies

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**Abstract:** Institutions either promote or constrain economic performance, but which parts of institutions advance or restrict performance, and why do economies sharing similar institutions sometimes perform differently? This paper is a modest attempt at addressing a small part of these questions. It applies a novel model that is capable of separating infrastructural and superstructural effects of institutions on aggregate and average income across 84 U.S. Native American economies (USNAEs). It finds that USNAEs have much in common with developing countries inasmuch as their aggregate and average incomes depend mainly on the accumulation of physical capital and exogenously-given labor**.** However, resources and resource productivity are necessary but insufficient determinants of income for institutional reasons. Because of the apparent scarcity of physical capital, infrastructures that aid human capital formation (schools, hospitals, and the like) are inadequate, so that even when the local superstructure is generally accepting of external technology, the impact of human capital on performance remains modest. Clearly infrastructural and superstructural aspects of institutions are competitive rather than complementary, which weakens the Nelson-Phelps channel for transmitting external technology into USNAEs.

**Keywords:** infrastructure, superstructure, performance constraints, institutions, human capital, U.S. Native American economies

**JEL Code:** O15, O57, J15, J24, R30, R23, R38, F43, D24, C31, C51, C21, C53, P47, P47, P17, O51

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## 0. Introduction

MOST conventional economic growth theories argue that differences in economic performance across economies are due to differences in factor endowment, factor productivity, technology, or some combinations of the above. The same theories then predict significant positive externalities from interactions among economies via trade, human capital, and even geographical location (Moreno and Trehan, 1997). Such predictions seem to suggest that parts of one economy should perform approximately the same as the whole economy, *ceteris paribus*. Yet ***U.S. Native American economies*** (USNAEs) differ in economic performance from their host(s) - the general U.S. economy and U.S. state economies - of which they are a part, and among themselves (Cornell and Kalt, 1998).[2] The difference in performance has significant implications for [the welfare of] Native Americans.

In the 1990s the average unemployment rate among Native Americans was about 25% compared to six percent for the USA as a whole. For the Fort Apache American Indians unemployment during this same time period was as high as 35.3%. About 14% of the entire Native American labor force remains unemployed to-date, and the unemployment rate among persons younger than 24 years of age approached 100% even when the U.S. natural rate of unemployment was estimated at between four to six percent. Consequently, at $21,000 the median income for a Native American family is nearly $15,000 lower than that of a fellow average American. Considering the largest 25 American Indian tribes alone, there exists a large gap between the average per capita income of only $8,284 vis-a-vis the national average of $14,420. Up to 10% of Native American *families* and 13.1% of the *entire* Native American population live in poverty compared to nine percent and 11% respectively for the USA as a whole (Vinje, 1996). It is not surprising that the high school and higher educational

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[2]In this paper the USNAEs imply selected American Indian and Alaska Native Tribal Designated Statistical Areas (TDSAs), Tribal Jurisdiction Statistical Areas (TJSAs), and Reservations and Trust Lands (RATLs). The U.S. Bureau of Census defines TDSAs as "areas, delineated outside of Oklahoma by federally- and state-recognized tribes without land base or associated trust lands, to provide statistical areas for which the Census Bureau tabulates data. TDSAs represent areas generally containing the American Indian population over which federally-recognized tribes have jurisdiction and areas in which state tribes provide benefits and services to their members. The Census Bureau did not recognize TDSAs before the 1990 census", because some delineated TDSAs were only state-recognized tribes.

TJSAs are defined as "areas, delineated by federally recognized tribes in Oklahama without a reservation, for which th Census Bureau tabulates data. TJSAs represent areas generally containing the American Indian population over which one or more tribal governments have jurisdiction. If tribal officials delineated adjacent TJSAs so that they include duplicate territoy, the overlap area is called 'joint use area', which is treated as a separate TJSA for census purposes."

RATLs are defined as "areas with boundaries established by treaty, stature, and/or executive or court order, and recognized by the Federal Government as territory in which American Indian tribes have jurisdiction. State reservations are lands held in trust by State governments for the use and benefit of a given tribe. Trust lands are property associated with a particular American Indian reservation or tribe, held in trust by the federal Government. Trust lands may be held in trust either for a tribe (tribal trust land) or for an individual member of a tribe (individual trust land)." For a brief definition of all three designations, see http://factfinder.census.gov/metadoc/1990stf3td.pdf or the US Bureau of Census and Bureau of Indian Affairs (BIA) for details.

attainment of Native Americans 18 years and older averages only 43.3% compared to 53.1% or more for the entire U.S. population.

The question is: What explains the difference in economic performance between USNAEs and the U.S. economy? Researchers, especially those at the Harvard Project on American Indian Economic Development, and the Udall Center for Public Policy at the University of Arizona, have been grappling with this question for a while. For instance, Cornell and Kalt (1998) see the problem in the lack of effective institutions and argue for sovereignty and nation-building as remedies to the problem. Pickering and Mushinski (2001) and Mushinski and Pickering (2000) emphasize cultural imperatives. While the full verdict is not yet in, a general consensus has emerged that economic growth across USNAEs, just like across other embedded economies, is not about resources and simple expertise alone (Henson, 2003).

The objective of this paper is to apply a novel model for assessing aggregate and average economic performance across 84 USNAEs suggested in Amavilah (2004a) and tested on 50 reservation economies by Amavilah (2004). Presentation is organized in 5 parts plus an appendix. The next section scans the relevant literature. Section 2 develops the model, which is then extended the model in the third section to allow for separate estimates of infrastructural and superstructural effects of institutions on economic performance. Section 4 presents estimation results. The final section states the implications of the results and their conclusions. The appendix deals with data, variables, and other measurement issues.

## 1. Scanning the Literature

Solow's (1956, 1957), Swan's (1956, 2002) and other findings that capital contributes less than expected to observed economic growth, leaving unexplained a surprisingly large residual which Solow attributes to exogenous technical change, split research on economic growth into two groups. Some economists disputed, a few even repudiated, the appropriateness of the aggregate production function Solow employed, but their alternative models produced neither close nor enduring substitutes. Others saw research opportunities in explaining why the Solow residual deviated markedly from present-day theory.[3] In recognizing the cumulative nature of learning-by-doing and its implications for both economic growth and the Solow residual, Arrow (1962) made a breakthrough that upgraded Solow *originale* to a neo-Solow status.[4] And so, with Solow and Arrow on side, the

[3]Some critics pointed to model specification error (wrong functional form), while others saw mis-specification error (wrong variables included or correct variables excluded). The latter set of criticism has not gone away to-date; the former is not peculiar to Solow because it has been raised about the restrictiveness of the original Cobb-Douglas (1949) production function. Professor Joan Robinson was among those who detested the aggregate production function approach. In a related area, the interested reader may start with a recent retrospective and a reply by Cohen and Harcourt (2003a, 2003b) and the comments it provoked from Pasinetti (2003), Fisher (2003), Filipe and McCombie (2003), and Greenfield (2003).

[4]In my view neo-Solow models start with Solow's (1960) vintage paper, and matures with Arrow's (1962) learning-by-doing. Kenneth Arrow and Sir JR Hicks share the Nobel Prize in Economic Science for 1972 for their many contributions to the theories of general equilibrium and welfare, and the learning-by doing model was no less

first generation of neo-Solow models focused on the "elusive quest" for the causes of economic growth, meaures of growth, and especially why growth rates differ across economies (Easterly, 2002, Temple, 1999, Denison, 1962). The second generation of neo-Solow models sought to understand the interplay between the factors and forces of production on the one side, and policy on the other, but its success was confined to the elite research community, see, e.g., Abramovitz (1979), Kendrick (1961), Jorgenson and Grilliches (1967), Kaldor (1966), and many others. Despite the confinement, theory took significant steps into two directions. In one direction Lewis (1954) suggested that, given the dualism of some economies, differences in economic growth (development) are explained by a surplus supply of labor.[5] To some Lewis implies that sustained growth of the modern sector should bring upward the backward sector, increasing economic performance overall - Verdoon's law (Kaldor, 1978, 1975, Dixon and Thirlwall, 1975). Others accepted Lewis's implication, but disputed the conclusion inferred from it, because of the possible existence of the Young (1928)-Myrdal (1957) effect, or the so-called circular and cumulative causation in which good performance always begets good performance, and poor performance breeds poor performance. Therefore, while dual economy models are powerful, they are hardly useful tools for describing embedded economies such as USNAEs and their relationships to their host(s), mainly because embedded economies are dual themselves.

In the second direction research stressed the political economy of performance in which comparative growth rate differences are due to the interactions of political and economic factors (Mueller, 1983). The ideas generated by this line work led to the third generation of neo-Solow growth models marked by influential efforts like those by Romer (1986), Mankiw, Romer, and Weil (1992), Barro (1991, 1994), and Barro and Sala-I- Martin (1995). The initial modeling emphasis went into adjusting labor for quality, but progress created the momentum for new growth (endogenous) models (see Romer, 1989, 1990, 1994, Solow, 1994). According to the new models economic growth is a function of "objects" and "ideas", to borrow Paul Romer's lingo. A major distinction between ideas and objects is that objects are subject to the initial conditions of the economy and subsequent diminishing returns to scale, while ideas are not. In fact, scarcity gives incentives for innovations, which in turn allow different economies to grow at different rates even if their objects and object productivities are the same. Thus, one of the strongest contributions of the new growth models, after accounting for the shortcomings pointed by Pack (1994), is bringing to renewed attention the old idea that the factors and forces of production can, perhaps must, be treated as endogenous determinants of economic growth (Lucas, 1988, 1993, Grossman and Helpman, 1991, Romer, 1990, 1993, 1994).

Extant models clearly assert that differences in factor productivities explain growth differences across economies; they are less unambiguous in their explanations of the sources of factor productivity differences. Hence, the appeal of Adam Smith's thesis that, rather than resources and resource productivity per se, institutions are central to economic growth. In fact, Smith's reincarnations like

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significant a part of that. Solow 's (1997) reflection on the significance of of Arrow learning is excellent reading for any growth economist.

[5]See Choi (1983: 167-180) and Thirlwall (1978: 129-142) for an extensive review of the literature.

Sir W. Arthur Lewis (1965), T.W. Schultz (1981), and Gary Becker (1964) have long argued that , although necessary resources and resource productivity are insufficient drivers of economic growth. For Lewis, basic to resources and resource productivity are the historical, philosophical, and social structures that motivate and sustain "*the will to economize*", i.e., scarcity leads to institutions that are capable of organizing resources into productive uses, and therefore progress.[6] Thus, in attributing differences in average labor productivity across countries to institutions, broadly speaking, or social infrastructure particularly, Hall and Jones (1998, 1999) have resurrected the Smith-Lewis hypothesis. Their research effort is fresh, but the positive association alleged between strong economic performance and "good" institutions, has been asserted repeatedly, see, e.g., Polanyi (1957) and others. Acemoglu, Johnson, and Robinson (2001), and Lee (2002) also found evidence supporting the link between institutions and economic performance, evidence that is consistent with the model in which Smith sought the creation of institutions for progress (Angresano, 1992). Institutions are crucial to economic performance because they define the social relationships surrounding economic activities, and enable economic agents to pursue their self-interests to the ultimate benefit of society (Smith, 1957, 1974). Although from Temple (1998, 1999), Hall and Jones (1998, 1999), and others it is sufficiently clear that the differences in factor productivity across countries, and hence in economic growth rates, come from differences in institutions. Current literature on this topic does not tell us which parts of institutions are responsible for economic progress. The information gap about this question has basis in the real-world observation that some economies sharing similar institutions perform differently.

## 2. Modeling Economic Performance across USNAEs

### 2.1 Aggregate Economic Performance

Following Amavilah (2004a, 2004b) let us measure the economic performance of the ith USNAE by $Y_i$. Suppose $Y_i$ is produced using local physical capital ($K_i$ ), technology ($A_i$), and the *economically capable population* ($N_i$), as well as the general condition ($Y_j$ ) and the state of technology ($A_j$) of the host economy. Next assume that $A_i$ augments $L_i$ , $Y_j$ affects $Y_i$ directly, and $A_j$ affects $Y_i$ indirectly through $N_i$ - the Nelson-Phelps (1966) channel.[7] By supposing further a multiplicative production function and following Jones (1997, 1999) and Hall and Jones (1998, 2000), one can treat $N_i$ as decomposable into raw labor ($L_i$ ) and human capital ($H_i$ ), so that

$$Y_i = [(A_i L_i)^{\alpha} K_i^{\beta} (A_j e^{\phi S_i} L_i)^{\gamma} Y_j^{\delta}] e^{\mu_i}, \qquad (1)$$

[6]In some sense Paul Romer's objects-versus-ideas version of the new growth model is a re-interpretation of Lewis (1965), especially Chapter 2, pp.23-56. Lewis's book, first published in 1953, remains the best book on economic growth based on its coverage of theory, methodology, and policy.

[7]This analysis does not seek to characterize this channel; information theorists such as Shannon (1948, 1998), Ash (1965), and Khinchin (1957) are good references.

where $A_iL_i$ is effective local $L_i$, human capital is the equivalent of the quality-enhanced component of total labor given by $H_i = e^{\varphi S_i} L_i$ ; $S_i$ is a measure of $H_i$, such as schooling; and μ is the random error term.

However, (1) underutilizes "good" theory. For one, $L_i$ is too narrow a base for $H_i$ as it fails to recognize that the rate of diffusion of $A_j$ is a function of the capacity rate of the embedded economy to soak up $A_j$. The rate of diffusion in turn depends on the rate of adoption of $A_j$ by $N_i$, see, e.g., Rogers (1983:233).[8] Thus, (1) is mistaken to argue that the value of both human capital and raw labor becomes zero at retirement, and that children do not own human capital before the legal working age. It seems reasonable to argue that once accumulated, human capital retains some of its "scrap value" past retirement, and thus capitalized people continue to add value to economic performance even when those people are not directly employed in production. Such an argument contrasts to conventional approaches like those by Sianesi and Van Reenan (2003), and Harnom, Oosterbeek, and Waltker (2003), which measure returns to $H_i$ only as returns to education. Hence, it makes better sense to say that $H_i = e^{\varphi S_i} N_i$ such that

$$Y_i = [(A_iL_i)^{\alpha} K_i^{\beta} (A_j e^{\phi S_i} N_i)^{\gamma} Y_j^{\delta}] e^{\mu_i}, \qquad (2)$$

i.e., instead of $L_i$, $N_i$ is the Nelson-Phelps conduit (channel) that allows the adoption of external technology ($A_j$) via $H_i$.

**2.2. Average Economic Performance**

Dividing by $L_i$ and taking the natural logarithms of both sides of (1) gives the log average labor productivity as

$$lny_i = \alpha_0 + \beta \ln k_i + \phi S_i + \delta \ln y_j + \mu_i, \quad (\alpha_0 = \alpha \ln A_i + \gamma \ln A_j), \qquad (3)$$

where $y_i = Y_i/L_i$, $k_i = K_i/L_i$, and $y_j = Y_j/L_i$. Similarly, from (2), but this time using $N_i$ as the numeraire and logging naturally both sides, we get

$$\ln y_i^* = \alpha_0 + \alpha \ln \ell_i + \beta \ln k_i^* + \phi S_i + \delta \ln y_j^* + \mu_i, \quad [\alpha_0 = lnA_i + \ln A_j], \qquad (4)$$

[8]This is an old idea on how cultural factors can aid or inhibit technical change, see, e.g., Bury (1932), Mead (1953), Cipolla (1965), Volti (1992), Rogers (1983), Pytlik, Lauda, and Johnson (1985), and Fryer (2003). Many authors have hinted at that observation such as Adelman and Morris (1967), Temple and Johnson (1998), Coleman (1990), Fryer (2003), Nisbet (1980), and Castle (2003). The term "institutional sclerosis" has also been used to make this very same point, see, e.g., Choi (1983: Chapters 3 and 9).

where $\ell_I = L_i/N_i$ is the local physical labor intensity of $N_i$, $k^*_I = K_i/N_i$ is the physical capital intensity of $N_i$, and $y^*_j = Y_j/N_i$ is the host's output relative to $N_i$. From (1) and (2), $y_j$ and $y^*_j$ can be read either as spill-over effects of the host economy on the local economy, or as measures of what labor productivity would be if all U.S. output were produced by U.S. Native American labor alone, that is, the relative difference between local and host labor productivity.

At the aggregate level the lefthand sides of (1) and (2) mean the same thing. On the right side of (2) $H_i$ is drawn from the economically capable population ($N_i$) larger than $L_i$, and it is not surprising that (3) ≠ (4). But since $L_i$ is some proportion of $N_i$, we can rewrite (2) as

$$Y_i = [(A_i L_i)^{\alpha} K_i^{\beta} (A_j e^{\phi S_i} N_i L_i)^{\gamma} Y_j^{\delta}] e^{\mu_i}, \tag{5}$$

where $L_i$ is some fraction of $N_i$. For a precisely defined relationship between $N_i$ and $L_i$, the intensive form of (5) is equivalent to (3). Now the remaining task, to which we turn next, is to specify and measure $N_i$.

## 3. Economic Performance and Institutions

### 3.1 Mining Population for Human Capital: The Lasky Adaptation

Previous research measures $H_i$ as an institutional variable, and represents it with schooling, literacy, and the like. Then one can estimate (1) and (3) as stated above, assuming $H_i = e^{\varphi S_i} L_i$. In theory one can also estimate (4) and (5) assuming $H_i = e^{\varphi S_i} N_i$. The question is: how does one measure $N_i$? To measure $N_i$ I introduce a quantity-quality model familiar to economic geology, mining and geological engineering, and mineral economics. In its original use this model illustrates the responsiveness of a stock of resource, such as a mineral ore (quantity), to its average grade in one deposit or across deposits (Lasky, 1950).[9] By analogy I treat $N_i$ as a rich stock that can be "mined" for human capital, i.e., in this case the Lasky adaptation would represent an inverse relationship between the log of (cumulative) stock - the economically capable population ($N_i$) - and its corresponding quality ($\bar{q}_i$), i.e.,

$$lnN_i = \theta_0 + \theta_1 \bar{q}_i \Rightarrow \bar{q}_i = \lambda_0 + \lambda_1 \ln N_i, \quad [\lambda_0 = \theta_0/\theta_1 > 0 \;\; \lambda_1 = 1/\theta_1 < 0], \tag{6.1}$$

and hence, for

[9] Amavilah (2004a) outlined two other models of this type.

$$N_i = e^{\theta_0 + \theta_1 \bar{q}_i},\ H_i = e^{\phi_i S_i}[N_i] = e^{\theta_0 + \theta_1 \bar{q}_i + \phi_i S_i}. \tag{6.2}$$

Eq. (6) implies that measured conventionally, $S_i$ is not an adequate measure of $H_i$. For example, $e^{\theta_0 + \theta_1 \bar{q}_i + \phi_i S_i} \geq / \leq e^{\phi_i S_i}$ , and here is how that might happen.

According to the standard models, the desirable level of human capital ($H_i^*$) is

$$H_i^* = (1-\sigma) e^{\phi S_i} L_i = e^{\phi S_i} L_i,\ \sigma = 0,\ 0 < dlnH_i^* / dS_i = \phi < 1, \tag{7.1}$$

implying that there is no human capital drain ( or depreciation), either because $L_i$ is fully employed already, or because, being tied to local $A_i$ , it is unemployable outside the embedded economy. However, with nonzero human capital drain,

$$\begin{aligned} H_i^* &= (1-\sigma) e^{\phi S_i} N_i,\quad 0 < \sigma < 1\ \ (conventional\ \ iff\ N_i \equiv L_i) \\ &= (1-\sigma) e^{\theta_0 + \theta_1 \bar{q}_i + \phi S_i} \Rightarrow dlnH_i^* / d\bar{q}_i = \theta_1,\quad dlnH_i^* / dS_i = \phi \end{aligned} \tag{7.2}$$

Eq. (7.2) means that $A_j$ transforms $N_i$ into $H^*_I$ that can be employed inside and outside embedded economies (USNAEs), and in that case both σ and γ would be nonzero. Hence, $H_i^* < H_i$ depreciates slower with old age than it appreciates with youth.

### 3.2 Infrastructural Versus Superstructural Aspects of Institutions

The extent of the influences of $H_i$ on $Y_i$ reflects the strength and weakness of institutions in supporting economic performance. The question is: What parts of institutions are responsible for growth, since it is pretty obvious that economies with similar institutions are not performing similarly? To answer this question one can take advantage of a Marxian dichotomy that states that institutional determinants of economic growth can be either infrastructural or superstructural. With the dichotomy Marx was acknowledging the dynamics underlying production forces and social relations, in the sense that factors of production are responsible for the transformation of the material conditions of the economy - the basic structure or infrastructure. Changing the infrastructure tends to alter the factors of production and social relations of production, but that is not the whole story, because infrastructural changes alone do not automatically lead to progress (development). They do not lead to progress because the

infrastructure without the superstructure is like a skeleton without flesh on it. Again, changing the infrastructure is changing resources as well as social relations of production, but the effects of the change and their extent are muted or amplified by the superstructure (Marx, 1906, 1973, Cornforth, 1962, cf Rosenberg, 1982:34-51. Thus, one benefit of applying the Lasky model is that it permits us to separate the two aspects of institutions by letting $S_i$ proxy infrastructural elements of institutions, and q-bar represent the superstructural components of institutions. Compactly, then the appropriate human capital measure, with the possibility of $H_i^*$ drain, is

$$H_i^* = (1-\sigma)e^{\omega R}(N_i), \tag{8}$$

where ω is a vector of parameters θ and ϕ, and R is a vector of variables $S_i$ and $\bar{q}_i$. For $0 < \sigma < 1$, $H_i^* < H_i$, so that after accounting for $H_i^*$ drain, (8) combines infrastructural and superstructural factors in its first term; and infrastructural elements as in Hall and Jones in its second term, with the difference holding the place of purely superstructural factors. Note that $N_i = N^*_i - L_i$.

**4. Estimation Results**

Given full information on human capital drain and depreciation, the appropriate human capital to use is (7) and (8). Without such information we utilize (6.2) instead so that the equation for estimating aggregate income (output) is

$$\ln Y_i = \alpha_0 + (\alpha+\gamma)\ln L_i + \beta \ln K_i + \phi S_i + \theta \bar{q}_i + \delta \ln Y_j + \mu_i, \ [\alpha_0 = \alpha \ln A_i + \gamma \ln A_i + \theta_0]. \tag{9}$$

The average of (9) is

$$\ln y_i = \alpha_0 + \beta \ln k_i + \phi S_i + \theta \bar{q}_i + \delta \ln y_j + \mu_i, \ [\alpha_0 = \alpha \ln A_i + \gamma \ln A_j]. \tag{10}$$

Again variables Si and $\bar{q}_i$ measure institutional effects of human capital on performance, and they are discussed in the Appendix. The next part of this paper presents the results from the estimation of equations (9) and (10) for 84 USNAEs. Tables 1 and 2 report unrestricted 2SLS results. In particular Table 1.1 presents the findings for aggregate income considering the separate impacts of the economic conditions of the U.S. states in which USNAEs are located, whereas the results of Table 1.2 consider the economic condition of the USA as whole. In Table 2.1 corresponds to Table 1.1 and Table 2.2 to Table 1.2, but this time attention goes to average income per worker.

*U.S. Native American Aggregate Income and the Economic Conditions of U.S. States*

At the aggregate level the coefficient of capital ranges from 0.258 to 0.555, implying that the marginal effect of a one dollar increase in capital raises aggregate income by twenty-six to fifty-six cents. This range contains the usual "1/3 rule" and is consistent with the results of previous cross-sectional studies, e.g., . Holtz-Eakin (1993), Benhabib and Spiegel (1994), and Bloom, Canning and Sevilla (2004). At between 0.60 and 0.86 the marginal effect of labor on aggregate income is higher than that of capital; an additional worker adds an extra dollar to aggregate income.

The effect of human capital on aggregate income depends on which proxy of human capital is considered. If we took the percentage of workers with high school or better education ($E_{1i}$), which is close to the schooling variable often used, human capital contributes positively to aggregate income. For example, a one percentage point increase in the educational attainment of a worker adds a minimum of three cents to aggregate income. When broadened from simple educational attainment to include health/life expectancy and "other" components, human capital ($S_{1i}$) adds about 50 cents to aggregate income for every one percentage point change, that is, for each 10% rise. Moreover, whether in its narrow ($E_{1i}$) or expanded ($S_{1i}$) version, the impact of human capital on aggregate income is not statistically significant. Thus, econometric tuition recommends dropping $E_{1i}$ and $S_{1i}$ from estimation because they are not statistically different from zero. However, intuition argues for maintaining these variables, and for considering them in relation to the effects of $\overline{q}_i$ on aggregate income. Doing so shows that superstructural forces measured via $\overline{q}_i$ are negative, so that the net marginal impact of human capital on aggregate income is only 26 cents.

Next consider human capital as $E_{2i}$ and $S_{2i}$ ( see Appendix). In this case human capital has a negative, and significantly different from zero, impact on aggregate income. Between \$8.20 and \$12.40 of income is lost if human capital is increased by 10%, or one percentage point. There is negative net loss of income even after considering that $\overline{q}_i$ adds three cents to income for a similar increase in human capital. This suggests that human capital is both *thinly* and *shallowly* spread over the economically capable population ($N_i$). The consequence is that even though the superstructure is accepting of the transmission of external technology, the infrastructure is inadequately prepared for Hi accumulation as evidenced by a low human capital per economically capable person.

Finally, aggregate income responds with a fall of \$1.50 to \$1.80 for every one percent increase in the gross state product. One reason for this may be that 1990 was not a good year for the states involved. After all the prospects of the Gulf War I was already on the economy's mind. A second reason might be that the interaction between states and USNAEs is either weak, absent, or the economic conditions of states is not a good way of measuring state-USNAE relationships. One can also speculate that states and USNAEs are competitors for federal assistance, especially in recessions, as occasional debates over casinos and gaming often seem to indicate (Davis and Otterstrom, 1996, Evans and Topoleski, 1998).

**Table 1.1 - Aggregate Income of USNAEs Given Economic Condition of U.S. States, 1990[a]**
**(Dependent variable: $\ln Y_i$; Mean $\ln Y_i$: 18.517; Number of Observations: 84)**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Constant | 10.540 (6.342) | 10.119(3.700) | 14.193(8.542) | 10.106(3.678) | 10.819(4.074) | 17.250(9.940) | 17.249(9.873) |
| $\ln K_i$ | 0.237(2.417) | 0.555 (4.088) | 0.258(2.964) | 0.555(4.088) | 0.475(3.545) | 0.258(2.964) | 0.258(2.933) |
| $\ln L_i$ | 0.858(13.508) | 0.602 (5.86) | 0.815(14.285) | 0.603(5.586) | 0.671(6.282) | 0.815(14.285) | 0.815(14.195) |
| $E_{1i}$ | | 0.034 (0.229) | | | | | |
| $E_{2i}$ | -8.537(-10.565) | | -8.284(-11.528) | | | | |
| $S_{1i}$ | | | | 0.512(0.229) | 0.187(0.849) | | |
| $S_{2i}$ | | | | | | -12.425(-11.528) | -12.437-10.709) |
| $\overline{q}_i$ | | | | | -0.247(-2.722) | | 0.002(0.03?) |
| $\ln Y_s$ | | -0.181(-3.414) | -0.155(-4.765) | -0.181(-3.414) | -0.172(-3.366) | -0.155(-4.765z0 | -0.155(-4.734) |
| $R^2$ | 0.7524 | 0.4844 | 0.8076 | 0.4844 | 0.5292 | 0.8076 | 0.8077 |
| SEE | 0.92457 | 1.3425 | 0.8200 | 1.3425 | 1.2911 | 0.8200 | 0.8252 |
| LLF[b] | -110.554 | -141.353 | -99.9434 | -141.353 | -137.540 | -99.9434 | -99.9434 |
| DW(ρ) | 2.156(-0.080) | 2.107(-0.074) | 1.901(0.047) | 2.107(-0.074) | 2.248(-0.126) | 1.901(0.046) | 1.899(0.048) |

[a]Parentheses are t-values evaluated at the 5% level of significance.

[b]Log likelihood function

Table 1.2 - **Aggregate Income of USNAEs Given Economic Condition of the USA, 1990[a]**
**(Dependent variable: $\ln Y_i$; Mean $\ln Y_i$: 18.517; Number of Observations: 84)**

| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| Constant | No Constant | No Constant | No Constant | No Constant | No Constant | No Constant |
| $\ln K_i$ | 0.540(3.737) | 0.236(2.417) | 0.540(3.737) | 045493.192) | 0.236(2.417) | 0.236(2.383) |
| $\ln L_i$ | 0.661(5.29) | 0.859(13.508) | 0.661(5.29) | 0.731(6.536) | 0.859(13.508) | 0.859(13.422) |
| $E_{1i}$ | 0.072(0.456) | | | | | |
| $E_{2i}$ | | -8.537(-10.565) | | | | |
| $S_{1i}$ | | | 0.108(0.456) | 0.252(1.709) | | |
| $S_{2i}$ | | | | | -12.805(-10.565) | -12.775(-9.776) |
| $\overline{q}_i$ | | | | -0.266(-2.771) | | -0.0049-0.064) |
| $\ln Y_u$ | 0.188(2.1830 | 0.359(6.342) | 0.188(2.160) | 0.222(2.635) | 0.466(7.752) | 0.466(7.700) |
| $R^2$ | 0.4084 | 0.7524 | 0.4084 | 0.4608 | 0.7524 | 0.75624 |
| SEE | 1.4291 | 0.9246 | 1.4291 | 1.3729 | 0.9246 | 0.93038 |
| LLF[b] | -147.132 | -110.554 | -147.132 | -143.236 | -110.554 | -110.552 |
| DW(ρ) | 2.324(-0.183) | 2.156(-0.080) | 2.324(-0.183) | 2.452(-0.227) | 2.156(-0.080) | 2.162(-0.083) |

[a]Parentheses are t-values at 5% level of significance.

[b]Log likelihood function

Table 2.1 - **Average Income of USNAEs Given Economic Condition of the U.S. States, 1990[a]**
**(Dependent variable: $\ln y_i$; Mean $\ln y_i$: 12.158; Number of Observations: 84)**

| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| Constant | 8.049(11.15) | 8.078(10.61) | 10.28(10.40) | 11.79(20.15) | 13.53(20.71) | 10.26(10.52) | 10.88(11.25) | 16.61(20.57) | 16.63(20.32) |
| $\ln k_i$[b] | 0.423(8.830) | 0.417(4.891) | 0.603(6.099) | 0.171(3.239) | 0.340(5.621) | 0.603(6.099) | 0.521(5.211) | 0.340(5.621) | 0.341(5.581) |
| $E_{1i}$ | | 0.019(0.125) | 0.014(0.291) | | | | | | |
| $E_{2i}$ | | | | -8.58 (-10.7) | -8.36(-11.53) | | | | |
| $S_{1i}$ | | | | | | 0.062(0.291) | 0.199(0.944) | | |
| $S_{2i}$ | | | | | | | | -12.54(-11.5) | -12.60(-10.8) |
| $\overline{q}_i$ | | | | | | | -0.25(-2.70) | | 0.009(0.151) |
| $\ln y_s$ | | | -0.223(-3.25) | | -0.189(-4.49) | -0.223(-3.52) | -0.209(-3.16) | -0.189(-4.49) | -0.190(-4.47) |
| $R^2$ | 0.2930 | 0.2932 | 0.3757 | 0.7058 | 0.7652 | 0.3757 | 0.4285 | 0.7652 | 0.7653 |
| SEE | 1.4214 | 1.4300 | 1.3524 | 0.9225 | 0.8293 | 1.3524 | 1.3020 | 0.8293 | 0.83437 |
| LLF[c] | -147.717 | -1.47.70 | -142.497 | -110.888 | -101.414 | -142.497 | -138.783 | -101.414 | -101.402 |
| DW(ρ) | 2.141(-0.14) | 2.233(-0.15) | 2.162(-0.10) | 2.142(-0.07) | 1.923(0.035) | 2.162(-0.10) | 2.303(-0.15) | 1.923(0.035) | 1.907(0.042) |

[a]Parentheses are t-values at 5% level of significance.

[b] $\ln ki = \ln (K_i/L_i)$

[c]Log likelihood function

Table 2.2 - **Average Income of USNAEs Given Economic Condition of the USA, 1990[a]**
**(Dependent variable: $\ln y_i$; Mean $\ln y_i$: 12.158; Number of Observations: 84)**

| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| Constant | 11.476(3.486) | 13.317(6.707) | 11.449(3.500) | 11.992(3.808) | 16.467(8.067) | 16.452(7.951) |
| $\ln k_i$[b] | 0.541(3.746) | 0.237(2.423) | 0.541(3.746) | 0.455(3.199) | 0.237(2.391) | 0.237(2.391) |
| $E_{1i}$ | 0.073(0.459) | | | | | |
| $E_{2i}$ | | -8.536(-10.565) | | | | |
| $S_{1i}$ | | | 0.109(0.459) | 0.253(1.082) | | |
| $S_{2i}$ | | | | | -12.84(-10.565) | -12.774(-9.776) |
| $\overline{q}_i$ | | | | -0.266(-2.771) | | -0.431(-0.063) |
| $\ln y_u$ | -0.203(-1.061) | -0.095(-0.809) | -0.203(-1.016) | -0.187(-1.061) | -0.095(-0.808) | -0.0949-0.794) |
| $R^2$ | 0.3030 | 0.7082 | 0.3030 | 0.3647 | 0.7082 | 0.7082 |
| SEE | 1.4289 | 0.92449 | 1.4289 | 1.3728 | 0.9245 | 0.9303 |
| LLF[c] | -147.122 | -110.546 | -147.122 | -143.227 | -110.546 | -110.544 |
| DW(ρ) | 2.3146(-0.183) | 2.156(-0.080) | 2.3146(-0.183) | 2.453(-0.228) | 2.156(-0.080) | 2.162(-0.083) |

[a]Parentheses are t-values at 5% level of significance.

[b]$\ln k_i = \ln (K_i/L_i)$

[c]Log likelihood function

However, one cannot write this argument in stone because of the presence of large constant terms, although one can expect them to be large because they include local and national technical change. It seems that some important variables are missing. Even so, the regressions are well estimated, and most of them significant at the five percent level or lower. Forty-nine to eighty-one percent of variations in the regressions are explained by the included variables. The predictive power of each model is also reasonable, given the narrow range of the standard error of the estimate (0.82 - 1.35).

*U.S. Native American Aggregate Income and the Economic Condition of the USA*

The preceding discussion focused on aggregate income given the economic condition of the U.S. states. Considering the economic condition of the USA as a whole, the results show capital and labor contribute about the same to aggregate income as they did in the previous case (Table 1.1). Other things being constant, a one unit increase in capital and labor lead aggregate income to rise by 24 - 54 cents, and 67 - 86 cents, respectively. Estimates for both variables are reasonable, and compare well to findings such as those by Benhabib and Spiegel (1994), Cohen (1996), Holtz-Eakin (1993), and Bloom, Canning, and Sevilla (2004).

With respect to human capital both $E_{1i}$ and $S_{1i}$ have positive, but nonetheless insignificant, effects on aggregate income. The social return to E1i is about 7 per cent, and between 11% and 25% for $S_{1i}$. But there is a loss in aggregate income of 27% due to an increase in $\overline{q}_i$. The negative effect of $\overline{q}_i$ on aggregate income in the case of $S_{2i}$ is only -0.004, but both $E_{2i}$ and $S_{2i}$ tend to reduce aggregate income by $8.50 to $12.80 for a 10% rise in human capital, leaving an net impact of only two percent.

The economic condition of the USA has a strong marginal impact on the aggregate income of USNAEs. A dollar increase in U.S. GDP leads to an improvement in USNAEs of $19.00 at the minimum and $47 at the maximum. This result probably reflects the fact that USNAEs benefit from many U.S. federal government programs.

The predictive power of the estimated models is good judging from the standard error of the estimate of 0.93 - 1.43. An $R^2$ of 0.41 to 0.75 suggests reasonable goodness-of-fit. Even so, the constant terms and associated standard errors of the estimates are very large, leading to very low t-statistics, and were therefore suppressed.

*U.S. Native American Average Income and the Economic Condition of the U.S. states*

Turning to average income, the results show that increasing the capital-labor ratio by one percent increases average income a minimum of $17.00 and a maximum of $60.00. Measured conventionally, human capital ($E_{1i}$) adds about two percent to average income. Infrastructural dimensions of human capital as represented by $S_{1i}$ increased income by six percent to19.9%. Although these effects are not statistically significant, they are consistent with similar results for developing countries (see, e.g., Bloom, Canning, and Sevilla, 2004). Broadening the human capital measure, the results indicate that a one percentage point increase in human capital reduces average income by $8.50, considering $E_{2i}$, or by $12.60 using $S_{2i}$. What this means is that infrastructural aspects of Native American institutions tend to increase average income, but their effects are negated strongly by superstructural elements of institutions. The economic condition of states does not aid Native American average income. A dollar's worth of an increase in gross state product, means a reduction in Native American average income of up to $2.20. The negative sign means that average Native American average income is low because

infrastructural and superstructural elements of institutions are out of sync. The models which indicate that fact are reasonably well-explained and predicted as the goodness-of-fit of 29 % to 76% and standard error of the estimate of 1.43 respectively suggest.

*U.S. Native American Average Income and the Economic Condition of the USA*

While the US economic condition in 1990 helps Native American aggregate income to rise, it reduces average income by up to 20%. At between 0.24 and 0.54 the coefficient of the capital-labor ratio is strongly related to average income, and it falls within the range predicted by similar studies, e.g., Cohen (1996), Benhabib and Spiegel (1994), and Holtz-Eakin (1993). As in the case of the economic condition of states, conventional human capital ($E_{1i}$) contributes to average income in a manner not statistically different from zero, while the returns from extended human capital ($S_{1i}$) ranges from 11% to 25%. But those infrastructural effects are almost all offset by superstructural effects for which each percentage reduces human capital impact on average income by 27%. Similarly the superstructural forces reduce the contribution of human capital to average income by 43% in addition to significant losses due to $E_{2i}$ and $S_{2i}$.

As Table 1 shows 30-70% of variations in average income are explained by the included variables. But the large constant terms are a concern as they suggest missing variables. Figures 1 and 2 summarize the goodness-of-fit. Figure 1 compares actual to two predictions. The first (Predicted1) is Column 7 of Table 1.1 and Predicted2 is Column 6 of Table 1.2. Both indicate declining profiles of aggregate income across USNAEs as the linear trendline shows. Aggregate income falls between log $15 and log $25, with few exceptions below and above this narrow band. By the same token, Figure 2 shows even a more pronounced downward trend in average income. Based on actual and two predictions (Predicted1 or Column 9 of Table 2.1 and Predicted2 or Column 6 of Table 2.2), about half and half observed USNAEs have average income that falls within a band ranging from log $10 to log $18.

## 5. Implications of Results and Conclusions

What are the policy and further research implications of the results, and what conclusions do the implications suggest? The results indicate that aggregate income of USNAEs depends mainly on the accumulation of things (K and L). Marginal products of capital and labor in these economies are comparable to those of developing countries, and in that limited sense USNAEs have more in common with developing countries than with the developed countries of which they are physical parts. Average income investments in physical capital play the most important role; the marginal returns of 20% or higher, even discounting for risk, seem to be well above the cost of capital. They clearly imply capital scarcity. If this implication is correct, the calls for more investment made by people like Senator Tim Johnson (South Dakota) on behalf of Native economies is fully justified. Even so, it must be noted that dependence on objects is not such a bad thing in itself. Extensions of Romer shows that economic growth depends on the accumulation of objects in the early stages of economic development, and increasingly on ideas in the late stages of development (Graca, Jaffarey, and Philippopoulos, 1995, Amavilah and Newcomb, 2004).

**Figure 1 - Actual and Predicted Aggregate Income of USNAEs, 1990**

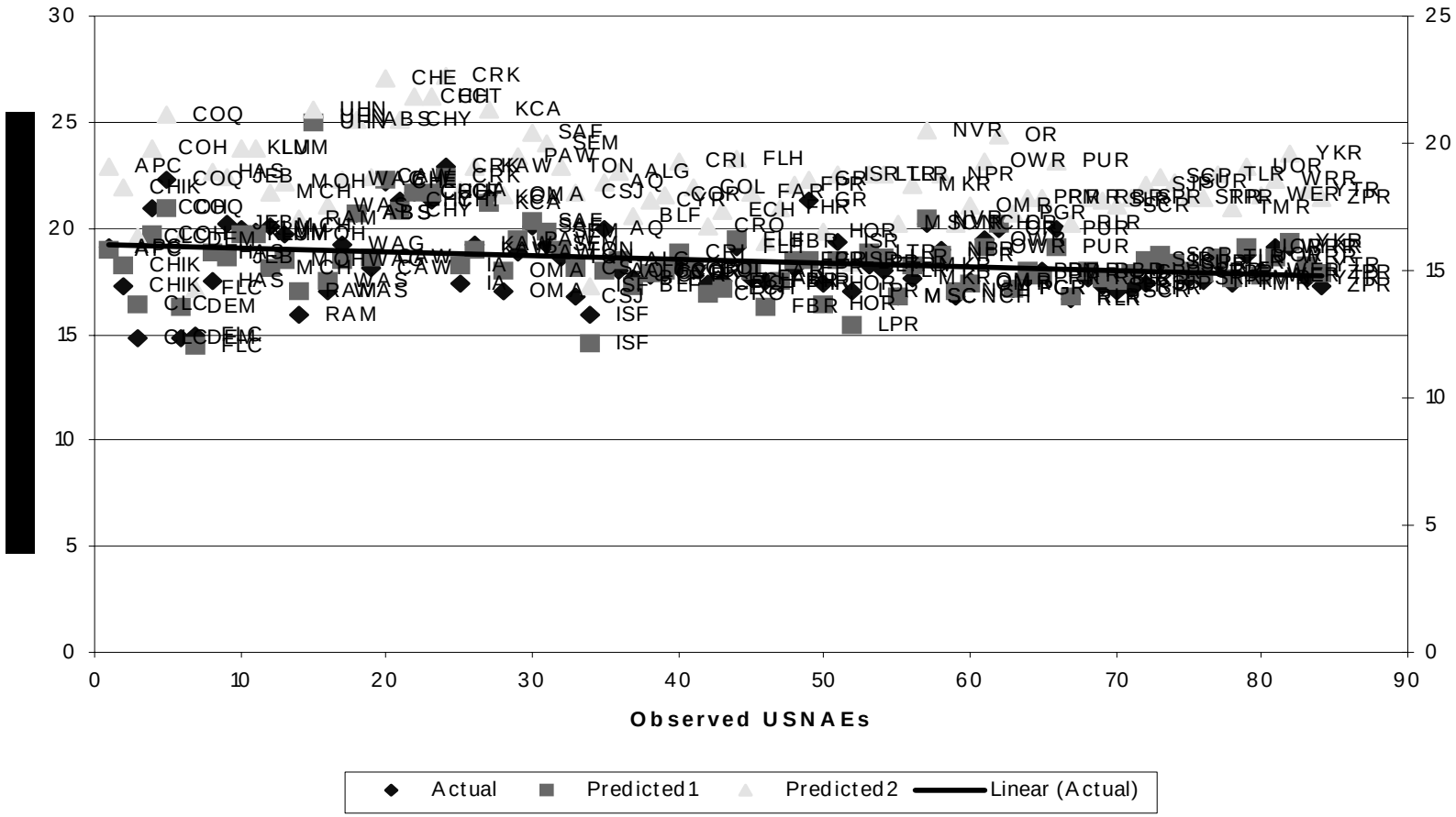
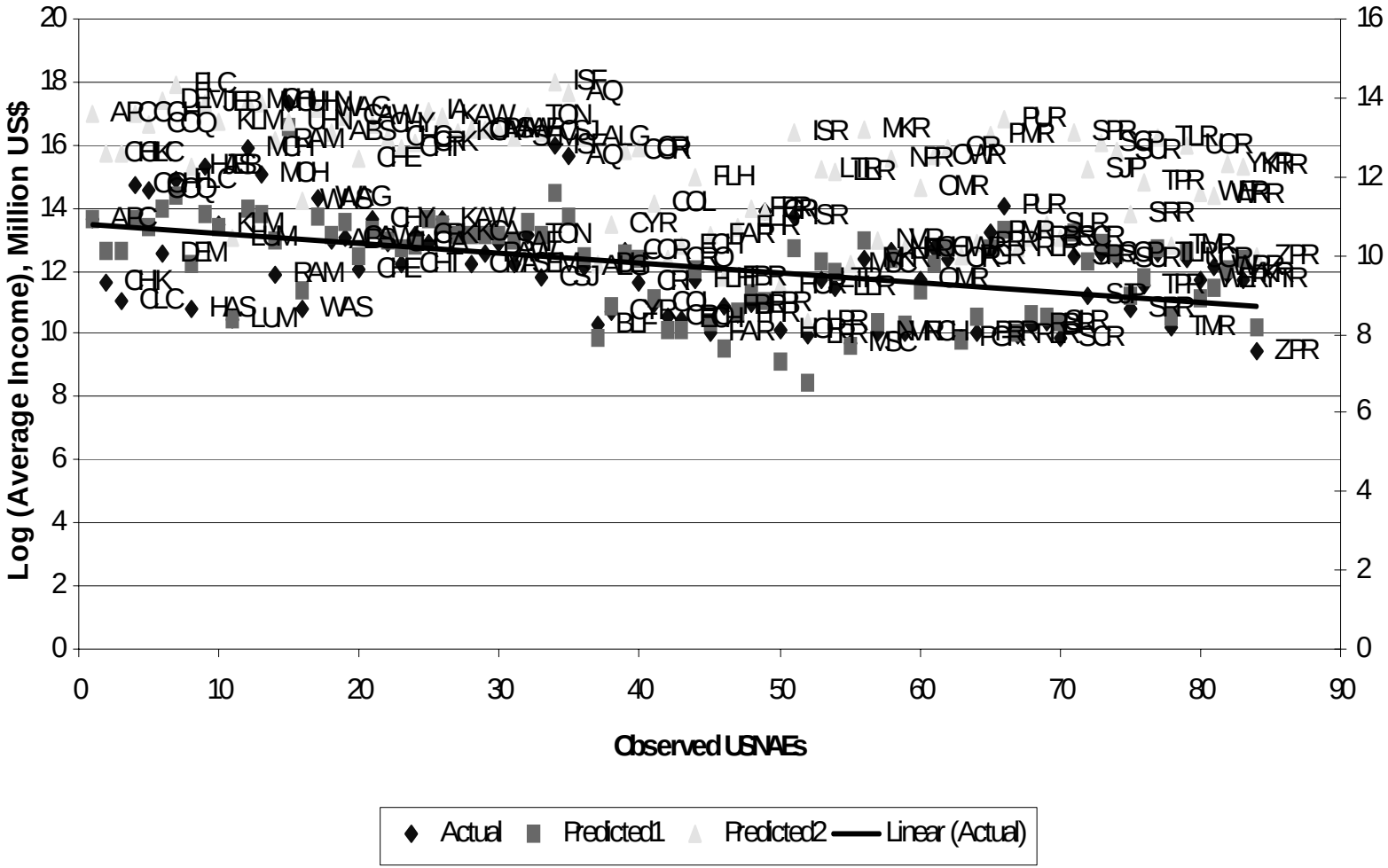


**Figure 2 - Actual and Predicted Average Income of USNAEs, 1990**



A further policy implication of low investment in physical capital is the less than expected effect of human capital on both aggregate and average income of USNAEs. Measured conventionally as educational attainment of labor and extended as educational attainment of labor plus two other dimensions of the quality of labor, health being one, human capital generally has a positive effect on the economic performance of USNAEs. However, these measures of human capital are too narrow to capture the full effect of change in economic performance resulting from a change in human capital. For instance, one potential benefit of human capital accumulation is the creation of the Nelson-Phelps conduit (channel) through which external technology and other forms of productive knowledge can flow into USNAEs. This linkage appears weak. Analysis shows that because of low investment in physical capital, human capital per capita is much lower than human capital per worker which slows down the adoption and spread of technology across the economically capable population. The model used here shows two forces at work. On one hand are infrastructural aspects associated with investment in physical stuff (schools, hospitals, and such, collectively $S_i$). On the other hand are superstructural elements designated by $\overline{q}_i$ . Unless the two forces are in sync, or infrastructural forces are stronger than superstructural forces, the positive effect of human capital on performance is similarly constrained. To benefit from human capital accumulation, and through it economic performance, it is imperative that the forces of infrastructure and superstructure are allied, or friction between them minimized. How that can be done is a good research question, but not a new question. In a statement before the U.S. Committee on Indian Affairs, Henson (2003) called for the creation of "capable institutions", establishment of a "cultural match", and enhancement of "sovereignty and self-determination" of USNAEs in order to "create environments that are conducive to economic development" (p. 5). Cornell and Kalt (1998) stress the need for sovereignty and nation-building in order to enable effective institutions, while Mushinski and Pickering (2000) and Pickering and Mushinski (2001) argue that culture is more important to the performance of USNAEs than previously shown.

The results also show that the economic condition of the U.S. economy as a whole is more important to the performance of USNAEs than the state of U.S. states in which USNAEs are located. That seems counterintuitive, but it is not. USNAEs and the U.S. states are competitors for scarce resources and for federal government resources, especially in bad economic times, like 1990. In that sense it is easy to see why both states and USNAEs may not count good performance by the other as beneficial to themselves.

This study claims neither a unique expertise of nor authority of USNAEs - and that may be its major weakness. It was motivated mainly by the desire to understand how embedded economies come to perform differently from their host(s), with whom they share basic institutions and location. USNAEs provide a useful case. Obviously the cost of aggregation is limited depth and possibly errors of commission and omission. The large constant terms of estimated regressions may be one example of the latter, which brings us back full circle to asking why the Solow residual is so large. As for errors of commission, I have deliberately refused the counsel of the econometric purist by leaving statistically insignificant variables in some regressions. My judgment is that the tradeoff between significance and substance was worth the loss of elegance. Technical efficiency of parameters is obviously important, but for now it belongs to a different project.

## Appendix - Variables, Data and Other Measurement Issues

The data for this study comes mostly from *The Statistical Record of Native North Americans (1996).* The *Statistical Record* draws its data mainly from the U.S. Bureau of Census and the Bureau of Indian Affairs. Other sources of data used here are indicated as the need arise.

Data collection focuses on a sample of 84 of the largest USNAEs listed in Table 0.0, and covers the variables described below.

### Local Dependent Variables ($Y_i$, $y_i$)

The dependent variables are aggregate ($Y_i$) and average ($y_i$) income in thousands of 1990 US dollars. We assume that ($Y_i$,$y_i$) is approximately equal to the value of local production, and treat income and output interchangeably.

### Local Independent Variables

### Investment ($I_i$) and Capital ($K_i$ , $k_i$)

In most empirical studies current capital stock ($K_i$) is calculated by the "perpetual inventory method" as the sum of current year investment ($I_i$) and depreciated previous year's capital stock ($K_{it-1}$ - $\Delta K_{it-1}$ ), or $K_i = I_i + (1-\Delta)K_{i-1}$, where $\Delta$ is the rate of depreciation ( time subscript is ignored for obvious reasons). Unfortunately, there is no data on either K or I. Instead, we found aggregate data on sales and receipts of all Native American-owned firms (ASR) by state and corresponding data on sales and receipts of Native American-owned firms with paid employees (WSR). One can argue that if capital is not paid, then the difference between ASR and WSR is *apparent profit* that was re-invested. This argument is no mere measuring without theory; the relationship between investment and expected profit is a clear one: high profit expectation drive demand for capital. And so profit is a reasonable proxy for capital. Exploratory attempts to use the ratio of apparent profit to income ((ASR-WSR)/$Y_i \approx I/Y_i \approx K_i$), produced unacceptable results and was abandoned. Hence it is assumed that $K_i \approx$ ASR-WSR. The problem here is that when this proxy is applied equally it favors smaller Native American economies located in large states like California. We offer no remedy for this bias at this time.

### *Population*

The U.S. Native American population is a significant resource as well as a constraint. As a resource economies with high population have high aggregate income; as a constraint high population means low average income, and even lower per capita income. Further examination of the Native American population by age shows a high number of people in the 1-4 year age group, followed by a drop in the 5-6 age group, a rise in the 7-14 age group, and a very steep decline in the 17-21 age group, which seems consistent with the above national average suicide rate in this group. The bulk of the population is in the 22 -59 and older group. There is a strong indication that Native Americans accumulate human capital later in life, and out, of necessity the process often continues past 65. This regularity ran against our *a priori* expectation that with technological advancement there would be a backward and forward propagation of human capital formation.

**Figure 1a - Aggregate Income, Capital, Labor, and Population Inputs in USNAEs, 1990**

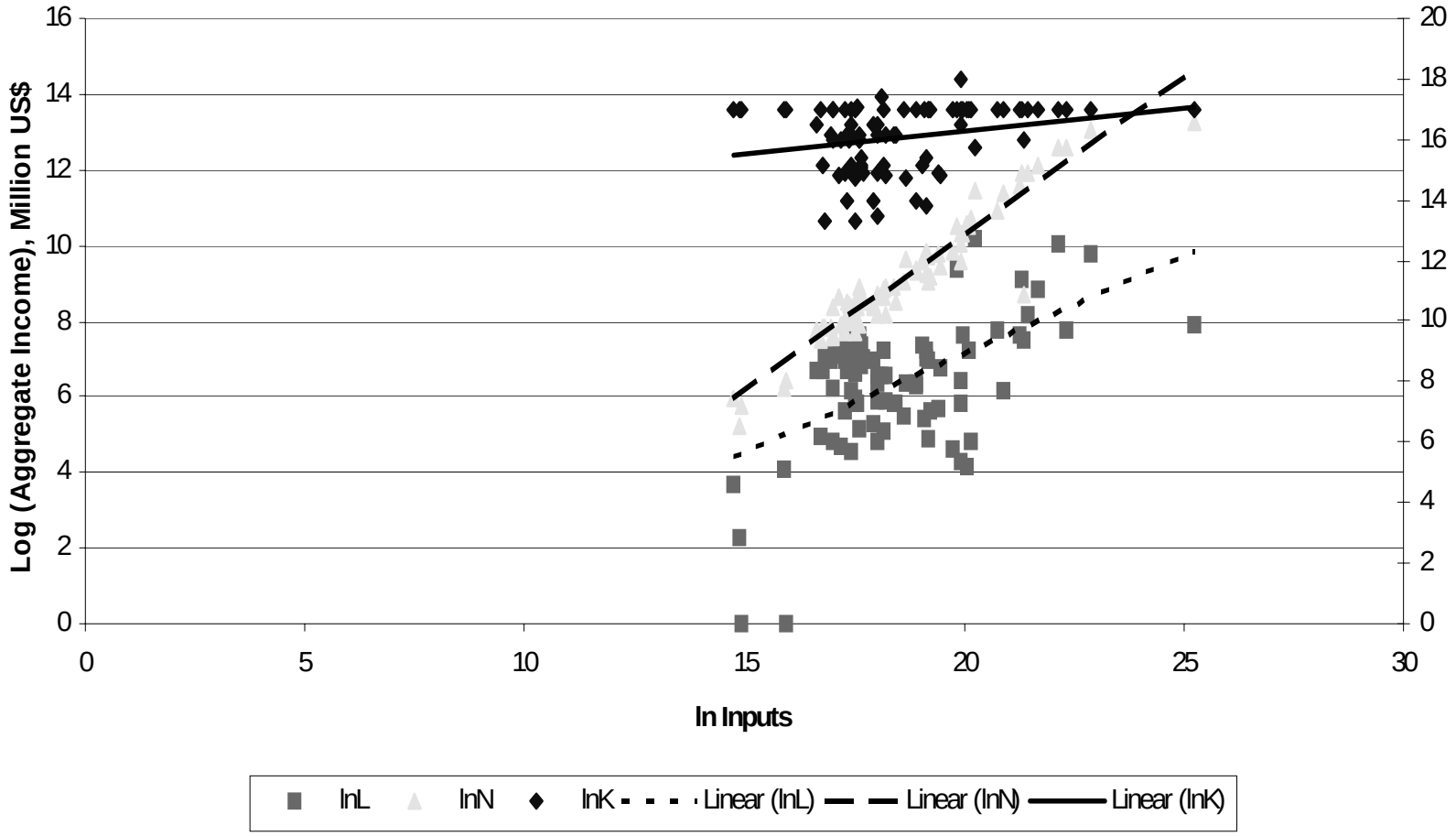


**Figure 2a - Aggregate Income and Varieties of Human Capital in USNAEs, 1990**

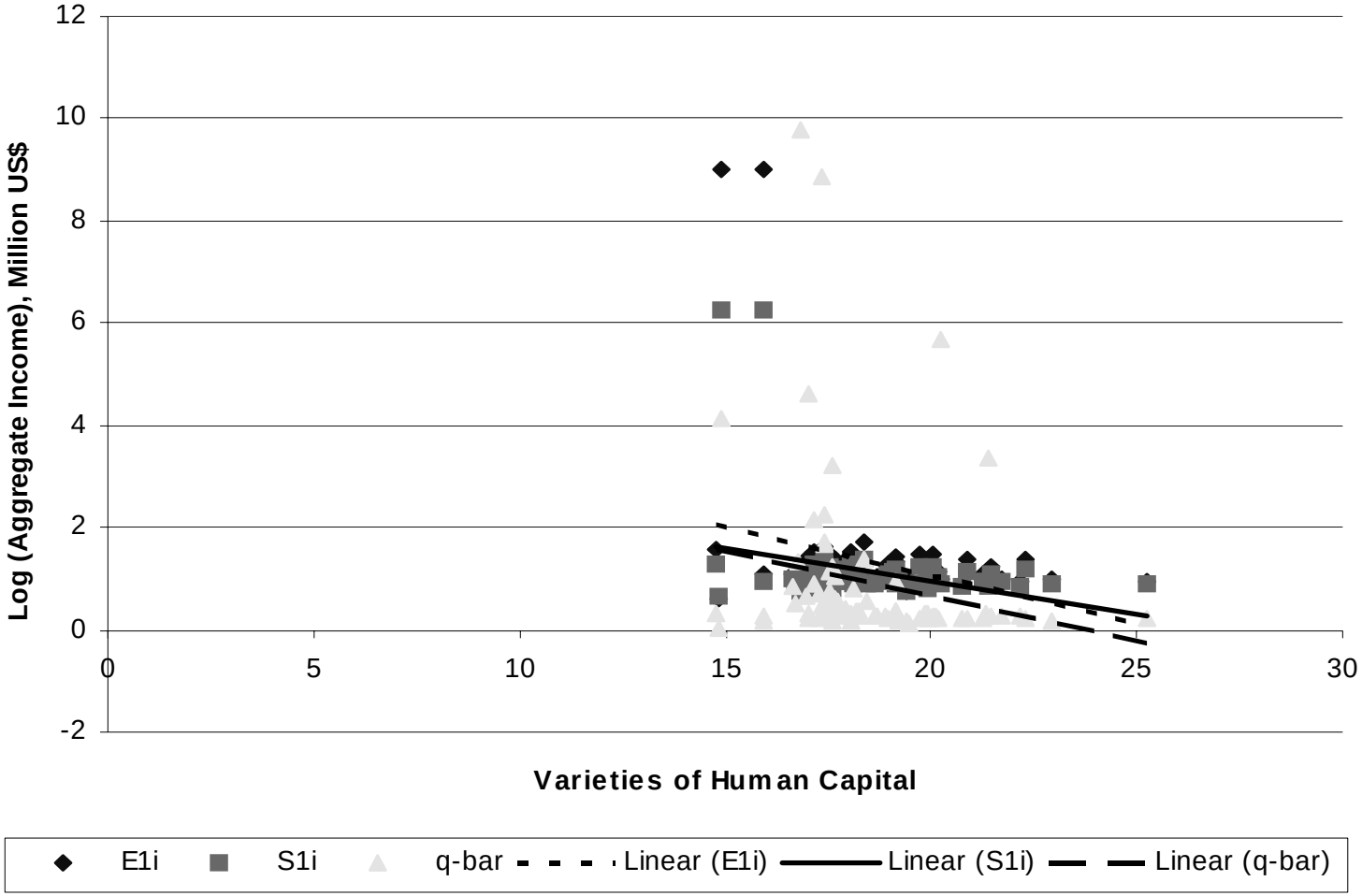


**Figure 3a - Aggregate Income and Varieties of Human Capital in USNAEs, 1990**

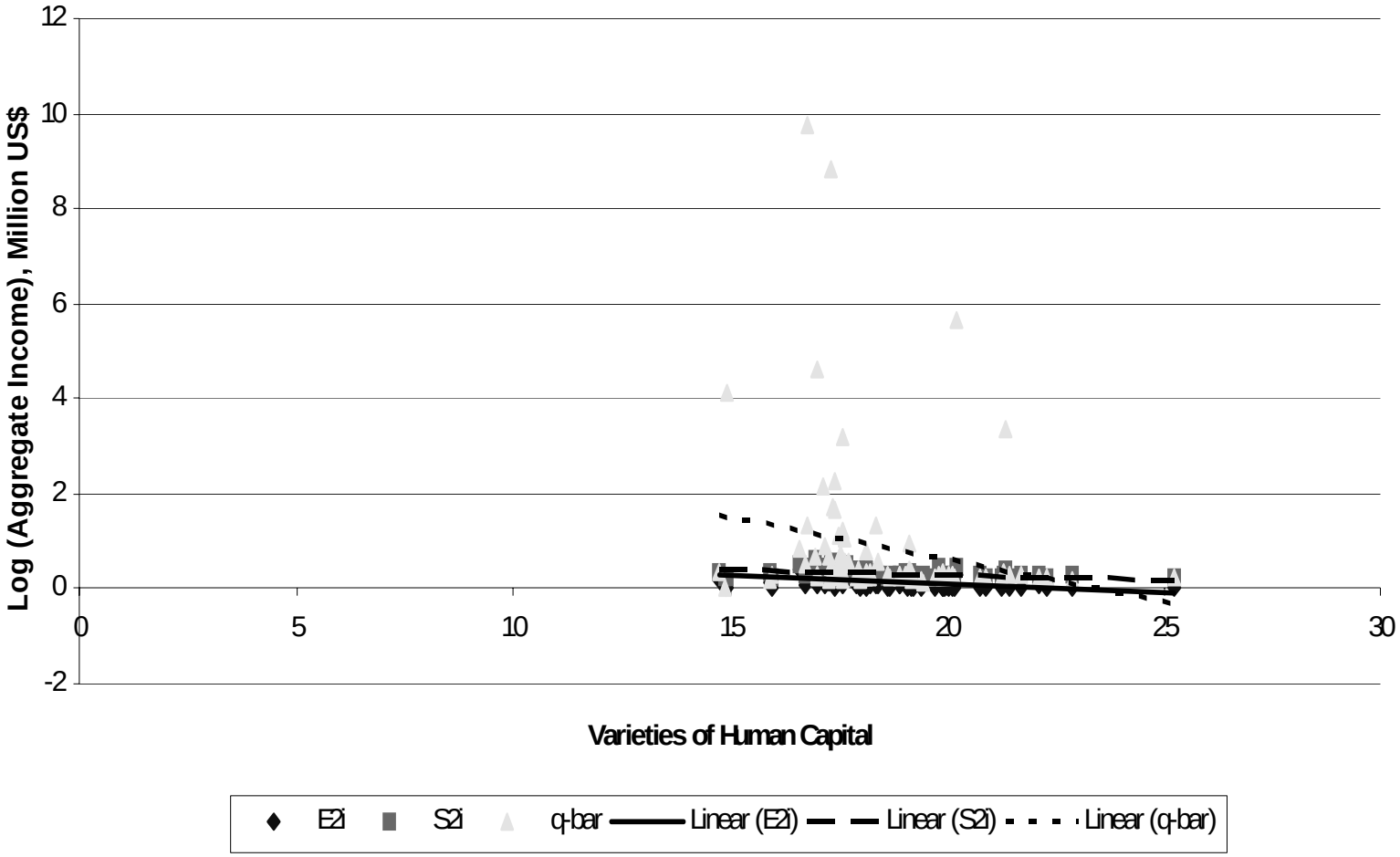


**Figure 4a - Average Income, K/L-ratio, and Varieties of Human Capital in USNAEs, 1990**

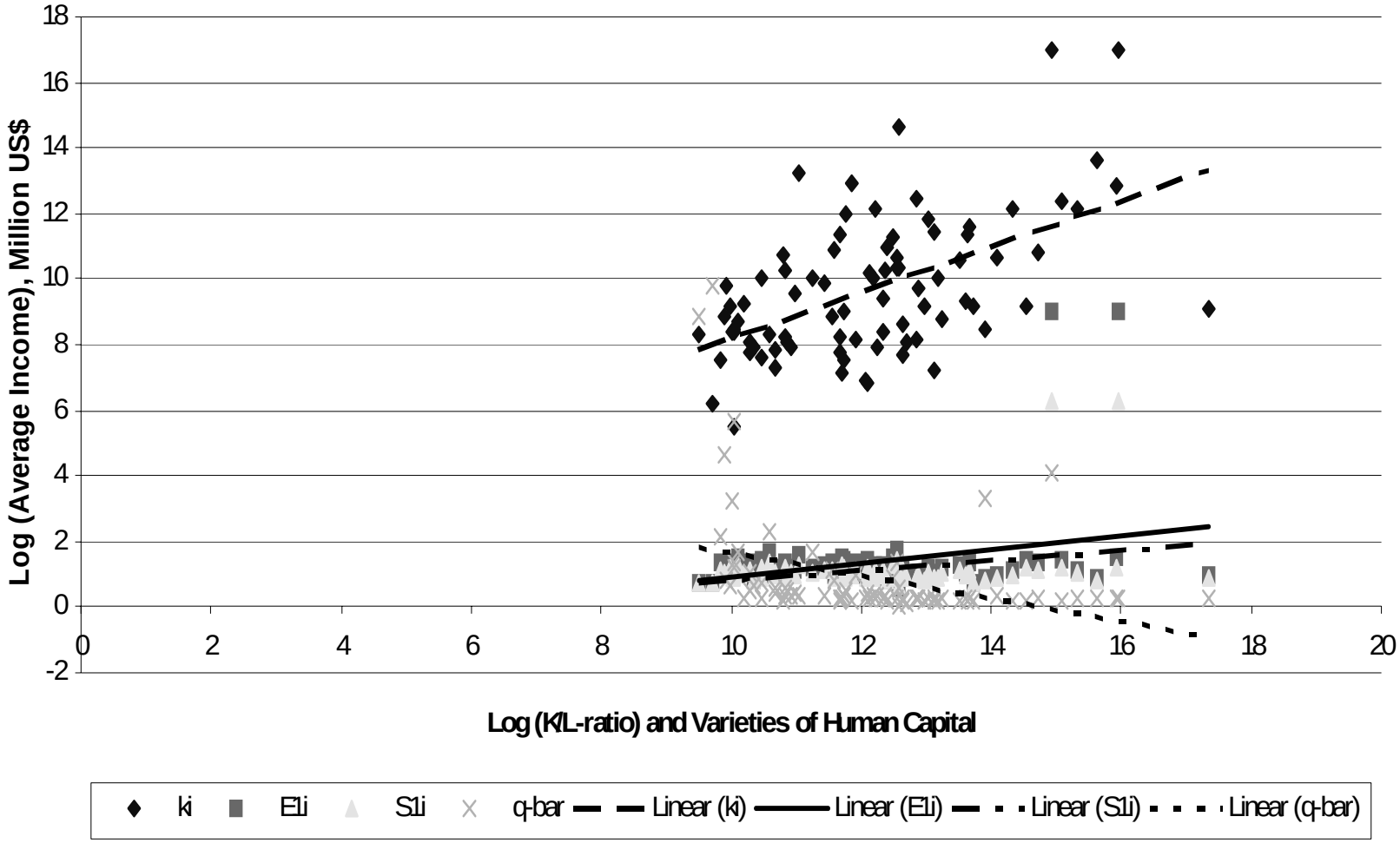


**Figure 5a - Average Income, K/L-ratio, and Varieties of Human Capital in USNAEs, 1990**

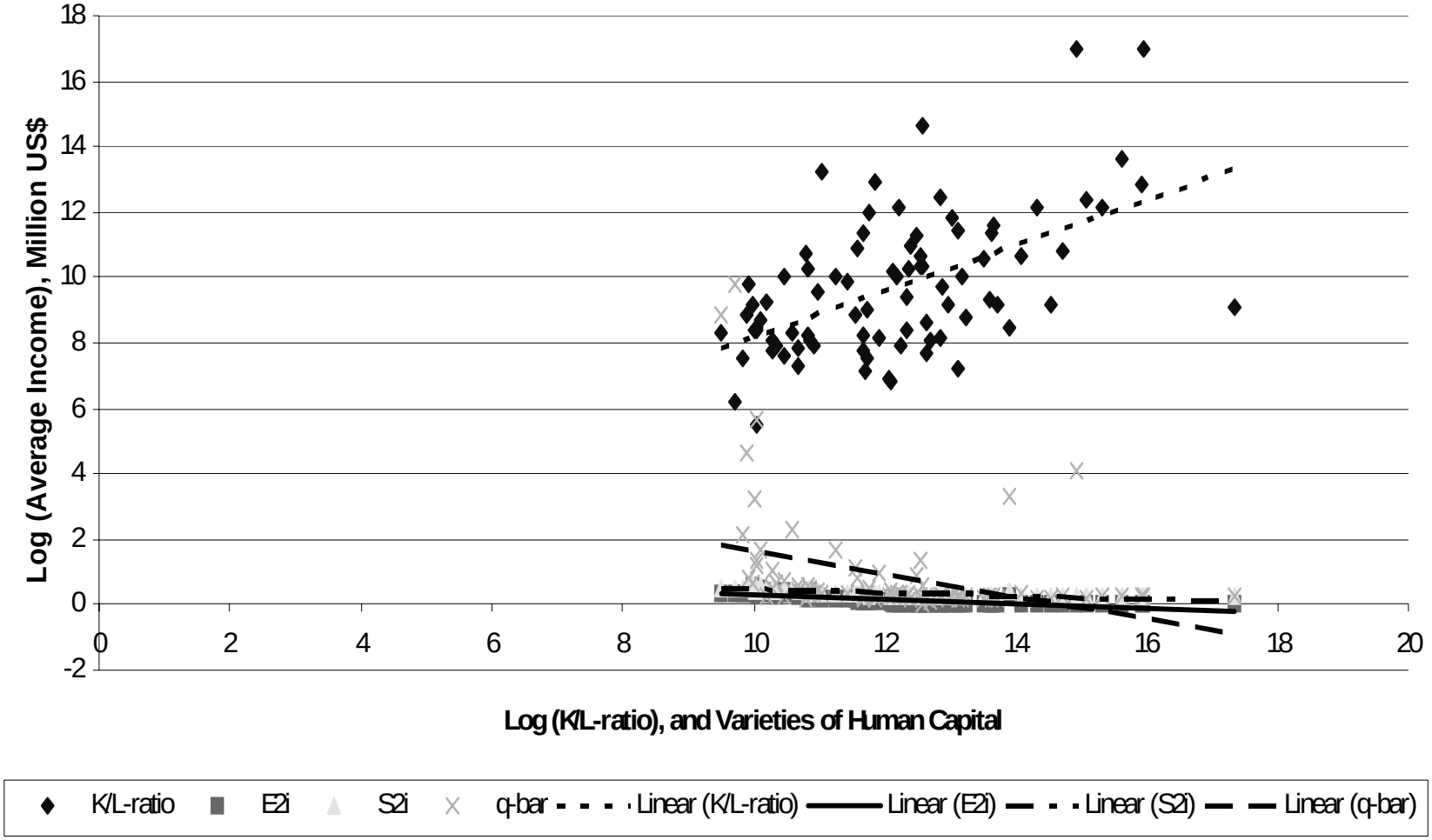


**Figure 6a1 - Capable Population and Varieties of Human Capital in USNAEs, 1990**

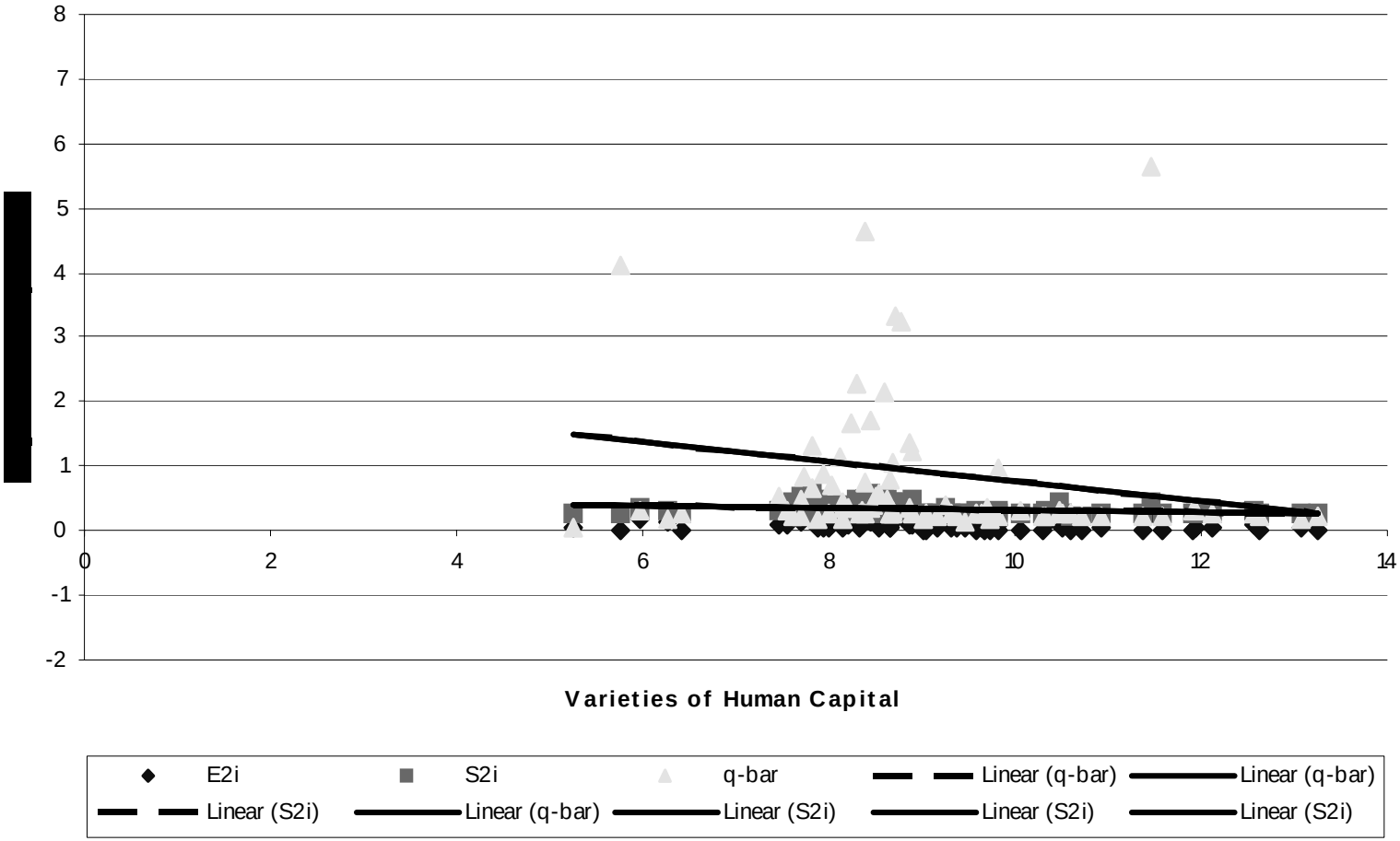
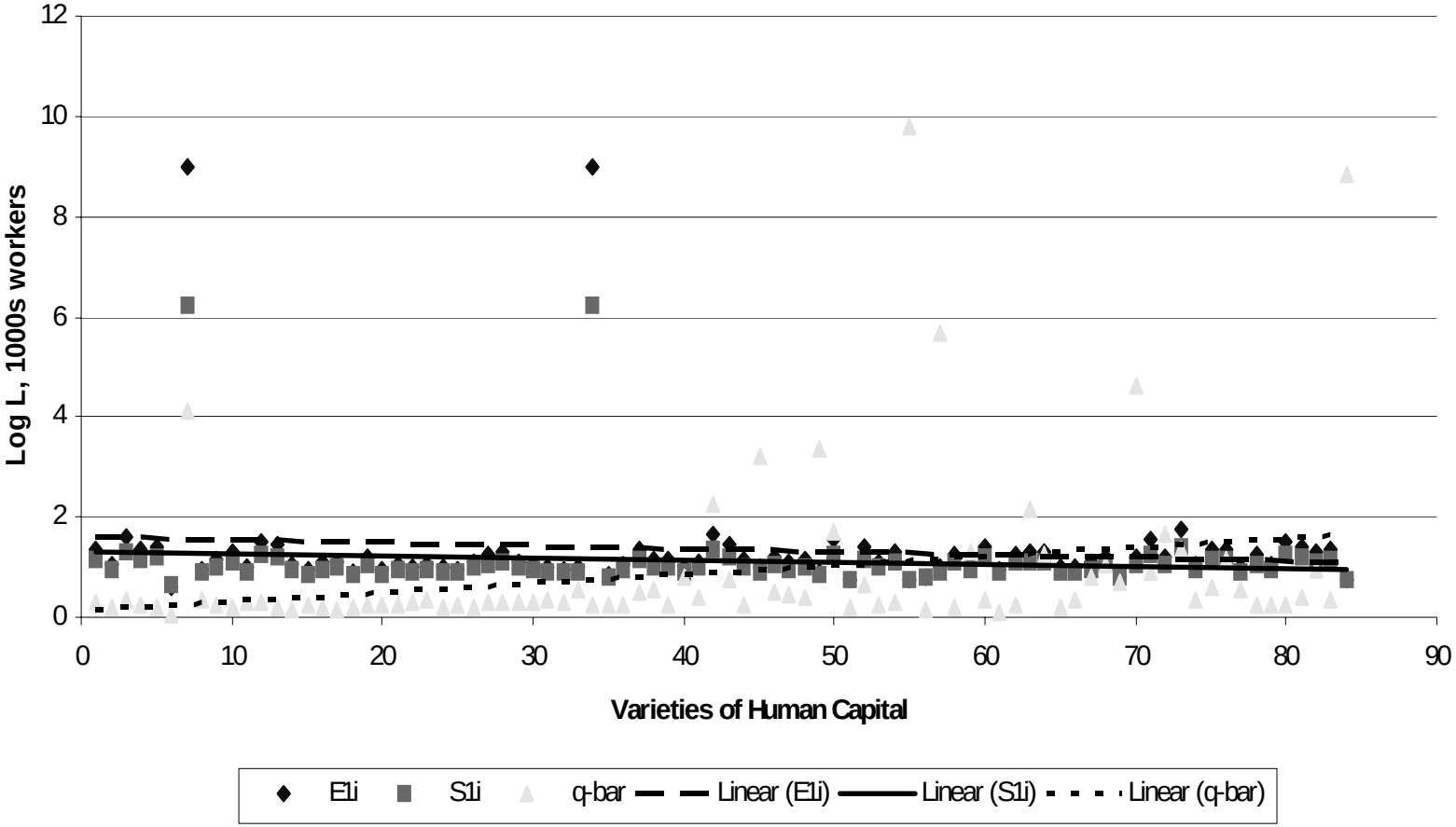


**Figure 6a2 - Workforce and Varieties of Human Capital in USNAEs, 1990**



***Total Labor and Workforce ($L_i$)***

*The labor force is workforce ($L_i$) plus the number of unemployed workers. The conventional and extended* measures of human capital ($E_{1i}$, $S_{1i}$) are based on $L_i$ . No data is available on the number of aggregate hours worked.

***Economically Capable Population ($N_i$)***

This variable includes all *economically capable* people aged 14 - 74 years, i.e., all people that are neither underage nor in restrictive institutions. Some people who are 16 - 65 years of age already belong to $L_i$, so that $N_i$ is the sum of $L_i$, pre-$L_i$ aged 14-15 years, and post-$L_i$ aged 66-74 years. A detailed investigation of the data shows that the majority of Li is in the 22-59 years age group, and it is here where unemployment has the worst effect, because at that age many people are married or are considering marriage and family. But since graduation from both high school and college comes later in life, with 25 years of age not uncommon, it appears that full-time careers start late in life, and often last past the typical retirement age of 65. Also past the retirement age, private sector employment of persons 66-74 years old falls, while employment in traditional occupations increases, which tends to reduce the transmission of $A_j$. Figure1 displays the relationship between aggregate income and capital, labor, and the economically capable population. Generally aggregate income is more correlated with capital than with labor and $N_i$, but the slope of $N_i$ is steepest.

***Human Capital ($H_i$, $h_i$)***

Note that $S_i$ has three dimensions to it. The first dimension is educational attainment measured here in two ways. In the first $E_{1i}$ is the ratio of workers with high school or better education to the total workforce ($L_i$ ). The second measure of educational attainment is the number of people with high school or better education relative to the economically capable population ($N_i$ ), which we designate by $E_{2i}$. From previous literature the $E_{ki}$ dimension accounts for two-thirds of the $S_i$ index.

The second dimension of $S_i$ is "Health". The rationale for this dimension is that a healthy population is likely to be physically and mentally more productive than a "sick" population. High productivity enables a population to earn high income. *Ceteris paribus*, with the high incomes a healthy population can stimulate and sustain human capital accumulation, reduce human capital depreciation, and probably increase the rate of human capital drain (cf. Bloom, Canning, and Sevilla, 2004). Here we measure "Health" by the average life expectancy (Life) of Native Americans over the 1980-1990 decade, calculated as

$$Life = \frac{LifeAct - LifeMin}{LifeMax - LifeMin} = \frac{71.5-61}{74.9-61} = 0.755, \qquad (11)$$

where LifeAct is actual life expectancy, LifeMin is the minimum life expectancy, which is what life expectancy was in the 1960s-1970s, and LifeMax is average life expectancy of all US racial groups.

The third and last dimension of Si, "Other", approximates as the percentage sum of Native American representations in radio and television (0.002), law and law enforcement (0.005), electoral process

(0.2002), and their impartial and objective attitudes toward governance (0.4763), i.e., Other = 0.002+ 0.005 + 0.2002 + 0.4763 = 0.7215.

The "Health" and "Other" variables account for 1/6th of Si such that

$$S_{1i}=1.47265 + 0.667*E_{1i}$$
$$S_{2i}=1.47265 + 0.667*E_{2i}. \quad (12)$$

In general $S_{ki} = a_0 + bE_{ki}$, which implies that all USNAEs are equally disposed to human capital accumulation, given the initial condition, $a_{0 = 1.47265}$.

The three dimensions of $S_i$ reflect institutional processes and systems that require investment in physical capital (schools, hospitals, public systems, etc.). Hence, they represent infrastructural aspects of institutions. To measure superstructural aspects of institutions we construct $\bar{q}_i$ as an index of local cultures and traditions that assist or resist $H_i$ building, and through it the transmission of $A_j$ via $H_i$. We argue that cultures and traditions can be open or closed to external influences, and construct $\bar{q}_i$ in a multidimensional

way so that it is capable of capturing superstructural effects of institutions. First, we consider the ratio of people who served or currently serving in the military to $N_i$ ($r_{m2n}$). The military exposes servicemen and women to other cultural and traditional experiences. Hence, a high military-$N_i$ ratio implies greater cultural/traditional openness. Second, we look at the ratio of languages spoken at home to the English language ($r_{h2e}$). In a closed economy people are more likely to speak their home language than foreign languages, including English if that is foreign to them, and the ratio should be high. Third, we take the ratio of Native Americans residing in tribal areas to those enrolled in respective tribes ($r_{r2e}$). If $r_{r2e} = 1$, the tribal economy is completely closed; if $0 < r_{r2e} < 1$, the economy is *open inwards*, hence more people live on tribal land than are enrolled in that tribe. And if $r_{r2e} > 1$, the economy is *open outward*, i.e., more people are enrolled in the tribe than reside in tribal lands. An inwardly open economy is potentially more accepting of the inward flow of $A_j$ than an outwardly open economy. Fourth, we consider the ratio of people in tribal occupations to $N_i$ ($r_{t2n}$). The higher this ratio, the more closed the economy. Finally, we take the ratio of people with telephones to those without ($r_{t2nt}$), the rational being that one would have telephone services only if external communications need to be maintained. For $r_{t2nt} > 1$, the economy is open and accepting of external technologies. Thus,

$$\bar{q}_i = r_{t2nt} + r_{t2n} + r_{r2e} + r_{h2e} + r_{m2n} = \sum_{i=1}^{M=5} r_i,\ 0<r_i<100\%. \quad (13)$$

*A priori* expectations are for the effects of Si and $\bar{q}_i$ on performance to be positive and negative, respectively. Figures 2-4 associate aggregate income with various measures of human capital. Figures 5-6 focus on human capital versus human capital measures, as well as $N_i$ versus the measures of human capital, while Figure 7 displays average income.

## External Independent Variables

### Conditions of State and National Economies ($Y_j$, $y_j$) and Technology ($A_j$)

The condition of U.S. states ($Y_s$, $y_s$), and those of the entire U.S. economy ($Y_u$,$y_u$) affect the performance of Native American economies, where ($Y_u$,$y_u$) = real U.S. GDP MINUS ($Y_i$, $y_i$), real state products ($Y_s$, $y_s$) LESS ($Y_i$, $y_i$), and capital letters represent aggregate, and lowercase stands for average, variables. Many Native Americans have full-time equivalent (FTE) employment with the federal, and local and state governments. In addition different federal departments support many programs for Native Americans. Support for these programs ebbs with the condition of the national economy. Data for these variables came from the *Statistical Abstract of the United States: 2003*, 123rd Edition. $A_j$ is assumed to be exogenous and to flow to Native American economies via $H_i$**.**

**Table 0.0 Codes and Full Names of U.S. Native American Economies[a]**

| No. Code | Full Name |
|---|---|
| 1. APC | Apache Choctaw |
| 2. CHIK | Chickahominy |
| 3. CLC | Clifton Choctaw |
| 4. COH | Coharie |
| 5. COQ | Coquille |
| 6. DEM | Delaware-Muncie |
| 7. FLC | Florida Tribe, Eastern Creek |
| 8. HAS | Haliwa-Saponi |
| 9. JEB | Jena Band, Choctaw |
| 10. KLM | Klemath |
| 11. LUM | Lumbee |
| 12. MCH | Meherrin |
| 13. MOH | Mohegan |
| 14. RAM | Ramapough |
| 15. UHN | United Houma Nation(s) |
| 16. WAS | Waccamaw Siouan |
| 17. WAG | Wampanong Gay Head |
| 18. ABS | Absentee Shawnee |
| 19. CAW | Caddo-Wihita-Delaware |
| 20. CHE | Cherokee |
| 21. CHY | Cheyenne-Arapaho |
| 22. CHC | Chickasaw |
| 23. CHT | Choctaw |
| 24. CRK | Creek |
| 25. IA | Iowa |
| 26. KAW | Kaw |

[a]1-17 are TDSAs; 18-34 are TJSAs; and 35-84 are reservations and trust lands.

| No. Code | Full Name |
|---|---|
| 27. KCA | Kiowa-Comanche-Apache |
| 28. OMA | Otoe-Missouria |
| 29. PAW | Pawnee |
| 30. SAF | Sac-Fox |
| 31. SEM | Seminole |
| 32. TON | Tonkawa |
| 33. CSJ | Creek-Seminole, Joint |
| 34. ISF | Iowa-Sac-Fox, Joint |
| 35. AQ | Agua Caliente |
| 36. ALG | Allegany |
| 37. BLF | Blackfeet |
| 38. CYR | Cheyenne River |
| 39. COR | Coeur d'Alene |
| 40. CRI | Colorado River Indian |
| 41. COL | Coville |
| 42. CRO | Crow |
| 43. ECH | Eastern Cherokee |
| 44. FLH | Flathead |
| 45. FAR | Fort Apache |
| 46. FBR | Fort Berthold |
| 47. FHR | Fort Hall |
| 48. FPR | Fort Peck |
| 49. GR | Gila River |
| 50. HOR | Hopi |
| 51. ISR | Isabella |
| 52. LPR | Laguna Pueblo |
| 53. LTR | Lake Traverse |
| 54. LLR | Leech Lake |
| 55. MSC | Mississippi Choctaw |

| No. Code | Full Name |
|---|---|
| 56. MKR | Muckleshoot |
| 57. NVR | Navajo |
| 58. NPR | Nez Perce |
| 59. NCH | Northern Cheyenne |
| 60. OMR | Omaha |
| 61. OWR | Oneida West |
| 62. OR | Osage |
| 63. PGR | Papago |
| 64. PRR | Pine Ridge |
| 65. PMR | Port Madison |
| 66. PUR | Puyallip |
| 67. RLR | Red Lake |
| 68. RBR | Rosebud |
| 69. SLR | Salt River |
| 70. SCR | San Carlos |
| 71. SPR | Sandia Pueblo |
| 72. SJP | San Juan Pueblo |
| 73. SCP | Santa Clara Pueblo |
| 74. SUR | Southern Ute |
| 75. SRR | Standing Rock |
| 76. TPR | Taos Pueblo |
| 77. TLR | Tulalip |
| 78. TMR | Turtle Mountain |
| 79. UOR | Uintah & Ouray |
| 80. WER | White Earth |
| 81. WRR | Wind River |
| 82. YKR | Yakima |
| 83. YTR | Yankton |
| 84. ZPR | Zuni Pueblo |

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