Decelerating Wage Inequality and Higher Education: Cross–State Evidence from the 1990s [1]

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Abstract

This paper exploits differences across the U.S. states in the evolution of the returns to college from 1979 to 2002, and in the evolution of nine-years lagged college enrollment rates, tuition levels and state appropriations per-college-age person, to investigate the potential links between wage inequality and higher education. Once the supply effects induced by declining cohort size and the "favorable" state-specific higher education policies of the mid-1980s are taken into account, the counterfactual returns to college no longer decelerate in the 1990s, rather they reach their highest points in the mid to late 1990s, but come down in the early 2000s. The implied changes for relative aggregate demand mirror these trends. The findings also highlight that inter-state migration is an important mechanism that weakens the connection between the college premium and relative labor supply shocks at the state level.

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1. Introduction

Increasing returns to education has been among the most scrutinized features of the important changes in wage inequality that took place over the past decades in the United States (Levy and Murnane (1992) , Katz and Autor (1999)). To the extent that this phenomenon is driven by increased demand for high skilled labor, this trend was expected to continue as long as the rate of growth of the relative supply of college/high school graduates remained insufficient to keep up with technologically induced demand. Yet, in the 1990s by contrast with the preceding decade, increases in the college/high school wage premium began to decelerate, as noted by Card and DiNardo (2002). Increasing the proportion of college educated workers had been suggested as an appropriate public policy response to increasing wage inequality (Johnson (1997), Ashenfelter and Rouse (2000)). In fact after fifteen years of near stagnation, enrollment rates at post-secondary institutions began to climb dramatically from the mid 1980s into the early 1990s. They were fueled by declining cohort size and "favorable" higher education policies, which included increases in the main sources of revenues of public post-secondary education institutions. Whether these increases in enrollment rates played a role in containing increases in wage inequality over the 1990s is the question that this paper wishes to address.

The link between wage inequality and higher education is not unambiguous as it can result from a combination of quantity, quality and price effects. On the one hand, increasing the proportion of college-educated in the workforce puts more weight, *ceteris paribus*, on a sub-distribution of wages exhibiting both higher mean and higher dispersion, this should increase measured wage inequality. Further, increasing the proportion of college-educated among the college-age population should increase skill heterogeneity among college graduates and this should widen the corresponding sub-distribution of wages, thereby increasing overall wage inequality.[2] On the other hand, increased skill (and ability) heterogeneity may also lower the average college premium, which would lower wage inequality.[3] Finally

[2]Pereira and Martins (2000) find empirical evidence from fifteen European countries that increasing education increases within wage inequality.

[3]Juhn, Kim and Vella (2000) investigate the link between cohort size and the average quality of college graduates and find a relatively small effect.

and perhaps more importantly, to the extent that the demand for highly educated workers does not outstrip supply, the increased proportion of college-educated persons should put downward pressure on the college premium and lower wage inequality.

The potential for higher education policies to lower wage inequality by increasing the supply of college-educated workers resides on the premise that this third effect—the price effect—, dominates. In turn, this price effect rests on the premise that the flow of college graduates is substantial enough or sufficiently distinct from the existing stock of college-educated workers to exert a shift on the relevant supply curve. Yet Bound, Groen, Kezdi and Turner (2001) find only a moderate, but significant, link between the flow (or production of undergraduate degree recipients) and their stock in the population. Card and Lemieux (2001a) on the other hand, using a model with imperfect substitution between similarly educated workers in different age groups, show that the own–cohort supply of college-educated workers has an important negative impact on the college wage premium. Here, the own–cohort effect is taken as a point of departure. This paper tries to establish a link between the college/high school wage premium among young workers and the relative supply of college-educated workers through nine-years lagged enrollment rates. Enrollment rates are negatively influenced by cohort size and tuition levels, themselves largely determined by the level of state appropriations.[4]

Because state policy makers determine the level of higher education funding, as well as tuition and capacity levels at public colleges and universities, it is appropriate to set the analysis at the state level. On the other hand, there are some problems with an analysis at the state level. First, to the extent that factor price equalization (FPE) holds across states, then state-specific relative labor supply shocks and national factor-demand shocks should lead to common relative wage responses across states suppressing state-specific relative labor supply effects. Yet to the extent that labor supply flows constitute a more important mechanism contributing to the FPE than flows of technology or goods, an estimation strategy that separates the impacts of the "homegrown" labor force from those

[4]Evidence on the latter links between enrollments, state appropriations and tuitions is also highlighted by Berger and Kostal (2002) who analyze NCES data for 48 continental states for the period 1990-95.

of demand induced in-migration will recover such supply effects.[5] Instrumenting state-specific relative labor supplies with lagged enrollment rates will prove to be a successful strategy to identify the impact of the "homegrown" relative supplies resulting from state-specific higher education policies. Second, in some states, college enrollments in privately funded institutions represent a substantial portion of total enrollments. Third, states may have other objectives when investing in college education, besides improving the equality of opportunities among their residents. Here, state appropriations are taken to be a reduced form estimate of equal opportunities objectives studied by others (e.g. Lowry (2001b)).[6] Data on the public/private enrollment mix, on the mobility of young workers, and on cross-state trade are exploited to contrast the impact of demographics and higher education policies on relative supplies and the college premiums across states.

This paper uses data from the Merged Outgoing Rotation Group (MORG) of the Current Population Surveys from 1979 to 2002 to compute college/high school wage premiums and relative supply measures at the state level. Data from the 1980, 1990 and 2000 Censuses are also used to provide corroborating evidence. These data are combined with state level data on enrollments in public and private 4-year post–secondary institutions from the National Center for Education Statistics (NCES) for the period 1969-70 to 1992-93. The NCES educational data is coupled with historical tuition data going back to 1972-73 obtained from the Washington Education Coordinating Board (Raudenbush (2002)) and with data on state appropriations from 1969-70 onwards obtained from the Grapevine database.[7]

The main finding of the paper is that, once the supply effects induced by declining cohort size and the "favorable" state-specific higher education policies of the mid-1980s are taken into account, the counterfactual returns to college no longer decelerate in the

[5]Hanson and Slaughter (2002) find that state-specific changes in production techniques account for relatively little factor absorption, rather changes in production techniques appear to be common across states. They also find a relatively small role for changes in the output of traded goods.

[6]Factors such as the impact of industry demand (Goldin and Katz (1999)) would manifest itself in the "grants and contracts" category of revenues.

[7]Similar tuition data were used in Kane (1994) for example. The NCES does not provide tuition data before 1986. The url of the Grapevine web site is: www.coe.ilstu.edu/grapevine/. See the data appendix for details.

1990s. Thus, consistent with the high tech boom of the 1990s, the implied changes in relative aggregate demand are actually greater in the 1990s than in the 1980s, but do come down in the early 2000s. The mid 1980s state-specific higher education policies that were "favorable" to skyrocketing enrollment rates included moderate real increases in the two main revenue sources of public institutions of higher education: tuition and state-appropriations (per-college-age person). This contrasts with the 1970s when real tuition plummeted and with the 1990s when state-appropriations per-college-age person flattered. The within-state estimates of the own-cohort supply effects also shed some light on the important issue of whether the U.S. labor market can be characterized as one national market or whether there exists state-specific labor markets.[8] They also highlight that inter-state migration is an important mechanism that weakens the connection between the college premium and relative labor supply shocks at the state level.

The remainder of the paper is organized as follows. The next section outlines a simple labor market model of supply and demand that nests an educational supply and demand model. Section 3 sets out the broad aggregate trends in the key variables of interest. The empirical results from various estimation strategies, along with robustness checks, are presented in section 4. The implications of the findings are discussed in the conclusion.

2. Economic Framework and Identification Strategy

This section outlines how within-state own-cohort supply effects can be identify using a simple labor market model of supply and demand that nests an educational supply and demand model. The model assumes that there are only two education groups: college-educated workers earning a wage w^c_{st}, and high school-educated workers earning a wage w^h_{st}. Therefore, only the relative price of college to high school workers, $r_{st} = \ln(w^c_{st}/w^h_{st})$, which can vary over time t and across states s, matters.

A labor market supply and demand framework usually consists of supply and demand functions showing the quantity of labor supplied or the quantity of labor demanded at

[8]This issue is important for the literature on immigration (Borjas, Freeman and Katz (1997), Card (2001)) and on local labor markets.

any price. The equilibrium price level is determined by the intersection of the supply and demand curves and identification of either curve requires the availability of instruments that shift one curve but not the other. Equivalently, the system can be written in terms of inverse demand and supply functions. These functions, which are not observed, describe the returns r_{st} or prices offered and demanded in market st for all possible values of the relative quantities q and all possible values of the instrument Z:

$$\begin{aligned} r_{st}^{D} &= \mathcal{D}_{st}(q, Z) \\ r_{st}^{S} &= \mathcal{S}_{st}(q, Z). \end{aligned} \tag{1}$$

Market clearing implies that equilibrium returns $r_{st}^{e}(Z)$ and relative equilibrium quantities $q_{st}^{e}(Z)$ for any value of the instrument will satisfy

$$r_{st}^{e}(Z) \equiv \mathcal{D}_{st}(q_{st}^{e}(Z), Z) = \mathcal{S}_{st}(q_{st}^{e}(Z), Z). \tag{2}$$

Here, the aim is to find an instrument that shifts the inverse supply functions in order to identify demand.

The inverse demand functions can be thought of as reduced forms originating from state-time specific production functions that use high school labor and college labor, which have different technological efficiency parameters.[9] Efficient utilization of the different skill groups will require that relative wages be equated to relative marginal products. This will imply a relationship that links the observed college/high school wage gap, $\ln(w_{st}^{c}/w_{st}^{h})$, to the relative supply of college-educated workers, $\ln(C_{st}/H_{st})$ (as in Katz and Murphy (1992) for example). In a model with imperfect substitution across age groups (Card and Lemieux (2001a)), the college/high school gap for a given age group will depend both on the aggregate relative supply and on the age-group specific relative supply of college labor.

When only two age groups are considered, a reduced form version of that model will include the relative supply of younger workers $q_{st} = \ln(C_{st}^{Y}/H_{st}^{Y})$ and the relative supply of

[9]This formulation implicitly assumes no instantaneous labor mobility across states or across time.

older workers $q^O_{st} = \ln(C^O_{st}/H^O_{st})$:

$$r^D_{st} = \alpha_0 + \alpha_1 q_{st} + \alpha_2 q^O_{st} + \epsilon_{st} \tag{3}$$

where the relative employment ratio of older workers is taken to be exogenous and with $\epsilon_{st} = \alpha_3 Y_{st} + S_s + P_t + \varepsilon^D_{st}$, where Y_{st} represents state-time specific demand variables, S_s represent state effects, and P_t time period effects. Note that because of the simultaneity in system (1), q_{st} and ε^D_{st} are likely positively correlated generating a positive bias in the least squares estimate of α_1 which then understates the true value of the negative coefficient. Relative supplies of young college educated workers q_{st} are likely contemporaneous correlated with demand shocks ϵ_{st} when, for example, high tech firms decide to locate in states with relatively high supplies of young college educated workers.

The current relative supply functions in state s and time t can be thought of as resulting from a two-stage decision process: the past decisions (medium run: 5-10 years) of high school graduates of whether or not to complete college and the recent decisions (short run: 1-5 years) of both college-educated and high school-educated workers to move into and/or stay and work in the state.[10] The reduced form relative supply of college-educated workers in state s at time t can be modeled in terms of relative in-migration and of the relative propensities of college enrollees from public and private institutions to work in the state where they were educated, after graduation:[11]

$$q_{st} = \pi_0 + \pi_1 E^{\text{PUB}}_{st-9} + \pi_2 E^{\text{PRI}}_{st-9} + \mu_{st} \tag{4}$$

where E^{PUB}_{st-9} and E^{PRI}_{st-9} denotes the logarithms of state enrollment rates in public and private institutions, respectively, and where μ_{st} includes the part of the relative supply that comes from in-migration. Given that the migration of students enrolled in private 4-year institutions is much greater than that of students enrolled in public 4-year institutions,

[10]The migration of college enrollees is also part of that process and will be considered by comparing states with high and low rates of net student migration.

[11]Clearly, only a fraction of enrollees become college graduates. Another fraction of college graduates may migrate to another state or country, yet another fraction may continue to graduate school or not enter the labor force for other reasons.

it is reasonable to assume that their respective propensity to work in the state where they were educated is quite different.[12]

Dahl (2002) studies the impact of self-selected migration across U.S. states on estimated returns to college. He find that the self-selection of higher educated individuals to states with higher returns to education leads to upward biases in the OLS estimates of the returns to college education. However, the variation in returns across states does not narrow as a result of the selection correction, suggesting that state-specific amenities play important roles in the in-migration decisions of individuals.[13] In the absence of internal migration data in the CPS data, the state-specific migration will be modeled as $\mu_{st} = A_s + P_t + \nu_{st}$ where state-specific amenities A_s are captured with state dummies and ν_{st} captures demand related migration. In this framework, the simultaneity bias arises from the correlation between ν_{st} and ε_{st}^D. With relative migration data from the Censuses, the positive impact of demand related in-migration on α_1 will be assessed directly in section 4.3.

If individuals are myopic or have sufficiently high discount rates, their expectations of state-specific relative labor prices nine years ahead may have little impact on their enrollment decisions.[14] To the extent that past enrollment rates are thus exogenous to current demand, two-stage least squares (IV) estimates of system (3) and (4) should provide a consistent estimate of the own-cohort relative supply effects in the presence of migration. Even if there remains some residual correlation between current demand shocks and nine-years lagged enrollment rates, as with the contemporaneous correlation it is likely to be positive. Acemoglu (2003) has argued that, across countries, increases in the supply of skills over time induce changes in technology thereafter increasing the demand for skill. This mechanism however is less likely to work across the United States since production technology is easily transferred across states as shown by Hanson and Slaughter (2002). In any event, because lagged enrollment rates and current relative supplies are also positively

[12]See tables 19 and 21 of NCES (1998a).

[13]While Dahl assumes that the state of birth does not have an effect of migration choice, here the measure of migration that is the most highly correlated with estimated college premia is linked to the state of birth, reflecting the fact that amenities of a state may be better known to its long-standing residents.

[14]As argued elsewhere, enrollees in private institutions are less likely to factor in state-specific relative labor prices.

correlated, this positive bias would move towards zero the negative coefficient estimated by instrumental variables. Thus the supply effects estimated using enrollment rates as instruments will be conservative.

The next question is whether past state-specific higher education policies exerted enough influence on past enrollment rates to impact current relative supplies, noting that higher education policies are likely to have a direct effect only on public enrollment rates.[15] States and local governments have historically invested heavily in college education through direct and indirect subsidies, but that support has been steadily eroding over time especially after the recession of the early 1990s.[16] In the mid-1980s though, many states were able to sustain relatively high levels of appropriations. These constituted about 58 percent of general education revenues of public higher education institutions in 1981 and 57 percent in 1986; by 1995 however, state appropriations were down to roughly 40 percent.[17] Faced with dwindling state support, public higher education institutions had to increase their tuition revenues, but the size and timing of the ensuing increases in tuition varied considerably across states.[18] The combination of sometimes abrupt changes in state tuition levels and state appropriations thus creates a potentially attractive source of identification. Also because as discussed earlier, these higher education policies are determined by considerations outside of the labor market, they arguably provide a more clearly exogenous source of identification.[19]

The observed past enrollment rates, E^{PUB}_{st-9}, can be seen as outcomes of an educational

[15]The historic interaction between the public and private higher education sector has been noted by Goldin and Katz (1999), Quigley and Rubinfeld (1993) among others.

[16]The share of federal appropriations, grants and contracts in general education revenues of post-secondary public institutions is also sizeable but has been more stable. It went from 16 percent in 1981 to 13 percent in 1986 and 14 percent in 1995.

[17]Computed from table 331 of NCES (2002a) and table 88 of NCES (1998b). Similar numbers are reported in table 39-1 of NCES (1999a) which gives the percentage distribution of general education revenues of higher education per FTE student by revenue sources and control and type of institution.

[18]Revenues from tuition and fees increased from 16 to 19 percent of general education revenues between 1981 and 1986, and went up to 24 percent in 1995.

[19]While cyclical downturns in state appropriations are not unrelated to state-specific labor market fluctuations, the response of state legislatures in adjusting tuition levels has varied in size and timing.

supply and demand model, where prospective students demand college seats and public institutions supply those seats with tuition fees serving as the intermediating price. Here, only a reduced form solution to the equilibrium enrollment rates is sought, where higher education policies will figure predominantly and where the returns to college are omitted to avoid potential endogeneity problems with the labor market model.

On the enrollment demand side, the enrollment decisions of high school graduates can be seen as solutions to a simplified version of the human capital investment model. Assume that after completing high school, individuals are faced with the decision of whether or not to complete college ($C_{ist-9} = 1$ or $C_{ist-9} = 0$) by maximizing the discounted present value of lifetime earnings, net of education costs.[20] Assuming that the marginal cost of attending college rises faster than the marginal benefit, the discounted lifetime earnings function is concave and the solution to this maximization problem equates the marginal costs of attending college to the marginal benefits: $MB(C_{ist-9}) = MC(C_{ist-9})$. Individual heterogeneity in the decision to attend college or not will arise from differences in the benefits of schooling or differences in the marginal costs of schooling. Aggregating across individuals in any given state will imply that state differences in college attainment will arise from differences in the returns to college and in the marginal costs of college education, in particular tuition fees. When real tuitions rise above the market equilibrium, as in the 1990s as shown below, enrollment demand becomes the short side of the enrollment market. More generally enrollment rates should be higher in states with higher returns to college and lower tuition fees, and conversely. Total enrollment demand in a state will also depend on the size of the state college-age population.

On the enrollment supply side, the ability of state public institutions of higher education to supply college seats greatly depends on state appropriations, which constitute their most important single revenue source.[21] Also as explained above, higher state appropriations

[20] This formulation is appropriate if people can borrow and lend at a fixed interest rate, and if they are indifferent between attending school and working. More generally, differences in aptitudes and tastes for schooling relative to work may lead to differences in the optimal level of schooling across individuals.

[21] The levels of state appropriations have been found to be determined by legislative choices (Koshal and Koshal (2000)) and by the lobbying activities of public institutions and their governing bodies (Lowry (2001b), Hearn, Griswold and Marine (1996)). Here, state appropriations

by keeping tuition levels low reduce the marginal costs of college education and have the potential to increase the number of college enrollees in a given state. As shown below during the 1970s, unindexed real tuitions declined below the market clearing level and despite climbing state appropriations, enrollment supply became the short side of the enrollment market. Recent research (Card and Lemieux (2001b), Bound and Turner (2002)) has identified a significant negative relationship between within-state changes in cohort size and collegiate attainment rates as evidence of a "cohort crowding" effect. Card and Lemieux (2001b) argue that the capacity of the higher education system may have only partially adjusted to the temporary bulge in enrollment caused by the baby boom. Bound and Turner (2002) argue that the "crowding effect" occurred because financial resources did not fully adjust to the expansion of the college-age population. Here, college-age population will prove to be a powerful determinant of enrollment rates independently of the significant role of financial variables, but it will be a less reliable determinant of relative supply especially in states with high private enrollment.[22] In any event, this calls for the inclusion of the logarithm of the number of college-age persons in the enrollment equation.

Thus a reduced form estimate of state-specific public enrollment rates that focuses on higher education policies will take the form:

$$E^{\text{PUB}}_{st-9} = \gamma_0 + \gamma_1 Tui_{st-9} + \gamma_2 App_{st-9} + \gamma_3 Col_{st-9} + \eta_{st-9} \tag{5}$$

where Tui_{st-9} represents the logarithm of average state tuition of public institutions, App_{st-9} represents the logarithm of per-college-age person state appropriations, Col_{st-9} the logarithm of the number of college-age persons, and where $\eta_{st-9} = S_{t-9} + P_{t-9} + \upsilon_{st-9}$.

A simple estimation strategy to identify relative labor demand would use these latter determinants of lagged enrollment rates as instruments in the estimation of relative demand (3). However, to the extent that the leakage processes described by the relative supply equation (4) are sizeable these variables are likely to be weak instruments, as reported

are seen as reduced form solution to a more complex process.

[22]Estimates using lagged college–age population using as sole instrument are presented in tables 8 and 9.

below in section 4.3.[23] Since there are more instruments than endogenous variables, it is always possible to reduce the instruments set by using a linear combination of these instruments. Here the enrollment equation (5) provides the key to a linear projection that will be strongly related to relative supplies. A three-step procedure is thus implemented: it estimates the relative demand (3) and supply (4) system by the two-stage least squares, replacing public enrollments E^{PUB}_{st-9} by the predicted values from enrollment equation (5). As shown in Pagan (1984), this procedure yields a consistent estimate of the relative supply effects predicted by the impact of past higher education policies, provided that past higher education policies are exogenous to current labor demand. In effect, in cases below where the instruments are not weak, this three-step procedure yields estimates similar to those from the simple two-stage procedure.[24]

3. Data and Aggregate Trends

Data from the NBER extracts of the MORG-CPS files are used to obtain measures of the evolution of the college/high school premium over time and across states. Since the educational data does not differentiate enrollments by gender, men and women are combined together to obtain the college premium. To facilitate the correspondence with the Fall Full-Time-Equivalent (FTE) enrollment data in 4-year institutions of higher education, the focus is on workers with a bachelor's degree. According to Jaeger (1997), this is best done by using workers with either 16 or 17 years of completed schooling before 1992 and those with a bachelor's degree thereafter; they are called "college-educated workers".[25] Similarly to capture "high school-educated workers", Jaeger (1997) suggests using workers with exactly 12 years of completed schooling before 1992 and from 1992 on, the "High school graduate" as well as those with "12th grade, no diploma".[26]

[23] Estimates from the 2SLS strategy that uses the determinants of lagged enrollment rates as instruments are presented in tables 8 and 9.

[24] As shown in column (1) table 8 and column (4) table 9.

[25] The education variable changed in the 1992 CPS.

[26] The robustness of estimated own-cohort supply effects to different measures of college and high school equivalents, as well as to the pooling of men and women, has been confirmed in Card and Lemieux (2001a).

Figure 1 shows trends in the average log wage differential between college-educated workers and high school-educated workers for two age groups, as well as the relative supply of college and high school workers over the last two decades. Panel A graphs the log wage differential for workers aged 26 to 35 while panel B graphs the same differential for workers aged 36 to 64. Consistent with the stylized fact that hourly wage inequality increased faster in the 1980s than in adjacent decades, the annual log wage changes among young workers are of 1.4 percent in the 1980s, 0.3 percent in the 1990s and -1.3 percent in the early 2000s. [27]

Panel B shows much smoother increases in the college/high school log wage differential among workers aged 36 to 64 over both decades, especially with considering all workers. The annual rate of changes in the log wage differential among older workers was of 0.6 percent in the 1980s, 0.4 percent in the 1990s and -0.6 percent in the early 2000s. It thus appears that the 1980s acceleration of the increase in the college wage premium is a phenomenon essentially driven by the experiences of younger workers. A second point illustrated in both panel A and B is that the trend for all workers (men and women combined) is very similar to the trend of men alone.

Panel C contrasts the stagnation in the growth of the relative supply of younger college workers in the 1980s with the continuous growth of the relative supply of older college workers.[28] In the 1980s, the annual rate of growth of the relative supply of college workers aged 26 to 35 was almost nil at -0.4 percent; in the 1990s, it was around 4.8 percent and in the early 2000s, 3.9 percent. By contrast, for workers aged 36 to 64, the corresponding annual rates of growth were 3.4 percent in the 1980s, 3.1 percent in the 1990s and 3.0 in the early 2000s, indicating a slow deceleration in the rate of growth of the relative supply of older college workers.

To illustrate the potentially important contribution of demographic changes to the

[27] This stylized fact is also observed, albeit with differences in magnitude and timing, using different data sources (March CPS, Census PUMS, CPS ORG) and inequality measures as shown in Katz and Autor (1999).

[28] The relative supply measures are computed as the natural logarithm of the ratio of the number of college graduates to the number of high school graduates in the indicated age ranges. A correction factor is used to adjust for the change in the definition of the educational classes in 1992.

above changes in relative supply, panel A of figure 2 presents a dramatic illustration of the changes in the college-age population (individuals aged 18 to 24) relative to other groups.[29] The baby boom and the baby bust are clearly shown in panel A. Panel B focuses on total enrollment in institutions of higher education per capita and per employed person.[30] Interestingly, the declines in the college-age population of panel A are not matched in panel B by similar declines in college enrollment per capita and per employed person. This implies that the enrollment rate (enrollment per college-age person) had to increase substantially to stabilize the enrollment per capita or per employed person, as illustrated in panel C. Basically, the baby bust created an opportunity, which I will argue is modulated by higher education policies, for enrollment rates to climb up as more college seats per college-age person became available. Note however that there is substantially variability across states in both the time patterns of both college-age population and enrollment rates. For example, as shown in figure A1a and A1b, some states (such as Nevada and Utah) saw an increase in their college-age population in the 1990s.

Figure 3 displays per-college-age person aggregate growth indexes (1980=100) of full-time equivalent (FTE) enrollment in 4-year public institutions of higher education, as well as indexes for real financial and higher education policy variables.[31] In panel A, the growth of FTE-4yr public enrollment and expenditures per college-age person is illustrated.[32] The left-angled trend in FTE-4yr enrollment rate among men and women together reflects the combination of gender-specific trends reported elsewhere (Juhn et al. (2000)).[33] In

[29] The inclusion of 22 to 24 year olds in the college-age population is motivated by the fact that this age group constituted 16 percent of undergraduate enrollment at degree-granting post-secondary institutions in the Fall 1997 (see NCES (1999b), table 13). Indeed, 18 to 22 year olds constituted only 54 percent of all undergraduate enrollments; by including the 22 to 24 years, 70 percent of potential enrollees are captured. The population estimates by age are obtained from the U.S. Bureau of Census, and the total employment data is from U.S. Bureau of Labor Statistics. See the data appendix for more detail.

[30] Total enrollments in institutions of higher education are from table 52 (NCES (1998b)). See the data appendix for detail.

[31] The financial variables are deflated using the CPI index (1995=100).

[32] The FTE fall enrollment in 4-year public institutions data are from table 58 of NCES (1998b). The expenditures information is extracted from table 88 of NCES (1998b). While enrollments are available separately for 2-year and 4-year institutions, the educational and general expenditures are not.

[33] Juhn et al. (2000) report trends in the share of 20-24 year olds in school or college grads

the 1970s, the annual rate of growth of the enrollment rate was stagnant exhibiting a negative growth of -0.8 percent. This relative stagnation of enrollment rates of the 1970s, by comparison with the rising enrollment rates of the previous decades, is explained in Card and Lemieux (2001b) in terms of cohort size and returns to education. In the early 1980s, enrollment rates began trending up exhibiting an annual growth rate of 3 percent from 1982 to 1989, but came back down to 1.5 percent from 1990 to 1996. With an approximate 8 to 10 years time lag, this pattern is similar to the one found in the relative supply of college workers aged 26 to 35 (Figure 1, panel C), noting that the denominator of enrollment rates also includes high school drop-outs. Given the time delay from enrollment in college to entry in the labor market, this means that the ensuing increases in the supply of college graduates were not going to have an impact until the early 1990s.

Panel A of figure 3 also shows that, from 1980 onwards, the per-college-age person real educational and general expenditures of public institutions experienced sizeable annual growth rates. Panel B plots the growth indexes of the two main revenue sources of public institutions of higher education: tuition and state appropriations. In the late-1970s, tuition increases did not match the two-digit inflation rates of the period, so the growth in real average tuition exhibits a negative trend up to 1981. A similar negative trend is found in the growth of real average salary of faculty in Panel C, a trend that Froomkin (1990) has credited for the relative flat growth in public educational expenditures until 1984.[34] That negative trend in real tuition levels halted with the recession of the early 1980s. While some states (such as California and West Virginia) imposed sharp tuition increases right away to bring tuition up to the real mid-1970s levels, most states imposed gradual or delayed increases.[35] In the 1980s, the annual growth rate of real tuition at 4.8 percent was similar to that of educational expenditures, which averaged 5.2 percent over the entire decade.

computed from CPS data separately by gender. The trend among men shows a U-shaped pattern over that period while the trend among women is one of steady increase from 1970 onwards. Note that the FTE-4yr enrollment numbers are themselves increasing steadily over the period.

[34]The average salary of faculty is an average of the state levels average salary of full-time faculty on 9-month contracts in institutions of higher education from table 78 of NCES (1998b).

[35]See Appendix Figures A2a and A2b for a display of the growth indexes of tuition levels and state appropriations (per-college-age person) for each of the 50 states. Note that there are no state appropriations for the District of Columbia and that the tuition growth indexes are truncated at 225.

Also reported in panel B of figure 3 is the growth index of real state appropriations per-college-age person computed using data from the Grapevine database. An important characteristic of this index is its cyclical nature (see Humphreys (2000)). The highest annual rates of growth (8 percent on average) in state appropriations per-college-age person were found in the 1970s, and are touted as having permitted the low nominal tuition increases of the 1970s. After the cyclical downturn of the early 1980s, the annual growth rate of state appropriations fared at a robust 5.6 percent from 1982 to 1989, but became negative again with the recession of the early 1990s.

Given that tuition revenues and state appropriations are the two most important sources of revenues of higher education institutions, whenever the growth of public educational expenditures is non-negative, a decline in state appropriations will eventually have to be compensated by an increase in tuition revenues and conversely. In many states, there is thus a negative relationship between tuition levels and state appropriations, as pointed out by others (Berger and Kostal (2002), Lowry (2001a), Koshal and Koshal (2000)) who find cross-sectional evidence of that relationship. However, the timing and the size of the tuition increases that followed the 1980s recession and the accompanying decline in state appropriations varied considerably by state. Panel A of Figure 4 illustrates the same trends as in panel B of figure 3 for three representative states: Florida, Texas and California, displaying the 3 years averages used in the estimation.

4. Empirical Implementation and Results

4.1. Cross-State Evidence of Supply Effects in the College Premium

The aggregate trends in wage inequality presented in Figure 1 mask important differences across states in both the level and the evolution of the college/high school wage premium. In order to get reasonable sample sizes by state and to smooth out excessive variability in the college premiums, three years of data are pooled to obtain eight time periods from 1979 to 2002.[36]

[36]The three years averaging is used instead of a three-years moving average in order to minimize potential autocorrelation problems, which are actually found not to be important.

The wage premiums are estimated separately for each state and each of the eight time periods (each regrouping 3 years) using samples of men and women (together) aged 26 to 35, who are either "college-educated" or "high school-educated":

$$\ln w_{ist} = \beta_{st} X_{ist} + r_{st} C_{ist} + \epsilon_{ist}, \tag{6}$$

The regression models include age, a dummy for college graduate, and dummies for gender, non-white, part-time, marital status, and year. The individual state time patterns in the college premium, $\widehat{r}_{st}$, along with 95% confidence bands, are presented in appendix Figures A3a and A3b.[37] Despite the larger confidence bands for the smaller states, a variety of patterns emerge. Panel b of Figure 4 illustrates some of the typical patterns for three large states,— Florida, Texas and California—, where the college-age population did not decline in the 1990s, thus abstracting for the mechanical increase in enrollment rate that comes with such a decline. These patterns corroborate the hypothesis that sustained growth in per-college-age person real state appropriations and moderate tuition increases in the mid-1980s are associated with lower (or negative) rate of growth in the college premium in the mid-1990s.[38]

The levels of the log college premium in Florida are relatively high but show relatively slow growth over the period, averaging an annual log wage change of 0.2 percent over the entire period. In Florida, per-college-age person real state appropriations exhibit little decline in the recession of the early 1980s and show sustained growth from the mid 1980s to 1990 with no increases in real average tuition fees until the 1990s. In Texas, the log college premium exhibited a fast rate of 1.5 annual log wage changes until the early 1990s, but slow down to an annual rate of 0.5 percent after 1993 (where the indicated years are mid-point of the three years time periods). Interestingly, sustained per-college-age person real state appropriations until 1984 meant that Texas was able to offer declining real tuition fees until that time, resulting in an average annual rate of increase of 6.9 percent in real

[37]The District of Columbia is omitted from the Figures, but is included in part of the analysis.

[38]Again, the reasons for the slowdown in enrollment rates in the 1970s, despite (or perhaps in spite of) declining real average tuition, and the ensuing increases in the college wage premium have been analyzed by Card and Lemieux (2001b).

average tuition from 1984 to 1993. Finally, California is among the states that exhibited the more sustained growth in its log college premium over the entire time period with an annual log change average of 1.6 percent.[39] California is also a state where the growth in per-college-age person real state appropriations was severely hit by recessions and where real average tuition fees increased at an annual rate of 9.7 percent from 1984 to 1993.

The more formal analysis of the potential links between wage inequality and higher education begins by trying to establish a link between state-specific relative supplies and returns to college. To benchmark the magnitude of the own-cohort supply effect, table 1 first reports in column (1) the OLS estimate using the yearly aggregate college premium computed using all U.S. states.[40] The estimated effect of -0.207 (0.027) is similar to the effect of -0.220 (0.020) [for men and women combined] estimated by Card and Lemieux (2001a) for the 1970 to 1995 period. The estimates from column (2) to (6) are within-state estimates using the state-specific college premia as dependent variable. When a simple time trend and state dummies are included, the estimate in columns (2) yields a significant own-cohort relative supply effect of less than half the aggregate estimate. When a quadratic trend or a complete set of time period dummies are introduced in column (3) and (4), the own-cohort effect is reduced further. The effect of the relative supply of older workers is not significant, but positive possibly capturing some state-specific demand effects. In columns (5) and (6), the logarithm of state-specific unemployment rates is included to capture other demand related effects as well as any state-specific cyclical effects.[41] State trends are introduced in column (6) to capture other possible state-specific linear trends. While state unemployment rates have little effect of the magnitude of the coefficient, state-specific trends increase its magnitude.

The relative smallness of the own-cohort effect can be interpreted as evidence of simultaneity bias or of state-specific relative supplies having little impact on state-specific

[39]There was a slight slowdown in that rate of annual log wage changes to 1 percent in 1990, corresponding the 1980 lowest tuition level and relatively high level of state appropriation.

[40]All OLS procedures are actually WLS estimations using the inverses of the sampling variances of the estimated premium from equation (6) as weights.

[41]State unemployment rates may also capture the impact of state-specific share of young adults on the labor market (Shimer (2001), Foote (2002)).

relative prices consistent with FPE resulting from cross-state flows of labor, goods or technology. The impact of demand-related relative labor flows is addressed next with an instrumental variable strategy, the impact of flows of goods is discussed below in section 4.3.

Another salient point is made in table 2. The highly significant and negative coefficient of the quadratic time trend in column (3) traces a concave pattern for returns to college over time. A more precise measure of the deceleration of the college premium is provided by the time effect estimates of columns (4)–(6). These estimates from column (5) are plotted in panel A of figure 5 against the time trend of column (2), and clearly illustrate an acceleration in the 1980s followed by a deceleration in the 1990s. The implied decelerating relative demand for college educated workers seems inconsistent with skill-biased technological change theory or with observed trends in the high tech sector in the late 1990s. To the extent that OLS estimates suffer from an endogeneity bias, because the error terms from the demand function will be positively correlated with relative quantities, the OLS estimates will understate the true slope of the demand function. Because the OLS estimated demand functions will be flatter, the distance between the intercepts determined by the time period dummies will also be biased.

An instrumental variable (2SLS) solution to the endogeneity problem is explored next. First, the aggregate level results from the two-stage least squares estimation strategy using as instruments enrollment rates in public and private 4 years institutions of higher education, separately, are reported in column (1) of table 2. It yields an estimate virtually identical to the OLS estimate. Column (2) to (6) reports the within-state instrumental variables estimates of the own-cohort supply effects which is now of the benchmark order of magnitude ranging from -0.179 to -0.217 (0.30 to 0.80) and remarkably robust to the introduction of state-specific linear trends and even quadratic state trends.[42] In all specifications, the overidentification test confirm that the exogeneity of past enrollment rates to current demand cannot be rejected.

[42]The introduction of both quadratic state trends and year dummies oversaturated the model and yield an insignificant coefficient. Because there are no private institutions of higher education in Wyoming, I loose observations from that state. This reduces the number of observations to 400.

Interestingly, the IV estimated time effects from columns (3) and (4) do not corroborate the concave shape of the OLS estimated time effects of the returns to college. Rather as illustrated in panel B of figure 5, once the own-cohort supply effects are taken into account, the counterfactual returns to college actually continue to climb in the early 1990s, at a little faster rate than the time trend, culminate with the high tech boom of the late 1990s but come down with the bust of the early 2000s.[43] The implications of these time effects for relative aggregate demand are explored below.

4.2. Impact of Higher Education Policies

The next issue is whether higher education policies can be implicated in the relative supply effects that contributed to reduce the college premium in the 1990s. The 3-step procedure outlined earlier is explored first; the results of the alternative 2SLS are included among the robustness checks in the next section. The results of the first step of the 3-step procedure, the estimation of the determinants of enrollment rates, are shown in table 3. Because state-level tuition data is not available prior to 1973, the analysis covers the period 1973 to 1993 corresponding with a nine years lag to 1982 to 2002.[44]

The dramatic negative impact of log college–age population on log enrollment rates is shown in column (1). The estimated effect of about -0.55 (0.06) is very close to estimates of about -0.6 found in Bound and Turner (2002). Note that this effect remains stable to the introduction of financial education variables and of various state-specific trends in subsequent columns, the effect of log college age population thus appears largely independent from these variables.

In column (2), the logarithm of real average public tuition is added to the explanatory variables. The negative effect of log average public tuition is sizeable with an elasticity of enrollment demand of -0.166 (0.042). In the related literature, the impact of tuition on college enrollment rates is usually reported in terms of the impact of a $1000 change in

[43]Figure 5 panel B draws the estimates from table 2, column (3).

[44]Because tuition data is not available prior to 1973, I loose 51 observations from my first time period, 7 observations from the District of Columbia for which state appropriations are not relevant and another 7 observation from Wyoming, which does not have any private institutions of higher education. I am thus down to 343 observations.

direct costs and is found to be of about -0.04 (0.1) (e.g. Kane (2003)). Here, when average tuition (rather than log average tuition) is used, the within-state estimated coefficient is -0.048 (0.014), which is of the same order of magnitude as other studies.

In column (3), the logarithm of real state appropriations per-college-age person replace tuition and yields an estimated of the elasticity of enrollment supply with respect to state appropriation of 0.098 (0.045). In columns (4) to (7), a reduced form equation of enrollment rates corresponding to equation (5) is estimated using various specifications of time and state-specific trends. Column (4) and (5) each cover only the earlier period (1973-1982) or later period (1983-1993) confirming the respective roles of enrollment supply, determined by state appropriations per-college-age person in the earlier period, and of enrollment demand, determined by average tuition in the later period, as short sides of the enrollment market.

In most specifications covering the entire period, the negative effect of tuition dominates the positive effect of state appropriations.[45] When time and state-specific quadratic trends are introduced, both variables are statistically significant. The negative relationship between the two policies instrument is formally estimated in column (8).

Table 4 presents the results of the 3-step instrumental variables strategy outlined in section 2 using lagged log college age population, lagged log average tuition and lagged log state appropriation per college-age person, along with appropriate time and state-specific trends, as predictors for predicted enrollment rates. Column (1) reports the results at the aggregate level: they are similar to both the OLS and the simple 2SLS estimates of tables 1 and 2. The within-state estimates are presented in column (2) to (5). In column (2), the state-specific public enrollment rates predicted using column (5) of table 3 are used as sole instrument for relative supply. Column (3) adds private enrollment rates and corresponds to column (4) of table 2. The substitution of actual enrollment rates by predicted enrollment rates leads to estimate of the relative supply effects very much in the same range as estimates from table 2 and the first stage coefficient of predicted

[45] To the extent that important changes in state appropriations and tuition in almost all states took place during the early 1990s recession, the year dummies may be capturing some of that effect and thus the quadratic time trends allow the education variables to gather more explanatory power.

enrollment rates is also highly significant.[46] The estimated time effects in the returns to college from column (3) are displayed in panel c of figure 5. They closely follow the linear time trend until the early 2000s when they decline.[47] In column (4), state-specific linear trends are added. To the extent that they weakened the explanatory power of financial education variables, they also weakened the statistical significance of the own-cohort supply effects. Deleting year dummies but introducing quadratic time and state-specific trends provide more precise estimates. Overall the estimates from own-cohort relative supplies effect estimated using cohort size and financial education variables are very similar to those instrumented with enrollment rates and quite robust to the introduction of various state-specific trends. Both the instrumental strategy that uses lagged log enrollment rates and the 3-step procedure that is based on state-specific higher education policies and demographics show that when relative supplies effect are taken into account, the trends in the counterfactual returns to college are linear rather than concave. This has important implications for understanding trends in relative demand.

An important finding in the recent literature on wage inequality that has emphasized a supply and demand framework (Autor, Krueger and Katz (1998)) has been a deceleration in the relative aggregate demand of college-educated workers in the first half of the 1990s. Here, adding data up to the early 2000s and employing a within-state instrumental variable strategy to identify relative demand reveals a different picture. Using an estimate of the aggregate elasticity of substitution between college and high school young workers corresponding to the previous results (σ=5), the implied changes for relative aggregate demand for three of the estimation strategies used in the paper are reported in table 5. The implied relative aggregate demand changes do not show a deceleration of relative demand in the 1990s relative to the 1980s averages.[48] Rather, there is a slight acceleration in the mid to late 1990s and a severe deceleration accompanying the high tech bust of the early 2000s.[49] The findings from a supply and demand framework no longer seem at odds

[46]Also see table 9, column (3) and (4) for a comparison of the two procedures.

[47]When a time trend is added and the year 2001 is suppressed, I cannot reject the joint hypothesis that the time dummies are equal to zero (p-value=0.68).

[48]The implied relative changes in aggregate demand are computed as in (Autor et al. (1998))as $\sigma\times$ the changes in returns estimated by the time period effects.

[49]The three years averaging seems not to bracket the slowdown of the early 1990s appropriately,

with recent trends in information and communication technologies (ICT).

4.3. Effect of Confounding Factors and Alternative Specifications

Because some states with high private enrollments (such as Rhode Island) are involved in the production of educational services for exportation to other states, this may confound the potential link between the production of college graduates and the presence of college-educated workers at the state level.[50] The impact of state-specific higher education policies on the relative size of the college educated workforce may be mitigated in states with high private enrollment. In turn, the impact of state-specific "homegrown" relative labor supplies on relative labor returns may be weakened by factors such high labor mobility and high levels of cross-state trade. A first objective of this investigation of coufounding factors is to contrast the relative supply effects from states with low private private enrollment with those from states with high private enrollment. A second goal is to contrast the relative supply effects from states with relatively low migration to those from states with relatively high migration, because the latter may be contaminated by confounding effects (Dahl (2002)) and because migration flows are an obvious mechanism contributing to FPE. Third, because the trade of goods across states could provide another adjustment mechanism by which states could absorb differential changes in relative labor supplies through changes in output-mix, the relative supplies effects from states with low levels of cross-state trade will be compared with those of states with high levels of cross-state trade.

Table 6 reports the state–level cross–sectional measures of the public/private enrollment mix, the mobility of young college graduates (CG), and cross–state trade, used to assess the impact of these confounding factors. The public/private enrollment mix measure in Column 1 is the ratio of total enrollment in public institutions of higher education to total enrollment in all institutions of higher education in the state in Fall 1996.[51] Column 2 of table 6 reports a measure of the inter-state migration of college educated workers computed

it sets in 1988-1990 rather than in 1991-1993.

[50]See Hoxby (2000) on the issue of whether private higher education is integrated at the national level.

[51]The information is extracted from table 48 of NCES (1998b).

using the 5% sample of the 2000 U.S. Census. This measure is the proportion of college educated workers 31-40 year olds in 2000 (thus 26-35 in 1995) who migrated into the state in the previous five years. It captures the in-migration of young college graduates (CG).

Column 3 provides a measure of the level of cross-state trade. It is computed as the ratio of shipments of commodities (from 1997 Commodity Flow Survey) from the mining (except oil and gas extraction) and manufacturing sectors to other states to the gross state product (GSP) of that state.[52] There are some problems with commodity flow data since they include all shipments rather than only shipments from source to final users.[53] These problems are somewhat minimized by subtracting within-state flows from the origin commodity flow data. Despite these problems, they provide the best source of interstate trade data.[54]

The link between state-specific higher education policies, enrollment rates, college-educated workers, and the returns to college are likely to be tighter in states with low private enrollment, low CG in-migration, or low cross-state trade. Estimates from the 3-step procedure for related sample splits are presented in table 7.[55] They do indeed confirm that the own-cohort supply effect is stronger in states with either low private enrollment, low CG migration, or low cross-state trade. In groups of states with either high private enrollment, high mobility, or high level of cross-state trade, the 3-step estimated own-cohort supply effects are not statistically significant. In groups of states with either high private enrollment or high labor mobility, the first-stage [the relative supply equation (4)]

[52] See the data appendix for detail about the 1997 Commodity Flow Survey. Agricultural products used by manufacturing industries, such as live animals and fish, cereal grains, etc. are also included.

[53] Shipments from establishments in the wholesale trade and from catalog and mail-order houses are included!

[54] Alternative measures of trade such as the share of GSP in tradable sectors have a too unimodal distribution across states to provide meaningful sample splits.

[55] The states are classified according to the figures reported in table 6. States with low private enrollment are those where the enrollment rate in public institutions is greater than 82 percent. States with low CG migration are those where the share of 30-41 year olds college educated state residents in 2000 Census, who were resident of another state in 1995 is less or equal to 18 percent. States with low out-of-state shipments are those for which the ratio of the value of shipments to other states to the gross state product in 1997 is less than 57 percent. Other states are high out-of-state shipments.

is substantially weaker by comparison with their counter splits. In the group of states with high mobility and high trade levels, despite a significant first-stage, the second-stage [the relative demand equation (3)] fails, consistent with a role for factor price equalization. It is also important to note that the estimated time effects indicate less growth in the returns to college in the 1990s in states with looser links between higher education policies, relative supplies and relative returns than in states with tighter links.

The use of the 3-step procedure was justified by the leakage from the production of college educated workers to presence of college educated workers in that state resulting from worker mobility. To the extent that this leakage may be less important in states with either low private enrollment or low CG migration, the simple 2SLS estimation strategy may work for those groups of states. The results of an instrumental variable strategy that uses the determinants of lagged enrollment rates as instruments for relative supplies are reported in table 8 for all U.S. states and for the same sample splits as table 7.

Panel a) of table 8 reports the OLS estimates. Panel b) reports the 2SLS estimates using only demographic variation while panel c) also includes the education policy variables. In column (1) when all states are used, the 2SLS own-cohort supply estimates from both panels b) and c) are of a similar order of magnitude as the OLS estimates and not statistically significant. However, for samples of states with either low private enrollment or low CG migration, the 2SLS estimates are close to the 3-step estimates of table 7 (and table 4) and statistically significant. In particular, for states with low private enrollment where state-specific higher education policies should have more of an impact, the first stage estimates of lagged log college-age population and of lagged log average tuition on relative supplies are significant yielding a 2SLS estimate of the own-cohort supply effect of -0.222 (0.078). On the other hand, for groups of states where state-specific higher education policies are less likely to have an impact because of high private enrollment or high mobility (i.e. where the leakage described by equation (4) is likely important), the estimates from the simple 2SLS strategy are not statistically significant, close to zero or of the wrong sign.

Another possible explanation for the relatively small within-state OLS estimate of the own-cohort effect using CPS data is the possibility that measurement error from the relatively small sample size from some states may lead to some attenuation bias.[56] The previous estimation procedures are thus applied to data from the 1980, 1990 and 2000 Census and the results are reported in table 9. The point estimate for the own-cohort effect using the OLS specification with Census data in column (1) is identical to the CPS estimate of column (5) in table 1. Column (2) to (4) present the results of specifications using enrollment rates and their determinants as instruments for relative supplies; these corresponds to column (4) of table 2, column (2) of table 4 and column (1), panel c) of table 8. Here the results from the alternative instrumental variables specifications are very similar; they are somewhat smaller but of magnitude similar to the estimates using CPS data. The more significant role of log unemployment rate as a demand measure in these close-to-recession years can be implicated in this result as shown in column (5).

Column (6) and (7) of table 9 explored the use of alternative instruments, which are significantly correlated with the relative supply of college educated workers. First, lagged log college–age population is used as instrument in column (5). As explained earlier cohort size is an important determinant of enrollment rates, yet this variable yield an insignificant supply effect of similar magnitude as the OLS estimate. Second in column (7), two variables measuring relative migration, the relative return migration and the relative other recent in-migration, are used as instruments. The relative return migration is measured as the logarithm of the ratio of college educated returnees to high school returnees, where returnees are workers aged 26 to 35 born in the state of residence but not resident of 5 years before. Similarly, the relative other in-migration is computed as the logarithm of the ratio of college educated recent in-migrants to high school recent in-migrants, where recent in-migrants are workers aged 26 to 35 not born in the state of residence and not resident of 5 years before. As argued earlier, relative in-migration is likely positively correlated with demand shocks which should help estimate supply rather than demand. In effect, the estimated coefficient is positive although very small and not significant.

Overall the effect of confounding factors, alternative instruments and estimation strate-

[56]There is an oversampling of smaller states in the CPS data. Thus by comparison to Census data, the smaller states are given relatively more weight in estimations using CPS data. With the Census data, any measurement error in the regressor is likely not classical (i.e. uncorrelated with the regressor) and will not lead to an attenuation bias (Hyslop and Imbens (2001).)

gies are consistent with the model outlined in section 2 and the robustness of the estimates lend further credibility to the results.

5. Conclusion

To the extent that the late 1990s witnessed an expansion in high technology industries, the observed deceleration of the returns to college over that period presents a challenge for explanations of increasing returns to skill (and to college) based on skill-biased technological change (Krueger (1993), Berman, Bound and Griliches (1994), Autor et al. (1998)). Unless, as is argued here, the relative supply effects partially induced by the "favorable" state-specific higher education policies of the mid-1980s are taken into account. When accounting for relative supply effects, the counterfactual returns to college no longer decelerate in the 1990s. In fact, the increases in counterfactual returns to college reach their highest points in the mid to late 1990s, but come down in the early 2000s. The implied changes for relative aggregate demand mirror these trends. The debate concerning the causes of rising wage inequality in the United States often casts the leading explanations in terms of competing models. An important methodological contribution of this paper is to derive an instrumental variables strategy to credibly estimate relative demand. The analysis then shows that supply and demand explanations can be complementary to explanations based on skill-biased technological change, as well as support the role of public policies and institutions.

The paper exploits differences across the U.S. states in the evolution of the returns to college from 1979 to 2002 and in the evolution of college enrollment rates, tuition levels and state appropriations per-college-age person from 1970 to 1993, to investigate the potential links between wage inequality and higher education. The identification strategy relies on a simple reduced form supply and demand model of the labor market that nests an educational supply and demand model. Current relative supplies originate from past college enrollment rates–"homegrown" relative supplies–and relative in-migration. If individuals are myopic or have sufficiently high discount rates, the enrollment rates should be exogenous to current demand while relative in-migration is likely positively correlated with current demand. This leads to a first instrumental variable strategy that uses past enrollment rates to identify current demand. Estimations with Census data confirm the respective hypothesized roles of past college enrollment rates and relative in-migration. A second 3-step strategy uses state-specific higher education policies, namely past tuition levels and state appropriations along with demographics, to predict past public enrollment rates. The predicted public enrollment rates and the private enrollment rates then become instruments thought to shift the relative supply of college graduates while being exogenous to current demand.

The main finding of the paper is that the increases in the relative supply of college graduates, partially induced by favorable state-specific higher education policies in the mid 1980s, lead to the observed deceleration in the returns to college among young workers in the mid 1990s. In states where state appropriations per college-age person faltered in the 1980s (like California), the ensuing rise in tuition levels caused a reduction in enrollment rates which translated into a continuing rise in the college wage premium in the 1990s. In states with sustained state appropriations per college-age person in the 1980s (like Florida), there was relatively little rise. The link between state-specific higher education policies and changes in the returns to college is supported by additional checks.

Estimations performed on groups of states selected on the basis of stronger links between the production of college graduates and the supply of college-educated workers in the state lends further support to the hypothesis that higher education policies played a significant role in the deceleration of the returns to college. When all states or when groups of states characterized by either low private enrollment rate or low labor mobility or low cross-state trade levels are considered, state-specific relative labor supplies are shown to significantly affect state-specific relative labor prices. On the other hand, for groups of states where the links between the higher education policies and the relative supply of college-educated workers in the state are weak because either high private enrollment or high mobility, or where there is a high level of cross-state trade, it is not possible to reject the hypothesis that state-specific relative supplies of college graduates have no impact of state-specific relative wages. This is consistent with factor price equalization occurring across those states more importantly through relative labor flows across states but also through trade. These findings are similar in nature to those of Hanson and Slaughter (2002) who reject integration for their 14 big states sample but not for groups of contiguous states or states with similar relative labor supplies. The results thereby call for caution in interpreting significant within-state effects as evidence of complete U.S. labor market segregation, attention has to be paid to the source of identification of these effects.

In many U.S. states, higher education policies can influence the supply of college graduates. In turn, the increased supply of college graduates is shown to contribute, albeit with a delay, to the containment of increasing wage differentials between college-educated and high school-educated workers. The message here is that states can be active players in the containment of this dimension of wage inequality.[57] In the mid to late 1990s, however the ability of states to increase their appropriations to higher education has been severely curtailed and tuition levels have increased to unprecedented levels. This would entail that another surge of increasing wage inequality might be forthcoming in the mid-2000s. However, the negative impact of rising tuition fees on college attendance may be mitigated by recent changes in federal financial aid policy, as well as by other changes in state and institutional grant aid.[58] An important avenue of current (Kane (2003)) and future research is to analyze the mitigating impacts of new financial assistance packages, including guaranteed loans, on rising tuition in the determination of college enrollment rates.

[57]As argued elsewhere (Fortin and Lemieux (1997), Lee (1999)), states also dispose of instruments, such as minimum wages laws, to reduce wage inequality along dimensions that reflect the labor market outcomes of less skilled workers.

[58]For example, NCES (2002b) finds that from 1992-93 to 1999-2000, the combined increase in federal, state, institutional and other grant aid was sufficient to offset increases in the price of college attendance for low-income students, but not for middle and high-income students.

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Data Appendix

1. CPS Wage Data

The wage data are obtained from the Merged Outgoing Rotation Group File of the Current Population Surveys from 1979 to 2002, using the extracts prepared by the NBER. The following individuals were retained: individuals employed in the public or private sector (excluding the self-employed) with hours worked within the valid range of the survey. For individuals meeting these criteria, the hourly wage was computed as their weekly wage divided by their hours of workers for those who reported a weekly wage and as the hourly wage for those paid by the hour. Outliers with wages below $2.00 and above $150 in 1989 dollars were excluded.

2. Education Data

2.1. NCES Data

The educational information on enrollment, expenditures, faculty salary and the number of FTE-faculty is drawn from various reports, as indicated in the text, of the National Center for Education Statistics. A number of state level tabulations are performed by the NCES and are available through on-line publications at: www.nces.ed.gov. These reports collate data by state from the Integrated Postsecondary Education Data System (IPEDS), which began surveying institutions of higher education in 1986. The data prior to 1986 are from the Higher Education General Information Survey (HEGIS). Implemented in 1966, the HEGIS was an annual universe survey of accredited institutions. Both the IPEDS and the HEGIS acquire statistical data on institutional characteristics, faculty salaries, fall enrollment and completions, finances and more. In the IPEDS, this information acquisition is done through eight integrated survey components, two of which—the Fall Enrollment and the Financial Statistics—are used here. The response rates for these surveys were in the mid 90 percent range in 1995. One advantage of using these reports rather than the original HEGIS and IPEDS surveys is that in the reports "considerable effort has been made to present only comparable information on trends" (NCES (1998b)). In particular, statistics on vocational/technical institutions and adult education data are excluded because these data have not been gathered on a consistent basis over the period examined.

The enrollment data used is the full-time equivalent fall enrollment in 4-year institutions of higher education in a given state from tables 58 and 60 of NCES (1998b). The enrollment data is available separately for public and private institutions.

2.2. Tuition Data

Prior to 1986, tuition data is not available from the NCES. However, the Washington State Higher Education Coordination Board (Raudenbush (2002)) has compiled historically consistent data, from 1972-73 onwards, on tuition and fee rates at public institutions using surveys of state agencies or individual institutions. The data are available separately for resident and non-resident and for universities, colleges and state universities and community colleges. Where applicable, an average of the tuition at universities and at colleges and state universities is constructed for residents and non-residents separately. Then a weighted average of the tuition for residents and non-residents is constructed using the 1996 proportion of residents vs. non-residents tuition available from the table 7 of NCES (1998a)).

2.3. State Appropriations Data

Detailed state appropriations data is available in a series of "Appropriations of State Tax Funds for Operating Expenses" reports by M.M. Chambers, sometimes called the "Chambers Reports" available from 1961 to 2002. Most of the reports are posted on the Grapevine web site: www.coe.ilstu.edu/grapevine/Welcome.htm. Others are available through the Eric system, while still others exist only in the hardcopy paper form. Details of the amounts included in the appropriations for each of the 50 states are available in those reports. However, I use the state summary tables that should be viewed as approximations of the amounts that are destined to 4-year public institutions of higher education.

3. Census Data

The 5% sample of the 1980 U.S. Census (ICPSR#8101), the 5% sample of the 1990 U.S. Census, (ICPSR#9952) and the 5% sample of the 2000 U.S. Census, available on the BLS web site, were used to compute the state-specific college premiums, relative supplies of younger and older workers, as well as relative measures of return migrants and other in-migrants used in table 10. Employed individuals aged 26 to 35 with hours worked within the valid range of the survey were retained as young workers, whereas similar individuals aged 36 to 64 were the older workers. Information on the workers' state of birth, state of residence in the Census year and 5 years before was used to construct the mobility measures used.

The 5% sample of the 2000 U.S. Census was also used to construct a measure of intra-state worker mobility among 31 to 40 year olds in 2000, thus 26 to 35 year olds in 1995. College graduates aged 31 to 40 with hours worked within the valid range of the survey were retained. Information on their state of residence in 1995 and in 2000 was used to construct the mobility measures used.

4. Population Data

4.1. National and State-Level Population

The national estimates of the United States resident population were downloaded from the web site of U.S. Census Bureau: www.census.gov/population/www/estimates/nation2.html. The estimates include persons resident in the 50 States and the District of Columbia. The criteria for residence defines a resident of a specified area as a person "usually resident" in that area. College students living away from home while attending college are counted where they are living at college. College students living at their parental home while attending college are counted at their parental home. The population estimates by age are obtained from the U.S. Bureau of Census. These data are available on-line [www.census.gov/population/www/censusdata]. The population estimates by states were downloaded from the web site of U.S. Census Bureau: www.census.gov/population/www-/estimates/statepop.html. The data used were compiled from the "Single Years of age by sex" for the 1990s and 1980s, and from the "Selected Age groups" for the 1970s. Details on the sources and methods for obtaining the postcensal estimates are available from the web site.

4.2. Employment and Unemployment Data

The total employment estimate used in Figure 2 was sourced from the Bureau of Labor Statistics at: www.bls.gov. The data came from the "Labor Force Statistics from the Current Population Survey". The labor force and unemployment data are based on the same concepts and definitions as those used for the official national estimates obtained from the Current Population Survey (CPS). A detailed description of the estimation procedures is available from the BLS. The state-level unemployment data was sourced from an historical state labor force data file available through the Local Area Unemployment Statistics (LAUS) program [www.bls.gov/lau/] of the BLS.

5. Cross-State Trade Data

5.1. Commodity Flow Data

The cross-state trade data comes from the 1997 Commodity Flow Survey, a joint venture between the Bureau of Census and the Bureau of Transportation Statistics, and is available at: www.bts.gov/ntda/cfs/prod.html. The Commodity Flow Survey provides information on, among other things, the value of commodities shipped from an origin state to a destination state. The survey covers establishments in mining (excluding oil and gas extraction), manufacturing, wholesale trade and selected retail industries. The Commodity Flow Survey is not an ideal source for cross-state trade data since the data include all shipments, not only shipments from source to final users. Removing within-state shipments however may remove some intermediate shipments. Also, it comprises only agricultural products used by manufacturing establishments, excludes part of mining, and does not cover trade of services.

5.2. Gross State Product

The Gross State Product (GSP) is available from the Bureau of Economic Analysis at: www.bea.doc.gov/bea/regional/gsp/. In concept, the GSP data is a measure of "value added" equivalent to gross output minus its intermediate inputs. In practice, GSP estimates are measured as the sum of the distributions by industry and state of the components of gross domestic income, that is, the sum of the costs incurred and incomes earned in the production of GDP.

Table 1
OLS Estimated Supply Effects on the College-High School Log Wage Premium for Workers Aged 26-35 (1979-2002)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Aggregate Premium	State Specific Premia				
Own Relative Supply: $ln(C^Y/H^Y)$	-0.207 (0.027)	-0.093 (0.013)	-0.051 (0.015)	-0.044 (0.017)	-0.043 (0.017)	-0.073 (0.018)
Relative Supply of Older Workers: $ln(C^O/H^O)$	0.103 (0.108)	0.017 (0.013)	0.029 (0.014)	0.024 (0.020)	0.025 (0.020)	-0.005 (0.017)
Log State Unemployment Rate					0.002 (0.013)	0.005 (0.012)
Time Trend	0.012 (0.004)	0.035 (0.003)	0.047 (0.004)			
Time Squared ÷ 10			-0.024 (0.006)			
Year Effects: (1983 omitted)						
1980				-0.033 (0.008)	-0.033 (0.008)	-0.030 (0.007)
1986				0.053 (0.008)	0.053 (0.009)	0.050 (0.008)
1989				0.091 (0.009)	0.092 (0.011)	0.085 (0.012)
1992				0.114 (0.013)	0.115 (0.013)	0.111 (0.016)
1995				0.137 (0.015)	0.138 (0.007)	0.138 (0.019)
1998				0.158 (0.016)	0.159 (0.018)	0.160 (0.022)
2001				0.178 (0.027)	0.180 (0.029)	0.190 (0.029)
State Dummies	No	Yes	Yes	Yes	Yes	Yes
State Trends	No	No	No	No	No	Yes
R-squared	0.99	0.87	0.89	0.89	0.89	0.93
No. Observations	24	408	408	408	408	408

Note: The own-cohort supply variable is measured as the logarithm of the ratio of the number of 26 to 35 years old workers with either 16 or 17 years of completed schooling before 1992 and those with a bachelor's degree after 1992 in state s at time period t to the number of 26 to 35 years old workers with exactly 12 years of completed schooling prior to 1992 and after 1992, the "high school graduates" as well as workers with "12th grade, no diploma", as suggested in Jaeger (1997). The relative supply of older workers is measured similarly using workers 36 to 64 years old. Robust standard errors are in parentheses. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the estimated wage premia.

Table 2
Instrumental Variables Estimates (2SLS) of the Supply Effect Using Lagged Enrollment Rates as Instrument (1979-2002)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Aggregate Premium	State Specific Premia				
Own Relative Supply $ln(C^Y/H^Y)$	-0.192 (0.028)	-0.217 (0.030)	-0.201 (0.057)	-0.228 (0.080)	-0.179 (0.053)	-0.189 (0.067)
Relative Supply of Older Workers: $ln(C^O/H^O)$	0.201 (0.113)	0.078 (0.020)	0.075 (0.022)	0.094 (0.032)	0.017 (0.019)	0.028 (0.023)
Log Unemployment Rate	-0.022 (0.013)	-0.028 (0.013)	-0.027 (0.013)	-0.032 (0.022)	-0.001 (0.013)	-0.011 (0.012)
Time Trend	0.008 (0.004)	0.031 (0.003)	0.033 (0.006)			-0.004 (0.023)
Time Squared $\div$ 10			-0.000 (0.001)			0.004 (0.003)
Year Effects: (1983 omitted)						
1980				-0.034 (0.010)	-0.021 (0.009)	
1986				0.030 (0.014)	0.036 (0.011)	
1989				0.048 (0.023)	0.055 (0.020)	
1992				0.082 (0.018)	0.080 (0.021)	
1995				0.116 (0.019)	0.111 (0.023)	
1998				0.152 (0.020)	0.138 (0.025)	
2001				0.163 (0.030)	0.161 (0.033)	
State Dummies	No	Yes	Yes	Yes	Yes	Yes
State Trends	No	No	No	No	Yes	Yes
State Quadratic Trends	No	No	No	No	No	Yes
R-squared	0.99	0.85	0.86	0.86	0.92	0.93
No. of observations	24	400[a]	400[a]	400[a]	400[a]	400[a]
First-Stage Estimates of the Instruments:						
Log FTE 4-yr Public Enrollment per College Age Person$_{t-9}$	1.281 (0.037)	0.599 (0.063)	0.417 (0.071)	0.292 (0.068)	0.617 (0.108)	0.100 (0.110)
Log FTE 4-yr Private Enrollment per College Age Person$_{t-9}$	0.464 (0.468)	0.100 (0.038)	0.054 (0.038)	0.062 (0.035)	0.016 (0.058)	0.016 (0.037)
Overid Test (p-value)	0.545	0.900	0.945	0.872	0.325	0.549

Note: Robust standard errors are in parentheses. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the estimated wage premia.

[a] Excludes the state of Wyoming where there are no private institutions of higher education.

Table 3

Higher Education Policy Estimates for Predicted FTE-4yr State Public Enrollment Rates (1973-1993)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable:	State Log Public Enrollment Rates								Log Average Tuition
Log College Age Population	-0.554	-0.601	-0.532	-0.678[a]	-0.547[b]	-0.584	-0.614	-0.735	-0.340
	(0.084)	(0.069)	(0.070)	(0.137)	(0.127)	(0.070)	(0.101)	(0.081)	(0.093)
Log Average Public Tuition[b]		-0.166		-0.033	-0.186	-0.152	-0.036	-0.096	
		(0.042)		(0.065)	(0.073)	(0.043)	(0.048)	(0.039)	
Log State Appropriation per College-Age Person			0.098	0.208	-0.147	0.056	0.046	0.061	-0.271
			(0.045)	(0.062)	(0.117)	(0.046)	(0.047)	(0.029)	(0.061)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Quadratic Time Trend	No	No	No	No	No	No	No	Yes	No
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Trends	No	No	No	No	No	No	Yes	Yes	No
State Quadratic Trends	No	No	No	No	No	No	No	Yes	No
R-squared	0.95	0.95	0.95	0.97	0.97	0.95	0.99	0.99	0.94
No. Observations	343	343	343	147	196	343	343	343	343

Note: Robust standard errors are in parentheses. As in previous regressions, all variables are 3-year averages and the models are estimated by weighted least squares. For the whole sample period, the number of observations is 343 observations, that is 49×7 excluding Wyoming, where there are no private institutions of higher education, and the District of Columbia, where there are no state appropriations.

[a] Covers only 1973 to 1982.

[b] Covers only 1983 to 1993.

TABLE 4

3-STEP INSTRUMENTAL VARIABLES ESTIMATES OF THE RELATIVE SUPPLY EFFECTS USING LAGGED PREDICTED ENROLLMENT RATES AS INSTRUMENT (1982-2002)

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Aggregate Premium	State Specific Premia			
Own Relative Supply	-0.201	-0.175	-0.174	-0.201	-0.189
$ln(C^Y/H^Y)$	(0.030)	(0.087)	(0.081)	(0.124)	(0.046)
Relative Supply of Older	0.179	0.064	0.063	0.015	0.028
Workers: $ln(C^O/H^O)$	(0.118)	(0.036)	(0.033)	(0.028)	(0.022)
Log Unemployment	-0.018	-0.027	-0.027	-0.011	-0.010
Rate	(0.018)	(0.019)	(0.018)	(0.016)	(0.012)
Time Trend	0.009				-0.004
	(0.004)				(0.004)
Time Squared ÷ 10					0.004
					(0.002)
Year Effects: (1983 omitted)					
1986		0.037	0.037	0.035	
		(0.014)	(0.013)	(0.017)	
1989		0.061	0.061	0.054	
		(0.023)	(0.021)	(0.035)	
1992		0.096	0.096	0.087	
		(0.019)	(0.018)	(0.038)	
1995		0.127	0.128	0.123	
		(0.020)	(0.019)	(0.033)	
1998		0.158	0.158	0.152	
		(0.021)	(0.021)	(0.030)	
2001		0.176	0.176	0.180	
		(0.031)	(0.033)	(0.041)	
State Dummies	No	Yes	Yes	Yes	Yes
State Trends	No	No	No	Yes	Yes
State Quadratic Trends	No	No	No	No	Yes
R-squared	0.98	0.84	0.84	0.90	0.93
First-Stage Estimates of the Instruments:					
Predicted Log FTE 4-yr	1.285	0.842	0.813	1.131	2.164
Public Enrollment	(0.236)	(0.169)	(0.170)	(0.369)	(0.273)
per College Age Person$_{t-9}$					
Log FTE 4-yr Private Enrollment	0.531		0.070	-0.004	-0.192
per College Age Person$_{t-9}$	(0.374)		(0.039)	(0.060)	(0.086)
Overid Test (p-value)	0.362		0.949	0.405	0.550
No. Observations	21	343	343	343	343

Note: Robust standard errors are in parentheses. Because state-level tuition data is not available prior to 1973, the analysis covers the period 1982 to 2002. Lagged log average tuition and lagged log state appropriation per college-age person are used as policy predictors for predicted enrollment rates. The number of observations in the within-state estimations is 343 observations, that is 49 × 7 excluding Wyoming, where there are no private institutions of higher education, and the District of Columbia, where there are no state appropriations. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the estimated wage premia.

Table 5
Implied Changes in Relative Aggregate Demand for Young Workers

Econometric Specification:	Relative wage changes	Relative demand changes		
		OLS	IV	3-Step IV
1980–1983	1.16	5.82	5.72	
1983–1986	2.03	10.17	4.97	6.15
1986–1989	1.39	6.97	2.95	4.03
1989–1992	0.90	4.49	5.69	5.80
1992–1995	0.68	3.40	5.79	5.29
1995–1998	0.51	2.55	6.00	5.10
1998–2001	0.72	3.58	1.71	3.01
Decade averages:				
1980–1989	1.53	7.66	4.55	5.09
1989–1998	0.70	3.48	5.83	5.39

Note: Changes are annual log changes × 100. The aggregate elasticity of substitution between college and high school educated young workers is, as previously estimated, equal to 5. Annual log changes in the college premium are computed as a weighted average of the computed premia for each state and time period. The indicated years are the mid-points of the three years time periods. Relative demand changes are computed using the time effects estimated in the indicated regression: OLS from table 1, column 5, IV from table 2, column 4 and 3-Step IV from table 4, column 3.

Table 6 – Public/Private Enrollment Mix, Worker Mobility and Cross-State Trade by States

State	Proportion[a] enrolled in public institutions	Proportion[b] of CG in-migrants	Ratio of[c] Out–of–State Shipments to GSP
Alabama	0.90	0.13	0.64
Alaska	0.97	0.28	0.05
Arizona	0.93	0.28	0.44
Arkansas	0.89	0.15	0.78
California	0.86	0.07	0.30
Colorado	0.87	0.22	0.33
Connecticut	0.64	0.14	0.46
Delaware	0.82	0.31	0.41
DC	0.13	0.23	0.03
Florida	0.83	0.20	0.20
Georgia	0.79	0.19	0.59
Hawaii	0.79	0.16	0.01
Idaho	0.82	0.23	0.62
Illinois	0.74	0.11	0.56
Indiana	0.78	0.13	0.92
Iowa	0.70	0.15	0.86
Kansas	0.90	0.25	0.75
Kentucky	0.83	0.16	0.88
Louisiana	0.86	0.11	0.50
Maine	0.68	0.20	0.52
Maryland	0.84	0.18	0.34
Massachusetts	0.43	0.10	0.40
Michigan	0.84	0.10	0.61
Minnesota	0.77	0.15	0.63
Mississippi	0.90	0.19	0.69
Missouri	0.65	0.13	0.68
Montana	0.88	0.30	0.31
Nebraska	0.83	0.19	0.81
Nevada	0.98	0.37	0.22
New Hampshire	0.56	0.25	0.72
New Jersey	0.81	0.14	0.70
New Mexico	0.95	0.17	0.19
New York	0.57	0.07	0.25
North Carolina	0.81	0.20	0.71
North Dakota	0.91	0.09	0.57
Ohio	0.76	0.08	0.75
Oklahoma	0.87	0.20	0.47
Oregon	0.86	0.22	0.58
Pennsylvania	0.55	0.10	0.56
Rhode Island	0.52	0.12	0.40
South Carolina	0.85	0.19	0.74
South Dakota	0.81	0.31	0.80
Tennessee	0.79	0.18	0.78
Texas	0.88	0.12	0.38
Utah	0.75	0.18	0.44
Vermont	0.58	0.17	0.69
Virginia	0.82	0.18	0.38
Washington	0.86	0.17	0.43
West Virginia	0.87	0.20	0.71
Wisconsin	0.82	0.11	0.82
Wyoming	0.97	0.27	0.37

Sources: U.S. Department of Education, National Center for Education Statistics, "State Comparisons of Education Statistics: 1969-70 to 1996-97," by Snyder, T, Hoffman, L and C. Geddes, NCES98-018, Washington DC: 1998, Tables 48, 51, 88 and 90. Census of Population and Housing, 2000, United States, PUMS– 5% sample.
Bureau of Economic Statistics, 1997 Gross State Product Estimates and Bureau of Transportation Statistics, 1997 Commodity Flow Survey.
Notes:
[a] Ratio of the total number of students enrolled in public institutions of higher education in Fall 1996 to the total number of students enrolled in all institutions of higher education in the state.
[b] Shares of 30-41 year olds college educated (CG) workers that are state residents in 2000 Census, who were resident of another state in 1995.
[c] Ratio of the value of shipments from the mining (except oil and gas extraction), manufacturing, wholesale trade, and selected retail industries to other states from 1997 Commodity Flow Survey to Gross State Product.

Table 7
3-Step Instrumental Variables Estimates of the Relative Supply Effects Using Lagged Predicted State Enrollment Rates as Instrument (1982-2002) for Selected States

	(1)	(2)	(3)	(4)	(5)	(6)
State Selection	Low Private	High Private	Low CG Migration	High CG Migration	Low Out of State Shipments	High Out of State Shipments
Own Relative Supply	-0.236	0.151	-0.192	+0.050	-0.310	-0.051
$ln(C^Y_{st}/H^Y_{st})$	(0.088)	(0.196)	(0.078)	(0.124)	(0.161)	(0.110)
Relative Supply of Older	0.049	-0.065	0.061	-0.021	0.101	0.026
Workers: $ln(C^O_{st}/H^O_{st})$	(0.037)	(0.108)	(0.035)	(0.056)	(0.044)	(0.053)
Log State Unemployment	-0.004	-0.020	-0.038	-0.002	-0.015	-0.017
Rate	(0.029)	(0.036)	(0.022)	(0.020)	(0.026)	(0.026)
Year Effects: (1983 omitted)						
1986	0.041	0.062	0.037	0.066	0.038	0.048
	(0.016)	(0.030)	(0.015)	(0.021)	(0.016)	(0.023)
1989	0.060	0.121	0.066	0.101	0.052	0.083
	(0.027)	(0.047)	(0.023)	(0.033)	(0.026)	(0.036)
1992	0.092	0.157	0.109	0.123	0.078	0.115
	(0.024)	(0.042)	(0.020)	(0.034)	(0.024)	(0.030)
1995	0.151	0.147	0.140	0.139	0.133	0.122
	(0.027)	(0.038)	(0.023)	(0.028)	(0.027)	(0.029)
1998	0.188	0.141	0.178	0.127	0.179	0.137
	(0.031)	(0.026)	(0.027)	(0.025)	(0.037)	(0.031)
2000	0.217	0.190	0.200	0.152	0.205	0.148
	(0.041)	(0.059)	(0.041)	(0.032)	(0.050)	(0.040)
R-squared	0.80	0.83	0.86	0.85	0.83	0.81
No. of observations	217	126	189	154	175	168
First-Stage Estimates of the Instruments:						
Predicted Log FTE 4-yr	0.874	0.695	1.319	0.531	0.535	0.483
Public Enrollment	(0.183)	(0.442)	(0.262)	(0.261)	(0.221)	(0.248)
per College Age Person$_{t-9}$						
Log FTE 4-yr	0.080	-0.023	-0.102	0.089	0.052	0.369
Private Enrollment	(0.038)	(0.134)	(0.080)	(0.043)	(0.041)	(0.121)
per College Age Person$_{t-9}$						
Overid Test (p-value)	0.492	0.757	0.281	0.407	0.822	0.950

Note: State dummies are included in all regressions. Robust standard errors are in parentheses. Models are estimated by weighted least squares where the weights are the inverse sampling variance of the estimated wage gaps. Lagged log average tuition and lagged log state appropriation per college-age person are used as policy predictors for predicted enrollment rates.

States with low private enrollment are those where the ratio of students enrolled in public post-secondary institutions to the total number of students enrolled in both public and private institutions in the state is greater than 80 percent. Other states are high private enrollment. States with low CG migration are those where the share of 30-41 year olds college educated state residents in 2000 Census, who were resident of another state in 1995 is less or equal to 18 percent. Other states are high CG migration. Other states are high CG migration. States with low out-of-state shipments are those for which the ratio of the value of shipments to other states to the gross state product in 1997 is less than 57 percent. Other states are high out-of-state shipments. See Table 6.

Table 8

Alternative 2SLS Estimates of Own Relative Supply Effects (1982-2002)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
State Selection / Estimation Strategy	All States	Low Private	High Private	Low CG Migration	High CG Migration	Low Out of State Shipments	High Out of State Shipments
a) OLS	-0.052	-0.055	-0.078	-0.078	0.000	-0.046	-0.019
	(0.021)	(0.029)	(0.029)	(0.025)	(0.031)	(0.028)	(0.037)
b) 2SLS	-0.045	-0.161	+0.347	-0.161	-0.043	-0.049	+0.091
	(0.080)	(0.094)	(0.271)	(0.075)	(0.127)	(0.131)	(0.096)
First-Stage Estimates of the Instruments:							
Log of College Age	-0.549	-0.549	-0.464	-0.828	-0.934	-0.421	-0.743
Population $_{t-9}$	(0.105)	(0.115)	(0.304)	(0.175)	(0.292)	(0.118)	(0.209)
c) 2SLS	-0.099	-0.222	+0.114	-0.168	-0.006	-0.045	+0.073
	(0.074)	(0.078)	(0.137)	(0.073)	(0.086)	(0.109)	(0.081)
First-Stage Estimates of the Instruments:							
Log of College Age	-0.560	-0.614	-0.464	-0.978	-0.399	-0.441	-0.564
Population $_{t-9}$	(0.112)	(0.124)	(0.304)	(0.203)	(0.136)	(0.130)	(0.211)
Log Average	-0.078	-0.165	-0.052	-0.087	0.017	-0.070	0.136
Public Tuition$^{b}_{t-9}$	(0.060)	(0.075)	(0.116)	(0.083)	(0.097)	(0.070)	(0.112)
Log State Appropriation	-0.022	-0.080	0.103	0.046	-0.161	-0.100	0.163
per College-Age Person$_{t-9}$	(0.064)	(0.082)	(0.118)	(0.079)	(0.108)	(0.076)	(0.118)
Log FTE 4-yr Private Enrollment	0.060	0.074	-0.065	-0.120	0.072	0.044	0.432
per College Age Person$_{t-9}$	(0.039)	(0.038)	(0.144)	(0.083)	(0.044)	(0.041)	(0.124)
No. of observations	343	217	126	189	154	175	168

Note: The relative supply of older workers, the state unemployment rate, as well as state and time dummies are included in all regressions. Robust standard errors are in parentheses. Models are estimated by weighted least squares where the weights are the inverse sampling variance of the estimated wage gaps.
States with low private enrollment are those where the ratio of students enrolled in public post-secondary institutions to the total number of students enrolled in both public and private institutions in the state is greater than 80 percent. Other states are high private enrollment. States with low CG migration are those where the share of 30-41 year olds college educated state residents in 2000 Census, who were resident of another state in 1995 is less or equal to 18 percent. Other states are high college migration. States with low out-of-state shipments are those for which the ratio of the value of shipments to other states to the gross state product in 1997 is less than 57 percent. Other states are high out-of-state shipments. See Table 6.
[a] Excludes Alaska and Hawaii for which cross-states shipments are not available.

Table 9

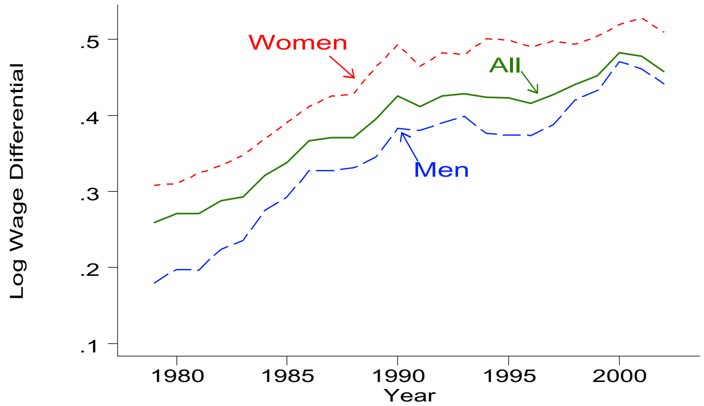
Census (1980-1990-2000) Estimates of the Own-Cohort Supply Effect Under Alternative Specifications

Econometric Specification	(1) OLS	(2) 2SLS	(3) 3-Step	(4) 2SLS	(5) 2SLS	(6) 2SLS	(7) 2SLS
Own Relative Supply	-0.043	-0.147	-0.152	-0.144	-0.202	-0.054	0.019
$ln(C^Y_{st}/H^Y_{st})$	(0.024)	(0.051)	(0.054)	(0.058)	(0.053)	(0.096)	(0.053)
Relative Supply of Older	0.069	0.112	0.114	0.111	0.131	0.074	0.043
Workers: $ln(C^O_{st}/H^O_{st})$	(0.033)	(0.037)	(0.038)	(0.042)	(0.041)	(0.055)	(0.035)
Log State Unemployment	0.072	0.048	0.048	0.050		0.070	0.086
Rate	(0.018)	(0.019)	(0.019)	(0.021)		(0.025)	(0.024)
First-Stage Estimates of the Instruments: Determinants of Relative Supply							
Log FTE 4-yr Public Enrollment		0.644			0.674		
per College Age Person$_{t-9}$		(0.101)			(0.093)		
Predicted Log FTE 4-yr Public Enrollment			0.791				
per College Age Person$_{t-9}$			(0.153)				
Log FTE 4-yr Private Enrollment		0.181	0.201	0.204	0.191		
per College Age Person$_{t-9}$		(0.061)	(0.065)	(0.066)	(0.060)		
Relative Return Migration							0.202
$ln(C^R_{st}/H^R_{st})$							(0.051)
Relative Other In-Migration							0.154
$ln(C^I_{st}/H^I_{st})$							(0.076)
Determinants of Enrollment Rates							
Log of College Age			-0.441	-0.298		-0.403	
Population $_{t-9}$			(0.091)	(0.109)		(0.115)	
Log Average			-0.027	-0.049			
Public Tuition$^b_{t-9}$			(0.040)	(0.044)			
Log State Appropriation			0.285	0.263			
per College-Age Person$_{t-9}$			(0.062)	(0.070)			
Overid Test (p-value)		0.261	0.349	0.534	0.351		0.564
R-squared	0.95	0.94	0.95	0.94	0.92	0.97	0.93
No. of observations	153	150[a]	147[b]	147[b]	150[a]	153	153

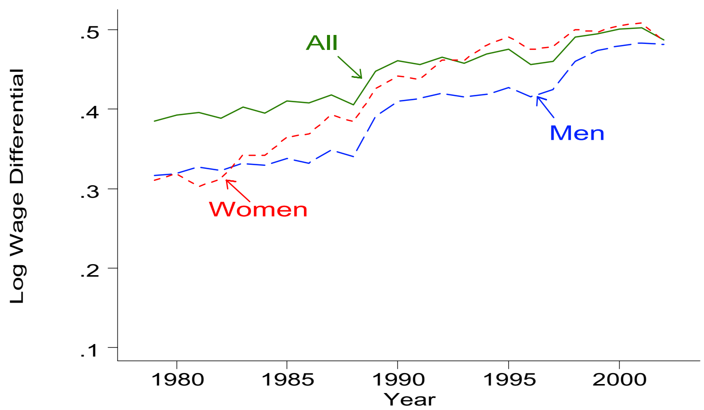
Note: Year and state dummies are included in all regressions. Robust standard errors are in parentheses. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the wage premia estimated with a specification similar to equation (6) using state level data from each ot the three (1980-1990-2000) Censuses. Relative return migration is computed as the logarithm of the ratio of college educated returnees to high school returnees where returnees are workers aged 26 to 35 born in the state of residence who were not resident of 5 years before. Relative other migration is computed as the logarithm of the ratio of college educated recent migrants to high school recent migrants where recent migrants are workers aged 26 to 35 not born in the state of residence who were not resident of 5 years before.

[a] Excludes the state of Wyoming where there are no private institutions

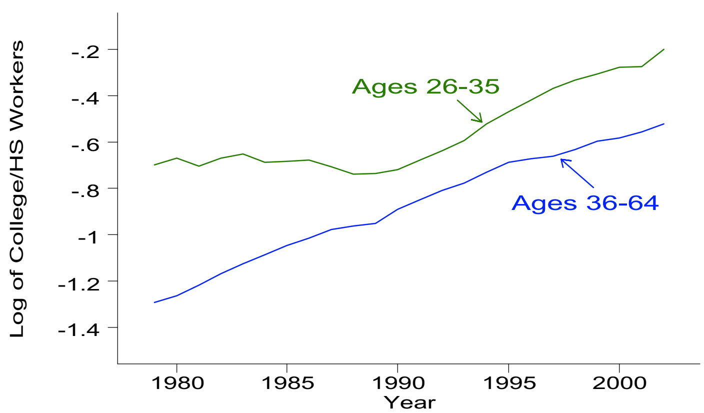
[b] Excludes the District of Columbia, where there are no state appropriations. Since state level tuition data is available only from 1973 onwards, the tuition data for 1970 was extrapolated from the state level tuition time series.



A. College/High School Log Wage Gap 26-35



B. College/High School Log Wage Gap 36-64



C. Relative Supply of College Graduates

Figure 1. Trends in the College/HS Gap
and Relative Supply of College Workers

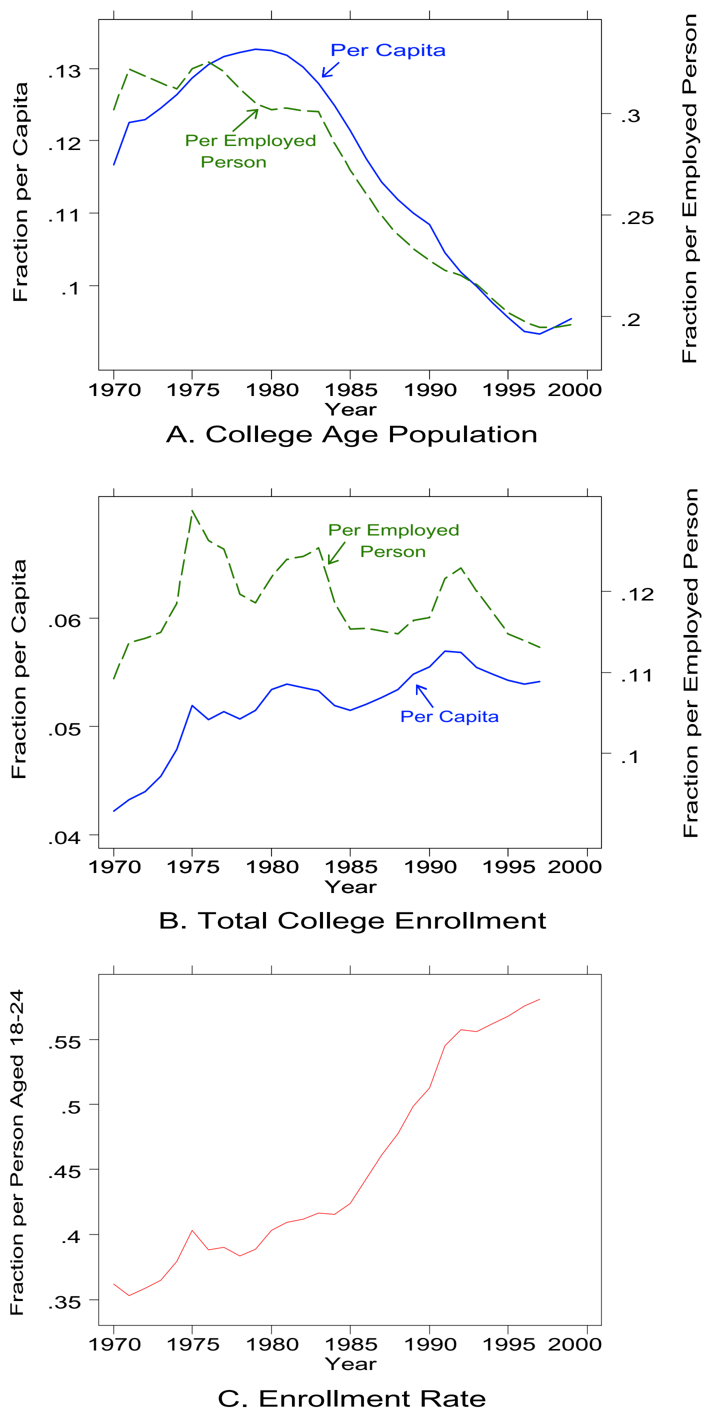


Figure 2. Demographic Trends

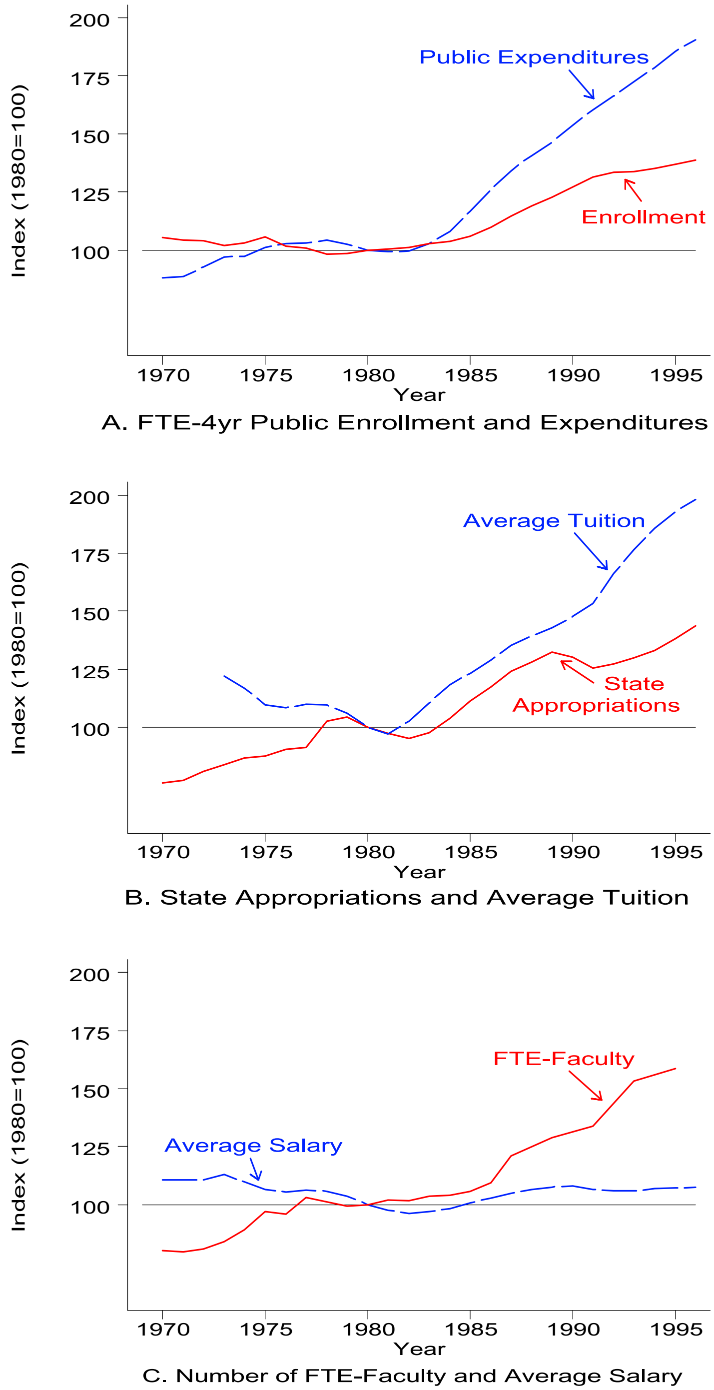
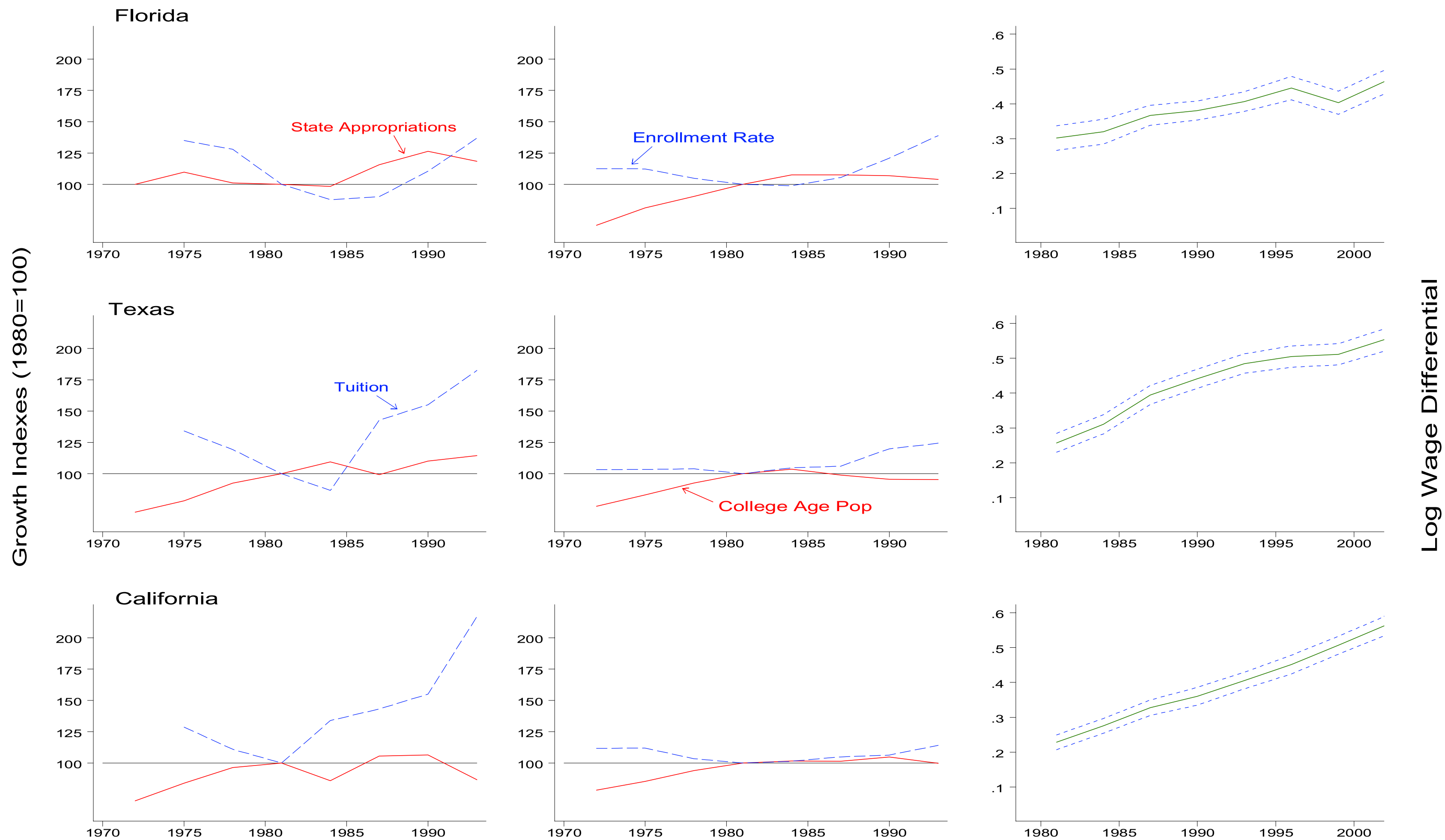


Figure 3. Per-college-age Person Growth Indexes

(except for Average Tuition and Average Salary)



a) Per-College-Age Person State Appropriations and Tuition

b) College-Age Population and FTE 4-yr Public Enrollment Rates

c) College Premium

Figure 4. Trends in Selected States

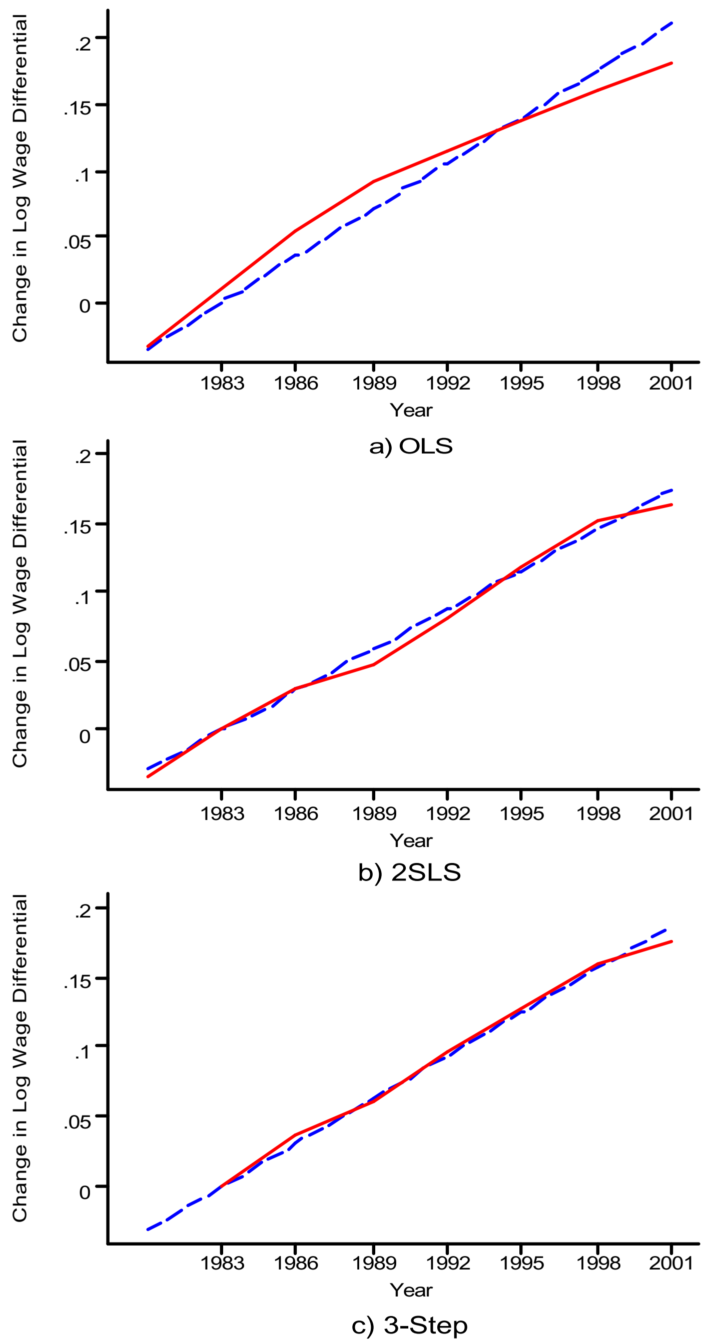


Figure 5. Estimated Time Effects
in the Returns to College

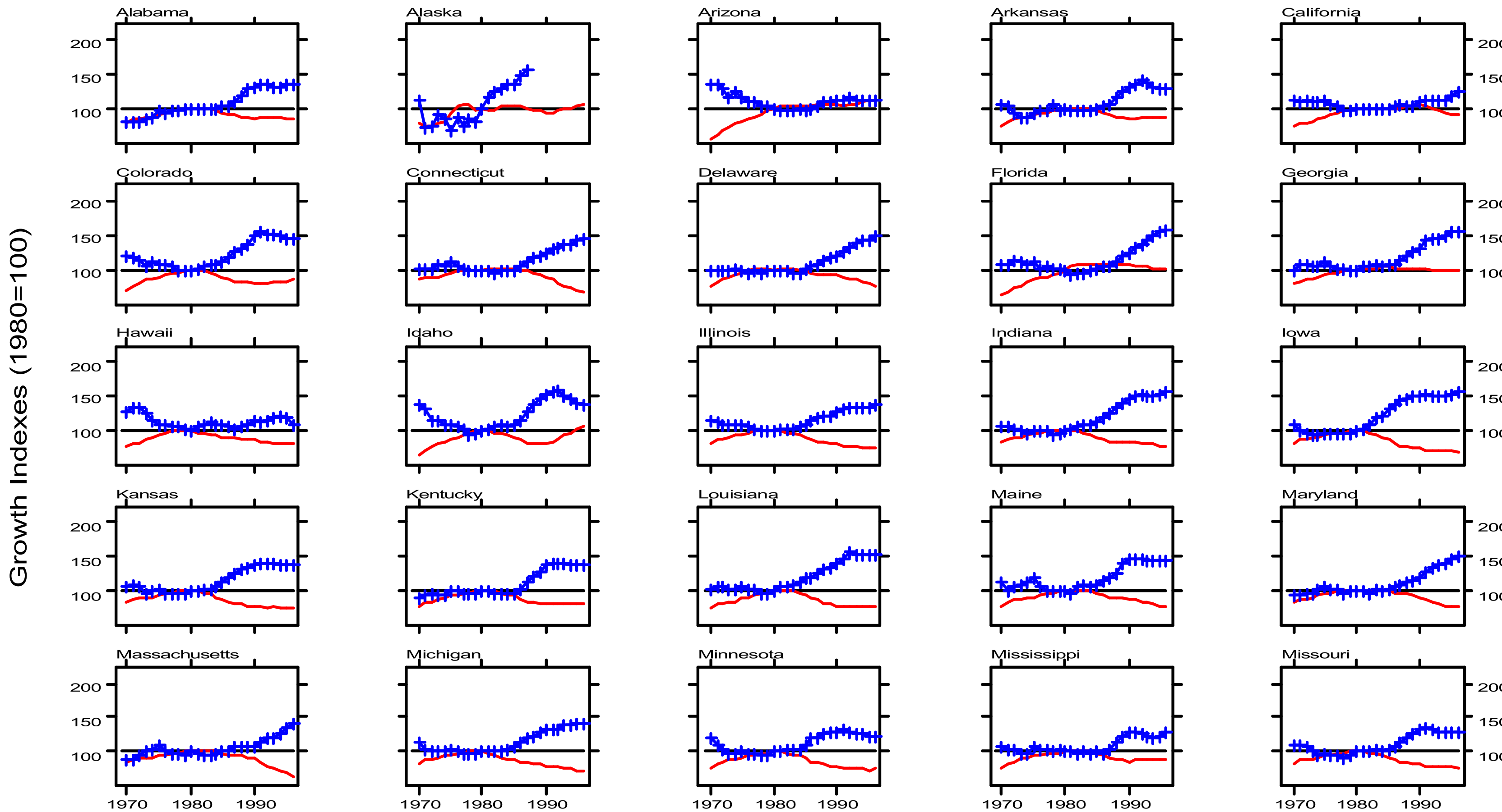


Figure A1a. College Age Population (solid line) and FTE 4-yr Public Enrollment Rates (plus line)

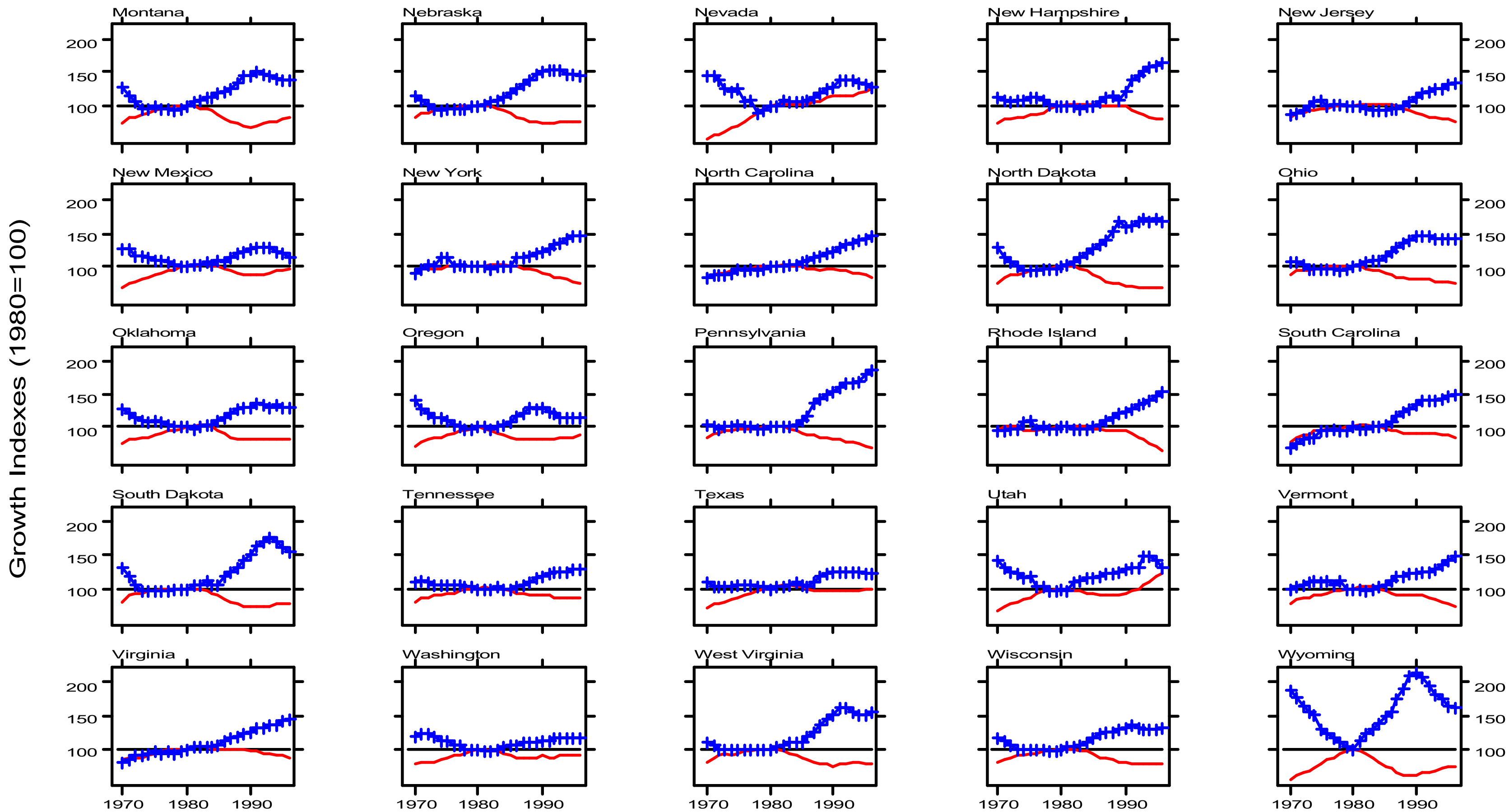


Figure A1b. College Age Population (solid line) and FTE 4-yr Public Enrollment Rates (plus line)

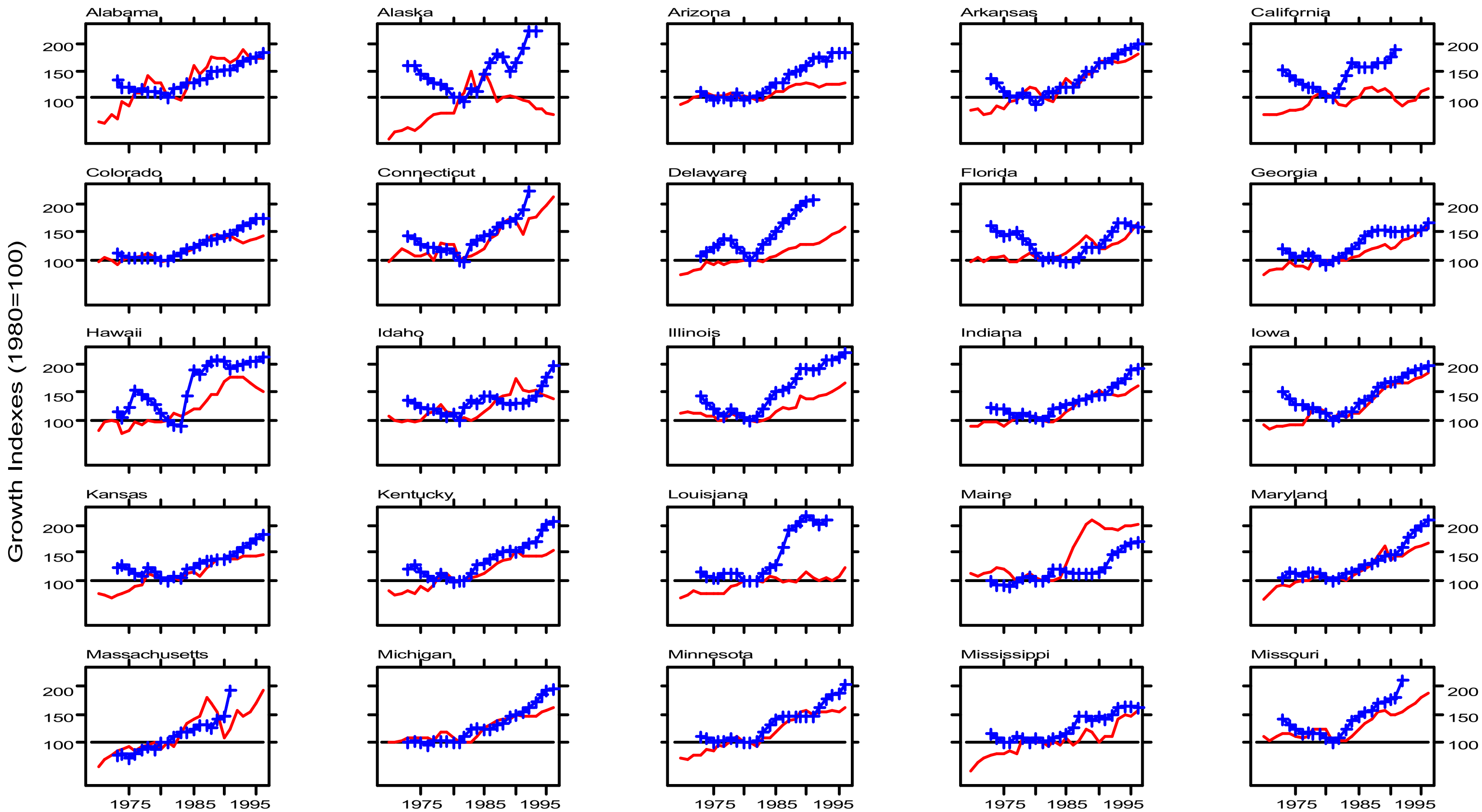


Figure A2a. State Appropriations per-college-age person (solid line) and Average Tuition (plus line)

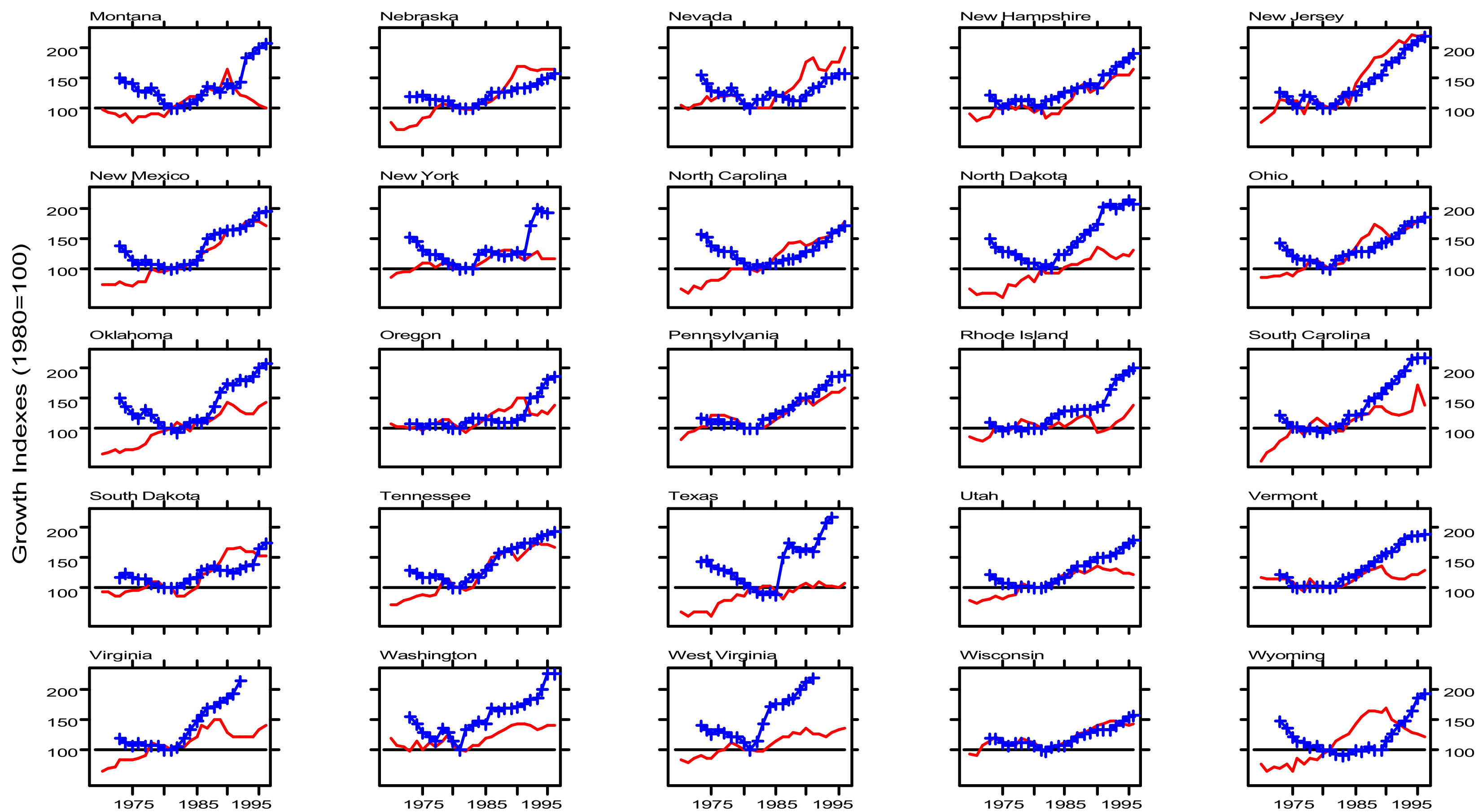


Figure A2b. State Appropriations per-college-age person (solid line) and Average Tuition (plus line)

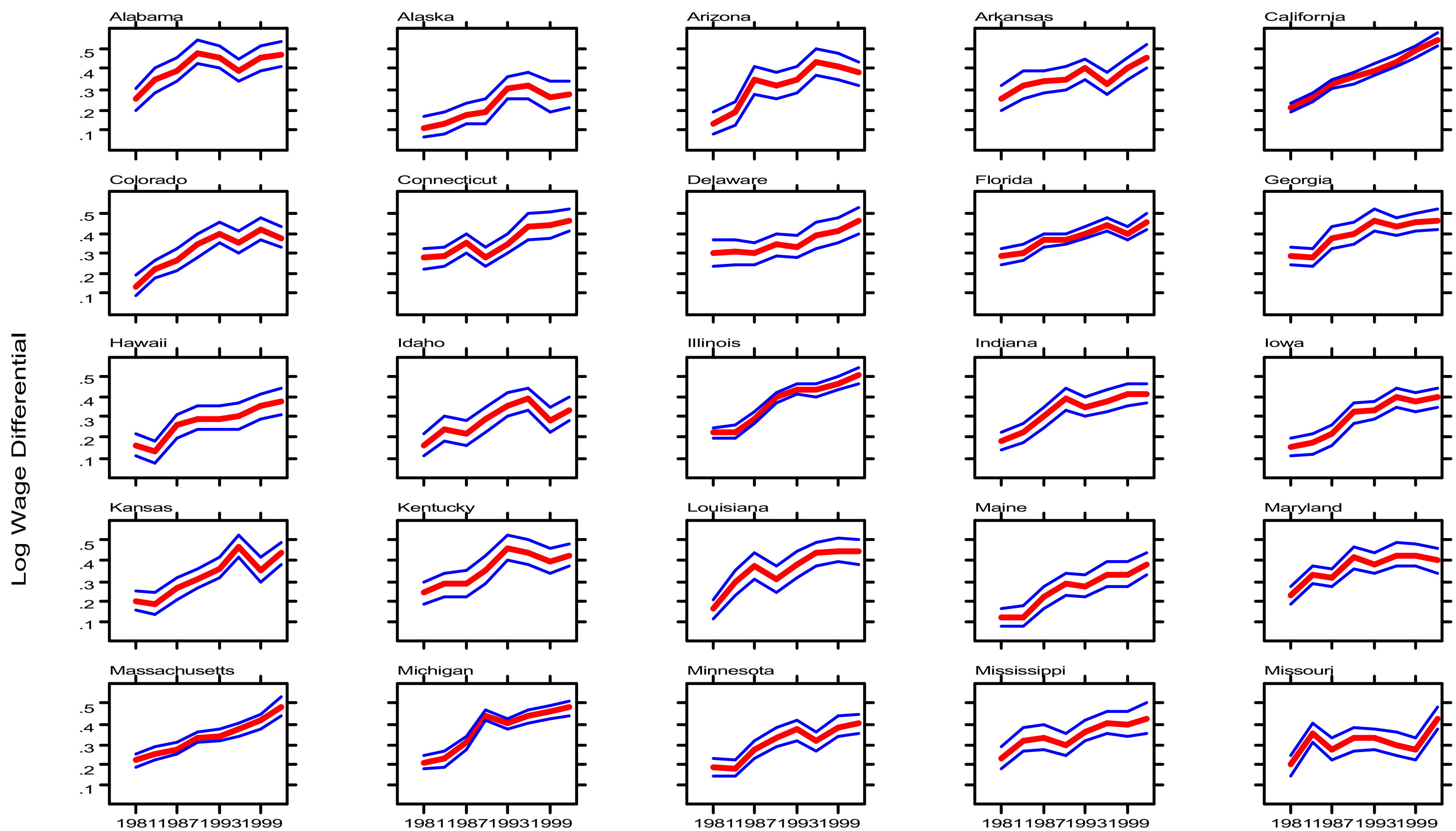


Figure A3a. College/High School Log Wage Premium by State (thick line) with 95% Confidence Bands (thin lines)

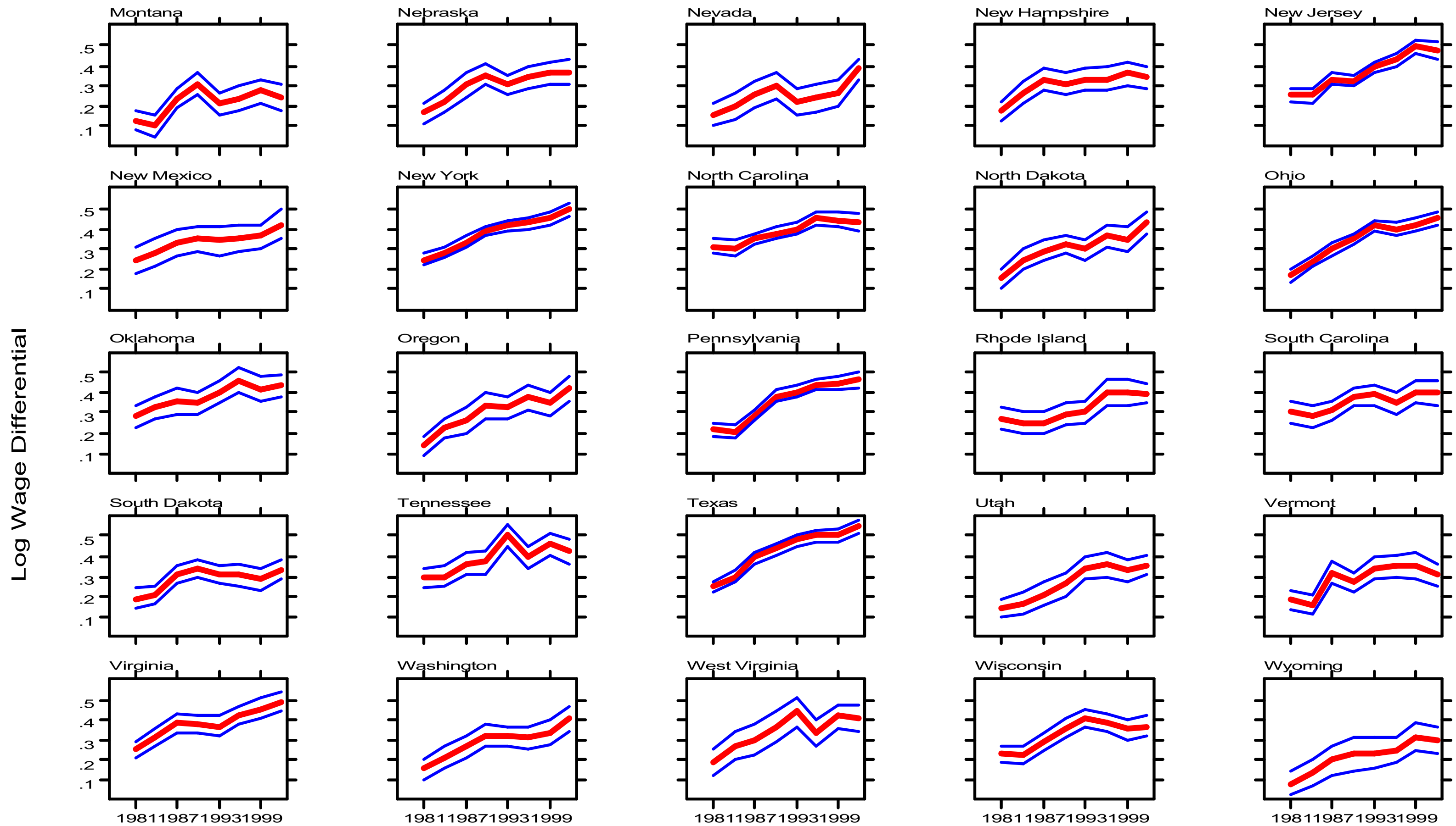


Figure A3b. College/High School Log Wage Premium by State (thick line) with 95% Confidence Bands (thin lines)