Higher Education Policies and the College Wage Premium: 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 of nine-years lagged college enrollment rates, tuition levels and state appropriations per-college-age person, to show that there is tight link between higher education policies, past enrollment rates, and recent changes in the college wage premium. The analysis shows however that this relationship is much weaker in states with either high private enrollments, high levels of mobility among college graduates, or high levels of inter-state trade. 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.

JEL Codes: J31, I22, J61, H71, D63

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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)). There is a consensus that changes in the college premium can be accounted for by fluctuations in the relative supply of college/high school graduates together with a linear trend increase in the relative demand for college graduates (Katz and Murphy (1992)).[2] Much research has been expanded on understanding the causes of the increased demand for high skilled labor, linking it to technological change (e.g. Krueger (1993), Berman, Bound and Griliches (1994), Autor, Krueger and Katz (1998)). Much less limelight has been placed on understanding of the sources of variation in the relative supply of college educated workers.

Early on, Freeman (1975) documented the rapid college expansion of the 1960s and the steep decline in the college premium of the 1970s, and further argued (Freeman 1976) that there was an oversupply of college educated workers. As the college premium began to rise precipitously in the 1980s, increasing the proportion of college educated workers was suggested as an appropriate public policy response to increasing wage inequality (Johnson (1997), Ashenfelter and Rouse (2000)). This paper proposes to investigate these suggested linkages empirically: first, linking the state-specific college premia among recent labor market entrants to college enrollment rates in the preceding decade; and second, linking state-specific higher education policies and demographic shocks to enrollment rates and the college premium. Traditionally, changes in college enrollment rates have been analyzed from the enrollment demand side, with the college premium as prime determinant. As pointed out by Kane (2003), this traditional approach essentially maintains the dubious assumption that the supply of college seats is perfectly elastic: here, determinants of enrollment supply are also included in the analysis.

The paper exploits the 1990s episode of decelerating college premium to show that the dramatic increases in college enrollment rates of the mid 1980s actually exerted some

[2] Among all workers, Autor, Katz and Kearney (2004) find a break in the linear trend around 1992. However, among young workers, the linear trend is still part of a parsimonious description of the changes in the college premium, as shown in appendix table 2 of Autor et al. (2004).

downward pressure on the college premium a decade later. These increases in enrollment rates were fueled by declining cohort size and relatively favorable higher education policies.

The link between higher education and wage inequality 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.[3] On the other hand, increased skill (and ability) heterogeneity may also lower the average college premium, which would lower wage inequality.[4] Finally 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 (2004) 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

[3]Hoxby and Terry (1999) argue that increasing within-inequality is the result not only of the increasingly diverse backgrounds of the students, but also of increasing student sorting across colleges of different quality.

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

supply of college-educated workers through nine-years lagged enrollment rates. Enrollment rates are negatively influenced by cohort size (Card and Lemieux (2001b), Bound and Turner (2002)) and tuition levels (Kane (1999)), themselves largely determined by the level of state appropriations.[5]

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 of demand induced in-migration will recover such supply effects.[6] 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. This is problematic when trying to link public enrollment rates to higher education policies because the latter may be less likely to have an impact on public enrollment rates in the presence of private alternatives. More importantly, there is substantially higher mobility among students enrolled in private institutions than among those enrolled in public institutions, that is, there is less of a state-specific educational supply in high private enrollment states. Even the concept of the relevant college age population in states with high private enrollment is unclear.[7]

[5]The links between enrollments, state appropriations and tuitions are also presented in Berger and Kostal (2002).

[6]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.

[7]The Bureau of Census counts college students living away from home while attending college

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)).[8] Data on the public/private enrollment mix, the mobility of younger 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 nine-year lagged state level data on enrollments in public and private 4-year post–secondary institutions from the National Center for Education Statistics (NCES) for 1969-70 onwards. 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.[9]

The main finding of the paper is that state-specific own-cohort relative supplies do have a significant negative effect on state-specific college premia among recent labor market entrants. The magnitude of the impact at about -0.2 indicates that an increase of 10 log points in relative supplies reduces the college premium by 2 log points. These supply effects are identically identified through lagged enrollment rates, or through their predicted values from state-specific higher education policies and demographics or through direct instrumentation with these predictors in the larger Censuses samples. In many U.S. states, higher education policies can favorably influence the supply of young college educated workers, and this, in turn, can exert some downward pressure on the increasing wage

in the state where they are living at college. But college students living at their parental home while attending college are counted at their parental home.

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

[9]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.

differentials between college and high-school educated workers.

The analysis shows however that this link is tenuous in states with either high private enrollments, high levels of mobility among college graduates, or high levels of inter-state trade. 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.[10] They 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 paper concludes with some simulations of the impact of alternative higher education policies and demographic shocks.

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 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

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

of inverse demand, $r^D_{st} = \mathcal{D}_{st}(q, Z)$, and supply, $r^S_{st} = \mathcal{S}_{st}(q, Z)$, 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. Market clearing implies that equilibrium returns $r^e_{st}(Z)$ and relative equilibrium quantities $q^e_{st}(Z)$ for any value of the instrument will satisfy

$$r^e_{st}(Z) \equiv \mathcal{D}_{st}(q^e_{st}(Z), Z) = \mathcal{S}_{st}(q^e_{st}(Z), Z). \tag{1}$$

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.[11] 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, $\ln(w^c_{st}/w^h_{st})$, 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 $q_{st} = \ln(C^Y_{st}/H^Y_{st})$ and the relative supply of older workers $q^O_{st} = \ln(C^O_{st}/H^O_{st})$:

$$r^D_{st} = \alpha_0 + \alpha_1 q_{st} + \alpha_2 q^O_{st} + \epsilon_{st} \tag{2}$$

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 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

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

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.[12]

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. 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:[13]

$$q_{st} = \pi_0 + \pi_1 E^{\text{PUB}}_{st-9} + \pi_2 E^{\text{PRI}}_{st-9} + \mu_{st} \qquad (3)$$

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, it is reasonable to assume that their respective propensity to work in the state where they were educated is quite different.[14]

In a study of the impact of self-selected migration across U.S. states on returns to college, Dahl (2002) finds that the self-selection leads to upward biases in the OLS estimates of the returns to college education. However, the variation in returns across states does not

[12]The aggregate level equation is unlikely to suffer from these types of biases.

[13]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.

[14]It is empirically possible to make this distinction since data on public and private enrollments are available. The simplifying assumption $\pi_1^{st} = \pi_1$ and $\pi_2^{st} = \pi_2$, for all s and t, is made because of the data limitation. Data on student migration by state is available only for a few years. The results of attempts to relax this assumption are reported below. See tables 19 and 21 of NCES (1998a) for differences in private and public student migration rates.

narrow as a result of the selection correction, suggesting that state-specific amenities play important roles in the in-migration decisions of individuals.[15] In the absence of 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^D_{st}. 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. To the extent that past enrollment rates are thus exogenous to current demand, two-stage least squares (IV) estimates of system (2) and (3) 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 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.[16] States

[15]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.

[16]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.

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.[17] 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.[18] 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.[19] 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.[20]

The observed past enrollment rates, E^{PUB}_{st-9}, can be seen as outcomes of an educational 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.[21]

[17]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.

[18]Computed from table 331 of NCES (2002) 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.

[19]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.

[20]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.

[21]State-specific time trends are used in some specifications to capture this type of effect. Using Census data, state-specific college premia are included among the explanatory variables in the enrollment rate equation. As reported in Table 9 column 10, they are found not to be statistically significant at conventional levels. Both strategies indicate that the own-cohort supply effects are

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.[22] 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. Kane (1994), Kane (1999) has indeed found that within-state changes in tuition policies have an important impact on public enrollment. 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.[23] Also as explained above, higher 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

robust to the inclusion of these effects.

[22]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.

[23]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)). Here, state appropriations are seen as a reduced form solution to a more complex process.

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.[24] 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:

$$E^{\text{PUB}}_{st-9} = \gamma_0 + \gamma_1 Tui_{st-9} + \gamma_2 App_{st-9} + \gamma_3 Col_{st-9} + \eta_{st-9} \quad (4)$$

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 IV estimation strategy would use these determinants of lagged enrollment rates directly as instruments in the estimation of relative demand (2). However, to the extent that the leakage processes described by the relative supply equation (3) are sizeable these variables are likely to be weak instruments, as reported below in section 4.3.[25] 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

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

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

equation (4) 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 (2) and supply (3) system by the two-stage least squares, replacing public enrollments E^{PUB}_{st-9} by the predicted values from enrollment equation (4). 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.[26] In effect, in cases below where the instruments are not weak or in the large samples from the Censuses, this three-step procedure yields estimates similar to those from the simple two-stage procedure.[27]

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 financial educational data (state appropriations and tuition fees) are not gender-specific, the college premium is computed pooling men and women together. 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".[28] 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". These definitions are similar to the ones used in Card and Lemieux (2001a), but the robustness of estimated own-cohort supply effects to other measures of college and high school equivalents is explored below.

[26]As noted by Blundell and Powell (2003), the idea of regressing the dependent variable on fitted values from the first stage goes back to Theil's version of 2SLS. The consistency of this method hinges on the linearity of the regression function.

[27]The consistency of the three-step procedures is more likely achieved in the larger Censuses samples, as shown in column (1) table 8 and column (4) table 9.

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

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 annualized log wage changes among young workers are of 1.4 log points in the 1980s, 0.6 log points in the 1990s and 0.1 log points in the early 2000s. [29]

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 annualized changes in the log wage differential among older workers was of 0.6 log points in the 1980s, 0.5 log points in the 1990s and -0.2 log points 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.[30] In the 1980s, the annualized changes in the relative supply of college workers aged 26 to 35 were almost nil at 0.4 log points; in the 1990s, they were around 4.4 log points and in the early 2000s, 3.7 log points. By contrast, for workers aged 36 to 64, the corresponding annualized changes were 3.8 log points in the 1980s, 3.6 log points in the 1990s and 2.6 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

[29] 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).

[30] 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 1992 change in the definition of the educational classes.

above changes in relative supply, panel A of figure 2 presents a dramatic illustration of the changes in the college-age population relative to the total population. Following conventional practice, individuals aged 18 to 24 are included in the college-age population. According to NCES (1999c), this age grouping captured 70 percent of FTE enrollees (82 percent of full-time enrollees) in 1997.[31] The baby boom and the baby bust are clearly shown in panel A, where the U.S. trends are contrasted with similar patterns in Canada.[32] Panel B displays the mirror-like trends in FTE 4-year enrollment per college-age person contrasting the U.S.-Canada differences, as well as U.S. trends in public enrollment. The graph clearly shows that demographic trends play an important role in the long term (low frequency) trends in enrollment rates. Yet the cross-country differences in the steepest of the slopes in the 1980s and 1990s indicate a potentially important role for higher education policies. The use of FTE enrollment rather than total enrollment minimizes the potential problem caused the increased time to degree completion, reflected in the growth of part-time enrollment over time (Turner (2004)).[33]

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, again contrasting U.S. and Canadian patterns. The actual levels of many of the corresponding variables for 1970, 1980, 1990 and 2000s, as well as ten-year growth rates, are reported in Table 1, which also shows the results of simulations to be discussed later. In panel A of figure 3, the left-angled trend in FTE-4yr enrollment rate among men and women together reflects the combination

[31]See table 13 of NCES (1999c). 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.

[32]Note also that there is substantially variability across states in both the time patterns of both college-age population and enrollment rates. For example, some states (such as Nevada and Utah) saw an increase in their college-age population in the 1990s.

[33]As explained in NCES (1999c),the FTE enrollment comprise the enrollment of full-time students, plus the full-time equivalent of part-time students as reported by the institutions of higher education. In the absence of an equivalent reported by an institution, the FTE enrollment is estimated by adding one-third of part-time enrollment to full-time enrollment. In its enrollment projection, the NCES uses scaling factor adjusted over time by category of institutions, presumably reflecting the reports of institutions. For Canada, the one-third scaling factor is used.

of gender-specific trends reported elsewhere (Juhn et al. (2000)).[34] Panel B displays the expenditures per-college-age person; it shows that, from 1980 onwards, the per-college-age person real educational and general expenditures of public institutions experienced sizeable annual growth rates.[35] Panel C and D plot the growth indexes of the two main revenue sources of public institutions of higher education: tuition fees 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: it halted with the recession of the early 1980s. Panel D illustrates the cyclical nature of state appropriations (Humphreys (2000)); after the cyclical downturn of the early 1980s, the growth of state appropriations exhibited robust increases, but became negative again with the recession of the early 1990s.

The comparison of panel A and C shows that it is thus difficult to discern the causal relationship between tuition and enrollment rates from the aggregate U.S. time-series alone (or from a state-specific time-series). In the 1980s and 1990s, both variables are increasing, but it is unlikely that an increase in tuition could lead to an increase in enrollment. The identification of the impact of higher education policies on enrollment rates requires inter-jurisdictional comparisons on the different time paths, as well as college-age population controls. The international comparison suggests that declining state/provincial appropriations are always unhelpful, but also that uncompensated declining tuition fees are unhelpful. In a ranking of the most to the least favorable higher education policies, rising appropriations that more than compensate for declining or stable tuition, as in Canada in the 1980s, rank as "most favorable".[36] "Least favorable" would be declining or stable appropriations and increasing tuition, as in Canada in the 1990s. The U.S. 1980s higher education policies thus appear "relatively favorable" by comparison with the U.S. policies of the 1970s when real tuition plummeted, or with those of the early 1990s when

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

[35]The expenditures information is extracted from tables 350 and 351 of National Center for Education Statistics (2003) combined with earlier data from table 88 of NCES (1999b).

[36]As shown in panel B, over the 1980s, Canadian expenditures rose at a rate similar to that of the United States despite almost no growth in tuition fees: increasing provincial appropriations played a compensating role.

state-appropriations per-college-age person flattered.

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. Because by contrast with U.S. states, Canadian provinces can and have run sizeable budget deficits, there is no evidence in Canada of the negative relationship between tuition levels and state appropriations, reported by many authors (Berger and Kostal (2002), Lowry (2001a), Koshal and Koshal (2000)) who find cross-sectional evidence of that relationship in the United States. This shows the limits of the above international comparison. Fortunately, there are substantial differences across the U.S. states in the timing and the size of the tuition increases that followed the 1980s recession and in the accompanying decline in state appropriations. 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.[37] Panel A of Figure 4 illustrates trends similar to those displayed in 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.[38]

[37]See the extra results for a display of the growth indexes of tuition levels and state appropriations (per-college-age person) for each of the 50 states.

[38]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":

$$\ln w_{ist} = \beta_{st} X_{ist} + r_{st} C_{ist} + \epsilon_{ist}, \tag{5}$$

The regression models include age, a dummy for college graduate, and dummies for gender, non-white, part-time, marital status, and year. A variety of individual state time patterns in the college premium emerge. Panel b of Figure 4 presents $\widehat{r}_{st}$, along with 95% confidence bands for three large states,—Florida, Texas and California.[39] In these large states, the confidence bands are tighter and the college-age population did not decline in the 1990s, thus abstracting from 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.[40]

In Florida, where per-college-age person real state appropriations exhibit little decline in the recession of the early 1980s and sustained growth from the mid 1980s to 1990 with no increases in real average tuition fees until the 1990s, the log college premium shows relatively slow growth over the entire period. In Texas, where sustained per-college-age person real state appropriations until 1984 meant that Texas was able to offer declining real tuition fees until that time, the log college premium exhibited a fast rate growth until the early 1990s, but slowed down thereafter. Finally, California is 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 a high annual rate. California is also among the states that exhibited the most sustained growth in its log college premium over the entire time

[39] The patterns for all states are available in the extra results. The District of Columbia is omitted from the Figures, but is included in part of the analysis.

[40] 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).

period.

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 in Table 2. When a simple time trend and state dummies are included, the estimate in columns (1) yields a significant negative own-cohort relative supply effect of magnitude less than half of that found at the aggregate level. When a complete set of time period dummies orthogonal to the time trend or a quadratic trend are added in column (2) and (3), 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. State trends are introduced in column (4) and (5) to capture other possible state-specific linear trends, they increased the magnitude of the coefficient.

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 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 important point is made in Table 2. There is a highly significant and negative coefficient of the quadratic time trend in the regression (column 6) that excludes all supply measures. This concave pattern for returns to college over time is however muted by introduction of the supply measures in columns (3) and (4), although the second order coefficient remains significant. This indicates a potentially important role of increased relative supplies in the deceleration of the college premium of the 1990s. Yet to the extent that OLS relative supply estimates suffer from an endogeneity bias, the OLS estimates of the time trend will also be biased.

An instrumental variable (2SLS) solution to the endogeneity problem is explored next. First, the 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 Table 3.[41] Column (1) to (5) reports the within-state instrumental variables

[41] 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.

estimates of the own-cohort supply effects now ranging from -0.176 to -0.228 (0.030 to 0.080) and remarkably robust to the introduction of state-specific linear trends and to an interaction between the time trend and the enrollment variables.[42] In all specifications, the overidentification test confirm that the exogeneity of past enrollment rates to current demand cannot be rejected. Interestingly, the concave shape of the returns to college completely disappear in column (3) and (5). When relative supplies effects are taken into account, the counterfactual returns to college no longer decelerate in the 1990s.

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 the decelerating college premium of the 1990s. The 3-step procedure outlined earlier is explored first; the results of the direct 2SLS are included among the robustness checks in the next section. Table 4 first reports the impact of the determinants of enrollment rates using yearly data and covering a longer time period than used in the 3-step analysis. The results of this first step using the three-year averaged data are included in the subsequent tables.

The dramatic negative impact of log college–age population on log enrollment rates is shown in column (1) of Table 4. The estimated effects in the range of about -0.5 (0.04) 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, the effect of log college age population thus appears largely independent from these variables. Estimates that control for linear and quadratic state-specific trends or focus on shorter periods are even higher.

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 -0.154 (0.02). In the related literature, the impact of tuition on college enrollment rates is usually reported in terms of the impact of a $1000 change

[42]These latter interactions attempted to allow for the possibility of time varying Empirically, only the interaction with private enrollment was significant in predicting relative supplies, but the estimate of the own-cohort effect at -0.202 (0.029) was in the above range.

in direct costs and is found to be of about -0.04 (0.01) (e.g. Kane (2003)). Here, the corresponding within-state estimated coefficient (using average tuition in $1000) is -0.032 (0.006), an order of magnitude similar to 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 0.121 (0.022). In columns (4) to (9), a reduced form equation of enrollment rates corresponding to equation (4) is estimated using various specifications of time and state-specific trends. Column (7) and (8) each cover only the earlier period (1973-1982) or mid-period (1983-1993), while column (9) covers the period to be linked with the college premium. The estimates confirm 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. When time and state-specific quadratic trends are introduced, both variables are statistically significant.

Table 5 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. The within-state estimates presented in column (1) to (3) correspond to those of Table 3. The substitution of actual enrollment rates by predicted enrollment rates leads to estimates of the relative supply effects very much in the same range as those from Table 3 and the first stage coefficient of predicted enrollment rates is also highly significant. Column (5) omits log state-appropriations per-college-age person, which could arguably be considered endogenous: this yields a similar own-cohort supply effect. Finally, the strategy in column (6) that uses only demographic shocks fails to identify significant supply effects. 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.

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.[43] 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. The impact of state-specific "homegrown" relative labor supplies on relative labor returns may also be weakened by factors such high labor mobility and high levels of cross-state trade. A first objective of this investigation of confounding factors is to contrast the relative supply effects from states with low 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.[44] Column 2 of Table 6 reports a measure of the inter-state migration of college educated workers computed 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

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

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

(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.[45] There are some problems with commodity flow data since they include all shipments rather than only shipments from source to final users.[46] 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.[47]

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. The estimates from the 3-step procedure for related sample splits, presented in Table 7, indeed confirm that the own-cohort supply effect is stronger in those states.[48] 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 (3)] 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 (2)] fails, consistent with a role for FPE. It is also interesting

[45] 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.

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

[47] 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.

[48] 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.

to note that the estimated quadratic time effects indicate more deceleration (concavity) in the counterfactual 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 direct 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 directly as instruments for relative supplies are reported in Table 8 for the same sample splits as Table 7 and for all U.S. states. 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. 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 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 -0.172 (0.065). 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 (3) is likely important), the estimates from the direct 2SLS strategy are not statistically significant, close to zero or of the wrong sign. In column (7) 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.

Another specification issue is the definition of college and high school educated workers used to compute the college-high premium and the relative supply measures. The somewhat narrow definition used is closely related to the measure of FTE 4-yr enrollment rates, but it is important to check the robustness of results to alternative more inclusive definitions. Table 9 reports the estimates for two alternatives measures and shows that the results are again very robust. The results in columns (1) to (3) are based on often used measure that includes workers with sixteen or more years of education in the college educated workers and those with exactly a high school degree in the high school educated workers. A potential advantage of this definition is that includes all college graduates that were once college enrollees.

The results in column (4) to (6) of Table 9 are based on broader definitions of college and high school "equivalent" based on the effective labor supply of workers of different education level. To account for different in effective supply of labor, workers from all education levels are weighted by the product of their weekly hours of work times the average wage of their education levels in each state for each 3 year period. The efficiency weighted drop-outs (college plus) are counted as high school (college educated) workers, while the "some college" are distributed among the two groups of "equivalents" according to a share that expresses their wage as a weighted average of the high school wage and the college wage, following Card and Lemieux (2001a).

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 small sample size from some states may lead to some attenuation bias.[49] The previous estimation procedures are thus applied to data from the 1980, 1990 and 2000 Census and the results are reported in Table 10. 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 (2) in Table 2. Columns (2) to (4) present the results of specifications using enrollment rates and their determinants as instruments for relative supplies; these correspond to column (4) of table 3, column (2) of Table 5 and column (7), 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 10 explore directly the hypothesized positive impact of

[49]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).)

migration using two variables to measure relative migration: relative return migration and the relative other recent in-migration. 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. When used as sole instruments in column (6), the estimated coefficient is positive although very small and not significant. As argued earlier, relative in-migration is likely positively correlated with demand shocks which should help estimate supply rather than demand. Thus when used in conjunction with the enrollment variables in column (7), the magnitude of the estimated supply effects is diminished and the overid test fails.

Columns (8) to (11) explore the use of alternative instruments, which are significantly correlated with the relative supply of college educated workers. 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. First, lagged log college–age population is used directly as instrument in column (8); then it is used as the sole determinant of public enrollment rates in the 3-step procedure in column (9). With either strategy, cohort size fails to identify significant state-specific relative supply effects.

The impact of including lagged state-specific log college premia among the determinants of enrollment rates is explored in the next column, which excludes data from the 1980 Census.[50] Column (10) benchmarks the results of the 3-step procedure based using only 1990 and 2000 Census data. The inclusion of the lagged log college premia in column (11) does not change the results and is found to be insignificant, while lagged log tuition is significant at the 10 percent level. This would seem to support the view (Kane (1999)), that youth are more sensitive to college costs than to labor market payoffs, or at least to state-differences in labor market payoffs. Overall the effect of confounding factors, alternative instruments and estimation strategies are consistent with the model outlined in section 2

[50]Since hours per week are not available in the 1970 Census, it is not possible to obtain a measure of state-specific college premia for 1970 similar to those from the other Censuses.

and the robustness of the estimates lend further credibility to the results.

5. Conclusion

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 college enrollment rates, tuition levels and state appropriations per-college-age person from 1970 to 1993, to investigate the potential links between higher education and the college premium among recent labor market entrants. 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.

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 prices for younger workers are shown to be strongly related to state-specific relative labor supplies, which in turn are shown to be significantly affected to state-specific higher education policies. This is a significant finding since this relationship has remained elusive until now. Indeed, it is a relationship that is easily missed since it is significantly weaken by cross-state migration and in the presence of high private college enrollment. In states with large private college enrollment, there is less of a "homegrown" supply of college-educated workers.

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. 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. 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. In turn, lower college premia and higher supplies of college-educated workers can put some states at an advantage in attracting skill-intensive industries.

Panel B of Table 1 displays the results of simulations based on the 3-step procedure applied to Census data and using the more precise elasticities with respect tuition and state appropriations per-college age person estimated in Table 3. The simulations show that holding tuition constant at the historical low 1980 levels (simulation 1) or sustaining the 1980s growth in state-appropriations per-college-age person into the 1990s (simulation 2) has the same impact on the U.S. public enrollment rate, and the college premium for recent labor market entrants, as assuming that the baby boom had not taken place (simulation 4). Simulation 3 which assumes away the baby bust, perhaps through an immigration policy targeted at foreign students, illustrates that it can account for only a small portion of the change in inequality. Higher education policies thus have a sizeable role in comparison to the arguably most important demographic shock of the 20th century, but their impact is perhaps not as large as hoped for.

Cameron and Heckman (1999) also ask whether tuition policy can combat rising wage inequality. They set the ambitious goal of reverting the college premium to its 1979 level and conclude, using commonly reported elasticities, that a 181 percent reduction in tuition level would be required. In light of the above simulation results, this appears like an unrealistic goal. In his analysis of the social policies that may help the sputtering labor market of the 21st century, Ellwood (2001) underlines the important limits of these policies to alleviate the foreseen skill shortages. He suggests that immigration, education and training policies may be the more effective ones. Again, the findings of this paper do not provide much evidence to fuel that optimism with regards to state-specific higher education policies. In addition, in the mid to late 1990s, the ability of states to increase their appropriations to higher education has been severely curtailed and tuition levels have increased to unprecedented levels.

The present findings focus on policies aim at bringing younger workers into the college-educated workforce and do not speak to the relationship between the overall college premium and that the one facing new labor market entrants. As Ellwood (2001) points out, significant increments to the skilled workforce may come from the increase participation of married women and older workers as a result of the incentives provided by the anticipated reform to Social Security. More research along the lines of Card and Lemieux (2001a), who study the substitutability between older and younger workers, would be needed to assess to impact of population aging on the human capital investment of the youth.

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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. 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.

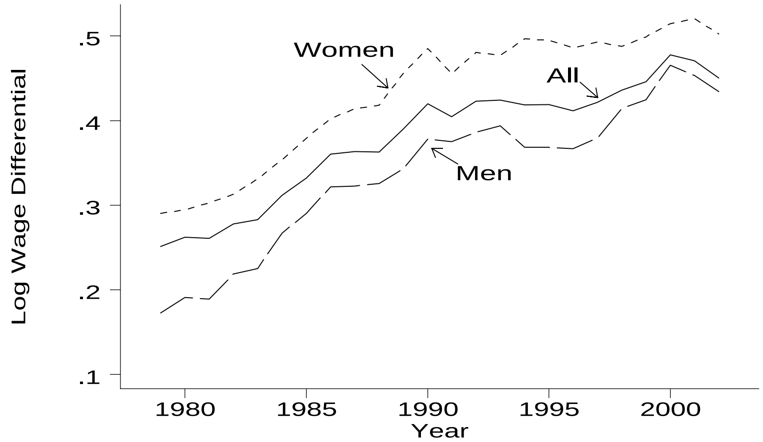
5. Cross-State Trade Data

5.1. Commodity Flow Data

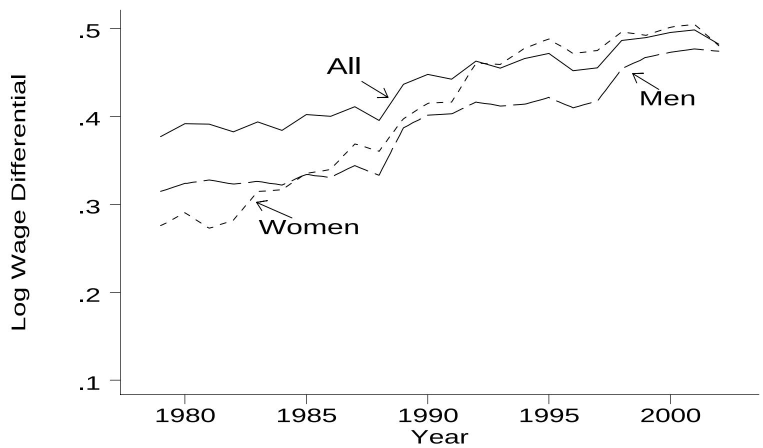
The cross-state trade data comes from the 1997 Commodity Flow Survey, a joint venture between the Bureau of Census and the Bureau of Transportation Statistics, and is available at: www.bts.gov/ntda/cfs/prod.html. The Commodity Flow Survey provides information on, among other things, the value of commodities 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

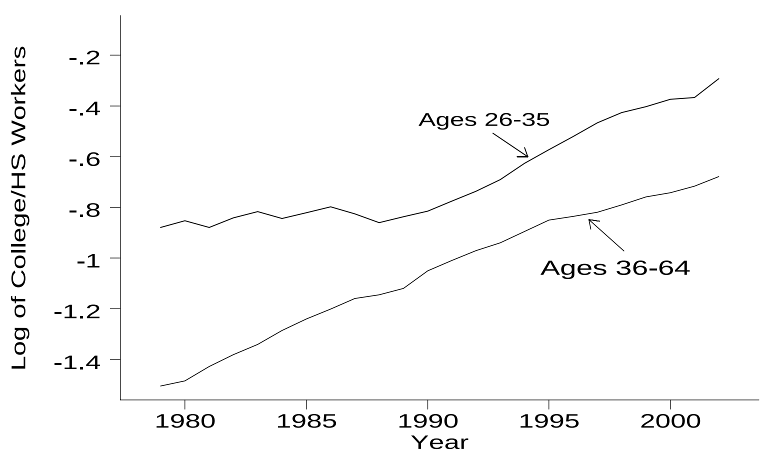
The Gross State Product (GSP) is available from the Bureau of Economic Analysis at: www.bea.doc.gov/bea/regional/gsp/. In concept, the GSP data is a measure of "value added" equivalent to gross output minus its intermediate inputs. In practice, GSP estimates are measured as the sum of the distributions 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.



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

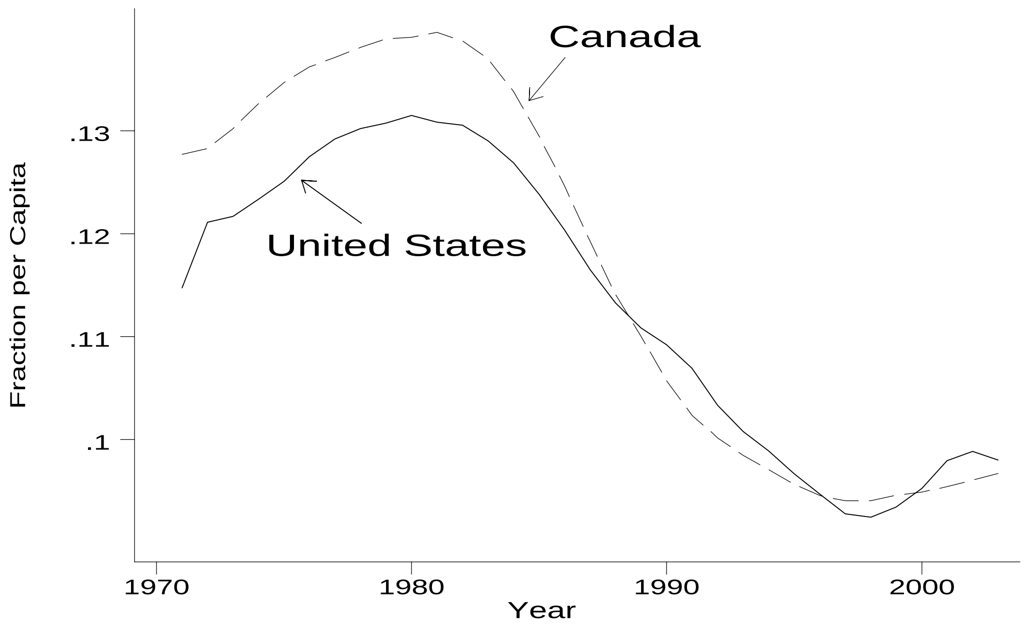


B. College/High School Log Wage Gap 36-64

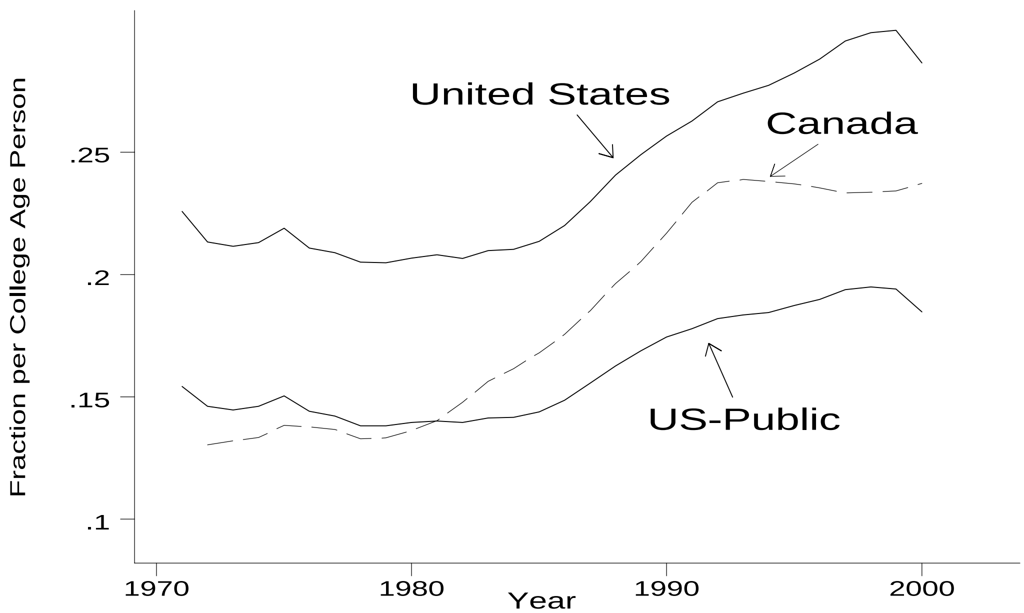


C. Relative Supply of College Graduates

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



A. College Age Population



B. FTE 4-year Enrollment

Figure 2. Population and Enrollment Trends

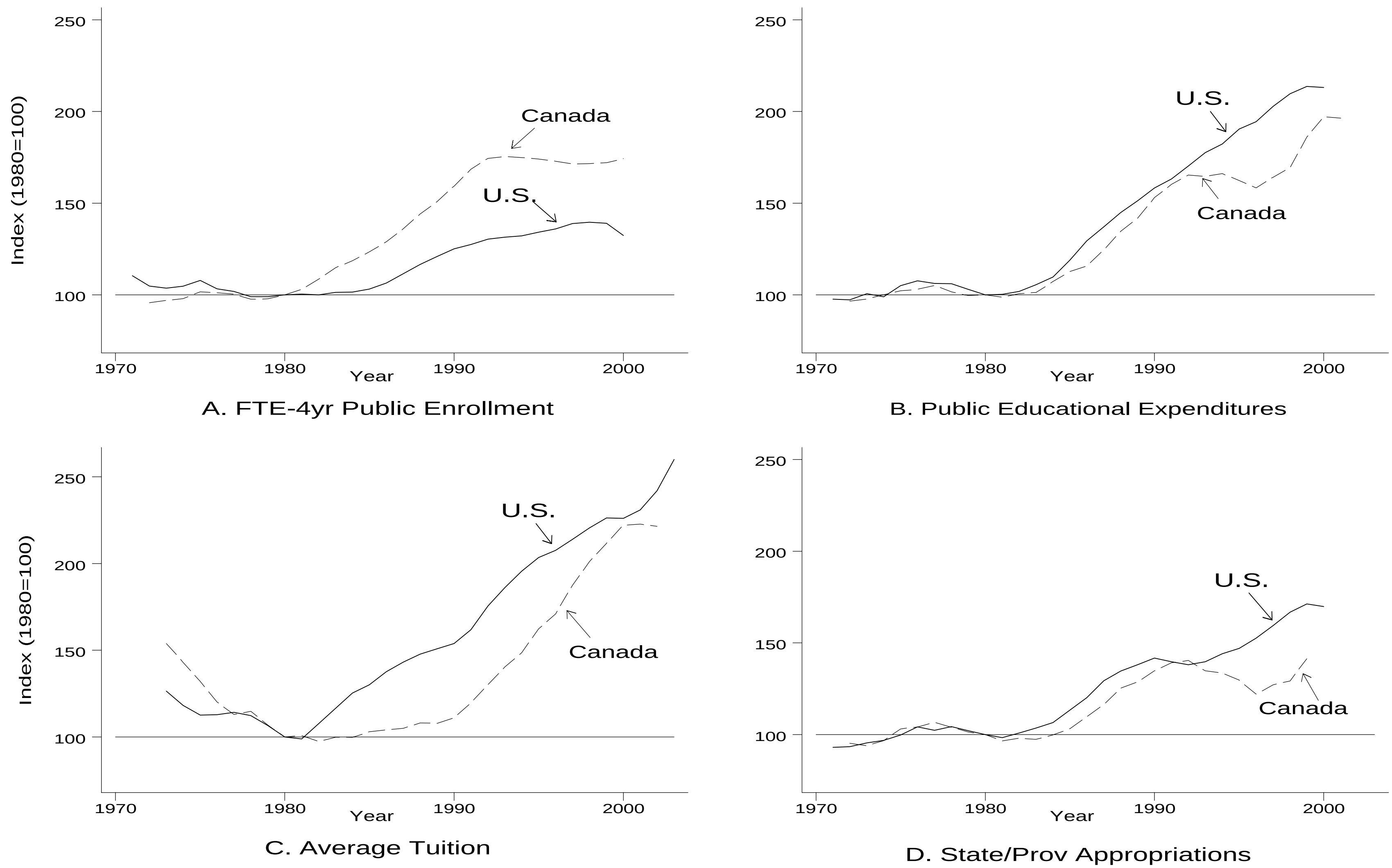


Figure 3. Per-College-Age-Person Growth Indexes

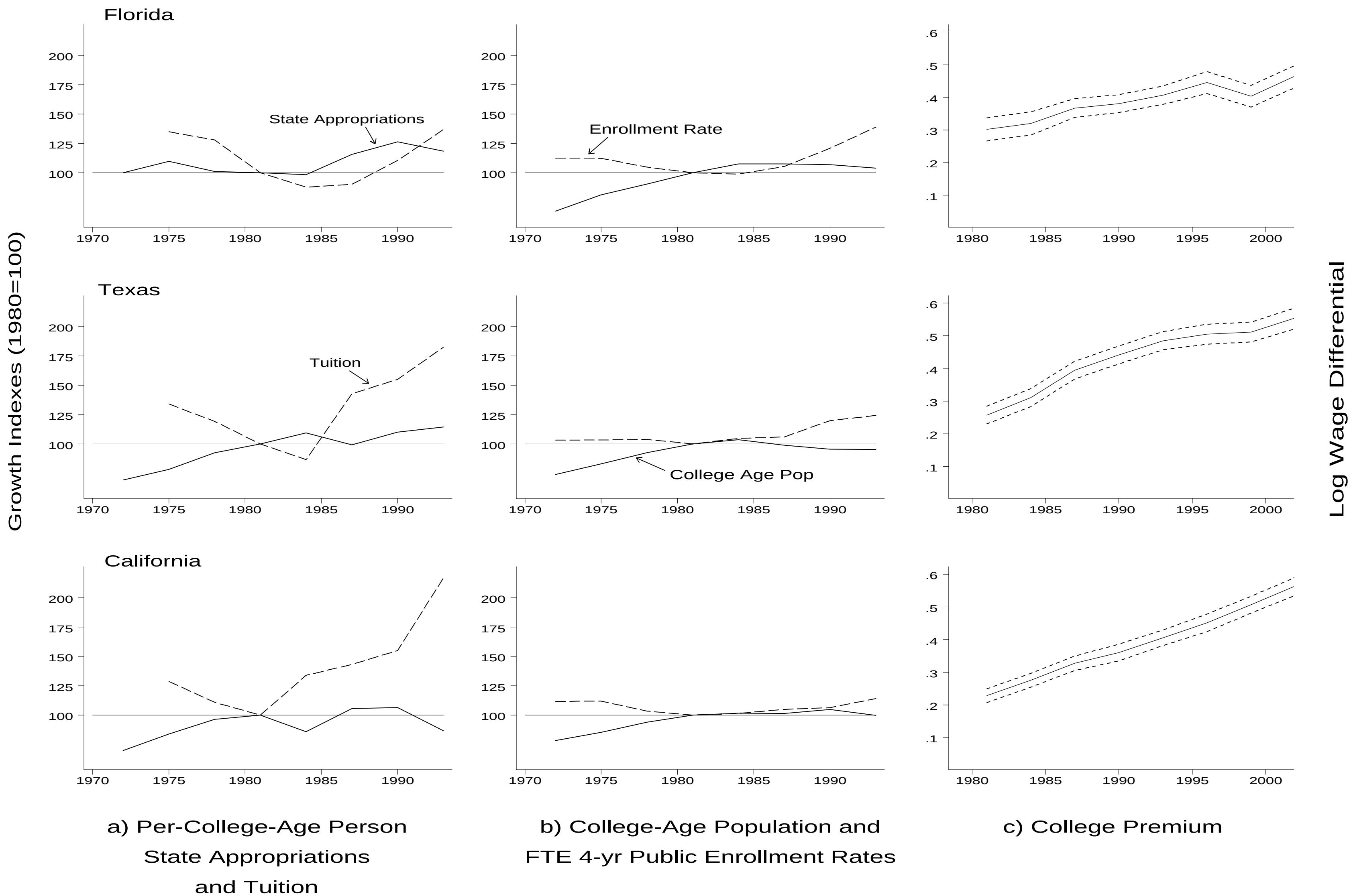


Figure 4. Trends in Selected States

Table 1

Levels, Ten-year Growth Rates and Simulation Results for Selected Variables - United States

Years	1970	%Δ	1980	%Δ	1990	%Δ	2000
A: Actual Levels and Ten-Years Growth Rates:							
State-Appropriations Per-College-Age Person (in $2000)	1,115	17.8	1,333	36.1	1,912	8.9	2,088
Average Tuition (in $2000)	3,070[a]	-36.1	2,140	42.1	3,260	40.8	4,900
College Age Population (in 1000's)	24,712	19.5	30,022	-10.8	26,956	0.7	27,141
FTE-4yr Public Enrollees (in 1000's)	3,469	18.1	4,158	13.1	4,740	5.8	5,026
FTE-4yr Private Enrollees (in 1000's)	1,677	17.8	2,003	10.6	2,228	21.8	2,770
Public Enrollment Rate	14.0	-1.3	13.9	23.9	17.6	5.2	18.5
Log College Premium (a decade later)			0.283	14.3	0.426	5.6	0.482
B: Simulations:							
1) Tuition held constant at 1980 levels							
Public Enrollment Rate	14.4	-2.8	14.0	26.8	18.3	16.1	21.5
Log College Premium			0.283	14.3	0.426	4.9	0.475
2) Growth in State Appropriations set at 1980 levels							
Public Enrollment Rate	14.4	-5.0	13.7	26.7	17.9	17.9	21.4
Log College Premium			0.283	14.6	0.429	4.9	0.478
3) College-Age Population held constant at 1980 levels (No baby bust)							
Public Enrollment Rate	14.4	-2.8	14.0	15.8	16.4	11.0	18.3
Log College Premium			0.283	14.3	0.426	5.8	0.487
4) College-Age Population held constant at 1970 levels (No baby boom)							
Public Enrollment Rate	14.4	9.3	15.8	15.8	18.5	10.3	20.5
Log College Premium			0.283	12.9	0.412	6.1	0.473

Sources: Tuition data from the Washington State Higher Education Coordination Board are available from 1972-73 onwards. State appropriations data are obtained from the Grapevine web site: www.coe.ilstu.edu/grapevine/Welcome.htm. The enrollment data is obtained from the National Center for Education Statistics at www.nces.ed.gov. The U.S. log college premium are computed as a weighted average of the state premia from the 1980, 1990 and 2000 Census used in table 10. See the data appendix for details.
Notes: The growth rates are computed as the difference between the logarithms of the levels times 100. The simulations of enrollment rates use the elasticities with respect to tuition (-0.13) and state-appropriations per-college-age person (0.08) more precisely estimated in table 3, column 4. The simulations of log college premium use a own-cohort supply effect of -0.16. The discrepancies between the actual levels (row 6 and 7) and the simulated levels for the 1970s (A, B, C, D), 1980s (A, B, and C) and 1990s (B) reflect random prediction errors.

[a] For 1972-73.

Table 2

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)
Own-Cohort Relative	-0.097	-0.043	-0.058	-0.073	-0.089	
Supply: $ln(C^Y/H^Y)$	(0.014)	(0.017)	(0.016)	(0.018)	(0.017)	
Relative Supply of Older	0.019	0.024	0.032	-0.005	0.007	
Workers: $ln(C^O/H^O)$	(0.014)	(0.020)	(0.016)	(0.017)	(0.015)	
Log State Unemployment	-0.009	0.002	-0.012	0.005	-0.007	
Rate	(0.011)	(0.013)	(0.010)	(0.011)	(0.009)	
Time Trend	0.035	0.016	0.046	0.023	0.039	0.053
	(0.003)	(0.007)	(0.004)	(0.006)	(0.005)	(0.003)
Time Squared ÷ 10			-0.024		-0.015	-0.031
			(0.006)		(0.004)	(0.004)
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
OTR Time Dummies	No	Yes	No	Yes	No	No
State Trends	No	No	No	Yes	Yes	No
R-squared	0.89	0.89	0.89	0.93	0.93	0.88
No. Observations	408	408	408	408	408	408

Notes: Robust standard errors are in parentheses. OTR Time Dummies add up to zero and are orthogonal to the time trend. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the estimated wage premia. 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.

Table 3

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

	(1)	(2)	(3)	(4)	(5)
Own-Cohort Relative	-0.217	-0.228	-0.201	-0.179	-0.176
Supply: $ln(C^Y/H^Y)$	(0.030)	(0.080)	(0.057)	(0.053)	(0.039)
Relative Supply of Older	0.078	0.094	0.075	0.017	0.016
Workers: $ln(C^O/H^O)$	(0.020)	(0.032)	(0.022)	(0.019)	(0.015)
Log Unemployment	-0.028	-0.032	-0.027	-0.001	-0.008
Rate	(0.013)	(0.022)	(0.013)	(0.013)	(0.010)
Time Trend	0.031	0.027	0.033	0.028	0.027
	(0.003)	(0.010)	(0.006)	(0.007)	(0.007)
Time Squared ÷ 10			-0.000		-0.001
			(0.001)		(0.008)
First-Stage Estimates of the Instruments:					
Log FTE 4-yr Public Enrollment	0.599	0.292	0.417	0.617	0.792
per College Age Person$_{t-9}$	(0.063)	(0.068)	(0.071)	(0.108)	(0.103)
Log FTE 4-yr Private Enrollment	0.100	0.062	0.054	0.016	-0.032
per College Age Person$_{t-9}$	(0.038)	(0.035)	(0.038)	(0.058)	(0.060)
F-Statistic	59.42	11.49	19.24	19.88	30.58
on Enrollment Variables					
Overid Test (p-value)	0.900	0.872	0.945	0.325	0.285
State Dummies	Yes	Yes	Yes	Yes	Yes
OTR Time Dummies	No	Yes	No	Yes	No
State Trends	No	No	No	Yes	Yes
R-squared	0.85	0.86	0.86	0.92	0.93
No. of observations	400	400	400	400	400

Notes: 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. There are 400 usable observations after excluding the state of Wyoming, where there are no private institutions of higher education.

Table 4

Impact of Higher Education Policy Estimates on FTE-4yr State Public Enrollment Rates Using Yearly Variables and State-Population Weights

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Time Period :			1973-2000				1973-1982	1983-1993	1973-1993
Log College Age Population	-0.513 (0.036)	-0.530 (0.031)	-0.596 (0.034)	-0.584 (0.029)	-0.963 (0.127)	-0.836 (0.036)	-0.870 (0.076)	-0.607 (0.076)	-0.701 (0.041)
Log Average Public Tuition[b]		-0.154 (0.018)		-0.134 (0.018)	-0.031 (0.015)	-0.070 (0.015)	0.031 (0.037)	-0.079 (0.030)	-0.104 (0.022)
Log State Appropriation per College-Age Person			0.121 (0.022)	0.081 (0.022)	0.109 (0.015)	0.063 (0.014)	0.172 (0.024)	0.064 (0.029)	0.075 (0.024)
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OTR Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Trends	No	No	No	No	Yes	Yes	No	No	No
State Quadratic Trends	No	No	No	No	No	Yes	No	No	No
R-squared	0.95	0.95	0.95	0.97	0.99	0.95	0.98	0.98	0.94
No. Observations	1400	1400	1400	1400	1400	1400	500	550	1050

Notes: Robust standard errors are in parentheses. Here, by contrast with the other tables, yearly data is used. The models are estimated by weighted least squares, using population weights. OTR Time Dummies add up to zero and are orthogonal to the time trend.

Table 5

3-Step Instrumental Variables Estimates of the Relative Supply Effects Using Lagged Predicted Enrollment Rates as Instrument (1982-2002)

	(1)	(2)	(3)	(4)	(5)	(6)
Own-Cohort Relative	-0.163	-0.174	-0.159	-0.165	-0.145	-0.085
Supply: $ln(C^Y/H^Y)$	(0.029)	(0.081)	(0.057)	(0.081)	(0.045)	(0.051)
Relative Supply of Older	0.048	0.063	0.054	0.013	0.050	0.031
Workers: $ln(C^O/H^O)$	(0.018)	(0.033)	(0.029)	(0.016)	(0.019)	(0.018)
Log Unemployment	-0.027	-0.027	-0.025	-0.013	-0.024	-0.017
Rate	(0.012)	(0.018)	(0.012)	(0.011)	(0.011)	(0.011)
Time Trend	0.032	0.068	0.038	0.033	0.040	0.047
	(0.004)	(0.005)	(0.008)	(0.009)	(0.008)	(0.008)
Time Squared ÷ 10			-0.010	-0.004	-0.012	-0.023
			(0.014)	(0.11)	(0.014)	(0.013)
First-Stage Estimates of the Instruments:						
Determinants of Relative Supply						
Predicted Log FTE 4-yr	1.222	0.813	1.195	1.186	1.387	1.412
Public Enrollment	(0.105)	(0.170)	(0.166)	(0.173)	(0.173)	(0.183)
per College Age Person$_{t-9}$						
Log FTE 4-yr	0.070	0.070	0.059	0.055	0.047	0.039
Private Enrollment	(0.041)	(0.039)	(0.042)	(0.042)	(0.041)	(0.042)
per College Age Person$_{t-9}$						
F-Statistic	80.24	14.02	27.93	28.12	25.62	31.79
on Enrollment Variables						
Overid Test (p-value)	0.563	0.949	0.946	0.311	0.866	0.545
Determinants of Public Enrollment Rates						
Log of College Age	-0.724	-0.584	-0.588	-0.625	-0.621	-0.561
Population $_{t-9}$	(0.070)	(0.070)	(0.069)	(0.080)	(0.041)	(0.067)
Log Average	-0.003	-0.152	-0.145	-0.042	-0.156	
Public Tuition$^b_{t-9}$	(0.037)	(0.043)	(0.041)	(0.031)	(0.041)	
Log State Appropriation	0.137	0.056	0.076	0.061		
per College-Age Person$_{t-9}$	(0.041)	(0.046)	(0.040)	(0.024)		
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
OTR Time Dummies	No	Yes	No	No	No	No
State Trends	No	No	No	Yes	No	No
R-squared	0.81	0.83	0.87	0.84	0.85	0.81

Notes: Robust standard errors are in parentheses.OTR Time Dummies add up to zero and are orthogonal to the time trend. Models are estimated by weighted least squares, where the weights are the inverse of the sampling variance of the estimated wage premia. Because state-level tuition data is not available prior to 1973, the analysis covers the period 1982 to 2002. 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.

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.
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-Cohort Relative	-0.217	0.022	-0.167	-0.052	-0.269	-0.055
Supply: $ln(C^Y_{st}/H^Y_{st})$	(0.070)	(0.063)	(0.053)	(0.068)	(0.124)	(0.054)
Relative Supply of Older	0.039	0.032	0.047	0.025	0.081	0.035
Workers: $ln(C^O_{st}/H^O_{st})$	(0.029)	(0.027)	(0.021)	(0.027)	(0.030)	(0.025)
Log State Unemployment	-0.011	-0.026	-0.029	-0.009	-0.027	-0.014
Rate	(0.022)	(0.036)	(0.014)	(0.014)	(0.017)	(0.018)
Time Trend	0.029	0.063	0.042	0.047	0.023	0.056
	(0.013)	(0.009)	(0.008)	(0.013)	(0.014)	(0.010)
Time Squared ÷ 10	0.009	-0.053	-0.008	-0.032	0.014	-0.042
	(0.017)	(0.013)	(0.014)	(0.017)	(0.024)	(0.015)
First-Stage Estimates of the Instruments: Determinants of Relative Supply						
Predicted Log FTE 4-yr	0.878	0.555	1.094	0.563	0.513	0.523
Public Enrollment	(0.185)	(0.327)	(0.217)	(0.268)	(0.216)	(0.240)
per College Age Person$_{t-9}$						
Log FTE 4-yr	0.080	-0.040	-0.106	0.090	0.052	0.373
Private Enrollment	(0.038)	(0.135)	(0.080)	(0.043)	(0.041)	(0.120)
per College Age Person$_{t-9}$						
F-Statistic on Enrollment Variables	14.23	1.44	13.26	4.32	4.08	8.93
Overid Test (p-value)	0.754	0.852	0.275	0.177	0.862	0.951
Determinants of Public Enrollment Rates						
Log of College Age	-0.569	-0.770	-0.851	-0.429	-0.518	-0.735
Population $_{t-9}$	(0.093)	(0.108)	(0.072)	(0.122)	(0.110)	(0.080)
Log Average	-0.115	-0.178	-0.117	-0.041	-0.121	-0.233
Public Tuition$^b_{t-9}$	(0.060)	(0.051)	(0.038)	(0.084)	(0.062)	(0.048)
Log State Appropriation	0.080	0.072	0.058	0.098	0.128	0.016
per College-Age Person$_{t-9}$	(0.061)	(0.046)	(0.034)	(0.070)	(0.064)	(0.041)
R-squared	0.81	0.83	0.87	0.84	0.83	0.81
No. of observations	217	126	189	154	175	168

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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
State Selection	Low Private	High Private	Low CG Migration	High CG Migration	Low Out of State Shipments	High Out of State Shipments	All States
Estimation Strategy							
a) OLS	-0.068	-0.078	-0.093	-0.024	-0.055	-0.046	-0.067
	(0.027)	(0.025)	(0.023)	(0.028)	(0.028)	(0.025)	(0.019)
b) 2SLS	-0.158	+0.056	-0.154	-0.076	-0.096	-0.027	-0.083
	(0.066)	(0.062)	(0.052)	(0.076)	(0.100)	(0.044)	(0.051)
First-Stage Estimates of the Instruments:							
Log of College Age	-0.549	-1.011	-1.141	-0.588	-0.505	-1.356	-0.549
Population $_{t-9}$	(0.115)	(0.256)	(0.161)	(0.126)	(0.119)	(0.188)	(0.105)
c) 2SLS	-0.172	-0.030	-0.165	-0.021	-0.128	-0.016	-0.108
	(0.065)	(0.049)	(0.053)	(0.064)	(0.100)	(0.039)	(0.051)
First-Stage Estimates of the Instruments:							
Log of College Age	-0.614	-0.960	-1.237	-0.518	-0.477	-1.008	-0.560
Population $_{t-9}$	(0.124)	(0.270)	(0.185)	(0.141)	(0.132)	(0.196)	(0.112)
Log Average	-0.165	0.011	-0.011	0.128	0.008	0.273	-0.078
Public Tuition$^{b}_{t-9}$	(0.075)	(0.120)	(0.083)	(0.096)	(0.070)	(0.107)	(0.060)
Log State Appropriation	-0.080	0.219	0.158	0.044	0.040	0.226	-0.022
per College-Age Person$_{t-9}$	(0.082)	(0.111)	(0.070)	(0.102)	(0.071)	(0.096)	(0.064)
Log FTE 4-yr Private Enrollment	0.074	-0.150	-0.164	0.056	0.022	0.471	0.060
per College Age Person$_{t-9}$	(0.038)	(0.148)	(0.085)	(0.047)	(0.043)	(0.128)	(0.039)
No. of observations	217	126	189	154	175	168	343

Notes: The relative supply of older workers, the state unemployment rate, a quadratic in time, as well as 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.

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.

Table 9

Robustness of the Results to Alternative Definitions of College and High School Educated Workers

Econometric Specification	(1) OLS	(2) 2SLS	(3) 3-Step	(4) OLS	(5) 2SLS	(6) 3-Step
	College Plus vs High School			Coll Equiv vs HS Equiv		
Own-Cohort Relative	-0.055	-0.218	-0.161	-0.072	-0.241	-0.197
Supply: $ln(C^Y/H^Y)$	(0.017)	(0.067)	(0.062)	(0.012)	(0.086)	(0.084)
Relative Supply of Older	0.019	0.110	0.065	0.012	0.072	0.040
Workers: $ln(C^O/H^O)$	(0.023)	(0.043)	(0.041)	(0.016)	(0.037)	(0.031)
Log Unemployment	-0.011	-0.023	-0.021	-0.008	-0.008	-0.008
Rate	(0.010)	(0.012)	(0.010)	(0.009)	(0.010)	(0.009)
Time Trend	0.048	0.020	0.032	0.035	0.010	0.021
	(0.006)	(0.013)	(0.015)	(0.005)	(0.014)	(0.015)
Time Squared ÷ 10	-0.021	0.020	0.004	-0.011	0.024	0.011
	(0.007)	(0.018)	(0.020)	(0.005)	(0.019)	(0.021)
First-Stage Estimates of the Instruments: Determinants of Relative Supply						
Log FTE 4-yr Public Enrollment		0.383			0.336	
per College Age Person$_{t-9}$		(0.068)			(0.075)	
Predicted Log FTE 4-yr			1.481			1.075
Public Enrollment			(0.088)			(0.109)
per College Age Person$_{t-9}$						
Log FTE 4-yr		0.057	0.067		-0.033	-0.034
Private Enrollment		(0.036)	(0.039)		(0.040)	(0.045)
per College Age Person$_{t-9}$						
F-Statistic		18.44	165.33		10.01	49.88
on Enrollment Variables						
Overid Test (p-value)		0.615	0.608		0.045	0.090
Determinants of Public Enrollment Rates						
Log of College Age			-0.584			-0.577
Population $_{t-9}$			(0.069)			(0.069)
Log Average			-0.143			-0.141
Public Tuition$^b_{t-9}$			(0.041)			(0.042)
Log State Appropriation			0.080			0.087
per College-Age Person$_{t-9}$			(0.040)			(0.041)
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.90	0.87	0.86	0.90	0.84	0.84
No. Observations	408	400	343	408	400	343

Notes: 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. The different definitions of the college-high school wage gap generate small differences in the sampling variances, which generate small differences in the estimates of the determinants of the enrollment rates. Inspection of the residual regression of the overid test in column (5) and (6) shows some marginally significant correlation between the residual and lagged log private enrollment rate.

Table 10a

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	-0.094	0.019
$ln(C^Y_{st}/H^Y_{st})$	(0.024)	(0.051)	(0.054)	(0.058)	(0.053)	(0.039)	(0.051)
Relative Supply of Older	0.069	0.112	0.114	0.111	0.131	0.091	0.043
Workers: $ln(C^O_{st}/H^O_{st})$	(0.033)	(0.037)	(0.038)	(0.042)	(0.041)	(0.033)	(0.036)
Log State Unemployment	0.072	0.048	0.048	0.050		0.061	0.086
Rate	(0.018)	(0.019)	(0.019)	(0.021)		(0.018)	(0.019)
First-Stage Estimates of the Instruments: Determinants of Relative Supply							
Log FTE 4-yr Public Enrollment		0.644			0.674	0.606	
per College Age Person$_{t-9}$		(0.101)			(0.093)	(0.091)	
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	0.135	
per College Age Person$_{t-9}$		(0.061)	(0.065)	(0.066)	(0.060)	(0.056)	
Relative Return Migration						0.171	0.202
$ln(C^R_{st}/H^R_{st})$						(0.042)	(0.051)
Relative Other In-Migration						0.120	0.154
$ln(C^I_{st}/H^I_{st})$						(0.062)	(0.076)
Determinants of Public Enrollment Rates							
Log of College Age			-0.441	-0.298			
Population $_{t-9}$			(0.091)	(0.109)			
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)			
Log College Premium$_{t-10}$ (1979-1989)							
Overid Test (p-value)		0.261	0.349	0.534	0.351	0.001	0.537
R-squared	0.95	0.94	0.95	0.94	0.92	0.95	0.94
No. of observations	153	150[a]	147[b]	147[b]	150[a]	153	150[a]

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

[b] Excludes the District of Columbia, where there are no state appropriations.

[c] Excludes data from the 1980 Census, for which state-level college premia are not available since the 1970 Census reports hours data only in categories.

TABLE 10B

CENSUS (1980-1990-2000) ESTIMATES OF THE OWN-COHORT SUPPLY EFFECT UNDER ALTERNATIVE SPECIFICATIONS

Econometric Specification	(8) 2SLS	(9) 3-Step	(10) 3-Step	(11) 3-Step
Own Relative Supply	-0.053	-0.061	-0.181	-0.194
$ln(C^Y_{st}/H^Y_{st})$	(0.095)	(0.072)	(0.056)	(0.049)
Relative Supply of Older	0.073	0.077	0.256	0.275
Workers: $ln(C^O_{st}/H^O_{st})$	(0.054)	(0.046)	(0.086)	(0.081)
Log State Unemployment	0.069	0.069	0.040	0.036
Rate	(0.025)	(0.022)	(0.027)	(0.026))
First-Stage Estimates of the Instruments: Determinants of Relative Supply				
Log FTE 4-yr Public Enrollment per College Age Person$_{t-9}$				
Predicted Log FTE 4-yr Public Enrollment		0.725	1.135	1.151
per College Age Person$_{t-9}$		(0.208)	(0.214)	(0.194)
Log FTE 4-yr Private Enrollment		0.199	0.210	0.195
per College Age Person$_{t-9}$		(0.070)	(0.088)	(0.084)
Relative Return Migration $ln(C^R_{st}/H^R_{st})$				
Relative Other In-Migration $ln(C^I_{st}/H^I_{st})$				
Determinants of Public Enrollment Rates				
Log of College Age	-0.405	-0.536	-0.610	-0.546
Population $_{t-9}$	(0.113)	(0.094)	(0.148)	(0.152)
Log Average			-0.132	-0.146
Public Tuition$^b_{t-9}$			(0.083)	(0.083)
Log State Appropriation			0.022	0.050
per College-Age Person$_{t-9}$			(0.112)	(0.112)
Log College Premium$_{t-10}$				0.480
(1979-1989)				(0.309)
Overid Test (p-value)		0.857	0.402	0.590
R-squared	0.95	0.96	0.90	0.96
No. of observations	153	150[a]	98[c]	98[c]

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

[b] Excludes the District of Columbia, where there are no state appropriations.

[c] Excludes data from the 1980 Census, for which state-level college premia are not available since the 1970 Census reports hours data only in categories.