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# A re-examination of the social returns to education: Evidence from U.S. cities

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## HIGHLIGHTS

- This paper re-examines the impact of city educational composition on wages.
- A strong, positive association is found in the 1980s, but not the 1990s.
- The findings are not consistent with standard models of technological spillovers.

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## ABSTRACT

This paper re-examines the impact of city educational composition on wages, often interpreted as human capital externalities. Using U.S. Census data, I find large, positive spillovers from college education in the 1980s, as documented by Moretti (2004a). In contrast, in the 1990s, the supply of skilled workers has no impact on average wages and may even negatively impact the wages of low-skill workers. These findings invite reinterpretation of previous studies on social returns to education, as shifts in the impact of city education composition on wages are not consistent with standard models of technological human capital externalities.



## 1. Introduction

There is little empirical consensus regarding either the existence or magnitude of human capital externalities. Studies using variation in lower educational attainment to identify external returns to education find little evidence of education spillovers Acemoglu (1999), while studies using variation in the proportion of college graduates in localities find external returns Moretti (2004a).

In this paper, I demonstrate that the effect of the share of college graduates in a city on wages is remarkably unstable over time. Using city level census data, I find large positive spillovers from college education in the 1980s, consistent with the previous literature. However, in the 1990s this result disappears. To gain further insight into the pattern of education spillovers, I examine the relation between college share and wages at different levels of education. The pattern of spillovers is difficult to reconcile with technological theories of spillovers, where externalities are built into the production function.

Using data from the 1980, 1990 and 2000 U.S. Censuses for 286 consistently defined metropolitan areas, I examine decadal changes in city-level wages and their relation to the change in the fraction of a city's labor force with at least a college degree. After controlling for the effect of own education, the coefficient on city college share measures the presence of human capital spillovers under conditions described later.

Working in differences allows me to control for possible correlations between city time-invariant factors and changes in college share by using within-city variation. However, there are still potential endogeneity concerns arising from omitted time-varying variables that are correlated with changes in the fraction of college graduates in a city. I address

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these concerns by using an instrumental variable strategy to predict changes in the local proportion of college graduates. I also address the potentially non-random location of workers across cities using a method first developed by Dahl (2002). Despite addressing several econometric concerns, the instability of the estimated education spillovers remains. These findings invite reinterpretation of previous studies on social returns to education, as parameter instability is not a general feature of models of human capital spillovers.

The remaining sections of this paper are organized as follows. In Section 2, I give a brief review of the literature on the social returns to education. In Section 3, I re-evaluate the evidence on education spillovers in U.S. cities from 1980–2000. Section 4 concludes.

## 2. Previous literature

The existing literature that estimates productivity spillovers from human capital often adopts a similar empirical specification that regresses wages on aggregate education while controlling for individual characteristics such as education. Consider the following representative estimating equation:

$$\ln w_{ict} = X'_{ict}\mu_t + \beta S_{ct} + Z'_{ct}\alpha_t + \delta_t + \delta_c + u_{ict}, \quad (1)$$

where the dependent variable is the log wage for individual $i$ in city $c$ in time $t$, $X_{ict}$ is a vector of individual characteristics including individual education, $Z_{ct}$ is a vector of city level time varying characteristics, $\delta_t$ and $\delta_c$ are year and city fixed effects, and $u_{ict}$ is an error term. $S_{ct}$ is a measure of city level aggregate education and $\beta$ is the term reflecting human capital spillovers under ideal conditions. This strand of literature has come to considerable disagreement regarding the magnitude of human capital spillovers.[1] For example, Lange and Topel (2006), Ciccone and Peri (2006), Rudd (2000) and Acemoglu and Angrist (2001) all find little evidence of externalities, while Moretti (2004a) and Iranzo and Peri (2009) find positive externalities associated with human capital measured by the share of college graduates in a local labor market.

There are several econometric problems to estimating $\beta$, and the literature can be broadly grouped by how researchers deal with endogeneity of local human capital. Earlier studies treat aggregate education as exogenous while later ones use instrumental variables to identify a causal effect of aggregate education on local wage outcomes. Two well known papers among this latter category are Acemoglu and Angrist (2001) and Moretti (2004a).

Acemoglu and Angrist (2001) use U.S. states as their geographical unit of analysis and identify social returns to education by using variation from compulsory schooling laws. They find that more restrictive laws are associated with higher average educational attainment. When they instrument average state education using these laws their estimates of the external impact of an additional year of average state education are typically around 1–2% but not statistically significant. Acemoglu and Angrist interpret these findings as providing little support for sizeable human capital externalities over the range of variation induced by compulsory schooling laws. In contrast to this, Moretti (2004a) finds significant spillovers to education using U.S. cities as his geographical unit of interest. In this study, the measure of local human capital is the proportion of workers in a city with a college degree. Moretti instruments this variable with lagged city age structure or the presence of a land grant college. He finds that a 1% increase in college share raises average city wages by 1.9% for high school graduates and 0.4% for college graduates.

There are three factors that could potentially explain differences in these findings. First, Moretti (2004a) finds that when states rather than cities are used as the level of analysis, the estimates are typically lower. Second, and the factor that has received the most attention in the literature, Acemoglu and Angrist (2001) identify spillovers using variation from compulsory school laws that affect the lower part of the education distribution, while Moretti (2004a) uses variation in the share of college graduates or the upper part of the education distribution. One emerging view is that externalities are associated with college graduates, while, for example, increasing the fraction of high school graduates has no discernible effect on wages.[2]

The last difference between these studies, and the one that I emphasize in this paper, is that they study different time periods. Acemoglu and Angrist (2001) mainly focus on the period from 1960 to 1980, while Moretti (2004a) studies only the 1980s. However, when Acemoglu and Angrist (2001) extend their data to include the 1980s, several of their estimates of education spillovers are positive and statistically significant. They interpret this result as being caused by a change in the way that education is coded in the U.S. census, while Moretti (2004a) argues that this had little impact (p. 37). This sensitivity to time period has not been examined closely in the literature and I use this as a starting point in my empirical work below.

## 3. A re-examination of social returns to higher education

### 3.1. Data and basic patterns

The data for this analysis come from U.S. Censuses for the years 1980–2000 extracted from IPUMS.[3] All analyses are restricted to individuals between the ages of 24 and 64 with positive weeks worked in the year proceeding the Census. Real wages are obtained by dividing wage and salary income by weeks worked and deflating by the CPI. Appendix A contains additional details on the processing of the Census data, including the construction of consistent city definitions over time.

The observation that I want to emphasize is that the relationship between changes in average city wages and aggregate human capital has changed considerably between the 1980s and the 1990s. The strong positive association between city average wages and college share in the 1980s, as previously documented by Moretti (2004a), disappears in the 1990s.

Fig. (1) plots city-level changes in wages against changes in the fraction of workers with a college degree for each decade.[4] The first panel contains the results for the 1980s and shows the strong positive association between these two variables. The solid line is the fitted regression line and has a coefficient on college share of 2.01 with a standard error of 0.26, and, as can be seen in the figure, this relationship is not driven by a subset of outlying cities. The next panel shows that, in the 1990s, the positive association between changes in city average wages and city college share is no longer present. The regression line in this panel has a coefficient on college share of 0.14with a standard error of 0.13. Given that this observation is rather striking, it seems necessary to assess its robustness.

### 3.2. Methods and results

To fix ideas, consider a model suggested by Moretti (2004a,b) to understand the effect of an increase in the fraction of college workers in a city. Each city is treated as a competitive economy that produces a single good that is traded on the national market. Output comes from a CES production function $F(\theta_U U, \theta_S S)$ where $U$ and $S$ refer to the quantities of unskilled and skilled labor, respectively, and the $\theta$s are labor

[1] See Moretti (2004b) or Harmon and Walker (2000) for a summary of the literature.

[2] For example, Iranzo and Peri (2009) estimate models in which they regress wages on both average years of education and the share of college graduates in U.S. states. Their results support this view. Wheeler and Jeunesse (2006) take this as the point of departure in their study on income distribution in U.S. metropolitan areas.

[3] See Ruggles et al. (2010) for a description of this data.

[4] Average wages in each year and city have been reweighted to hold the distribution of observable characteristics in each city at their 1990 levels, to avoid changes in average wages due to composition effects. See figure notes for additional details on its construction.