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Abstract

Workforce intermediation has emerged as a potential tool for guiding labor market adjustment. This article presents an empirical test of workforce intermediation through a study of community colleges in North Carolina. It demonstrates the positive contribution of intermediary colleges in increasing access to jobs in the pharmaceutical and bioprocessing industries. It also considers the limits of this strategy when adopted by only a subset of colleges within a larger labor market region and, specifically, the challenges this creates for forging strong relationships with employers outside the jurisdictional boundaries of individual colleges. The authors conclude by considering policy options for extending the reach of intermediation across the regional labor market through greater intercollege coordination. The authors argue that coordination efforts in North Carolina, although still in their infancy, hold considerable promise for other college systems that are looking to position themselves as institutional leaders in intermediation.

Keywords

workforce intermediation, biomanufacturing, community colleges, North Carolina, regional coordination

Workforce intermediation has emerged as a popular strategy for promoting job creation among disadvantaged populations (Giloth, 2004; Harrison & Weiss, 1998). Workforce intermediaries not only prepare job seekers for labor market entry through targeted training but also establish close working relationships with employers in an effort to influence and shape local hiring decisions (Fitzgerald, 2004; Osterman, 2007). Labor analysts and pro-labor foundations, including the Aspen Institute and the Ford Foundation, remain strong advocates of the workforce intermediation model, even recommending this as a core component of any future reform of the Federal Workforce Investment Act (Osterman, 2007).

In support of this policy direction, statewide community college systems are encouraged to position themselves as regional workforce intermediaries (Benner, Brownstein, Dresser, & Leete, 2001; Giloth, 2004; Osterman, 2007). This recommendation is based on community colleges' attributes: expansive labor market coverage, access to diverse and often marginalized populations, and, most important, a solid reputation within the business community (Osterman, 2007). Additionally, in many states, community college systems already provide extensive training support to the recipients of federal workforce development assistance programs and are therefore familiar with and tapped into federal funding and program streams (Garmise, 2006; Osterman & Batt, 1993).

These statewide systems are therefore seen as key institutional vehicles for extending the reach of workforce intermediation.

Given this proposed policy direction, it is valuable to take stock of the intermediation experiences of community college systems already moving forward with this ambitious agenda. This allows for the identification of potential implementation challenges and opportunities. This article focuses on workforce intermediation efforts currently under way within North Carolina's community college system. These intermediation efforts are designed to shape employment opportunities in the state's pharmaceutical and bioprocessing industries.

This article examines workforce intermediation in the context of an industry-specific training program called BioWork. BioWork is a 128-hour certificate course that provides specialized training for entry-level jobs in pharmaceutical and bioprocessing manufacturing (PBM). Prospective participants are required to have only as much as a high school degree, which

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makes BioWork an especially attractive training program for less educated job seekers and especially those displaced from traditional and declining manufacturing industries. Currently, 13 out of North Carolina's 58 community colleges offer this course and together enroll approximately 1,000 participants annually. For the most part, colleges that offer BioWork are concentrated in or adjacent to North Carolina's Research Triangle metropolitan area, also home to a large majority of the state's 40 PBM facilities.

A subset of community colleges offering BioWork has adopted a number of intermediary roles and thus provides us with a type of "natural experiment" for analyzing the effect of workforce intermediation on employment outcomes. All the 13 colleges referred to above provide similar vocational training for entry-level jobs in the PBM industry, but colleges that act as workforce intermediaries also establish close working relationships with PBM employers in their jurisdiction to enhance local job opportunities for their BioWork participants. More specifically, they draw on these employer relationships to negotiate local hiring and employee referral arrangements; build personal connections between job seekers, established PBM employees, and human resource managers; and help identify specific skills and qualifications that are most attractive to PBM employers in their area. By connecting job placement assistance to the needs of specific PBM employers in their jurisdiction, intermediary BioWork colleges go well beyond the general-purpose job placement assistance offered through more traditional one-stop employment centers in the state.

The next section of the article discusses the role of community colleges in workforce intermediation. The third section begins the empirical portion with a description of community college intermediation in the delivery of the BioWork program in North Carolina. We then test the effect of intermediation on workforce outcomes using panel data collected from participants of the BioWork program across a set of community colleges that display varying intermediation roles. The following section discusses the key finding of our analytic results—that intermediation significantly affects the chances of securing employment—in terms of a geographic mismatch between localized community college/employer relationships and the much wider regional labor market boundary within which program participants search for jobs. We conclude by offering a policy prescriptive for how to potentially solve this dilemma and by outlining the potential implications of extending intermediation support in North Carolina and beyond.

The Role of Community Colleges in Workforce Intermediation

Workforce intermediaries come in a variety of forms (Marano & Tarr, 2004). Generally speaking, however, they differ considerably from more traditional labor market intermediaries, such as private-sector staffing agencies, online job-posting boards,

and government-funded job placement centers, which typically limit their services to basic job matching (Benner, 2003; Benner, Leete, & Pastor, 2007; Peck & Theodore, 2007). Instead, workforce intermediaries adopt what is often described as a "dual-customer" approach—that is, they mediate the relationship between specific regional employers and job seekers to open up viable employment opportunities for less educated and low-income workers in a region (Gilothe, 2004). Workforce intermediaries increase the *supply* of trained job seekers in a region through specialized vocational training. But they also shape the *demand* for these skills by embedding themselves in dense networks of local employers. In traditional manufacturing industries, workforce intermediaries often strengthen their relationships with local employers by also offering specialized technical assistance (Fitzgerald, 2004; Gilothe, 2004). In emergent or growth sectors, they instead focus on continuous improvements in training in response to new technologies or innovations (Lowe, 2007). This not only enables them to maintain training programs that stay in step with constantly changing industry needs but also puts them in a much stronger position to leverage employer-oriented training support and technical assistance as a mechanism for influencing local hiring goals and employment decisions (Bernhardt, Pastor, Hatton, & Zimmerman, 2001; Fitzgerald, 2004; Lautsch & Osterman, 1998).

Community colleges play an important though understudied role in workforce intermediation. Documented cases tend to focus narrowly on the outsourced training services that community colleges provide to participants of nonprofit workforce intermediary programs rather than on their own experiences directly managing these programs (Benner et al., 2001; Dresser & Rogers, 2003; Gilothe, 2004). One oft-cited example is Project Quest, a nonprofit workforce intermediary based in San Antonio, Texas (Lautsch & Osterman, 1998). Project Quest contracts out training support for its participants to local community colleges. Through this institutional partnership, Project Quest is able to draw on its existing relationships with regional employers to identify outdated training programs and, in the process, mediate discussions between local employers and college staff that result in significant improvements to the existing community college training curriculum. These changes not only improve employment prospects for program participants in growth sectors of the economy but also help elevate the status of the community college within the local business community.

Project Quest represents a nonprofit-driven strategy for strengthening connections between community colleges and local businesses to improve job access for the disadvantaged job seeker. A more direct approach, in which community colleges position themselves centrally as workforce intermediaries, is also possible (Gilothe, 2004). This is evidenced by a 2002 survey of workforce organizations that reported that approximately 15% of workforce intermediary programs were managed by educational institutions, most of which were community and technical colleges (Marano & Tarr, 2004). Given the more

than 1,100 community colleges in the United States and their relatively stable funding situation, there is considerable opportunity to extend the reach of workforce intermediation by increasing community college involvement in program implementation (Giloith, 2004; Osterman, 2007). Still, for this to occur, we need a better understanding of the potential challenges specific to community colleges in implementing and supporting these kinds of programs.

One potential challenge facing community colleges is the insufficient resources to ensure that the most disadvantaged job seekers excel in their programs. It is important to remember that although most community college initiatives are accessible to disadvantaged job seekers, program participation is not necessarily limited to those individuals facing identifiable barriers to employment. Rather, college-based initiatives are usually designed to be open enrollment and therefore attract a wide variety of participants representing diverse socioeconomic and educational backgrounds (Bailey & Smith Morest, 2006; Osterman & Batt, 1993). In contrast, most successful nonprofit and labor union-backed workforce intermediaries make it their stated priority to target individuals who are low income and less educated or facing additional barriers to employment (Giloith, 2004). Given this targeting, participants in these programs often receive individualized counseling and case management assistance in addition to structured vocational training (Lautsch & Osterman, 1998). Community college programs, although clearly accessible to and used by low-income and less educated individuals, may not have the resources needed to offer this kind of targeted assistance. This raises important questions about their ability to implement workforce intermediation in a manner that facilitates upward mobility for all participants, especially those with greater needs. As colleges seek to enhance their intermediary role, it may be necessary for them to forge institutional partnerships that ensure that less advantaged participants succeed in these programs and have equal access to quality job opportunities at the end of their training. We return to this subject in our concluding section.

The second issue relates to the constraints facing many community colleges in establishing deep and transformative relationships with local employers (Garmise, 2006). In many respects, community colleges have considerable advantage in this area compared with other types of workforce intermediaries. Employer perceptions of community colleges remain strong, as evidenced by a recent survey of employer views of different types of labor market intermediaries, broadly defined (Laufer & Winship, 2004). As the authors of that study note, "Across all groups, industries and geographic locations and time periods, community colleges/vocational schools were generally perceived to be the *most* attractive source of workforce development programs for low-income people and nontraditional labor pools" (Laufer & Winship, 2004, p. 234) compared with other intermediaries, including community-based nonprofits, for-profit employment agencies, and industry trade organizations.

The solid reputation of community colleges within the business community has been well documented by other scholars of economic and workforce development (Benner et al., 2007; Rosenfeld, 2000; Willis, Connelly, & DeGraff, 2003). Still, for colleges to effectively play the role of workforce intermediaries, they also need to establish and maintain close relationships with employers, which will allow them to influence local labor market dynamics (Fitzgerald, 2004). Traditional channels for connecting with local business leaders—namely, those that encourage greater employer representation on collegewide advisory boards—may not guarantee the institutional depth needed to influence program implementation and outcomes. Rather, additional efforts may be needed to deepen the involvement of specific businesses at the training program level so that information and resources that can enhance job placement outcomes are continually exchanged and developed (Lautsch & Osterman, 1998).

A third, and related, issue pertains to the level at which intermediation support is provided. Implicit in current policy recommendations to expand workforce intermediation is an awareness that individual community colleges are themselves part of a larger, statewide community college system. This suggests the possibility that multiple colleges might coordinate their intermediation efforts in order to extend their reach across the regional labor market (Giloith, 2000). The physical proximity between individual colleges in many states adds additional support to strategy coordination. In some cases, the proximity between colleges reflects the fact that these systems were established in earlier decades, when employment commuting patterns were less dispersed. In other cases, it is by design, reflecting early efforts by policy makers to increase access for residents in more remote areas of their state; in North Carolina, for example, colleges were initially sited to ensure that all residents had access to at least one community college within 30 miles of their homes (Lancaster, 1999). This essentially means that multiple colleges often coexist within the same regional labor market boundary.

Still, although cross-college coordination of intermediation services may be the policy ideal, potential governance challenges exist that can undermine such partnerships (Giloith, 2000). Even in states that have more centralized system control, such as North Carolina (Garrett, 1999; Lancaster, 1999), there may be challenges in synchronizing efforts across individual colleges (Alssid et al., 2002; Hughes, 2000). Related to this, it is important to remember that most successful workforce intermediation efforts involve the formation of strong relationships within a localized business community. This enables the intermediary to tailor its job placement and training supports to the needs of specific employers while at the same time creating opportunities to identify emergent challenges facing local businesses, for which it can offer an institutional solution. Removing local contact and centralizing intermediation services at the state level may undermine this important aspect of

relationship building. Possible solutions include nested forms of coordination that encourage individual colleges to continue to develop close relationships within their respective business communities while at the same time allowing job seekers from multiple colleges to access and benefit from a wider reaching network of college–business relationships.

Turning next to the specifics of the North Carolina case, we glean insights into not just how regionally coordinated workforce intermediation initiatives might be designed and strengthened but also why they may be needed in the first place.

Workforce Intermediation in North Carolina

Several community colleges within North Carolina's 58-college system have undertaken innovative initiatives that fall under the broad category of workforce intermediation. The most extensive efforts are found in PBM and involve multiple colleges and, of late, coordinated assistance from an industry-specific division of the community college system. As with other workforce intermediary initiatives in North Carolina, those focused on the PBM industry were initially designed to help displaced workers from traditional and declining manufacturing industries transition to growth sectors in the state.

Traditional manufacturing industries in North Carolina, including tobacco processing, textiles, and furniture, have shed close to 200,000 jobs since 1990. Many of these displaced manufacturing workers have basic educational qualifications—a high school degree or less—yet considerable manufacturing experience and applied skills, which when supplemented with additional vocational training are often transferable to other industrial sectors. In addition to these traditional industry workers, the state also has a sizeable and growing group of job seekers with previous manufacturing employment experience in newer yet declining technology-based industries, especially microelectronics (i.e., computer, peripherals, and cellular phone manufacturing). Both sets of displaced workers are the explicit targets of community colleges that are trying to facilitate employment transitions to jobs in the PBM industry. This orientation to assisting displaced manufacturing workers is reinforced by the central role that community colleges in North Carolina play in retraining individuals who receive funding through federal training assistance programs. In fact, most of the vocational training programs in North Carolina that are authorized under the U.S. Workforce Investment Act are community college based. Generally speaking, the North Carolina community college system has an extensive labor market reach and has positioned itself as the state's main training provider for job seekers who face considerable barriers to employment.

Workforce intermediation in the PBM industry initially emerged as a grassroots effort. Central here are efforts made by a handful of community colleges that prepare job seekers

for entry-level positions in the industry. These institutions are part of a larger group of 13 community colleges that provide general enrollment training through the BioWork certificate program. Although all 13 BioWork colleges offer industry-specific training, four colleges—Johnston Community College, Wake Technical Community College, Wilson Technical Community College, and Vance-Granville Community College—stand out for their active role in mediating the relationship between PBM job seekers and local employers. These four colleges are categorized as workforce intermediaries because they provide industry-specific job placement assistance and directly engage with PBM employers in their service area in an effort to facilitate local hiring.

Although a complete review of all the varying functions of these four intermediary colleges is beyond the scope of this article (Lowe, 2007), several important institutional features are worth highlighting.¹ First and foremost, intermediary colleges employ a variety of strategies for developing close working relationships with employers. As part of this effort, training and program administration staff from intermediary colleges talk regularly with supervisors and human resource managers in the PBM companies in their service area. In some cases, this is done through frequent face-to-face meetings with representatives from individual companies; in other cases, it involves a weekly or bimonthly phone conversation. These exchanges serve two purposes. First, they allow college staff to keep track of broad industry trends and related employment swings, including anticipated job openings or layoffs. Second, they provide a direct communication channel for identifying potential gaps in worker training and skill level that can be addressed through additional college support.

Johnston Community College has gone the farthest in this area, hiring a part-time job counselor with PBM industry experience to help conduct outreach services at local PBM facilities. This counselor works closely with individual job seekers and is also embedded in local employer networks to strengthen the role of the college as jobs broker and skills developer. Other intermediaries that are not financially able to dedicate significant staff time to outreach activities may still engage on a weekly or monthly basis with PBM companies in their service areas. At some intermediary colleges, instructor–employee connections are used to maintain strong ties to local PBM businesses. At Vance-Granville Community College, for example, one BioWork instructor was hired directly from the county's main bioprocessing facility, Novozymes. She has retained her connections with company personnel and continues to build on a close working relationship established between the company and the college in the late 1990s, when Novozymes, Vance-Granville College, and North Carolina Biotechnology Center initially partnered to create the BioWork curriculum (Fitzgerald, 2006; Lowe, 2007).

Through these exchanges, intermediary colleges and employers are able to identify opportunities for mutual support

and reinforce their interdependency. Colleges draw on these relationships when making improvements to classroom instruction and developing customized and shortened modules of BioWork for incumbent PBM workers. Colleges also use these connections to solicit equipment donations from PBM companies when they need to update and expand their training facilities. At Johnston Community College, for example, classroom laboratories used for BioWork training are actually named after the county's large-scale bioprocessing firms, NovoNordisk, Hospira, and Talecris. These labs not only contain equipment donated by these companies but are also located in a satellite training facility built to serve the county's PBM industry on land deeded to the college by these same companies. These companies also contribute financially to a college training fund that helps defray the operating costs of the satellite facility. The training center not only offers open-enrollment BioWork courses for prospective PBM job seekers but also trains incumbent PBM workers during the regularly scheduled maintenance shutdowns.

At Wilson Tech Community College, the interdependency between the college and local PBM employers is reflected in the curriculum itself. Pharmaceutical firms in Wilson Tech's service area, including Leiner Health Products, Eon Labs, and Purdue Pharmaceuticals, rely on chemical rather than biological production processes. In response, Wilson Tech modified BioWork by giving students an opportunity to develop skills in chemical mixing, solid dose tableting, and coating rather than cell growth and fermentation (Lowe, 2007). This modified version of BioWork more closely reflects the specific skills needs of PBM employers in the Wilson area.

By embedding themselves in local employer networks and customizing training provisions to meet the specific needs of these firms, intermediary colleges are positioning themselves as crucial institutional supports for the PBM industry, which enables them to influence local hiring practices at some of these firms. Wilson Tech Community College provides an especially important example of this. In recognition of Wilson Tech's modification of the BioWork curriculum, pharmaceutical manufacturers in the region have agreed to guarantee job interviews for Wilson Tech BioWork graduates. This arrangement gives Wilson Tech students a leg up in the application process and also allows program administrators to request feedback from companies when Wilson applicants are not offered a job (Lowe, 2007). Other intermediaries have also been able to build on their close relationships with local employers to promote their BioWork graduates. Vance-Granville, for example, provides Novozymes with a list of top-performing students from each BioWork class. Students on the list are sent a company job application, which human resource managers keep on file for job openings. As with the case of Wilson College, this list service essentially functions as a de facto "first-source" referral arrangement, giving students from a referring agency an early lead in the job search. Although Wilson and Vance-Granville have more

developed arrangements of this type, Johnston and Wake Tech also use their strong relationships with local employers to extend their labor market influence. Instructors at both colleges have acted as references for short-listed candidates from their respective programs.

These strong relationships with employers ultimately create opportunities for structured exchanges between BioWork participants and company representatives. Intermediary colleges, for example, organize tours at large-scale PBM facilities in their service areas to allow BioWork students to observe the specific work environments they are preparing to enter. Related to this, they invite human resource personnel and manufacturing supervisors from these facilities into BioWork classrooms to discuss employment-related issues and concerns. As an example, Johnston Community College initiated a speaker series involving representatives from different companies in its service area. BioWork students from the college were encouraged to attend these sessions and network with the company representatives.

Given that four of the seven colleges in our survey can be categorized as workforce intermediaries, what happens at the remaining three? One important difference between the two groups pertains to the nature and intensity of their relationships with local PBM employers and whether these relationships are leveraged to enhance employment opportunities for BioWork participants. At the time of our survey, each of the three nonintermediary colleges had at most one large-scale PBM facility in its service area, whereas the intermediary colleges typically had several large-sized establishments to connect with—Vance-Granville, an intermediary, was the one exception. This effectively means that the ability of each of the three nonintermediary colleges to develop and sustain intermediation strategies depends on the engagement desires and growth strategies of a single prominent employer. In the case of Pitt Community College, for example, the county's large-scale PBM employer had gone through several ownership changes and subsequent rounds of downsizing in the past decade. This has made it difficult for the college to rely on this company to support and maintain intermediation strategies that could benefit the college's BioWork students. Similarly, Durham County had no large-scale PBM employers at the time of our survey, though this changed in 2007, when Merck announced that it would open a sizeable vaccine manufacturing facility in the county. In contrast, Central Carolina maintains a close working relationship with Wyeth, its county's largest PBM employer. Still, the benefits of this relationship do not necessarily result in intermediation support for the college's open-enrollment BioWork students. This is because Wyeth, with earlier help from the college, had already established a Wyeth-specific version of BioWork for newly hired employees. This limits the influence of the college on Wyeth's hiring decisions as they relate to participants of the open-enrollment version of BioWork.

In addition to these differences in college–employer relations, intermediaries and nonintermediaries also differ in how they structure job placement support. Job placement assistance by nonintermediaries is typically offered through general-purpose career counseling offices or One-Stop Centers, as devised under the Federal Workforce Investment Act. In contrast to that offered at intermediary colleges, this assistance is not industry focused. That said, instructors at some nonintermediaries do try to supplement general placement support with information about specific job opportunities in the PBM industry. This typically comes in the form of a group e-mail. Still, in contrast to intermediary colleges, this placement support tends to be less formal and less structured.

Despite these limits regarding intermediation, these three colleges can still be characterized as innovators. Central Carolina, for example, through its close working relationship with Wyeth, has demonstrated its ability to develop high-quality customized training, thus making it an attractive institutional anchor for other firms that are interested in locating in its service area. Pitt Community College has adopted innovative strategies for encouraging its BioWork students to use the course as a springboard for its life science curriculum and associate's degree programs. As a result, the college is helping increase educational levels and improve career development opportunities in the life sciences. Similarly, at Durham Tech, BioWork administrators and instructors have established close working relationships with third party staffing agencies that service multiple life science–related employers in the region—they even invite representatives from the staffing agencies to meet with BioWork students to review resumes and interviewing techniques. Efforts to further institutionalize relationships with staffing agencies are currently under way and could represent a future variety of intermediation support.

In conclusion, we find that relationships with local PBM employers and job placement provisions involving the four colleges that display strong intermediary traits are more robust and have deeper institutional support. They are also designed to benefit participants in open-enrollment versions of BioWork and thus have a much wider labor market reach. Related to this, intermediary colleges actively develop, maintain, and deepen relationships with multiple large-scale PBM employers to enhance and influence local employment opportunities.

The Effect of Intermediation on Employment Outcomes

Comparing colleges in terms of their intermediary roles ultimately allows us to consider whether or not institutional differences in program implementation affect PBM employment outcomes. In other words, do the stronger employer relationships that intermediary colleges develop and foster positively influence the PBM employment outcomes of participants in BioWork? And related to this, does enrollment at intermediary

colleges help BioWork job seekers overcome potential barriers to PBM employment?

To address these questions, we conducted two surveys of BioWork trainees in 2006 and 2007. Our first survey was administered to students enrolled in BioWork during the spring semester at seven community colleges: Central Carolina, Johnston, Vance-Granville, Wilson Tech, Durham Tech, Wake Tech, and Pitt. We selected this set of colleges based on the total BioWork enrollment rates for the semester. Five colleges with fewer than 8 enrollees were excluded from the survey, as the enrollment levels were considered too low to allow for sufficient examination of the institutional variables. Our first survey was completed by 255 of the 309 students enrolled in BioWork during the Spring 2006 semester. The difference between the total enrollment and our survey population size reflects student absences at the time the survey was administered or, in a small number of cases, refusal by a student to complete the in-class survey.

Between mid-October 2006 and February 2007, we conducted follow-up phone surveys with BioWork students from the Spring 2006 cohort. We attempted to contact all 203 students who indicated interest in participating in the follow-up survey. Eliminating students with inaccurate contact information reduced the population eligible for the second survey to 164. During the course of 4 months, we were able to complete surveys with 125 of these students, providing us with a sample size of 76% (based on the eligibility total of 164), or roughly 50% of the students who completed the first survey. Every eligible student was contacted at least three times by telephone and once by e-mail. We ruled out response bias in the second survey by performing chi-square distribution tests on relevant variables in the model. The tests indicated that there is no evidence that the respondents differed from the sample population in terms of community college attended, gender, educational attainment, or work experience.

Combined, our two surveys provided us with detailed demographic and employment information on each surveyed participant. We collected information on individual characteristics, such as the age, race, and gender of each participant, as well as detailed employment histories. As a part of these histories, we gathered information on all industries in which the participants had existing work experience, their occupational titles and job description in these industries, and whether or not they had recently lost a job as a result of corporate downsizing or industry restructuring. We also collected detailed information on educational backgrounds, including levels of formal schooling and previous vocational training experience.

Several of these measures, particularly those pertaining to educational attainment levels, employment status, and industry experience, represent potential barriers to employment. As in other industries, employers in PBM may be less inclined to hire someone with low levels of education or who is unemployed or underemployed. We also considered additional barriers related to past employment experience. For example,

Table 1. Select Descriptive Statistics, by Community College

College	N	% Woman	% Black	Average Age (Years)	% Associate	% SciMath	% Micro	% LayoffPost00	% PBW ^a
Central	24	83.3	66.7	43.2	4.2	25.0	0.0	25.0	16.7
Durham	10	50.0	90.0	38.9	30.0	90.0	40.0	60.0	20.0
Johnston	18	77.8	50.0	38.9	22.2	55.6	11.1	22.2	16.7
Pitt	9	66.7	55.6	42.0	33.3	55.6	0.0	33.3	55.6
VG	4	75.0	50.0	48.0	25.0	50.0	0.0	25.0	0.0
Wake	15	40.0	26.7	39.9	40.0	73.3	33.3	33.3	13.3
Wilson	4	50.0	75.0	39.6	0.0	50.0	0.0	50.0	0.0

Note: VG = Vance-Granville

a. Percentage that accessed the program through Pre-BioWork, a remedial education preparation course.

training experts in the PBM industry explicitly told us that they expected individuals with previous microelectronics employment to outperform those with only traditional manufacturing experience. This is due to immediate transferability of skills from microelectronics to PBM, especially knowledge of clean room manufacturing processes and related production standards. We therefore included detailed information on employment history to test the validity of this assumption and determine whether or not traditional manufacturing experience acts as a potential barrier to PBM employment. We felt that this was an especially important factor to include in our analysis given that BioWork was initially conceived as a job creation program for displaced workers from traditional manufacturing industries (Lowe, 2007). Descriptive statistics of the students are presented by college in Table 1.

In addition to this individual-level information, we also compiled county-level economic data to reflect the economic climate that applicants faced in their job search, such as county unemployment rate and recent employment growth. In considering local economic conditions, we also created a job access variable based on a PBM employment survey conducted by the North Carolina Biotechnology Center in 2007. This survey asked individual PBM employers in North Carolina to list all new and replacement hires made between January and December 2007. We recognize that this is not a perfect match with the time period of our follow-up survey (mid-October 2006 through February 2007), but we feel that it provides a reasonable measure of job access, especially given the possibility that the hires made in early 2007 were the result of job postings from late 2006, when some of our survey respondents were initially applying for jobs. Furthermore, economic conditions in the second half of 2006 and throughout 2007 were similar enough to use this as a proxy for industry employment growth in the earlier period.

Data collected through interviews with BioWork administrators and instructors at all seven community colleges were used to develop a variable to represent a college's intermediary status. We asked detailed questions about the job placement support provided by individual colleges and collected

information about the nature of their relationships with local PBM employers. We asked if the college had hired trainers from specific companies in its service area, received equipment donations or financial assistance from these same firms, or established local hiring agreements in the PBM sector. We also asked how frequently a BioWork instructor, administrator, or industry liaison from the college contacted or met with a representative from a PBM facility. In addition, we asked for descriptions of significant challenges in program implementation.

We used this information to develop a variable to measure the extent of the intermediary services provided at each of the community colleges. We specified workforce intermediation in two alternative ways. In the first (InterSum), we simply counted the number of specific intermediary services at each college on a 0 to 7 scale, based on the data provided by the BioWork administrators. For the second measure (InterWSum), based on our interpretation of the intermediation literature that some functions are more important than others, we assigned weights to the seven dimensions of intermediary services and then calculated the weighted sum for each community college. We used a continuous variable in our models because most colleges have adopted some elements of an intermediation strategy. That said, the colleges in this study tend to cluster at either ends of this continuum, thus allowing us to say something about the additional effect of stronger intermediary strategies. Each of the two alternative measures is included in our final set of models.

Our set of variables comprises four groups of explanatory factors: (a) individual demographic characteristics and human capital variables, (b) employment history and previous labor market experiences, (c) local economic and labor market conditions, and (d) the institutional characteristics of each community college's program that qualify as workforce intermediary traits. The theoretical justification for including each of these categories of variables has been described in considerable detail elsewhere (Goldstein, Lowe, & Donegan, 2010). Because each category corresponds to a different potential employment trigger or influence, combining the varied categories in our model allows us to compare across these different influences

Table 2. Variable Definitions

Variable Name	Measure	Source
Female	1 if female; 0 if male	Questionnaire to enrollees
Above40	1 if 40 years old or more; 0 otherwise	Questionnaire to enrollees
Black	1 if African American; 0 otherwise	Questionnaire to enrollees
Associate	1 if associate's degree or higher; 0 otherwise	Questionnaire to enrollees
SciMath	1 if previously took a college-level course in math, biology, or chemistry; 0 otherwise	Questionnaire to enrollees
PreBio	1 if enrolled in a pre-BioWork course just prior to BioWork; 0 otherwise	Questionnaire to enrollees
Traditional	1 if previous or longest held job was in tobacco, furniture, or textiles; 0 otherwise	Questionnaire to enrollees
Micro	1 if previously worked in microelectronics industry; 0 otherwise	Questionnaire to enrollees
Unemployed	1 if unemployed just prior to BioWork enrollment; 0 otherwise	Questionnaire to enrollees
LayoffPost00	1 if experienced a layoff post-2000; 0 otherwise	Questionnaire to enrollees
InterSum	Sum of the number of individual intermediary attributes; range 0-7; attributes include first source, internship, employer linkages, equipment, instructors, job placement, and human resources	Community college interview
InterVSum	Weighted sum of the number of individual intermediary attributes; weights are First source 1.5 Internship 1.5 Employer linkages 1.0 Equipment 1.0 Instructors 1.0 Job placement 0.5 Human resources 0.5	Community college interview
Accessibility	Index of accessibility to bioprocessing job openings in 2006. $I_j = \sum E_i \times d_{ij}^\alpha$, where E_i is the number of job openings in location i and d_{ij} is the airline distance between the location of the community college and job openings, up to maximum of 80 miles. $\alpha = -1.0$.	NC Biotechnology Center, Arcview
UrbanLive	1 if enrollee's residence is in an urban county; 0 otherwise	Questionnaire to enrollees, Census
Growth9403	Compound per annum employment growth rate, 1994-2003 of enrollee's county of residence	Questionnaire to enrollees, BEA
UR2006	Enrollee's county of residence unemployment rate, annual average 2006	Questionnaire to enrollees, BLS

as well as examine whether or not institutional factors add additional explanatory value to the job search experience, controlling for individual experience and local economic environment.

We originally considered a number of additional variables for which we had data from the community colleges or from our survey of BioWork participants. Our relatively small N and the need to preserve degrees of freedom made it necessary to select from among this larger set of measured variables. We excluded variables either because of multicollinearity issues or because there was no clear theoretical justification for their inclusion. We did, however, experiment with the creation of several interaction variables formed by multiplying an individual demographic or human capital characteristic with a location or local economic characteristic. Two of these (UrbanLive \times Layoff and Above40 \times Access) were retained in the final model to better take into account that we obtained counterintuitive, negative signs on the coefficients for the variables indicating living in an urban area and geographic proximity to jobs. A third interaction variable, InterWMicro, was created to test

whether individuals who disproportionately benefited from intermediary functions were those with prior labor market advantages, as measured by having previously worked in the microelectronics industry. By including this interaction variable, we are able to determine whether being at an intermediary college reduces or heightens this potential advantage.

The dependent variable in our models takes a binary form and measures whether or not a BioWork graduate received a job offer in the PBM industry. The data on the outcomes of the job search are self-reported. Because of our strong commitment to abide by the confidentiality agreements with the BioWork participants, we did not attempt to verify the outcomes with their employers. Given our interest in identifying the factors that determine whether or not a BioWork graduate received a job offer, we eliminated from the analysis those individuals who did not apply for any bioprocessing or biomanufacturing jobs by the time of the second survey. This gave us an effective $N = 84$ for our analysis. For a detailed description of each of the variables used in the model, see Table 2.

Robust standard errors were clustered by the community colleges in our models to allow for potential interdependence among the students at each community college. We decided not to use an additional dependent variable of whether the job offer was accepted because the offer might be declined for reasons unrelated to BioWork's potential success. We know from anecdotal evidence, for example, that some BioWork graduates decided to enroll in an associate's or 4-year degree program after completing BioWork, despite having a PBM job offer in hand. Although this is another potentially successful outcome of the program (i.e., encouraging BioWork participants to commit to additional higher education), we chose not to examine it here because it reflects the experience of only a few participants, thus making it difficult to determine whether it reflects cross-institutional differences.

We estimated three alternative logit models to answer the question of which factors most influence whether or not participants receive PBM job offers. Variables from all four of our theoretical blocks are significant in explaining PBM offers, as evidenced by the results in Table 3. Being laid off from a job within the past 5 years reduces a student's chances of receiving a PBM job offer. In one of the models, being female was also associated with a negative employment outcome. However, having previous science or math courses in college and having employment experience in the microelectronics industry each positively influence a student's likelihood of receiving a PBM offer. The statistical significance of the interaction variable UrbanLive \times Layoff (in Model C) indicates that having been laid off and *also* living in urban areas—rather than in rural areas—decreases successful outcomes in the job search. Thus, there seems to be a potential urban disadvantage effect that partially accounts for the unexpected negative sign on UrbanLive. That the interaction variable InterWMicro is not significant in Model C means that the beneficiaries of intermediation were not disproportionately those in the BioWork program who already had the most advantages. This, along with the finding that participants with higher levels of education (i.e., an associate's degree) are no better off than those with only a high school degree, suggests that intermediary colleges do level the playing field for those facing greater potential disadvantages (i.e., less education or lacking microelectronics work experience). Still, the finding that previous enrollment in a remedial pre-BioWork program reduces the likelihood of receiving a job offer does suggest the need for additional program review and possibly individualized support. We interpret this to mean that participants enrolling in pre-BioWork may face additional barriers that remedial training alone may not fully resolve.

In general, the demographic characteristics of the individuals and local labor market conditions are not as strong predictors of receiving a job offer as are human capital and previous employment factors. The key result, however, is that BioWork participation at an intermediary community college positively influences the likelihood of receiving a PBM offer, even after

Table 3. Logit Regression Models for Receiving an Offer in Pharmaceutical and Bioprocessing Manufacturing

Variable	Model A	Model B	Model C
Female	-0.430*	-0.356	-0.595
Above40	-0.449	-0.495	0.611
Black	0.138	0.183	-0.192
Associate	0.884	0.899	0.883
SciMath	0.769**	0.830**	0.793*
PreBio	-1.171**	-1.110*	-1.297*
Traditional	0.719	0.672	0.186
Micro	1.959***	2.023***	3.987
Unemployed	-0.525	-0.533	-0.543
LayoffPost00	-1.422***	-1.518***	-0.753
Accessibility	-0.013	-0.004	0.036
UrbanLive	-1.663**	-1.924***	-1.326
Growth9403	-0.091	-0.140	-0.150
UR2006	-0.442	-0.683	-0.586
InterSum	0.279***		
InterWSum		0.425***	0.405***
InterWMicro			-0.603
UrbanLive \times Layoff			-2.546**
Above40 \times Access			-0.096**
Constant	1.434	2.589	1.951
N	84	84	84
LL	-40.073	-39.552	-38.059
AIC	92.145	91.104	88.119
Pseudo-R ²	.216	.227	.259

Note: LL = log likelihood ratio; AIC = Akaike information criterion.
* $p < .10$. ** $p < .05$. *** $p < .01$.

controlling for the local labor market characteristics and an individual's ascribed characteristics, human capital, and accumulated skills gained through prior employment. The significance of the intermediary variable underscores the importance of the college's role in a student securing a job offer and suggests that the intermediary's role as a key link between students and potential employers is critical to future PBM labor market experience. Although individual colleges were able to customize their curriculum, we believe that the degree of customization was comparatively minor relative to the standardized curriculum. As curriculum customization was confined to one case, it does not conflate the direct effect of intermediation in interpreting our results. In short, integrated intermediary services that go beyond classroom instruction pay off for BioWork students during their job search.

Coordinating Workforce Intermediation

As our survey results indicate, students enrolled in BioWork at colleges that perform strong intermediary roles are more successful in securing jobs in the PBM sector than are their BioWork counterparts at colleges that do not. This suggests

that there may be additional employment gains from encouraging more BioWork colleges to adopt similar workforce intermediation strategies. Still, it is important to acknowledge limits to the current intermediation efforts and consider what these might imply for program diffusion. Although strategies designed to further embed individual colleges within localized employer networks are certainly important, we believe that there may be additional gains from cross-college coordination.

The need for intercollege coordination primarily stems from the geographic limits of college-level workforce intermediation. Whereas the employer relations on which college-level workforce intermediation strategies are built are mostly confined to the narrow jurisdictional boundaries of an individual college, the actual labor market area in which BioWork participants search for jobs is considerably wider. Our survey of students completing the BioWork program in 2006 confirms the geographic spread of the PBM job search. We asked job seekers at all colleges to list the counties in which they applied for jobs in the PBM sector and related industries that use similar manufacturing processes. Table 4 lists the counties mentioned by at least one job seeker at each surveyed college. Table 5 captures the intensity of the job search in specific counties, featuring only those counties that were mentioned most often. In addition to documenting which county was mentioned most often, we also note the county mentioned second most often by job seekers. This allows us to observe both primary and secondary search locations. For both tables, we only include counties where PBM facilities are located. By including these various frequency categories, we are able to estimate not only the relative importance of particular counties during the job search process but also the broader regional labor market boundaries.

Several observations are worth noting. First, as illustrated in Table 4, job seekers at all colleges list the county served by their college as a location for their job search. Still, we also see evidence of an extended search boundary. In fact, at least two counties outside each college's jurisdictional area were mentioned as part of the extended search location area. This brings us to a second important observation, which is the frequency with which Wake County is mentioned most often or second most often as a search county by job seekers at all the surveyed colleges. As Table 5 indicates, Wake County appears in at least one search category for six colleges, including the college serving that county, Wake Technical Community College. The relative importance of Wake County is understandable when we consider its large share of PBM establishments and the relative PBM job growth in recent years: In 2007, Wake County had the largest number of PBM jobs created among all the counties in North Carolina. After Wake, the next most important outside county mentioned is Johnston, which is tied with Wake County as the most frequently mentioned by job seekers at Vance-Granville Community College. In addition, Durham County was the second most frequently mentioned county by job seekers at Wake Technical Community College.

Table 4. Job Application Submissions by County and College Location

BioWork College Where Enrolled	Counties Where Applied for Jobs
Central Carolina CC	Chatham ^a Durham Lee ^a Wake
Durham Tech CC	Durham ^a Lee Wake
Johnston CC	Durham Johnston ^a Wake Wilson
Pitt CC	Durham Lee Pitt ^a Wake Wilson
Vance-Granville CC	Durham Franklin ^a Johnston Lee Wake Wilson
Wake Tech CC	Durham Johnston Lee Wake ^a
Wilson Tech CC	Durham Johnston Wake Wilson ^a

Note: CC = Community College.

a. Counties served by college.

This reflects the growing presence of PBM facilities in these counties.

Why might a job search boundary extended beyond the service area of the individual college where a BioWork student receives training and job placement assistance matter for workforce intermediation? Although intermediary colleges certainly prepare job seekers for employment opportunities outside their immediate jurisdictions, they lose considerable labor market power because of weaker connections to companies outside their bounded service areas. This is not to say that these colleges have no interaction with outside companies. To give an illustration, Vance-Granville Community College was contacted in 2005 by the pharmaceutical giant GSK, based in Zebulon, which is a section of Wake County. The company requested that Vance-Granville host a 2-hour GSK-specific job recruitment event for students completing the college's BioWork program. Other schools have accommodated similar requests from nonlocal PBM employers. By organizing

Table 5. Frequency of Job Application Submissions by County and College Location

BioWork College Where Enrolled	Counties Served by College	County Most Mentioned	Second County Most Mentioned
Nonintermediary Central Carolina CC	Chatham Lee Harnett	Lee	Wake
Durham Tech CC Pitt CC	Durham Pitt	Durham Pitt	Wake Wake
Intermediary Johnston CC Vance-Granville CC	Johnston Franklin Granville Warren Vance	Johnston Wake ^a Johnston ^a	Wake NT
Wake Tech CC Wilson Tech CC	Wake Wilson	Wake NT	Durham NT

Note: CC = Community College; NT = no clear trend.

a. Tied for position.

recruitment events at multiple colleges, these companies are able to secure a sizeable applicant pool from which to select qualified new hires. Still, these are neither regularly scheduled nor frequent events but rather are used by companies at a specific juncture in their development, especially when they are scaling up manufacturing production and thus need large numbers of new employees. Furthermore, because of the clearly demarcated institutional boundaries of individual colleges, employer-centered arrangements such as this, involving outside facilities, are typically reactive rather than proactive. That is to say, intermediary colleges respond to an outside company's request rather than actively soliciting ongoing support for and feedback on vocational training and job placement activities and practices. As this suggests, interactions with nonlocal firms are sporadic and temporal rather than well nurtured and long lasting.

At first glance, one possible solution to the geographic limits of localized workforce intermediation might be the creation of a centralized intermediary agency and, thus, an institutional rescaling to the regional level. In its centralized form, a regional intermediary agency could solicit student resumes from multiple colleges and help match those students to relevant job openings at PBM facilities in the regional labor market. Still, from a workforce intermediation perspective, there are potential problems with a centralized approach. For starters, workforce intermediation strategies work well precisely because they are locally rooted and thus draw on local knowledge of the needs and characteristics of both job seekers and PBM employers in a college service area. This local knowledge is not simply transmitted through a written resume or job application but is based on ongoing, mediated exchanges with multiple employers and job seekers. Intermediary colleges, in intervening in and

guiding the job search and hiring process, help filter important information and transmit it to both parties and, thus, can reveal initially obscured local skills and talents and establish shared expectations about the work environment. This not only helps with initial job matching but also improves worker retention and job satisfaction. Centralizing job placement support essentially risks the loss of local knowledge and relational depth, which are central to successful workforce intermediation (Gilothe, 2004). Related to this, a centralized approach involves the added political challenge of crossing jurisdictional boundaries within a well-established state community college system. Individual colleges are likely to raise concerns that a centralized approach will undermine their ability to establish and deepen relationships with local businesses, thus foreclosing opportunities to identify and develop new kinds of customized training and job placement supports. This suggests the need for a more nuanced approach to intercollege coordination that allows individual schools to continue to build on established industry and student relationships while also assuring job seekers the benefits of extended job placement support.

Since the time we concluded our surveys of BioWork students in 2007, North Carolina's community college system has created an additional institutional layer that is helping to scale up workforce intermediation in ways that strike a balance between these two objectives. Central to this effort is a regional training center, the BioNetwork Capstone Center, which is financed through North Carolina's community college system. Seven community colleges from the Research Triangle metropolitan area are currently linked to the center, including five represented in our BioWork survey. Students that complete BioWork at these colleges are encouraged to attend short courses (i.e., 3-5 full days of instruction) at the Capstone Center—in

late 2008, more than 30% of short-course attendees were referred by one of the seven participating community colleges. Others came directly from industry or via employment assistance agencies. Although the center's driving goal is not necessarily coordinated workforce intermediation, it nonetheless represents an alternative to agency centralization for extending workforce intermediation across the regional labor market.

Two features of the Capstone Center model are important in this regard. First, it is not designed to compete with or replace colleges in terms of the relational connections they make within the PBM business community. In fact, through their activities, Capstone Center staff and administrators actually help forge and strengthen local college–business connections. They do so in several ways. When PBM companies initially inquire about customized training support offered at the Capstone Center, administrators redirect them to their respective community colleges, which then contract out incumbent worker training back to the center. The college point person is responsible for sitting down with center administrators and company representatives to finalize the details of the contract and establish a fee schedule. He or she also helps the company apply for state training subsidies. Through this exchange, companies become more familiar with the broad array of training supports offered through their local colleges, above and beyond the specialty training the companies are able to contract out.

By encouraging companies to work through their local colleges, the Capstone Center is helping diffuse workforce intermediation practices across the community college system. This is especially important in cases where colleges might initially lack established employer relations on which to build an effective intermediation strategy. Durham Tech is a case in point. As indicated above, Durham Tech has developed close relationships with third party staffing agencies that provide workers for PBM employers in the region. Initially, direct contact with local PBM businesses was not very common, and Durham Tech functioned as a nonintermediary college at the time of our survey. With assistance from the Capstone Center, Durham Tech has been able to establish stronger, direct relations with new and existing PBM facilities in its service area. As one recent example, the Capstone Center directed Durham newcomer Merck to work with Durham Tech after it expressed interest in the incumbent worker training support offered through the Capstone Center.

So how then does the Capstone Center move intermediation to the regional level? After all, by redirecting companies to their respective local colleges, the center could further localize or concentrate rather than extend the boundaries of intermediation. This brings us to a second, complementary set of practices. The Capstone Center is made up of individuals that have strong established connections to the state's PBM industry. The dean of the Capstone Center, Dr. Lin Wu, has extensive PBM industry experience, having worked at numerous pharmaceutical and biotechnology firms during his professional

career (Lowe, 2007). In turn, Dean Wu requires all instructors at the center to have previous PBM industry employment experience. Full-time instructors are often recent industry retirees, some with more than 20 years of work experience in the local industry. Many adjunct instructors at the center remain full-time employees of PBM companies and, with their employer's permission, take short leaves of absence to teach training modules each semester.

As at intermediary colleges, Capstone Center instructors and administrators draw on industry networks to keep track of job openings and help place their students in these jobs, including providing job references for their students when contacted by PBM employers in need of trained workers. They also use their industry knowledge to help students revise resumes and better prepare for interviews. Related to this, each class at the Capstone Center is team taught, meaning that students enrolled in a single short course gain exposure to multiple instructors, each of who builds on an individual industry network to facilitate job placement. When developing or revising a course, they also solicit industry input on all instructional materials, thus ensuring continuous demand for skills learned at the center.

In addition to this classroom-level activity, the Capstone Center uses its advisory boards to forge stronger connections between community college administrators and PBM businesses. With this goal in mind, the center recently combined its community college and industry advisory boards in an effort to better coordinate discussions about regional industry training needs. During these meetings, community college administrators gain direct access to industry representatives throughout the region, who share important insights about new production practices and, thus, new skill needs. This information allows colleges to keep track of broad industry trends that affect firms within and outside their service areas and thus helps in the development of college-level training supports, as well as inter-college training partnerships and course-credit sharing programs, that may have a broader regional appeal. At the same time, these meetings allow participating operations managers at PBM facilities to learn more about college services outside of their immediate area and, in the process, begin to extend the institutional networks they use for worker recruitment. By building on rather than duplicating local workforce intermediation efforts, the Capstone Center functions as part of a nested regional workforce development system for facilitating job creation in North Carolina's PBM industry. Efforts are currently underway by the state's Community College System to extend this model of regional training and resource centers to include other clusters of colleges throughout the state.

Lessons from North Carolina

The North Carolina case provides an empirical test of sectoral workforce intermediation. This article demonstrates the contribution of intermediary community colleges to improved job

access in North Carolina's pharmaceutical and bioprocessing industry. Students enrolled in BioWork at colleges gain insider information about company-level employment needs, learn about worker qualities and experiences most valued by the company, and benefit from steps taken by colleges to influence local hiring practices. This intermediation support translates into improved employment prospects for PBM job seekers.

Still, as our analysis also illustrates, additional steps can be taken to deepen and extend the benefits of intermediation in North Carolina. Within existing intermediary colleges, additional interventions may be needed to help especially vulnerable program participants overcome significant barriers to employment. Although intermediation does help level the playing field for those with traditional manufacturing work experience (i.e., the program's initial target group), intermediation support alone is not sufficient to address the additional challenges facing participants who enter BioWork through a remedial education feeder program. Additional research is needed to determine the nature of the specific challenges facing individuals in this group, but our results suggest that there may be opportunities for community colleges to replicate certain elements of successful nonprofit workforce intermediaries. For example, it may be useful for community colleges to consider partnering with specialized agencies that can provide targeted mentoring and case management support for this subset of disadvantaged job seekers.

Additionally, greater intercollege coordination may be necessary for ensuring that intermediation strategies continue to help diverse job seekers adjust to rapidly changing regional economic conditions. The 2008-2010 economic downturn and its uneven impact on regional labor markets in North Carolina only intensifies the need to analyze and address institutional opportunities and challenges to cross-college coordination. By addressing potential challenges, program administrators can help job seekers in struggling local economies identify and access more stable job opportunities in growth areas of the state.

The North Carolina case not only provides evidence that workforce intermediation can be implemented at the community college level but also illustrates how community college systems can support and complement localized intermediation efforts. Although still in their infancy, the regional coordination efforts emerging in North Carolina hold considerable promise for other community college systems that are now looking to position themselves as institutional leaders in workforce intermediation. By drawing out lessons and insights from the North Carolina case, we hope to aid these systems as they take steps to shape job creation and employment transition opportunities in their own labor market settings.

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Bios

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