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Abstract

College students select majors for a variety of reasons, including expected returns in the labor market. This paper demonstrates an empirical method linking a census of U.S. degrees and fields of study with measures of the knowledge content of jobs. The study combines individual wage and employment data from the Current Population Survey (CPS) with ratings on 27 knowledge content areas from the Occupational Information Network (O*NET), thus providing measures of the economy-wide knowledge content of jobs. Fields of study and corresponding BA degree data from the *Digest of Education Statistics* for 1976-77 through 2001-02 are linked to these 27 content areas. We find that the choice of college major is responsive to changes in the knowledge composition of jobs and, more problematically, the wage returns to types of knowledge. Women's degree responsiveness to knowledge content appears to be stronger than men's, but their response to wage returns is weak. [*JEL Classification*: J24; I21; J31]

Keywords: Demand for schooling; Human capital; Salary wage differentials; Rate of return

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1. **Introduction**

Approximately 1.4 million students obtain BA decrees at U.S. colleges and universities each year. An additional 600 thousand obtain post-graduate degrees.[1] Students' choices of major and fields of study have varied considerably over time. Much of the prior work by economists on college majors has attempted to identify the returns on alternative choices. Such work is typically based on micro data sets containing both an individual's current earnings and previous college major. A limitation of such data sets is that sample sizes of majors within detailed degree fields (if provided) are small. Such studies also contain no direct information on current degree choice among students. These limitations are unfortunate. There exist excellent U.S. data on total degrees awarded by degree type (BA, MA, and PhD), detailed field of study, and degrees by gender from all four-year institutions of higher education. These degree data go back more than 35 years. An obvious difficulty in using such data is that it is difficult to make a link between the areas of study chosen by students and the value of acquired knowledge in the labor market.

The purpose of this paper is to provide such a link, albeit an imperfect one. The link is formed by relating nationwide information on degree choices to data on the knowledge content, employment, and wages of jobs (occupations). The Occupational Information Network (O*NET) is a relatively new government database providing hundreds of job descriptors on highly detailed occupations. A subset of O*NET descriptors (27 are used in our analysis) include content areas for which knowledge is required on the job, everything from philosophy and religion to physics to economics, finance, and accounting. The O*NET information on the knowledge content of jobs can be matched to the approximately 500 detailed occupations in the Current Population Survey (CPS), household surveys with large sample sizes stretching back into the 1970s (and earlier). Merged CPS-O*NET files thus provide information on the knowledge requirements by field in the U.S. labor market across a long time period, with changes being determined by changes in occupational employment and wages over time. At the same time specific college majors or fields of study can be linked to the 27 O*NET knowledge descriptors. The question then arises: Do degrees by field of knowledge increase as the corresponding knowledge content area is more widely utilized and more highly rewarded in the labor market?

For a variety of reasons, our method linking a near-census of U.S. post-secondary degrees (majors) to labor market employment opportunities and returns is far from ideal. We will argue, however, that this novel approach provides insight into the degree choice process and makes possible a direct link between the knowledge content of jobs and student choices of college major.

2. **Previous literature**

There exists a sizable literature on the choice of college major. Emphasis has been on the determinants of degree choice and the relationship between student majors and expected lifetime earnings (utility).[2] The choice of degree depends not only on market differentials across fields, but on differences in individuals' expected work lives and career plans, individual preferences, and relative abilities (i.e., sorting). Several articles in this literature have focused on sex differences in college major and how these have changed over time.[3] Some studies have focused on how enrollments, particularly at community colleges, vary with the business cycle.[4] A largely distinct literature examines the effect of tuition and financial aid on college attendance and choice.[5]

Much of the literature on choice of major utilizes individual data, with multinomial logit used to estimate choices among a limited number of broad fields of study. Such studies are valuable, but have inherent shortcomings. Because of estimation difficulties and sample size limitations, these studies only consider a small number of very broad fields of study. Even then, the sample sizes within each field are not large and the surveys are for selective (and sometimes dated) years based on the particular data source.

Our analysis follows the spirit of the previous literature in that it links choice of college majors to their expected relative benefits (net of costs). We are unaware of previous studies, however, that explicitly link the choice of college major to changes in the *knowledge content* of jobs.[6] Besides being an interesting topic in its own right, our approach allows us to examine a large number of majors and nearly all U.S. degrees over a lengthy time period.

3. Integrating data on degrees and the knowledge content of jobs

The analysis in this paper integrates three distinct data sources, one providing information on national degree data by year and field of study, a second consisting of large household surveys of individual workers and wages over time, and a third providing job descriptors on detailed occupations, including required knowledge content.

Degree data are from the *Digest of Education Statistics*, published annually by the National Center for Education Statistics (NCES). Among other things, the *Digest* provides data on the number of Bachelor's, Master's and Doctorate degrees awarded in each academic year (AY), collected from the Integrated Postsecondary Education Data System (IPEDS) survey since 1986 and prior to that by the Higher Education General Information Survey (HEGIS). The *Digest* is effectively a Census of accredited U.S. higher education institutions (for details, see USDOE, 2004). Figure 1a shows the aggregate number of BAs degrees conferred in the U.S. across all fields, by sex, for each academic year from 1972-73 through 2001-02 (shown as 1973-2002).[7] Although the analysis described in this paper is primarily for BA degrees, the *Digest* also provides degree data for MAs and PhDs, as shown in figures 1b and 1c. As widely recognized, college-going has increased sharply over this period among women, but not men.

[Figure 1a-1c here]

Information on detailed degree is provided separately by gender, allowing us to compare how degree choices by women and men differ with respect to changes in the knowledge content of jobs.[8] Degrees are tabulated according to major and concentration based on highly disaggregated degree classification categories, revised roughly every 10 years. Common sets of classification categories have been used during AY 1971-02 through 1981-82, 1982-83 through 1990-91, and 1991-92 through 2001-02 (new codes began in 2002-3, but degree data for these years were not yet released when our analysis was conducted). A special project by the NCES reviewed degrees from previous years assigned under older coding systems and reassigned them to a common set of fields based on the 1991-92/2001-02 classification codes. This provides a high degree of time consistency in the degree data (USDOE, 1997).

We aggregate degrees into 27 knowledge categories measured in O*NET (described subsequently), a database with ratings by detailed occupation on hundreds of job descriptors.[9] Table 1 provides the degree types matched to each O*NET knowledge category. Approximately 90% of all bachelor's degrees are included in these 27 knowledge categories, 90.7% in 1976-77, the first year used in subsequent regression analysis, and 88.9% in 2001-02. In many cases, matching of degrees to knowledge areas was straightforward, often involving a single (broad) degree classification, for example, O*NET knowledge area "Chemistry" was matched to IPEDS degree area "Chemistry, total" and knowledge area "Psychology" was matched to degree area "Psychology, total." Others were more complex and involved judgment on our part. For example, O*NET knowledge category "Economics, Finance, and Accounting" was matched with degrees in seven areas: "Economics," "Accounting," "Business/managerial economics," "Finance, general and banking and financial support services," "Actuarial sciences," "Insurance and risk management," and "Investments and securities and financial planning." We matched the knowledge category "Law, Government and Jurisprudence," to seven degree categories: "Political science and government, general," "Law and legal studies," "Public administration," "Community organization, resources and services," "Public policy analysis, "Public affairs, other," and "International relations and affairs," (apart from the first, all have small numbers of BA degrees).

[Table 1 here]

The Occupational Information Network (O*NET) is a comprehensive database system for collecting, organizing, and describing data on job characteristics and worker attributes.[10] O*NET is sponsored by the U.S. Department of Labor's Employment and Training Administration and is intended to replace the Dictionary of Occupational Titles (DOT). Data in this paper are from O*NET 98, Version 1.0, containing 484 variables for 1,122 occupations. The O*NET database was created by job analysts, based primarily on detailed job analyses, many conducted as part of the DOT. O*NET 98 provides a cross-walk mapping 1,122 O*NET codes to the approximately 500 Census occupational codes used in the Current Population Survey (CPS) through 2002. The cross-walk is generally clear-cut, with many O*NET and Census occupations mapping one-to-one. Where more than one O*NET occupation is assigned to a Census occupation, mean values of the O*NET variables are calculated. In a small number of cases where no O*NET occupation maps directly to the Census, close occupational matches were readily identified.[11] Since the initial release of O*NET 98, ratings have been updated for groups of occupations on a rolling basis, with plans to continue updating in the future.

The CPS sample of individuals is drawn from the May 1973-78 CPS earnings files, which include all rotation groups in May only, and the monthly January-December CPS Outgoing Rotation Group (ORG) earnings files for 1979-2002, which include the quarter sample of the full CPS who are administered the earnings supplement. The sample includes all employed wage and salary workers with at least a BA degree, ages 20 and over (a few workers for whom valid hourly earnings measures cannot be calculated are deleted). The CPS sample size of college graduates for 1973-2002 is 1,004,591.

Using the combined CPS-O*NET data set, we calculate the importance and return to the 27 O*NET job knowledge content areas, variables designated as *C* for content and *R* for return. *C* is constructed as follows. Each O*NET job knowledge variable, coded as continuous values between 0 and 7 for low to high importance, is matched to each of the approximately 500 detailed occupational categories in the CPS. These values are fixed over the years of our sample. Thus, each worker in the CPS is assigned a value for each of the 27 knowledge content variables based on the O*NET ratings for a worker's detailed occupation. For example, a registered nurse in the CPS will be assigned a relatively low O*NET rating for required knowledge of law, government and jurisprudence and high ratings for medicine and dentistry and for biology. A police officer in the CPS will receive a high O*NET rating for required knowledge of law, government and jurisprudence, but relatively low ratings for required knowledge in sales and marketing.

With every CPS worker having a rating for all the 27 knowledge content areas, we can then calculate C_{kt}, the importance of each knowledge area *k* in the labor market during year *t*. Specifically, for each O*NET knowledge content area *k*, C_{kt} is calculated as the weighted mean value by year *t* using the CPS sample of employed wage and salaried workers, ages 20 and above with at least a BA degree. The weights are the inverse of the sampling probability for each worker being included in the CPS (employment weights for each individual are provided by the Census). Job knowledge content C_{kt}, is thus calculated for 27 content areas *k* over 26 years *t*, for a total 702 values. Each value of C_{kt} measures the "importance" of knowledge content area *k* in the labor market during year *t*, with the variation in *C* across years due to occupational employment shifts.

We next construct measures of R_{kt}, the "returns" to the job knowledge content for each of the 27 *k* content areas by year *t*. R_{kt} variables are calculated in two alternative ways. Our preferred approach is as follows. Using the CPS data on employed college graduates, log wage equations are estimated separately by year for each of the 27 knowledge content variables. For example we regress individual (log) wages in 2002 on required importance of knowledge in "Economics, Finance, and Accounting," whose variation across individuals is based on variation in the O*NET value across workers' detailed occupations. Likewise, we regress 2002 individual wages on the other 25 O*NET content area variables, and run identical sets of wage regressions for all the earlier years. We thus compile *k*-by-*t* ($27\ x{\cdot}26$) values of R_{kt} from 702 separate wage regressions, where each individual R_{kt} is the regression coefficient on knowledge content *k* in year *t*.. These coefficients are then used as measures of the labor market "returns" to investment in alternative fields of knowledge.

An alternative method of calculating the returns to job knowledge content is to estimate a single log wage equation by year (rather than 27 regressions each year), where each wage regression includes all 27 knowledge content variables.[12] The coefficient on each O*NET job knowledge content variable is then used as an estimate of the *partial* or relative labor market returns to the various fields of knowledge. In principle, this approach has the advantage of isolating the separate labor market returns of each field of study, holding constant knowledge in other fields, precisely the information that a wealth-maximizing student would use to choose a major. We have two reservations about this approach. First, students have highly imperfect information and beliefs about the knowledge requirements of jobs and returns to fields of study. The information on which they base their decisions may well be closer to the returns measured using the first rather than the second estimation approach. Students may be more likely to observe the separate *simple* correlations between occupational wages and required levels of knowledge for each content area (method 1) than they are to discern the *partial* correlations between wages and levels of knowledge for all 27 job content areas (method 2). If our conjecture is correct, then method 1 may be preferred to method 2. Second, because subsets of the 27 knowledge content variables can be highly collinear across occupations, the ability to estimate precise partial returns (prices) on job knowledge content using method 2 is questionable. Imprecise estimates of the partial returns are likely to cause attenuation in the estimated responses of degrees to R_{kt}. Although our preference is method 1, we show results using both methods to calculate R_{kt}.

In addition to compiling measures of C_{kt} and R_{kt} based on all college graduates in the CPS, we compile these measures based separately on male and female college graduates in the CPS (there are no gender-specific occupation descriptors in O*NET). It is an open question whether young men and women base their decisions on how workers fare in general, or if they focus on those of the same sex. Given that the period under study was one in which both occupational segregation by sex and the gender wage gap declined, our expectation is that young women would focus more on the overall labor market than on the experience of older female cohorts.

Before presenting descriptive evidence on fields of study (college majors) and the knowledge content of jobs, it is important to note that common O*NET values for each occupation are matched to workers, regardless of year. Thus, changes over time in the knowledge content area means (C_{kt}) derive entirely from annual changes in detailed occupational employment. Changes over time in measured returns (R_{kt}) – the wage equation coefficients on the job knowledge content variables – may reflect not only changes due to a changing price (wage), but also *unmeasured* changes in quantity (knowledge content). In short, an important limitation of our data is the inability to measure changes over time in knowledge content within narrow occupations. As O*NET values are revised over time, studies (far in the future) may be able to account for within-occupation changes in knowledge content.

4. **Descriptive evidence on job knowledge content and BA degrees by field**

Much of the underlying data used in our analysis is shown in figure 2. A separate panel is provided for each of the 27 knowledge content areas. On the left-side vertical scale is the *share* of total Bachelor's degrees for the college majors in each knowledge area, shown separately for academic years 1972-73 through 2001-02, shown on the horizontal axis using the end year number. The right-side vertical axis shows values for C_{kt}, the employment-weighted mean O*NET value for knowledge area k, compiled by year t across college-educated workers in the CPS. Both the underlying degree data and the job content measures are used in the subsequent regression analysis. The right-side and left-side scales in figure 2 vary across knowledge fields owing to large differences across fields in the magnitudes of the O*NET means and in shares of majors.

[Figure 2 here]

The six fields with the largest number of Bachelor's degrees in 2001-02 are Administration and Management; Education and Training; Economics, Finance and Accounting; Psychology; Engineering and Technology, and Computers and Electronics. Careful comparison of the relationship between job knowledge requirements and degree choice must await subsequent regression analysis, which relates log changes in degrees (rather than degree shares, as shown in figure 2) to prior changes in job content (importance and return). What is evident from the figures are substantial differences across fields in the patterns of change in the knowledge content of jobs and even more substantial variation in patterns of degree choice. The O*NET knowledge values typically exhibit either steady increase (often preceded by several years of flat values) or decrease, in some cases substantial and in other cases quite trivial. We see little evidence of changing directions in C_k, with clear-cut increases followed by clear-cut decreases, or vice-versa.[13]

Choices in college major vary considerably over time. For example, engineering degrees rose sharply through the mid-1980s, but have fallen since that time, consistent with declines in the engineering and technology O*NET knowledge variable seen since the early 1980s. As widely recognized, business administration, management, economics, finance, and accounting degree shares fell from roughly the mid-1980s through mid-1990s, despite steadily rising values on the corresponding O*NET knowledge variables.[14] Sociology and anthropology degrees fell sharply during the 1970s through the mid-1980s (following earlier flat values in the O*NET variable), but rebounded in part during the late 1980s and 1990s, consistent with the rising importance of the sociology and anthropology knowledge in the labor market since the early 1980s. By contrast, education degree shares fell throughout much of the period, despite the rising importance of education skills in the broader labor market.

5. **Method of analysis**

The economic approach to college and degree choice starts from the proposition that individuals choose the path expected to maximize lifetime utility, given individuals' comparative advantage in abilities, preferences (i.e., subjective discount rate; lifetime labor supply with respect to hours in market work, home production, and leisure; the valuation of job amenities and disamenities; risk aversion; etc.), and constraints (cost of investment funds and the wage/employment offer set for alternative paths).

In practice, researchers attempting to implement a specific model make numerous simplifications, including the assumption that expected income is the maximand.[15] Many if not most career path determinants cannot be readily measured. The economics literature has focused on wage differences across occupations independent of the field of study, or across individuals with different college majors. The latter has proven difficult owing to data limitations and fundamental identification issues regarding quantity and price; that is, distinguishing the effects of wages on career choices versus career choices on wages.

In our data set, we observe the number of students receiving BA degrees, by knowledge content area *k* during academic year *t*, and the "importance" and "valuation" of each knowledge content area in the labor market at the time degree decisions are made. As explained in the data section, the "importance" of each knowledge content area in the labor market during time *t* is compiled across all wage and salary workers with at least a BA degree based on the importance rating given each of the 27 knowledge area requirements for their detailed occupations (i.e., C_{kt} are employment weighted knowledge indices). R_{kt}, the "valuation" of each of 27 job knowledge content fields *k* in each year *t*, is based (using method 1) on the year-specific log wage regression coefficients on the 27 knowledge content values, based on CPS samples of college graduates.

Approximate "identification" of the causal effects of job knowledge content on degree choice is approached in two ways. First, we focus on deviations from means in degrees, thus mitigating the need to specify and measure other important determinants of degree choice. This is effected by inclusion of field dummies in the degree choice regression. Second, we rely on lags to insure that causation runs principally from the labor market environment to degree choice and not the other way around. Student decisions on college major are made well before degrees are completed, based (in part) on the market importance and valuation of job knowledge content at the time of the decision.[16]

The models estimated and reported in the paper specify degree outcomes by field and time period as a function of the knowledge content of jobs at the time when decisions about field of study are made. Specifically, we estimate:

$$\ln D_{kt} = \alpha + \theta \ln C_{k,\,t-4} + \Psi R_{k,\,t-4} + \Sigma_k\, \Omega_k Fields_k + \Sigma_t\, \tau_t Year_t + \mu_{kt}\,, \qquad (1)$$

where $\ln D_{kt}$ is the natural log of the number of BA degrees awarded in knowledge area or field *k* in year *t*, $C_{k,t-4}$ is the importance of job knowledge content area *k* in year *t-4*, and $R_{k,t-4}$ is the log wage "return" or valuation on knowledge content *k* in year *t-4*. *C* and *R* are calculated as explained in Section III. The estimated parameters θ and Ψ attach to *lnC* and *R*.

Included in (1) are an intercept term α (reference field) and dummy variables for the remaining 26 degree fields or knowledge content areas, with Ω_k the log difference in degrees between each field and the omitted reference field. This effectively converts equation (1) into a change or deviations from mean model. The $Fields_k$ dummies will capture much of the omitted and largely non-measurable determinants of degree choice, allowing us to better isolate the partial effects of job market knowledge content on degree choice. In addition, a set of *Year* dummies is included to account for time variation in overall number of degrees. Field fixed effects and year dummies control for most of the variation in degrees across fields and time.

The choice of a four-year lag appears reasonable because it matches labor market information compiled from the calendar year in which students enroll as freshmen. Although the choice of major is finalized after that time, students' decision making begins early on as they, along with their families, fellow students, and advisors, gradually absorb information about the labor market.[17] In a subsequent section, we examine the sensitivity of results to that assumption.

Before presenting empirical results, it is worth highlighting the strengths and weaknesses of our approach. The strength and novelty of the approach is that measures of the knowledge content of jobs over a long time period are compiled and linked to a near-census of undergraduate degree programs within U.S. colleges and universities. Despite the appeal of such an approach, it has limitations. As previously noted, changes over time in our measure of the knowledge content of jobs are employment driven and do not capture changes within detailed occupations. Second, the link between college degrees and job content is far from perfect. Students obtain knowledge not only in their primary major, but across a wide number of classes. There may be changes in student training in, say, math or communications without corresponding changes in math and communications majors. Moreover, knowledge regarding math is obtained not only in math classes, knowledge about communications is obtained not only in communications classes, and so forth. Despite these limitations, our expectation is that if the labor market importance and return to the knowledge content of jobs are important determinants of degree choice, these links should be revealed by our empirical approach.

6. The effect of job knowledge content and returns on choice of major: Regression results

We first examine estimates from equation (1), where the log of bachelors degrees by field and year are regressed on the importance of the job knowledge content area (*C*), based on employment-weighted mean values of the O*NET importance of knowledge measures, and the estimated log wage return (*R*) of O*NET job knowledge, measured by field area and year. *R* and *lnC* are lagged four years to correspond approximately to the information available to students when decisions about majors are made. We focus discussion on estimates of the parameters θ and Ψ, the former the coefficient on *lnC* and the latter on *R*. Also included are degree and year dummies. The number of observations is 702, corresponding to 27 knowledge fields and 26 time periods. Clustered standard errors are calculated to account for error correlation within fields across time and across fields at each point in time.

Table 2 presents regression results for BA degree recipients. Panels A and B of table 2 show results using the two alternative measures (discussed in the data section) of the field-specific returns or valuation of job knowledge content, R_{kt}. Panel A shows the results obtained using our preferred measure of R_{kt}, estimated from 27 separate log wage equations each year to measure "returns" to each job knowledge content field across the labor market. Panel B shows the results using a measure of R_{kt}, in which the coefficients (relative returns) for all 27 fields are obtained from a single log wage equation each year.

[Table 2 here]

We first discuss results shown in panel A. As expected, most of the total variation in choice of major is accounted for by knowledge content area (field) dummies and year dummies, with R^2s being about 0.97. Estimates for men and women combined are shown in the first three columns, with regressors *lnC* and *R* included jointly and separately. Estimates of θ and Ψ are slightly larger when both variables are included than when each is included separately. In column 1, we obtain an estimate of θ = 1.9 and of Ψ = 3.8. The θ estimate implies that a .10 log point (or 10.5%) increase in a knowledge area or field's job content value produces a .19 log point (20.6%) increase in majors in that field.[18] A Ψ = 3.8 implies that each .01 change in the return to a field knowledge area is associated with a .038 log point change in BA degrees. The interquartile range of *R* is .110; implying a very large .418 log point (51.9%) higher level of BA degrees associated with returns at the 75th versus 25th percentile. As discussed below, estimates of Ψ shown in panel B, based on the alternative measure of *R*, are much smaller.

To obtain gender-specific values of θ and Ψ, we estimated models based both on use of common (i.e., combined male and female) values of *lnC* and *R* and values of *lnC* and *R* compiled separately for men and women. As evident in panel A of table 2 (columns 4 and 5), this distinction makes little difference for men, estimates of θ_m (where subscripts *m* and *f* designate gender) being moderately higher and those of Ψ_m lower when substituting male-specific values. In contrast, estimates of θ_f are substantially lower (less than half) using female rather than common values of *lnC* (estimates of Ψ_f are similar). It is clear that in making degree decisions, women are responding to market-wide rather than gender-specific information on labor market knowledge content. This suggests that women graduates during these years expected to pursue career paths more similar to men than to older cohorts of women. Based on the common values of *lnC* and *R*, parameter estimates for men are θ_m = 1.3 and Ψ_m = 4.1, while those for women are θ_f = 2.5 and Ψ_f = 2.1. Women's choice of major appears to be more sensitive than men's to changes in job knowledge content (*lnC*). Men's degree choices are considerably more sensitive than are women's to changes in the wage returns to knowledge content (*R*).[19]

Panel B results are based on identical model estimates, except that an alternative measure of *R* (discussed in the data section) is included as a regressor. In principle, the panel B measures of relative *R* by field are preferable if they are precisely estimated and if the information on which students base their choices is better approximated by the returns used in panel B than in panel A. As discussed previously, we are skeptical that either of these conditions holds. What is important to note is that estimates of Ψ shown in panel B are substantially lower than in panel A, while estimates of θ are somewhat lower in the male and the joint degree regressions, but not in the female regressions. Indeed, none of the estimates of Ψ shown in panel B is statistically significant, although most remain economically significant. In short, panel B results continue to support the importance of job knowledge content *C* in influencing student choice of college majors. Estimates linking degree choice to the valuation of knowledge content are fragile, however, being highly sensitive to measurement of *R.*

Finally, we note a large difference by gender in the values of the year dummies (not shown). As evident in figure 1a, BA degrees among women increased sharply during the 1972-73 to 2001-02 period, from about 404 thousand to 742 thousand. Men's degrees remained stagnant over this same period from 518 thousand in 1972-73 to 550 thousand in 2001-02. These patterns are evident in the year dummies, which show the log differentials by year, holding constant field means and the job knowledge content. The year coefficients for men show no sharp patterns, but do indicate a small decline throughout the late 1970s and 1980s, followed by a climb in the early 1990s, after which time there is little systematic change. These coefficients match the patterns seen in figure 1. For women, we see steady increases in the year dummy coefficients throughout the period, increases that *exceed* the growth in BA degrees among women. Although changes in job knowledge content and (possibly) returns affect women's choices of majors, our model does not account for the secular increase in women's B.A. degrees over this period.

7. **Probing BA degree choice results**

Our baseline results for BA degree choice have been presented above. This section briefly reviews additional empirical probes intended to explore the robustness of these results.

<u>*Including changes in job knowledge content*</u>. In addition to inclusion of *lnC* and *R*, we estimated equations that added variables measuring *changes* in these two variables, ΔlnC and ΔR. These were calculated over the four-year period (t-2)-(t-6), centered on year t-4. Both jointly and separately by gender, we find positive (and statistically significant) coefficients on

ΔlnC. The effects of ΔlnC reinforce those of *lnC*, with the coefficient θ increasing following inclusion ΔlnC. In short, students respond to changes in job knowledge content associated with both employment levels and employment changes. Inclusion of ΔR produces what is generally a negative coefficient, but one that is small in magnitude and generally insignificant.

Variation in lag structure. To investigate whether our findings are sensitive to variations in lag structure, we replaced $\ln C_{t-4}$ and R_{t-4} with lnC_{t-2} and R_{t-2}, allowing for a quicker updating of the importance and returns to job knowledge content. For example, substituting a two-year lag in our *lnC* and *R* variables, while holding constant the sample period, increases our panel A estimate of θ from 1.9 to 2.3 and decreases slightly our estimate of Ψ from 3.8 to 3.7. While the gender specific estimates remain statistically significant, we find larger increase in the magnitude of θ_m and θ_f and decreases in Ψ_m and Ψ_f. Taken at face value, these (minor) changes resulting from change in the lag structure suggest that students' choices of major are most responsive to nearly concurrent information on employment and job knowledge content, but less responsive to concurrent changes in the returns to job content.

Accounting for the error structure. Standard errors shown in Table 2 account for the correlation of error terms within clusters – specifically within degree fields across years. Use of the much smaller OLS standard errors (about a third of the size of those shown in the table) would greatly overstate the precision with which the model parameters are estimated.[20]

In Table 2, we separately examined coefficient estimates for women and men. A Breusch-Pagan test for independence of error terms between the male and female equations (columns 4 and 6) indicates that the errors terms in panel B are correlated.[21] In such cases, it is useful to re-estimate these equations within a seemingly unrelated regression (SUR) framework, which accounts for correlation of the error terms across equations, and test jointly whether the coefficients on *lnC* and *R* significantly differ between women and men. In panel A, the $\chi^2(1)$ test statistics of 126.5 and 30.6 confirm that the parameters θ and Ψ differ by gender, after accounting for the correlation of errors between the male and female equations. In panel B, we obtain test statistics of 213.0 and 0.3. We cannot reject equivalence of Ψ_m and Ψ_f (with point estimates of 0.81 and 0.63), each of which is small and statistically insignificant.

Weighted least squares. The results presented in Table 2 provide equal weights to all fields, treating field of knowledge *k* in a particular year as an equally important data observation. It can be argued that one should attach greater weight to larger or more important fields. In order to check the sensitivity of the results to an alternative weighting, we estimate weighted least squares (WLS) regressions, with the number of degrees by field and year as the weight. Our qualitative inferences are not affected by use of WLS, but there is some sensitivity in coefficient estimates. The estimates of θ, the coefficients on ln*C*, generally decrease, while estimates of Ψ, the coefficient on *R*, show modest changes in both directions. For example, estimates from a WLS version of the overall BA degree equation produces θ = 1.4 and Ψ = 4.0, as compared to OLS results of θ = 1.9 and Ψ = 3.8 seen in column (1) of panel A. Gender specific WLS estimates are $\theta_m = 0.9$ and $\Psi_m = 4.2$ for men and $\theta_f = 2.1$ and $\Psi_f = 1.6$ for women, which can be compared to the OLS results in columns (4) and (6) of panel A. Although qualitative conclusions are unchanged by use of WLS, it appears safe to say that degree choice in some of the larger fields of study display a weaker (proportional) relationship with knowledge content in the labor market than do fields of small and average size.

Variation in response across fields. To examine variation in response across fields, we estimate equations that include *lnC*, *R*, and a time trend for each of the 27 degrees fields. These estimates are presented in Table 3. We estimate this within a seemingly unrelated regressions (SUR) framework to jointly test for significance of parameters across equations. Coefficient estimates are identical to OLS. Given the small sample size for each degree field, estimates are imprecise and should be interpreted with caution. We find statistically significant and positive effects of *both* the "importance" and "returns" to job knowledge content (θ and Ψ) in chemistry, biology, psychology, sociology and anthropology, therapy and counseling, education, and foreign language degree fields. Among these degree fields, estimates of θ and Ψ vary considerably. Estimates of θ vary from 6.9 in sociology and anthropology to 1.8 in foreign language, while estimates of Ψ range from 13.2 in therapy and counseling to 4.2 in foreign languages.

[Table 3 here]

Among other fields, degrees in economics, finance, and accounting, sales and marketing, personnel and human resources, design, geography, fine arts, history and archeology, and philosophy fields appear to respond positively to employment-induced changes in job knowledge content in these fields (*lnC*), while degrees in engineering and technology, mathematics, physics, medicine and dentistry, English, and law, government, and jurisprudence are responsive to changes in the returns to the job knowledge content (*R*). Degree choices in computer and electronics and in public safety and security fields are not significantly related to either the employment or returns in their fields.[22] Surprisingly, degrees in administration and management, customer and personal service, and communication and media are negatively related to changes in employment, while degrees in food production are negatively related to returns.

Graduate degrees. Evidence in tables 2 and 3 pertain exclusively to BA degrees. As seen in table 1, the NCES presents degree data for MA and PhDs, making it possible to conduct a parallel analysis for the choice of graduate degrees. But there are drawbacks. First, choice of graduate degree is determined partly by choices made as an undergraduate, suggesting potentially long lags between degree data and the labor market environment. Second, measures of *C* and *R*, which measure the job knowledge content of occupations, cannot be estimated reliably for just MAs or PhDs, not only because CPS sample sizes of workers with graduate degrees are small, but because O*NET job descriptors for many occupations would not provide reliable ratings for those jobs occupied by workers with graduate degrees.

Despite the limitations, a brief description of results estimating graduate degree choices is informative (results are available on request). For the MA degree data, we use a method of analysis identical to that for BAs, including the same lag structure on the job content variables and the calculation of *C* and *R* over all college graduates. The four-year lag structure for MA degrees is reasonable given that degrees typically take two years and choices are formed while still in college or out of school. Results for the MA degree with respect to *lnC* are highly similar to those seen for BA degrees in panel A of table 2. The estimate of θ for MAs is 1.6, as compared to 1.9 for BA degrees. Men's estimates of θ_m are higher when using male-specific values (1.6 versus 1.0), whereas estimates of θ_f are lower using the female rather than common values (1.5 versus 2.5). In contrast to the BA estimates, we find no substantive or significant relationship between MA degree choice and the wage returns to field of study (the parameter Ψ), estimated jointly or separately by gender.[23] In short, MA students choose fields of knowledge based in part on employment patterns in the labor market, but display little sensitivity to differences in wage returns.

Applying this framework to fields chosen by PhD recipients asks a lot of the data. In addition to the problems cited above, PhDs in most fields are concentrated in academia or a limited number of fields, making the market wide measures of *C* and *R* of limited relevance. To the extent that academic jobs are driven by the BA enrollments and choices of fields, however, PhD degree choices may be influenced by *C*, the employment-weighted importance of the knowledge content areas throughout the labor market. Given the time required to complete a doctorate, the four-year lag structure used in the BA and MA analysis for *lnC* and *R* is too short. We instead assume a lag structure of six years, with degree data now running 24 years, from 1978-79 through 2001-02.

Estimates obtained for PhD degrees look much like those seen for MA degrees. Both men and women respond positively to employment-weighted job knowledge content, with estimates of θ positive and significant. If anything, women appear to be more responsive to changes in *lnC* than are men. As with the MA students, we see no positive response to *R*, with negative but insignificant coefficients for men and women. Choices of doctorate fields clearly move with labor market employment changes, but not with respect to wage changes, at least not wage changes in the overall market for college graduates. Use of WLS in the MA and PhD analyses cause coefficients on ln*C* and *R* to decrease in absolute value.

The purpose of this paper has been to develop a framework to link the majors chosen by *undergraduates* with knowledge content in the labor market. This framework is less helpful in understanding choices in fields among graduate degree recipients.

8. **Conclusion**

A large literature has examined multiple aspects of degree choice among college majors, most frequently linking the choice between broad categories of majors to subsequent earnings in the labor market. This paper provides a novel look at the topic of degree choice, linking choice of degree or knowledge area to changes in the knowledge content of jobs and its valuation in the labor market. Although the analysis has limitations, the approach appears promising. Analyzing degree choice among a near-census of BA recipients in the U.S., we have found a clear link between changes in degree choice among 27 knowledge areas over 26 years and changes in labor market job knowledge content due to employment shifts. The magnitude of these effects is reasonably large and as strong or stronger for women as for men. The choice of undergraduate major also appears to respond to changes in the wage returns to knowledge areas, although here the response is stronger for men than women and results are highly fragile, being particularly sensitive to the measurement of wage returns.

A shortcoming of our approach – one that we cannot remedy – is that the job content measures differ across detailed occupations, but do not vary over time within occupations. Hence, changes over time are driven by occupational employment shifts and changing relative wages across occupations, but not by changes in the knowledge content within occupations. Because O*NET is expected to be an on-going project with regular revisions of occupational ratings, at some point years into the future one may be able to use changes in O*NET ratings within occupations to account for the changing job content within occupations. At this time, we must settle for the rather modest conclusion that a link between degree choice and the knowledge content of jobs has been established. It is hoped that future studies can provide a deeper understanding of this link.

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Notes

[1] In the 2003-04 academic year (the most recent data available in June 2007), there were 1,399,542 bachelor's, 558,940 master's and 48,378 doctor's degrees (U.S. Department of Education, 2006, Table 252). Corresponding numbers in 1972-73 were 922,362, 263,371, and 34,777 (U.S. Department of Education, 2004, Table 255; U.S. Department of Education, 1997, Table 18).

[2] Studies include Fiorito and Dauffenbach (1982), Berger (1988), Rumberger and Thomas (1993), Montmarquette, Cannings, and Mahseredjian (2002), Black, Sanders, and Taylor (2003), Finnie and Frenette (2003), Arcidiacono (2004), and Boudarbat (forthcoming).

[3] An oft-cited study is Turner and Bowen (1999). Earlier papers include Polachek (1978), Blakemore and Low (1984), Daymont and Andrisani (1984), and Paglin and Rufolo (1990). For a recent paper, see Bourdarbat and Montmarquette (2007).

[4] For example, see Betts and McFarland (1995).

[5] The general finding in this literature is that financial aid has a large impact on what school is chosen (including a two- versus four-year institution), but a modest affect on overall college-attendance. For a recent paper, see Abraham and Clark (2006). Dynarski (2002) provides a nice discussion of the identification issue, along with evidence on the Georgia HOPE scholarships.

[6] The approach most similar to our own is a paper by Fiorito and Dauffenbach (1982) in which the authors link male baccalaureate degrees in engineering and the sciences to employment and wages in pertinent fields. They emphasize the importance of non-economic factors on degree choice. A related but rather different question is whether skills acquired in one's college major are used on the job (Robst, 2007).

[7] In subsequent regression analysis, the first year of degree data is for 1976-77, since choice of major is made prior to the receipt of degree, the latter being what is measured in the *Digest.*

[8] Racial and ethnic differences in access to labor market information and degree choice are likely to exist, but data on detailed degree by race/ethnicity are not provided by NCES.

[9] We did not use six O*NET knowledge categories for which no significant number of degree recipients could be matched. The excluded knowledge categories are: Clerical, Production and Processing, Building and Construction, Mechanical, Telecommunications, and Transportation.

[10] The O*NET Resource Center, at http://www.onetcenter.org/, provides comprehensive documentation and links to numerous O*NET resources.

[11] The CPS used 1990 Census occupational codes (COC) for 1992-2002. Matching O*NET to 1980 COC codes used in the 1983-91 CPS was straightforward given the similarity of 1980 and 1990 COCs. Mapping O*NET values to 1970 COC, used in the CPS during 1973- 83, required a probabilistic crosswalk between 1980 and 1970 COC. O*NET mean values show no unusual jumps between 1982 and 1983 or 1991 and 1992 attributable to COC code changes. Beginning in 2003, the CPS began use

of Standard Occupation Codes (SOC), which cannot be cleanly matched to COC codes. Likewise, O*NET has now switched to SOC codes, making a match between newer CPS and O*NET ratings possible. Apart from the coding changes, CPS data for these recent years are not needed since they influence degree outcomes not yet observed.

[12] We thank a referee for suggesting this approach.

[13] For knowledge descriptors whose overall change is minor over the 30-year period, small year-to-year changes appear large due to the vertical scaling.

[14] For an analysis of falling economics enrollments, see Lombardi, Ramrattan, and Szenberg (2004).

[15] Theoretical models of school choice or degree choice include Card's (2001) endogenous schooling model and Boudurat's (forthcoming) lifecycle model of field of study. These models assume that an individual chooses a field of study (or years of schooling) and a consumption path to maximize discounted lifetime utility, subject to an intertemporal budget constraint. Making simplifying assumptions about an individual's utility function and subjective discount rate, these models show that choosing a field of study (or years of schooling) that maximizes discounted lifetime utility is equivalent to the choice that maximizes discounted lifetime earnings.

[16] Although we cannot rule out rational expectations, students' ability to forecast the future of labor markets seems unlikely. A greater concern is that student knowledge of the labor market is rather limited and updated slowly.

[17] Betts (1996) provides evidence regarding undergraduates' knowledge of wages in the labor market. He concludes that they have limited information about differences in wages across occupations and that much of the information they do have is acquired in their senior year, *after* choosing a major. Comparing Dutch students' stated expectations with subsequent starting salaries, Webbink and Hartog (2004) provide a more positive assessment of student knowledge.

[18] Over the 24-year period and across all fields, there is little *average* change or trend in *lnC* despite considerable variation. Visual inspection of the individual fields in Figure 2 illustrates how values of *lnC* change by field.

[19] We also estimated male equations using female values of job knowledge and female equations using male measures. Women's degree choices with respect to men's values are roughly similar to those shown in column (6), whereas men's degree choices are largely unrelated to women's values.

[20] Accounting for the error correlation across degree fields within years produces standard errors highly similar to OLS.

[21] In panel A, the $\chi^2(1)$ test statistic for the Breusch-Pagan test for independence of error terms is 449.2 and the residual correlation coefficient between the male and female specification is 0.799. Equivalent values for panel B are 445.9 and 0.797.

[22] Demand for computing skills has increased within most occupations, yet the O*NET occupational ratings are fixed, *lnC* and *R* varying over time due to employment and wage changes.

[23] Results were insensitive to omission of the fields of education and training or administration and management, the two largest MA degree fields.

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Table 1: O*NET knowledge areas and degrees conferred by field, 2001-2002

	BA	MA	PhD
Administration and management	**136,557**	**86,646**	**772**
Business, general	27,281	10,273	177
Business administration and management, total	105,159	74,985	581
Quantitative methods and management science, total	4,117	1,388	14
Economics, finance, and accounting	**84,471**	**14,194**	**968**
Accounting	32,460	5,921	36
Business/managerial economics	3,493	199	41
Finance, general and banking and financial support services	26,231	5,142	61
Actuarial sciences	248	53	0
Insurance and risk management	547	168	4
Investments and securities and financial planning	565	381	0
Economics	20,927	2,330	826
Sales and marketing	**33,803**	**2,110**	**48**
Marketing management and research	28,916	1,603	45
Marketing operations/marketing and distribution, total	4,887	507	3
Customer and personal service	**6,303**	**494**	**18**
Hospitality services management	5,907	493	18
Consumer and personal services	396	1	0
Personnel and human resources	**7,944**	**5,663**	**116**
Human resources management	4,900	2,813	24
Labor/personnel relations and studies	880	591	16
Organizational behavior studies	2,164	2,259	76
Food production	**17,782**	**2,832**	**847**
Agricultural business and production, total	5,976	557	175
Agricultural sciences, total	8,442	1,649	616
Food and nutrition studies	3,364	626	56
Computers and electronics	**68,981**	**22,120**	**764**
Business information systems, total	21,682	6,007	14
Computer and information sciences, total	47,299	16,113	750
Engineering and technology	**73,964**	**26,920**	**5,210**
Engineering and engineering-related technologies, total	73,964	26,920	5,210
Design	**8,808**	**4,566**	**183**
Architecture and related programs, total	8,808	4,566	183
Mathematics	**12,395**	**3,487**	**958**
Mathematics, total	12,395	3,487	958
Physics	**3,508**	**1,237**	**1,014**
Physics, total	3,508	1,237	1,014
Chemistry	**9,136**	**1,845**	**2,027**
Chemistry, total	9,136	1,845	2,027
Biology	**60,256**	**6,205**	**4,489**
Biological sciences/life sciences, total	60,256	6,205	4,489
Psychology	**76,671**	**14,888**	**4,341**
Psychology, total	76,671	14,888	4,341
Sociology and anthropology	**32,220**	**2,918**	**1,026**
Anthropology	7,018	990	492
Sociology	25,202	1,928	534
Geography	**4,002**	**759**	**205**
Geography, total	4,002	759	205

Table 1 (cont.): O*NET knowledge areas and degrees conferred by field, 2001-2002

	BA	MA	PhD
Medicine and dentistry	**64,343**	**34,465**	**2,736**
Health professions & related sciences, total (exc. rehab)	64,343	34,465	2,736
Therapy and counseling	**26,725**	**26,241**	**1,225**
Social work	13,713	15,679	248
Rehabilitation/therapeutic services, total	6,174	9,179	787
Individual and family development studies	6,838	1,383	190
Education and training	**106,383**	**136,579**	**6,967**
Education, total	106,383	136,579	6,967
English language	**53,162**	**7,268**	**1,446**
English language and literature/letters, total	53,162	7,268	1,446
Foreign language	**15,318**	**2,861**	**843**
Foreign languages and literatures, total	15,318	2,861	843
Fine arts	**66,773**	**11,595**	**1,114**
Visual and performing arts, total	66,773	11,595	1,114
History and archeology	**26,161**	**2,447**	**940**
Archeology	160	27	16
History	26,001	2,420	924
Philosophy and theology	**17,091**	**6,286**	**1,961**
Philosophy and religion, total	9,306	1,334	606
Theological studies/religious vocations, total	7,785	4,952	1,355
Public safety and security	**28,717**	**3,165**	**64**
Protective services, total	25,536	2,935	49
Criminology	3,181	230	15
Law, government and jurisprudence	**42,486**	**17,816**	**1,078**
Law and legal studies, total	1,971	4,053	79
Public administration	2,318	7,411	189
Community organization, resources and services	2,103	650	7
Public affairs, other	554	720	8
Public policy analysis	704	988	119
International relations and affairs	5,482	2,353	51
Political science and government, general	29,354	1,641	625
Communications and media	**63,901**	**6,059**	**383**
Communications and communications technologies, total	63,901	6,059	383
Degrees in included fields	1,147,861	451,666	41,743
Total degrees	1,291,900	482,118	44,160
Proportion degrees included	0.889	0.937	0.945

See text for data description. Shown in bold are 27 O*NET job knowledge content variables. Under each is listed the majors or degree fields grouped into each knowledge content area. Degree information for 2001-02 is provided in USDOE, NCES *Digest of Education Statistics, 2003* (2004). Degree information for 1972-73 through 2001-02 was compiled from the USDOE, NCES *Chartbook* (1997) and annual *Digest of Education Statistics* (1996 through 2004).

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Table 2: Degree choice and job knowledge content, BAs

	All			Men		Women	
	Joint	Joint	Joint	Joint	Own	Joint	Own
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
lnC	1.872	1.361	–	1.256	1.562	2.509	0.904
	(.495)	(.458)		(.456)	(.579)	(.588)	(.285)
R	3.835	–	1.352	4.087	3.092	2.146	2.092
	(1.308)		(1.472)	(1.232)	(1.15`9)	(1.595)	(1.468)
R^2	0.968	0.966	0.962	0.964	0.964	0.970	0.968
Panel B							
lnC	1.376	1.361	–	0.727	0.996	2.235	1.058
	(.450)	(.458)		(.441)	(.642)	(.514)	(.247)
R	0.756	–	0.523	0.806	0.204	0.629	-0.276
	(.937)		(1.040)	(.963)	(.729)	(1.043)	(.728)
R^2	0.966	0.966	0.961	0.961	0.961	0.970	0.968

All specifications include dummies for knowledge field and for year. The dependent variable is the log of number of BA degrees for 27 knowledge content areas for 26 academic years, 1976-77 through 2001-02, with n = 702. The variable *lnC* measures the four year lagged employment weighted mean of the O*NET job knowledge content variable for each of the 27 knowledge areas in each calendar year from 1973 forward. In panel A, the variable *R* is an estimate of the "price" or return to each O*NET knowledge variable based on the coefficient on the knowledge variable in a log wage equation estimated separately for each knowledge area by year. In panel B, R is based on the coefficients on the knowledge variables in a log wage equation estimated for all knowledge areas by year. Columns designated as "Joint" include estimates *C* and *R* compiled by year and knowledge area over a joint sample of employed male and female college graduates, while columns designated "Own" compile the estimates by gender. Clustered standard errors, accounting for correlation within knowledge areas across years, are shown in parentheses.

Table 3: Regression results, BA degree choice by knowledge content field, 1976-77 to 2001-02

	lnC		R		Time		
Knowledge Content Area	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	R-squared
Administration and management	-4.844	1.500*	-2.775	1.761	0.015	0.002*	0.70
Economics, finance, and accounting	6.442	0.841*	-1.619	2.462	-0.032	0.007*	0.80
Sales and marketing	9.409	1.053*	1.584	3.077	-0.035	0.007*	0.84
Customer and personal service	-23.926	3.787*	6.308	6.282	0.064	0.012*	0.92
Personnel and human resources	4.422	1.966*	3.254	3.351	0.023	0.013	0.92
Food production	-0.749	2.264	-3.538	1.431*	-0.014	0.008	0.29
Computers and electronics	-13.266	16.266	-3.021	21.797	0.070	0.027*	0.61
Engineering and technology	2.518	1.394	10.423	4.514*	0.013	0.005*	0.50
Design	1.154	0.480*	1.080	1.413	-0.004	0.001*	0.64
Mathematics	6.129	5.393	9.344	2.985*	0.008	0.005	0.33
Physics	-1.270	1.117	7.702	3.107*	-0.014	0.009	0.60
Chemistry	2.162	0.424*	5.945	2.008*	0.001	0.004	0.72
Biology	3.216	0.432*	6.089	2.220*	0.024	0.006*	0.88
Psychology	4.336	0.969*	8.738	2.824*	0.010	0.009	0.91
Sociology and anthropology	6.943	0.803*	9.620	3.744*	0.037	0.012*	0.84
Geography	1.580	0.741*	-2.029	3.590	0.027	0.005*	0.62
Medicine and dentistry	0.490	0.521	5.336	1.334*	-0.001	0.003	0.75
Therapy and counseling	2.282	0.232*	13.178	1.806*	0.002	0.005	0.96
Education and training	4.746	0.745*	11.770	4.215*	-0.014	0.009	0.70
English language	4.387	2.209	5.693	2.175*	0.007	0.009	0.81
Foreign language	1.823	0.302*	4.227	1.283*	0.009	0.007	0.79
Fine arts	2.124	0.188*	1.633	1.264	0.042	0.003*	0.95
History and archeology	1.675	0.614*	9.365	5.984	0.024	0.011*	0.54
Philosophy and theology	1.746	0.198*	0.250	1.382	0.027	0.004*	0.85
Public safety and security	0.509	6.400	-3.965	2.509	0.034	0.005*	0.72
Law, government and jurisprudence	0.725	3.096	6.148	1.635*	0.007	0.003*	0.74
Communications and media	-9.555	4.174*	2.135	2.004	0.033	0.005*	0.86

*Designates significance at the .05 level. Sample size for each regression is 26 years. Each regression includes the variables *lnC* measuring the employment weighted mean of the O*NET job knowledge content variable in the respective field lagged four years, the regression estimate *R* measuring the return to each O*NET field variable lagged four years, and a linear time trend.

Figure 1a: BA degrees by sex, 1973-2002

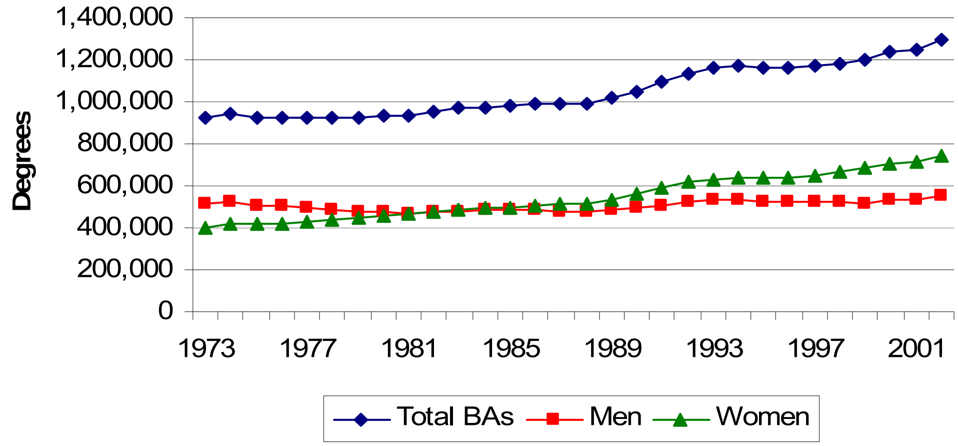


Figure 1b: MA degrees by sex, 1973-2002

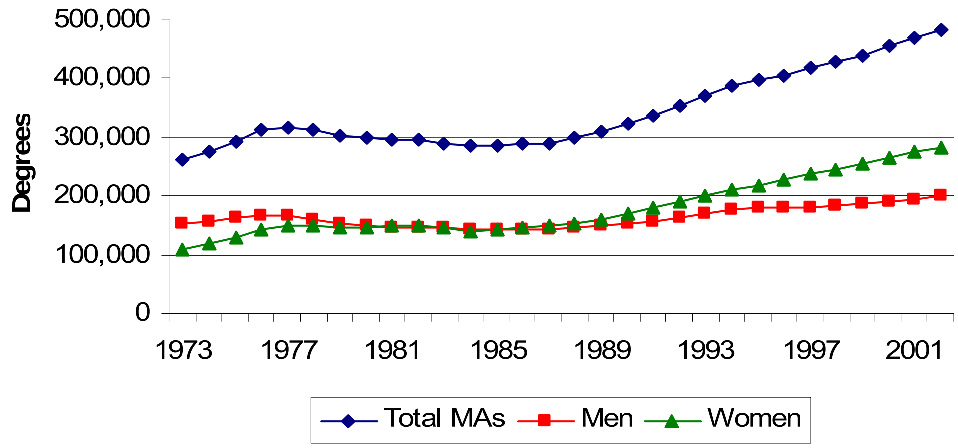


Figure 1c: PhD degrees by sex, 1973-2002

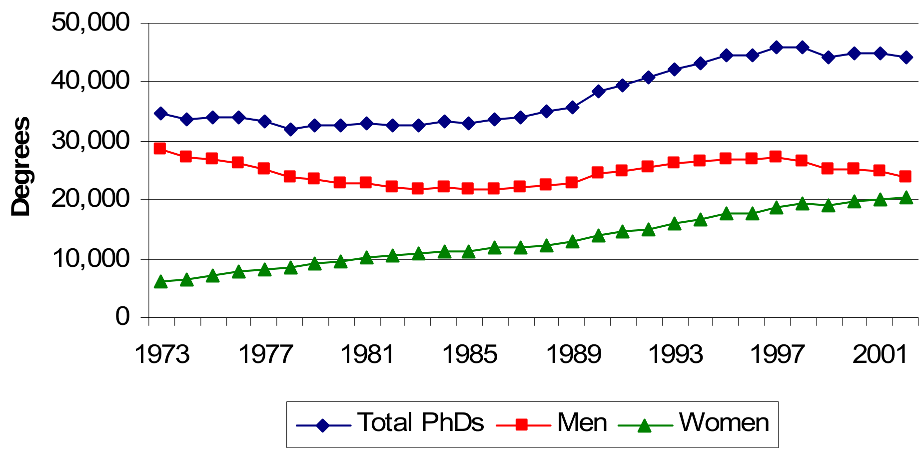
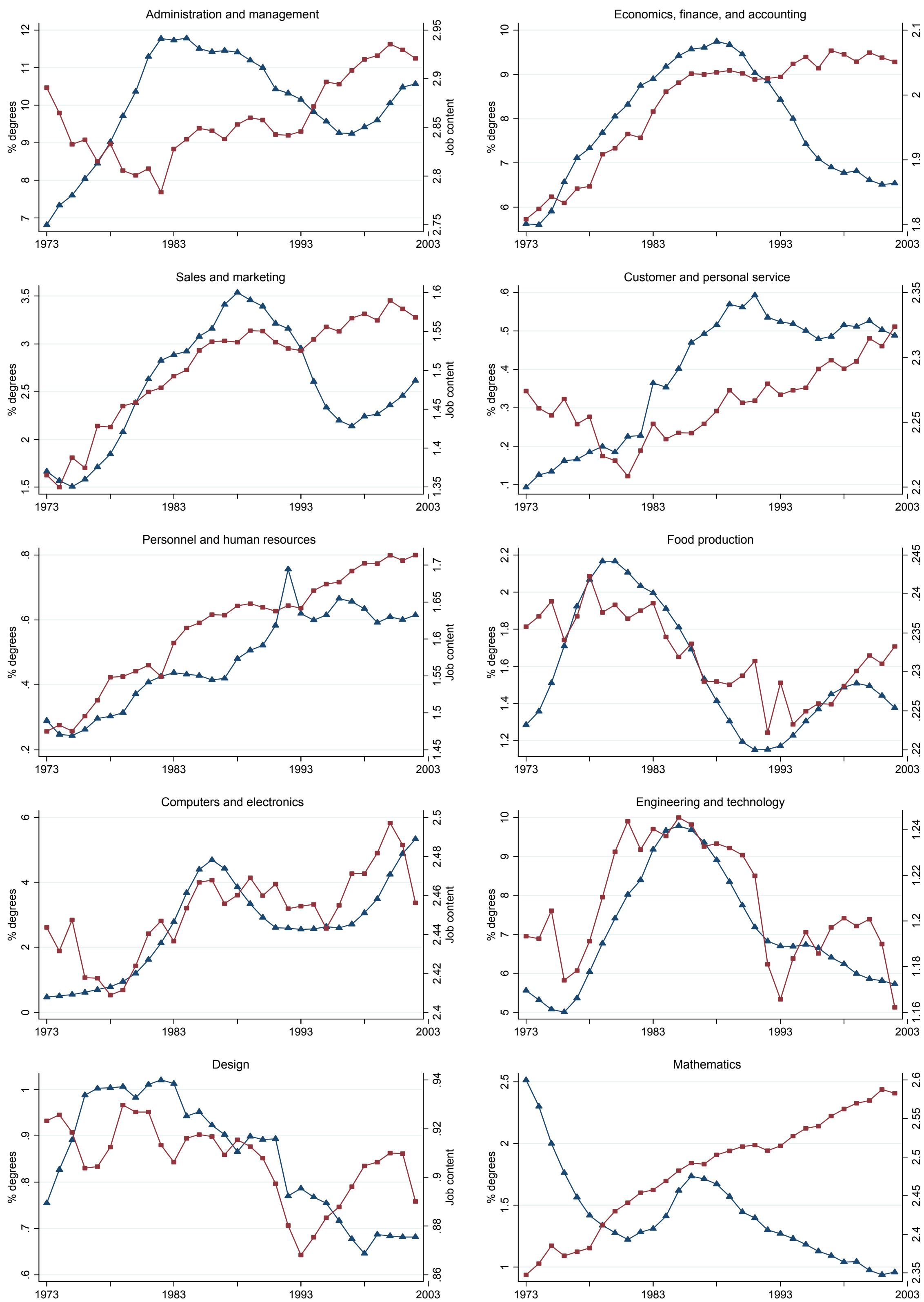
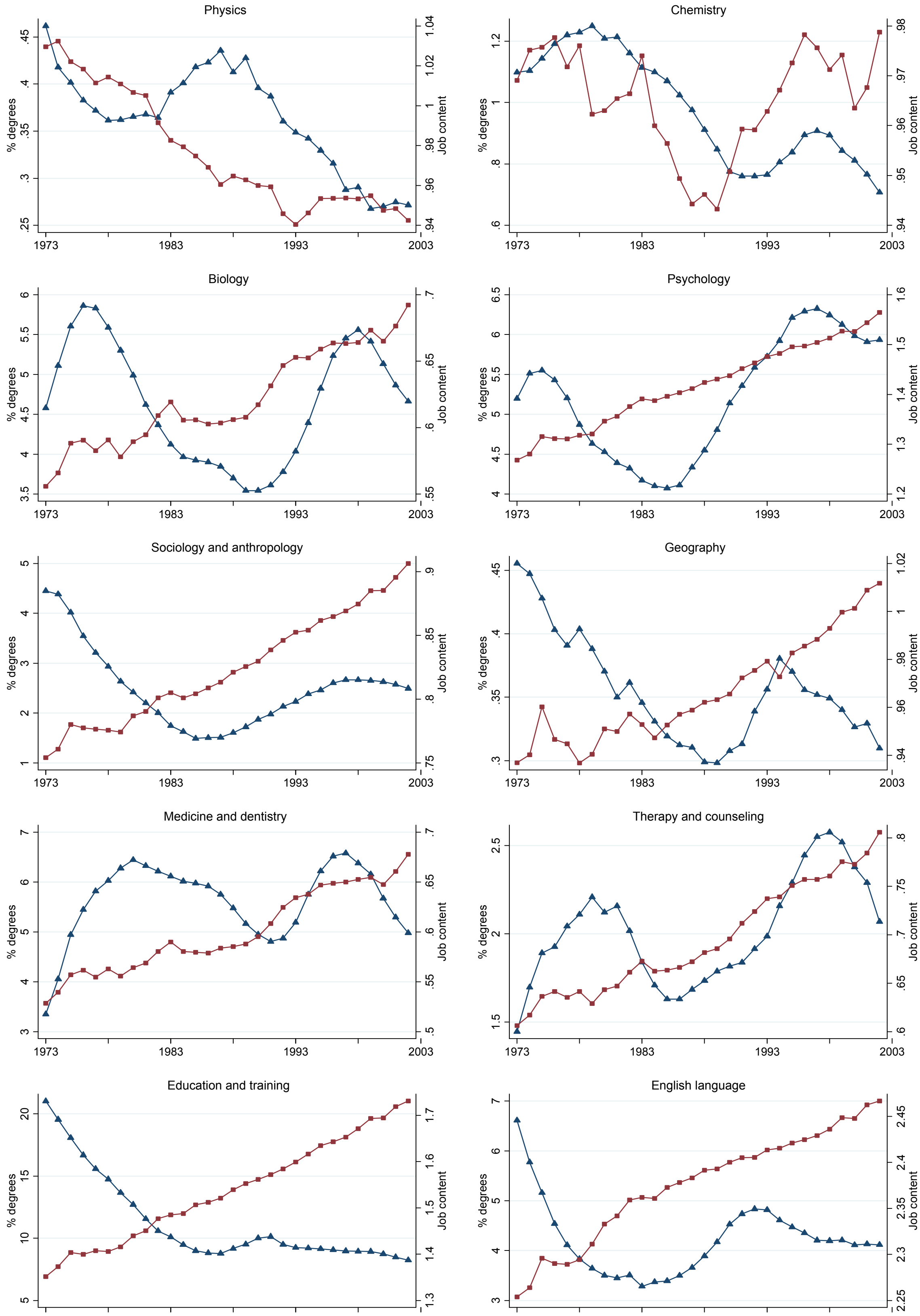


Figure 2: College majors and the knowledge content of jobs, 1973-2002



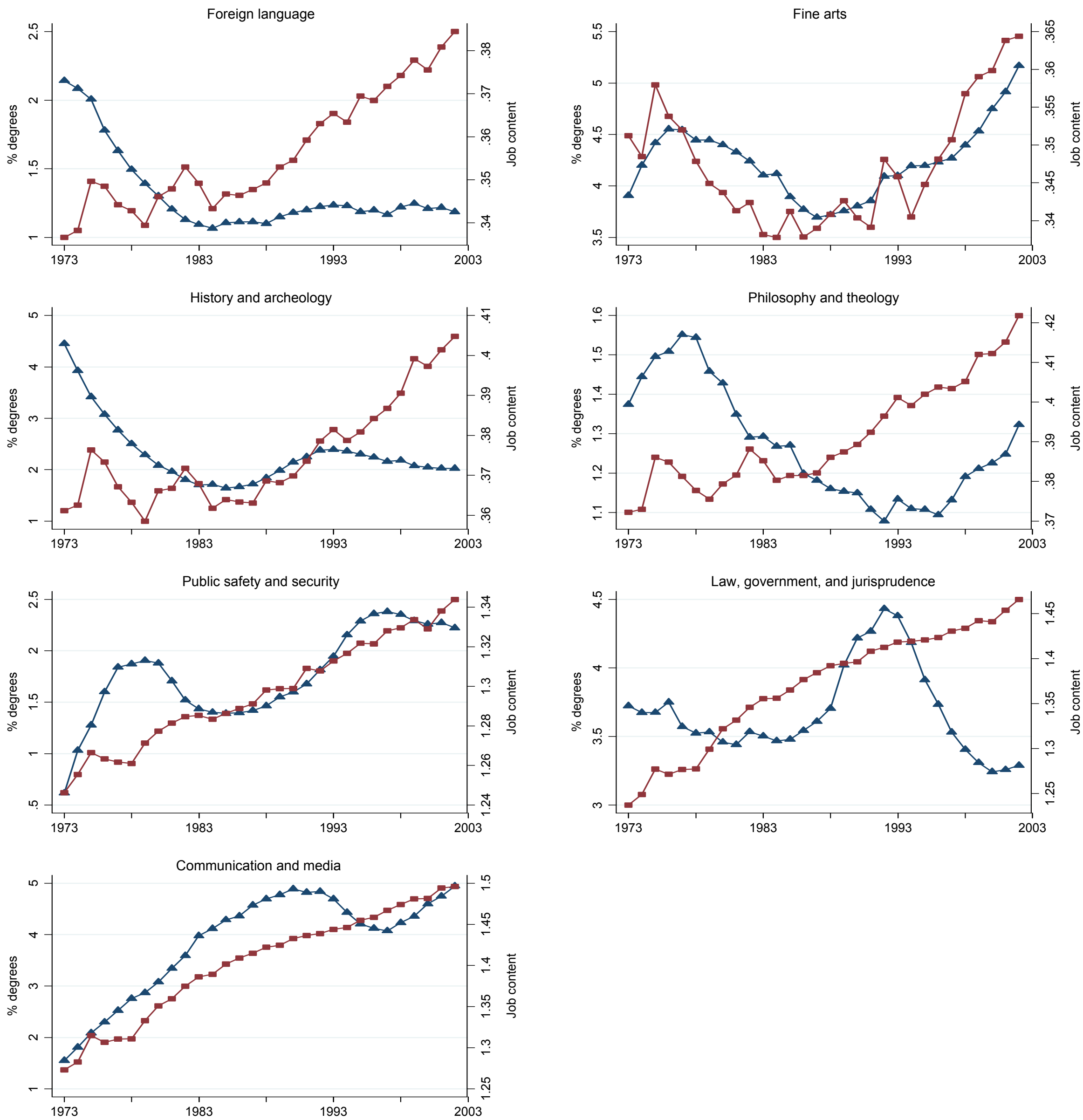
Note: Triangles show % of total BA degrees. Squares show mean job knowledge content (C).

Figure 2 (continued): College majors and the knowledge content of jobs



Note: Triangles show % of total BA degrees. Squares show mean job knowledge content (C).

Figure 2 (continued): College majors and the knowledge content of jobs



Note: Triangles show % of total BA degrees. Squares show mean job knowledge content (C).

Percent of bachelor's degrees in each knowledge content area derived from data in U.S. Department of Education, NCES, *Chartbook* (1997) and annual *Digest of Education Statistics* (1996-2004). Job knowledge content calculated from the Occupation Information Network (O*NET), the May 1973-1978 CPS and the 1979-2002 CPS-ORG monthly earnings files. Shown are employment-weighted means of the O*NET knowledge variables for wage and salary workers with at least a BA. Scales shown for percent degrees and job knowledge content vary by field. See text for details.