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Major-job match, Earnings and Job Satisfaction

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Major-job match, Earnings and Job Satisfaction

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Keywords: major-job match, college graduates, job satisfaction, earnings

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Dear Editors,

Submission of "The Effects of Major-job Mismatch on Early Career Earnings and Job Satisfaction" by Yu, Halliday and Kaufman

In our submission package, please find included the following documents:

- Anonymous main manuscript
- Tables 1 through 7 included at the end of the manuscript
- Cover page with author information
- Highlights page

The authors declare no conflicts of interest and we used no external funding. We used restricted use data provided by the US Department of Education (the Baccalaureate and Beyond data set) and have complied with all regulations stipulated to the data's use. Though we cannot provide the data as they are federally protected, we shall provide STATA do files that were used to analyze the data as supplementary materials upon acceptance.

Do please let us know if you require any additional information.
Best regards,
Simon D. Halliday
Assistant Professor

Major-job match, Earnings and Job Satisfaction

AUTHORS BLINDED FOR REVIEW

Abstract: We use the U.S. Department of Education's Baccalaureate and Beyond restricted survey data to estimate the determinants of major-job mismatch and its effects on post-graduate earnings and job satisfaction. We are among the few researchers who control for both the quality of students and colleges. Controlling for a graduate's ability, we find that graduates who chose undergraduate majors that provided substantial occupational and job-specific training are more likely to work in jobs that are closely related to their majors one and four years after graduation and have higher earnings and greater job satisfaction. Finally, we exploit the panel data to estimate the effects of changes in job relatedness on income and job satisfaction over time.

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Introduction

Economists who study the relationship between education and post-graduate earnings have distinguished between 'vertical mismatches,' and 'horizontal mismatches.' Vertical mismatches occur when workers have more education than their jobs require (Duncan & Hoffman, 1982; Sloane et al., 1999; Nordin et al (2010); Hartog, 2000).[1] Horizontal mismatches occur when there is a mismatch between the substance of one's undergraduate major (rather than just years of schooling) and one's occupation. Horizontal mismatches have been found to reduce post-graduate earnings and job satisfaction (Robst (2007a and 2007b); Nordin et al (2010); Wolniak & Pascarella (2003); Belfield and Harris (2002), Bender and Heywood (2006); Smart el al., (1986); Elton & Smart, (1988); Bender and Heywood (2011); Yuen (2010); Kinsler and Pavan (2015); Lemieux (2014); Lindley and McIntosh (2015)).

We use data from the U.S. Department of Education's Baccalaureate & Beyond surveys to estimate the determinants of horizontal major-job mismatch and its effects on earnings and job satisfaction for graduates at two different points in time. The survey provides data on graduates one and four years after graduation, in 2009 and 2012. It includes questions about undergraduate major, primary job, earnings, and other demographic information. The data also include undergraduate grade point average (GPA), which we use as a proxy for underlying ability. Most other studies have data on a graduate's major, but not their grades. We also control for the quality of the graduate's undergraduate educational institution using data on college selectivity. Finally, we exploit the panel data to estimate the effects of changes in job relatedness on income and job satisfaction over time.

We estimate regressions of the log of wages one and four years after graduation on major-job match to understand the extent to which major-job match confers a wage premium, while controlling for ability. The data also allow us to investigate the question of whether major-job relatedness has an effect on job satisfaction, both directly and indirectly via higher wages.

We take as our departure point the work of Robst (2007a and 2007b), Nordin et al (2010), and Wolniak & Pascarella (2003) and focus on addressing the following questions: Which undergraduate majors are likely to lead to greater major-job match after graduation and how much does major-job match affect earnings one and four years after graduation? What is the influence of major-job match on self-reported job satisfaction and how do changes in the degree of job relatedness over time affect both earnings and job satisfaction? Is income related to overall job satisfaction, independent of job match, and is overall job satisfaction still related to the degree of major-job match after controlling for income? We address a gap in the literature by controlling for

[1] See Leuven and Oosterbeck (2011) for an exhaustive survey of the effects of vertical mismatch.

ability with GPA and by examining the dynamics of major-job match and job satisfaction over time in the United States.[2]

We find that graduates who chose undergraduate majors that provided substantial occupational and job-specific training are more likely to work in jobs that are closely related to their majors one and four years after graduation, with the wage premia persisting four years after graduation. Major-job relatedness also corresponds to greater job satisfaction both one and four years after graduation. These results are robust to controlling for underlying ability with GPA, but the major-job match premium persists. Considering potential transitions in job-match status over time, which is another significant contribution we make, we find that a reduction in the major-job match over time reduces the wage premium and job satisfaction. Our results thus suggest that graduates who chose jobs outside their major typically did not do so in order to increase their job satisfaction. Finally, while major-job relatedness has a direct effect on job satisfaction it also increases satisfaction indirectly by increasing income.

Background and Literature Review

As Lemieux (2014) notes, more education can lead to greater earnings for at least three reasons. First, education makes workers more productive, and students who choose majors that provide more training (either general skills like language, critical thinking, and communication skills, or job-specific skills like electrical engineering skills) will *ceteris paribus* earn more after graduation. Secondly, more education helps workers get assigned to higher paying occupations when output is sensitive to skill.[3] Thirdly, workers earn more when they are matched to a job that is related to their major. Furthermore, students who choose majors that provide a lot of job or occupation-specific training will incur greater earnings premiums if they experience a job match. Engineering majors who find jobs as engineers, for example, might earn considerably more than those who majored in but could not find a job in engineering. On the other hand, graduates who majored in subjects in which there was a great deal of general training will have higher earnings but smaller job-match premia because their productivity is higher in a broad range of jobs regardless of their major

The wage premium for major-job matches may change over time as workers gain additional on-the-job training and job experience. The premium might be temporary as workers eventually find jobs outside their college major where they can utilize their particular skills. On the other hand, if on-the-job training and job experience are complements to the occupation-specific skills gained in college, the job match premium may grow over time.[4]

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[2] Nordin et al (2010) use a cognitive test administered to Swedish citizens as a proxy for ability, but this does not give as complete a picture as a four-year GPA.

[3] Education can also act as a signal that leads to higher earnings and better job placement even if it does not increase productivity.

[4] Hartog (2000) argues that a job (or task) mismatch could be the consequence of imperfect information. This disadvantage may fade as one gains more experience and gathers more information.

This paper extends the work of Robst (2007a), Nordin et al (2010), and Boudarbat and Chernoff (2012), Robst used data from the 1993 National Survey of College Graduates conducted by the National Science Foundation. He investigated how closely people perceived their current job to be related to the field in which they received their undergraduate degree. Fifty-five percent of the subjects in his study reported working in a field closely related to the field in which they attained their highest degree. The incidence of job match is lowest among those who majored in English and foreign languages, social sciences, and liberal arts, while the most frequent matches occurred in skill-specific majors such as computer science, engineering and health professions.

Although the incidence of mismatch in Robst's sample was lower in skill-specific majors, people in these degree fields received a higher wage penalty for working in a job unrelated to their major. For example, mismatches among engineering majors, which involve relatively more occupation-specific skills, led to 25% lower annual income while mismatches for social sciences majors, which involve mostly general skills, lowered annual income by 4%, *ceteris paribus*. Overall, Robst's (2007a) results indicated that working outside of one's degree field is associated with about 11 percent lower earnings for both men and women. Robst (2007b) found that overall men were slightly more likely to be mismatched than women, but there were substantial gender differences in the reasons for mismatch.

Nordin et al (2010) also estimated the effects of major-job match on income. Their methodology was similar to Robst, but differed in several important ways. First, they were able to obtain data for the entire Swedish population between the ages of 28 and 39. Second, instead of using a self-reported measure of job match, Nordin et al used detailed education and occupational classifications to construct a more objective measure. Third, they were able to control for ability by including each student's cognitive score on the Swedish military enlistment test. It is important to control for student ability because, as Robst and Nordin note, more able students are more likely to find high-paying jobs related to their majors. Their higher earnings, however, will be the result of their greater innate abilities rather than their greater job relatedness. Nordin et al found an average job match premium (between major-job not related and closely related) of 12 percent for women and 20 percent for men. More recently, Zhu (2014) used a non-parametric estimation and found a considerably smaller job match premium in China, but he does not control for ability and he analyzes the effects on earnings only one year after graduation.

Our paper extends the work of Robst, Nordin et al, and other researchers because we do all of the following. First, we examine the impact of (horizontal) major-job match on the incomes of college graduates in their first year after graduation and then three years later. This allows us to determine how the job match premium changes over time.[5] Secondly, we address the problem of omitted variable bias by including variables on the selectivity of the undergraduate institution from which the survey respondent graduated as well as a graduate's undergraduate GPA. This allows us to control for ability, albeit imperfectly. While many researchers have included college selectivity as a regressor, few authors have had data on undergraduate GPA. Thirdly, we estimate the effects of job match on job satisfaction, again one year after graduation and three years later. Fourthly, we

[5] Bender and Heywood (2011) look at the effects of mismatch for a panel of scientists and social scientists over a fourteen-year period. They find that the incidence of mismatch and its negative consequences are concentrated late in one's career, but they do not control for ability.

explore the effects of changes in job relatedness between 2009 and 2012 on earnings and job satisfaction. Finally, by limiting our analysis to those who graduated in the same year and are approximately the same age, we can control for external factors that can change the relationships among job match, earnings, and job satisfaction from one generation to another.

Among the numerous studies examining the relationship between major-job match and job satisfaction perhaps the most detailed analysis was conducted by Wolniak and Pascarella (2005). These authors used alumni data collected from 30 private and public colleges in the Appalachian region to estimate a causal model. Their results indicated that both income and major-job congruence (match) are mediating factors in the relationship between major and job satisfaction. They also found a direct effect of college major on job satisfaction, independent of income and major-job congruence. Although graduates with arts and humanities majors were financially worse-off, these majors tended to achieve significantly higher job satisfaction in terms of autonomy and personal fulfillment, independent of earnings and major-job congruence. Although our data are not as detailed, we use logit to examine the effects of major-job match on overall job satisfaction in 2009 and ordered logit to examine the effects of job match on several types of job satisfaction three years later.

Current Study

Research Questions

We extend the work of Robst (2007a, 2007b), Nordin et al (2010) and Wolniak & Pascarella (2003) by addressing the following questions: 1) Which undergraduate majors are likely to lead to greater major-job match after graduation? 2) How much does major-job match affect earnings one and four years after college graduation? 3) How do changes in the degree of job relatedness over time affect earnings and job satisfaction? 4) What is the influence of major-job match on self-perceived job satisfaction one and four years after graduation? 5) Is income related to overall job satisfaction, independently of job match? 6) Is overall job satisfaction still related to the degree of major-job match after controlling for income?[6]

Data and Model Specification

The Baccalaureate and Beyond Longitudinal Study (B&B) is an on-going survey that gathers information about students' education and work experiences after they complete a bachelor's degree.[7] Subjects in the sample were first interviewed in 2009, one year after receiving their bachelor's degrees. Interviewees were asked about their undergraduate experience, including their

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[6] Endemic to this literature is the difficulty in identifying the causal relationship between major-job match and the outcome variables of interest, such as wages or job satisfaction. Though we are able to control for underlying ability better than much existing research through the use of GPA and to deal with the omitted variable bias of college quality, we cannot claim that we are able to deal with all sources of endogeneity. A recent alternative approach, Kirkeboen, Leuven, and Mogstad (2016), uses a regression discontinuity design in admission tests for degree programs to deal with endogeneity.

[7] 'About B&B.' *National Center for Educational Statistics*.

academic performance, undergraduate college, undergraduate major, grades in individual courses, financial aid, and employment experience in 2009. They were re-interviewed in 2012 and asked questions about their employment and finances between 2009 and 2012. The sample was stratified on a variety of characteristics, such as whether graduates were SMART grant recipients, business or STEM majors, and others. The stratification is important because within the population of graduates, a high proportion had a business major and thus business majors were undersampled, whereas STEM majors were oversampled. Furthermore, the sample from 2012 (B & B: 08/12) includes analysis weights to ensure consistency with the B & B: 08/09 sample. All summary statistics and regression analysis that we undertake in the paper take the survey design into account. The restricted use data were kindly provided by the U.S. Department of Education.

We estimate several equations with a similar set of regressors:

$$y_{it} = \alpha + \beta_0 GPA_i + \beta_1 SR_{it} + \beta_2 CR_{it} + \beta_3 CHR_i + \beta_4 MS_i + \beta_5 VS_i + \delta MAJ_i + X_i + \varepsilon_{it} \quad 1.1$$

In Equation 1.1, y_{it} is the response variable of graduate *i* in period *t* in a variety of regressions. In the first set of regressions, y_{it} measures a graduate's job relatedness. In the second set of regressions, y_{it} measures the logarithm of graduate *i*'s annualized real earnings in each period and, in the third set of regressions, y_{it} measures graduate *i*'s degree of job satisfaction in each period. GPA_i is graduate i's undergraduate grade point average. SR_{it} and CR_{it} are indicator variables for whether graduate *i*'s job is somewhat related or closely related to her major in period *t.* (These are not used as regressors in the regressions on job match itself). CHR_i is a set of indicator variables that measure changes in job relatedness between 2009 and 2012. MS_i and VS_i are indicator variables for the quality of graduate *i*'s undergraduate institution (moderately selective and very selective). MAJ_i is a set of dummy variables for graduate *i's* major/field. X_i is a vector of individual characteristics for graduate *i* and ε_{it} is the customary error term.

Results

The 2012 sample had about 19,000 subjects. We included only those who listed bachelor's degree as their highest degree level attained one and four years after graduation. Those who had obtained more advanced degrees were excluded from our sample because their incomes were probably determined by the subject in which they achieved their higher degree, rather than their undergraduate major. To separate the effects of job match on productivity (as opposed to part-time employment) we limited the sample to full-time employees, i.e., those who worked more than 35 hours per week.[8]

Table 1 presents the means and standard deviations of the main variables in our model. The average annualized real earnings in 2009 dollars of those in our sample were $39,630 in 2009 and $46,774 in 2012. The means are somewhat higher than the medians, reflecting the typical situation in which a few people have very high incomes. About 55 percent of the sample were

[8] Robst included workers with any positive earnings in his regressions, while Nordin et al presented regressions with and without part-time workers. Regressions using all workers are available from the authors upon request.

female, 8 percent were black and 9 percent were Latino. Seventy-five percent of the respondents were satisfied overall with their job in 2009. The job satisfaction variables for 2012 were coded differently than those for 2009, as we explain in the footnote to Table 1.

[Table 1 about here.]

Table 2 depicts the self-reported degree to which each respondent's jobs in 2009 and 2012 were related to his or her undergraduate major in each of the 23 majors. Overall, one year after graduation 23.7 percent of all subjects were working in jobs that were not related to their undergraduate majors; and 49.2 percent were working in jobs that were closely related to their major. These percentages are very similar to those in Robst's sample. Majors whose graduates experienced the greatest degree of job match (and hence the highest level of major-job relatedness) in 2009 were generally STEM majors and majors in health care, architecture, and education. Conversely, the majors whose graduates experienced the lowest degree of job-match (and hence the lowest level of job relatedness) were generally in the liberal arts: general studies, social sciences, psychology, humanities, history, and theology. Between 2009 and 2012 the overall percentage of individuals that worked in areas unrelated to their majors fell slightly from 23.7 percent to 21.0 percent, while the percentage that worked in areas closely related to their majors also fell slightly from 49.2 percent to 44 percent. Consequently, those in the third category, who worked in a job that was 'somewhat' related to their major, rose but not by very much. Furthermore, the relative patterns of job relatedness for each major remained relatively stable between 2009 and 2012.

[Table 2 about here.]

In Table 3 we used an ordered logit regression to estimate the factors that determine early-career major-job relatedness. The dependent variable in the regressions is the extent of major-job match in 2009. This variable had three values: 'not related (=0),' 'somewhat related (=1),' and 'closely related (=2).' As the value of the dependent variable rose, the degree of job relatedness increases. This coding is the inverse of that used by Robst and Nordin et al. but it is consistent with much of the job satisfaction literature (e.g., Wolniak and Pascarella (2005). We report the results of the ordered logit in Columns (1) and (3), and the derived odds-ratios in Columns (2) and (4).

[Table 3 about here.]

While none of the gender or race variables (not shown) are statistically significant, the coefficients on most of the undergraduate major variables are statistically significant at the 1 percent level, and the patterns for the coefficients on each major are similar to those reported in Table 2. Since the reference major is humanities, the 2.079 coefficient on the engineering dummy in

2009 implies that the log odds of students who majored in engineering exceed the log odds of graduates who majored in humanities in 2009 by approximately 2.079 units. The odds ratio of 8.0 for engineering can be interpreted as follows. Consider two graduates, one graduate with an engineering major and another graduate with a humanities major, while the other independent variables for these two graduates have identical values. The engineering major is 8 times as likely as the humanities major to work in a job that is closely related to her major relative to the combined category of a job that is somewhat or unrelated to her major. The odds ratio in the ordered logit regression can also be interpreted as indicating that the engineering major is 8 times as likely as the humanities major to be in a job that is in the combined category of being closely or somewhat related to her major relative to someone whose job is not related to her major.

The coefficients on the college selectivity dummy variables in 2009 are not statistically significant, but the coefficient on undergraduate GPA is both positive and statistically significant. A student with a higher undergraduate GPA is considerably more likely to work in a job that is a closer match to their major.

Following the patterns in Table 2, the odds of STEM majors like engineering and health care or education having a close job match after graduation is greater than that of the humanities, *ceteris paribus.* These majors give students relatively more occupation-specific skills, which are highly transferrable to existing occupations.[9] Finally, comparing the coefficients in Columns (1) and (2) for 2009 with those in Columns (3) and (4) for 2012, relative to humanities majors the likelihood of working in jobs that are somewhat or more closely related to undergraduate major falls from 2009 to 2012 for each major except history and design and applied arts. A smaller coefficient in the later year is consistent with the theory suggesting that on-the-job experience (with learning-by-doing) may substitute for job-major match.

Table 4 shows the results of a linear regression with the logarithm of annualized earnings as the dependent variable. The numbers in the first two columns are coefficients from 2009 earnings regressions while those in the next three columns are coefficients from 2012 earnings regressions.[10] The reference or omitted independent variables in the regressions reported in the first four columns were: job unrelated to major, humanities majors, minimally selective or open admissions college selectivity, whites, and males.

[Table 4 about here.]

The results in Columns (1) – (4) indicate that major-job match had a significant impact on earnings. Compared with those whose jobs were not related to their undergraduate major, those

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[9] While one might not initially describe an education major as specific-training intensive, many education graduates immediately become teachers after graduation.

[10] In the 2009 survey participants were asked to report their earnings and hours of work on their current job at the time of the interview.. In the 2012 survey participants were asked to report their earnings and hours of work on their last 'primary' job, not necessarily their current one. By limiting the sample to those who worked at least 35 hours, a respondent's current job in 2012 was very likely to be a primary job.

whose jobs were somewhat related to their major earned about 10.4 per cent more in 2009, and those whose jobs were closely related to their major earned 17.5 per cent more.[11] Regressions using all workers rather than just full-time workers yielded coefficients that were about 10 percent larger.

Holding hours worked constant, women earned 8.4 percent less than men in 2009. When we ran separate regressions for men and women, the coefficients on job-relatedness were similar. Robst obtained comparable results for the U.S. while Nordin et al found substantial gender differences in Sweden. A considerable part of the difference between Nordin's results and ours is due to the fact that we excluded part-time workers in our sample.

Comparing the regressions in Columns (2) and (4), the job relatedness earnings premia increased from 2009 to 2012.[12] Compared with those whose jobs were not related to their major, the earnings premia in 2012 for those whose jobs were moderately and closely related to their undergraduate major were 17.0 log points (18.5 percent) and 21.3 log points (23.7 percent), respectively. These estimates were substantially greater than Robst's. One possible explanation is that the major-job matches in 2009, right after graduation, may have an initial randomness and it takes time for a match to manifest itself.

Regressions using all workers rather than just full-time workers yielded coefficients that were about 10-30 per cent larger. Our coefficients on the ethnicity variables (not shown) were very small and not statistically significant one year after graduation in 2009. However, four years after graduation in 2012 both blacks and Latinos earned about 6.5 percent less than whites, *ceteris paribus,* and both coefficients were statistically significant. The GPA coefficients were positive and significant; an A average student (with a GPA, or grade-point average, of 4.0) earned 9.5 percent more than a B student (with a GPA of 3.0) in 2009 and 6.8 percent more in 2012. More importantly, when GPA was included in the regressions, the coefficients on major-job relatedness fell, but only slightly. Consequently, the positive effect of job relatedness on earnings frequently reported by other researches is probably not the result on omitting GPA and other measures of quality.

The dummy variables for majors (not shown) reveal substantial differences in income independently of job relatedness although many of the coefficients are not statistically significant. *Ceteris paribus* engineers earned 48.1 log points (62 percent) more than humanities majors, the lowest paid major. College selectivity did not affect earnings at minimal, open admissions, or moderate levels of selectivity, but graduates of very selective colleges earned 7.4 percent more than minimally selective and open admission colleges in 2012, holding job-relatedness (and the other variables) constant.

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[11] Technically, the premia are 10.4 log points and 17.5 log points, respectively. The actual percentages would $e^b - 1$ = 11.0 percent and 19.1 percent, respectively. For the rest of this discussion we typically use the log-point difference.

[12] One possible explanation for this is the fact that 2009 was in the middle of the Great Recession. Summerfield and Theodossiou (2017) and Altonji, Kahn, and Speer (2014) have shown that graduating in a recession with a mismatch can have lingering effects over one's entire career, especially for certain majors.

In the fifth column of Table 4 we explore the effects of *changes* in one's job relatedness between 2009 and 2012 on earnings in 2012. To do this we constructed a set of nine dummy variables for the nine possible transitions. For example one dummy variable equalled 1 for a graduate who had a job in 2009 that was unrelated to his or her undergraduate major but whose job in 2012 was closely related to her major. The overall distribution for these transitions are summarized in Table 5.

[Table 5 about here.]

The largest proportion (31.8 percent) was for graduates who had jobs closely related to their majors in both years. Twenty-two percent of graduates improved their major-job match between 2009 and 2012 while 19 percent experienced a decline. Using our previous example. 4.81 per cent of those who had full-time jobs and positive earnings in both years had jobs in 2009 that were unrelated to their majors and had jobs in 2012 that were closely related to their majors.

In the fifth column of Table 4 these transition dummy variables were added to the earnings regression. The coefficients on these variables indicate that those who had the highest earnings in 2012 *ceteris paribus* had jobs in both 2009 and 2012 that were closely related to their undergraduate majors.[13] These people typically chose their majors in order to maximize their career earnings and found jobs that utilized their human capital. Their job experience appears to be a complement to their education. Those whose jobs in 2012 were somewhat related to their majors had substantial but slightly smaller income premiums regardless of their levels of major-job match in 2009.

Those who had the lowest earnings in 2012 *ceteris paribus* had jobs in 2012 that were not related to their undergraduate major regardless of their degree of major-job match in 2009. These results are consistent with Bender and Heywood's (2011) finding that major-job mismatch has its greatest effect later in one's career. [14] Robst (2007a) and others note that mismatches might lead to lower earnings but greater non-monetary benefits, such as job satisfaction. As we explain below, that does not appear to be the typical case in our sample.

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[13] We could not reject the hypothesis that there was no difference in incomes between those whose jobs in both 2009 and 2012 were unrelated to their major and those whose 2009 jobs were unrelated to their major but whose jobs in 2012 were closely related to their major. The cell size, however, was small.

[14] The number of observations in Column 5 is considerably smaller than the number in the other columns because we included only those who worked more than 35 hours per week in both 2009 and 2012 and had positive earnings in both years.

[Table 6 here.]

Tables 6 and 7 describe the results of using job satisfaction in 2009 and 2012 as the response variable in our basic specification. In the first two columns of Table 6 we use a linear probability model to estimate the determinants of overall job satisfaction in 2009, where this variable was coded on a [0, 1] scale. Almost none of the 23 majors (not shown) were statistically significant in either the linear probability or logit models.[15]

For the logit model we report both the actual regression coefficients (for the change in the logarithm of the odds of being satisfied overall) and the odds ratio itself. All of the coefficients on the job relatedness variables are positive and significant and the qualitative magnitudes are similar. For example, the odds of being satisfied overall with one's job is about twice as great for those whose jobs are somewhat related to their jobs compared with those whose jobs are unrelated to their major. The boost in job satisfaction among those with greater job relatedness is considerably larger. The odds of being satisfied with one's job is about 4.97 times as great for those whose jobs are closely related to their jobs as compared with those whose jobs are unrelated their major.

We also estimated versions of both the linear probability and logit regressions using earnings as an additional regressor (not shown). The coefficients on earnings indicated that a $10,000 increase in earnings would raise the probability of being satisfied with one's job by 2.6 percentage points. The coefficients on job relatedness, however, fell only slightly when earnings were included. The results of both specifications indicated that, without controlling for earnings, the percentage of respondents who reported that they were satisfied with their job increased by 16 percentage points relative to no major-job match if their jobs were somewhat related to their major and about 30 percentage points if their jobs were closely related to their major. [16]

There was no variable measuring overall satisfaction with employment in the 2012 sample, so we used subcategories of job satisfaction as dependent variables. In particular, in Table 7 we looked at two subcategories: importance of work and challenge of work and a third summary measure that combined the scores of these two dimensions plus four others. The dependent variables in Columns (1) and (4) represent how satisfied participants were with the challenge of their job, whereas the dependent variables in Columns (2) and (5) represent how satisfied they were with the importance of their job. Since respondents could respond with one of five degrees of satisfaction: (very dissatisfied, dissatisfied, neither satisfied nor dissatisfied, satisfied, and very satisfied) there was a definite hierarchy, so we estimated an ordered logit model.

[Table 7 about here.]

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[15] We also ran regressions in which we included several specific fringe benefits. While some of the coefficients were statistically significant, they did not appreciably affect the coefficients on the principal variables.

[16] Being black reduced the probability of being satisfied with one's job in both models.

As shown in the Columns (1) and (2) of Table 7, the coefficients on the job-relatedness variables continue to be both substantial and statistically significant. The value of 1.35 for the effect of close major-job relatedness on satisfaction with the challenge of work indicates that the log odds for someone with a close major-job match exceeds the log odds for someone whose major is unrelated to her job by 1.35 units. The effects of close major-job match on satisfaction with the challenge and importance of one's job are slightly less for satisfaction with the challenge of one's job than satisfaction with its importance.[17]

We also constructed a summary job satisfaction variable for each participant by summing her scores for each sub-level of satisfaction.[18] This summary value had a potential range between 0 and 30. We converted the total to a standardized z-score and used the z-score as the dependent variable in an OLS regression, and the results are reported in Column (3) of Table 7. Once again, the job relatedness coefficients are substantial and statistically significant. The z-score of someone whose job was closely related to her major had a z-score that was 0.512 standard deviations higher than someone whose job was unrelated to her major *ceteris paribus*. As before, few of the remaining independent variables were statistically significant.

Finally, in the last three columns of Table 7 we repeated the exercise of including the relatedness transition variables, as we did in the earnings regressions in Table 4. The coefficients on these variables indicate that those who had the greatest job satisfaction in 2012 *ceteris paribus* had jobs in 2012 that were closely related to their undergraduate major regardless of their level of job match in 2009, whereas those who had the lowest job satisfaction in 2012 had jobs in 2012 that were not related to their undergraduate major regardless of their level of job match in 2009. It might be argued that a graduate may choose to leave a job in which she has a major-job match in 2009 for a job where she believes she will be more satisfied, though not matched to her major (Robst, 2008). Such an interpretation is inconsistent with our results because graduates who are were somewhat or closely matched in 2009 are less satisfied on average in 2012, suggesting that graduates are leaving their matched jobs for reasons other than job satisfaction.

Conclusion

Graduates who chose undergraduate majors that provided substantial occupational and job-specific training are more likely to work in jobs that are closely related to their majors one and four years after graduation. We find that the wage premia for those who do have a job closely related to their major is higher among majors that provided substantial occupation-specific skills, such as health care and engineering. Furthermore, these wage premia increase for at least four

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[17] As before, we also estimated regressions that included earnings as a regressor. Once again, the coefficients on earnings were small and statistically significant, and the coefficients on job relatedness fell slightly.

[18] In addition to challenge and importance, the other job satisfaction sub-categories were satisfaction with work-life balance, fringe benefits, pay, and job security.

years subsequent to graduation. Major-job relatedness also increases satisfaction with one's job both one and four years after graduation. We find that these results persist while controlling for a graduate's ability with their GPA – which itself is positively and statistically significantly related to wages and job satisfaction – and while controlling for the quality of the graduate's educational institution. With some exceptions, workers can become high-earners and achieve high levels of job satisfaction regardless of their levels of major-job matching right after graduation, but a reduction in the major-job match between 2009 and 2012 generally reduces both the wage premia and job satisfaction. Our results therefore suggest that graduates who chose jobs outside their major typically did not do so to increase their job satisfaction. Finally, while major-job relatedness has a direct effect on job satisfaction it also increases satisfaction indirectly by increasing income.

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Table 1: Sample means and standard deviations

Notes: The measure of job satisfaction changed between 2009 and 2012. In 2009, the variable is a [0,1] measure where the graduate indicated if they were satisfied (1) or not (0). Therefore, we report the proportion of the sample that reported they were satisfied with their job. In 2012, there are six measures, each on a 5-point scale, for which we report the sum of the six measures (out of a potential maximum of 30 points). In 2012, a mean satisfaction score of 22.6/30 is roughly 75 percent, which corresponds to the proportion of individuals who are satisfied in 2009 of 0.748.

	2009 Sample		2012 Sample	
	Mean	Std. Dev	Mean	Std. Dev
Annualized earnings in 2009 dollars	39629.951	18246.505	46773.931	25911.240
Hours worked per week	43.419	6.315	43.636	7.127
Female	0.557	0.464	0.544	0.473
Black or African American	0.085	0.261	0.080	0.257
Latino or Hispanic	0.089	0.266	0.090	0.272
Asian American	0.050	0.204	0.050	0.208
Native American, Pacific Islander, Other, Mixed	0.036	0.175	0.032	0.166
GPA	3.248	0.447	3.226	0.462
Moderately selective college	0.516	0.467	0.526	0.474
Very selective college	0.276	0.417	0.271	0.422
Satisfied with job overall	0.748	0.405	-	-
Total Satisfaction Score	-	-	22.623	4.296

Table 2: Distribution of Major-Job Relatedness by major in 2009 and 2012

	Job Relatedness 2009			Job Relatedness 2012		
	Not	Somewhat	Closely	Not	Somewhat	Closely
Computer and information sciences	0.157	0.175	0.668	0.0995	0.323	0.578
Engineering and engineering technology	0.0795	0.312	0.609	0.110	0.391	0.498
Biological or physical science, science technology	0.268	0.245	0.487	0.279	0.296	0.425
Mathematics	0.212	0.133	0.655	0.0935	0.424	0.483
Agriculture and natural resources	0.260	0.209	0.531	0.191	0.398	0.412
General studies and other	0.366	0.373	0.261	0.316	0.452	0.232
Social sciences	0.394	0.385	0.221	0.368	0.423	0.209
Psychology	0.369	0.367	0.264	0.315	0.391	0.294
Humanities	0.530	0.241	0.229	0.379	0.362	0.258
History	0.684	0.179	0.137	0.488	0.352	0.160
Personal and consumer services	0.235	0.304	0.462	0.236	0.314	0.450
Manufacturing/construction/repair/transportation	0.252	0.0773	0.671	0.250	0.180	0.570
Military technology and protective services	0.434	0.248	0.318	0.341	0.254	0.405
Health care fields	0.0823	0.0946	0.823	0.0838	0.177	0.740
Business	0.158	0.356	0.486	0.150	0.418	0.432
Education	0.0934	0.0967	0.810	0.116	0.165	0.719
Architecture	0.0762	0.0944	0.829	0.185	0.197	0.618
Communications	0.332	0.306	0.362	0.217	0.435	0.348
Public administration and human services	0.218	0.189	0.593	0.166	0.352	0.482
Design and applied arts	0.258	0.269	0.474	0.154	0.170	0.675
Law and legal studies	0.245	0.366	0.389	0.317	0.437	0.246
Theology and religious vocations	0.504	0.223	0.272	0.546	0.300	0.154
Total	0.237	0.272	0.492	0.210	0.350	0.440

Within a year, the proportions of each of the three job relatedness categories sum to one. The library sciences major is excluded because of only one observation in 2009 and none in 2012.

Table 3: Determinants of Major-Job Relatedness, 2009 and 2012, dependent variable Job Relatedness

	(1) 2009 OL Coefficients	(2) 2009 Odds Ratios	(3) 2012 OL Coefficients	(4) 2012 Odds Ratios
Female	0.0777	1.081	0.0292	1.030
	(0.0750)	(0.0811)	(0.0784)	(0.0808)
GPA	0.363***	1.438***	0.232***	1.261***
	(0.0736)	(0.106)	(0.0769)	(0.0970)
Computer and information sciences	2.152***	8.603***	1.527***	4.604***
	(0.257)	(2.210)	(0.225)	(1.034)
Engineering and engineering technology	2.079***	8.000***	1.268***	3.553***
	(0.185)	(1.479)	(0.182)	(0.647)
Biological or physical science	1.333***	3.794***	0.706***	2.026***
	(0.205)	(0.776)	(0.214)	(0.433)
Mathematics	1.852***	6.372***	1.181***	3.259***
	(0.443)	(2.821)	(0.370)	(1.206)
Agriculture and natural resources	1.420***	4.138***	0.901***	2.461***
	(0.377)	(1.561)	(0.293)	(0.722)
General studies and other	0.594***	1.811***	0.178	1.195
	(0.218)	(0.395)	(0.214)	(0.256)
Social science	0.422**	1.524**	-0.0255	0.975
	(0.165)	(0.252)	(0.167)	(0.163)
Psychology	0.611***	1.843***	0.362*	1.437*
	(0.178)	(0.329)	(0.194)	(0.279)
History	-0.610*	0.543*	-0.463	0.629
	(0.322)	(0.175)	(0.287)	(0.180)
Personal and consumer services	1.371***	3.939***	0.909***	2.481***
	(0.297)	(1.168)	(0.314)	(0.778)
Manufacturing/construction/repair	2.443***	11.51***	1.670***	5.311***
	(0.605)	(6.961)	(0.534)	(2.837)
Military tech or protection	0.562**	1.754**	0.538*	1.712*
	(0.244)	(0.429)	(0.284)	(0.485)
Health care fields	3.031***	20.72***	2.238***	9.374***
	(0.211)	(4.372)	(0.201)	(1.886)
Business	1.529***	4.614***	1.006***	2.735***
	(0.145)	(0.669)	(0.143)	(0.390)
Education	2.798***	16.41***	2.034***	7.644***
	(0.189)	(3.101)	(0.186)	(1.423)
Architecture	3.016***	20.42***	1.491***	4.442***
	(0.627)	(12.80)	(0.468)	(2.078)

Communication	0.887***	2.428***	0.679***	1.972***
	(0.190)	(0.462)	(0.174)	(0.343)
Public administration and human services	1.695***	5.446***	1.124***	3.078***
	(0.262)	(1.427)	(0.255)	(0.785)
Design and applied arts	1.339***	3.814***	1.825***	6.204***
	(0.270)	(1.031)	(0.290)	(1.798)
Law and legal studies	0.854**	2.349**	0.227	1.255
	(0.418)	(0.982)	(0.467)	(0.586)
Theology and religious vocations	0.174	1.190	-0.643	0.526
	(0.473)	(0.563)	(0.531)	(0.279)
Moderately selective college	0.0144	1.014	-0.0813	0.922
	(0.0923)	(0.0936)	(0.0965)	(0.0890)
Very selective college	0.0346	1.035	0.00165	1.002
	(0.102)	(0.106)	(0.109)	(0.109)
Hours worked per week in 2009	0.0243***	1.025***		
	(0.00588)	(0.00603)		
Hours worked per week in 2012			0.00610	1.006
			(0.00460)	(0.00463)
cut1	2.332	10.30	0.426	1.530
	(0.380)	(3.910)	(0.356)	(0.545)
cut2	3.762	43.05	2.163	8.700
	(0.384)	(16.54)	(0.360)	(3.131)
Observations	8220	8220	7290	7290

Standard errors in parentheses

All regression included controls for ethnicity.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Determinants of Annual Earnings, dependent variable equals the log of earnings

	(1)	(2)	(3)	(4)	(5)
	Log of 2009 Earnings	Log of 2009 Earnings	Log of 2012 Earnings	Log of 2012 Earnings	Log of 2012 Earnings
Job somewhat related to major in 2009	0.106***	0.104***			
	(0.0222)	(0.0220)			
Job closely related to major in 2009	0.182***	0.175***			
	(0.0198)	(0.0199)			
Job somewhat related to major in 2012			0.178***	0.170***	
			(0.0315)	(0.0313)	
Job closely related to major in 2012			0.221***	0.213***	
			(0.0305)	(0.0304)	
Not related in 2009, somewhat related in 2012					0.142**
					(0.0587)
Not related in 2009, closely related in 2012					0.0586
					(0.0632)
Somewhat related in 2009, not related in 2012					0.0645
					(0.0606)
Somewhat related in both 2009 and 2012					0.219***
					(0.0548)
Somewhat related in 2009, closely related in 2012					0.174***
					(0.0581)
Closely related in 2009, not related in 2012					0.0568
					(0.0860)
Closely related in 2009, somewhat related in 2012					0.220***
					(0.0578)
Closely related in both 2009 and 2012					0.265***
					(0.0541)
Hours worked per week in 2009	0.0175***	0.0171***			
	(0.00134)	(0.00133)			
Hours worked per week in 2012			0.0141***	0.0136***	0.0118***
			(0.00234)	(0.00236)	(0.00277)
Female	-0.0729***	-0.0844***	-0.0826***	-0.0896***	-0.0958***
	(0.0162)	(0.0164)	(0.0177)	(0.0176)	(0.0191)
GPA		0.0954***		0.0675***	0.0610***
		(0.0169)		(0.0181)	(0.0208)

Moderately selective college		-0.0420** (0.0192)		-0.0149 (0.0228)	-0.0179 (0.0245)
Very selective college		0.00125 (0.0220)		0.0741*** (0.0264)	0.0734** (0.0291)
Constant	9.426*** (0.0660)	9.157*** (0.0892)	9.739*** (0.0989)	9.522*** (0.129)	9.706*** (0.148)
R^2	0.229	0.238	0.194	0.203	0.200
Observations	8300	8220	7330	7290	5820

Standard errors in parentheses

All regressions include controls for undergraduate major and ethnicity.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Distribution of Major-Job Relatedness 2009 and 2012

	Job Relatedness			
	Not related	Somewhat related	Closely related	Total
Not related	0.135	0.0908	0.0481	0.274
Somewhat related	0.0476	0.136	0.0812	0.265
Closely related	0.0346	0.108	0.318	0.461
Total	0.217	0.335	0.447	1

Table 6: Determinants of overall job satisfaction in 2009, Satisfied = 1, Not = 0

	(1) LPM	(2) Logit Coefficients	(3) Logit Odds Ratio
Job somewhat related to major in 2009	0.161***	0.708***	2.030***
	(0.0233)	(0.106)	(0.215)
Job closely related to major in 2009	0.303***	1.603***	4.968***
	(0.0213)	(0.113)	(0.561)
Female	-0.00181	-0.0000810	1.000
	(0.0162)	(0.0928)	(0.0928)
GPA	0.0341**	0.191**	1.211**
	(0.0160)	(0.0910)	(0.110)
Moderately selective college	-0.0338*	-0.204*	0.816*
	(0.0182)	(0.110)	(0.0897)
Very selective college	-0.00353	-0.0271	0.973
	(0.0204)	(0.126)	(0.122)
Hours worked per week in 2009	0.00449***	0.0280***	1.028***
	(0.00106)	(0.00724)	(0.00745)
Constant	0.287***	-1.391***	0.249***
	(0.0773)	(0.457)	(0.114)
R^2	0.107	-	-
Observations	8220	8220	8220

Standard errors in parentheses

All regressions include controls for undergraduate major and ethnicity.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Determinants of several measures of job satisfaction in 2012

	(1)	(2)	(3)	(4)	(5)	(6)
	Satisfaction: Challenge (OL)	Satisfaction: Importance (OL)	Satisfaction Z-Score (OLS)	Satisfaction: Challenge (OL)	Satisfaction: Importance (OL)	Satisfaction Z-Score (OLS)
Job somewhat related to major in 2012	0.741*** (0.0934)	0.771*** (0.0988)	0.330*** (0.0382)			
Job closely related to major in 2012	1.348*** (0.0970)	1.436*** (0.101)	0.512*** (0.0375)			
Not related in 2009, somewhat related in 2012				0.731*** (0.160)	0.710*** (0.173)	0.329*** (0.0703)
Not related in 2009, closely related in 2012				0.959*** (0.237)	1.209*** (0.219)	0.382*** (0.0937)
Somewhat related in 2009, not related in 2012				-0.582** (0.235)	-0.331 (0.235)	-0.254*** (0.0911)
Somewhat related in both 2009 and 2012				0.622*** (0.139)	0.632*** (0.145)	0.333*** (0.0547)
Somewhat related in 2009, closely related in 2012				1.286*** (0.183)	1.437*** (0.187)	0.489*** (0.0651)
Closely related in 2009, not related in 2012				0.479** (0.241)	0.470 (0.305)	0.120 (0.106)
Closely related in 2009,				0.709*** (0.158)	0.854*** (0.164)	0.308*** (0.0608)

somewhat related in 2012						
Closely related in both 2009 and 2012				1.243*** (0.135)	1.305*** (0.141)	0.488*** (0.0527)
Female	0.102 (0.0756)	0.242*** (0.0752)	0.0413 (0.0286)	0.105 (0.0850)	0.260*** (0.0849)	0.0499 (0.0315)
GPA	0.170** (0.0706)	0.111 (0.0734)	0.0142 (0.0282)	0.172** (0.0766)	0.118 (0.0802)	0.000240 (0.0294)
Moderately selective college	0.0142 (0.0886)	-0.154* (0.0920)	0.0353 (0.0341)	0.0793 (0.0974)	-0.0715 (0.100)	0.0549 (0.0369)
Very selective college	-0.0764 (0.101)	-0.201* (0.107)	0.0287 (0.0397)	-0.00847 (0.112)	-0.120 (0.119)	0.0601 (0.0431)
Hours worked per week in 2012	0.0360*** (0.00481)	0.0185*** (0.00505)	-0.000532 (0.00182)	0.0366*** (0.00533)	0.0204*** (0.00570)	-0.000924 (0.00199)
Constant			-0.483*** (0.136)			-0.377** (0.148)
cut1	0.00234 (0.365)	-1.134 (0.382)		-0.0559 (0.394)	-1.063 (0.422)	
cut2	1.134 (0.362)	0.0834 (0.377)		1.073 (0.392)	0.157 (0.411)	
cut3	2.198 (0.360)	1.196 (0.375)		2.155 (0.391)	1.297 (0.411)	
cut4	3.756 (0.365)	2.901 (0.378)		3.725 (0.397)	3.020 (0.414)	
R^2			0.085			0.092
Observations	7290	7290	7290	5820	5820	5820

Standard errors in parentheses

All regressions include controls for undergraduate major and ethnicity.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Highlights of
"The Effects of Major-job Mismatch on Early Career Earnings and Job Satisfaction"

- We use a United States restricted-use dataset to analyze data on major-job match one year after graduation (2009) and three years later (2012)
- Unlike other papers using US data, we are able to control for ability using undergraduate GPA and college selectivity.
- We exploit the panel data to estimate the effects of changes in job relatedness on income and job satisfaction over time.
- We find that major-job match wage premia exist one year after graduation and persist three years later, with the greatest premia for consistent close matches over both periods.
- We find that job satisfaction one and four years after graduation is greater among graduates with a closer major-job match in a given period, or those who transition into, or persist in, a close match in the second period.