ANALYSIS OF LONG-TERM OUTCOMES FOR UNIVERSITY GRADUATES IN INFORMATION AND COMMUNICATION TECHNOLOGY PROGRAMS

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I. Introduction

This report presents the results of an analysis of labour market outcomes of graduates of Information and Communications Technology (ICT) programs from the University of Ottawa. The project exploits a unique dataset which links university administrative data with tax record data, allowing us to follow individuals from their post-secondary education (PSE) experiences into their post-graduation labour market outcomes. This linked dataset allows us to see how students with different schooling backgrounds do in the labour market, and to do so on a year-by-year basis following graduation for a continuous range of cohorts of graduates dating as far back as 1998 and as recently as 2010.

This report profiles the earnings of graduates from ICT programs on a cohort-by-cohort basis across time. Along with comparing mean earnings between ICT graduates, graduates of non-ICT engineering programs (the 'closest' comparison group) and graduates of all other programs, we also conduct a quartile comparison of earnings for these groups. Finally, we present a separate analysis of mean earnings of each group by gender.

II. Context

The ICT sector is an important part of Canada's digital economy. Although generally considered to be critical to Canada's economic prosperity, it may be facing a shortage of skills and talent. These shortages may hinder the ICT sector from being internationally competitive. Policy makers have been limited in their efforts to address these issues due to a lack of concrete information on the labour market outcomes of ICT graduates. Providing new empirical evidence on the numbers of ICT graduates and their early labour market outcomes on a year-by-year, cohort-by-cohort basis will help inform these issues.

This study uses the administrative data of one post-secondary education (PSE) institution, serving as a pilot project to demonstrate the worth of linking PSE institutional data to tax record data to study labour market outcomes. In doing so, we are able to provide data on labour market outcomes that is more accurate than the small and biased samples on graduates currently carried out by post-secondary education (PSE) institutions themselves and more accurate than using Census data. Using a data linkage strategy, we are able to answer the following questions: Are graduates of ICT programs doing well in the labour market? How do earnings patterns of ICT

students evolve over the years following graduation, taking into account experience on future earnings? Have earnings patterns changed over time (i.e., across graduating cohorts and between graduates of ICT and non-ICT programs)?

Those areas of study where graduates have received higher earnings (and increasing over time) presumably represent areas where there is strong demand for the skills obtained by studying those disciplines, and the converse could be inferred for those earning less. This kind of information could help inform a range of policies relating to labour markets and the PSE system, as students are likely to be drawn to areas of high demand (where their skills are presumably needed) and PSE institutions have incentives to respond with the programs they offer.

Such dynamics – the flow of students into disciplines where labour market demand is high – are a central element of the standard human capital model of skill acquisition and (related) post-schooling outcomes, which leads to human resources going where they will be most productive. However, this can only happen to the degree that there is accurate information on labour market outcomes, which is an area where there currently exist significant shortcomings.

III. Main Findings

This section presents the key findings of the research project.

III.1. Number of Graduates

- Relatively few students graduated from an ICT program at the University of Ottawa over the 13 year period covered by this study. An even smaller number of students graduated from non-ICT engineering programs in all but the final two years included in this analysis.
- The number of students that graduated from ICT programs varied over the timeframe of this analysis. The number of ICT graduates increased from 80 in the 1998 graduating cohort to a high of 260 in the 2004 cohort, and then fell to 150 graduates in the 2008 cohort and fell further still to 70 in 2009 and 80 in 2010.
- This pattern may reflect the dramatic decline in the relative earnings position of ICT graduates following the dot-com bust of 2001.
- There appears to be negative relationship in the number of students graduating from ICT and engineering (non-ICT) programs over the timeframe covered by this study. This perhaps suggests that potential ICT students, who have similar qualifications to

engineering students, chose to enroll in engineering rather than ICT following the decline in ICT earnings prospects.

III.2. Earning Patterns

- ICT graduates registered an earnings premium over graduates from all other (non-ICT) programs for every cohort examined. This premium was particularly large prior to 2001 and persisted for the entire period for every cohort.
- ICT graduates also registered an earnings premium over graduates from engineering (non-ICT) programs in all cohorts prior to 2001. After 2001, however, engineering graduates performed as well, if not better than, ICT graduates.
- The dot-com bubble burst had a strongly negative effect on 1st year mean earnings for ICT graduates. For example, 1st year earnings for the ICT group varied between a maximum of $75,000 for those who graduated in 1998, and then fell to a low of $43,100 for those who graduated in 2004. First year earnings then recovered through 2007, after which they held relatively steady in the $50,000 range.
- Engineering (non-ICT) graduates experienced similar swings in 1st year earnings, but these were not as great as those for ICT graduates. Earnings patterns of this comparator group were relatively consistent with those of the ICT graduates.
- The 1st year mean earnings of non-ICT graduates were, conversely, much more stable. First year earnings for this group varied by no more than $5,000 over the entire period covered (including after the 2008 financial crisis).
- Fifth year mean earnings patterns tended to be consistent with those observed in the 1st year mean earnings.

III.3. Gender and Quartile Findings

- In all cohorts prior to 2002, ICT graduates were earning more at each quartile than non-ICT graduates and Engineering graduates.
- The lower quartile earnings were most impacted by the dot-com bubble burst. They saw a consistent decrease in 1st year earnings between 2001 and 2004, moving from $63,100 to $23,900. Since 2004, 1st year lower quartile earnings increased to $41,000.
- Women tended to have lower earnings than men for both graduates of ICT programs and

non-ICT programs.

- For each of the three groups of graduates, the gap in earnings between men and women grew over time for each cohort.

IV. Data and Methodology

This section describes the creation of the dataset which links administrative University of Ottawa with tax data, and the steps taken to undertake the final analysis. Addressed below are the creation of the measure of earnings, the sample inclusion and the censoring strategy for graduates that do not file taxes and those that return to school, and the construction of the ICT, non-ICT and comparator groups.

IV.1. Creation of Linked Dataset

The University of Ottawa's Institutional Research and Planning (IRP) office provided Statistics Canada with the administrative data on all graduating students from the University of Ottawa between the years 1998 and 2010. These data include specific information on students such as gender and program of study, among others. The University also provided a separate file that included the individual student identifiers required to link students to the tax data (e.g., full name, precise date of birth, and geographical information). At no point were the two files containing student information at Statistics Canada at the same time, further ensuring a high level of student-privacy and confidentiality. Identifiable, individual-level student information was destroyed after the linkage was completed by Statistics Canada and the analysis file does not include any of the above-mentioned student identifiers. Additionally, researchers were not given direct access to micro records and instead worked with an analyst at Statistics Canada.

Statistics Canada's tax record data for this study is available from 1998 to 2011. This tax data represents the adult population very well as the rate of tax filing in Canada is very high. Upper and middle-income Canadians are required to file, whereas lower-income Canadians have strong financial incentives to file as they can recover a part of their income tax and other payroll tax deductions made throughout the year, or receive various tax credits. As a result, over 99 percent of graduating students at the University of Ottawa could be matched to at least one tax year record. The final dataset consists of 82,000 University of Ottawa graduates.

IV.2. Statistics Canada Disclosure Rules

The results below follow Statistics Canada's disclosure rules. These rules state that where observation counts are lower than 15, the results must be suppressed. Furthermore, to protect individual privacy, all counts are rounded to the nearest 10 and final earnings to the nearest $100.

IV.3. Measure of Earnings

To measure labour market outcomes, this analysis focuses on total before-tax earnings, created by combining three measures of each graduate's yearly income. We combine the earnings from the T4 slips with any declared self-employment income and other employment income. The focus on before tax income ensures that the effects of various tax credits and transfer programs, which would disproportionately affect the after tax earnings of some types of graduates, are not captured. For example, individuals with children could claim a tax credit that would raise their after tax earnings relative to those that do not have children and have the same level of before tax earnings.

In order to track each individual's earnings over time, and to capture the effects of labour market experience on earnings, this analysis will examine earnings on a cohort-by-cohort basis by year after graduation. As an example: for a student who graduated in 1998 (the 1998 cohort), we observe their earnings at one year after graduation, i.e. in fiscal/tax year 1999, and follow them on a yearly basis for as long as we have earnings information. For this earliest cohort, we have earnings information spanning 13 years (until 2011), while for later cohorts we have less information; for example, for the 1999 cohort, we would have 12 years of earnings information, while for the 2010 cohort, we would only have a year of earnings information.

As part of the analysis, we also examine the change in earnings in the 1st year after graduation between cohorts. This serves as a measure of labour market value of new entrants into the labour force and allows us to capture the effects of the business cycle on the earnings of recent graduates. In the cases where the analysis is focused on 1st year earnings, the fiscal year following the year of graduation is considered year 1 but the findings are presented on a yearly basis (ie. 1999 through to 2011).

We focus exclusively on mean earnings in this report. All earnings are Consumer Price Index (CPI) adjusted to 2011 dollars.

IV.4. Sample Inclusions and Censoring

Since we want to include only individuals that worked in a given year, we censor graduates in every year in which their total before tax earnings are lower than or equal to $1000, under the assumption that earnings below $1000 represent an individual that did not work in that fiscal year. We exclude individuals that did not file taxes in a given year, but allow them to return into the sample for all years for which there is tax information for them.

Additionally, individuals are censored if they returned to school in any given year and for all subsequent years thereafter. We consider individuals to have returned to school if they claim more than $100 in tuition expenses in a given tax year. This approach ensures that we do not include those who returned to school to upgrade their skills, as we would expect these individuals to obtain an earnings premium compared to those who have not completed additional schooling.

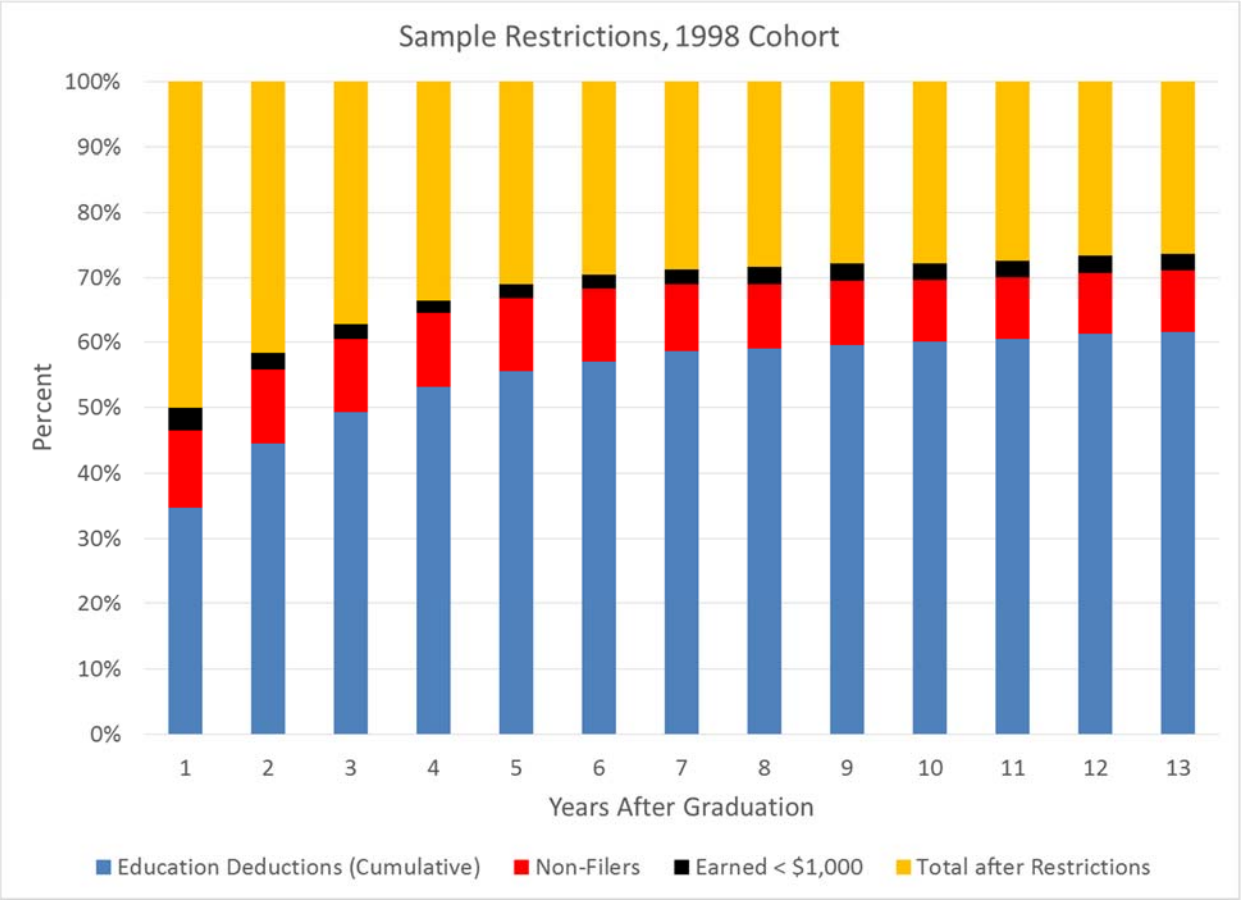
Graph 1 presents the effects of the censoring strategy on the subset of the 1998 cohort of graduates (see Table 1 in Appendix 1). We present the entire subset of the 1998 graduating class as a whole due to the small number of graduates from ICT programs which would lead to the suppression of results.

In the 1st year after graduation around 35% of graduating students of the 1998 cohort are censored because they were found to be in school (ie. they claimed at least $100 in education deductions in the 1st full year after graduation). For each additional year after graduation, a significantly smaller number of graduates returned to school, but the total proportion grows over time due to the fact that this censoring criterion is cumulative (those that returned to school in the 1st year after graduation are counted in all subsequent years). The education deductions in years 9, 11 and 13 are imputed because less than 15 individuals were found to be in school in those years (we impute by taking the mean of the number of students with education deductions in the previous and subsequent years).

Around 10% of the sample is censored in the 1st year after graduation because these individuals did not file their taxes in that year. The number of graduates that did not file their taxes remains roughly the same for this cohort for each year after graduation. An even smaller number (around 4%) is censored in every year due to the fact that these individuals earned $1,000 or less in that year. As with the education deductions, the number of students who earned less than our

threshold is imputed for years 9, 11 and 13.

Graph 1 – Sample Restrictions, 1998 Cohort



For the 1998 cohort, the total sample size in the 1st year after graduation is around 50% of the total number of graduates in that cohort (around 1,150 graduates in total). By year 13 after graduation, the total sample is reduced to a quarter of the total number of graduating students (around 600).

IV.5. Employment Rates

Due to the relatively small sample size of ICT graduates and Statistics Canada disclosure rules, we are unable to generate meaningful employment rates. Employment rates were generated by dividing the number of students with earnings in a given year (generally the first year after graduation) by the sum of the number of students with earnings and the number of student with no earnings, for each cohort. For most cohorts of ICT graduates very few individuals were unemployed after graduation, generating employment rates that were 100% due to the Statistics

Canada rounding requirements. In order to generate meaningful employment rates in the future, we would need a larger sample size by including more post-secondary education (PSE) institutions in the analysis.

IV.6. Definition of ICT, Non-ICT and Comparator Groups

This analysis is confined to graduates who obtained a bachelor degree and excludes individuals that graduated with advanced degrees. Bachelor degrees which cannot be started directly from high school (e.g. education or law) are excluded. Given that we also have information about graduate degree holders from the University of Ottawa, future analyses could be undertaken to examine the outcomes of graduates with advanced degrees.

The entire bachelors degree holding sample is divided into three groups. We create the 'ICT' group by grouping together students who graduated from programs with the following Classification of Instructional Programs (CIP) codes:

- 11: Computer and information sciences and support services
- 14.09: Computer engineering
- 14.10: Electrical, electronics and communications engineering
- 15.12: Computer engineering technologies/technicians
- 30.06: Systems science and theory
- 30.08: Mathematics and computer science
- 30.16: Accounting and computer science
- 27.0303: Computational mathematics

To create a comparison group to the ICT graduates, we include all graduates of engineering programs not included in the ICT group above. We refer to this group as 'Engineering' and it consists of all graduates from programs with an engineering CIP code (14), but excludes Computer Engineering (14.09) and Electrical, Electronics and Communications Engineering (14.10).

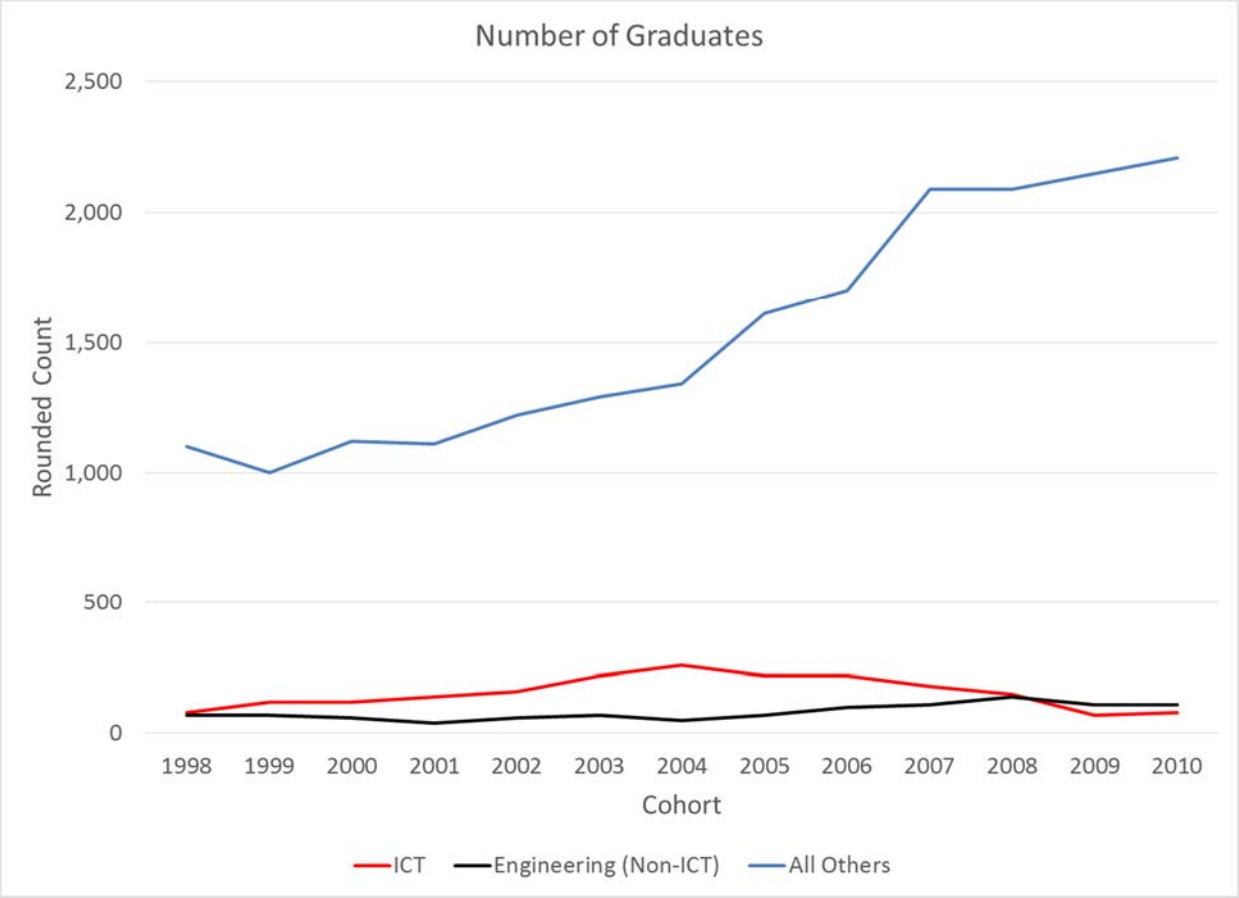
Finally, all graduates not part of the two groups mentioned above are a part of the 'non-ICT (All Others)' group. This group includes graduates from very diverse programs and faculties ranging from the Fine Arts to the Social Sciences.

V. Descriptive Statistics

V.1. Number of Graduates

This section presents the number of graduates in each of the three groups included in the sample in the 1st year after graduation. As Graphs 1a and 1b demonstrate, in the first cohort (students that graduated in 1998), we observe 80 ICT graduates, 70 Engineering graduates and 1100 graduates from non-ICT (All Other) programs. In the last cohort (2010), the number of graduates from non-ICT programs roughly doubles in size to 2210, while the numbers of ICT graduates remains the same as in the first cohort (a total of 80 graduates) and the number of Engineering graduates increases to 110.

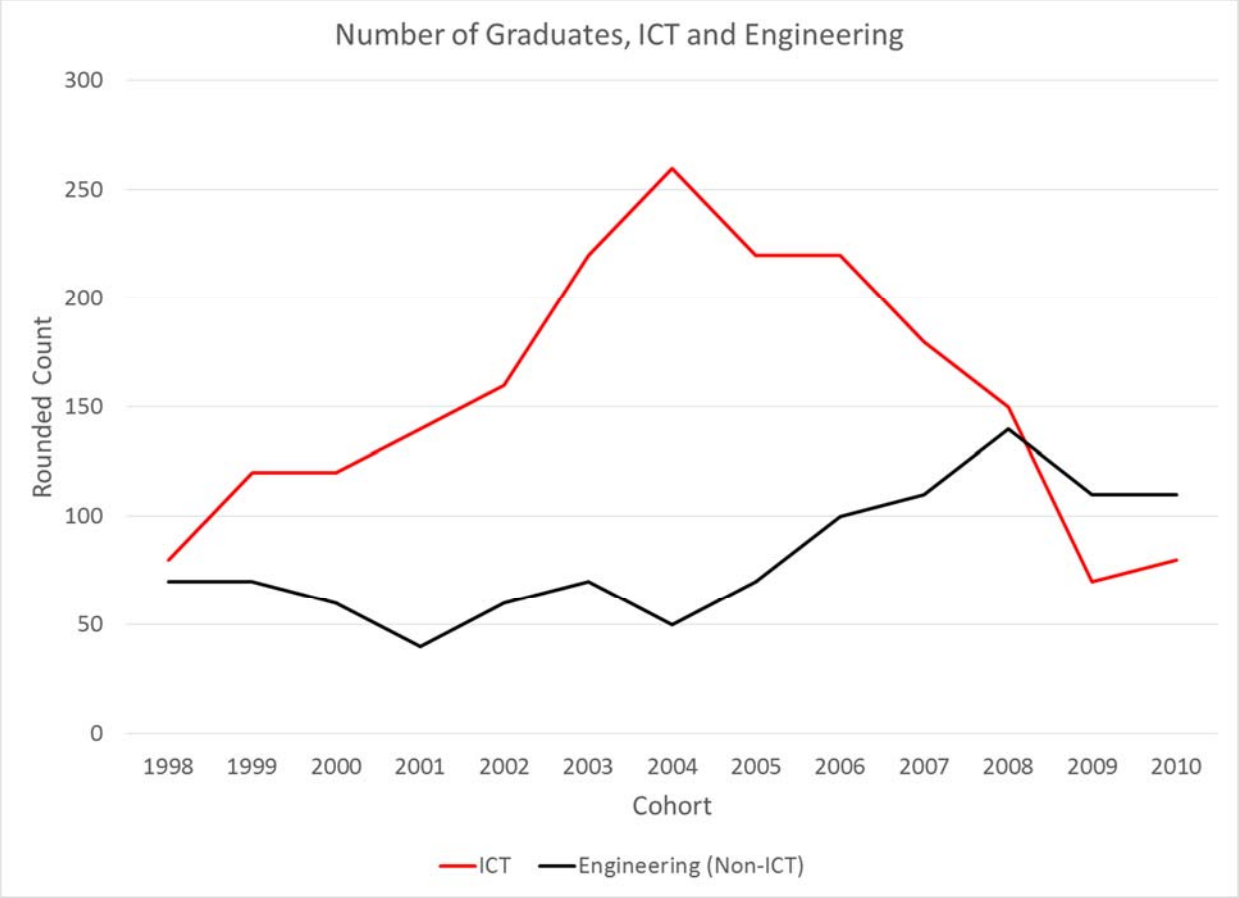
Graph 1a – Number of Graduates



Graph 1b looks at the distribution of graduates of ICT and Engineering programs only. The largest number of students graduating from ICT programs during the timeframe of this analysis

occurred in the year 2004 (2004 cohort), when there were 260 graduates. While the number of graduates from non-ICT programs (All Others) has been increasing continuously over time, the number of ICT graduates peaked in 2004 and then decreased, falling below the 1998 level in the final cohort of this study. As we will see below, the number of graduates from ICT programs appears to reflect earning opportunities prevailing in the sector when these students would have entered university.

Graph 1b – Number of Graduates, ICT and Engineers



The numbers of Engineering graduates has been generally increasing over time, with small drops in 2001 and 2004. Since 2004, however, the numbers of graduates from engineering programs has been steadily increasing, peaking in 2008. Given the negative relationship between the number of graduating students from engineering and ICT programs over time, and especially after 2004, we speculate that students were choosing to enter one of these two areas of study and that their choice was affected, at least in part, by earnings opportunities prevailing in the field when

they entered university.

V.2. Cohort Analysis

This section examines earnings by years after graduation for different cohorts of graduates (defined with respect to the year they finished their studies). As mentioned above, since this analysis uses tax information between fiscal years 1999-2011, later cohorts have less complete earnings profiles than earlier cohorts, while the first cohort (1998) has a complete profile of 13 years. We focus on cohorts 1998, 2000, 2004 and 2008 throughout most of this report. For the earnings profiles of the remaining cohorts refer to the graphs and Tables 3 (mean earnings) and 4 (median earnings) in the appendix.

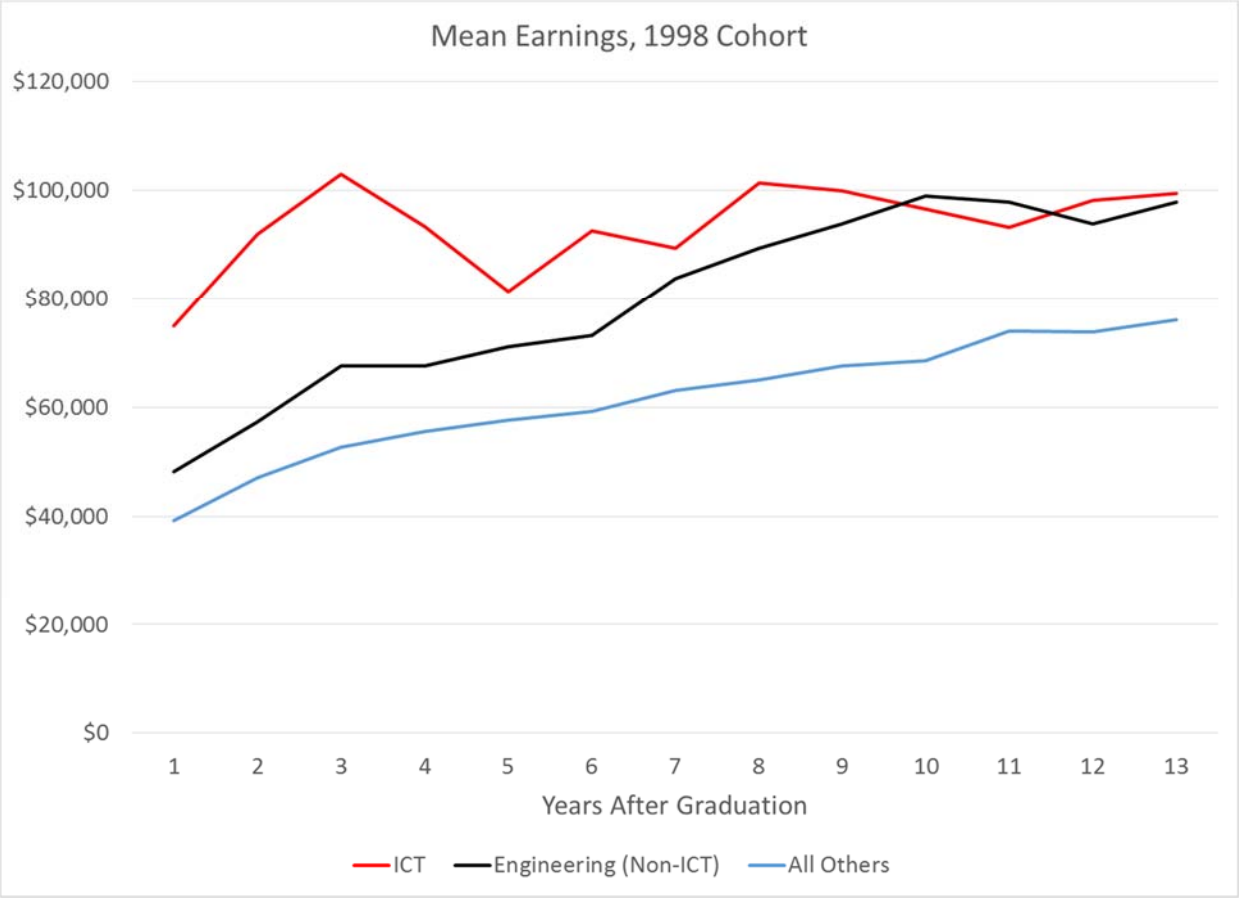
1. 1998 Cohort - A complete profile

Graph 2a presents the earnings profiles of ICT graduates, Engineering (Non-ICT) graduates as well as graduates from non-ICT (All Other) programs from the 1998 cohort. Year 1 after graduation corresponds to fiscal year 1999, year 2 after graduation corresponds to fiscal year 2000 and so on until year 13 after graduation (fiscal year 2011).

The 1998 cohort of ICT graduates entered the workforce with significantly higher earnings than both Engineering graduates (around $27,000 higher) and graduates of all other programs (around $35,000 higher). The gap between ICT graduates and all other graduates narrowed to around $20,000 at the end of the 13 year period, while it was almost entirely eliminated between ICT and Engineering graduates.

The effects of the dot-com bubble and the recession of 2008 are clearly visible on the earnings of our earliest cohort. The 1998 cohort of ICT graduates saw rapid increases in their yearly earnings leading up to the dot-com bubble burst in 2001 (3 years after graduation). The effects of the burst are evident in the substantial decreases in earnings in the 4th and 5th year after graduation (fiscal years 2002 and 2003). There is significant variability in yearly earnings between years 5 and 8, with earnings increasing in one year then decreasing in the next. After year 8 (fiscal year 2006) earnings decrease for three consecutive years, including during the fiscal years spanning the 2008 recession (years 10 and 11 after graduation). This cohort of ICT graduates rebounds from the 2008 recession quickly, however, as earnings rise back to near pre-recession levels over the next 2 years.

Graph 2 – Mean Earnings, 1998 Cohort



The 1998 cohort of non-ICT engineers experiences large gains in year-over-year earnings during the first three years of employment (fiscal years 1999-2001) similar to ICT graduates, but unlike ICT graduates, experiences no earnings decreases during the years following the dot-com bubble burst. For this group, earnings rise by around $10,000 per year during the first 3 years, potentially as the result of the engineers entering the ICT sector in place of graduates from more ICT programs. The effect of the 2001 bubble burst does not lead to lower yearly earnings for this group, but a one year period of stagnation. Leading up to the recession of 2008, non-ICT engineers continue to experience year-over-year earnings gains, surpassing the earnings of ICT graduates in their 10th year after graduation. The effect of the 2008 recession is observable with earnings decreasing slightly in years 11 and 12 after graduation.

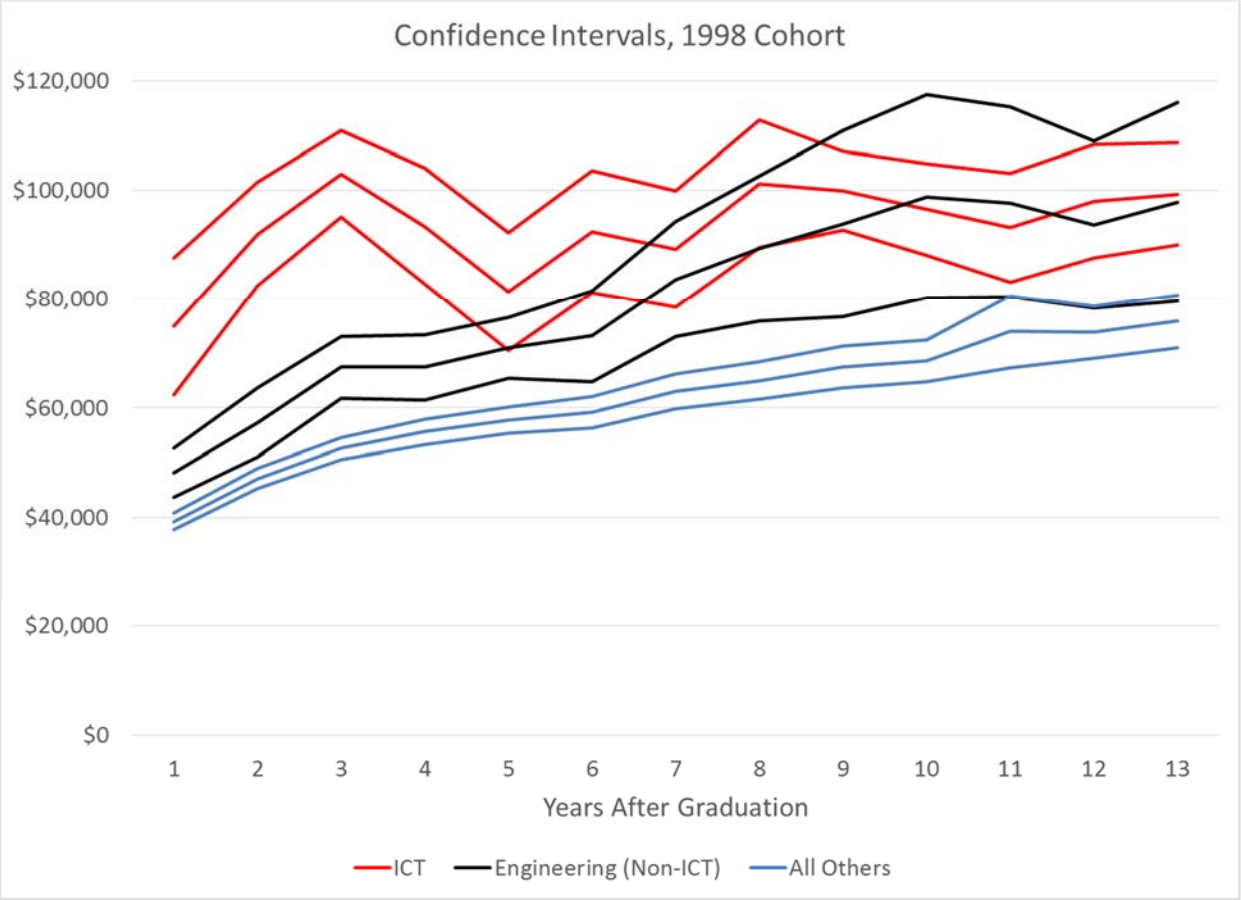
The same cohort of graduates from All Other programs had a much smoother earnings profile. For this group earnings rise fastest during the first 3 years after graduation, potentially

resulting from the expanding economy prior to the dot-com bust. The 2001 burst and the 2008 recession have little observable effect on this group as earnings only plateau between years 11 and 12 after graduation (fiscal years 2009 and 2010).

2. 1998 Cohort - Confidence Intervals

Graph 2b builds on Graph 2a above (mean earnings of the 1998 cohort) but adds the 95% confidence intervals. The middle of the three lines of the same colour represents the mean earnings of each group we presented above, while the line above and the line below denote the upper and the lower confidence limit of the mean, respectively. The variance in confidence limits captures the underlying differences in income distribution, as well as the differing sample sizes among our three groups.

Graph 2b – Confidence Intervals – 1998 Cohort



Graduates of ICT programs had moderate differences between the upper and lower limits of actual earnings for each of the 13 years after graduation (around $10,000). These differences

remain roughly constant over the 13 year period for which we have data.

Engineering graduates of the 1998 cohort began the 13 year period with narrower confidence intervals. However, in the final year of the analysis there was close to a $40,000 difference between the upper and lower limit. This result appears to be primarily driven by the fact that there were large differences in the income distribution among graduates of this group later on in their careers.

Graduates of All Other programs had narrower confidence intervals than the other two groups. As this group is the largest of the three examined, the large sample size is likely to explain some of the difference in variance, although as we will see below in our quartile analysis, they also reflect a somewhat tighter distribution in incomes, compared to the ICT and Engineering graduates.

Looking at the confidence intervals in this way allows us to solidify some of the initial findings above. For example, the upper limit of actual earnings for graduates of All Other programs is lower than the lowest limits of the ICT graduates in all years after graduation, and is also lower than the lowest limits of Engineering graduates for all years except the final two. The results, therefore, further demonstrate that earnings tend to be highest for ICT graduates, followed by Engineering graduates and finally graduates of All Other programs.

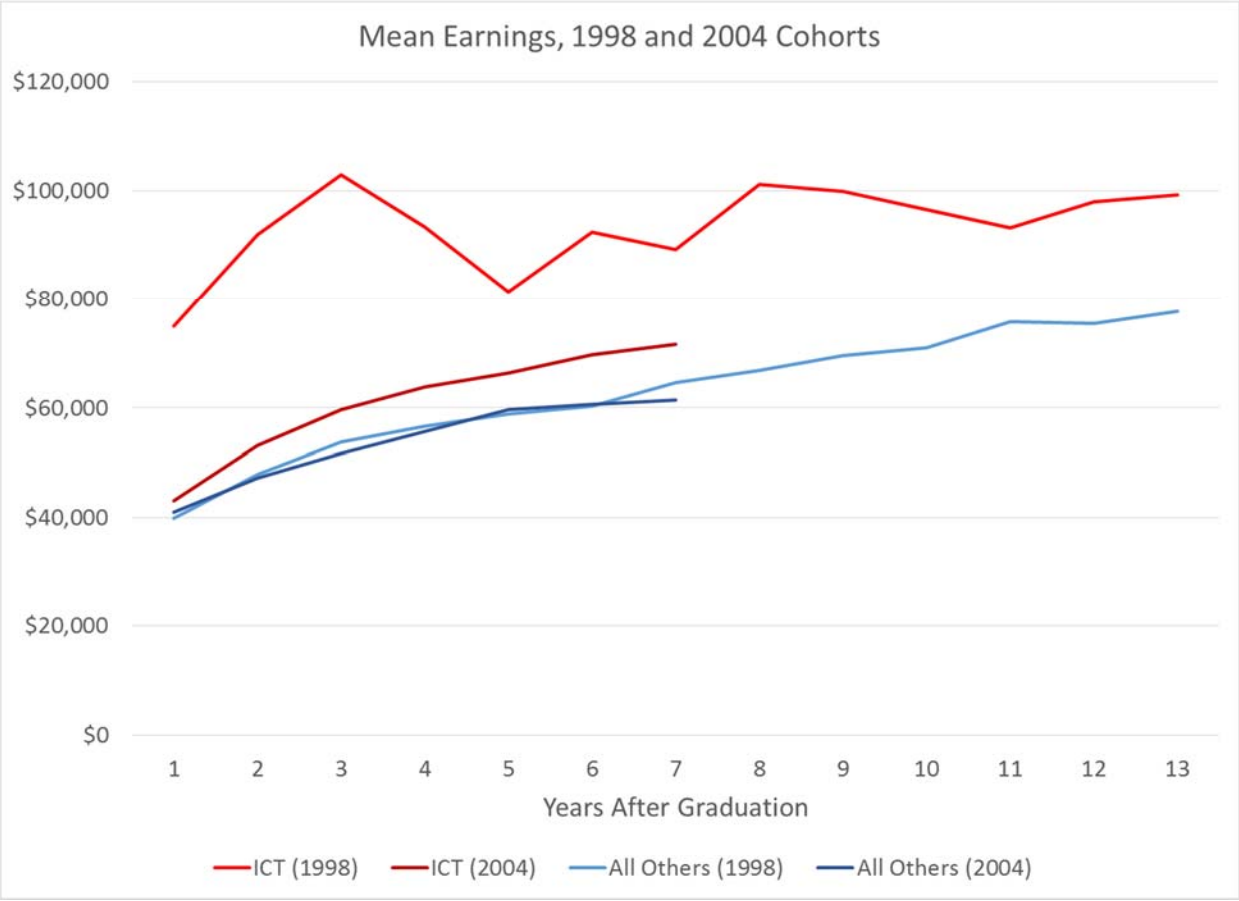
3. Cohorts Compared - the 1998 and 2004 Cohorts together

Graph 3 adds the earnings profiles of the 2004 cohort on top of those of the 1998 cohort for comparative purposes. In order to simplify the comparison we do not present graduates of Engineering programs in this section.

The 2004 cohort of ICT graduates entered the workforce several years after the dot-com bust and this is reflected in their substantially lower earnings in the 1st year after graduation relative to the 1998 cohort of ICT graduates. Graduates of ICT programs in the 2004 cohort had mean 1st year earnings of around $43,100, the second lowest of all ICT cohorts in this analysis and close to the mean 1st year earnings of all other graduates of non-ICT programs in the same cohort ($40,500). The improved economic situation in fiscal year 2006 (2nd year after graduation for the 2004 cohort) led to an increase in earnings of around $10,000 between the 1st and 2nd year after graduation. For the remainder of the timeframe for which we have data on this cohort, graduates

of ICT programs saw their earnings increase year-over-year.

Graph 3 – Mean Earnings, 1998 and 2004 Cohorts



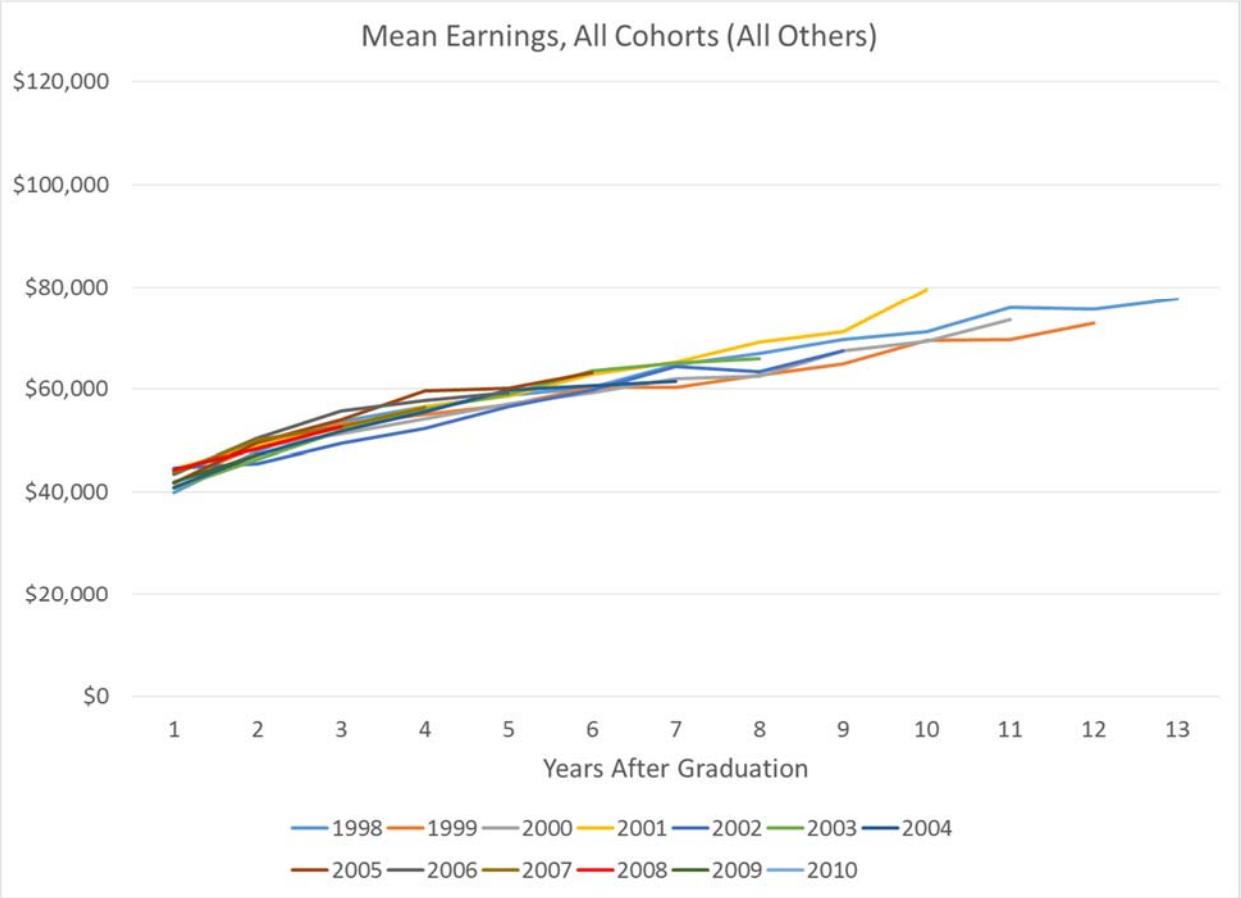
All Other graduates of the 2004 cohort registered one of lowest 1st year earnings of any non-ICT cohort ($40,500). This low figure would suggest that the effects of the dot-com bubble were felt throughout the economy, as earnings in the 1st year after graduation dropped for subsequent cohorts of graduates from non-ICT programs after 2001. During the 7 year timeframe for which we have tax information for the 2004 cohort of non-ICT graduates, this group registered year-over-year increases in earnings, with the smallest increases occurring in the last two years (fiscal years 2010 and 2011).

A significant effect of the dot-com bubble burst has been the bubble's effect on earnings later in the careers of ICT graduates, particularly for those who entered the labour force after the collapse of the bubble. In year 7 after graduation, the 1998 cohort of ICT graduates was earning around $17,500 more than ICT graduates from the 2004 cohort at the same point in their careers.

4. All Cohorts Together

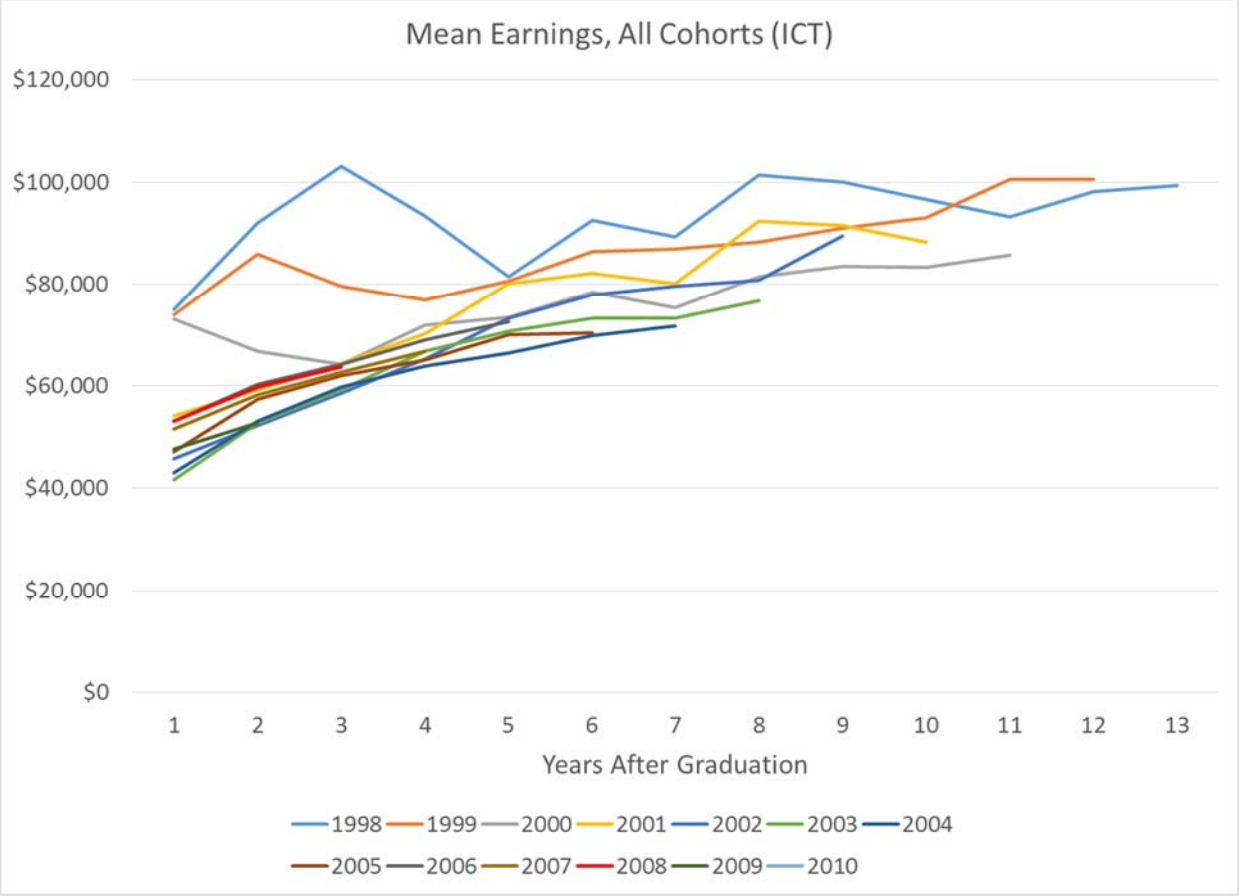
Graph 4a groups the earnings profiles of all the cohorts of graduates from non-ICT programs (All Others), Graph 4b does the same for all the cohorts of ICT graduates and Graph 4c groups the earnings profiles of all cohorts of graduates from Engineering programs, allowing us to see how the various cohorts compare.

Graph 4a – Mean Earnings, All Cohorts (All Others)



The earnings profiles of all cohorts of graduates of non-ICT programs (All Others) are remarkably stable, with every cohort increasing their earnings over time. The variation in mean earnings in the 1st year after graduation between the cohorts is small (contained to around $5,000), but appears to have an impact on earnings over time for some of the earlier cohorts. For example, the 2001 cohort had higher earnings in the 1st year after graduation than the 1998, 1999 and 2000 cohorts, and was earning significantly more than these previous three cohorts in year 10 after graduation.

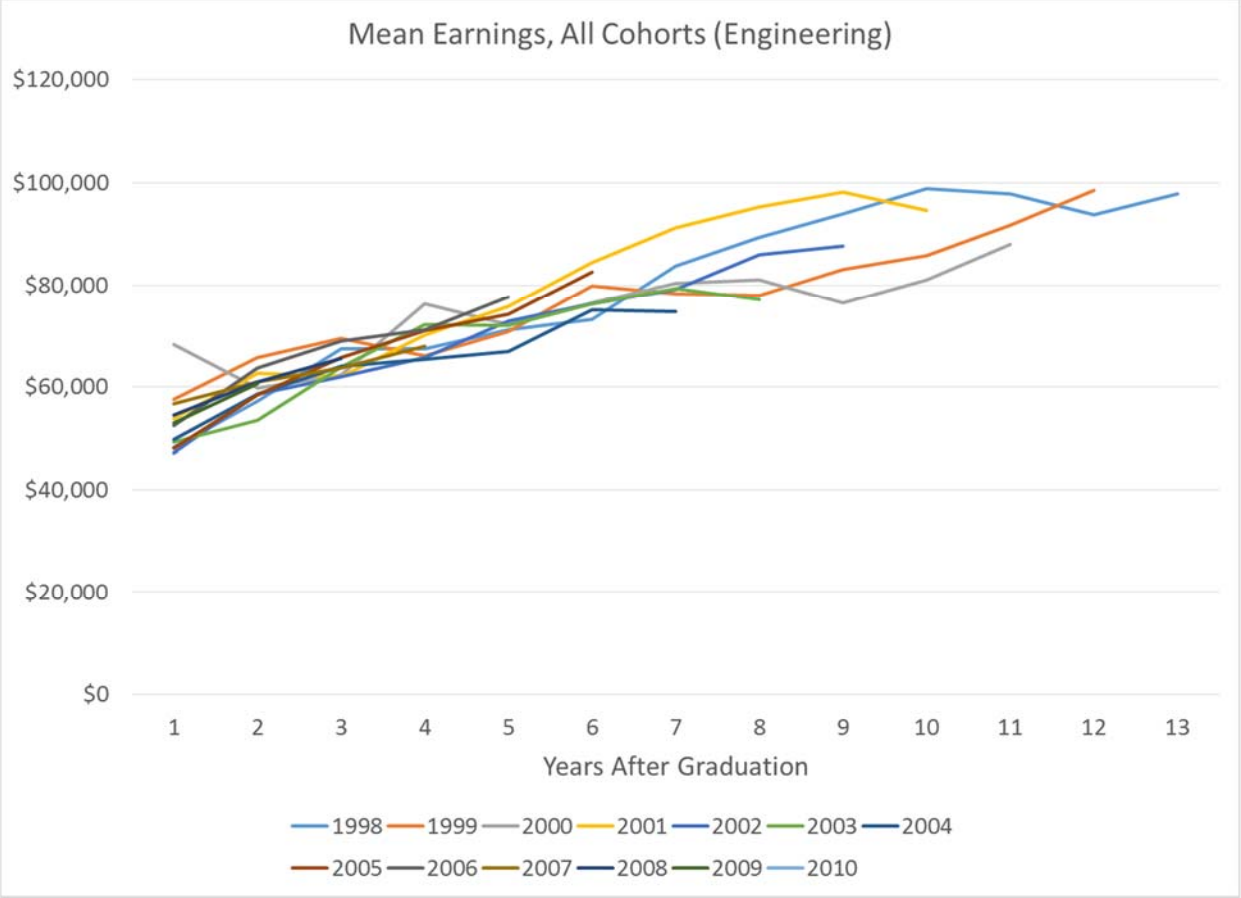
Graph 4b – Mean Earnings, All Cohorts (ICT)



There is considerably more variability in the mean earnings profiles between the cohorts of graduates from ICT programs. This is particularly evident when looking at the 1st year earnings. The first three cohort (1998, 1999 and 2000) had significantly higher 1st year earnings than all the subsequent cohorts, while also exhibiting much more variability in earnings year-over-year. The remaining cohorts exhibit less variability in earnings across time than do the first three, but have significantly lower earnings at most years after graduation. The only exception to this rule is the 2002 cohort, which does better than the 2000 cohort in the final few years for which we have data.

The earnings profiles of all the cohorts of Engineering graduates is less variable than those of the ICT graduates, but exhibits more variability than those of the All Others group. Similar to the ICT group there are sizable differences in 1st year earnings between the cohorts. This is especially true with the 2000 cohort of Engineers which earned significantly more in the 1st year after graduation than all the other cohorts.

Graph 4c – Mean Earnings, All Cohorts (Engineering)



5. Selected Cohorts - 1998, 2000, 2004, 2008

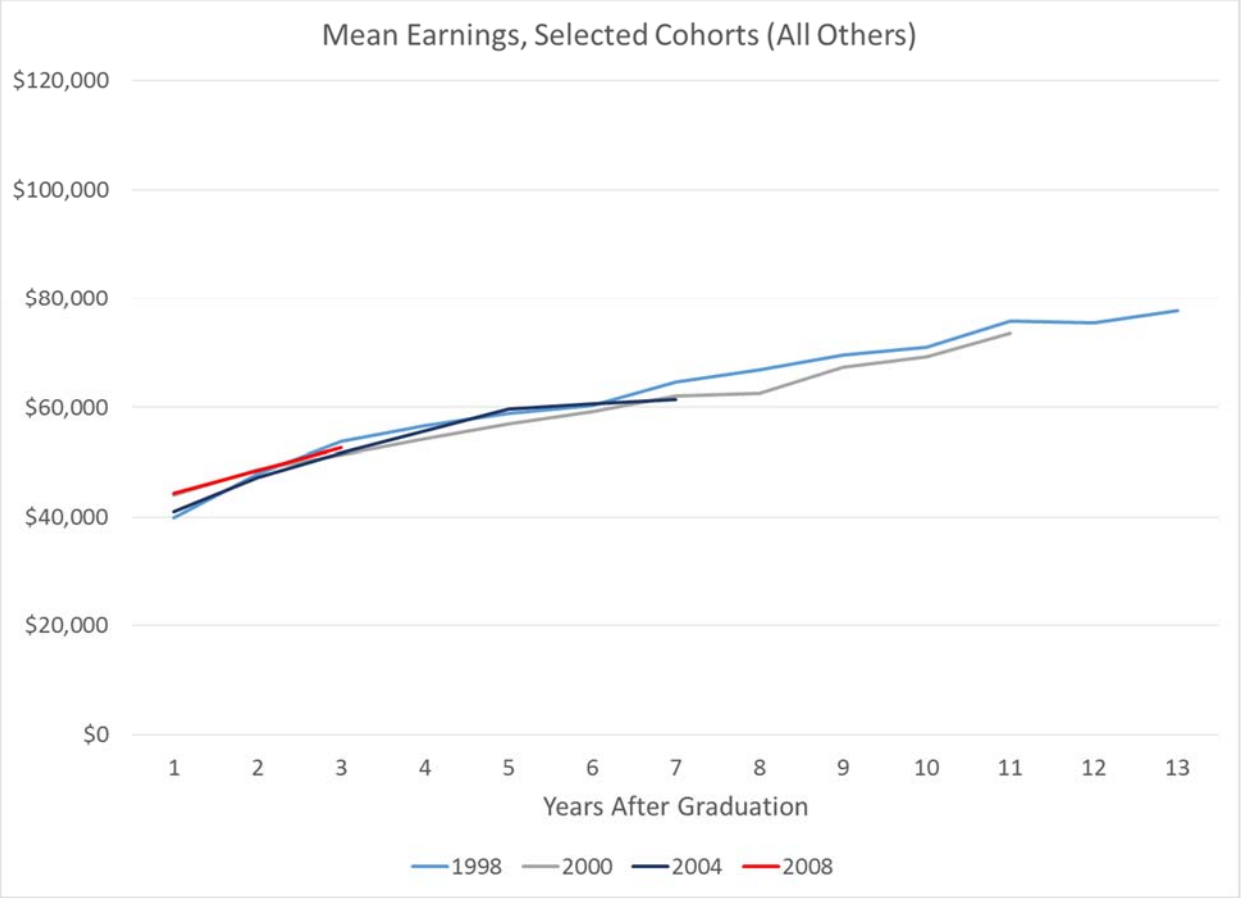
Graph 5a keeps only four cohorts from Graph 4a, Graph 5b does the same from Graph 4b, and Graph 5c keeps only four cohorts from Graph 4c, allowing us to observe the earnings profiles of a select number of cohorts. Below we describe the earnings profiles of ICT, Engineering and All Other graduates from cohorts 1998, 2000, 2004 and 2008.

Graduates from the 2000 cohort of non-ICT programs (All Others) had higher first year earnings than the 1998 and 2004 cohorts of graduates from the same group. At year 3 after graduation, however, and for all subsequent years with the exception of year 7, this cohort earned less than the other three selected cohorts of non-ICT graduates. Earnings increase year-over-year for this cohort, including through fiscal years 2007 and 2008 (years 7 and 8 after graduation).

The 2004 cohort registered first year earnings slightly higher than those of the 1998 cohort of non-ICT graduates. This cohort experienced steady growth in earnings until the 5th year after

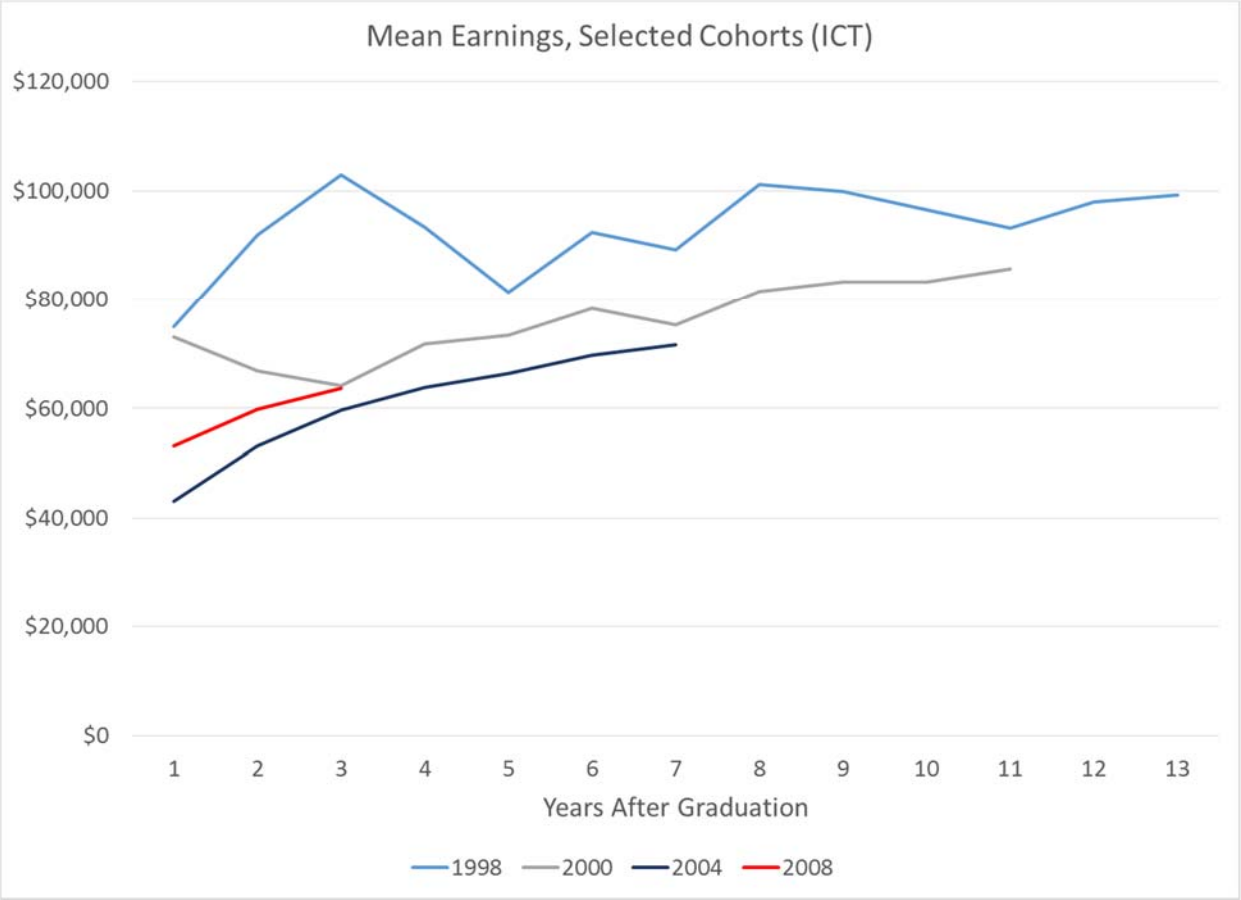
graduation (fiscal year 2009), at which point the earnings continued to grow but at a smaller rate. During the 7 years since graduation, this cohort of non-ICT graduates registered year-over-year increases in earnings, with the lowest increase occurring in the last two years (fiscal year 2010-2011).

Graph 5a – Mean Earnings, Selected Cohorts (All Others)



Non-ICT graduates from the 2008 cohort had the highest first year earnings of any of the four selected cohorts. Their earnings rise over the three year period for which we have data, surpassing the earnings of the 2000 and 2004 cohorts at year 3 after graduation but not reaching the same earnings level as the 1998 cohort.

Graph 5b – Mean Earnings, Selected Cohorts (ICT)



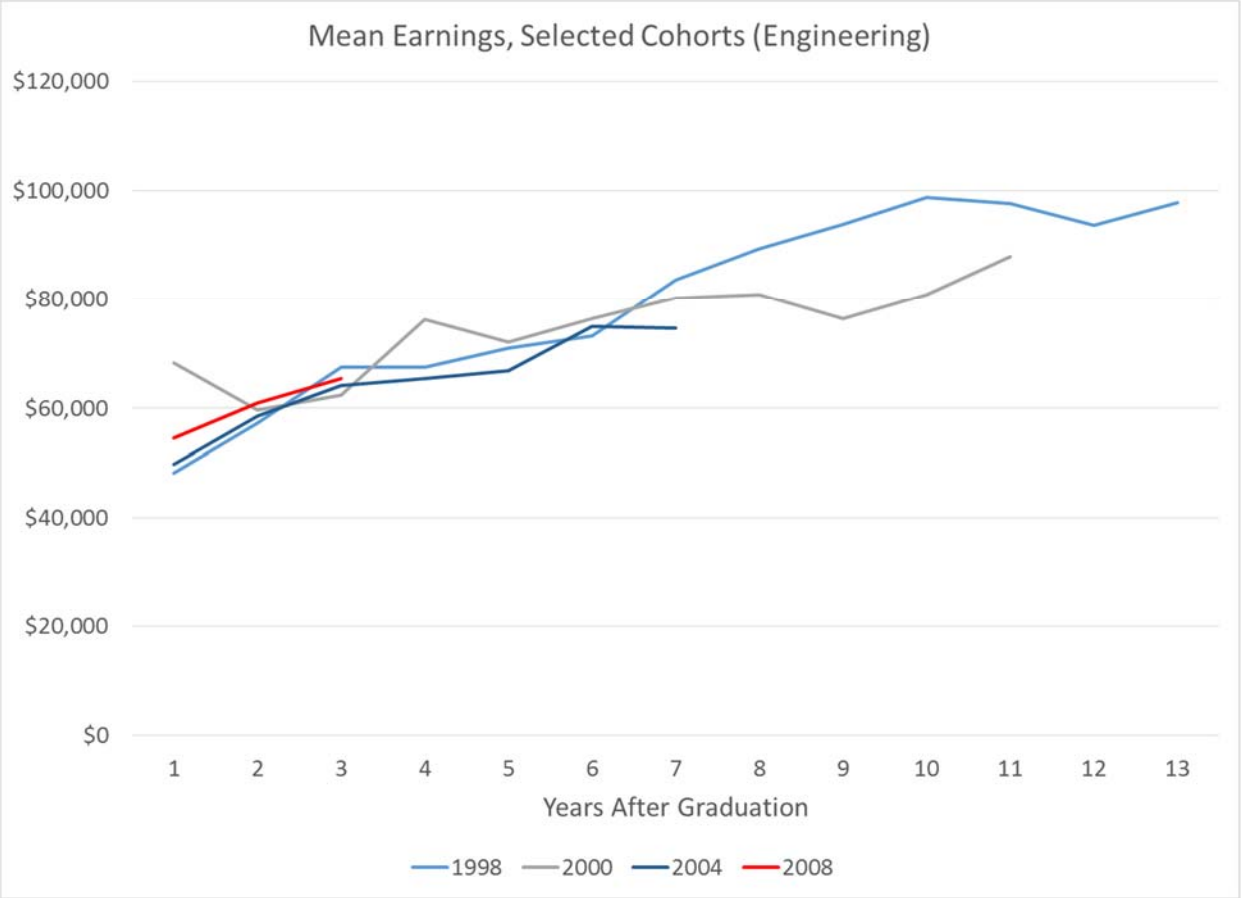
The 2000 cohort of ICT graduates entered the workforce immediately before of the dot-com bust. The 1st year earnings of ICT graduates in this cohort were only slightly lower than those of graduates from the same group in the 1998 cohort ($73,100 compared to $75,000 for the 1998 cohort). The yearly earnings for this group steadily decrease for the first 3 years of employment after graduation (until fiscal year 2003), however, from year 3 to year 6 after graduation, earnings increase steadily. At no point do earnings of this cohort for a given year after graduation surpass the earnings of the 1998 cohort of ICT graduates at the same point in their careers.

The 2004 cohort of ICT graduates entered the workforce at the trough of the dot-com bust. For graduates in this cohort, their first year salary of $41,700 was the lowest of all cohorts in this analysis and neared the level of first year earnings reported by all other graduates of non-ICT programs ($40,300) in the same cohort. The improved situation of the ICT sector in fiscal years 2005 and 2006 (1st and 2nd year after graduation for the 2004 cohort) led to steady increases in

earnings during those years. For the remainder of the timeframe of this analysis, this cohort of ICT graduates saw their earnings increase year-over-year but never to the same earnings levels of the 1998 and 2000 cohorts for any year after graduation.

ICT graduates in the 2008 cohort had higher first year earnings (around $10,000 higher) than those of the 2004 cohort and around $20,000 lower than the 1998 and 2000 cohorts. For each of the 3 years for which we have tax information, this cohort registered increasing earnings although never surpassing the 1998 and 2000 cohorts for any given year after graduation.

Graph 5c – Mean Earnings, Selected Cohorts (Engineering)



The 2000 cohort of Engineering graduates had the highest 1st year earnings of the four selected Engineering cohorts (around $68,300). Earnings drop in the 2nd year after graduation for this cohort, possibly the result of the dot-com bubble burst, but rebound in the following two years. At the end of the 11 year period for which we have tax data, this cohort registered earnings of $88,000, close to $10,000 less than the 1998 cohort at the same point after graduation.

The 2004 cohort had the second lowest earnings of the selected cohorts of Engineering graduates in the 1st year after graduation, earning $49,800. The only cohort to have earned less in the 1st year was the 1998 cohort. Earnings increase year-over-year for the 2004 cohort in all years except year 7, where earnings fall by $1,000 dollars relative to the previous year. For all years after graduation for which we have data this cohort tends to be among the lowest earning of the selected four cohorts of Engineering graduates.

Engineering graduates of the 2008 cohort had 1st year earnings of $54,500, the second highest of the four selected cohorts. Earnings rise year-over-year for the three years for which we have tax data for this cohort.

V.3. First Year Earnings

Graph 6 profiles the 1st year earnings of each cohort of ICT, Engineering and All Other graduates, but presents the information by fiscal/tax year. Fiscal year 1999 below indicates the 1st year earnings of the 1998 cohort, fiscal year 2000 indicates the 1st year earnings of the 1999 cohort and so on until fiscal year 2011, which indicates the 1st year earnings of the 2010 cohort.

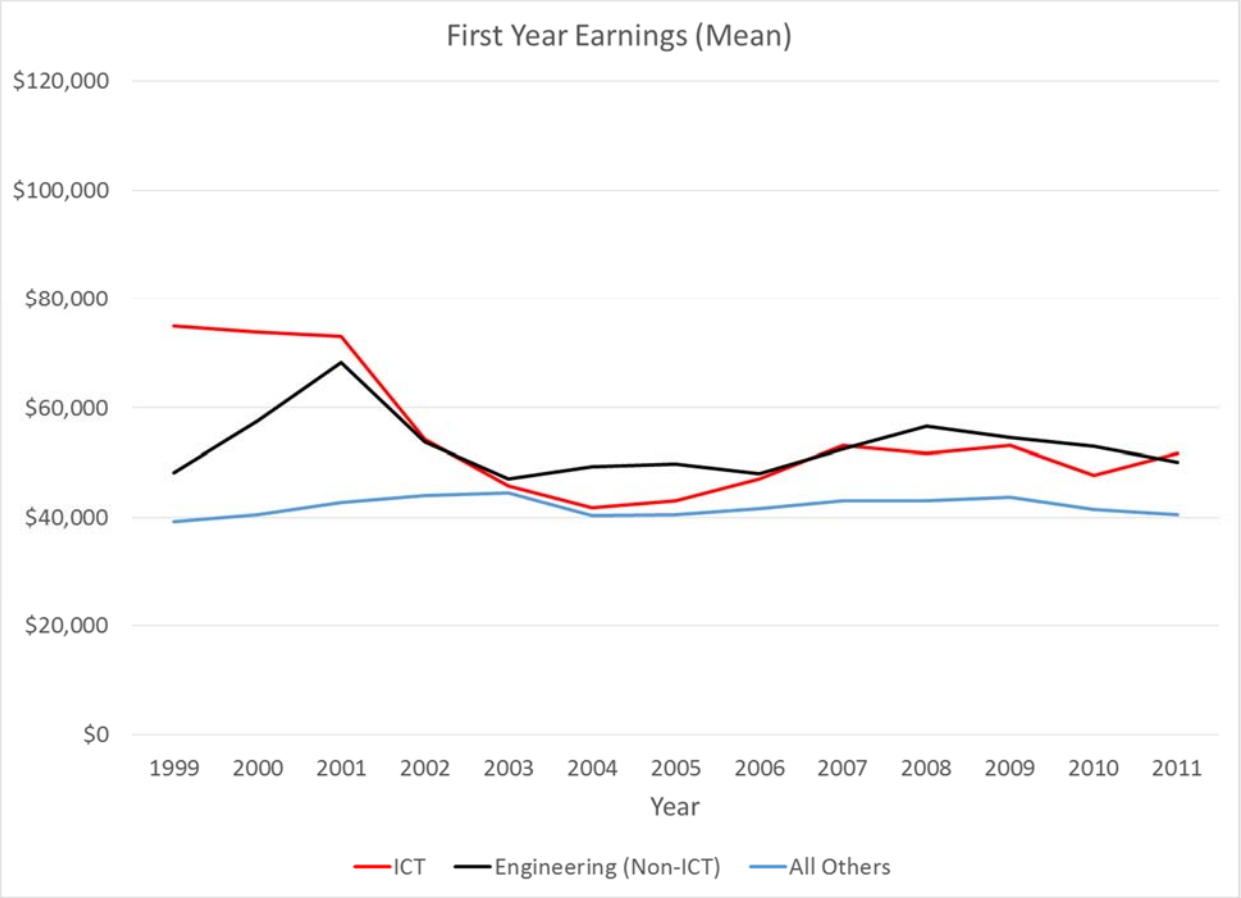
Graduates from non-ICT programs (All Others) had the lowest 1st year earnings of the three groups in every year covered by this study. Earnings in the 1st year after graduation are relatively constant for these graduates for the duration of the 13 years covered by this study, varying between a low of $39,200 and a high of $44,400.

ICT graduates had higher 1st year earnings than graduates from non-ICT programs (All Others) in every year covered by this study. The earnings premium of ICT graduates was particularly large before the collapse of the dot-com bubble in 2001, when ICT graduates earned around $35,000 more than graduates from All Other programs, on average. The 1st year earnings premium for ICT graduates is almost entirely eliminated by the time the 2003 cohort enters the labour force in 2004. Since 2004, however, the gap between ICT and non-ICT graduates (All Others) began to widen once again, although never to the level observed prior to the crash of the dot-com bubble. For the last cohort in this analysis (2010 graduates), ICT graduates earned around $11,000 more in their 1st year compared to non-ICT graduates (All Others).

The comparator group of Engineering graduates follows roughly the same pattern of 1st year earnings as those experienced by ICT graduates and earns more at every year after graduation

than non-ICT graduates (All Others). For the first three cohorts (fiscal years 1999, 2000 and 2001), Engineering graduates saw rapid increases in their 1st year earnings. We speculate that this rapid increase could be the result of the ICT sector hiring engineering graduates in place of ICT graduates as a way to fill positions at lower cost, thereby driving up the earnings of Engineering graduates in those years while decreasing slightly the earnings of ICT graduates. Engineering graduates were also heavily affected by the bursting of the dot-com bubble, as their first year earnings decreased substantially between fiscal years 2001 and 2003. After 2003, 1st year earnings of Engineering and ICT graduates have tended to be roughly similar with Engineering graduates earning somewhat more in several of the latter years.

Graph 6 – First Year Earnings (Mean)

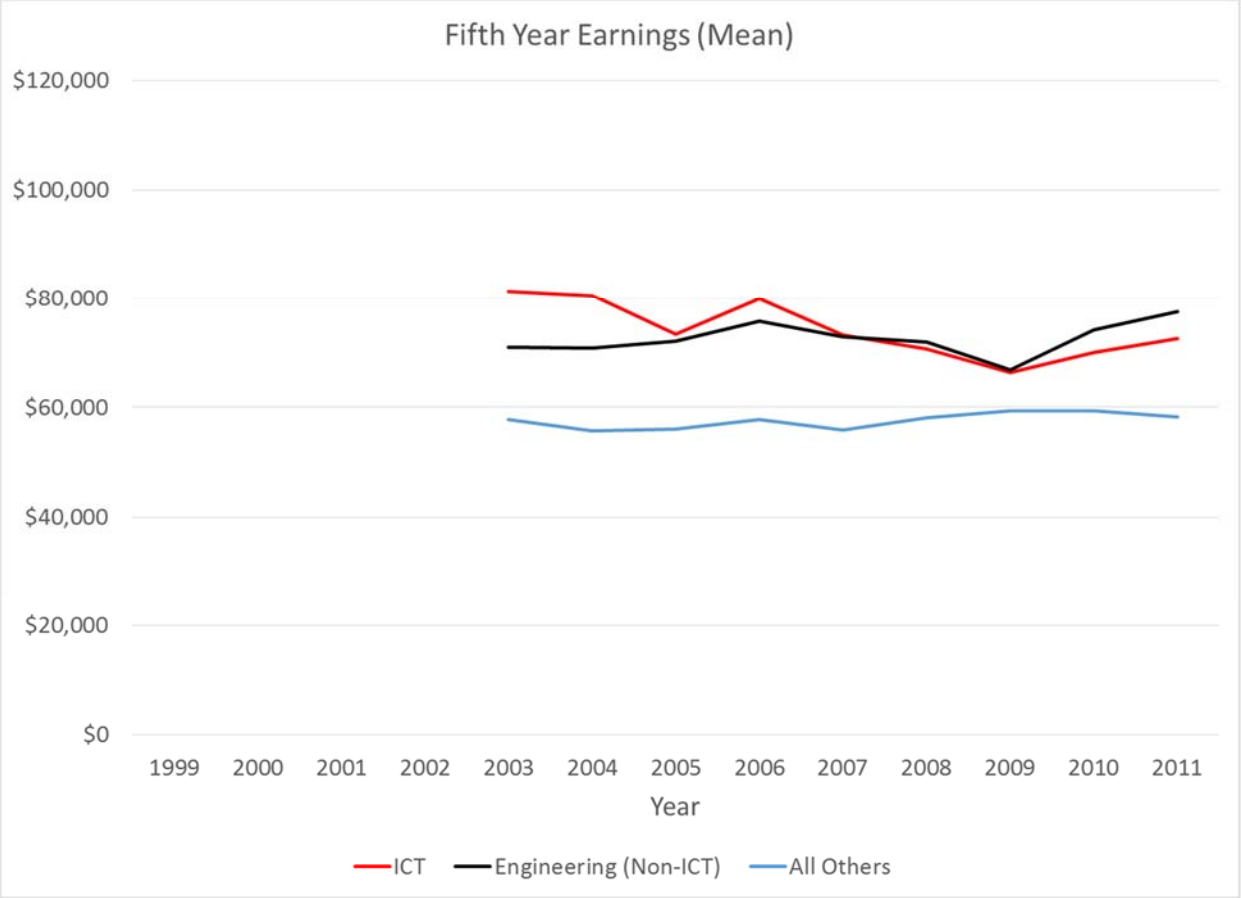


V.4. Fifth Year Earnings

Graph 7 profiles the earnings in the 5th year after graduation of each cohort of ICT, Engineering and All Other graduates, but presents the information by fiscal/tax year. Fiscal year

2003 below indicates the 5th year earnings of the 1998 cohort, fiscal year 2004 indicates the 5th year earnings of the 1999 cohort and so on until fiscal year 2011, which indicates the 5th year earnings of the 2006 cohort, the latest cohort for which we have data on earnings in the 5th year after graduation.

Graph 7 – Fifth Year Earnings (Mean)



Differences in 5th year earnings between ICT graduates and non-ICT graduates (All Others) decrease for each subsequent cohort until 2004, mirroring the relationship observed in 1st year earnings between these groups. The $30,000 difference in earnings in the 1st year after graduation between ICT and non-ICT graduates (All Others) of the 1998 cohort is reduced to around $24,000 in the 5th year after graduation. Engineering graduates of the 1998 cohort do even better at reducing the $27,000 gap in earnings in the 1st year after graduation between them and ICT graduates. In the 5th year after graduation, Engineering graduates of the 1998 cohort were earning around $10,000 less than ICT graduates from the same cohort.

In fiscal year 2009 (5th year earnings of the 2004 cohort), the difference in earnings between ICT graduates and graduates of All Other programs is the smallest. Both ICT and Engineering graduates of the 2004 cohort, had 5th year earnings around $7,000 higher, on average, than those of non-ICT graduates (All Others) in the same cohort. In the last two cohorts (cohorts 2005 and 2006), the differences in 5th year earnings between all three groups begins to grow again.

V.5. Distribution of Earnings

This section examines the distribution of earnings in selected cohorts by quartile. The amounts presented below are rounded cut points of the 25th, 50th, and 75th percentiles of earners. Because we are not interested in individual outcomes but rather aggregate earnings, we allow individuals to move between the quartiles across years. As a result, the analysis in this section takes the form of a repeated cross-section analysis.

Below we present the distribution of earnings of the 1998 and 2004 cohorts of ICT, Engineering and non-ICT (All Others) graduates only. For the remaining cohorts refer to the appendix.

1. 1998 Cohort - Quartiles

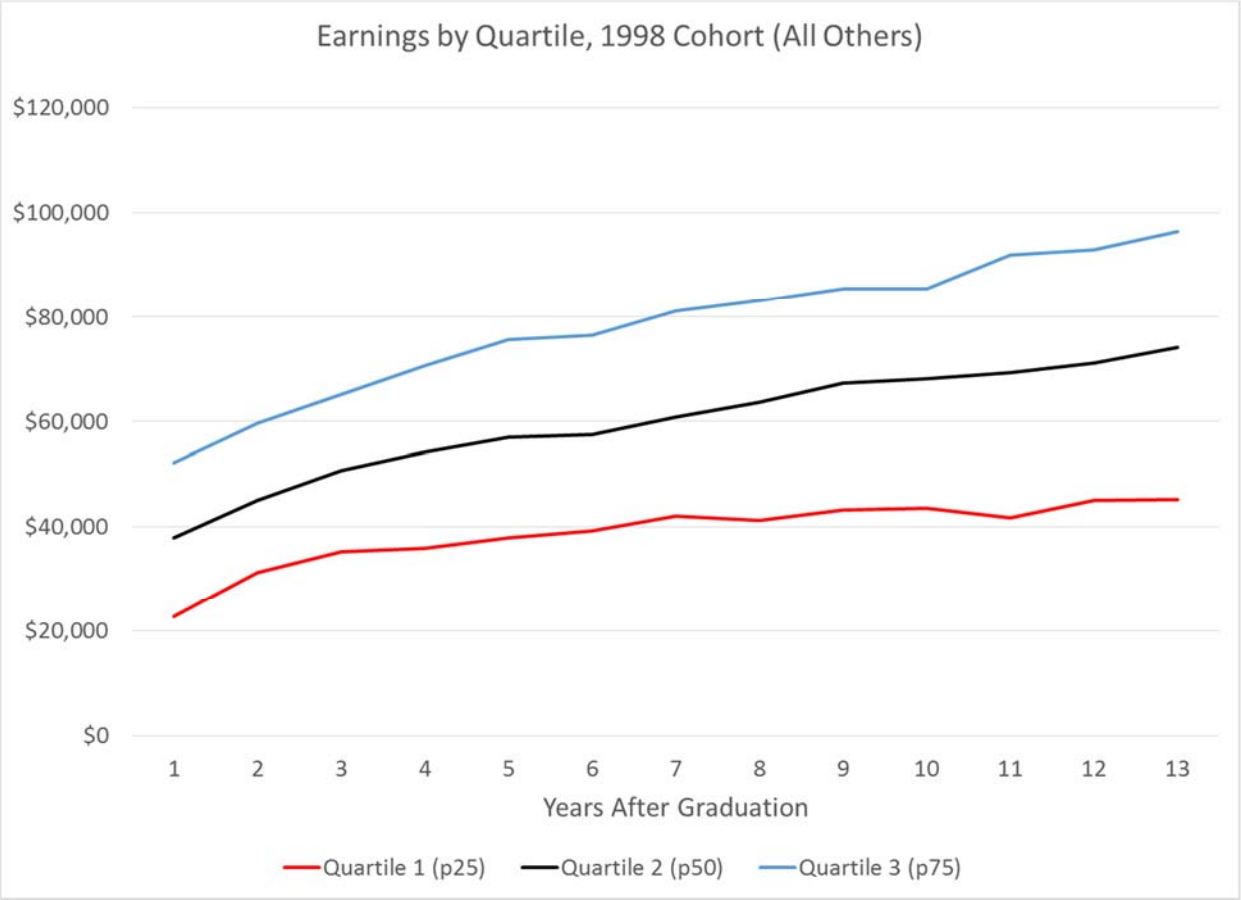
Graphs 7a, 7b, and 7c present the distribution of earnings by quartile for the 1998 cohort of non-ICT graduates (All Others) (7a), the 1998 cohort of ICT graduates (7b) and the 1998 cohort of Engineering graduates (7c).

The lower quartile earnings for non-ICT program (All Others) was $22,600 in the 1998 cohort. In the 13th year after graduation, the earnings for this quartile almost double, to $45,100.

Median earnings of this group in the 1st year were around $37,900, almost $15,000 more than the lower quartile. At the end of the 13 year period for which we have data, median earnings were $74,100, almost $30,000 more than first quartile earnings at the same point.

The non-ICT upper quartile earnings experience the greatest increases over the 13 years after graduation for the 1998 cohort. The upper quartile earnings move from $52,100 in the 1st year to $96,400 in the 13th year after graduation. The third quartile earnings by the 13th year is therefore more than twice as high as the first quartile.

Graph 7a – Earnings by Quartile, 1998 Cohort (All Others)

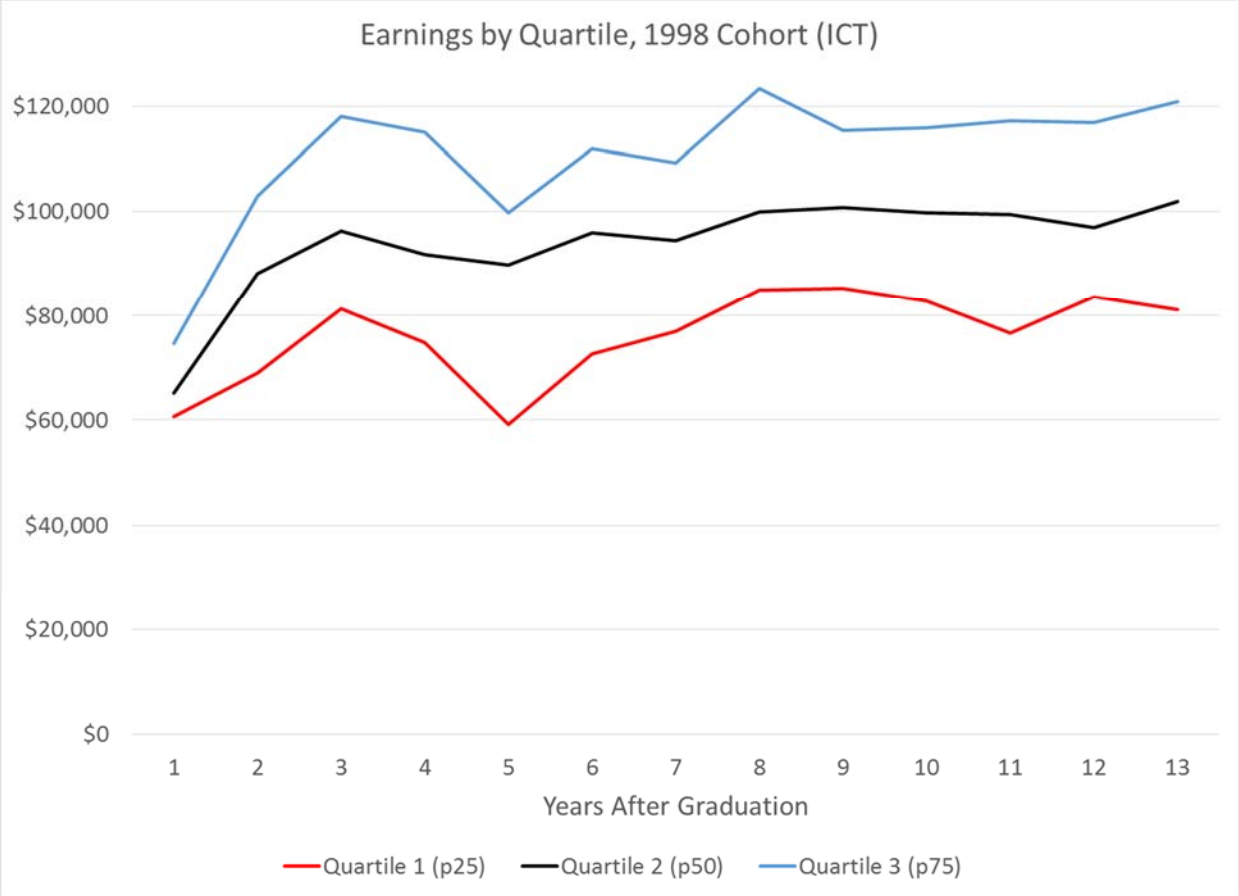


The 1998 cohort of ICT graduates had higher earnings for each quartile relative to the comparable quartile of non-ICT graduates (All Others) in the same cohort. Whereas the lower quartile earnings were $22,600 for non-ICT graduates in the1st year, the corresponding amount for ICT graduates was $60,600—almost three times as much. In fact, the upper quartile earnings among non-ICT graduates is lower than the lower quartile earnings among the ICT graduates. The bursting of the dot-com bubble appears to have had the strongest effect on the first quartile. The effect can be seen starting at year 3 after graduation where earnings begin to fall significantly, bottoming out at $59,100 at year 5 after graduation (fiscal year 2003).

The median earnings for this cohort of ICT graduates is only somewhat greater in the 1st year after graduation than that observed in the first quartile ($65,100 vs $60,600). This points to a tight distribution of incomes between the lower quartile and the median at the career start of the ICT graduates. However, the gap between the first quartile and the median widens over time, and

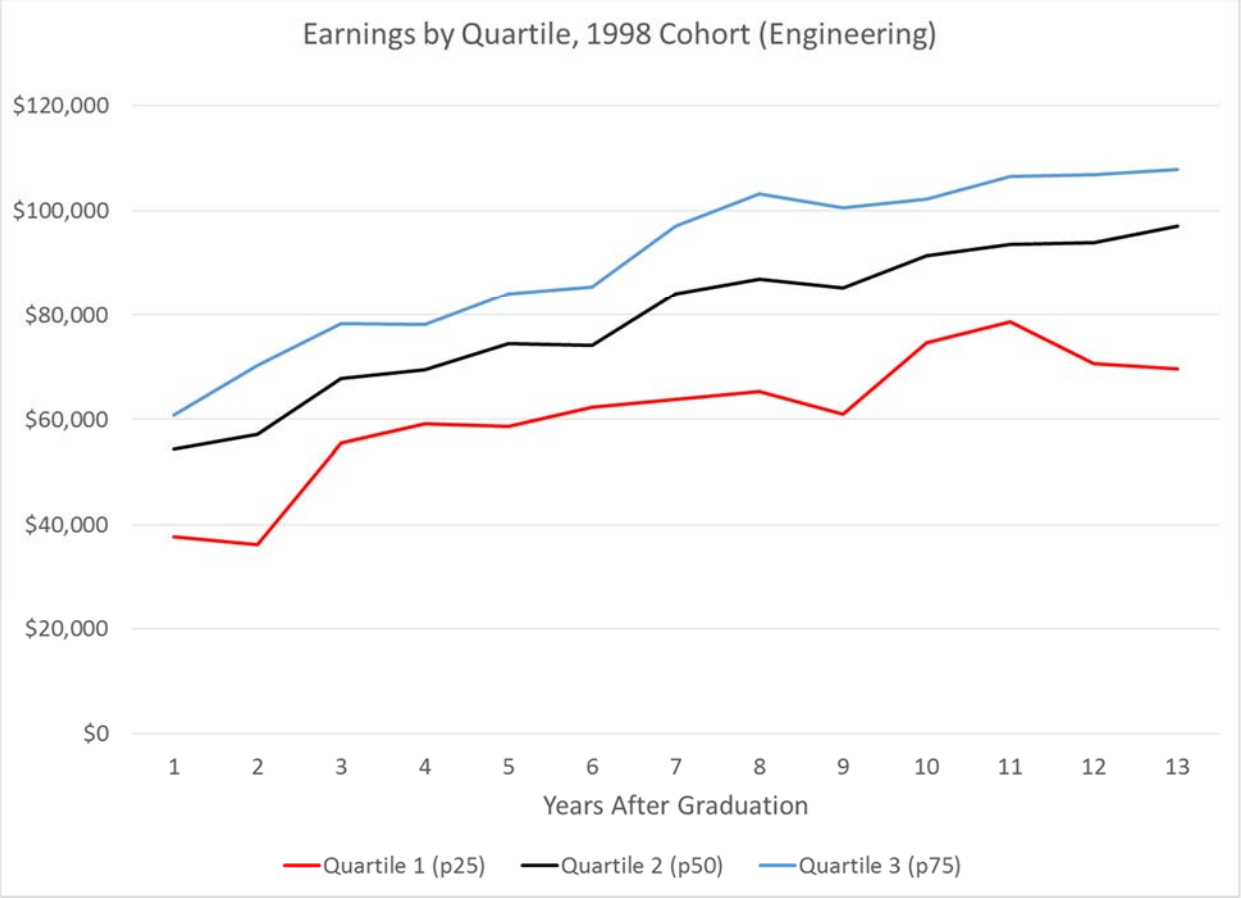
is particularly deep in the fifth year 5 after graduation, which occurs after the dot-com bust ($59,100 vs $89,800 for the lower quartile and the median, respectively). The median itself decreases significantly with the dot-com bubble burst (here evident in the year 4 and 5 after graduation), but begins to climb once again afterwards and reaches $100,000 in year 8 after graduation. It remains relatively steady for the remainder of the years, with the exception of a slight dip in year 12 after graduation—likely a result of the 2008 recession.

Graph 7b – Earnings by Quartile, 1998 Cohort (ICT)



The upper quartile earnings for ICT graduates of the 1998 was $74,700 in the 1st year, almost $10,000 higher than the median. The third quartile is also significantly affected by the 2001 dot-com bust, as earnings decreases by almost $20,000 between years 3 to 5 after graduation, bottoming out at $99,800. After 2003 (year 5 after graduation), earnings steadily begin to increase. At the end of the 13 year period, the upper quartile earnings stood at $120,900, about $40,000 higher than the lower quartile.

Graph 7c – Earnings by Quartile, 1998 Cohort (Engineering)



The lower quartile earnings for Engineering graduates in the 1st year after graduation stood at $37,600. This is higher than the lower quartile earnings of non-ICT graduates (All Others) but lower than the comparable quartile of ICT graduates of the same cohort. The general trajectory of the first quartile earnings for Engineering graduates is more stable (especially for the first seven years of graduation) than what we see among ICT graduates, and the dot-com bubble burst appears to have little visible effect on the overall pattern for this cohort. The lower quartile earnings increase rapidly after the second year, and remain stable until year 8 after graduation, when they stand at $65,300. At this point earnings dip to $61,000 in year 9, only to rapidly increase in year 10 and 11 (to $74,700 and $78,700, respectively), and then fall to $69,700 by year 13, likely as a result of the recession. By year 13 after graduation, the lower quartile earnings for Engineering graduates is over $10,000 lower than for ICT graduates of the same cohort.

In the 1st year after graduation, Engineering graduates had median earnings of $54,300,

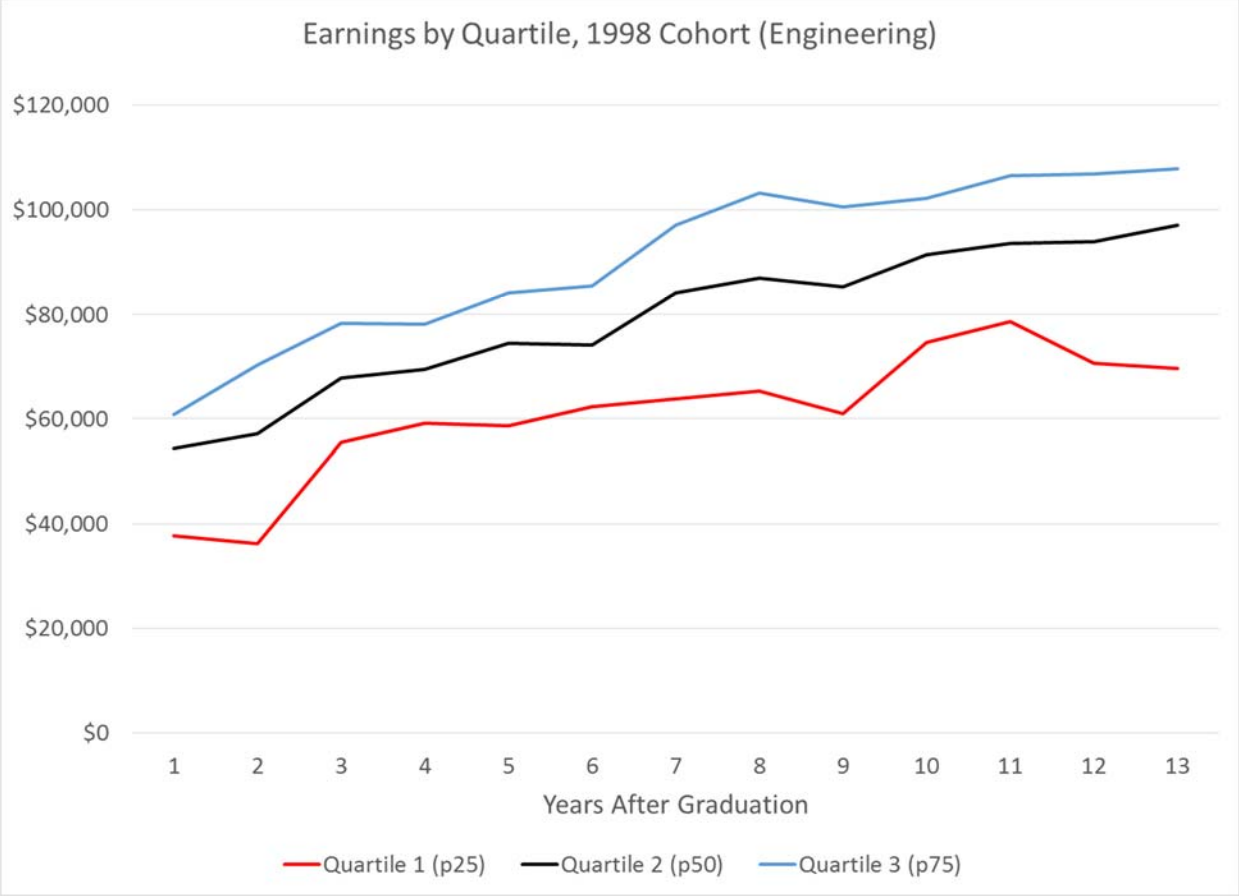
significantly less than 1st year median earnings of ICT graduates from the same cohort. At the end of the 13 year period, median earnings were $97,100, almost $30,000 higher than the first quartile, and only slightly lower than median earnings of the 1998 ICT graduates in the 13th year after graduation.

The third quartile earnings for Engineering in the 1998 cohort appear to have a very similar trajectory to what we observe for the medians. The upper quartile earnings move from $60,800 in the 1st year to $108,000 by the 13th year after graduation, almost $13,000 less than what we observe for the third quartile among the 1998 ICT graduates at this point in time.

2. 2004 Cohort - Quartiles

Graphs 8a, 8b and 8c present the distribution of earnings by quartile for the 2004 cohort of non-ICT graduates (All Others) (8a), the 2004 cohort of ICT graduates (8b) and the 2004 cohort of Engineering graduates (8c).

Graph 8a – Earnings by Quartile, 2004 Cohort (All Others)

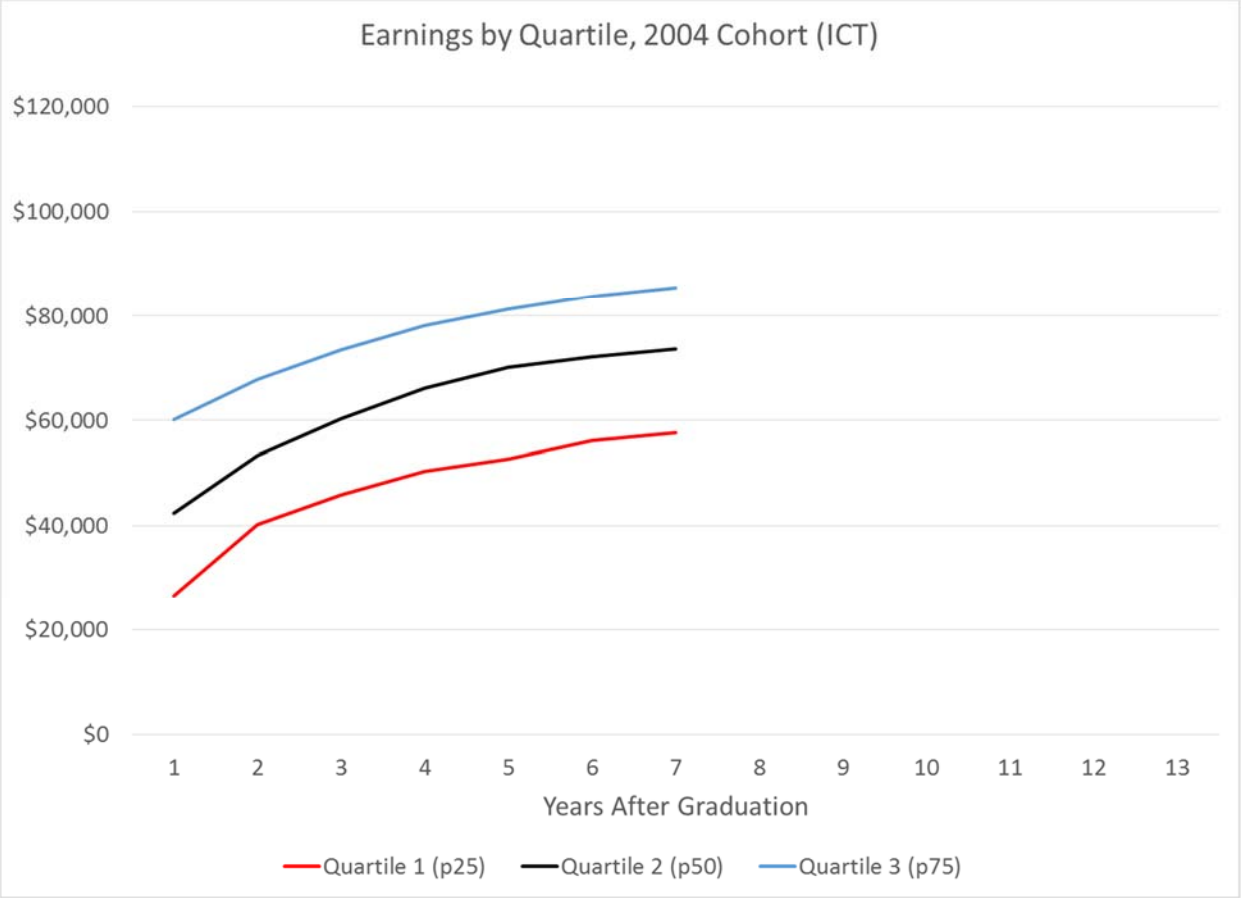


The quartile earnings pattern for the 2004 cohort of non-ICT (All Other) graduates is very similar to what we observe for the 1998 non-ICT graduates. The lower quartile earnings stands at $24,100 in the first year after graduation. Leading up to year 5 after graduation (2008 recession), the first quartile earnings increases year-after-year. The lower quartile of incomes stagnates after this point, and finishes at $40,200 in year 7 after graduation.

The median of 1st year earnings for non-ICT graduates was $39,500, slightly higher than the corresponding amount for the 1998 cohort. Earnings increase year-over-year for this cohort, but stagnate after the 5th year of graduation (fiscal year 2008). By the 7th year after graduation, the first quartile of non-ICT graduates stands at $61,200, more than $20,000 than the first quartile.

The upper quartile for non-ICT (All Others) graduates is $54,700 in the first year after graduation. This third quartiles continues to increase for the duration of the time period for which we have data, finishing the 7 year period with earnings of $79,200.

Graph 8b - Earnings by Quartile, 2004 Cohort (ICT)



The lowest quartile earnings for the 2004 ICT graduates were $26,500. This is only slightly higher than the 1st year earnings of the first quartile of the 2004 non-ICT (All Others) group. It is also less than half of the 1st year lower quartile earnings of the ICT group in the 1998 cohort. Nonetheless, the ICT lower quartile in this cohort increases faster than the non-ICT (All Others) quartile, finishing with earnings of $57,600 after the 7th year of graduation.

Median earnings for the 2004 ICT cohort were $42,400 in the first year of graduation – once again, only slightly higher than the non-ICT (All Others) median. However, median earnings rise for the entire 7 years, while the earnings gap between the first quartile and the median increases slightly over time. In the 7th year after graduation, median earnings of ICT graduates for this cohort were $73,700. As with the first quartile, the median earnings of ICT graduates of the 2004 cohort increase faster than the median earnings of non-ICT graduates (All Others) of the same cohort.

The upper quartile earnings for ICT graduates stood at $60,200 in the 1st year after graduation, slightly higher than the 1st year earnings of the third quartile of the non-ICT group (All Others). Earnings for this quartile increase year-over-year and are $85,400 by year 7 after graduation, or $6,200 higher than the non-ICT group.

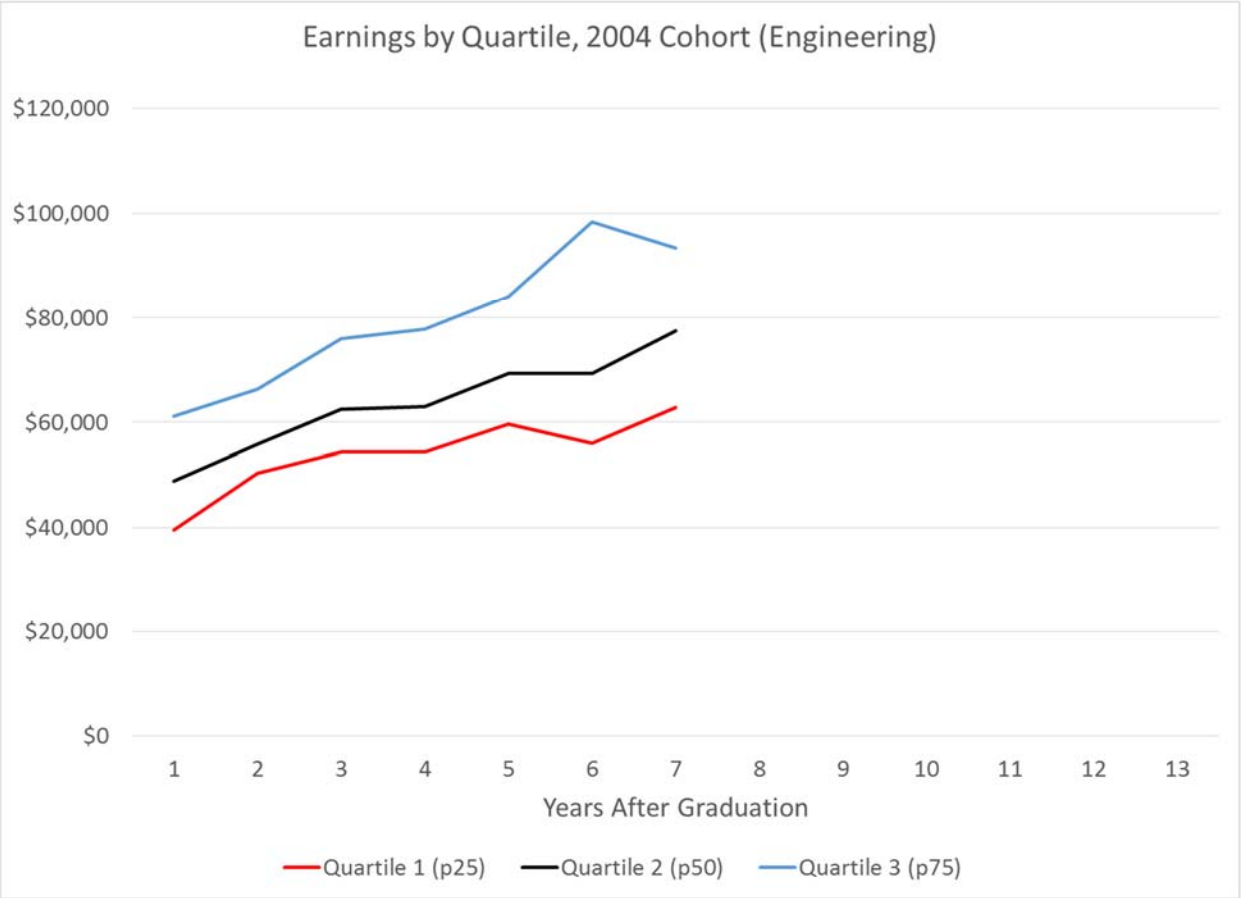
The 2004 cohort of Engineering graduates registered higher earnings for each quartile relative to the comparable quartile of ICT graduates in the same cohort. The lower quartile 1st year earnings for the Engineering graduate group amounted to $39,500, or $13,000 higher than the 1st year earnings of the ICT graduates quartile. By year 7 after graduation, the lowest quartile earnings for the Engineering group were $62,800, around $5,000 higher than those of the comparable ICT group.

The median earnings of this cohort of Engineering graduates were $48,800 – around $6,000 more than the median earnings for the same cohort of ICT graduates in their 1st year after graduation. At 7 years after graduation, median earnings of Engineering graduateswere $77,400, or still $3,700 higher than the ICT group at the same point.

The earning discrepancy between the 2004 Engineering and ICT graduates appears to even out at the upper quartiles, but the gaps widen over time in favour of Engineering graduates. The third quartile of Engineering graduates had 1st year earnings of $61,200, exactly $1,000 higher

than the comparable ICT quartile. The earnings for this quartile reached $93,500 at the end of the 7 year period, almost $12,000 more than the comparable ICT upper quartile of ICT graduates from the same cohort.

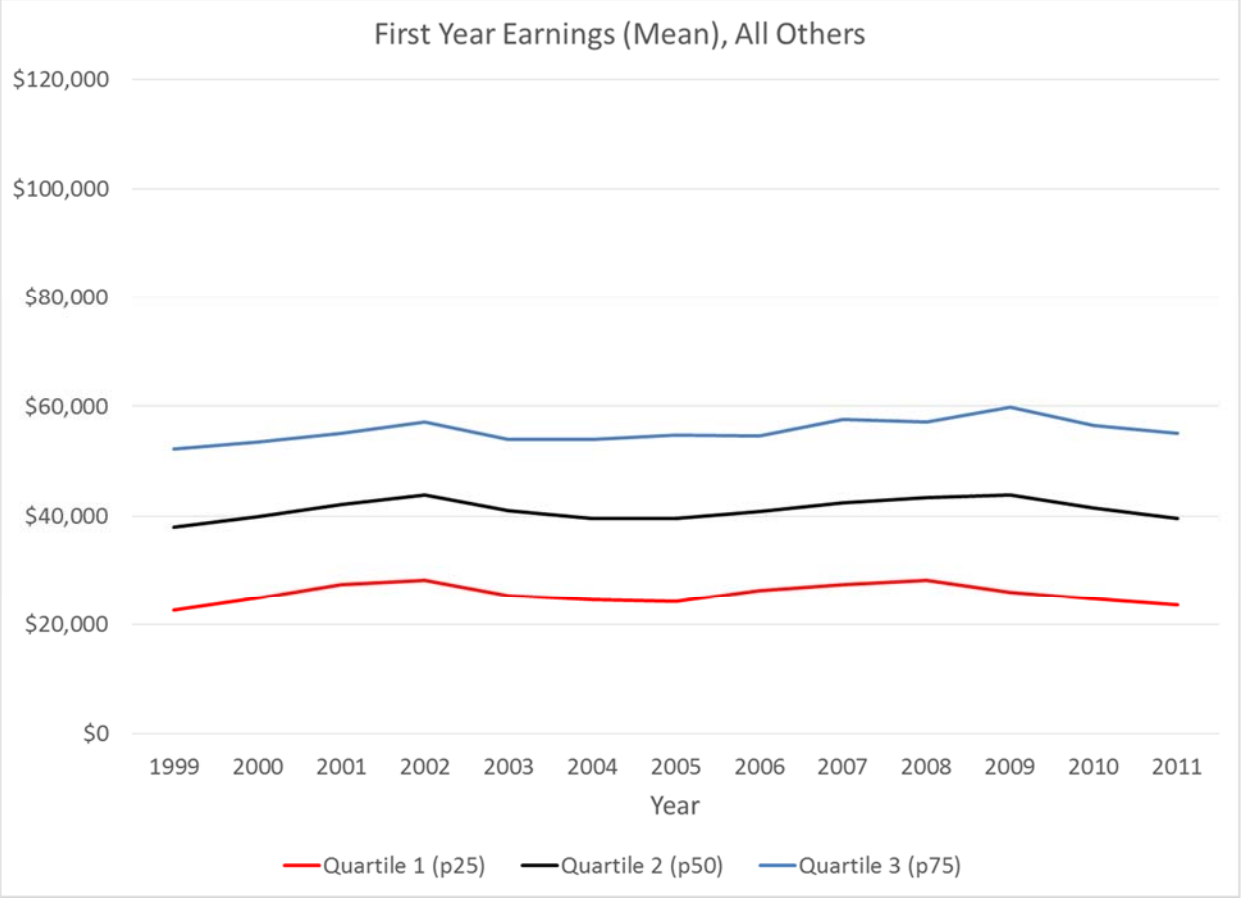
Graph 8c – Earnings by Quartile, 2004 Cohort (Engineering)



3. First Year Earnings - Quartiles

Graphs 9a, 9b and 9c profile the 1st year mean earnings of each of the non-ICT cohorts (All Others) (10a), ICT cohorts (10b) and Engineering cohorts (10c). As with other times when we look at 1st year earnings only, the information is presented by fiscal/tax year. Fiscal year 1999 below indicates the 1st year earnings of the 1998 cohort, fiscal year 2000 indicates the 1st year earnings of the 1999 cohort and so on until fiscal year 2011, which indicates the 1st year earnings of the 2010 cohort.

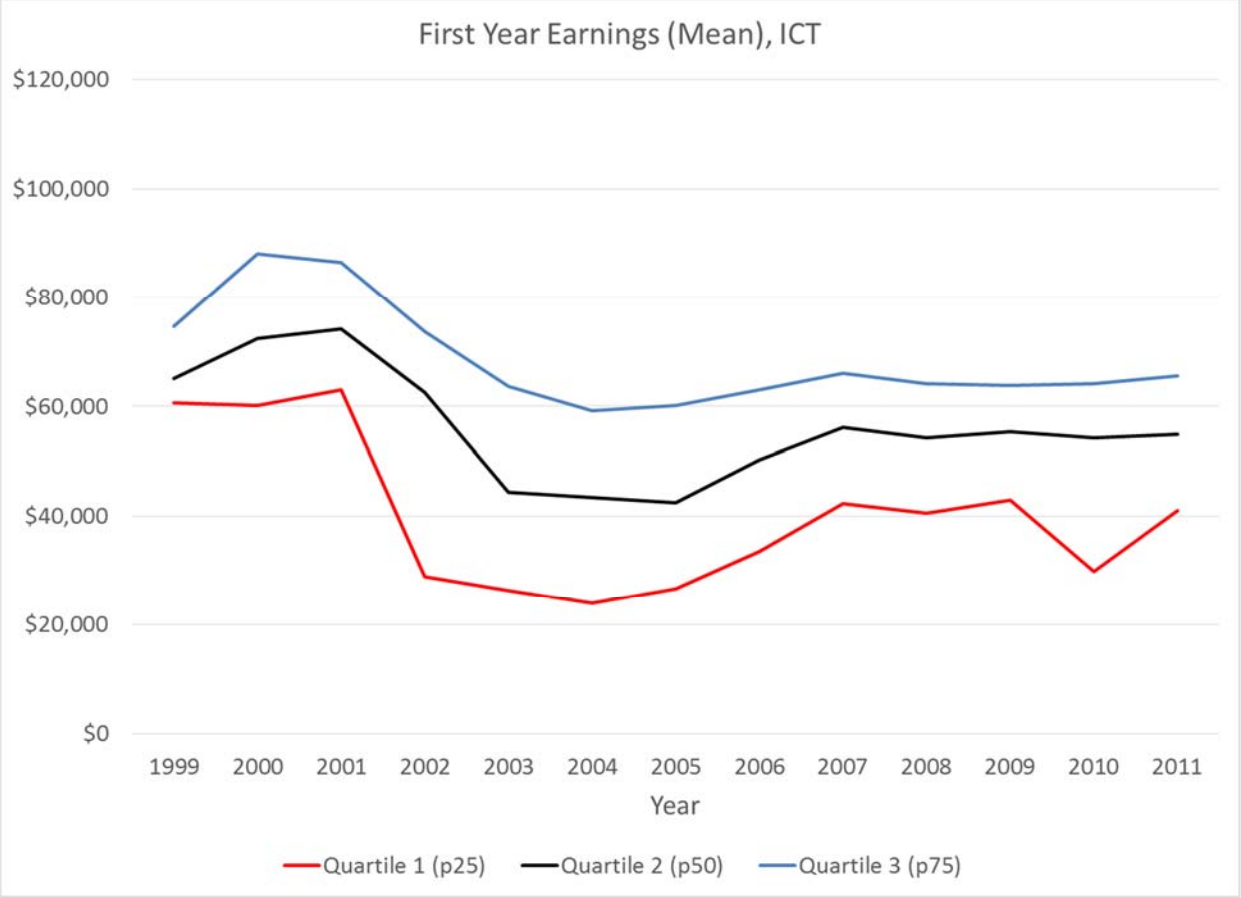
Graph 10a – First Year Earnings - Quartiles (All Others)



The overall distribution of 1st year earnings of graduates of non-ICT programs (All Others) appears to be fairly stable across time for each quartile. All quartiles register small decreases in 1st year earnings in the years following the dot-com bubble bust and the years spanning the 2008 recession.

The lower quartile earnings for non-ICT (All Others) group were lowest in 1999 ($22,600) and highest in 2002 and 2008 ($28,100). In other words, the maximum variation in first year earnings for this group was $5,500. The median earnings of graduates of non-ICT programs (All Others) varied between $37,900 and $43,900, a difference of $6,000 over the timeframe of this study. Finally, upper quartile earnings varied between a low of $52,100 and a high of $59,900, a difference of $7,800.

Graph 10b – First Year Earnings – Quartiles (ICT)



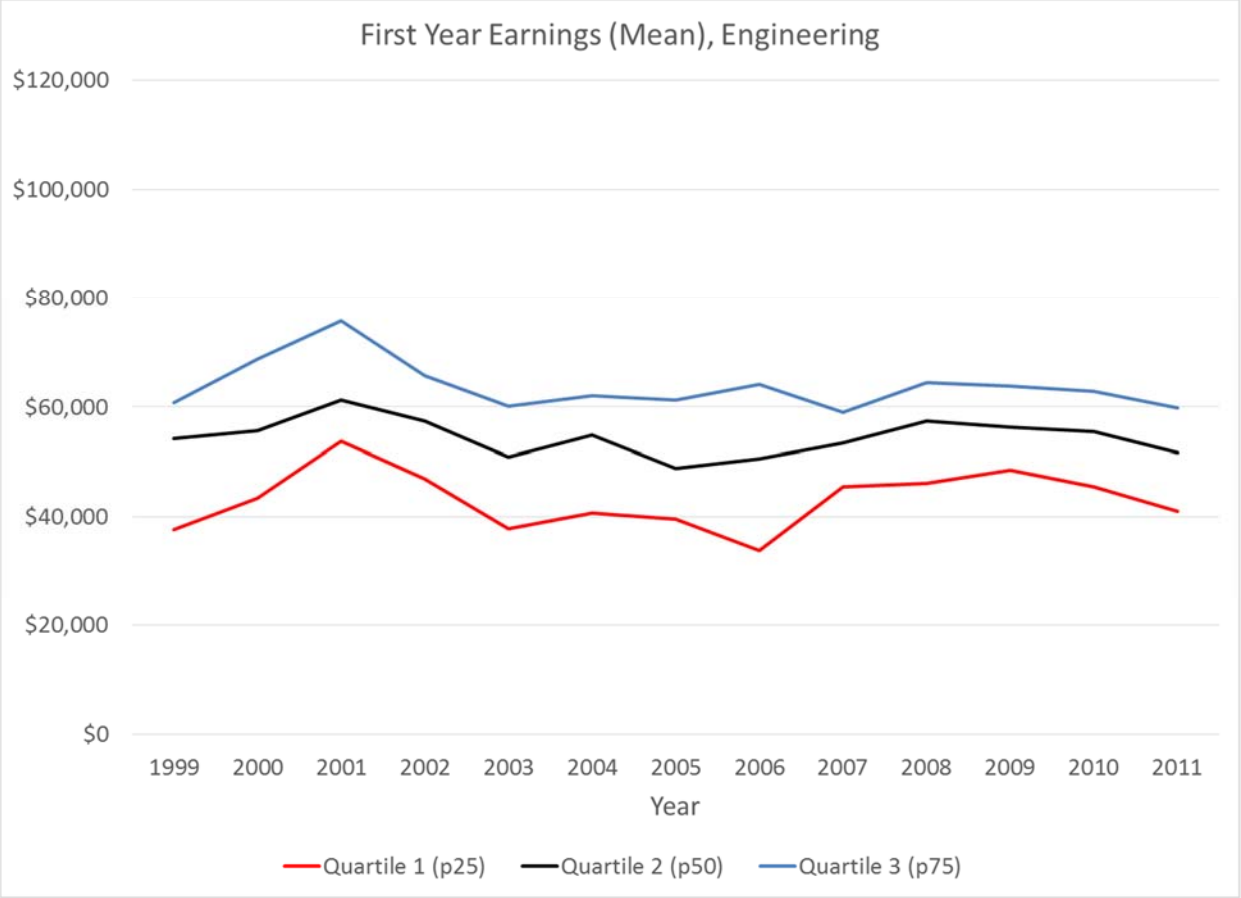
ICT cohorts had higher 1st year earnings for every quartile relative to graduates of non-ICT (All Other) programs, but experienced far more volatility. This volatility in 1st year earnings is evident in all quartiles. The 1st year earnings of the lower quartile were $63,100 in 2001. The effects of the dot-com bubble are the most dramatic for the lower quartile, as the earnings for this quartile fall to $23,900 or lower, a difference of $39,200 compared to 1st year earnings of the same quartile in 2001. The first year earnings of the first quartile increase once again between 2004 and 2009, reaching $42,800 in 2009. The effect of the 2008 recession are also clearly visible for this quartile as earnings drop sharply downwards to $29,800, although the effect appears to be delayed until 2010.

The median 1st year earnings of ICT graduates followed the same pattern as the first quartile, although the drop in earnings resulting from the dot-com bubble burst were not as severe. Median earnings in the 1st year reached a high of $74,300 in 2001, before dropping to a low of

$42,400 in 2005, a difference of $31,900. From 2005 to 2007, median 1st year earnings increased steadily but plateaued thereafter.

The ICT upper quartile appears the least affected (in relative terms) by the dot-com bubble. This quartile saw 1st year earnings of $86,600 in 2001 drop to $59,200 in 2004, a decrease in 1st year earnings of $27,400. Much like the median, 1st year earnings of the top earning 25% increase between 2004 and 2007, but plateau after that.

Graph 10c - First Year Earnings – Quartiles (Engineering)



Each quartile of Engineering graduates appears to have been impacted by the dot-com bubble bursting, as 1st year earnings increase leading up to 2001 and are followed by several years of lower 1st year earnings.

The lower quartile of the Engineering graduates had 1st year earnings of $53,700 in 2001, significantly lower than the 1st year earnings of the comparable quartile of ICT graduates in the

same year. Earnings decrease in the following several years, bottoming out in 2006 when the first year earnings of the lower quartile are $33,800. In the final year for which we have data, 1st year earnings of the lower quartile for this group were $41,000.

Median 1st year earnings of Engineering graduates were $54,300 in 1999 and increased to a high of $61,300 in 2001. Similar to the lower quartile, 1st year earnings decreased for the next several years bottoming out at $48,800 in 2005, a year earlier than the low point for the first quartile. Median 1st year earnings in the final year were $51,700.

The upper quartile of Engineering graduates also experienced a run-up in earnings, with first year earnings climbing to a high of 75,800 in 2001. Again, third quartile earnings dropped for several consecutive years after 2001, bottoming out at $60,200 in 2003. Since 2003, 1st year earnings remained relatively stagnant, ranging between $64,000 and $59,000.

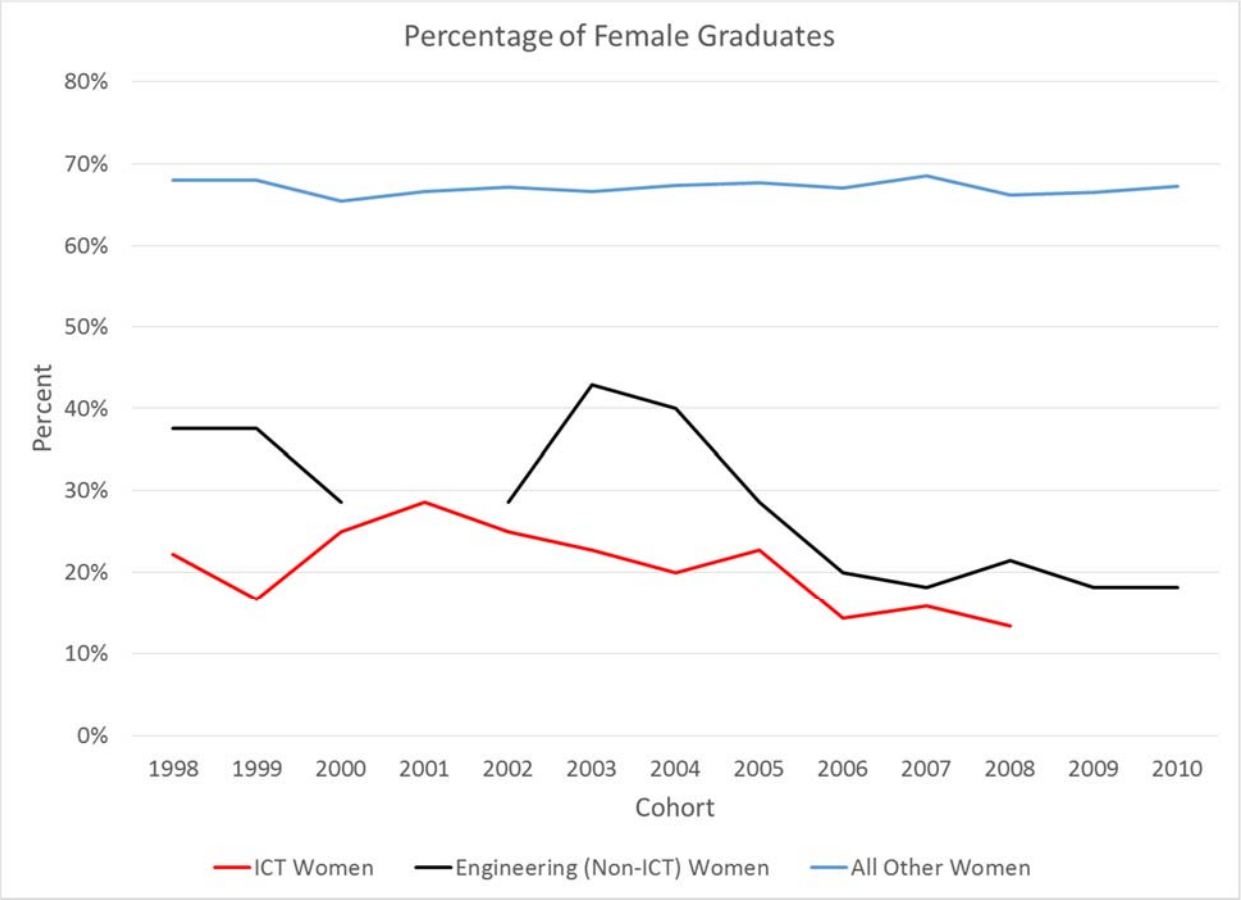
V.6. Earnings by Gender

This section presents the percentage of female in each of the graduating cohorts of non-ICT (All Others), ICT and Engineering graduates. Additionally, we present the earnings profiles by gender for several cohorts of graduates from each of the three groups.

1. Percentage of Female Graduates

As Graph 11 demonstrates, women make up a significantly larger share of graduates in non-ICT programs (All Others) than in ICT or Engineering programs. In each of the 13 cohorts examined, just under 70% of graduates of non-ICT programs are women. Women make up the smallest share of graduates of ICT programs, where they represented, on average, 20% of the graduating population in each cohort. The 2001 cohort of ICT graduates had the highest percentage of females (just under 30%), while the 2008 cohort had the lowest percentage (less than 15%). Between 2004 and 2008 there was a steady decrease in the percentage of females making up the graduating class of ICT graduates. Female graduates are relatively better represented in the Engineering group, where in 2003, they made up more than 40% of engineering graduates. Much like graduates of ICT programs, the percentage of women in cohorts of Engineering graduates has decreased over time. In the final cohort of this analysis, women made up less than 20% of all Engineering graduates.

Graph 11 – Percentage of Female Graduates

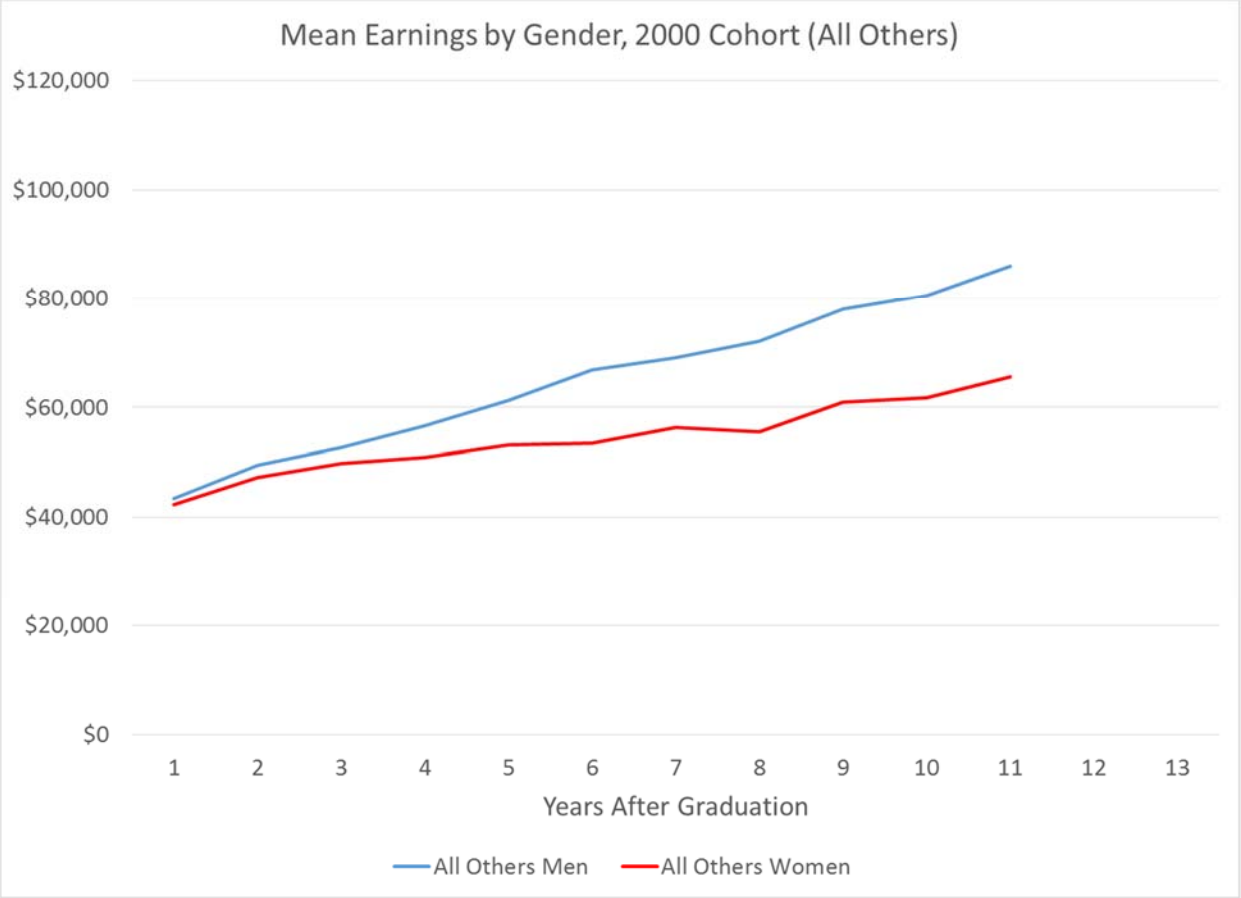


Graph 12a presents the earnings profile of the 2000 cohort of non-ICT graduates and Graph 12b the earnings profile of the 2000 cohort of ICT graduates. We use the 2000 cohort because it is the earliest cohort for which we have earnings information for both ICT and non-ICT (All Others) graduates. We are not able to include graduates of Engineering programs part of the 2000 cohort due to small sample size.

As a result of the already small sample size of both ICT and Engineering graduates, further breakdowns of these groups by gender leads to even smaller sample sizes and the suppression of data. As a result, below we present only two complete earning profiles from the 2000 and 2004 cohorts. For the remaining cohorts refer to the appendix.

2. 2000 Cohort

Graph 12a – Mean Earnings by Gender, 2000 Cohort (All Others)

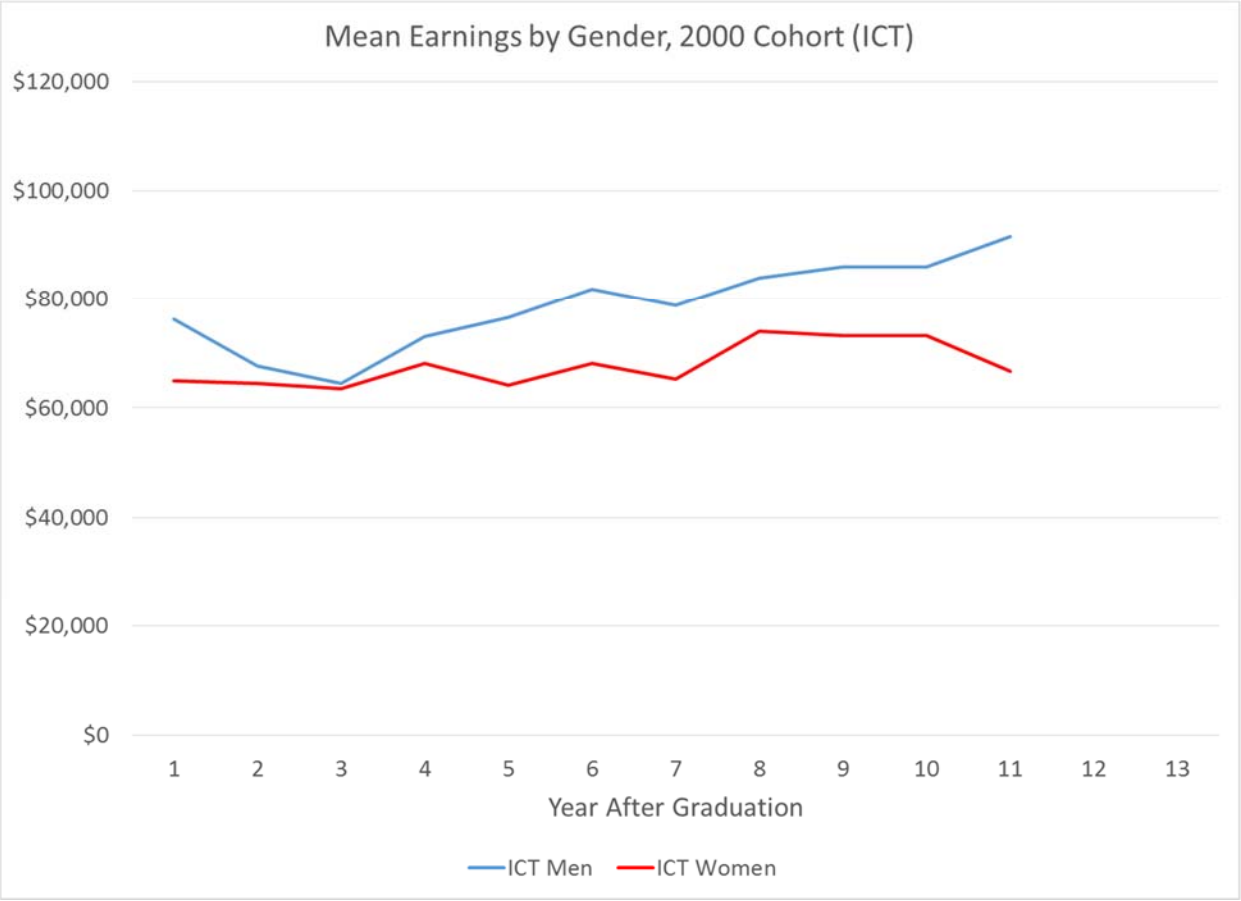


The earnings gap between men and women widens over time for the 2000 cohort of non-ICT graduates (All Others). Although women start with earnings around $5,000 less than men in the 1st year after graduation, this gap widens to around $20,000 at year 11 after graduation. This gap begins to widen significantly at year 3 after graduation for this particular cohort.

A similar income gap between men's and women's earnings is observed in the 2000 cohort of ICT graduates. The income gap at year 1 after graduation is larger between men and women who graduated from ICT programs than between non-ICT men and women (around $10,000) for this cohort. While both ICT men and women see earnings decrease in the first three years after graduation, men's earnings appear to be more affected by the dot-com bubble (at year 3 after graduation). Although the gap narrows in year 3 after graduation, it steadily increases thereafter. At the end of the 11 year period for which we have information, ICT men earned around $22,000

more than ICT women.

Graph 12b – Mean Earnings by Gender, 2000 Cohort (ICT)

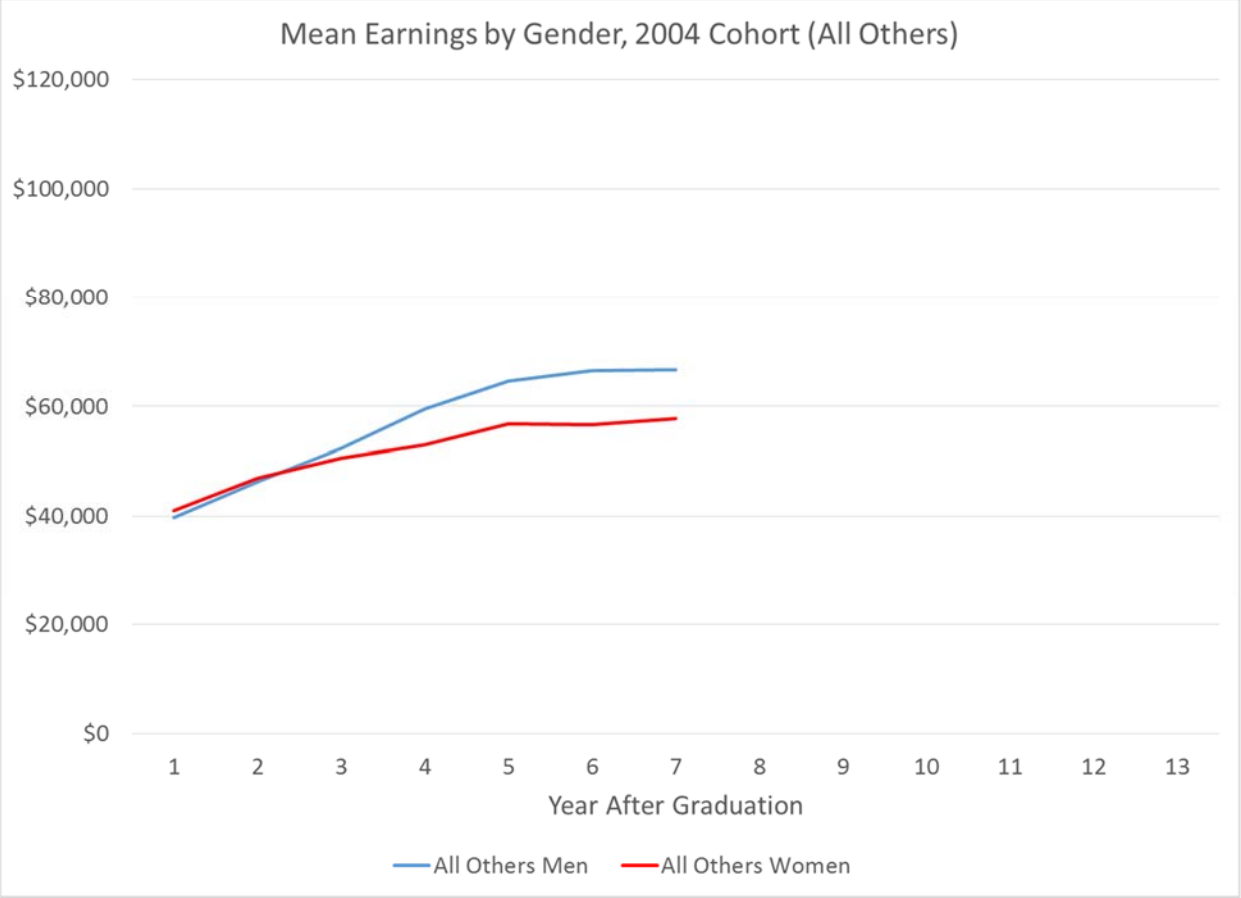


3. 2004 Cohort

Graph 13a presents the earnings profile of the 2004 cohort of non-ICT graduates (All Others), Graph 13b presents the earnings profile of the 2004 cohort of ICT graduates and Graph 13c presents the earnings profile of the 2004 cohort of Engineering graduates.

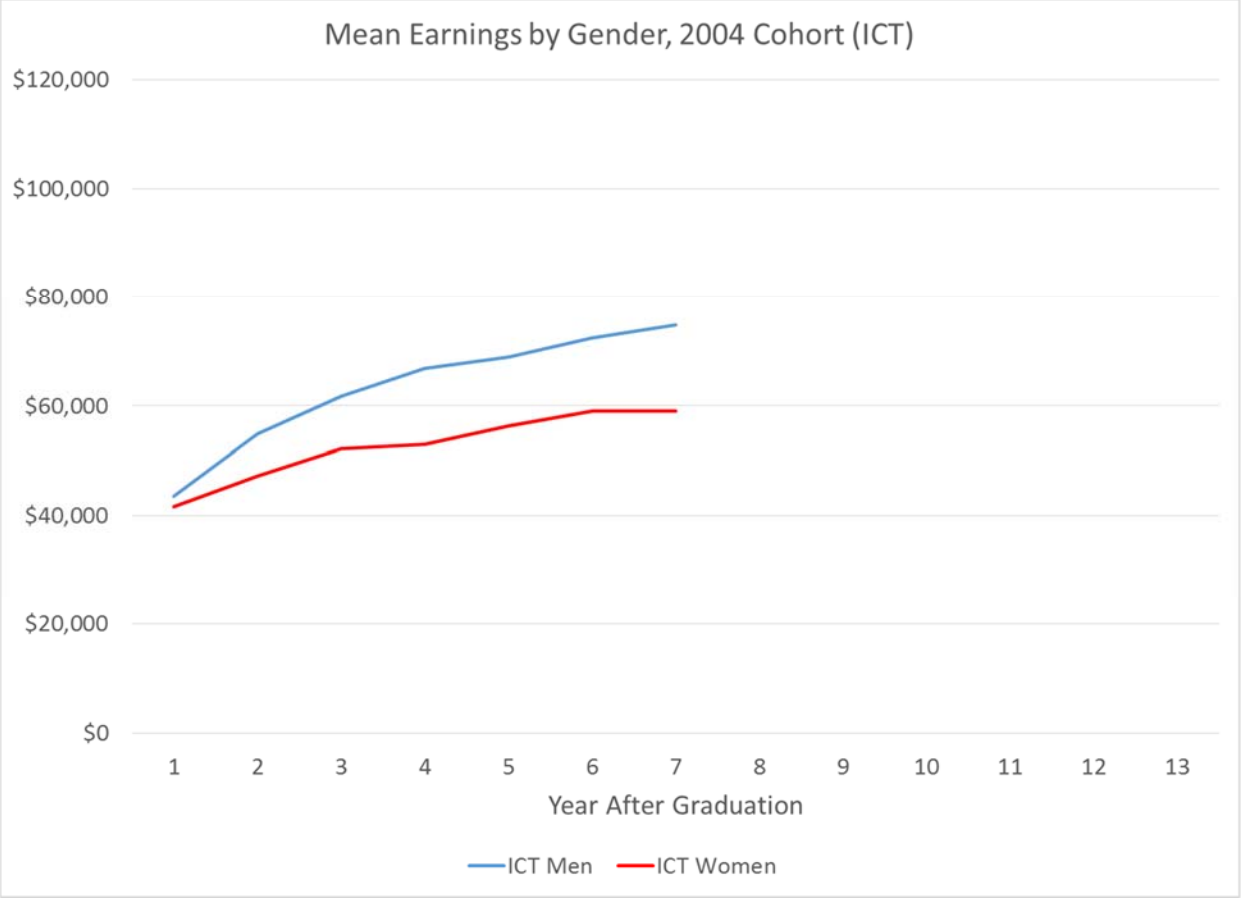
Female graduates of non-ICT (All Other) programs part of the 2004 cohort had slightly higher earnings then male graduates from the same group in the first two years after graduation. Similar to the 2000 cohort of non-ICT graduates, men started to earn significantly more at year 3 after graduation, finishing the 7 year period for which we have data with earnings close to $10,000 higher than women.

Graph 13a – Mean Earnings by Gender, 2004 Cohort (All Others)



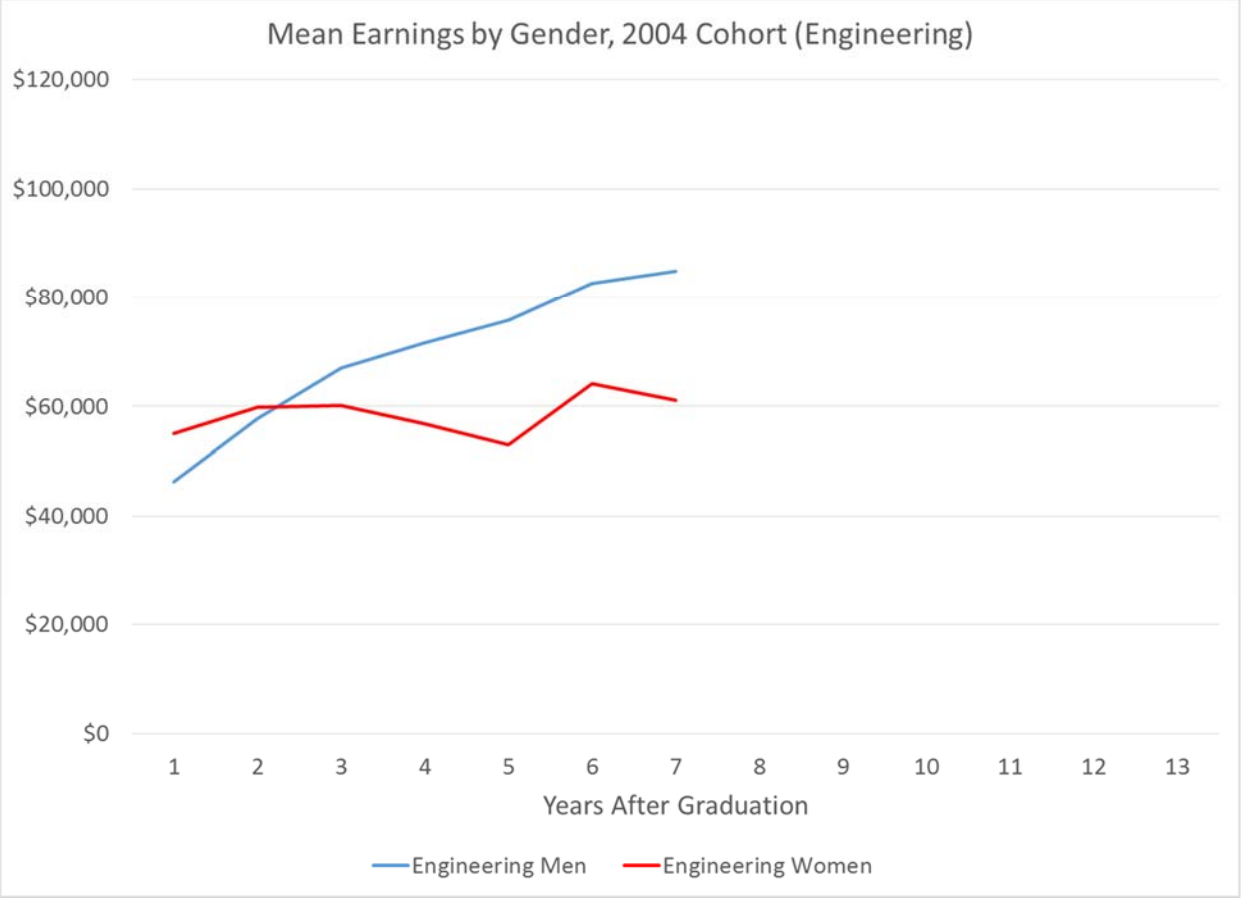
Both female and male graduates of ICT programs had higher 1st year earnings than non-ICT (All Others) graduates. ICT men performed better than non-ICT men in this cohort, registering earnings close to $75,000 in year 7 after graduation, while ICT women performed about as well as non-ICT women. As a result, there was a bigger gap in earnings between ICT men and women than non-ICT men and women at the end of the 7 years for which we have data. Male graduates of ICT were earning about $15,000 more than female graduates from ICT programs in the final year.

Graph 13b – Mean Earnings – 2004 Cohort (ICT)



Male graduates of Engineering programs were the best performing men in this cohort. They had 1st year earnings of around $47,000 and finished with earnings of around $85,000, higher than men in the other two groups at both points after graduation. Engineering women were also the best performing female graduates in this cohort, even though they suffered earnings decreases in years 4 and 5 after graduation. Interestingly, female graduates of the 2004 cohort of engineers had higher earnings than Engineering men in the first two years after graduation. Female graduates of Engineering programs finished the 7 year period with earnings of $61,000, the highest of all female graduates in the 2004 cohort. As well as these women performed in the labour market, at year 7 after graduation, male Engineering graduates earned around $25,000 more.

Graph 13c – Mean Earning by Gender, 2004 Cohort (Engineering)

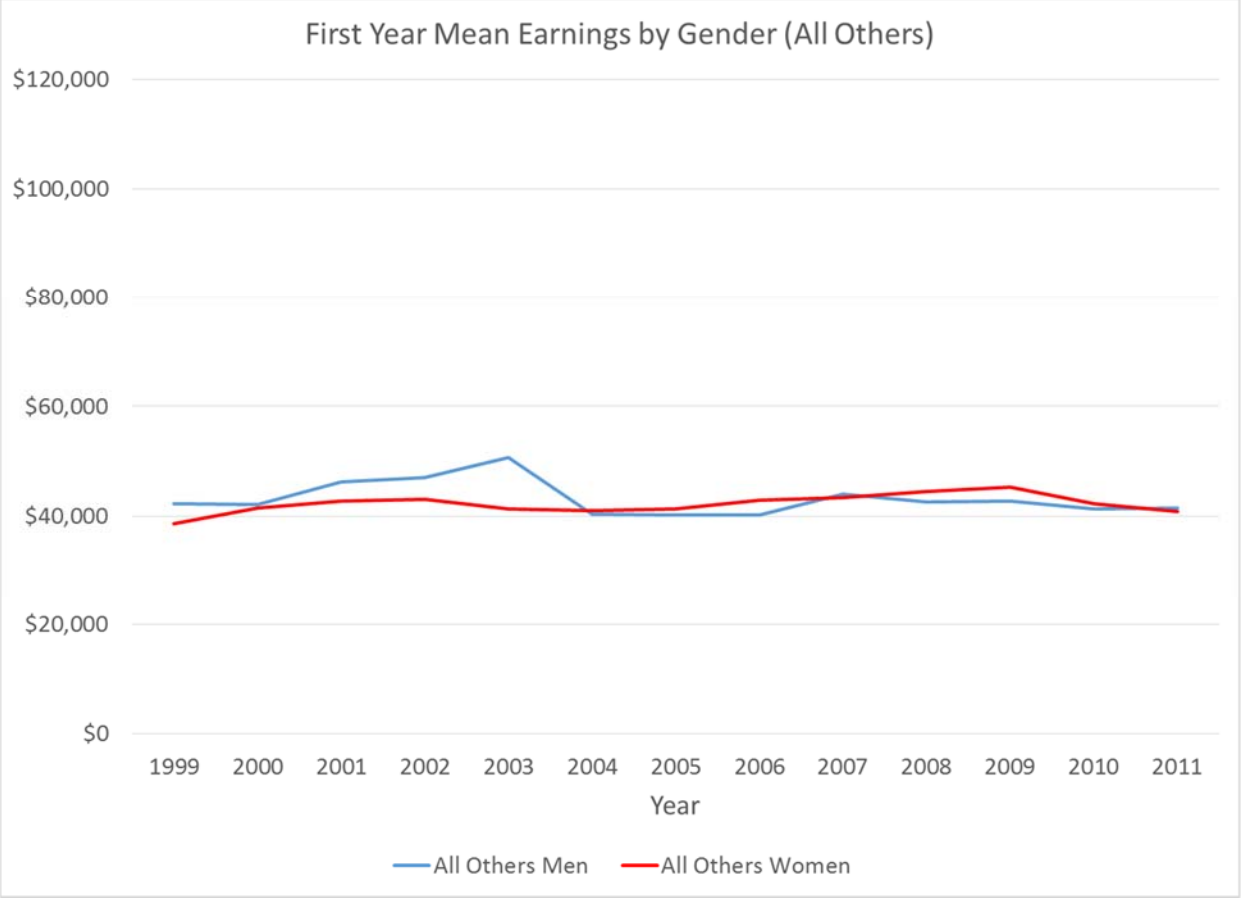


4. First Year Earnings – Gender

Graph 14a presents the 1st year mean earnings by gender of graduates from non-ICT (All Other) programs, Graph 14b does the same for graduates of ICT and Graph 14c presents the 1st year mean earnings of Engineering graduates by gender.

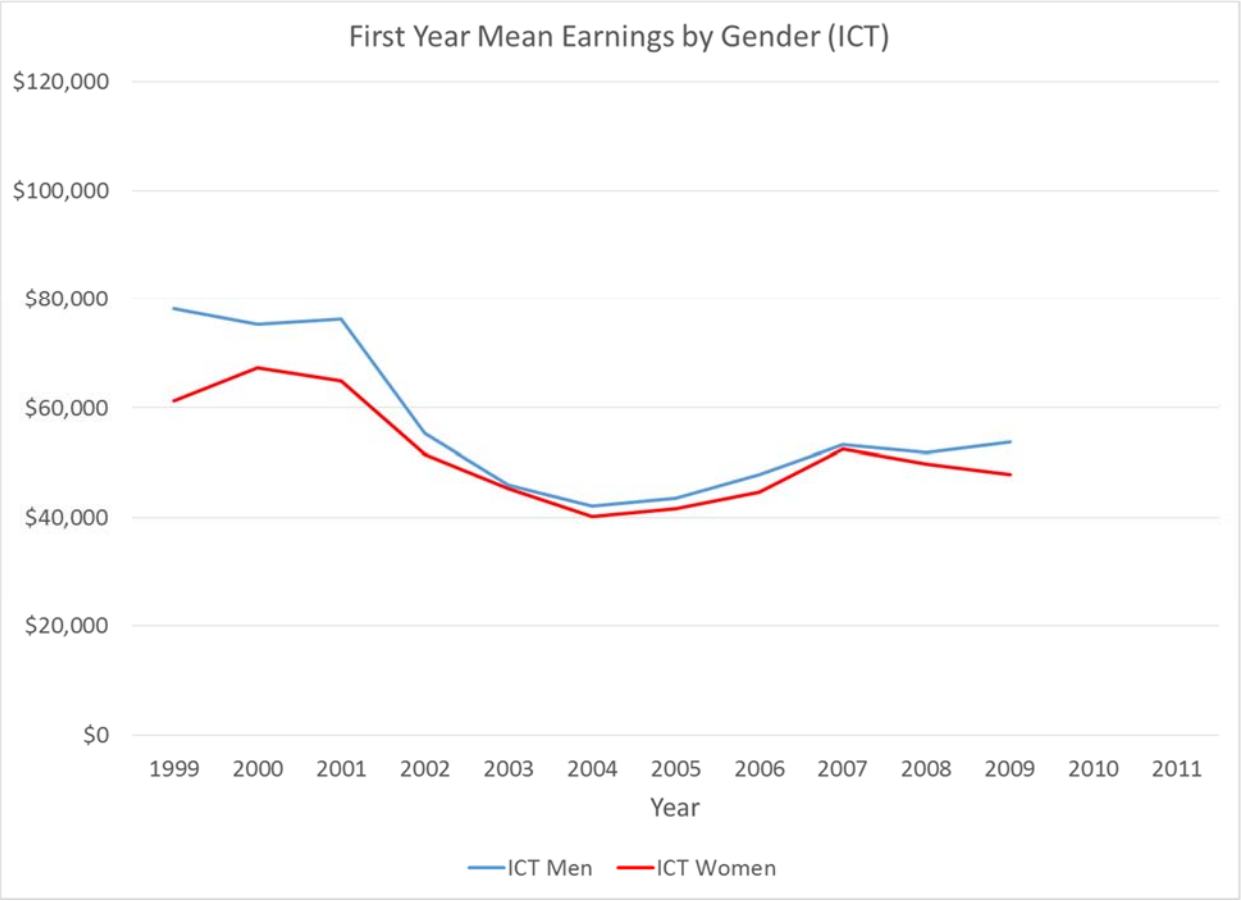
Female graduates of non-ICT programs had lower 1st year earnings than male graduates in all years prior to 2004. In 2003, male non-ICT graduates earned around $10,000 more than female non-ICT graduates, the largest difference in 1st year earnings between non-ICT men and women in all the years covered by this study. After 2004, however, female graduates had higher, or roughly equal, earnings to males in the 1st year after graduation.

Graph 14a – First Year Mean Earnings by Gender (All Others)



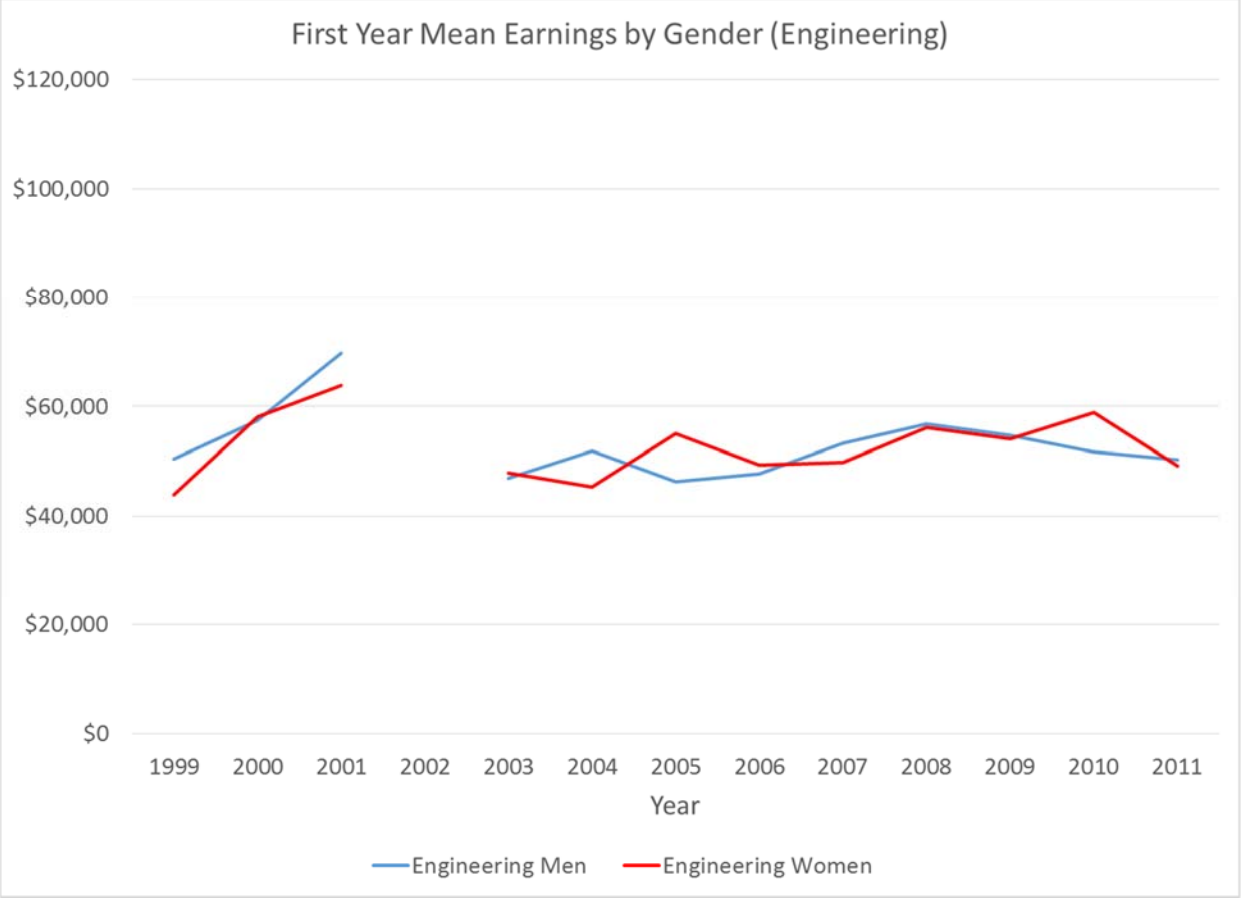
Male graduates of ICT programs earned more in their 1st year after graduation than female graduates in every year covered by this study. Similar to graduates of non-ICT (All Others) programs, there was a large gap in earnings between male and female graduates of ICT programs in the first several cohorts. The dot-com bubble burst of 2001 seemed to have brought earnings between men and women closer towards parity, although never entirely. Female graduates of ICT programs had higher 1st year earnings than female graduates of non-ICT programs in every year except 2004.

Graph 14b - First Year Mean Earnings by Gender (ICT)



First year earnings of both male and female graduates from Engineering programs increased dramatically in the years before the 2001 dot-com bubble burst, potentially reflecting the fact that there was a large demand for these graduates from the ICT sector. At the peak of earnings for both men and women engineering graduates (in 2001), 1st year earnings were still lower relative to male and female graduates of ICT programs at the same point in time. Since 2003, male and female graduates of Engineering programs tended to have roughly similar earnings in the 1st year after graduation, and these were similar to ICT men and women.

Graph 14c- First Year Mean Earnings by Gender (Engineering)



VI. Conclusion and Discussion

This report presents the results of a descriptive analysis of labour market outcomes of graduates of Information Communications Technology (ICT) programs from the University of Ottawa. We explore the earnings of ICT graduates on a cohort-by-cohort basis using a unique dataset which links university administrative data held on students with tax record data.

The findings demonstrate that, although relatively few students graduated from an ICT program and that the number of graduating students varied across time, these students have tended to do better in the labour market. Although ICT graduates had higher earnings relative to all others, there were large differences in earnings between cohorts of these graduates. Earnings of ICT graduates tended to be more variable, suggesting a greater vulnerability to changes in the business cycle. In particular, the dot-com bubble burst had a strongly negative effect on earnings for ICT

graduates, while the earnings of non-ICT graduates remained relatively stable throughout the period of analysis. Engineering graduates tended to perform just as well as ICT graduates in the labour market, especially after the dot-com bubble burst.

The number of ICT graduates seems to have been responsive to labour market conditions. In particular, the number of graduates rose from 1998 to 2004, reflecting the strong labour market outcomes prevailing at the time these individuals made their PSE schooling choices. Unfortunately, this meant that these individuals arrived in the labour market just when earnings were at their worst. Indeed, the increased supply of graduates may have played a role in driving starting salaries downward – although the greatest effect on the earnings would surely have been the general weakening of the demand for individuals with ICT skills as the sector collapsed.

The PSE system does seem to have been responsive to labour market conditions, but those conditions then shifted in a way such that the increased supply came on to the labour market just as it was at its lowest point and these graduates had relatively unfortunate outcomes rather than the promising ones anticipated when they entered their studies – which presumably drove those higher enrollment rates. Furthermore, those rises and declines in labour market fortunes would presumably dampen interest in ICT disciplines in the future, as prospective students may wonder if another crash is coming. Similarly, universities may also hesitate to again expand their programs even when labour market outcomes of current graduates are strong, for similar reasons. These two sets of factors – on the part of students and on the part of universities – may temper *future* responses of the PSE system to any tightness in the ICT labour market. Given the post cyclical nature of outcomes for ICT graduates, and the ICT sector more generally, such dampened responses may in fact be a bad thing. Conversely, if we truly do face a shortage of ICT talent that is going to extend into the future, such a lack of responsiveness of the PSE system may be a problem.

In this context, we also point to a lukewarm recovery of ICT earning since the depths of the crash. This would seem to cast doubt on assertions that we are facing a crisis of ICT talent, as we revert to the basic economic principle that increased demand should, ceteris paribus, lead to rising wages. That said, industry representatives make other arguments sometimes persuasive. These include that there is not a general shortage of ICT talent, but a shortage of very top-level talent; that there is a shortage of ICT graduates who have other skills of emerging importance,

such as the capability to work as part of a multidisciplinary team, possessing a strong business sense, or being able to think 'outside the box'; or that skill shortages do exist and employment opportunities are strong, but earnings patterns of the type inspected here do not reveal these. These arguments may or may not be true, but testing them lies beyond the scope of this analysis.

Building on the work undertaken here could be done by making further use of the existing University of Ottawa data. For example, it would be possible to examine how labour market outcomes relate to performance while in PSE, and even while in high school. Another promising area of focus using the existing data would be look at the movement of individuals in the income distribution to see the extent of earnings mobility of ICT graduates.

In most cases, however, more institutions would need to be added to truly further this analysis. Doing so would increase sample size, allowing us to generate meaningful employment rates, have more robust gender profiles, compare outcomes of graduate students, undertake a more detailed comparison of outcomes of graduates from different ICT programs, compare outcomes of different types of student (international, for example), examine differences in outcomes between those taking specific combinations of courses, and compare outcomes of students taking co-op and other forms of experiential learning. Adding more institutions would also allow us to see if the results obtained here generalize to graduates from other institutions and in labour markets in other regions.

Appendix 1 – Tables

Table 1- Sample Selection, 1998 Cohort

Sample Selection, 1998 Cohort					
Years After Graduation	Total Graduates	Education Restriction (Cumulative)	Non-Filers	Threshold Restriction	Restricted Total
1	2,300	800	270	80	1,150
2	2,300	1,030	260	60	960
3	2,300	1,140	260	50	860
4	2,300	1,220	260	40	770
5	2,300	1,280	260	50	710
6	2,300	1,320	260	50	680
7	2,300	1,350	240	50	660
8	2,300	1,360	230	60	650
9	2,300	1,375*	230	60*	640
10	2,300	1,390	220	60	640
11	2,300	1,400*	220	60*	630
12	2,300	1,410	220	60	610
13	2,300	1,410*	220	60*	600

* denotes an imputed number

Table 2- Number of Graduates

Number of Graduates by Discipline (Rounded Counts)													
	Cohort												
Discipline	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ICT	80	120	120	140	160	220	260	220	220	180	150	70	80
Engineering (Non-ICT)	70	70	60	40	60	70	50	70	100	110	140	110	110
All Others	1,100	1,000	1,120	1,110	1,220	1,290	1,340	1,610	1,700	2,090	2,090	2,150	2,210

Table 3 - Mean Earnings by Cohort

Mean Earnings by Cohort

	Cohort												
Years After Graduation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
ICT Graduates													
1	75,000	73,900	73,100	54,200	45,800	41,700	43,100	47,100	53,100	51,600	53,100	47,700	51,600
2	92,000	85,800	66,800	59,300	52,200	52,800	53,100	57,300	60,200	58,200	59,800	52,800	
3	103,000	79,600	64,200	64,300	58,500	59,300	59,700	61,900	64,200	62,700	63,600		
4	93,400	76,800	71,800	70,100	65,300	66,700	63,900	65,100	68,900	66,700			
5	81,400	80,600	73,400	80,000	73,200	70,700	66,400	70,000	72,600				
6	92,500	86,300	78,400	82,100	77,900	73,200	69,800	70,400					
7	89,300	86,800	75,300	80,100	79,500	73,200	71,700						
8	101,300	88,300	81,500	92,300	80,800	76,600							
9	100,000	90,900	83,400	91,400	89,400								
10	96,600	93,000	83,300	88,300									
11	93,200	100,600	85,700										
12	98,100	100,500											
13	99,400												
Engineering (Non-ICT)													
1	48,200	57,600	68,300	53,800	47,100	49,200	49,800	48,000	52,400	56,700	54,500	52,900	50,100
2	57,300	65,800	59,700	62,600	58,600	53,400	58,600	58,400	63,600	60,900	61,000	60,600	
3	67,500	69,500	62,400	62,000	61,900	63,800	64,100	65,700	68,900	63,700	65,500		
4	67,500	66,000	76,300	70,100	65,800	72,100	65,400	71,000	71,200	68,000			
5	71,100	70,800	72,200	75,800	72,900	72,000	66,900	74,200	77,600				
6	73,200	79,800	76,500	84,500	76,200	76,300	75,000	82,500					
7	83,700	78,300	80,300	91,300	79,200	79,300	74,700						
8	89,400	77,900	81,000	95,300	86,000	77,100							
9	93,900	83,100	76,400	98,200	87,700								
10	98,900	85,700	81,000	94,700									
11	97,800	91,700	88,000										
12	93,800	98,500											
13	97,900												

All Others (Non-ICT)

1	39,200	40,500	42,700	44,000	44,400	40,300	40,500	41,600	43,000	43,100	43,600	41,400	40,500
2	47,000	47,700	47,900	48,300	44,800	46,000	46,600	49,200	49,600	49,500	47,600	46,400	
3	52,600	51,900	50,700	52,000	48,800	50,900	51,100	53,400	54,900	52,000	51,900		
4	55,600	54,100	52,800	55,900	51,500	55,100	55,100	59,000	57,000	55,600			
5	57,700	55,600	56,000	57,800	55,800	58,100	59,300	59,400	58,200				
6	59,200	58,700	58,100	61,700	58,700	62,600	60,000	62,200					
7	63,100	58,800	60,800	64,000	63,400	64,000	60,700						
8	65,000	61,500	61,300	67,900	62,100	65,200							
9	67,500	63,300	66,800	69,800	66,400								
10	68,600	68,100	68,500	78,700									
11	74,000	67,700	72,700										
12	73,900	70,500											
13	76,000												

Table 4 - Median Earnings by Cohort

Median Earnings by Cohort

	Cohort												
Years After Graduation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
ICT Graduates													
1	65,100	72,500	74,300	62,500	44,300	43,700	42,500	50,200	56,300	54,400	55,300	54,300	54,200
2	88,200	80,700	71,800	65,600	54,400	55,700	53,700	59,900	63,500	61,900	62,200	57,400	
3	96,300	79,900	70,900	67,600	62,700	65,300	60,400	64,000	68,000	63,700	67,000		
4	91,800	80,000	75,000	71,200	69,600	69,700	66,300	69,200	71,800	68,900			
5	89,800	85,600	74,900	79,400	75,800	72,000	70,200	72,900	73,000				
6	95,900	88,300	79,500	82,200	81,000	74,200	72,300	75,400					
7	94,400	89,800	79,900	79,800	82,300	76,500	73,900						
8	100,000	91,000	84,500	87,100	80,400	77,100							
9	100,800	94,600	84,000	91,600	83,800								
10	99,800	91,700	83,900	87,300									
11	99,400	92,800	82,000										
12	96,900	98,100											
13	102,000												
Engineering (Non-ICT)													
1	54,300	55,600	61,300	56,900	50,800	53,200	49,100	50,600	53,300	57,100	56,300	55,400	52,100
2	57,200	64,700	61,600	64,700	59,100	56,900	55,000	56,700	61,400	61,400	62,000	59,000	
3	67,800	67,000	62,700	68,000	62,000	63,500	61,100	66,100	63,500	63,500	64,500		
4	69,500	63,500	66,200	70,600	69,800	72,700	62,800	71,800	67,400	66,200			
5	74,500	69,900	71,800	76,500	72,600	74,800	67,900	75,300	69,200				
6	74,200	77,800	76,800	79,300	75,200	76,600	68,600	80,100					
7	84,200	79,500	78,400	90,700	82,400	83,100	74,100						
8	86,900	78,200	80,500	89,100	86,200	82,100							
9	85,300	85,900	82,900	90,400	86,300								
10	91,400	83,800	85,600	98,100									
11	93,600	89,200	89,300										
12	94,000	92,400											
13	97,100												

All Others (Non-ICT)													
1	37,900	39,900	42,000	43,900	40,800	39,600	39,500	40,800	42,400	43,400	43,800	41,500	39,500
2	45,000	47,000	47,700	48,800	46,200	46,300	47,600	49,000	50,200	51,100	49,300	47,700	
3	50,600	51,300	50,500	51,800	49,800	50,600	52,500	52,800	55,500	53,500	54,000		
4	54,200	54,400	54,900	57,700	53,000	54,600	55,900	59,500	57,200	57,400			
5	57,000	56,600	57,100	58,800	55,700	58,300	60,100	59,800	58,900				
6	57,500	58,800	58,500	62,200	58,100	63,500	60,300	62,400					
7	60,900	59,800	60,700	64,500	64,200	64,800	61,200						
8	63,700	61,300	60,700	69,500	64,500	65,900							
9	67,400	63,600	65,900	69,400	65,900								
10	68,100	68,800	66,900	73,800									
11	69,300	66,200	71,300										
12	71,100	69,400											
13	74,100												

Table 5 - First Year Earnings (Mean)

First Year Earnings (Mean)

	Year												
Discipline	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
ICT	75,000	73,900	73,100	54,200	45,800	41,700	43,100	47,100	53,100	51,600	53,100	47,700	51,600
Engineering (Non-ICT)	48,200	57,600	68,300	53,800	47,100	49,200	49,800	48,000	52,400	56,700	54,500	52,900	50,100
All Other (Non-ICT)	39,200	40,500	42,700	44,000	44,400	40,300	40,500	41,600	43,000	43,100	43,600	41,400	40,500

Table 6 - Fifth Year Earnings (Mean)

Fifth Year Earnings (Mean)

	Year												
Discipline	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
ICT					81,400	80,600	73,400	80,000	73,200	70,700	66,400	70,000	72,600
Engineering (Non-ICT)					71,100	70,800	72,200	75,800	72,900	72,000	66,900	74,200	77,600
All Other (Non-ICT)					57,700	55,600	56,000	57,800	55,800	58,100	59,300	59,400	58,200

Table 7 - Earnings by Quartile, All Others (Non-ICT)

Earnings by Quartile, All Others

	Cohort												
Years After Graduation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Quartile 1 (p25)													
1	22,600	24,800	27,300	28,100	25,300	24,500	24,100	26,300	27,400	28,100	26,000	24,600	23,600
2	31,200	33,400	32,200	33,000	28,900	30,800	30,400	33,800	34,300	34,500	31,200	30,400	
3	35,200	36,200	33,900	37,100	32,000	36,100	34,400	38,200	38,800	36,400	35,500		
4	35,800	36,700	32,200	39,500	34,900	38,700	38,700	41,400	41,900	39,000			
5	37,800	35,500	34,900	40,700	39,000	40,300	41,200	41,000	40,000				
6	39,200	39,200	37,400	42,700	38,800	44,900	40,800	42,800					
7	42,000	37,100	39,800	43,100	44,500	46,000	40,200						
8	41,100	39,000	38,200	44,500	41,900	44,300							
9	43,100	39,800	42,700	46,300	47,100								
10	43,500	42,500	47,100	47,500									
11	41,700	42,300	47,000										
12	45,000	46,700											
13	45,100												
Quartile 2 (p50)													
1	37,900	39,900	42,000	43,900	40,900	39,600	39,500	40,800	42,400	43,400	43,800	41,500	39,500
2	45,000	47,000	47,700	48,800	46,300	46,300	47,600	49,000	50,200	51,100	49,300	47,700	
3	50,600	51,300	50,500	51,800	49,700	50,600	52,500	52,800	55,500	53,500	54,000		
4	54,200	54,400	54,900	57,700	53,000	54,600	55,800	59,500	57,100	57,400			
5	57,000	56,600	57,100	59,000	55,700	58,300	60,100	59,800	58,800				
6	57,500	58,800	58,500	62,200	58,100	63,500	60,300	62,400					
7	60,900	59,800	60,700	64,500	64,300	64,800	61,200						
8	63,700	61,300	60,700	69,500	64,600	65,900							
9	67,400	63,600	65,900	69,500	65,900								
10	68,100	68,800	66,900	73,900									
11	69,300	66,200	71,300										
12	71,100	69,400											
13	74,100												

Quartile 3 (p75)													
1	52,100	53,400	55,000	57,100	53,900	53,900	54,700	54,600	57,600	57,100	59,900	56,400	55,000
2	59,600	60,300	62,500	62,400	58,900	60,800	60,300	62,800	63,800	64,500	63,400	61,100	
3	65,200	66,200	64,200	67,100	64,000	65,400	65,200	66,800	70,400	67,100	67,100		
4	70,600	68,600	68,900	71,800	66,900	70,900	70,200	74,300	72,800	71,700			
5	75,600	71,400	73,300	75,300	71,800	75,000	75,500	76,600	75,900				
6	76,400	76,600	75,800	78,700	76,100	81,200	77,600	78,700					
7	81,200	75,500	79,900	81,800	80,400	81,900	79,200						
8	83,200	80,700	81,800	88,700	81,800	84,500							
9	85,400	83,200	88,700	87,700	85,000								
10	85,500	88,000	87,800	91,700									
11	92,000	87,600	93,700										
12	92,900	89,600											
13	96,400												

Table 8 - Earnings by Quartile, ICT

Earnings by Quartile, ICT

	Cohort												
Years After Graduation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Quartile 1 (p25)													
1	60,600	60,200	63,100	28,800	26,300	23,900	26,500	33,500	42,200	40,500	42,800	29,800	41,000
2	69,000	68,800	55,200	34,300	32,900	35,400	40,100	46,600	51,100	46,200	50,500	38,900	
3	81,300	64,100	53,600	39,400	38,300	44,600	45,800	49,800	54,200	54,200	52,800		
4	74,900	61,800	55,000	46,700	48,100	49,800	50,400	53,700	56,100	57,600			
5	59,100	59,200	57,300	53,300	53,900	53,600	52,700	59,700	64,600				
6	72,600	67,800	64,500	56,900	59,100	54,000	56,200	55,200					
7	76,900	69,600	49,500	55,200	64,600	52,700	57,600						
8	85,000	68,600	61,600	62,400	59,200	55,400							
9	85,300	73,600	62,700	59,700	68,700								
10	82,800	67,400	60,500	55,400									
11	76,600	69,100	61,300										
12	83,600	77,700											
13	81,200												

Quartile 2 (p50)

1	65,100	72,500	74,300	62,500	44,300	43,400	42,400	50,200	56,100	54,300	55,300	54,300	54,800
2	88,200	80,700	71,800	65,300	54,400	55,400	53,400	59,800	63,500	61,500	62,000	57,900	
3	96,300	79,900	70,900	66,800	62,700	64,800	60,300	64,200	67,900	63,500	66,000		
4	91,800	80,000	75,000	71,100	69,600	69,600	66,200	69,300	71,800	68,700			
5	89,800	85,600	74,900	79,100	75,800	71,900	70,100	72,900	73,000				
6	95,900	88,300	79,500	82,200	81,000	73,600	72,200	76,300					
7	94,400	89,800	79,900	79,500	82,300	76,500	73,700						
8	100,000	91,000	84,500	87,000	80,400	76,900							
9	100,800	94,600	84,000	91,400	83,800								
10	99,800	91,700	83,900	87,300									
11	99,400	92,800	82,000										
12	96,900	98,100											
13	102,000												

Quartile 3 (p75)

1	74,700	88,100	86,600	73,800	63,700	59,200	60,200	63,000	66,000	64,100	63,800	64,200	65,600
2	102,900	106,400	82,700	76,000	68,900	69,500	67,900	71,600	74,900	72,000	68,700	68,200	
3	118,200	102,100	84,800	80,200	75,000	76,200	73,500	76,400	79,600	75,300	73,100		
4	115,200	96,900	90,800	84,700	81,300	81,500	78,200	81,600	84,400	78,000			
5	99,800	100,000	92,600	93,200	88,400	88,000	81,300	86,500	86,900				
6	112,000	102,300	94,700	96,800	97,600	90,800	83,800	89,000					
7	109,300	104,600	98,000	101,100	98,800	94,600	85,400						
8	123,400	105,400	100,600	101,700	98,200	94,100							
9	115,500	109,400	103,300	100,000	101,500								
10	116,000	111,600	104,100	103,500									
11	117,300	111,300	102,600										
12	117,000	116,800											
13	120,900												

Table 9 - Earnings by Quartile, Engineering (Non-ICT)

Earnings by Quartile, Engineering (Non-ICT)

	Cohort												
Years After Graduation	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Quartile 1 (p25)													
1	37,600	43,300	53,700	46,900	37,700	40,700	39,500	33,800	45,400	46,000	48,500	45,400	41,000
2	36,200	51,800	48,600	47,900	49,800	43,300	50,300	45,800	53,000	52,200	55,200	52,100	
3	55,500	55,200	52,200	47,900	53,300	56,800	54,300	52,400	56,600	55,700	58,000		
4	59,100	52,600	55,200	47,900	53,400	63,900	54,400	58,600	57,800	58,500			
5	58,700	60,100	55,900	61,000	59,400	62,100	59,600	62,900	63,500				
6	62,300	63,800	66,400	66,800	59,800	62,600	56,000	65,300					
7	63,900	62,800	68,800	65,600	58,300	69,200	62,800						
8	65,300	61,200	73,200	79,200	65,900	59,700							
9	61,000	53,400	65,200	81,800	69,600								
10	74,700	63,200	69,500	78,100									
11	78,700	67,500	76,600										
12	70,700	78,200											
13	69,700												
Quartile 2 (p50)													
1	54,300	55,600	61,300	57,500	50,800	54,900	48,800	50,600	53,400	57,400	56,300	55,500	51,700
2	57,200	64,700	61,600	65,400	59,100	57,300	55,900	56,400	61,400	61,900	62,300	58,800	
3	67,800	67,000	62,700	68,200	62,200	64,600	62,500	65,700	63,800	64,400	64,600		
4	69,500	63,500	66,200	70,600	69,800	73,700	63,000	71,400	67,400	66,900			
5	74,500	69,900	71,800	75,500	72,600	76,000	69,400	74,800	68,700				
6	74,200	77,800	76,800	79,400	76,700	78,900	69,300	79,600					
7	84,200	79,500	78,400	90,700	83,000	84,000	77,400						
8	86,900	78,200	80,500	90,000	85,600	84,200							
9	85,300	85,900	82,900	91,000	86,100								
10	91,400	83,800	85,600	98,200									
11	93,600	89,200	89,300										
12	94,000	92,400											
13	97,100												

Quartile 3 (p75)

1	60,800	68,800	75,800	65,800	60,200	62,000	61,200	64,100	59,100	64,500	63,900	62,800	59,800
2	70,300	81,500	71,100	72,600	68,200	65,600	66,400	75,500	73,300	71,200	69,000	67,700	
3	78,300	87,000	72,300	76,300	73,400	77,400	76,000	79,600	79,900	75,000	73,500		
4	78,100	86,300	77,100	86,900	77,100	80,900	77,800	84,300	83,000	77,400			
5	84,200	92,100	83,600	91,300	85,000	82,500	84,200	87,700	86,300				
6	85,400	95,800	89,200	95,000	87,300	91,800	98,500	99,700					
7	97,100	96,700	94,000	104,900	96,700	97,200	93,500						
8	103,300	96,100	90,200	116,000	103,700	99,100							
9	100,700	110,000	93,400	109,600	98,700								
10	102,300	108,300	95,000	117,500									
11	106,600	109,200	103,700										
12	106,900	122,300											
13	108,000												

Table 10 - Percentage of Graduates by Gender

Percentage of Graduates by Gender

	ICT		Engineering		All Others	
Cohort	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**
1998	22%	78%	38%	63%	68%	32%
1999	17%	83%	38%	63%	68%	32%
2000	25%	75%	29%	71%	65%	35%
2001	29%	71%			67%	33%
2002	25%	75%	29%	71%	67%	33%
2003	23%	77%	43%	57%	67%	33%
2004	20%	80%	40%	60%	67%	33%
2005	23%	77%	29%	71%	68%	32%
2006	14%	86%	20%	80%	67%	33%
2007	16%	84%	18%	82%	69%	31%
2008	13%	87%	21%	79%	66%	34%
2009			18%	82%	67%	33%
2010			18%	82%	67%	33%

Table 11 - Mean Earnings by Cohort and Gender (1998-2004)

Mean Earnings by Cohort and Gender (1998-2004)

	Cohort													
	1998		1999		2000		2001		2002		2003		2004	
Years After Graduation	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
ICT Graduates														
1	78,300	61,300	75,400	67,300	76,300	64,900	55,400	51,500	45,900	45,300	42,100	40,200	43,500	41,600
2			87,100	78,600	67,600	64,400	59,700	58,000	51,900	53,600	53,600	50,300	54,800	47,200
3			79,300	80,900	64,500	63,500	66,500	58,800	59,000	56,200	60,200	56,700	61,800	52,100
4					73,100	68,100	72,000	65,900	67,100	56,900	68,000	62,700	66,800	52,900
5					76,700	64,200	85,300	69,700	75,800	60,500	73,000	63,900	68,900	56,300
6					81,900	68,100	87,200	71,200	80,800	63,100	76,800	62,200	72,500	59,100
7					78,800	65,200	87,300	65,700	83,200	61,000	76,500	63,600	74,800	59,000
8					83,900	74,100	101,400	73,200	85,100	61,400	81,200	63,700		
9					86,100	73,200	99,700	74,100	93,500	69,500				
10					86,100	73,200	97,700	69,300						
11					91,700	66,700								
12														
13														
Engineering (Non-ICT)														
1	50,400	43,800	57,400	58,000	69,800	63,800			46,800	47,900	51,800	45,300	46,200	55,000
2	62,500	45,900	63,400	71,000							56,900	48,100	57,700	59,900
3	72,300	57,000	68,400	71,800							66,700	59,200	67,000	60,100
4	71,900	56,700	66,600	64,500					67,200	63,300	75,700	66,000	71,700	56,800
5	72,800	66,500	71,500	68,900					76,200	66,900	78,000	62,600	75,800	52,900
6									77,700	73,300	84,300	62,800	82,700	64,200
7									88,400	62,000	87,600	62,900	85,000	61,100
8											90,000	52,400		
9														
10			89,800	77,100										
11														
12														
13														

All Others (Non-ICT)														
1	40,900	38,400	39,800	40,900	43,400	42,300	46,500	42,800	51,100	41,200	39,200	40,900	39,700	40,900
2	49,500	45,800	51,000	46,200	49,400	47,200	51,400	46,600	45,600	44,300	47,200	45,300	46,200	46,800
3	57,900	49,700	54,500	50,700	52,700	49,700	54,800	50,500	52,200	47,100	53,900	49,500	52,300	50,600
4	61,200	52,600	61,400	50,800	56,600	50,900	61,200	53,300	55,700	49,400	61,700	51,900	59,500	52,900
5	65,800	53,400	62,100	52,600	61,300	53,100	65,200	54,000	59,900	53,400	65,900	53,900	64,600	56,800
6	67,700	54,500	66,600	55,300	66,900	53,400	69,900	57,400	65,700	54,800	71,700	57,900	66,500	56,600
7	73,000	57,600	68,400	54,400	69,100	56,300	73,600	59,000	73,400	58,000	73,500	59,100	66,700	57,700
8	77,700	57,800	72,800	56,600	72,100	55,500	78,800	62,100	72,200	56,500	75,400	59,900		
9	80,900	59,100	73,200	58,800	78,100	60,900	81,900	63,700	76,800	60,700				
10	82,300	60,200	78,500	63,300	80,600	61,800	83,500	76,200						
11	94,900	61,700	78,900	62,400	86,000	65,600								
12	92,400	62,800	81,200	65,400										
13	92,300	66,300												

Table 12- Mean Earnings by Cohort and Gender (2005-2010)

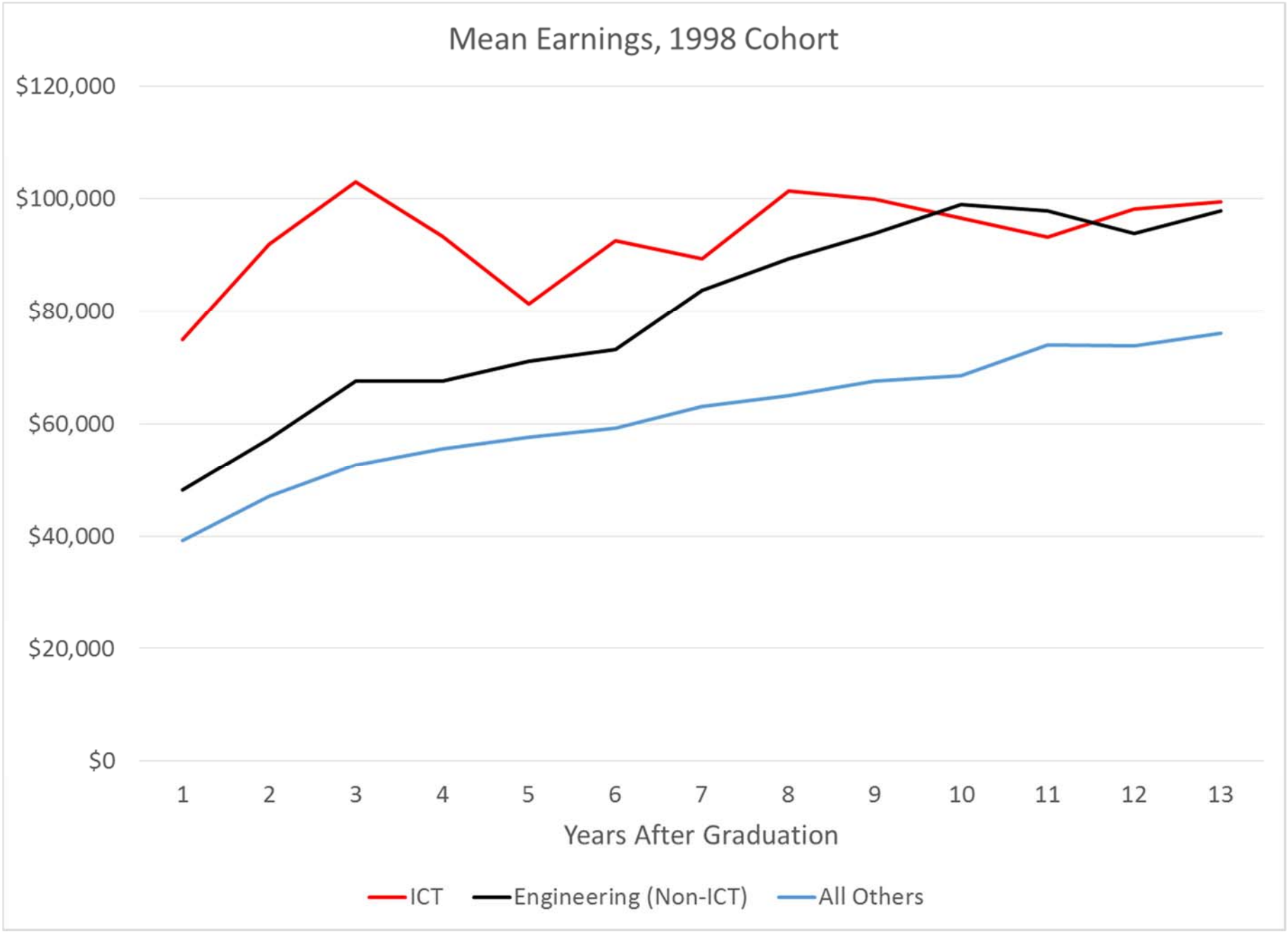
Mean Earnings by Cohort and Gender (2005-2010)

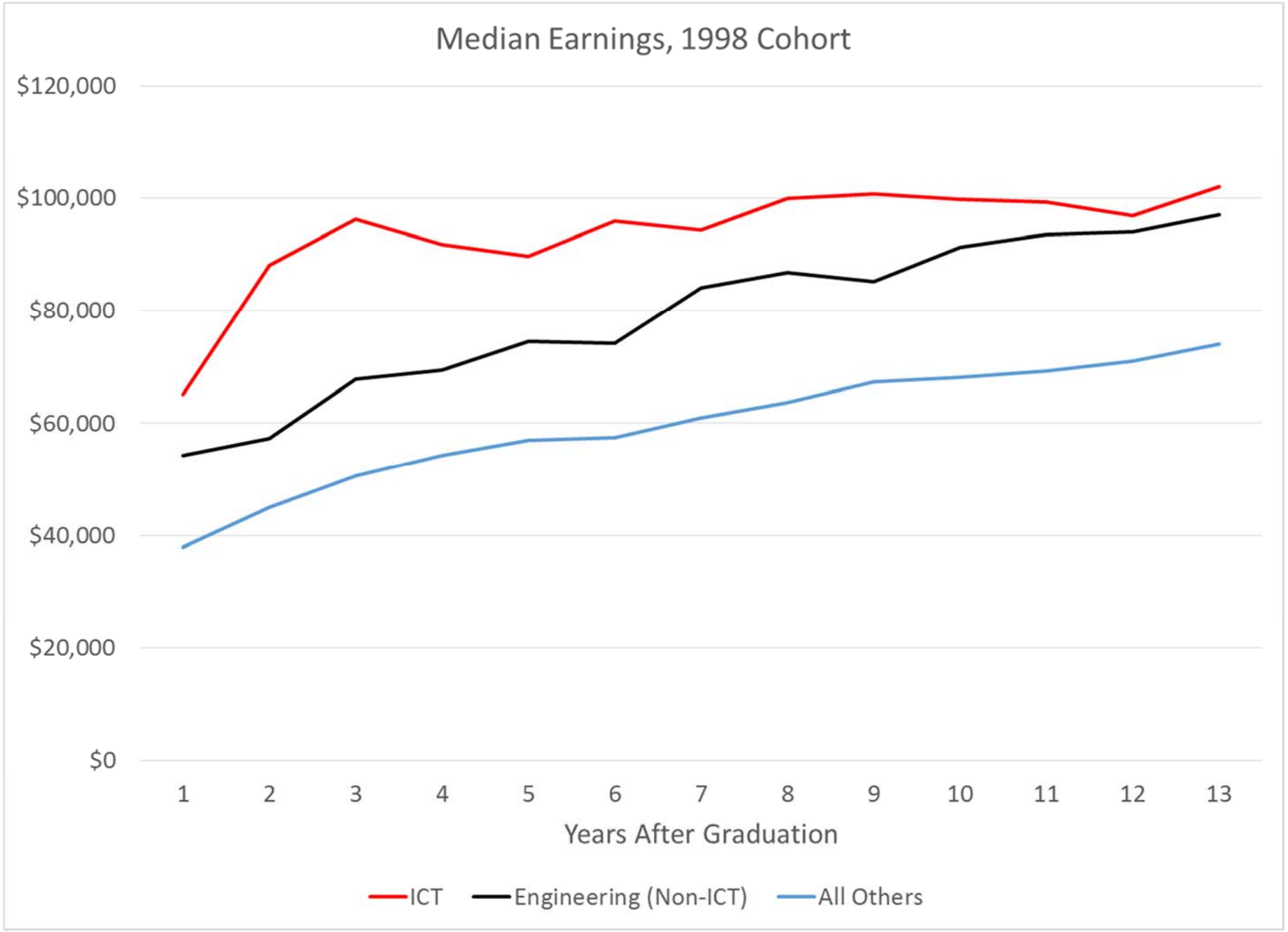
	2005		2006		2007		2008		2009		2010	
Years After Graduation	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
ICT Graduates												
1	47,900	44,600	53,200	52,500	51,900	49,800	53,700	47,800				
2	59,000	52,200	61,300	54,800	57,900	59,900						
3	63,600	56,400	64,800	61,200	62,300	65,500						
4	69,100	53,800	70,300	61,200	67,100	63,900						
5	74,400	57,500	74,300	62,300								
6	75,500	55,800										
7												
8												
9												
10												
11												
12												
13												
Engineering (Non-ICT)												
1	47,700	49,200	53,300	49,800	56,800	56,100	54,700	54,100	51,600	58,800	50,300	49,100
2			66,100	56,600	60,400	63,100	61,300	59,600	60,200	62,300		
3			71,300	62,000	62,000	71,100	66,200	61,900				
4			74,000	63,700	67,600	69,900						
5			81,300	68,800								
6												
7												
8												
9												
10												
11												
12												
13												

All Others (Non-ICT)

1	39,300	42,700	42,800	43,100	40,500	44,300	40,800	45,100	40,000	42,000	40,300	40,700
2	48,700	49,400	51,700	48,500	48,200	50,000	46,400	48,200	47,000	46,100		
3	53,600	53,300	58,800	52,900	51,300	52,300	51,800	51,900				
4	60,100	58,500	63,000	54,100	57,400	54,800						
5	64,300	57,000	65,800	54,500								
6	68,200	59,300										
7												
8												
9												
10												
11												
12												
13												

Appendix 2 – Graphs




Median Earnings, 1998 Cohort
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$60,000
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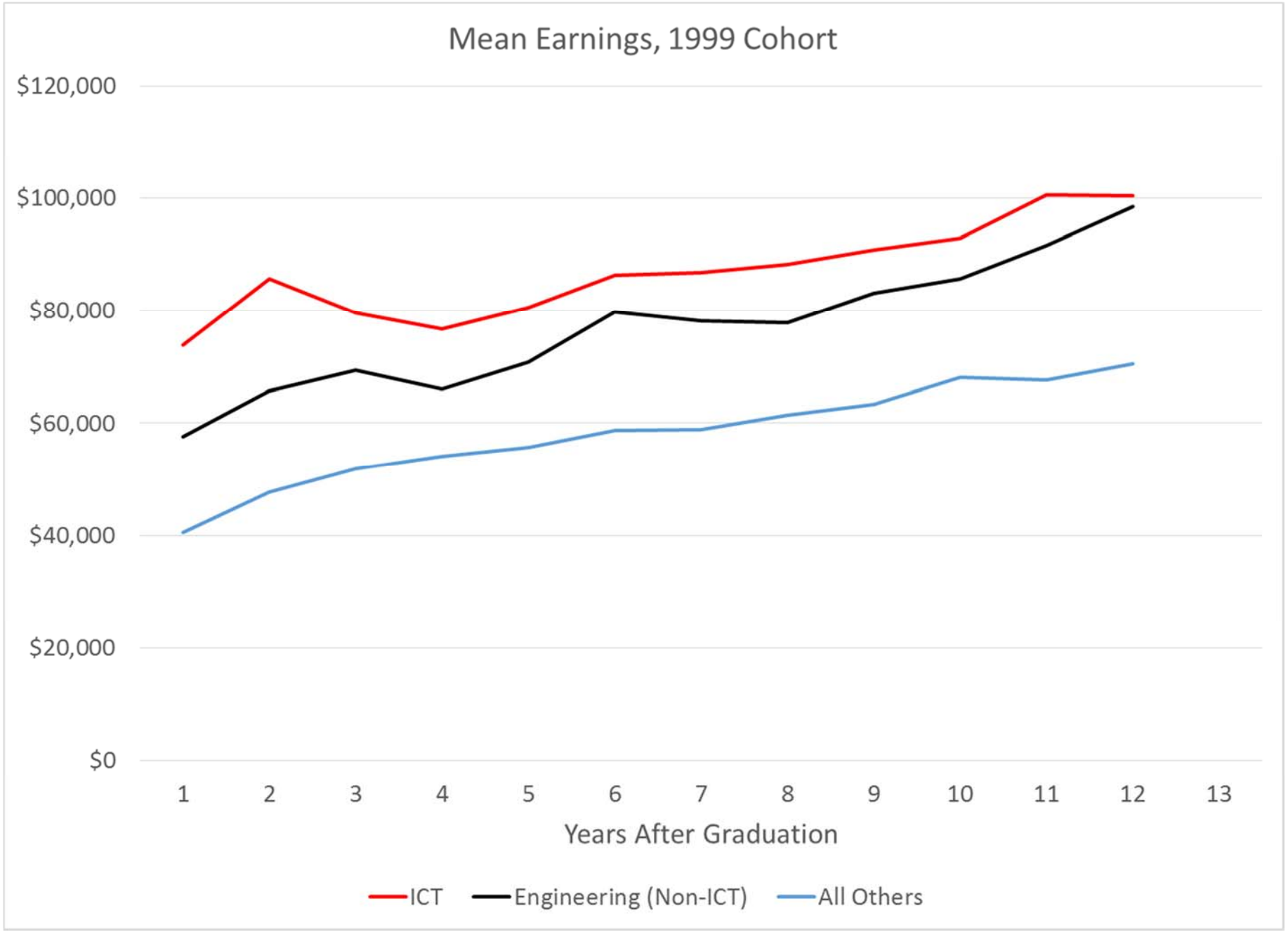
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 1999 Cohort
$120,000
$100,000
$80,000
$60,000
$40,000
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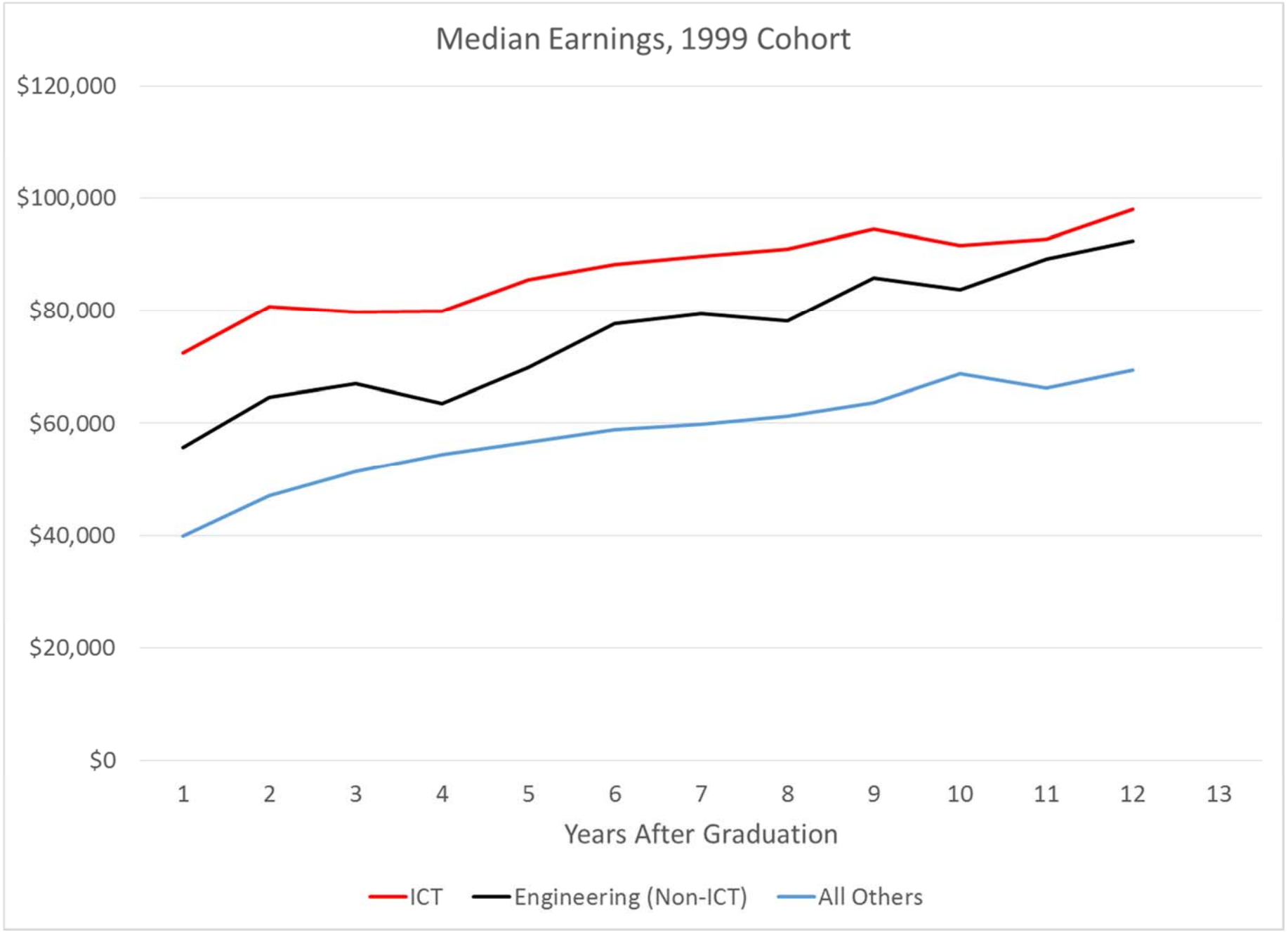
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 1999 Cohort
$120,000
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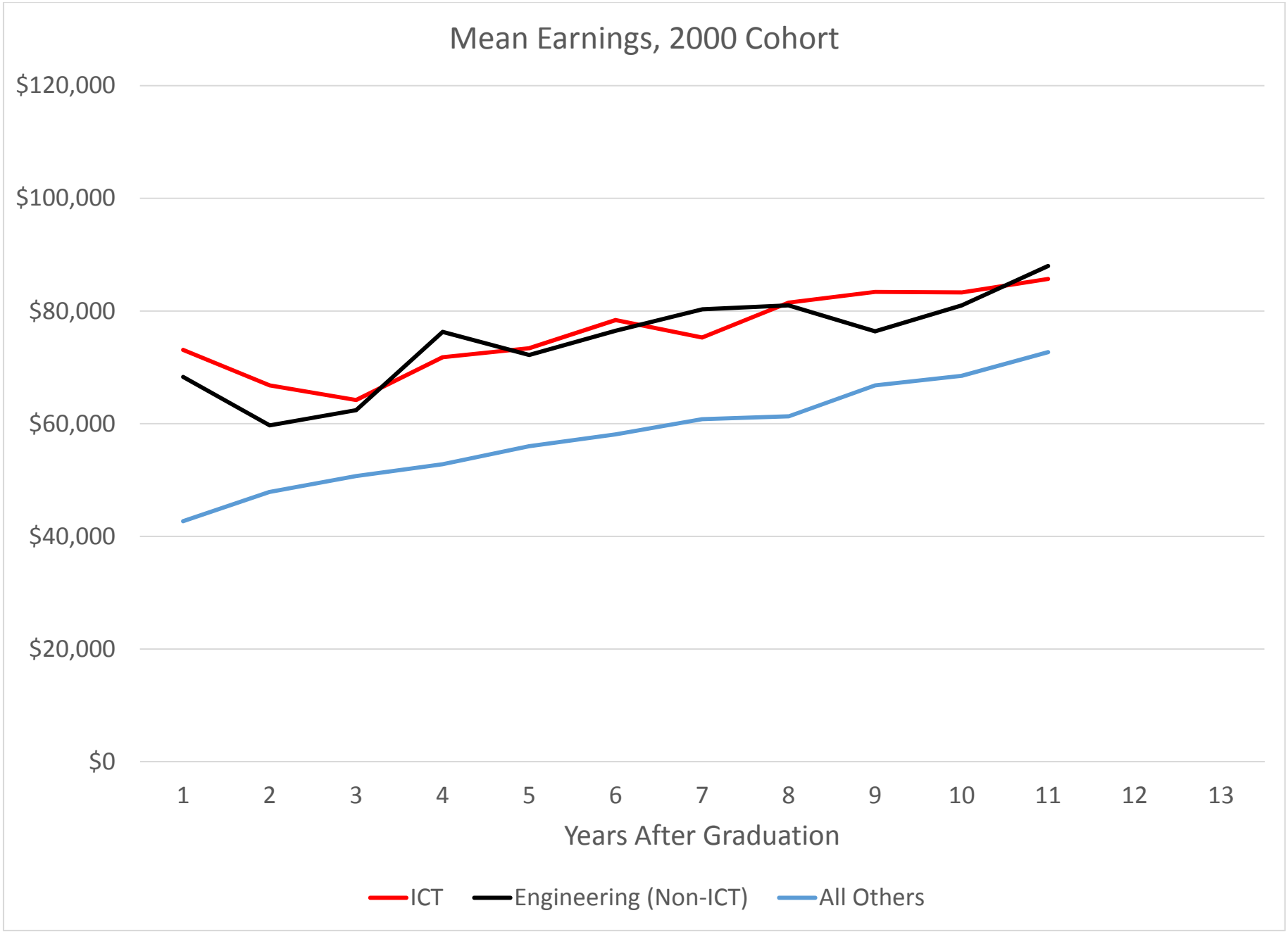
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2000 Cohort
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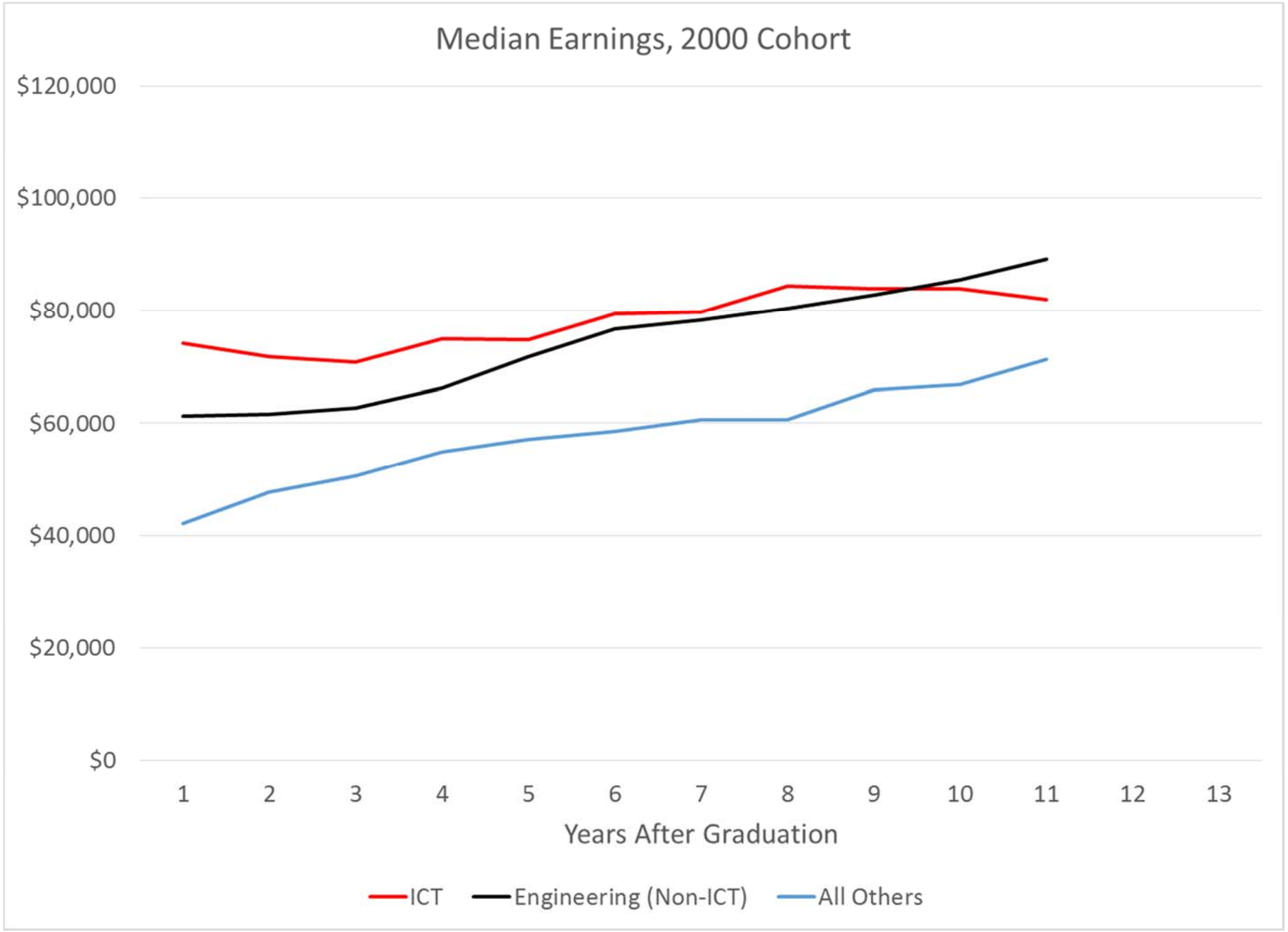
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2000 Cohort
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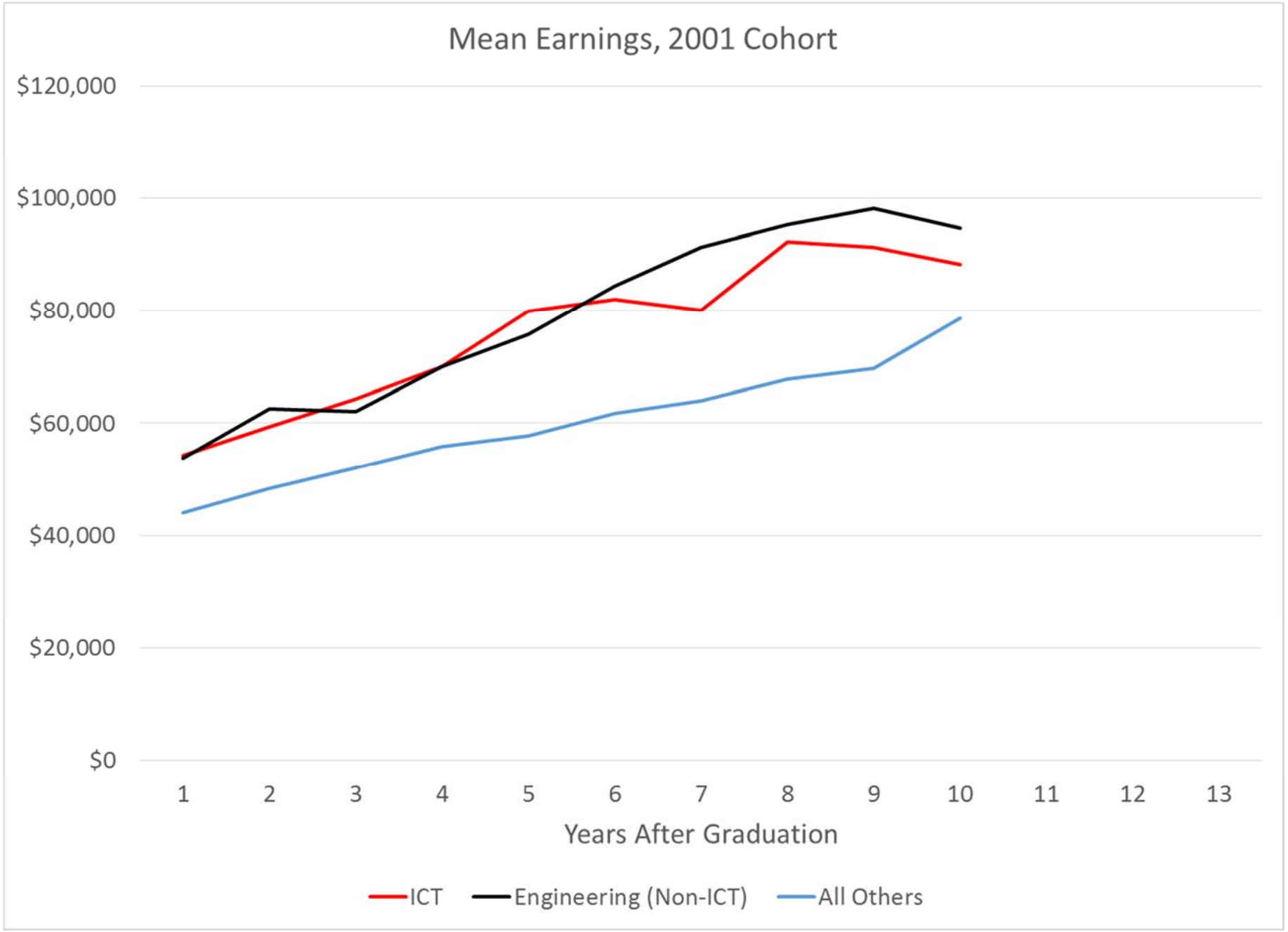
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2001 Cohort
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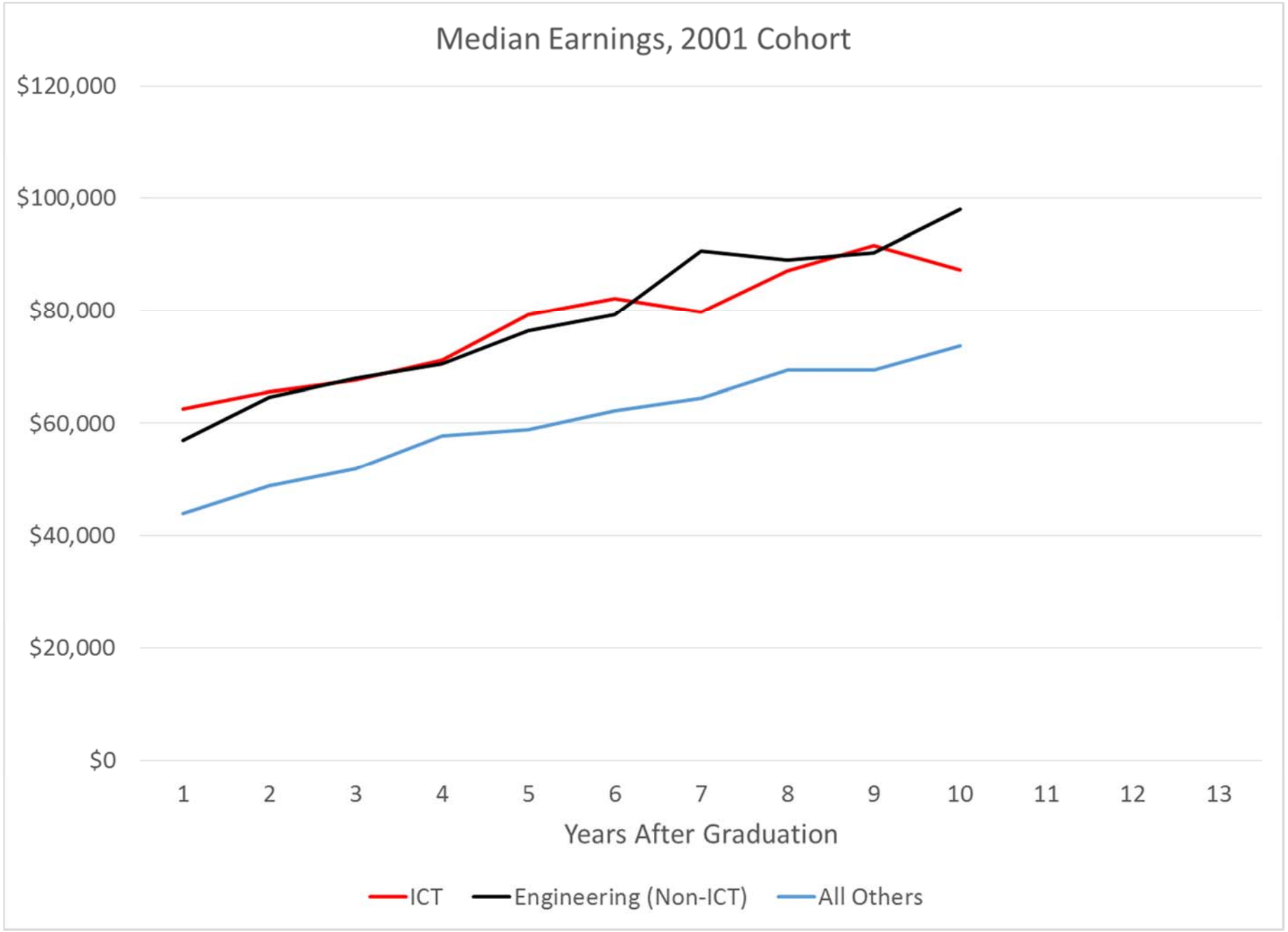
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2001 Cohort
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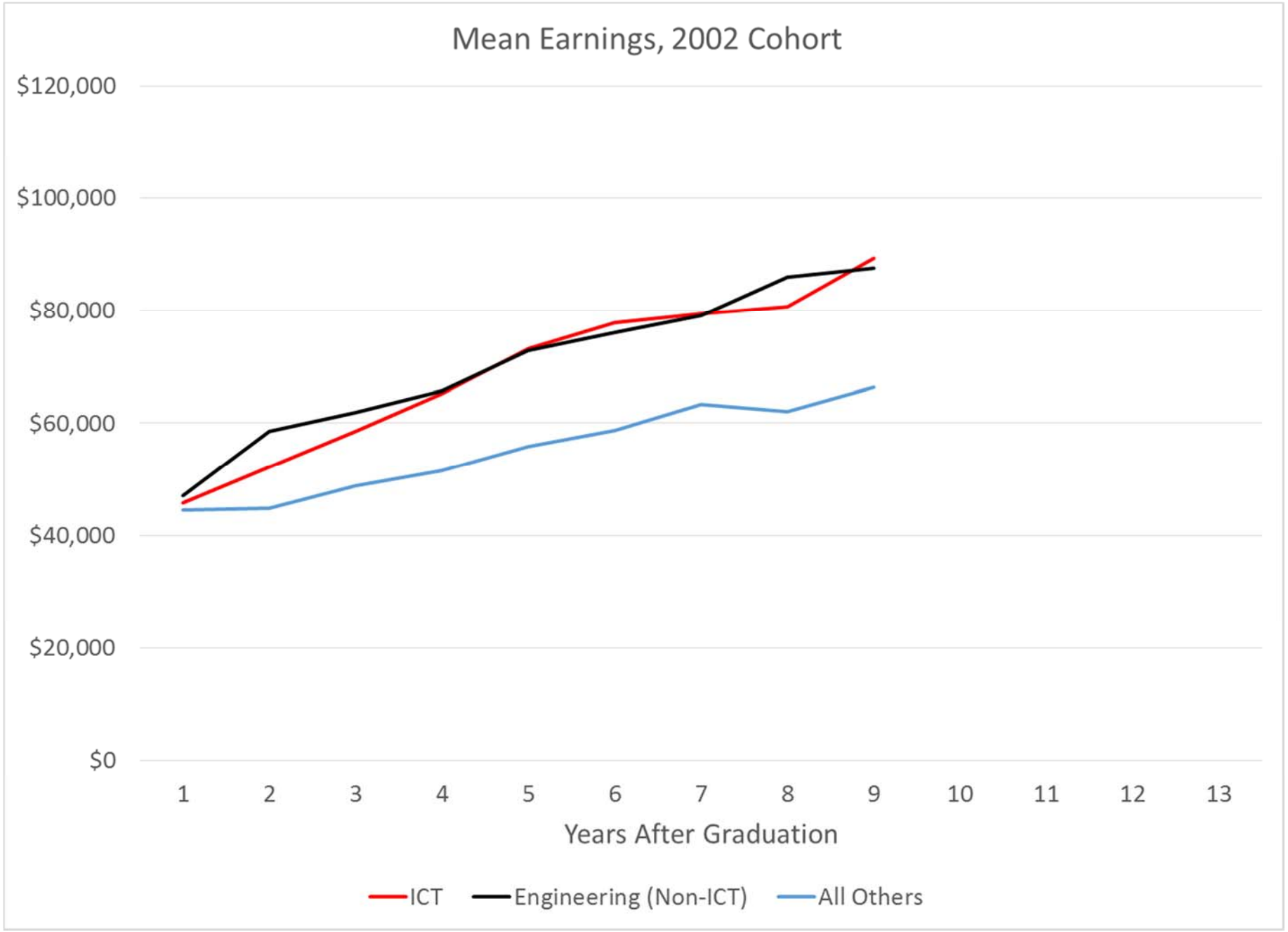
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2002 Cohort
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$60,000
$40,000
$20,000
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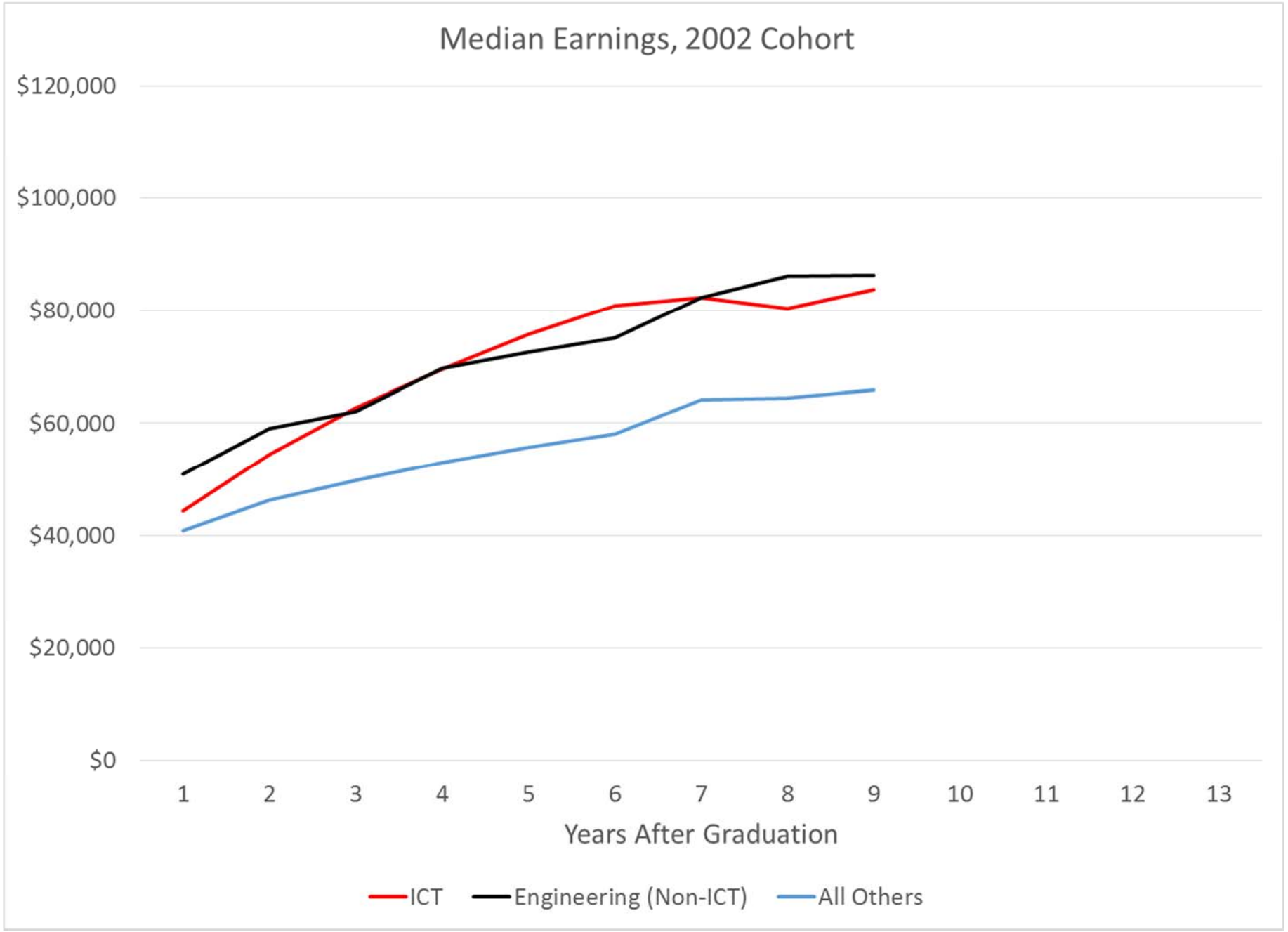
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2002 Cohort
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$100,000
$80,000
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$40,000
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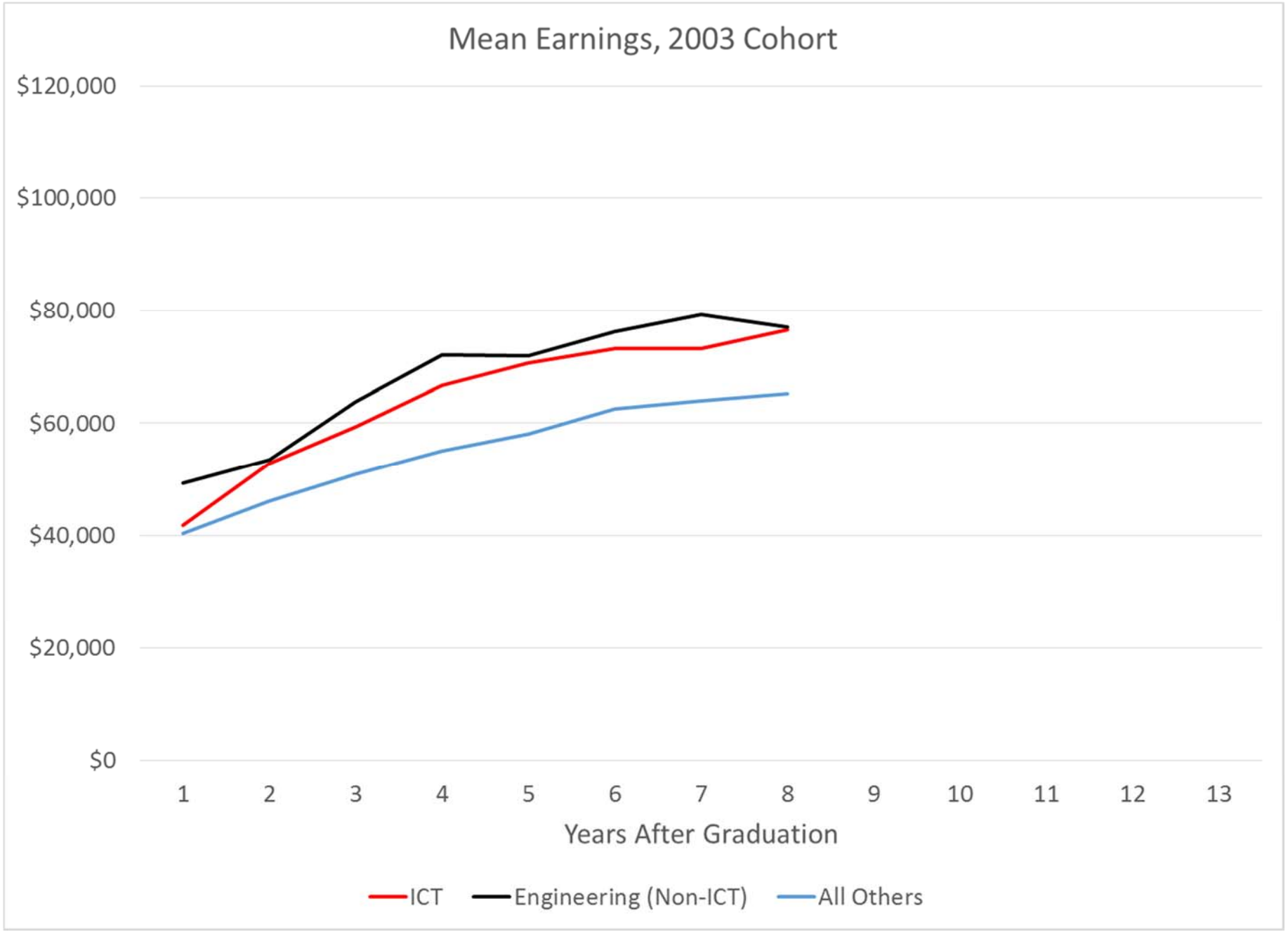
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2003 Cohort
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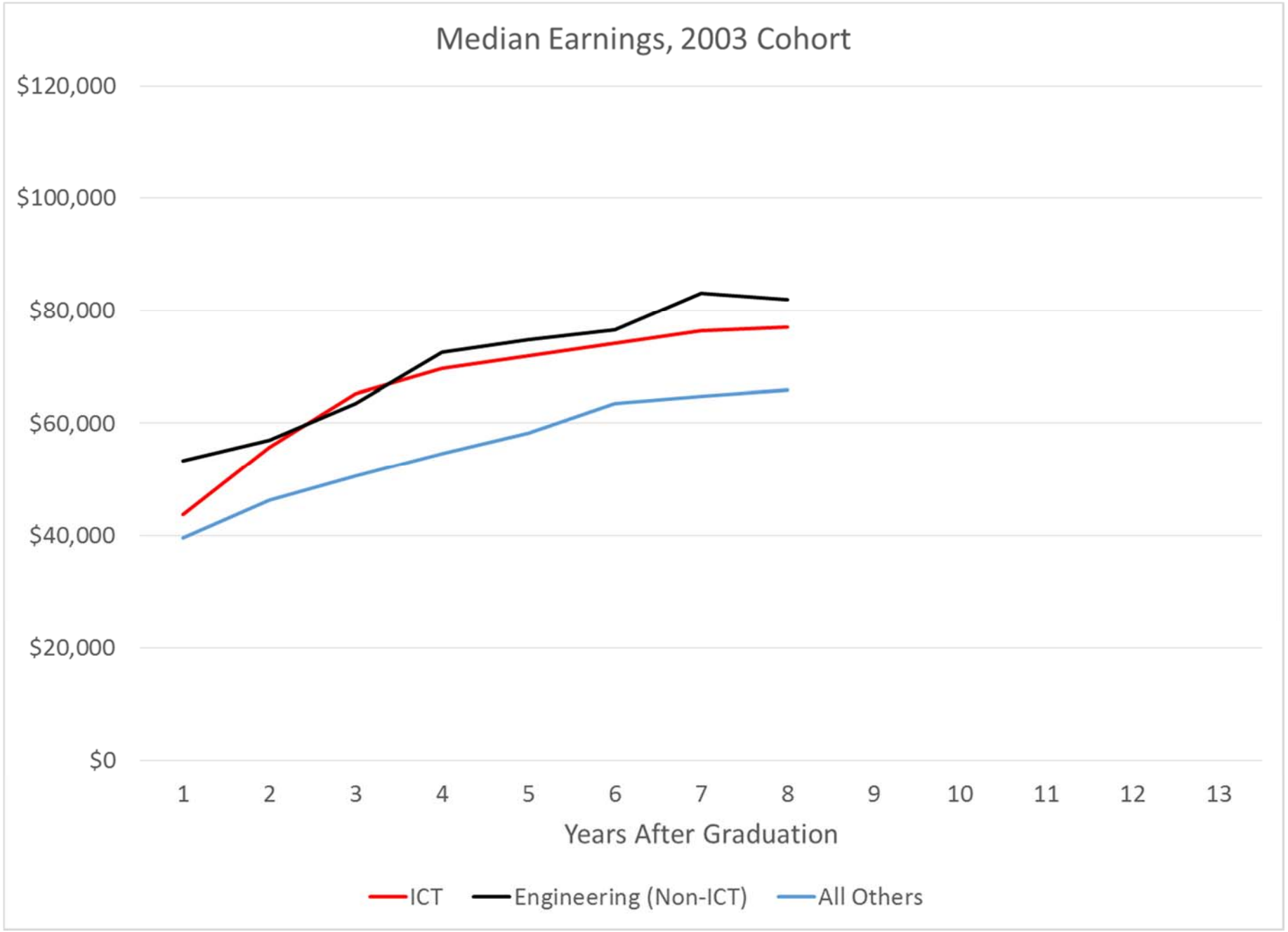
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2003 Cohort
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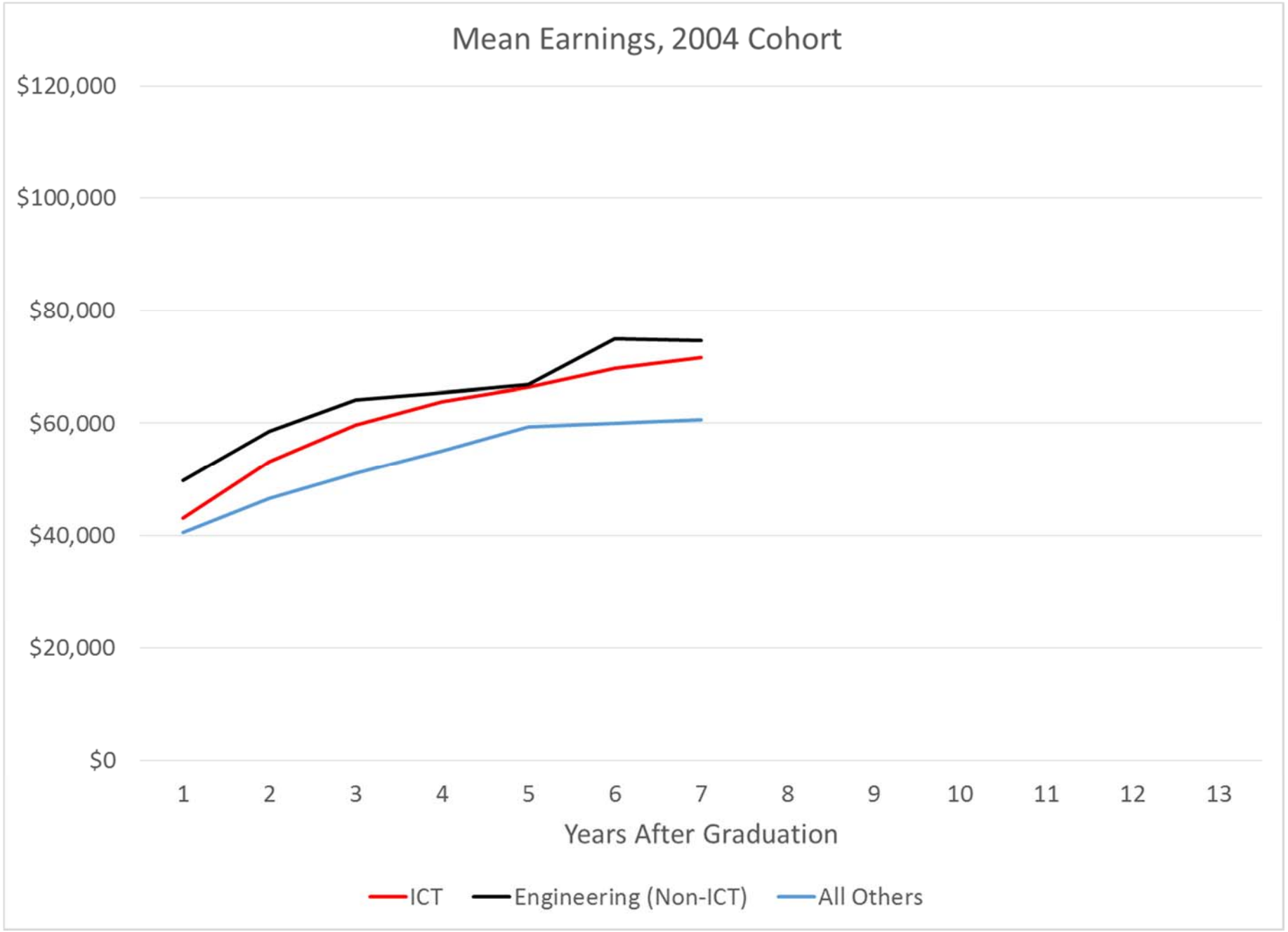
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2004 Cohort
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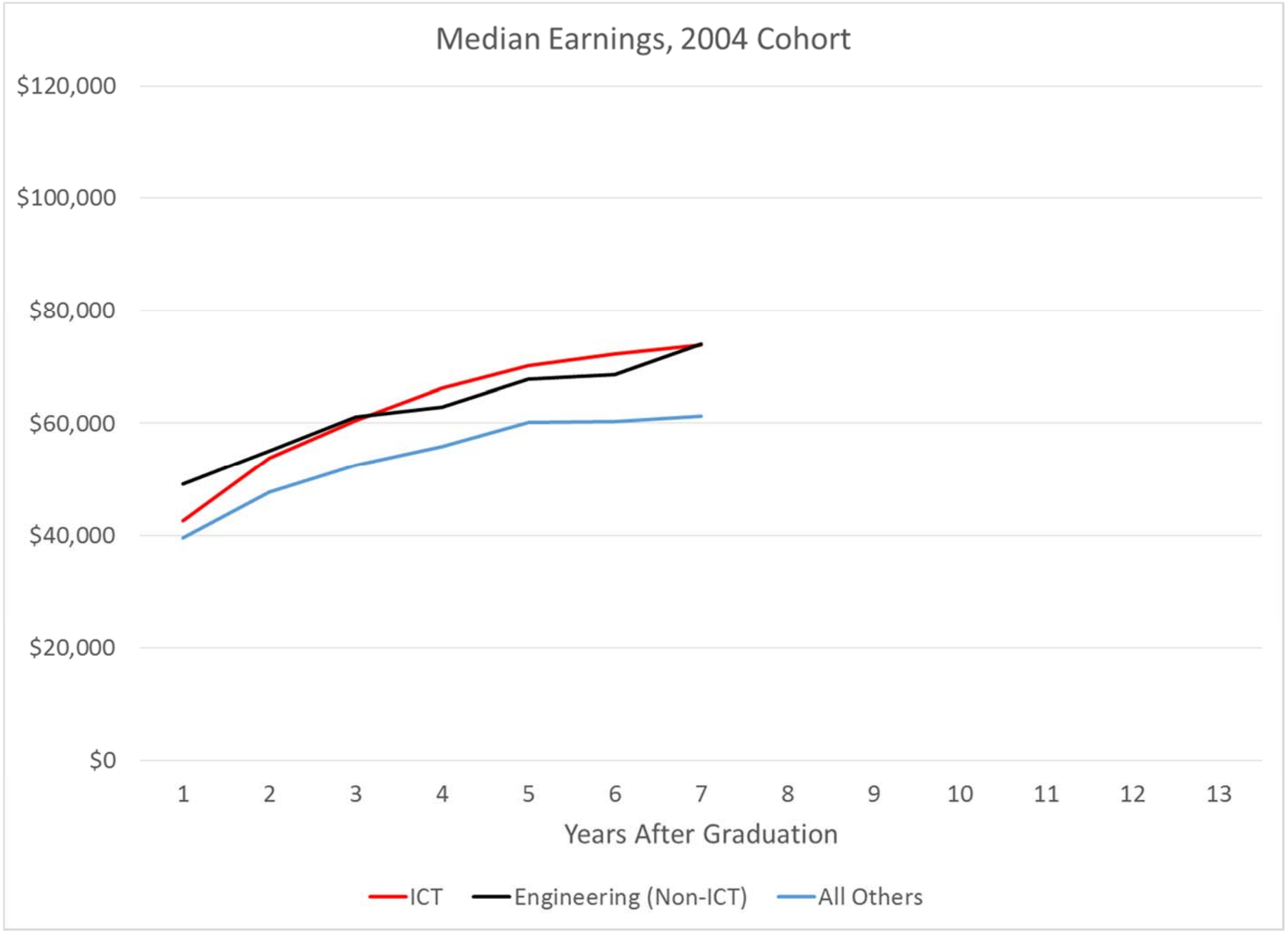
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2004 Cohort
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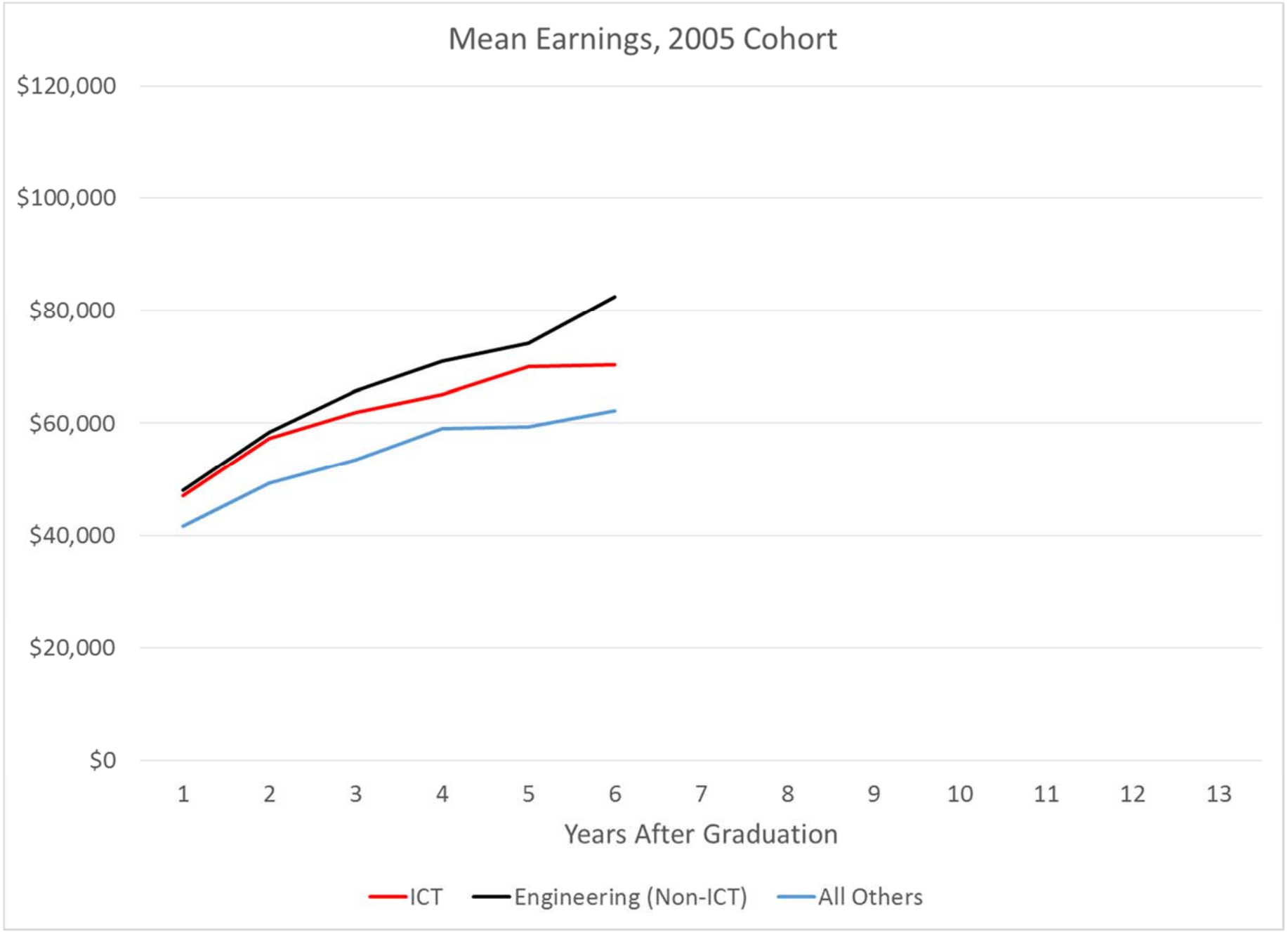
Years After Graduation
ICT
Engineering (Non-ICT)
All Others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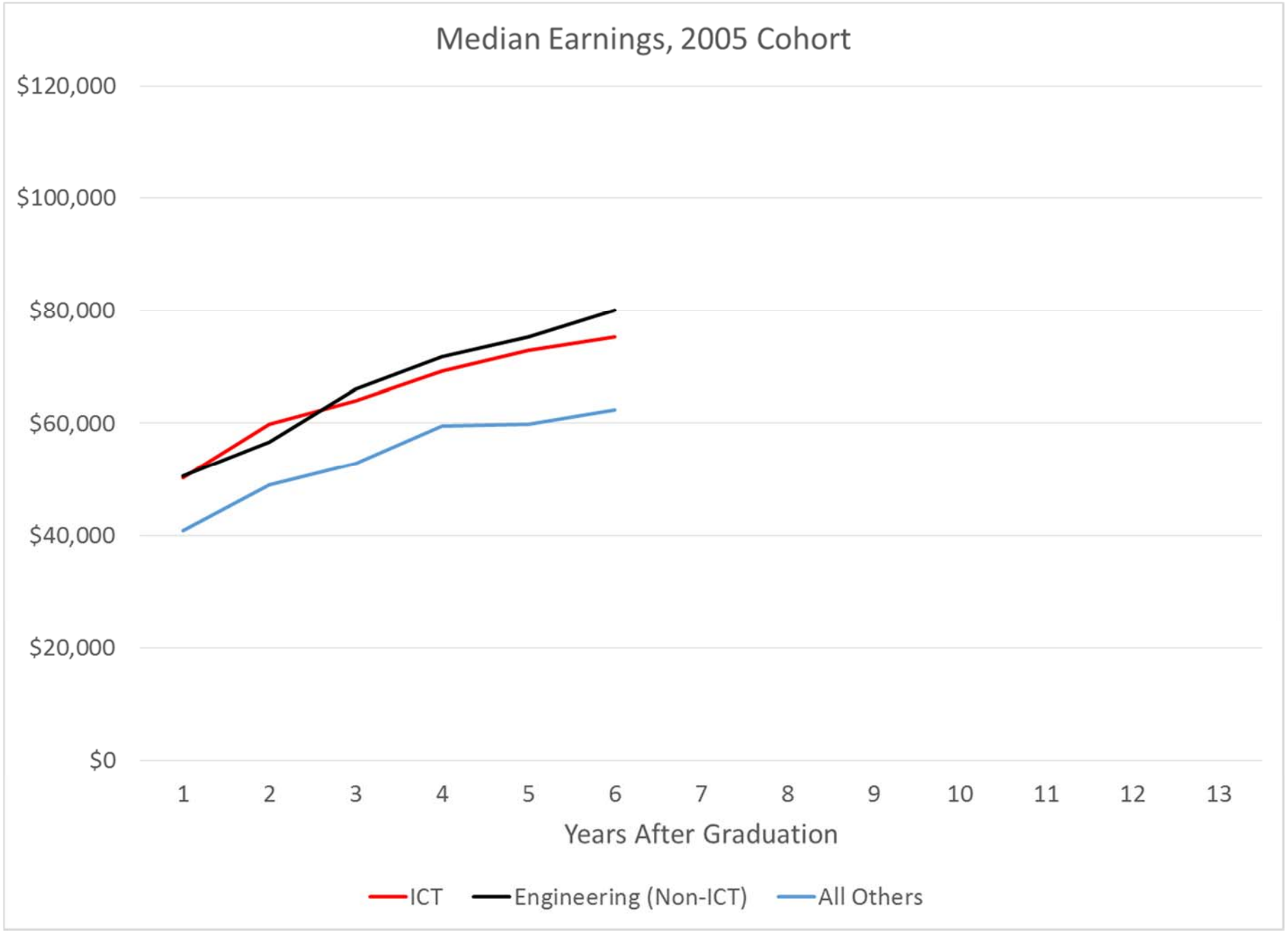
Years After Graduation
ICT
Engineering (Non-ICT)
All Others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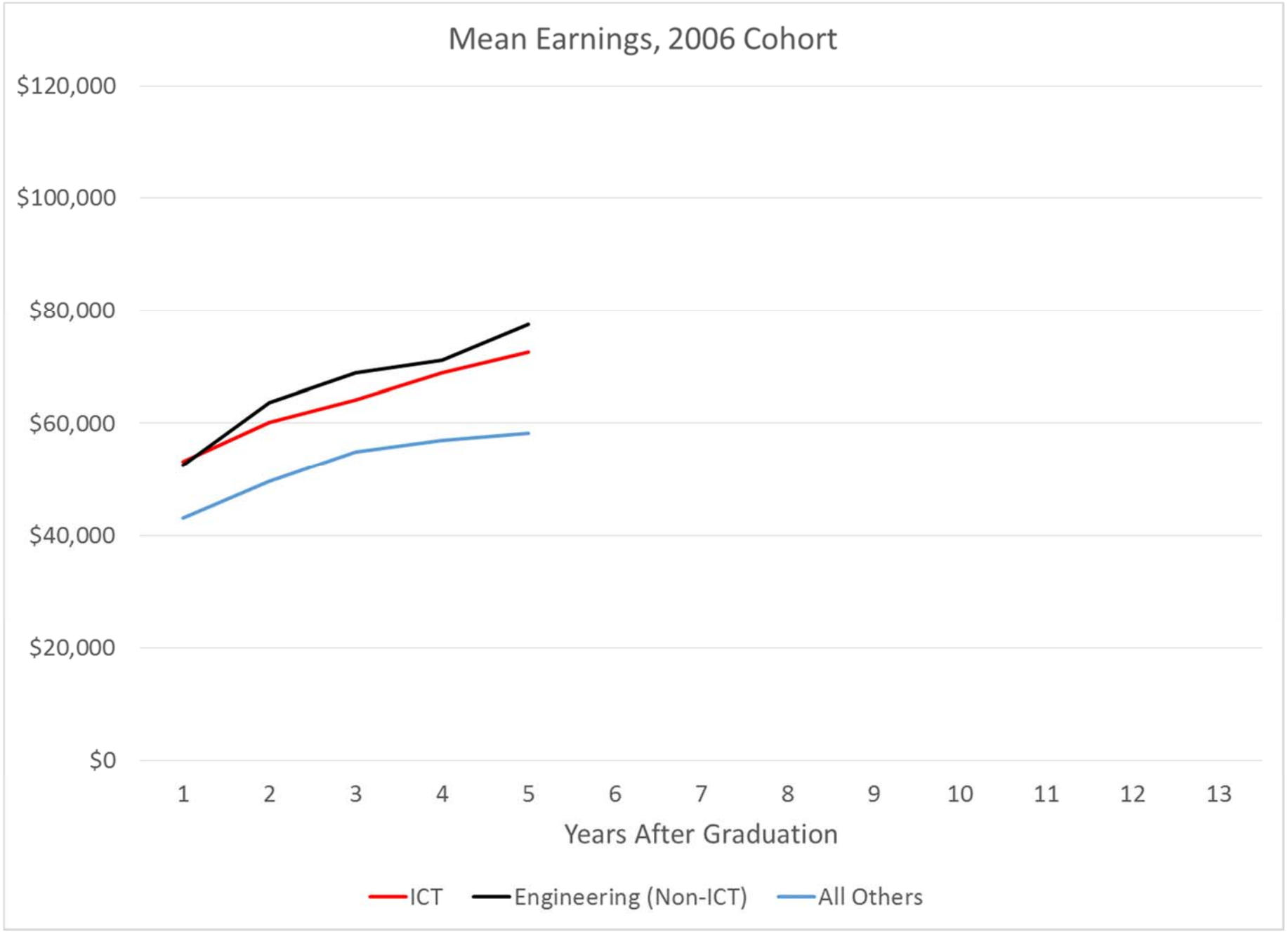
Years After Graduation
ICT
Engineering (Non-ICT)
All Others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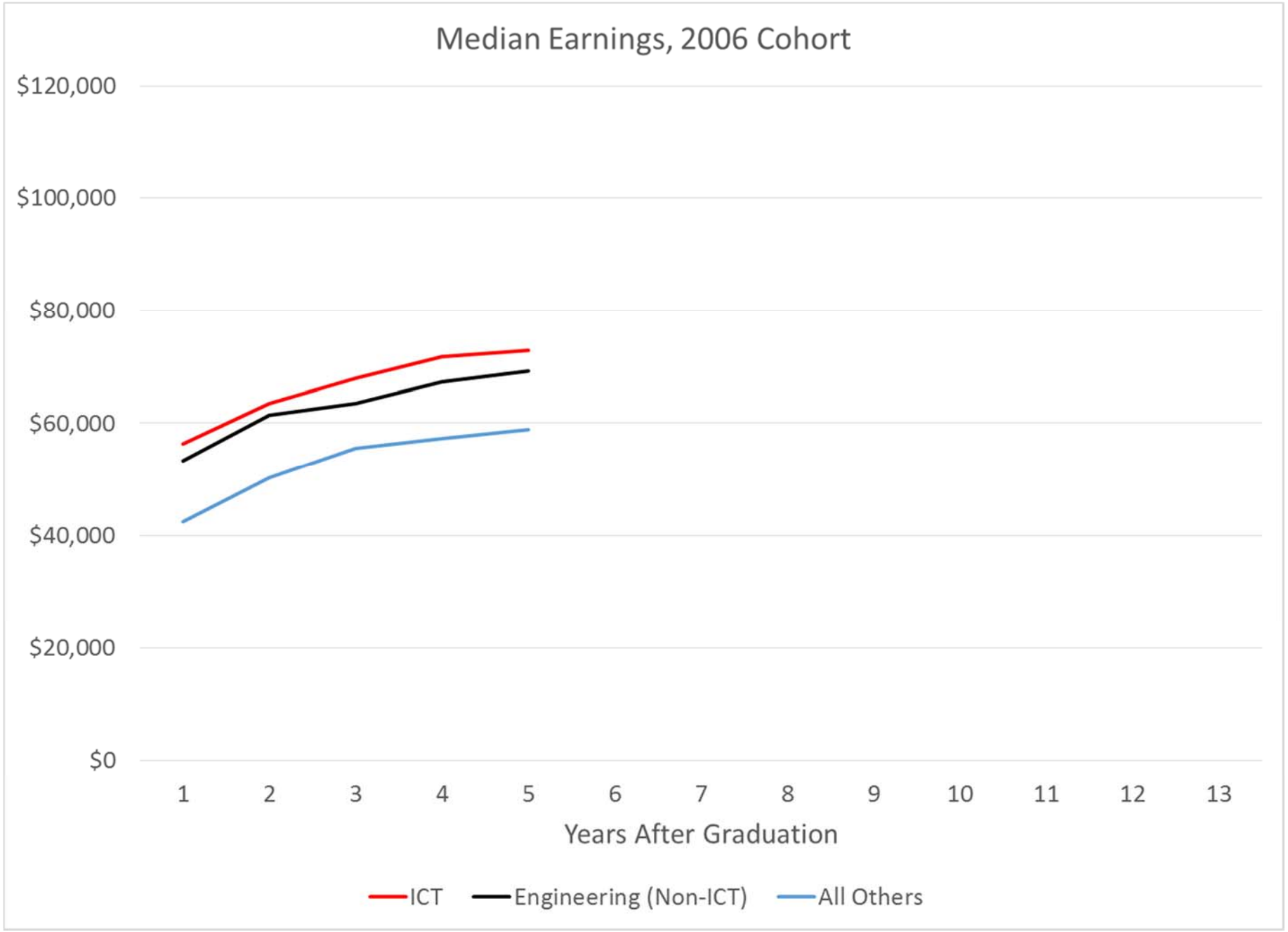
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2006 Cohort
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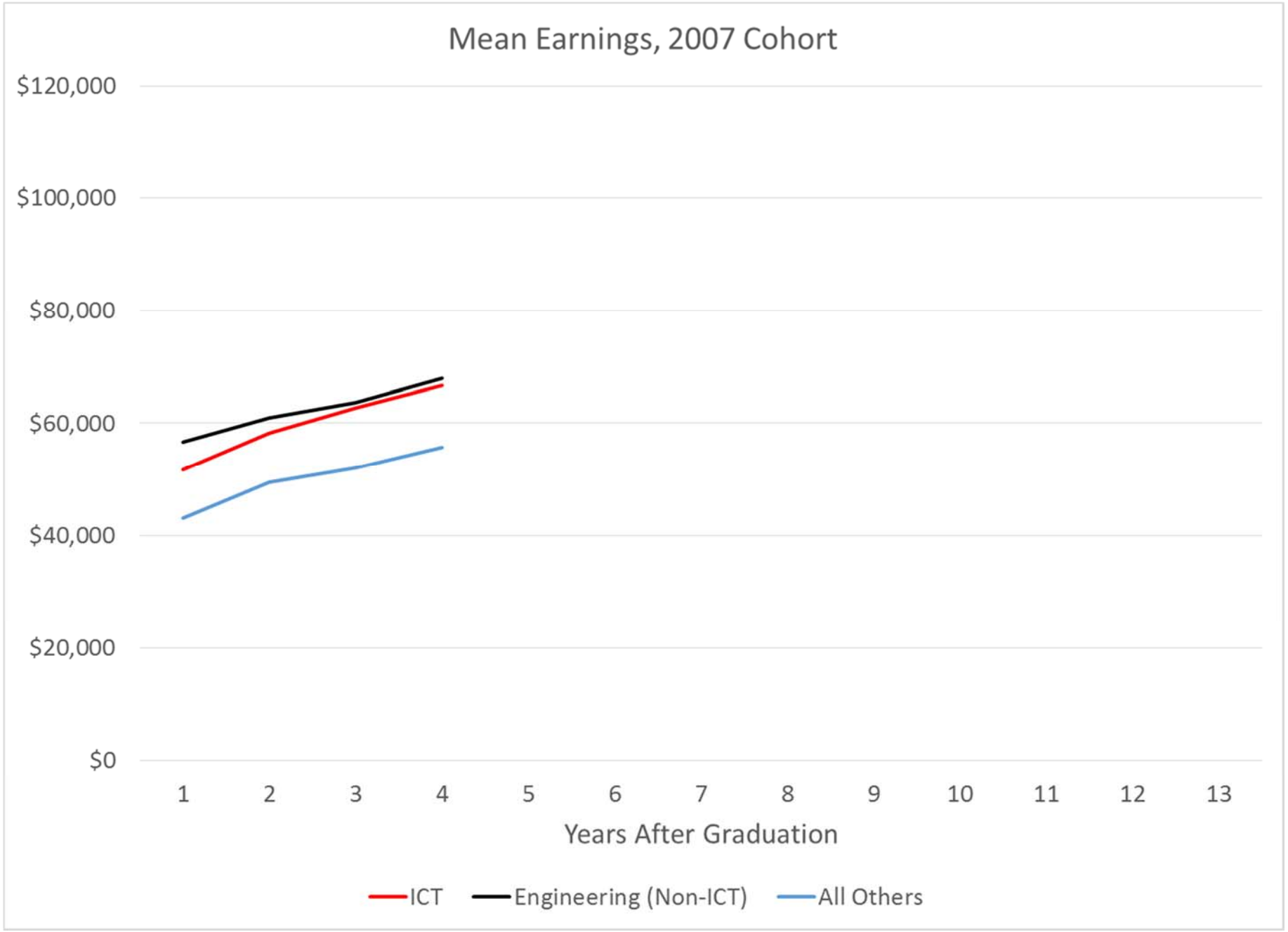
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2007 Cohort
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Years After Graduation
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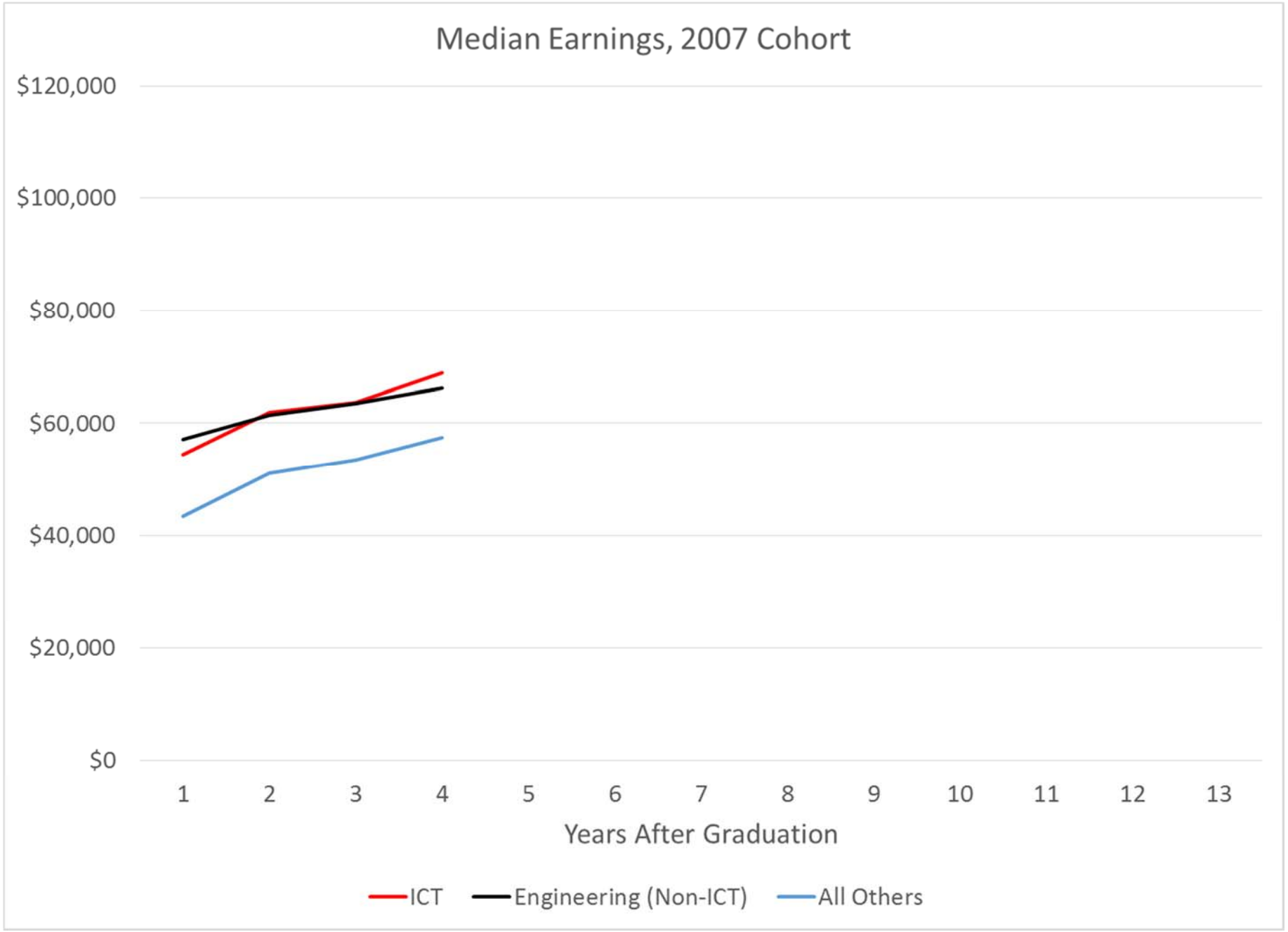
Engineering (Non-ICT)
All Others


Median Earnings, 2007 Cohort
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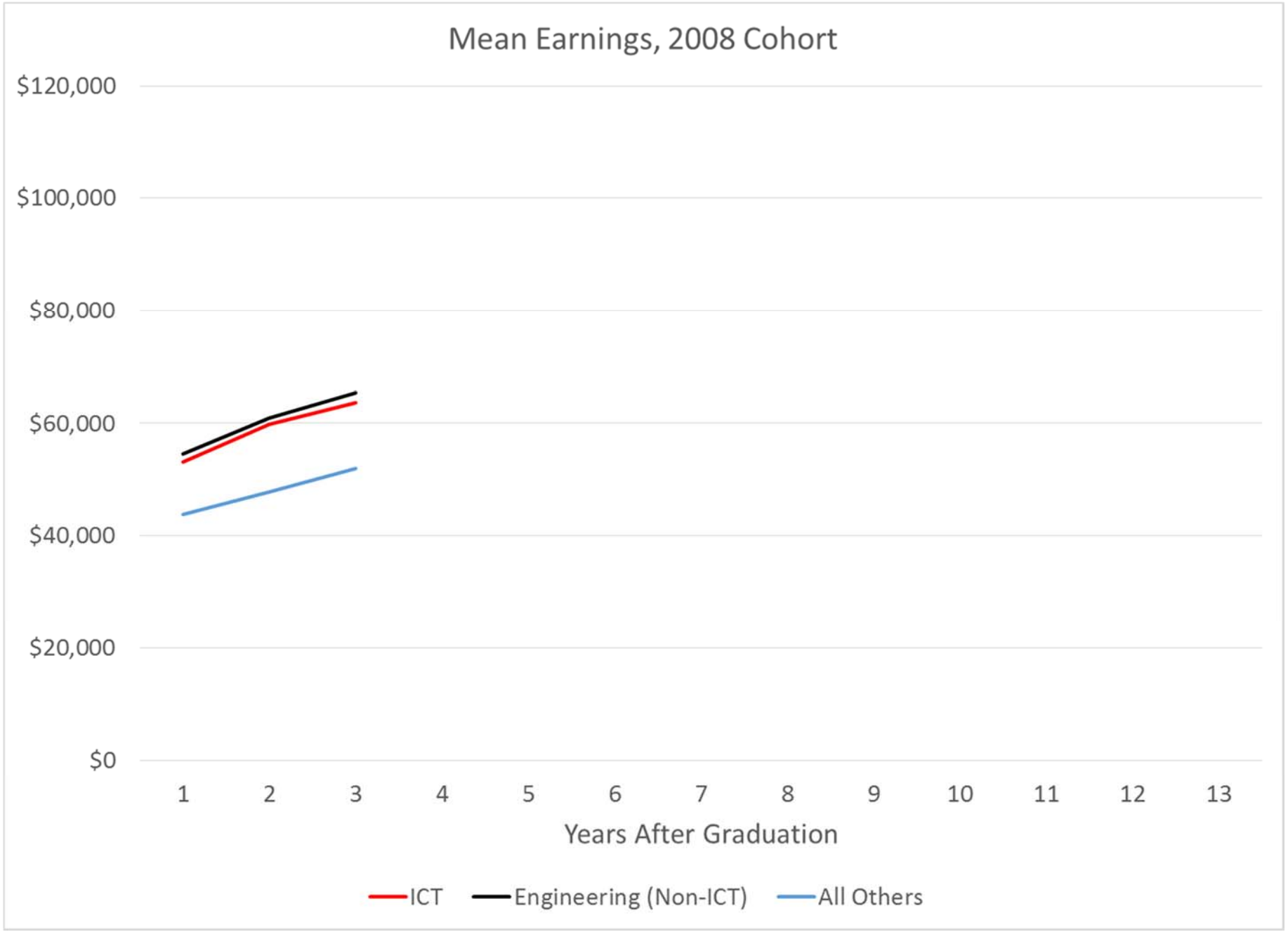
Years After Graduation
ICT
Engineering (Non-ICT)
All Others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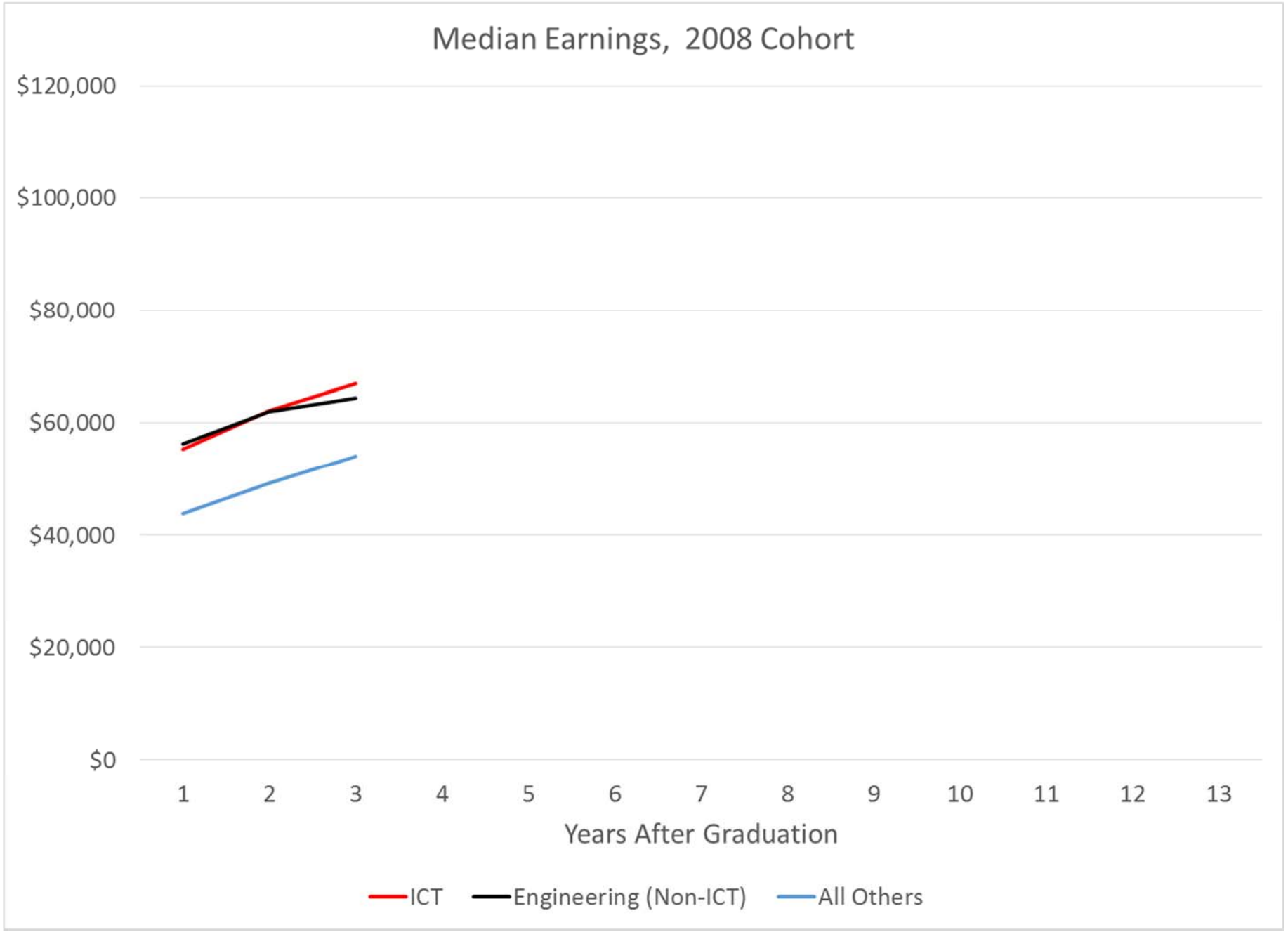
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2008 Cohort
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Years After Graduation
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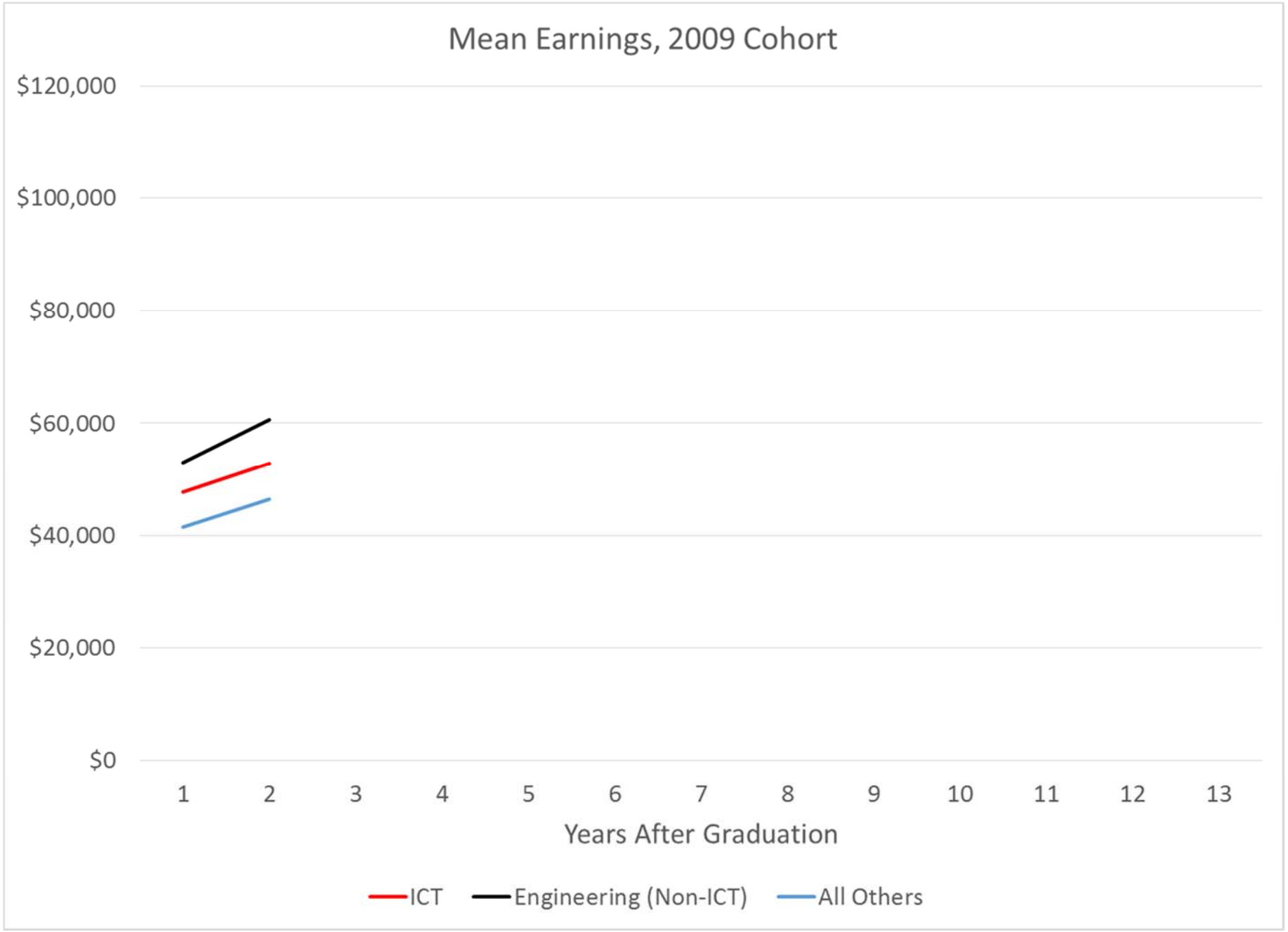
Engineering (Non-ICT)
All Others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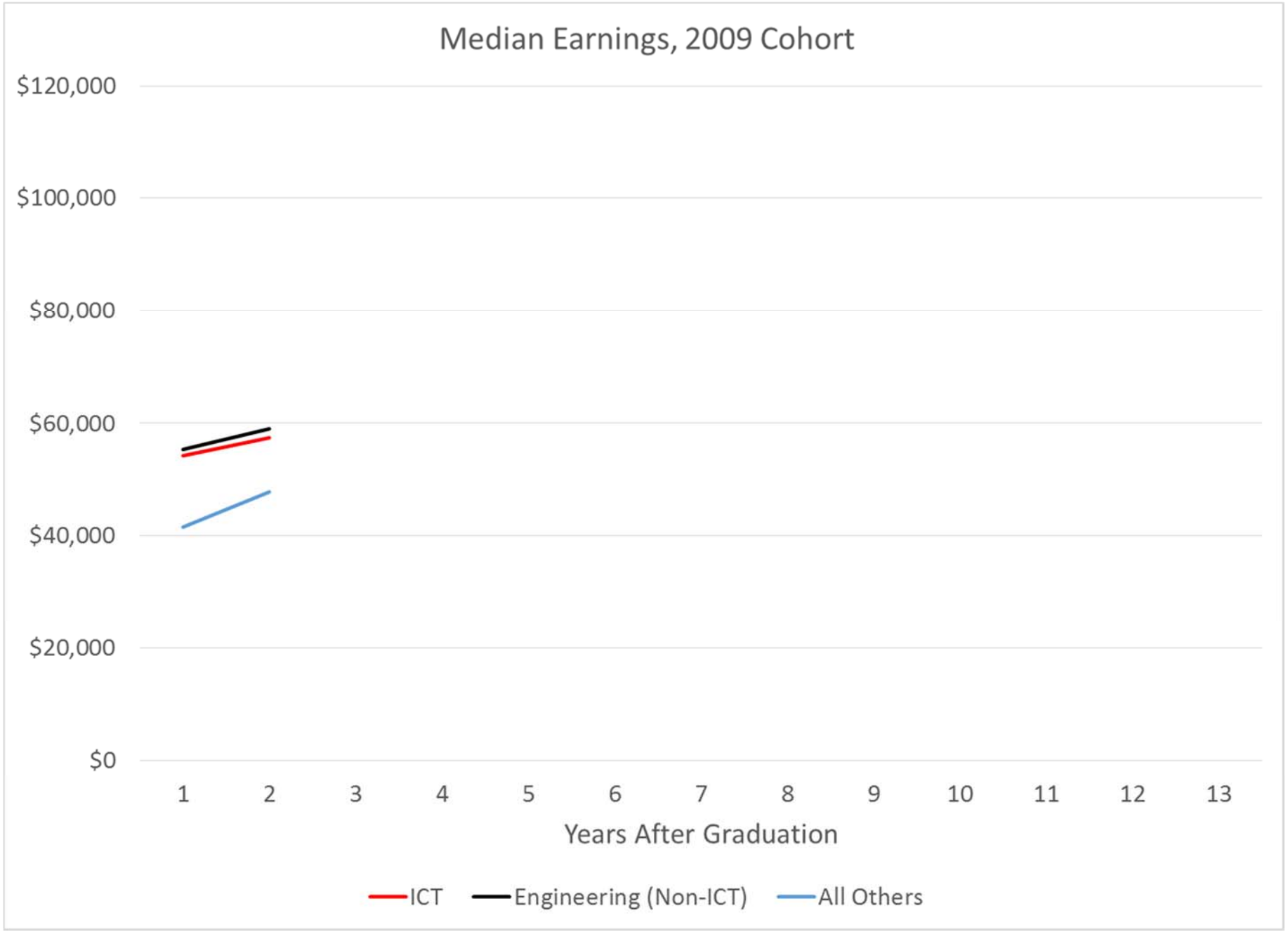
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Median Earnings, 2009 Cohort
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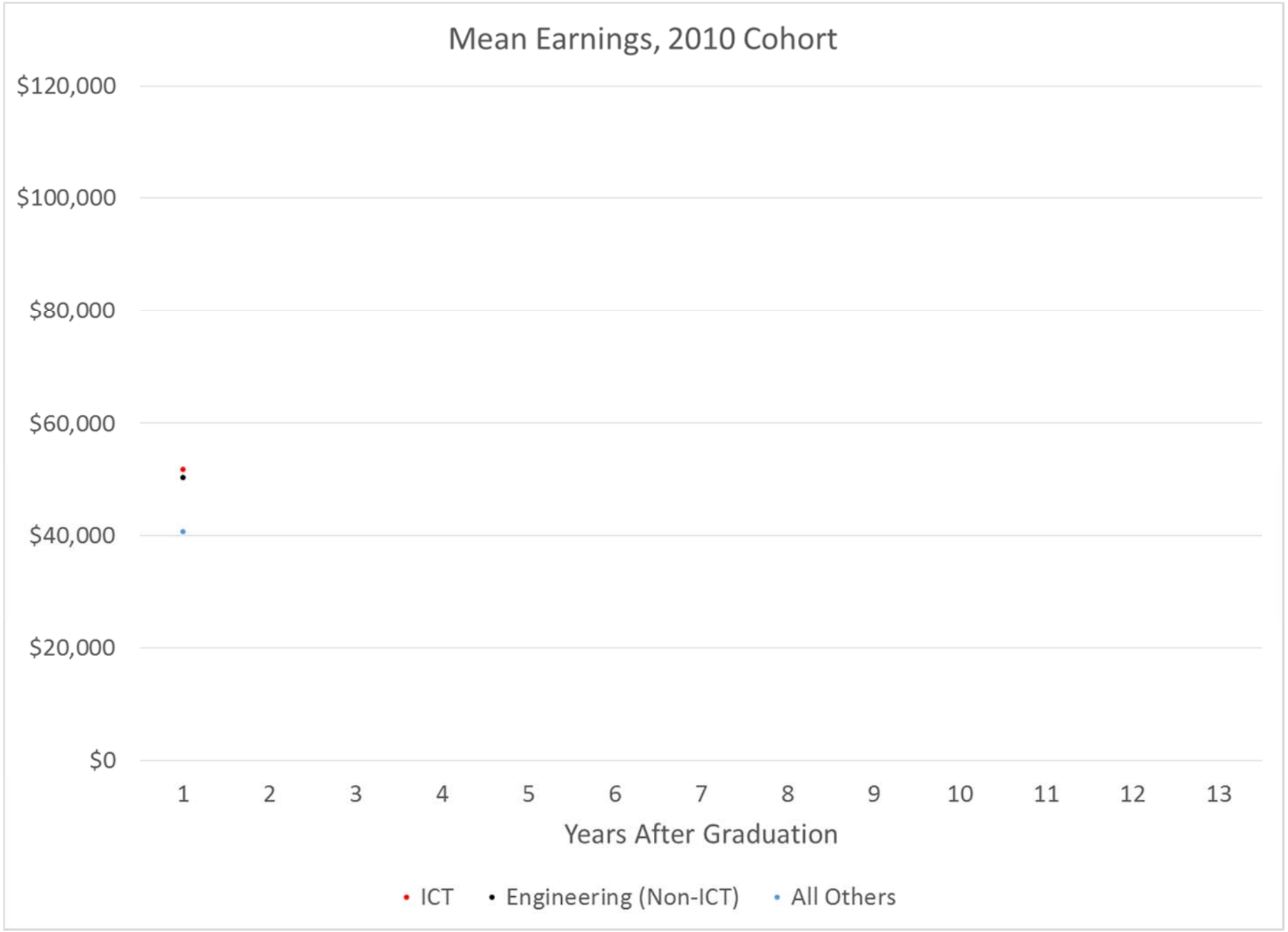
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, 2010 Cohort
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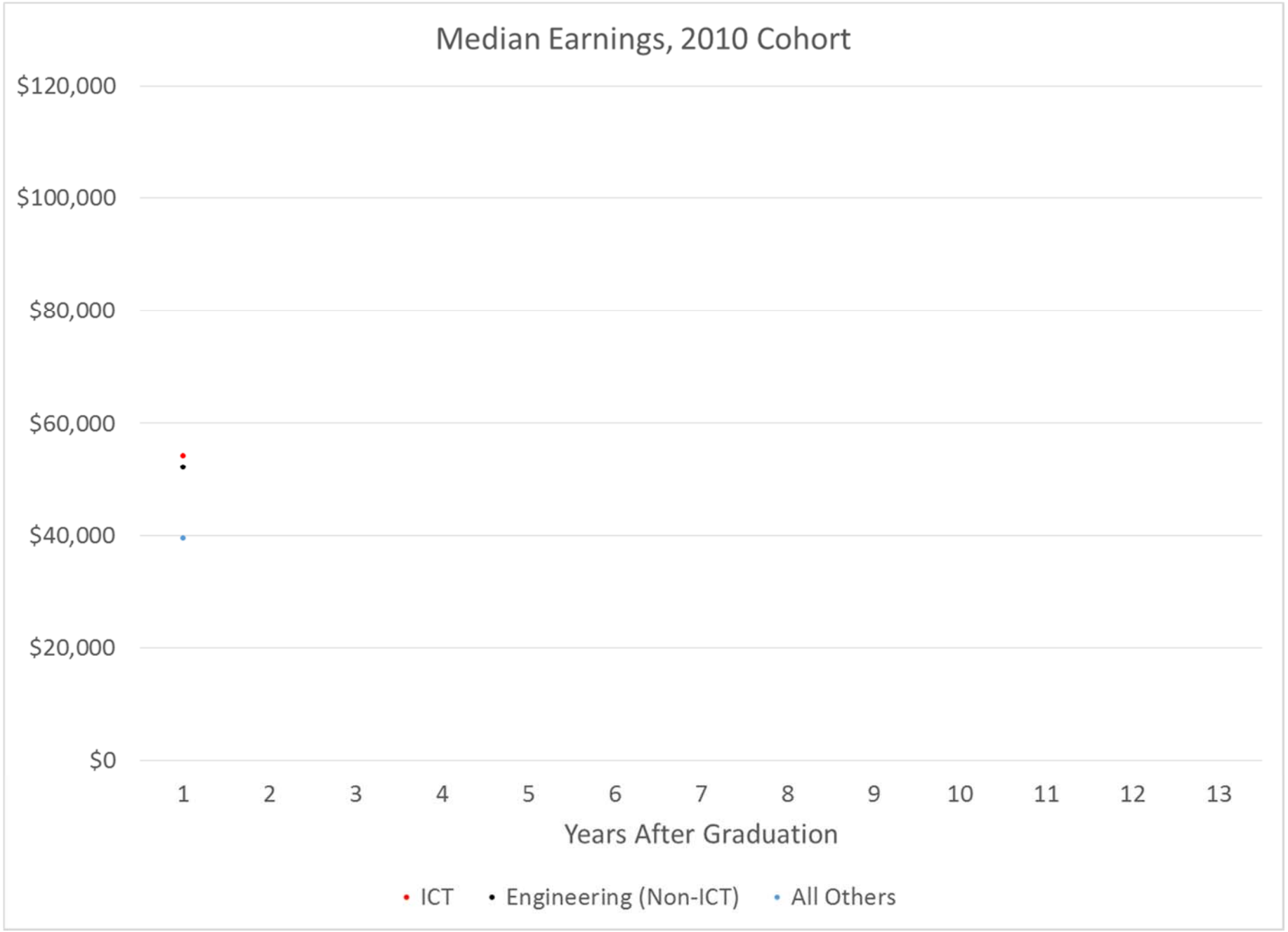
Years After Graduation
ICT
Engineering (Non-ICT)
All Others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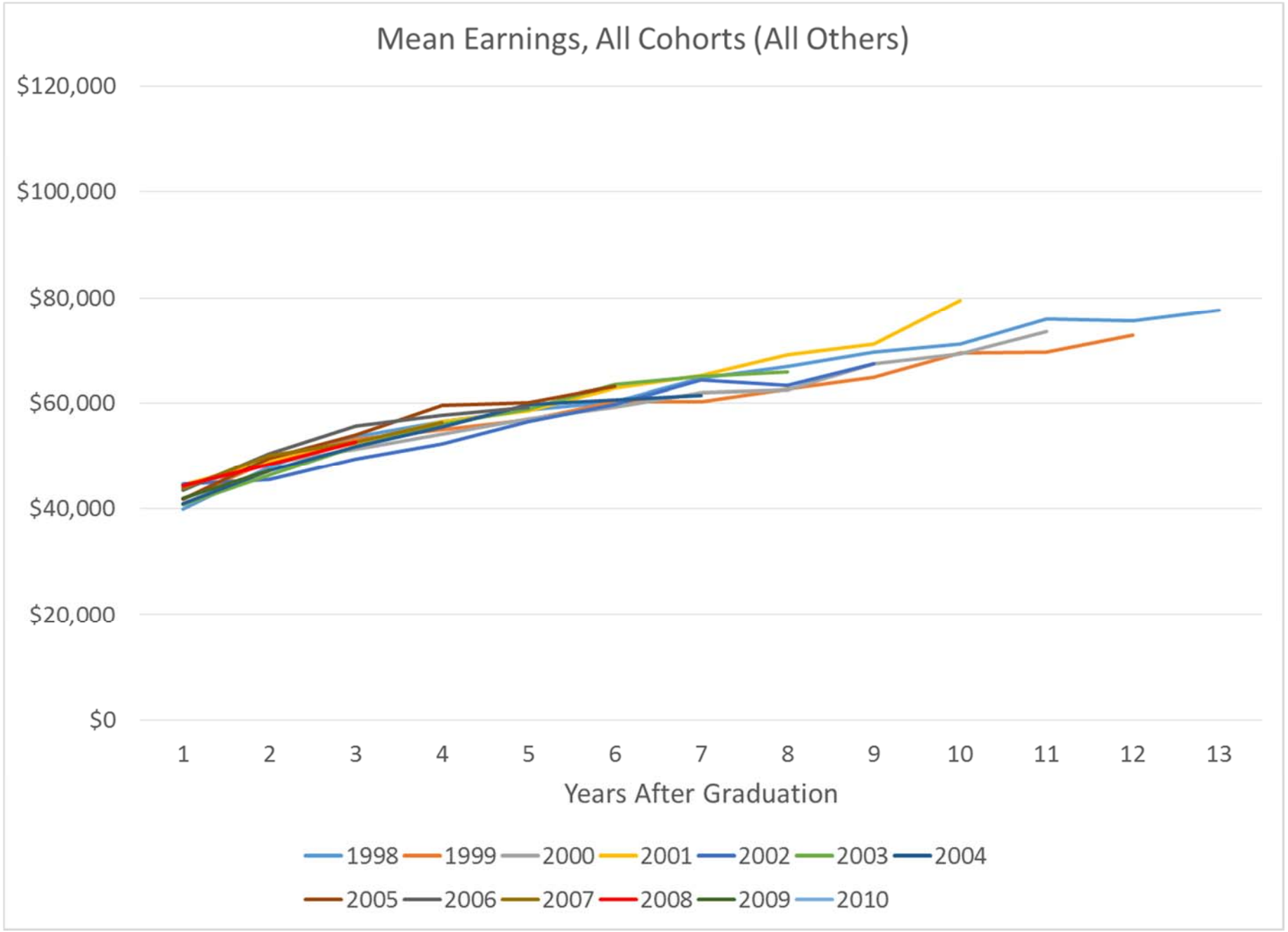
Years After Graduation
ICT
Engineering (Non-ICT)
All Others


Mean Earnings, All Cohorts (All Others)
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$100,000
$80,000
$60,000
$40,000
$20,000
$0
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Years After Graduation
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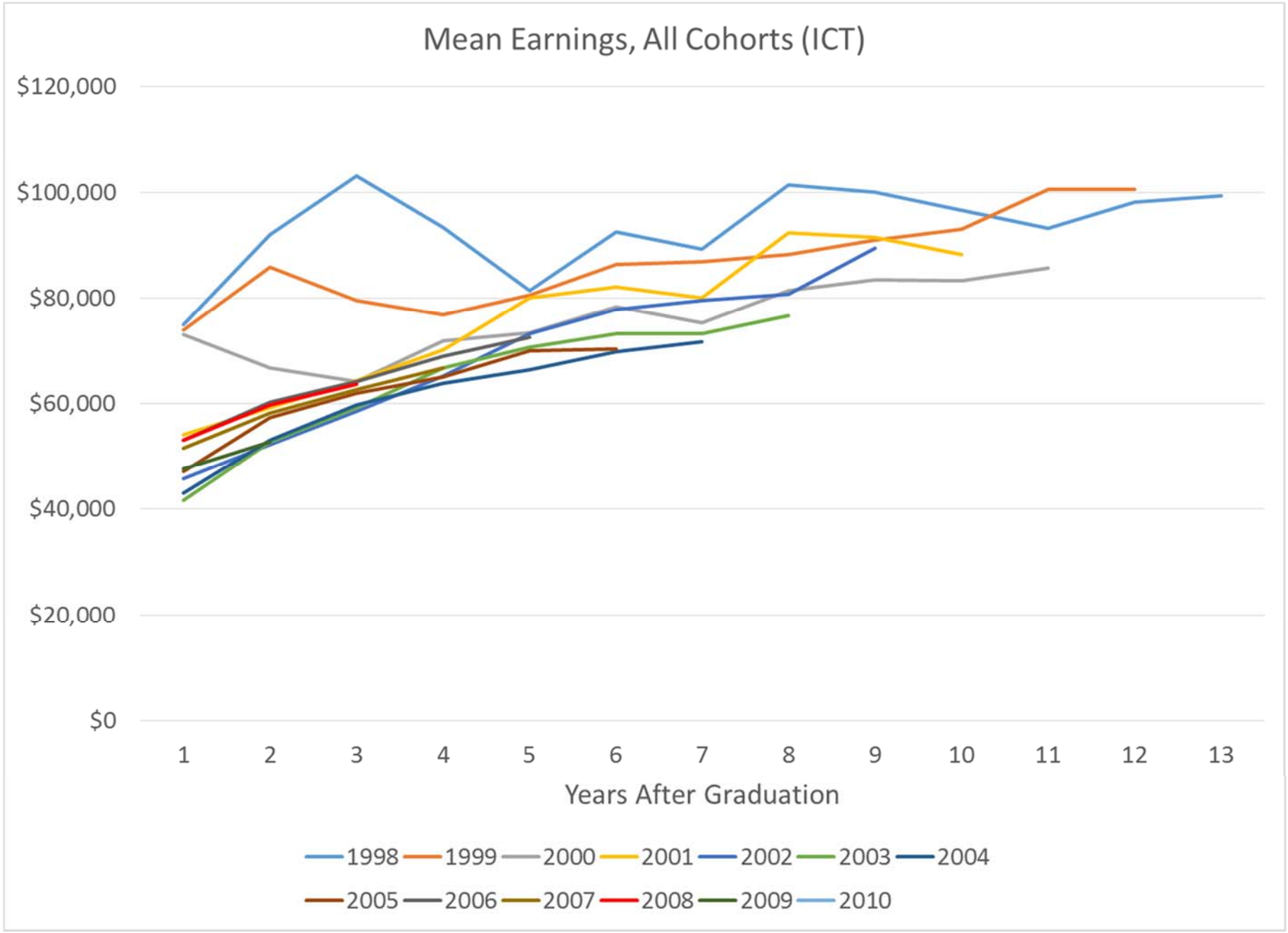
Mean Earnings, All Cohorts (ICT)
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Years After Graduation
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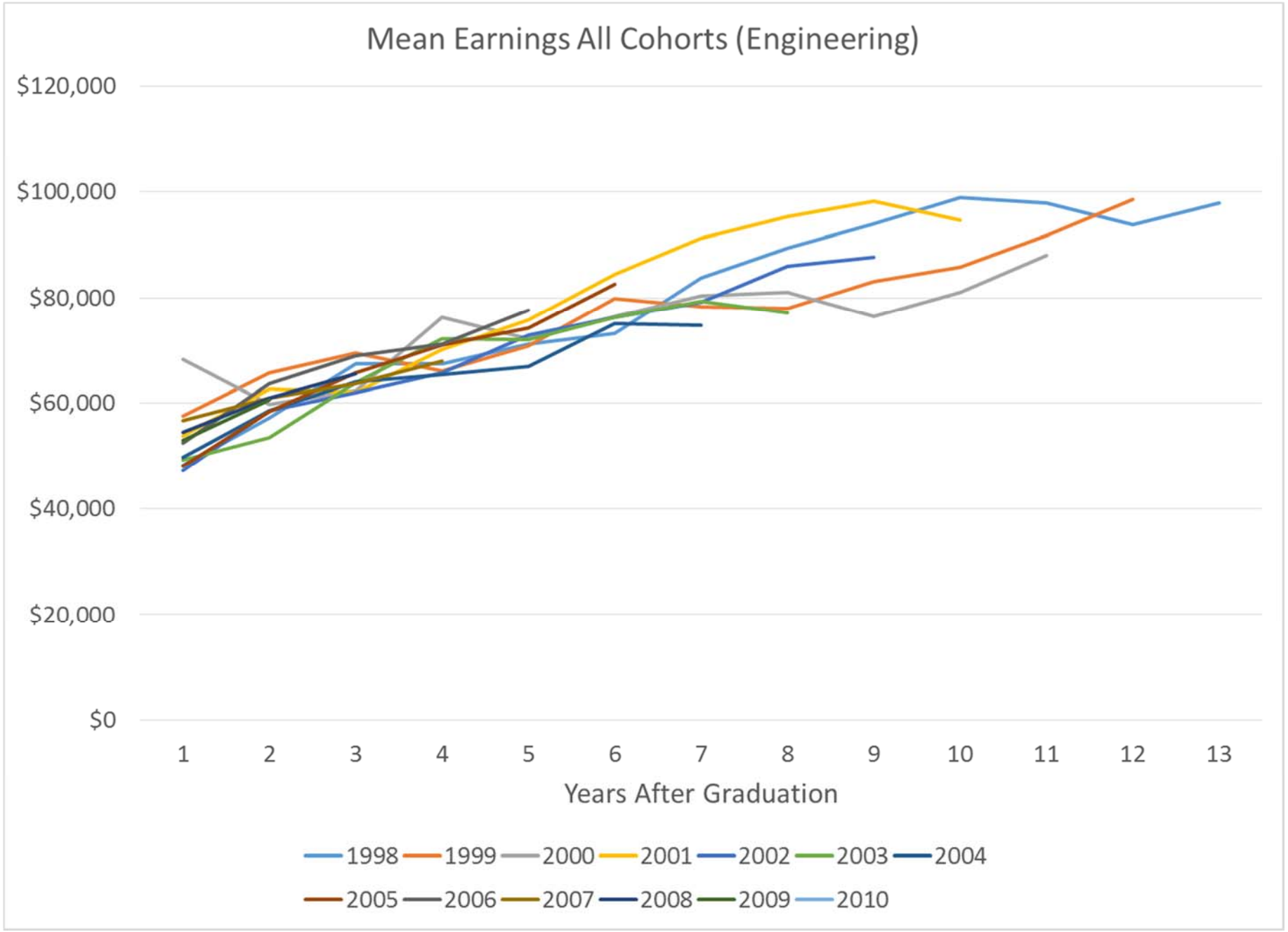
Mean Earnings All Cohorts (Engineering)
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$60,000
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Years After Graduation
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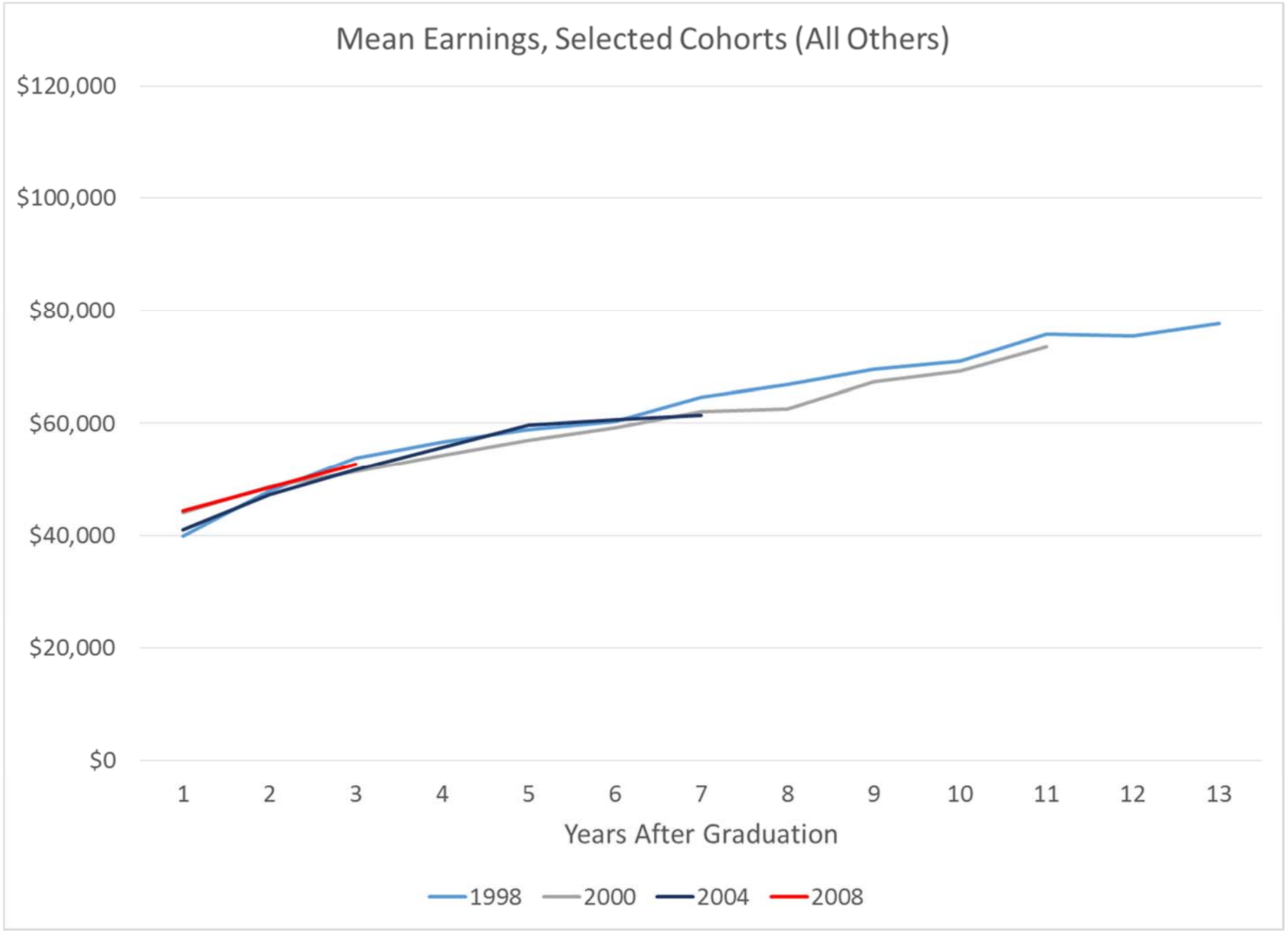
Mean Earnings, Selected Cohorts (All Others)
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$80,000
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Years After Graduation
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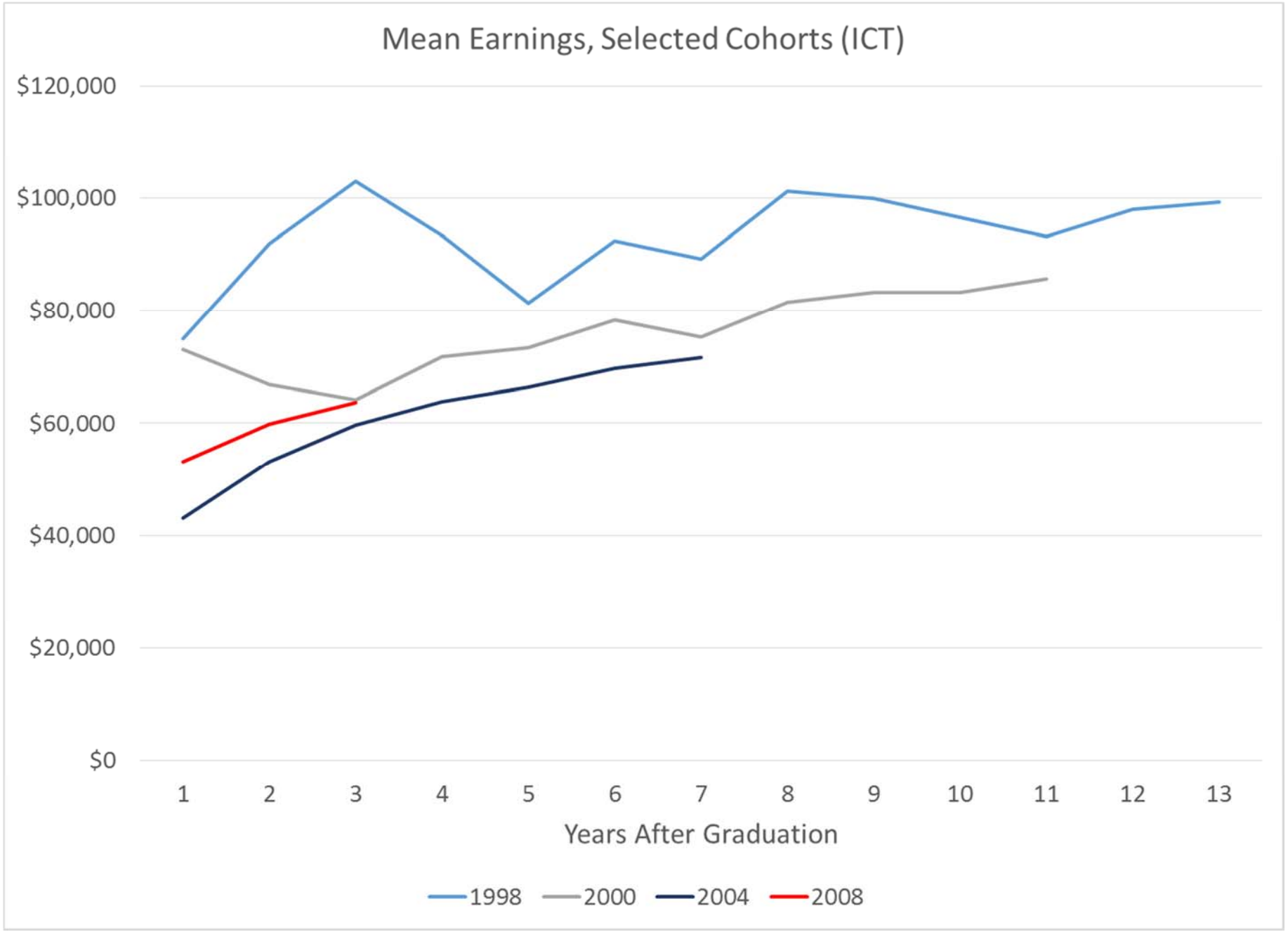
Mean Earnings, Selected Cohorts (ICT)
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Years After Graduation
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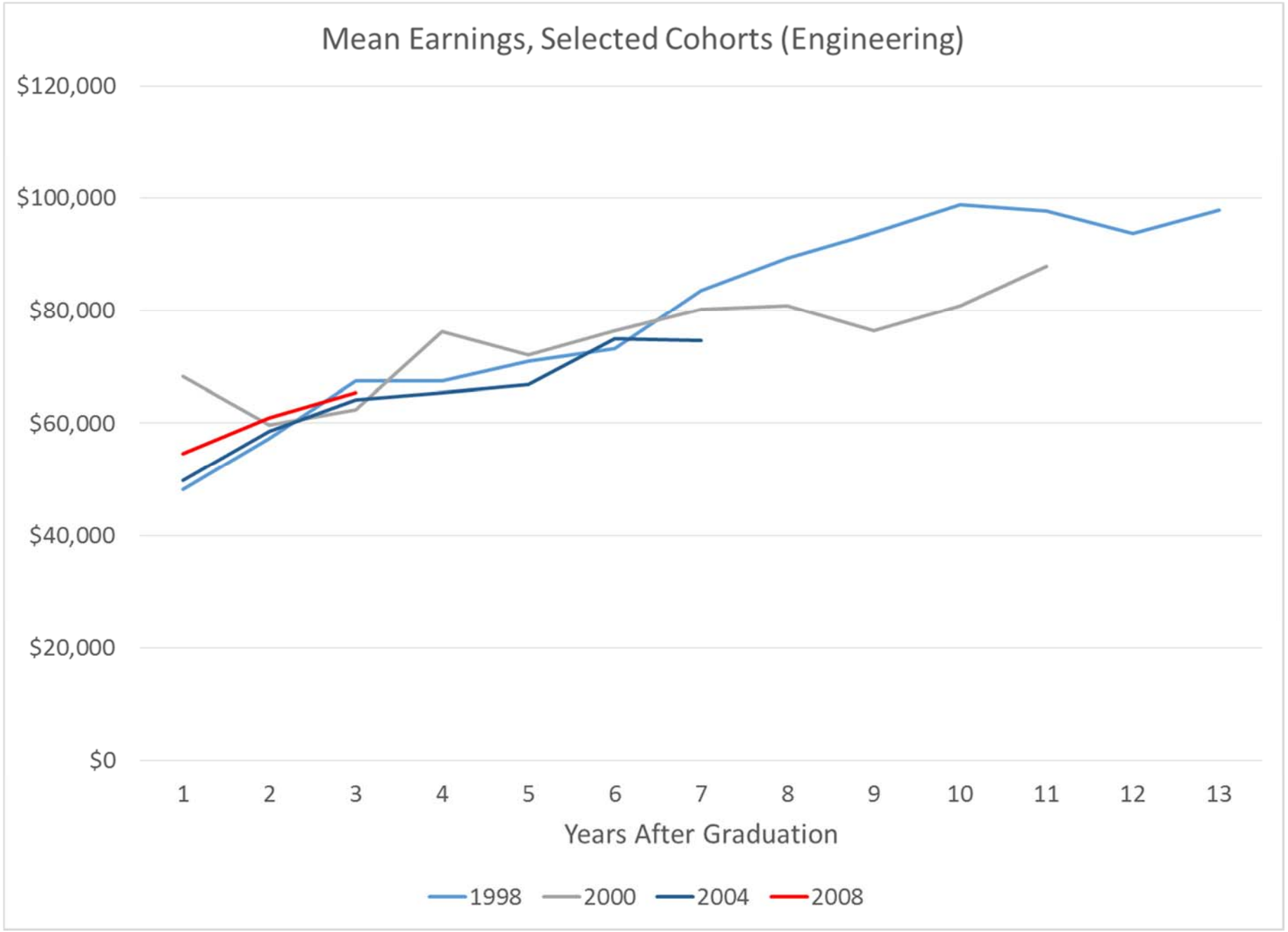
Mean Earnings, Selected Cohorts (Engineering)
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Years After Graduation
1998
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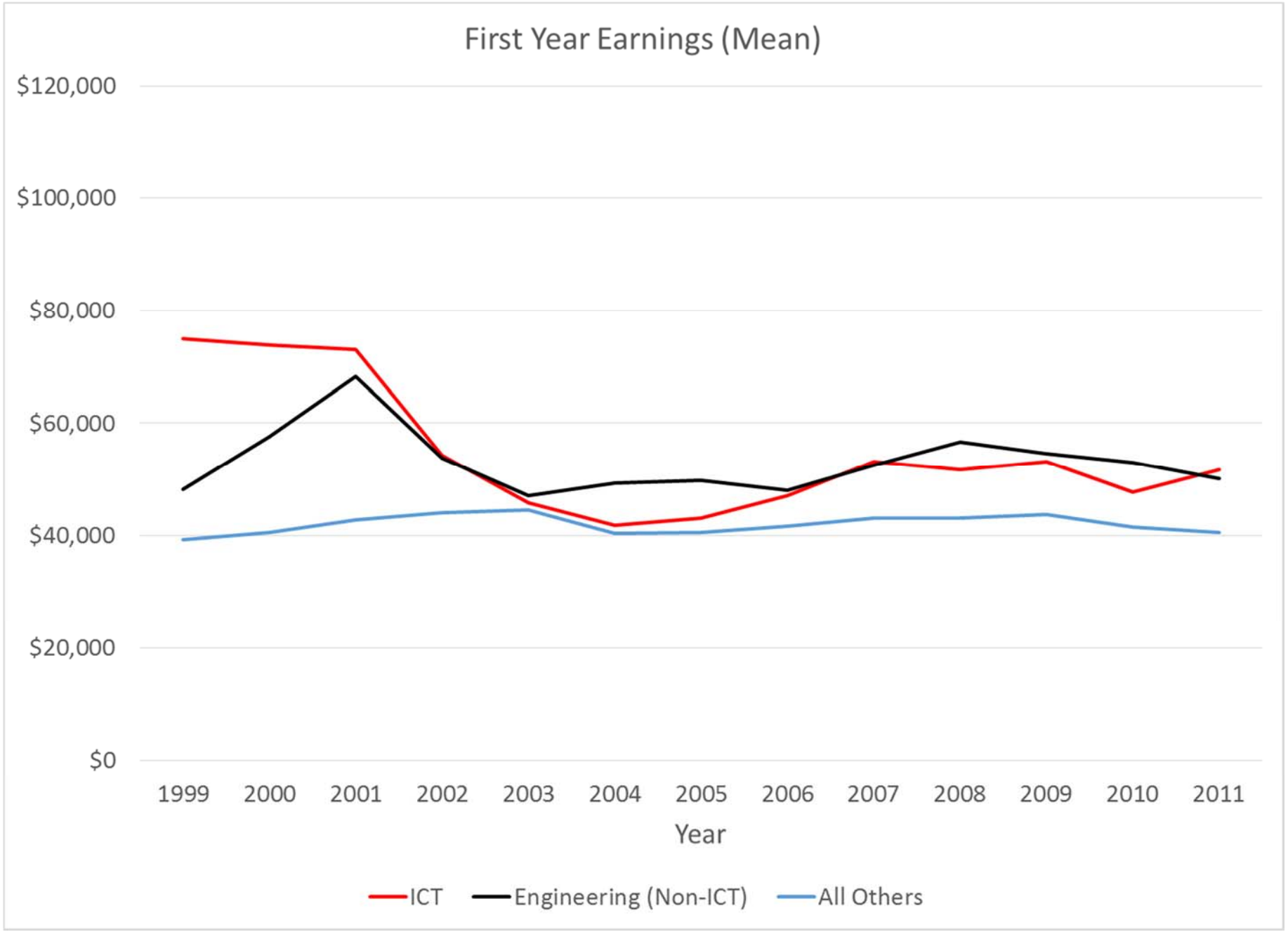
First Year Earnings (Mean)
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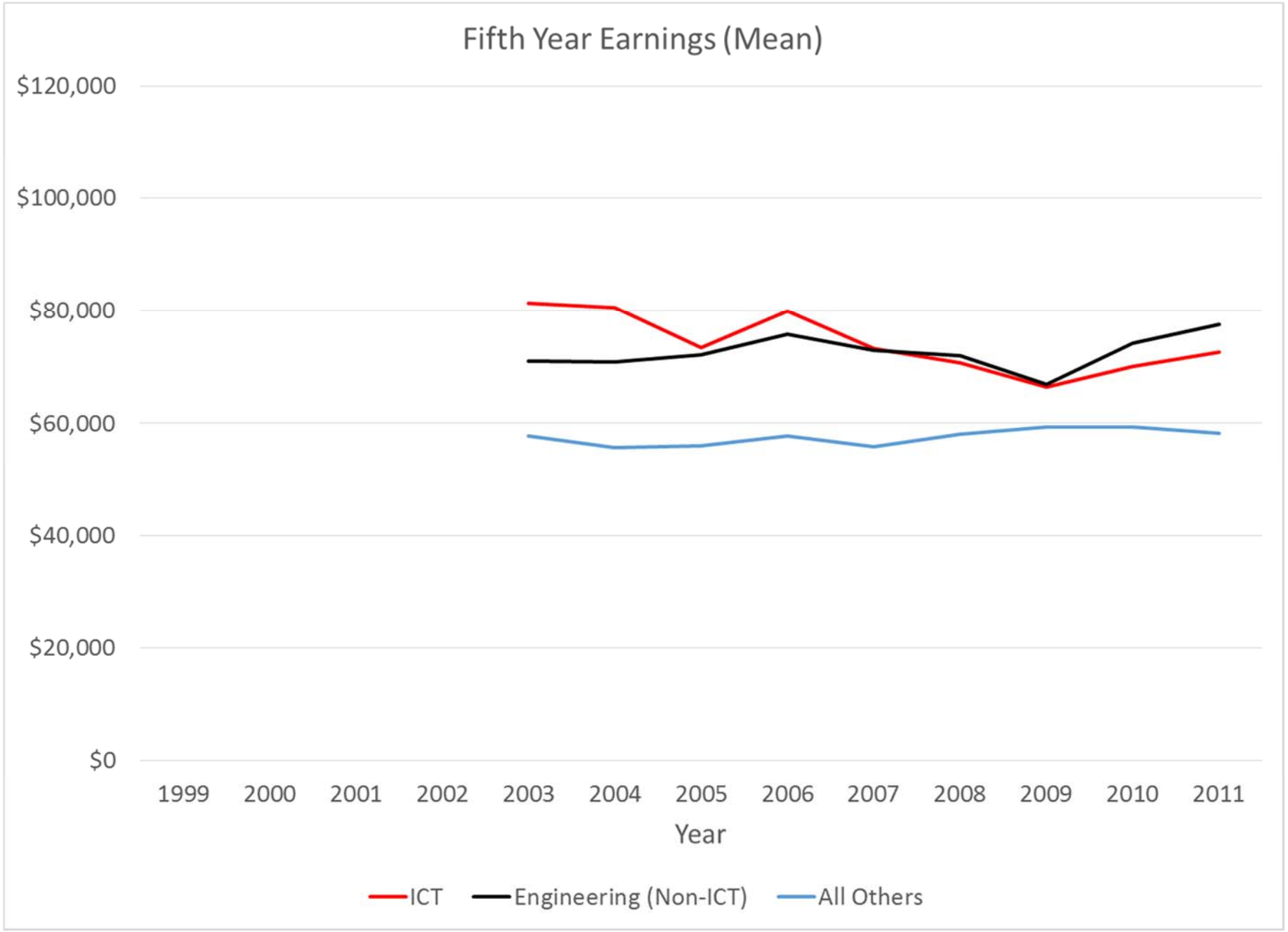
2010
2011
Year
ICT
Engineering (Non-ICT)
All Others


Fifth Year Earnings (Mean)
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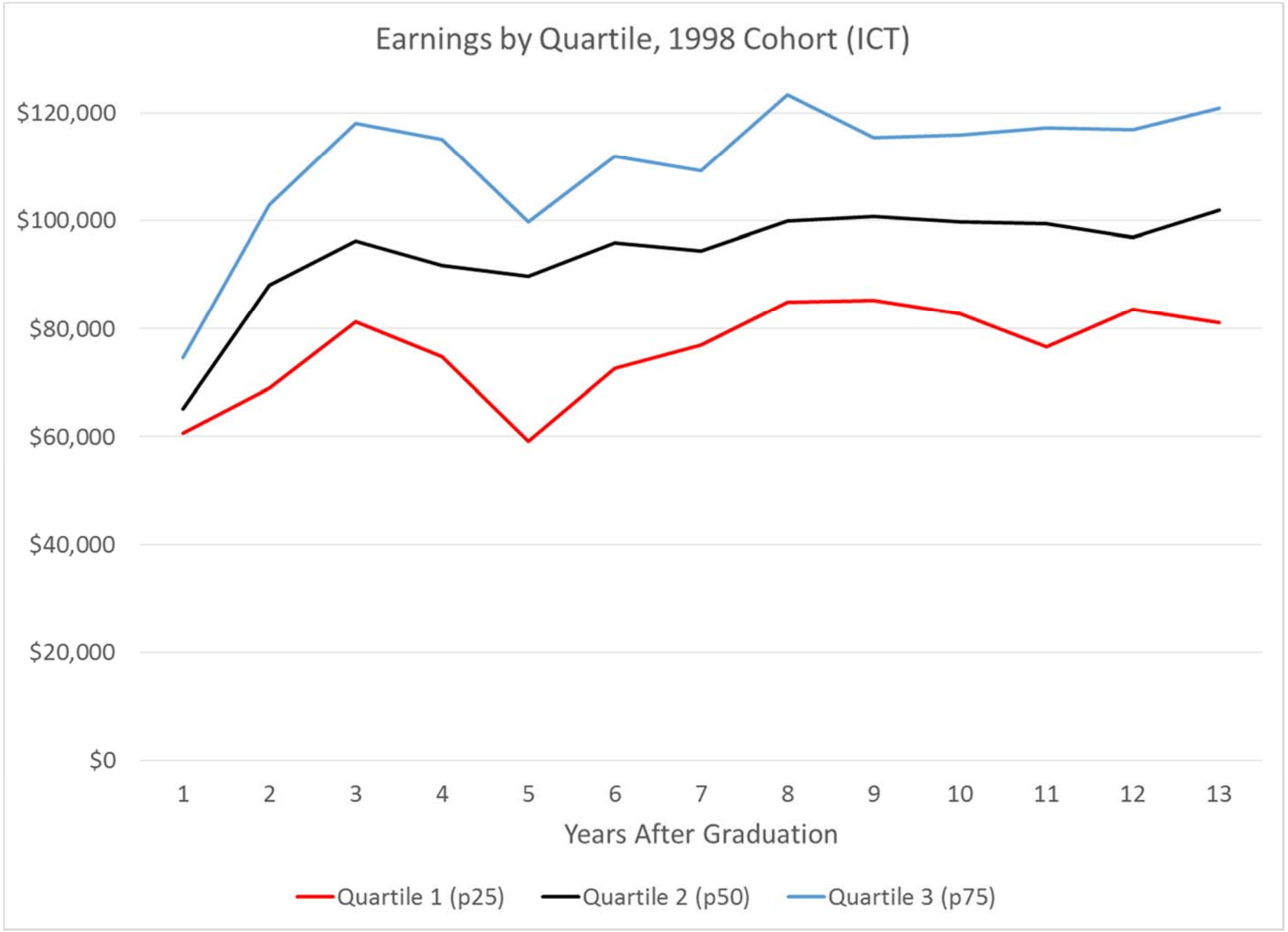
ICT
Engineering (Non-ICT)
All Others


Earnings by Quartile, 1998 Cohort (ICT)
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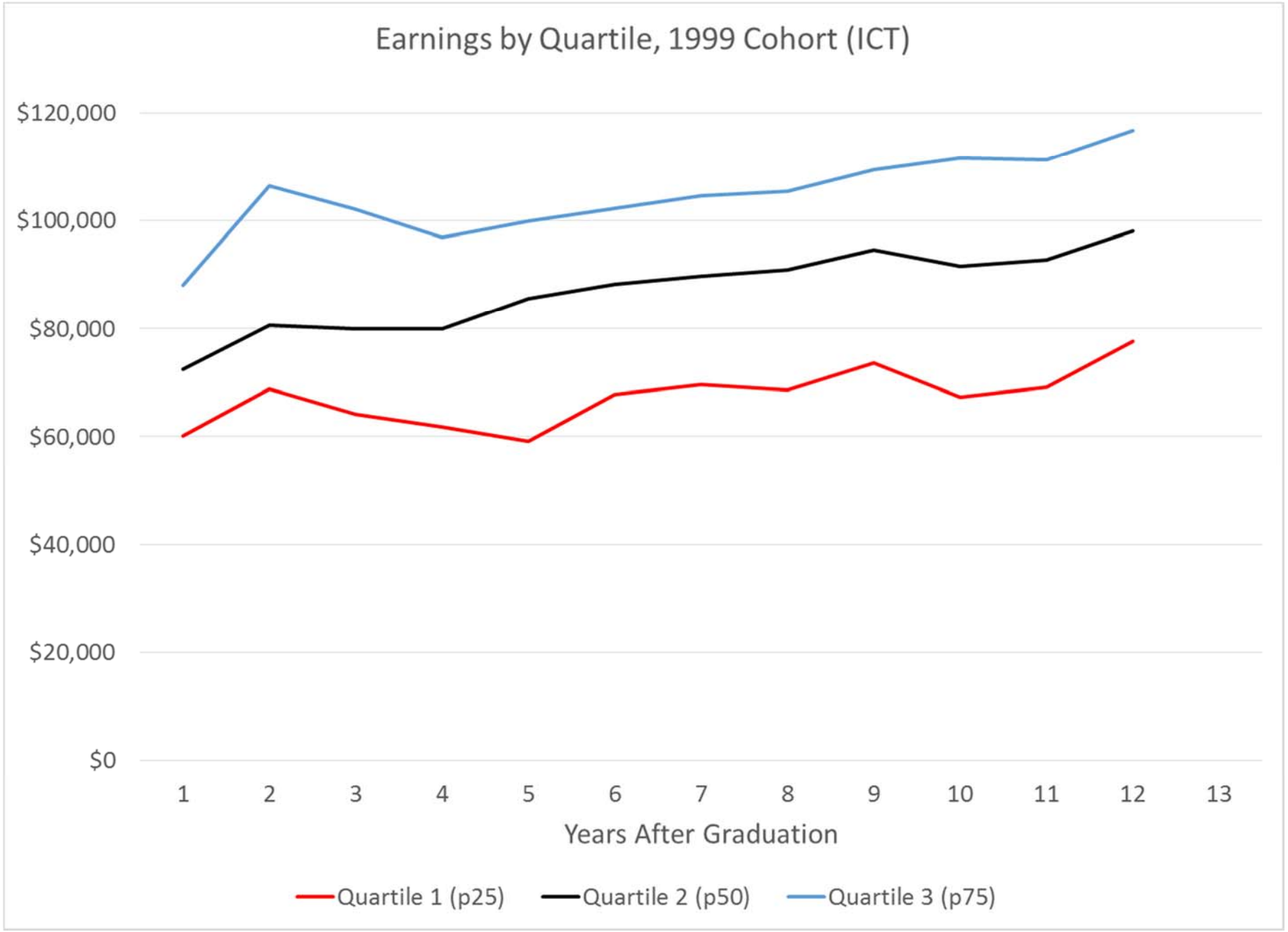
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 1999 Cohort (ICT)
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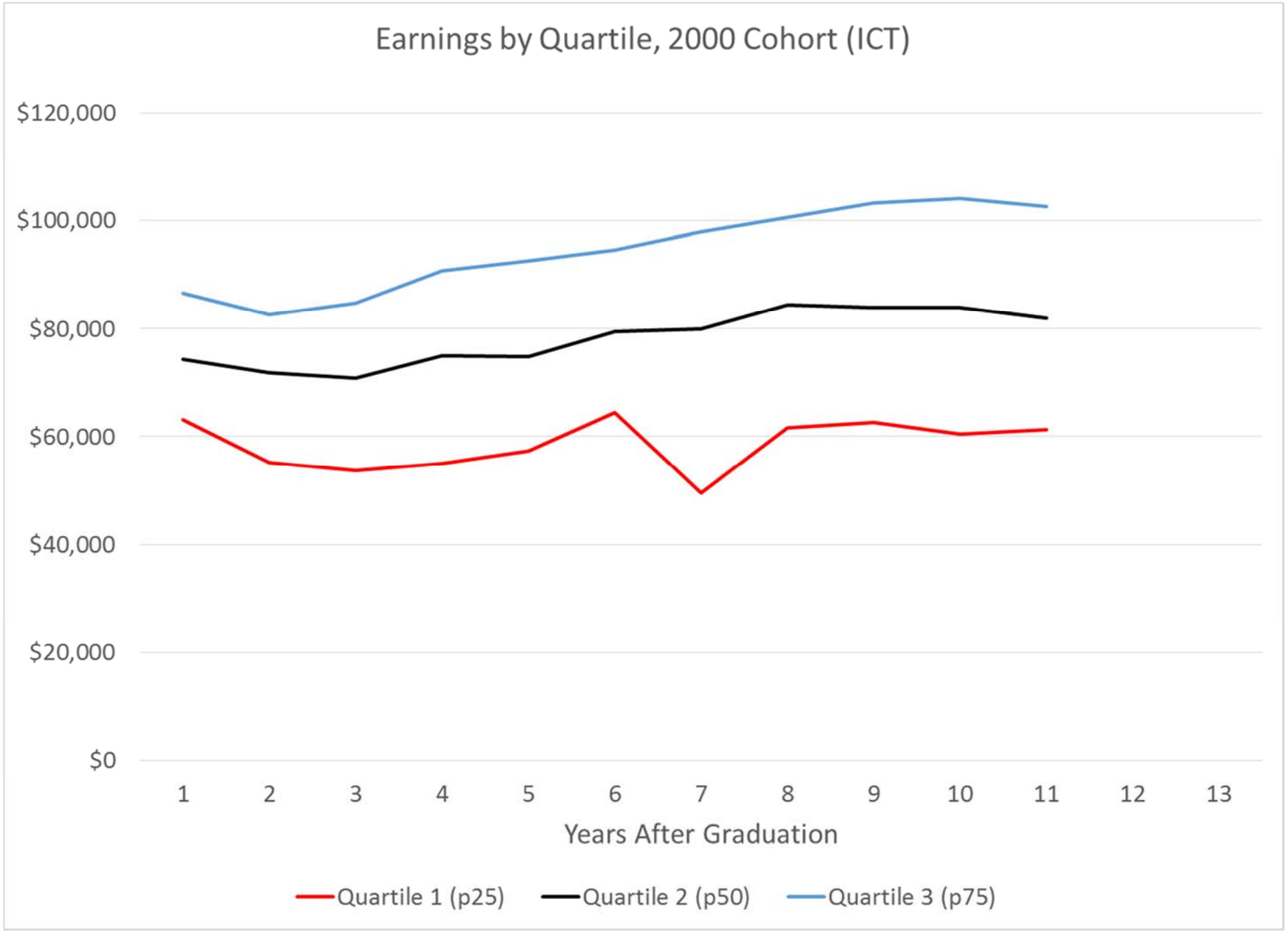
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2000 Cohort (ICT)
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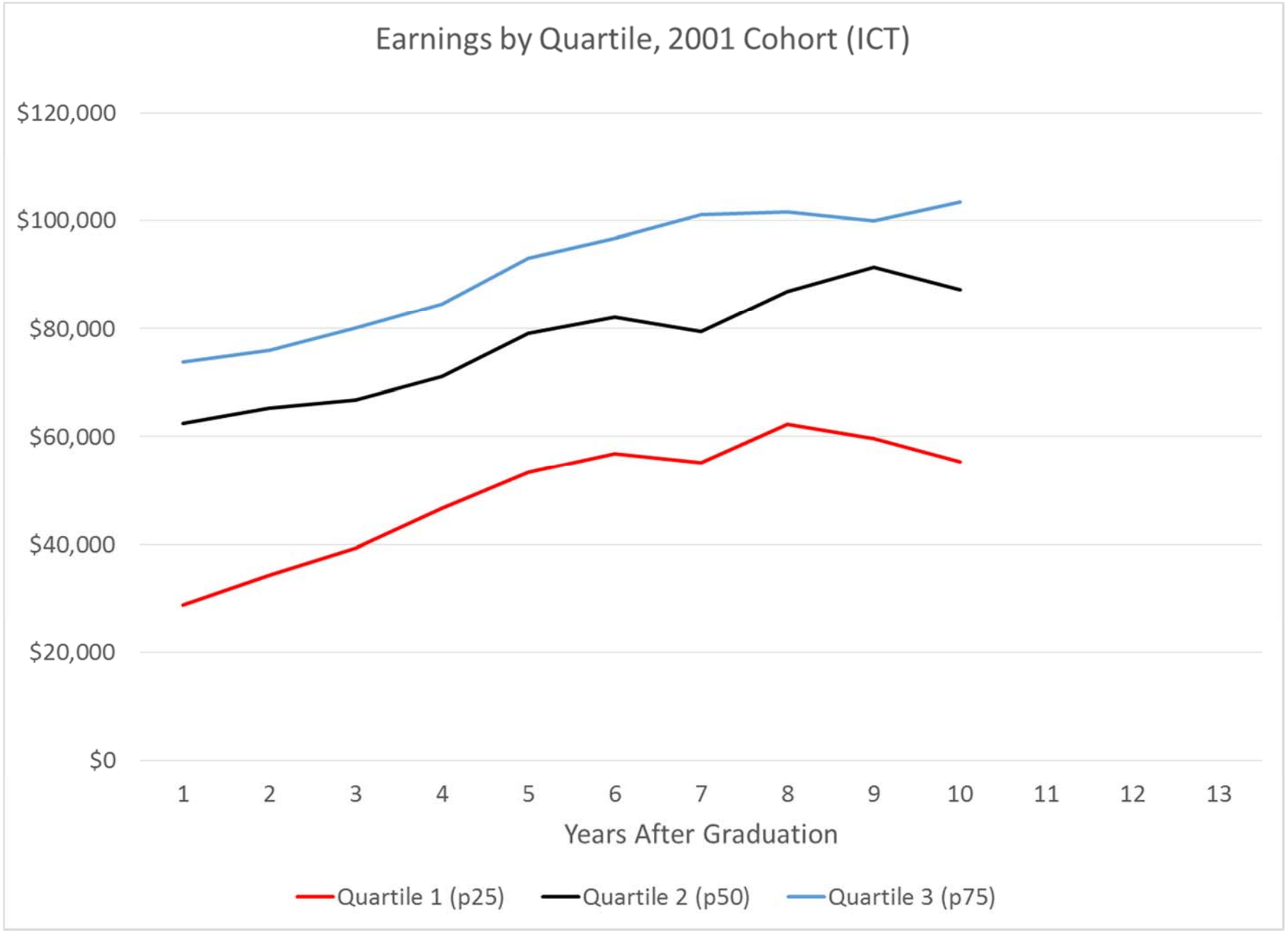
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2001 Cohort (ICT)
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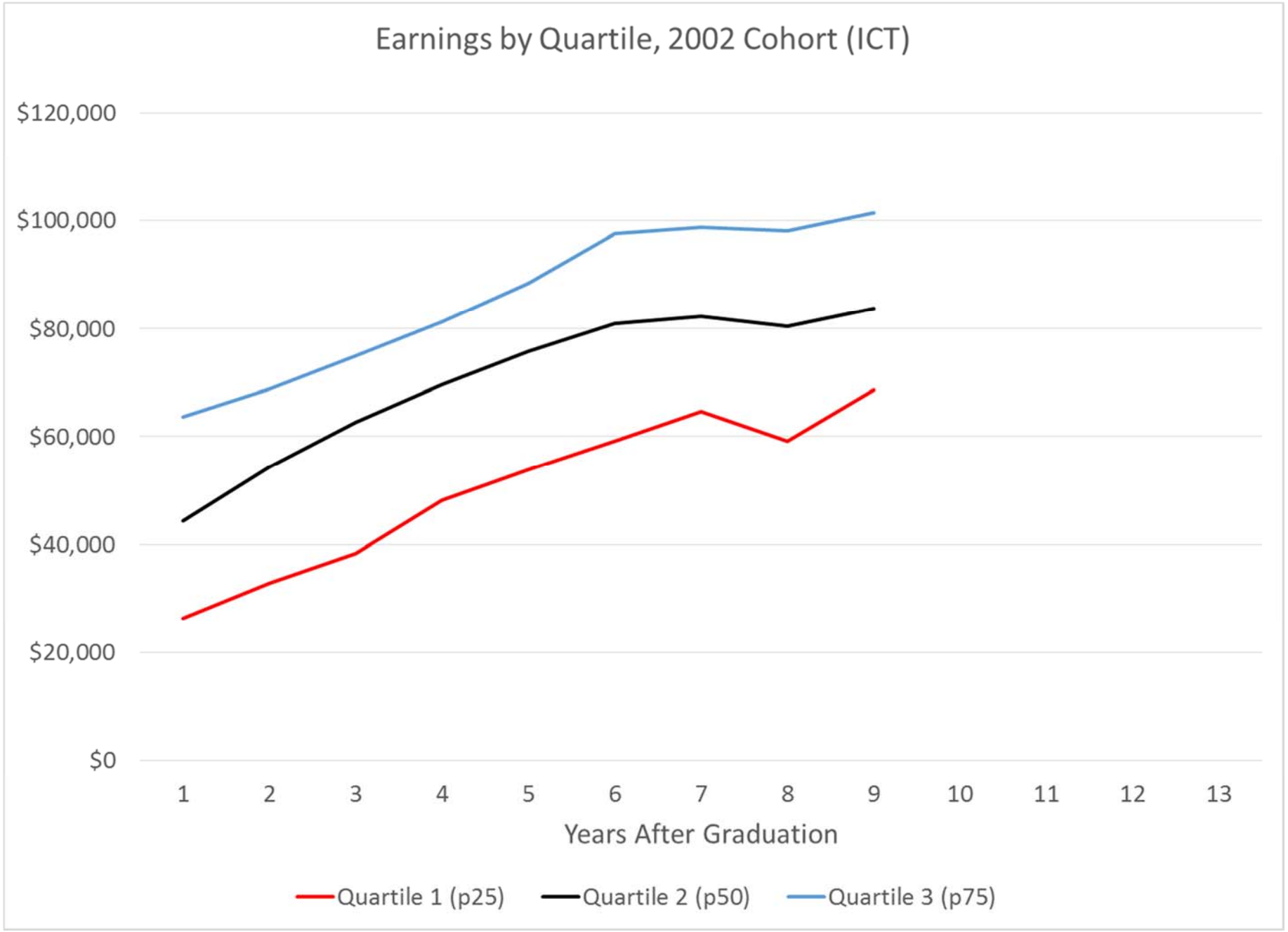
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2002 Cohort (ICT)
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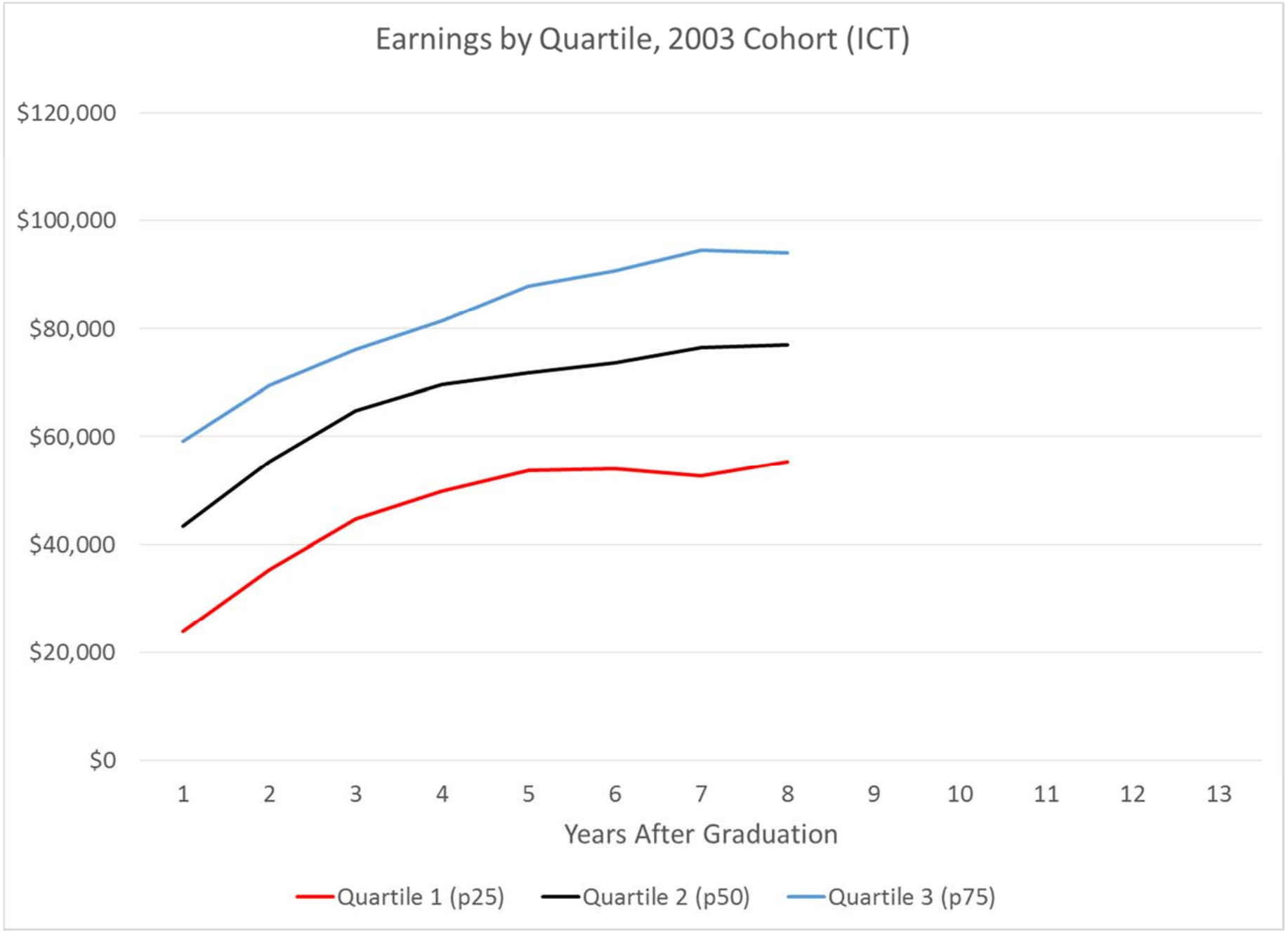
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2003 Cohort (ICT)
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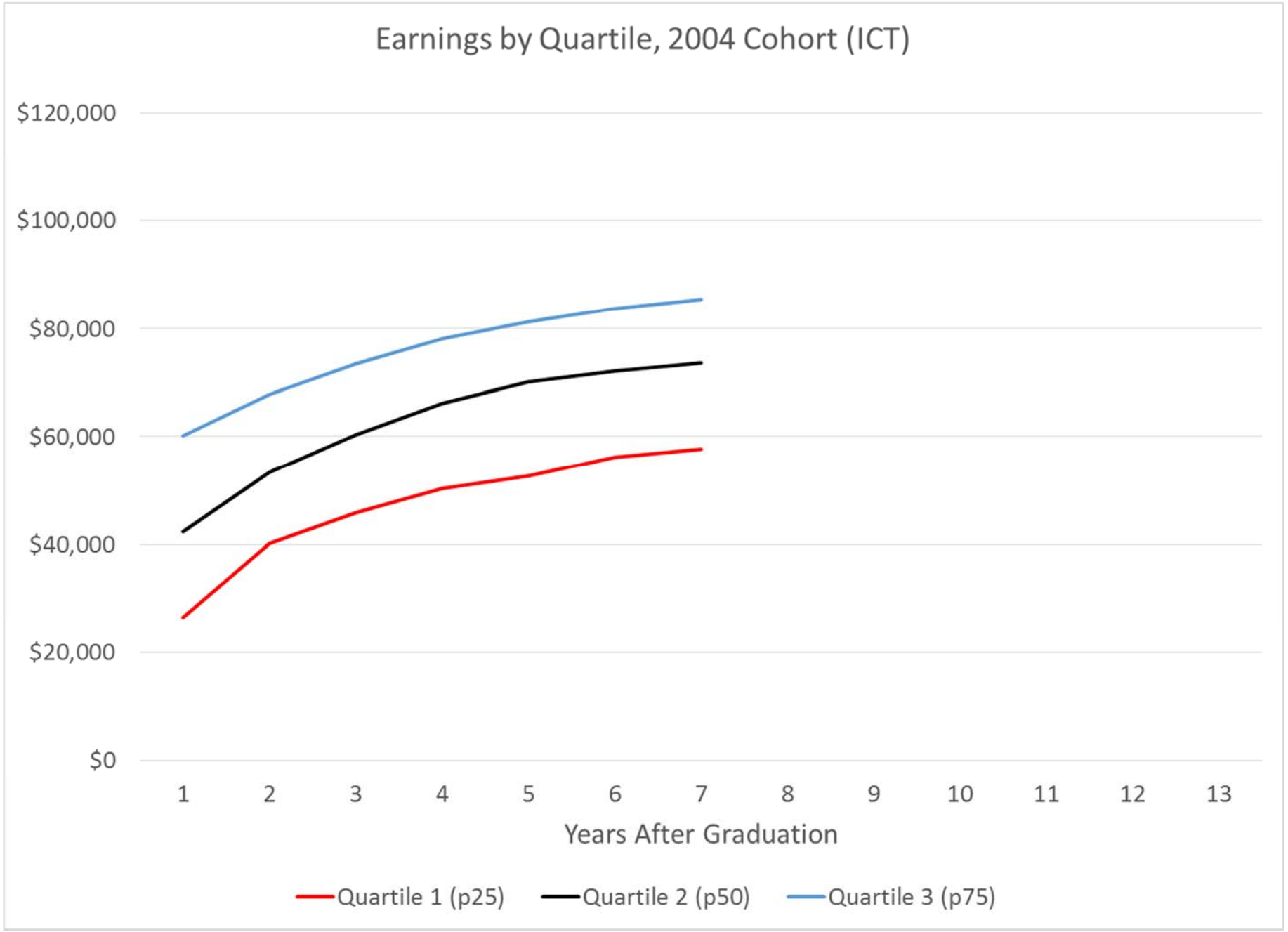
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)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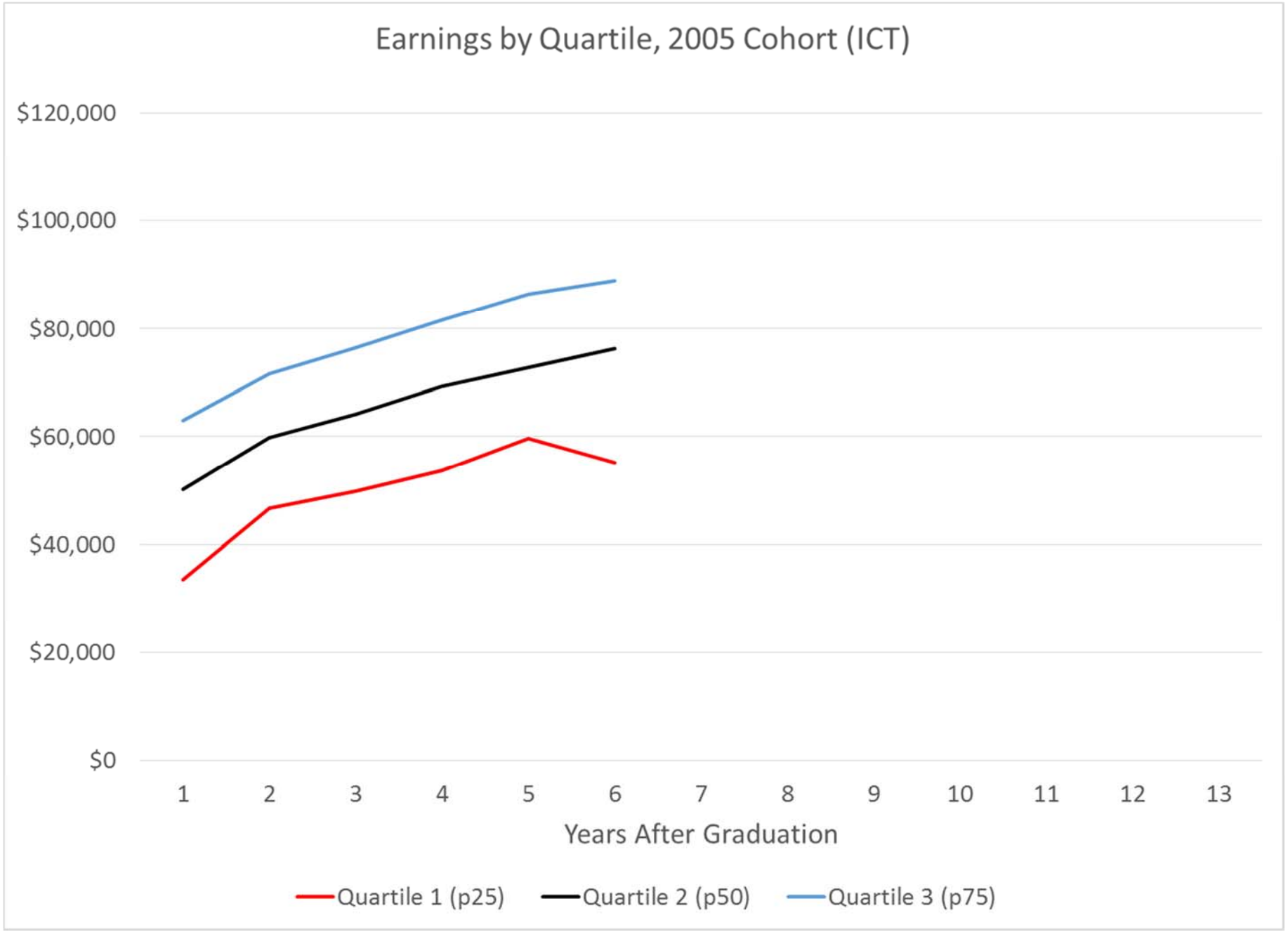
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2005 Cohort (ICT)
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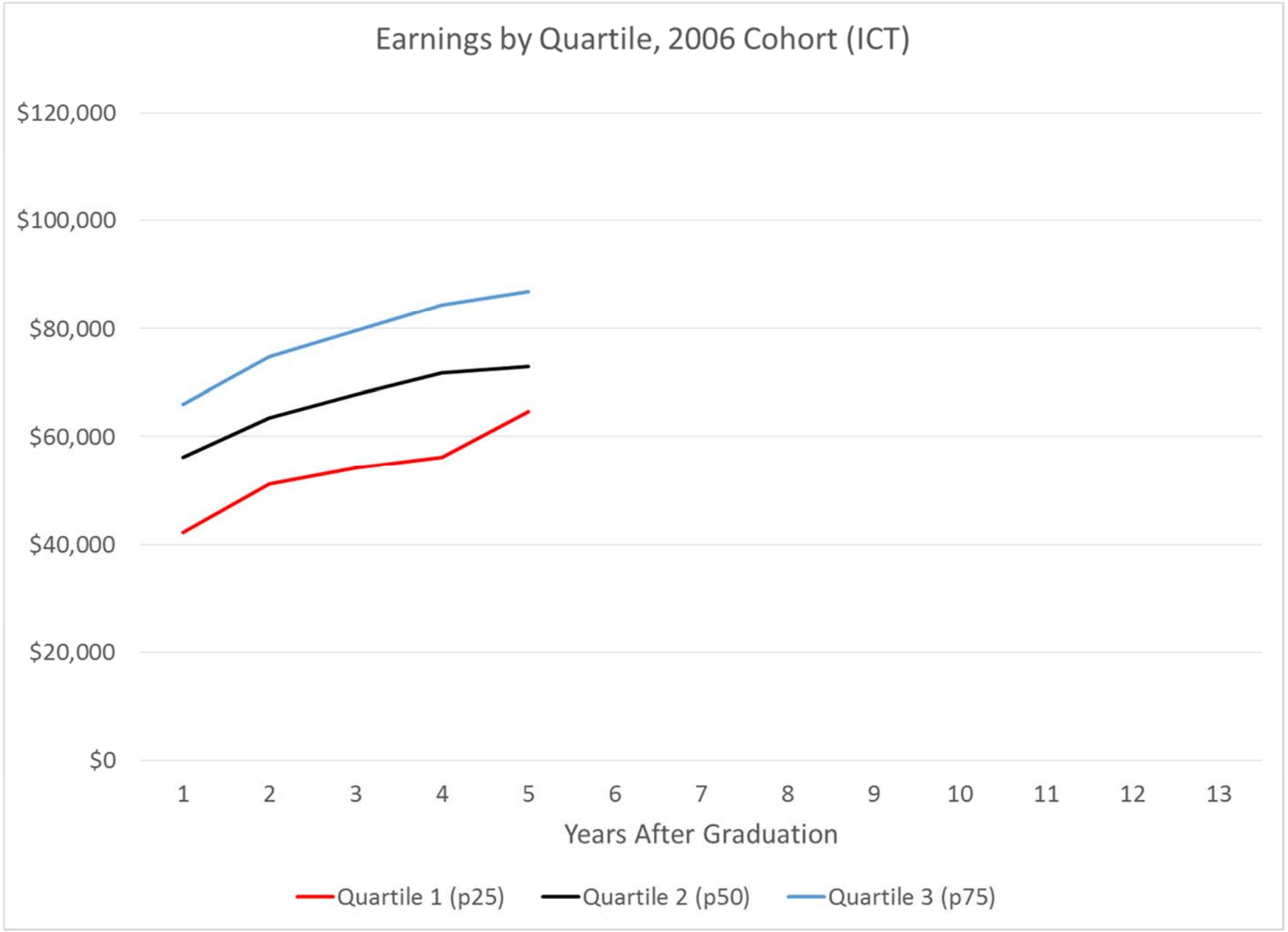
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2006 Cohort (ICT)
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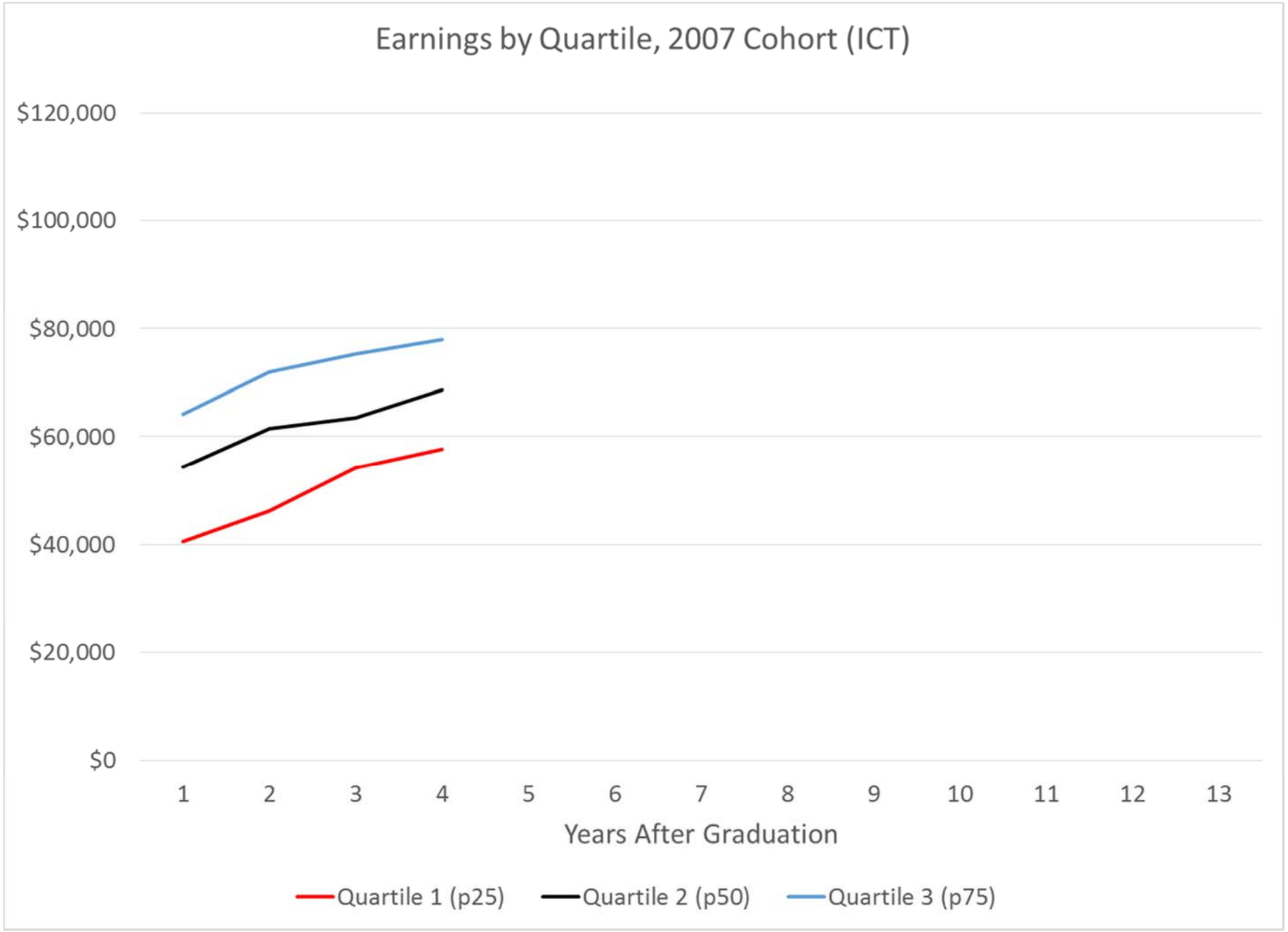
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2007 Cohort (ICT)
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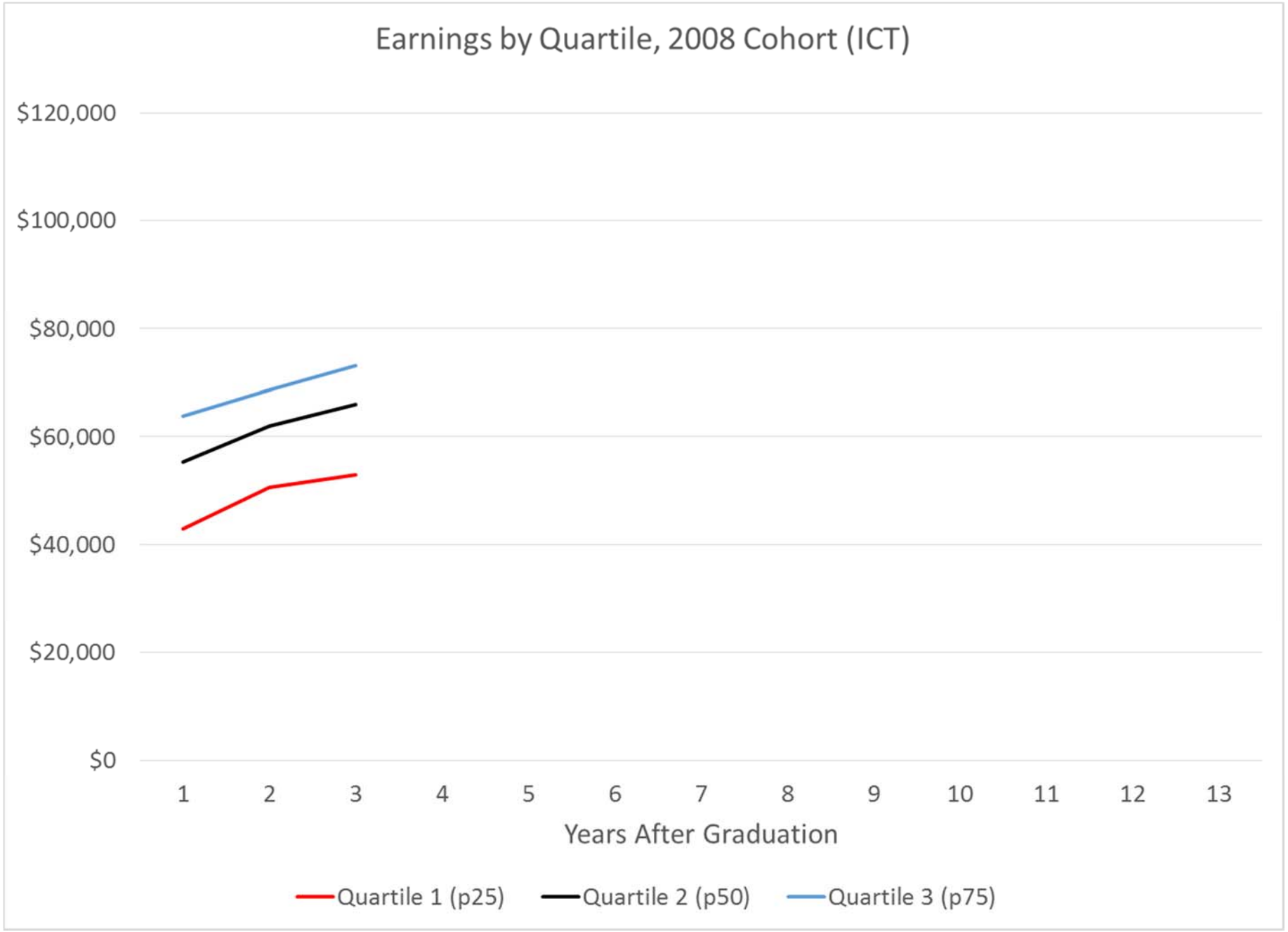
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2008 Cohort (ICT)
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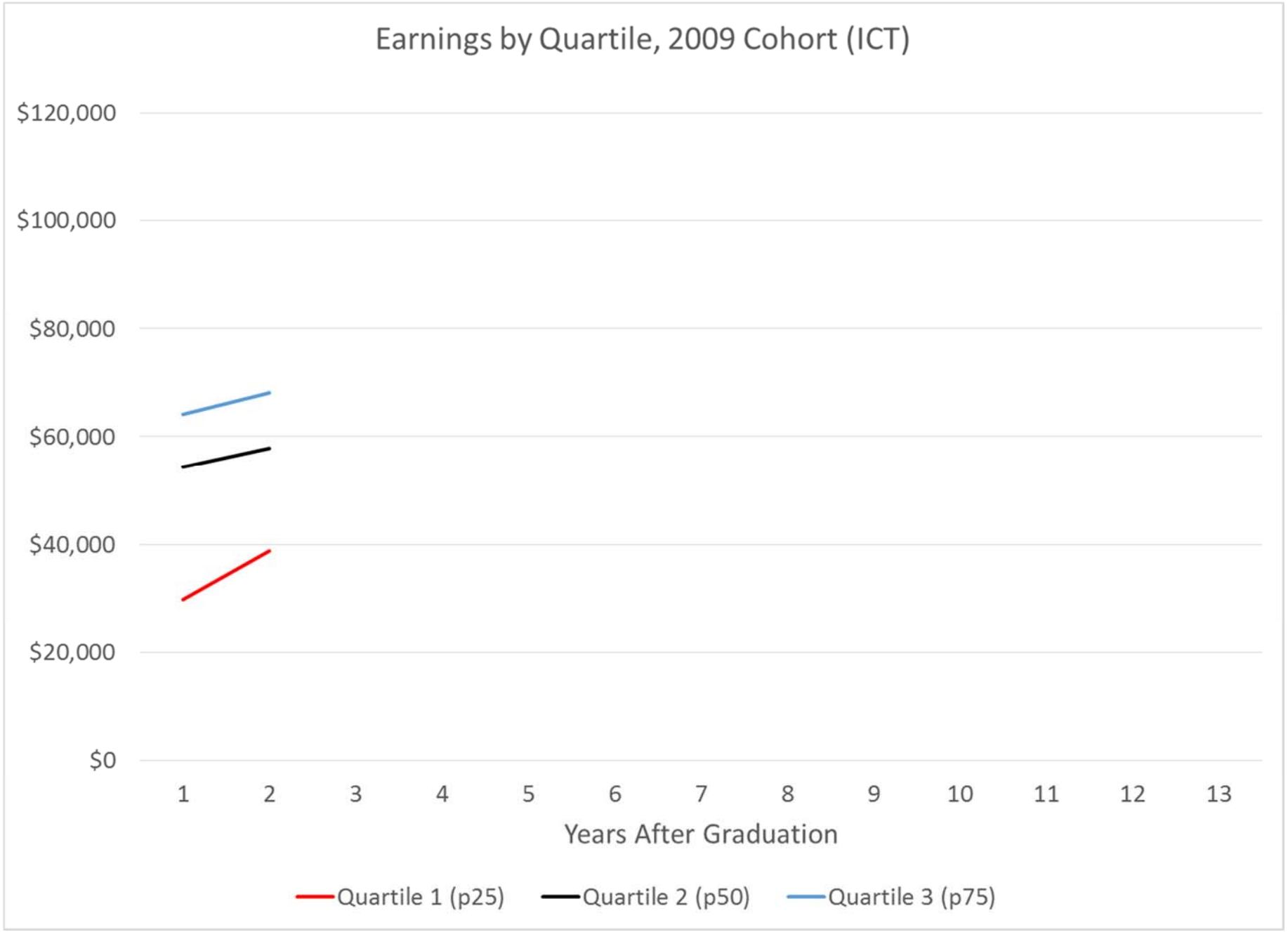
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 2009 Cohort (ICT)
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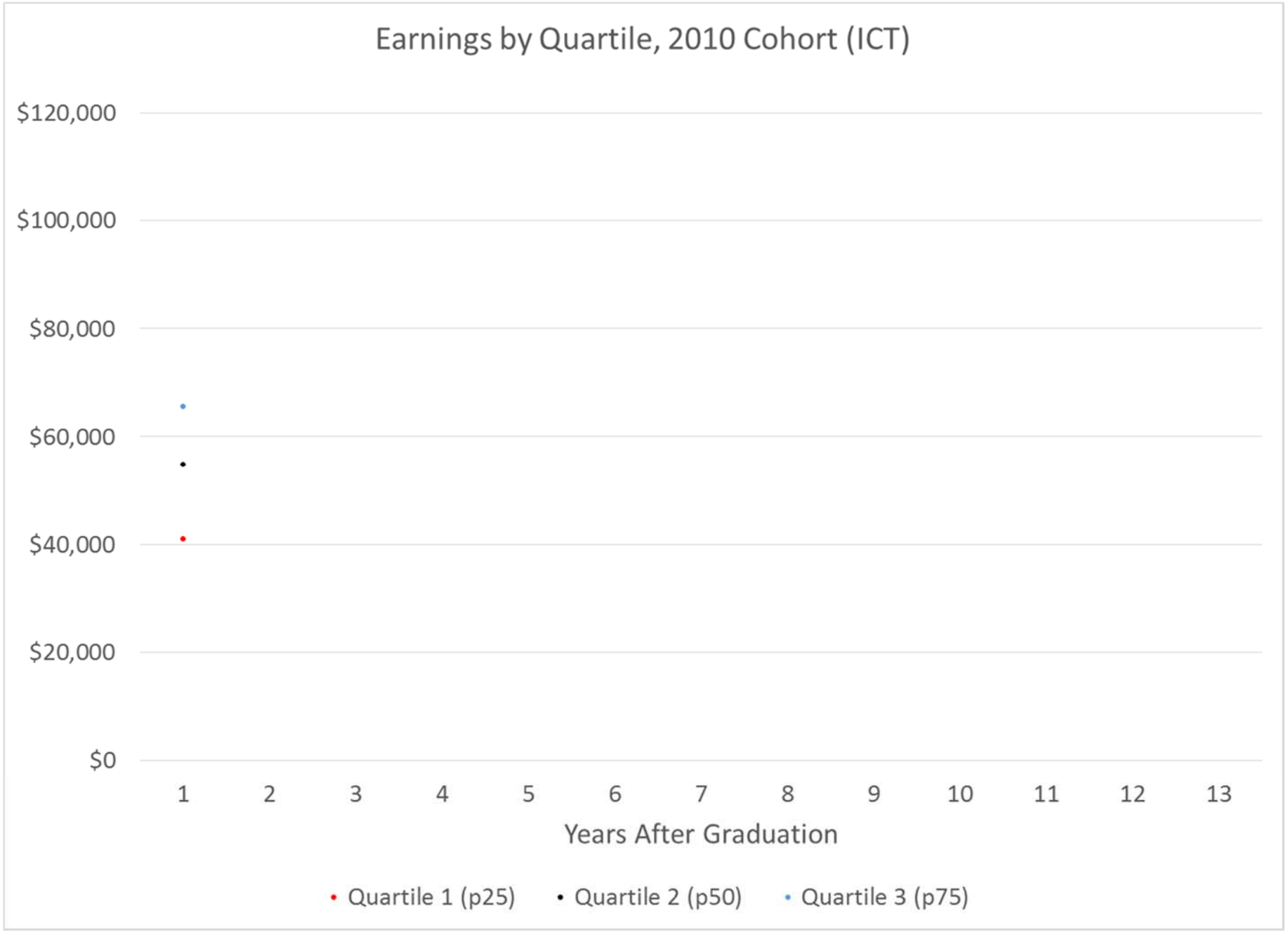
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)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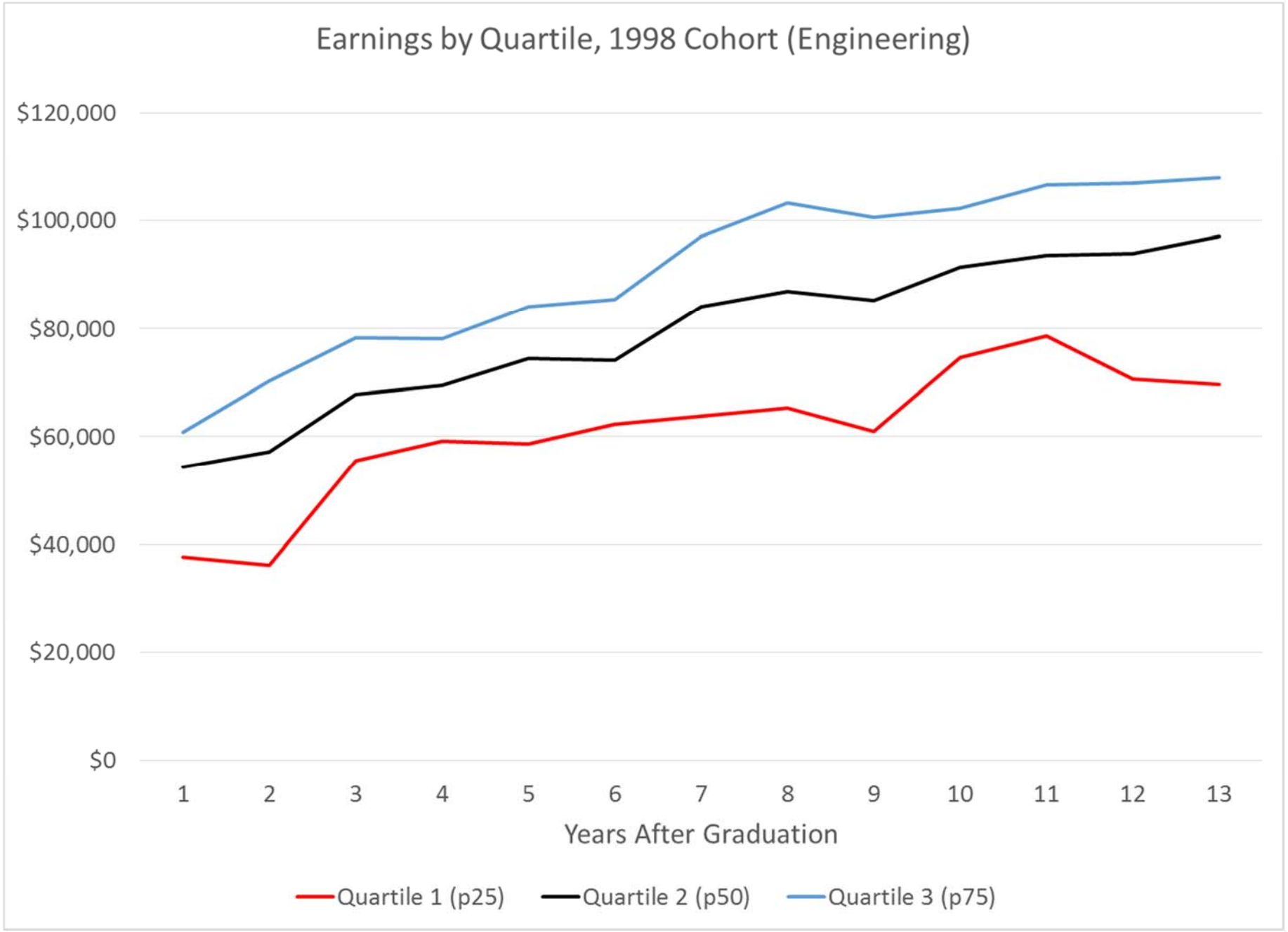
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)


Earnings by Quartile, 1998 Cohort (Engineering)
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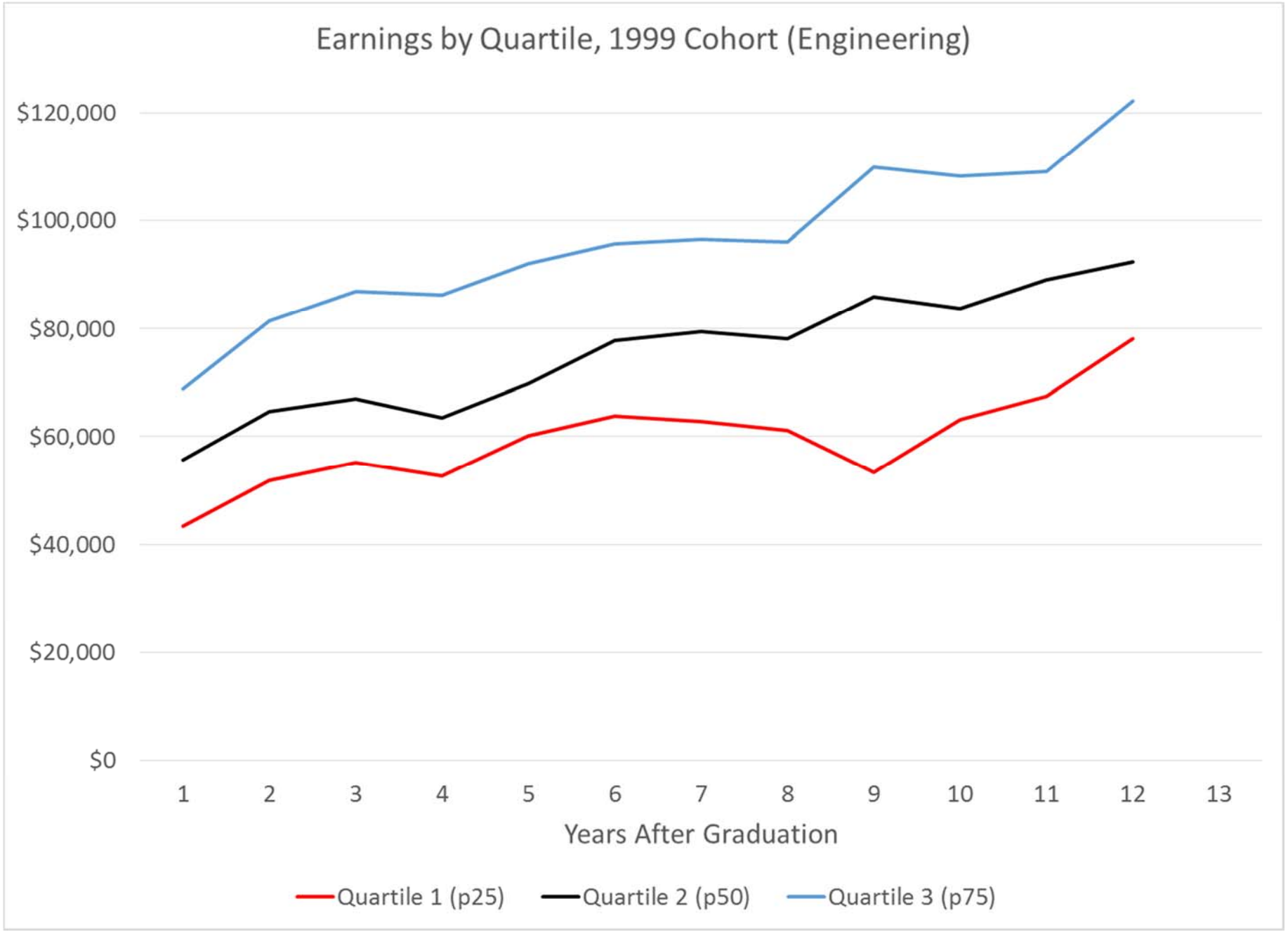
Years After Graduation
Quartile 1 (p25)
Quartile 2 (p50)
Quartile 3 (p75)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Years After Graduation
Quartile 1 (p25)
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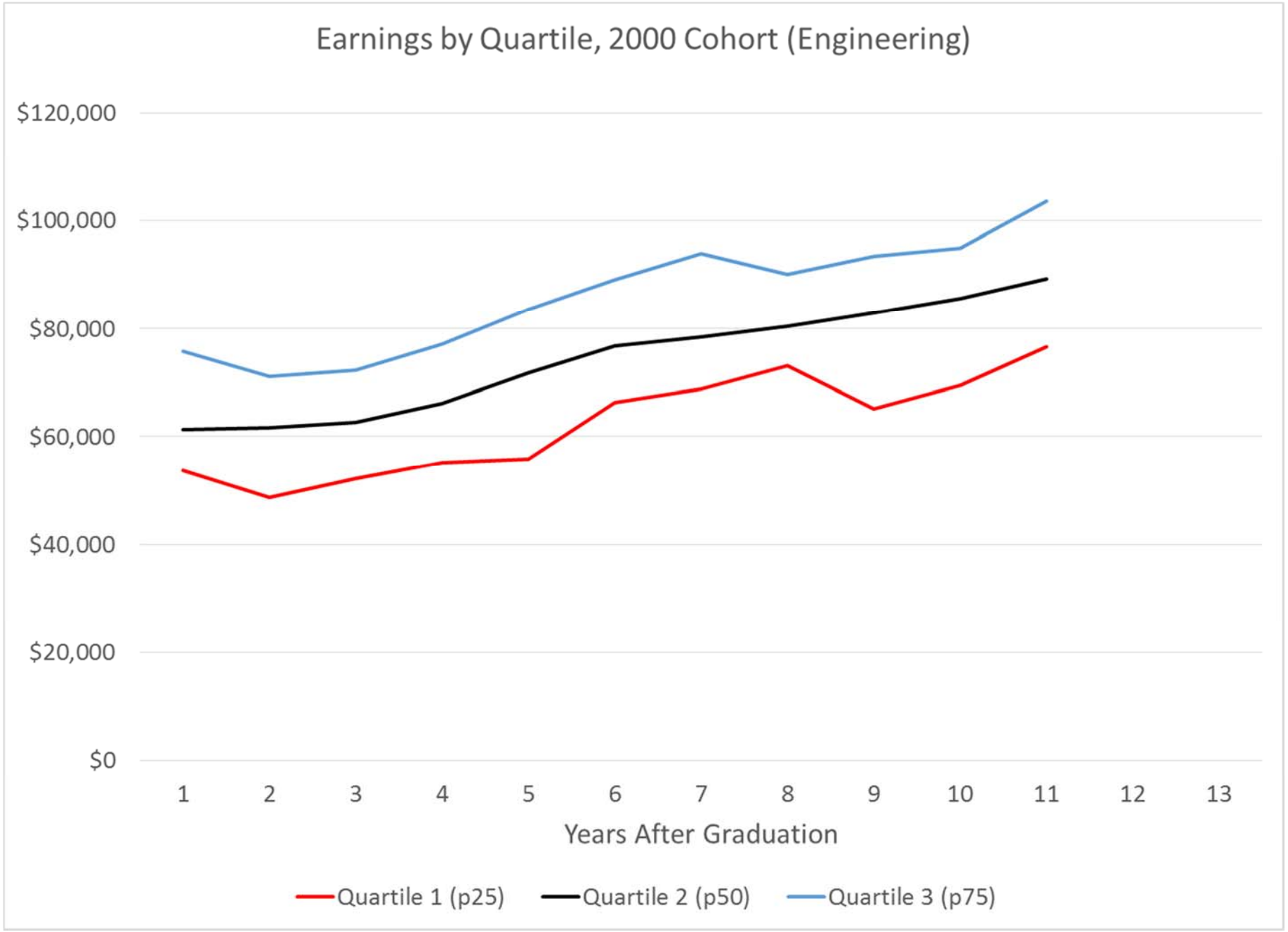
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Years After Graduation
Quartile 1 (p25)
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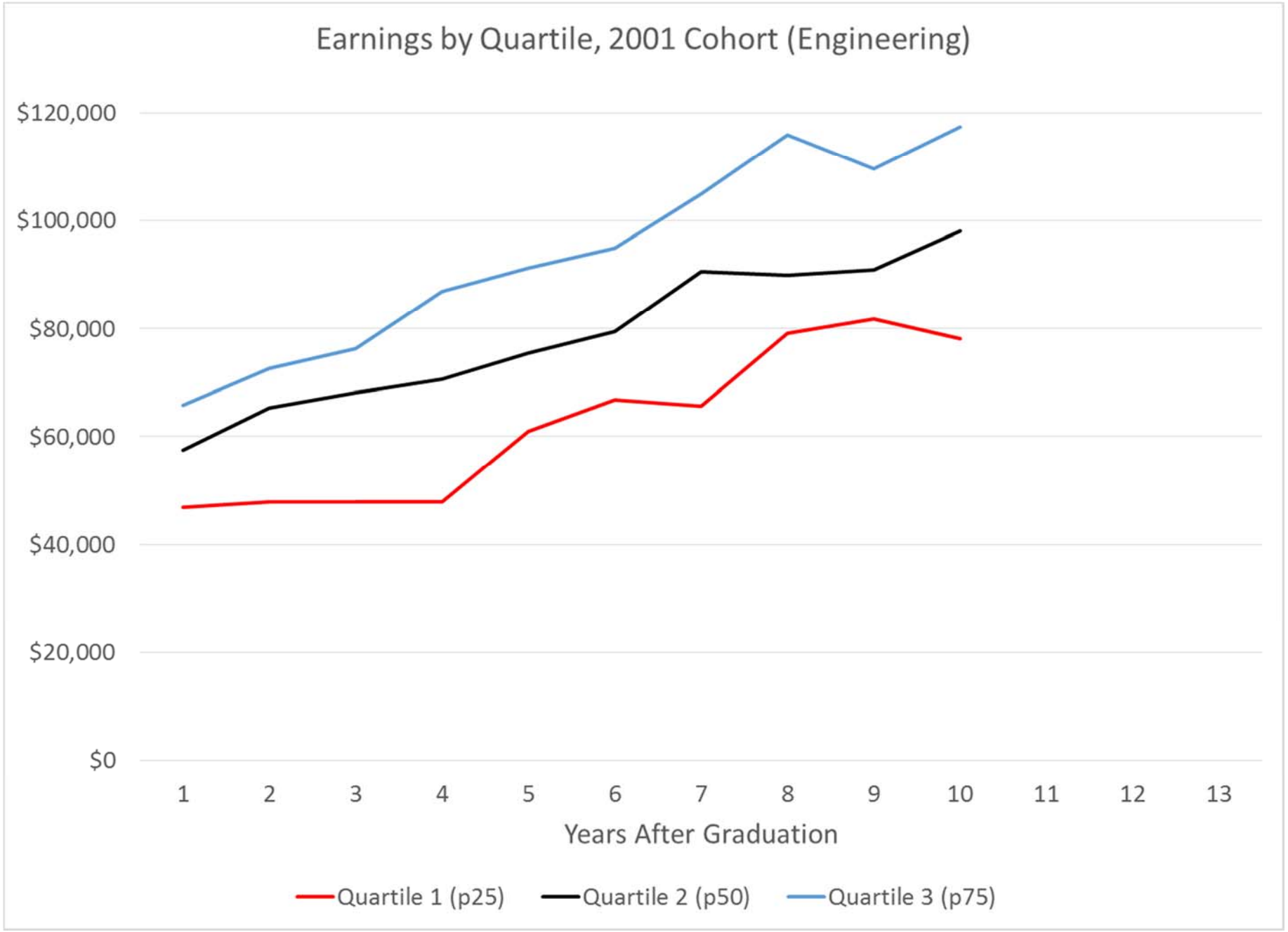
Quartile 3 (p75)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Years After Graduation
Quartile 1 (p25)
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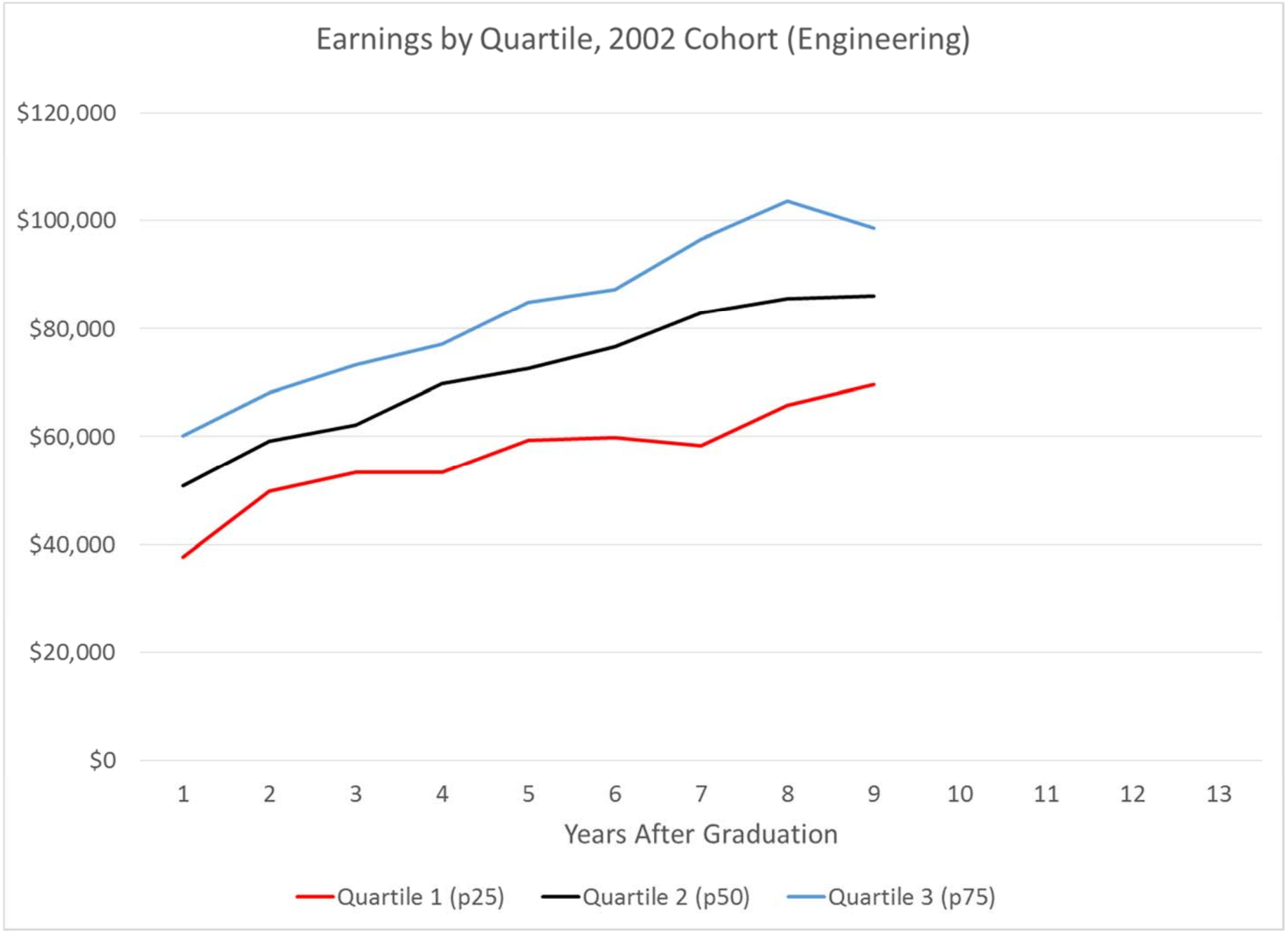
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Years After Graduation
Quartile 1 (p25)
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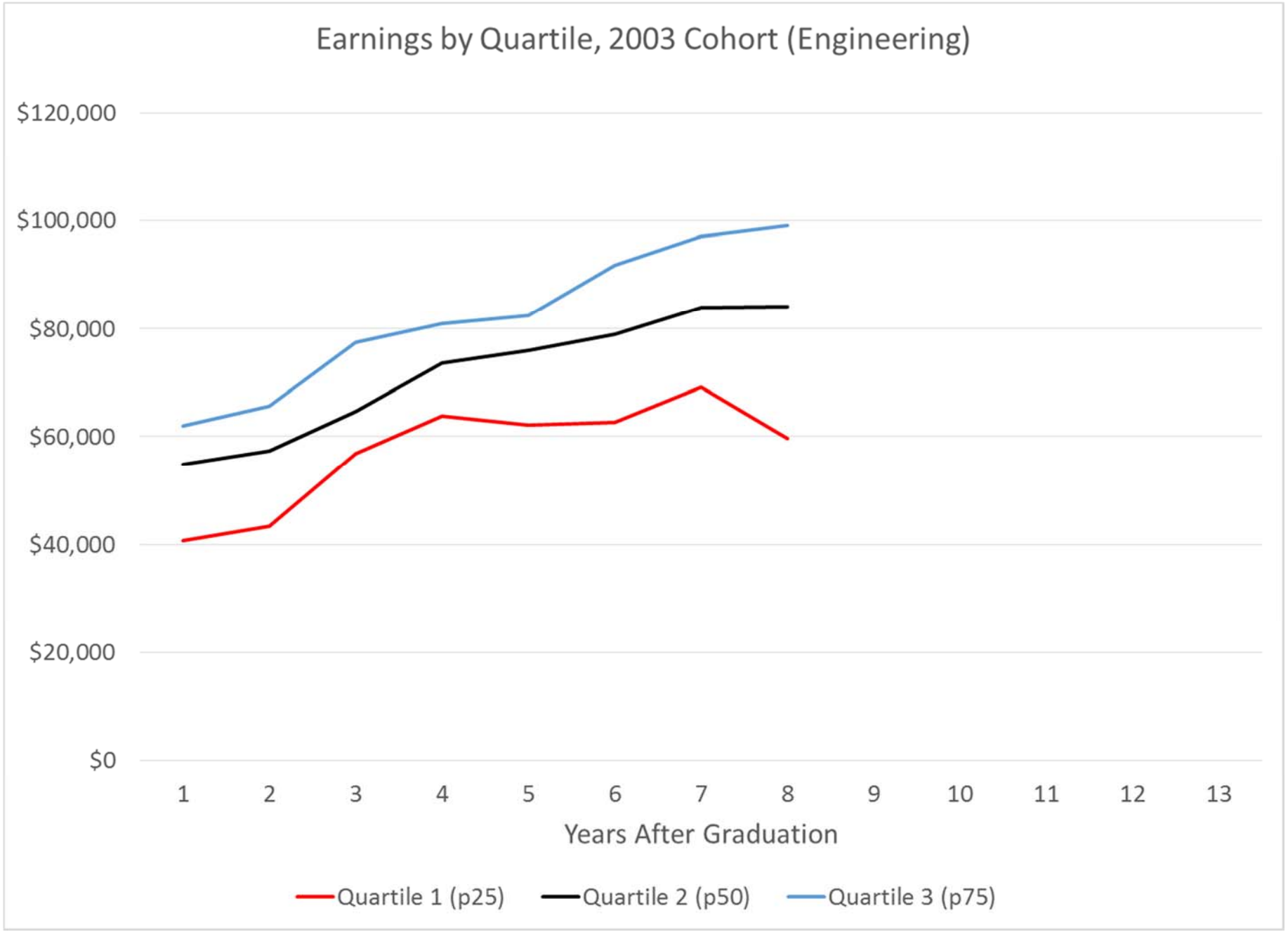
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Years After Graduation
Quartile 1 (p25)
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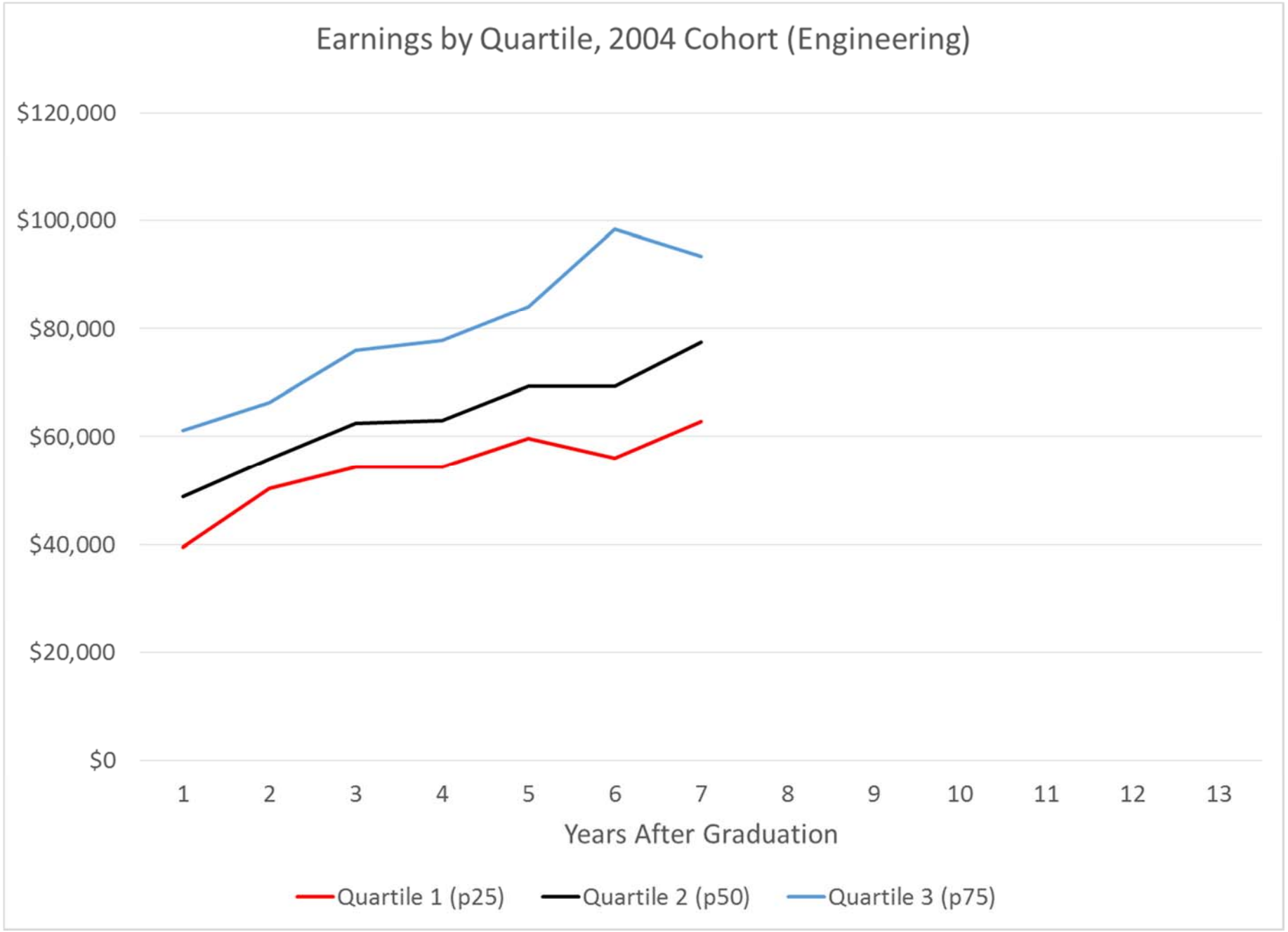
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Years After Graduation
Quartile 1 (p25)
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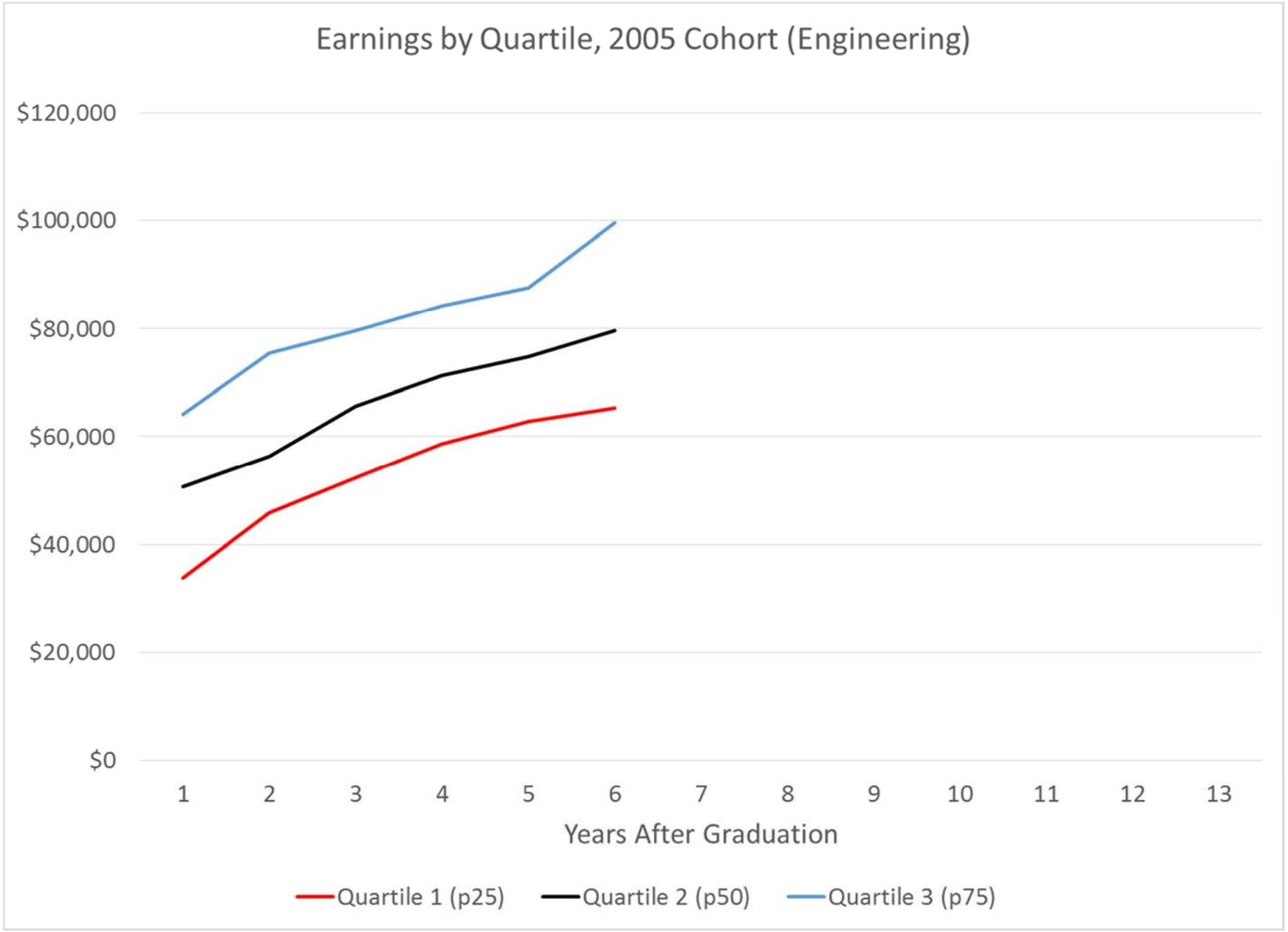
Earnings by Quartile, 2005 Cohort (Engineering)
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Years After Graduation
Quartile 1 (p25)
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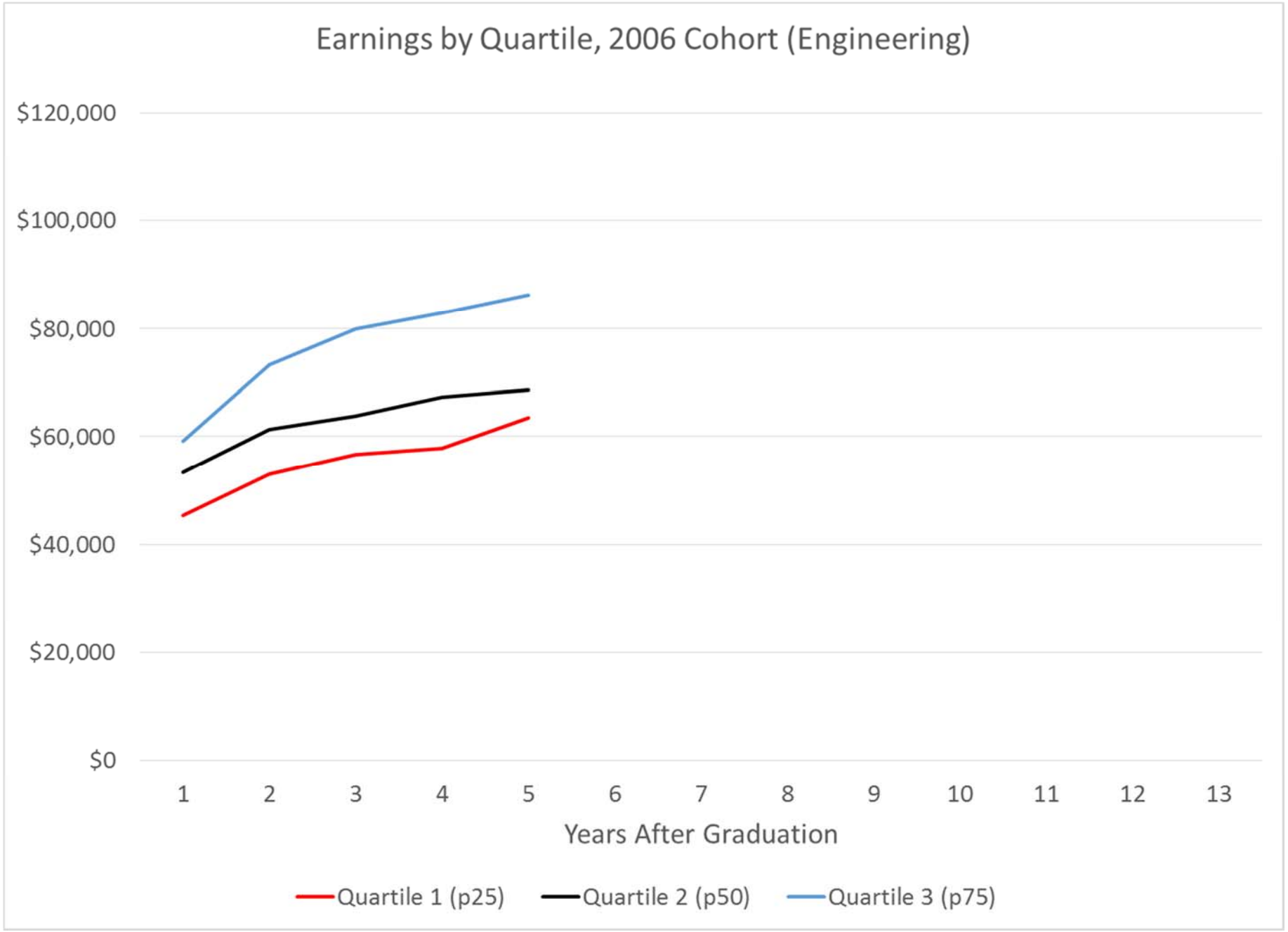
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Years After Graduation
Quartile 1 (p25)
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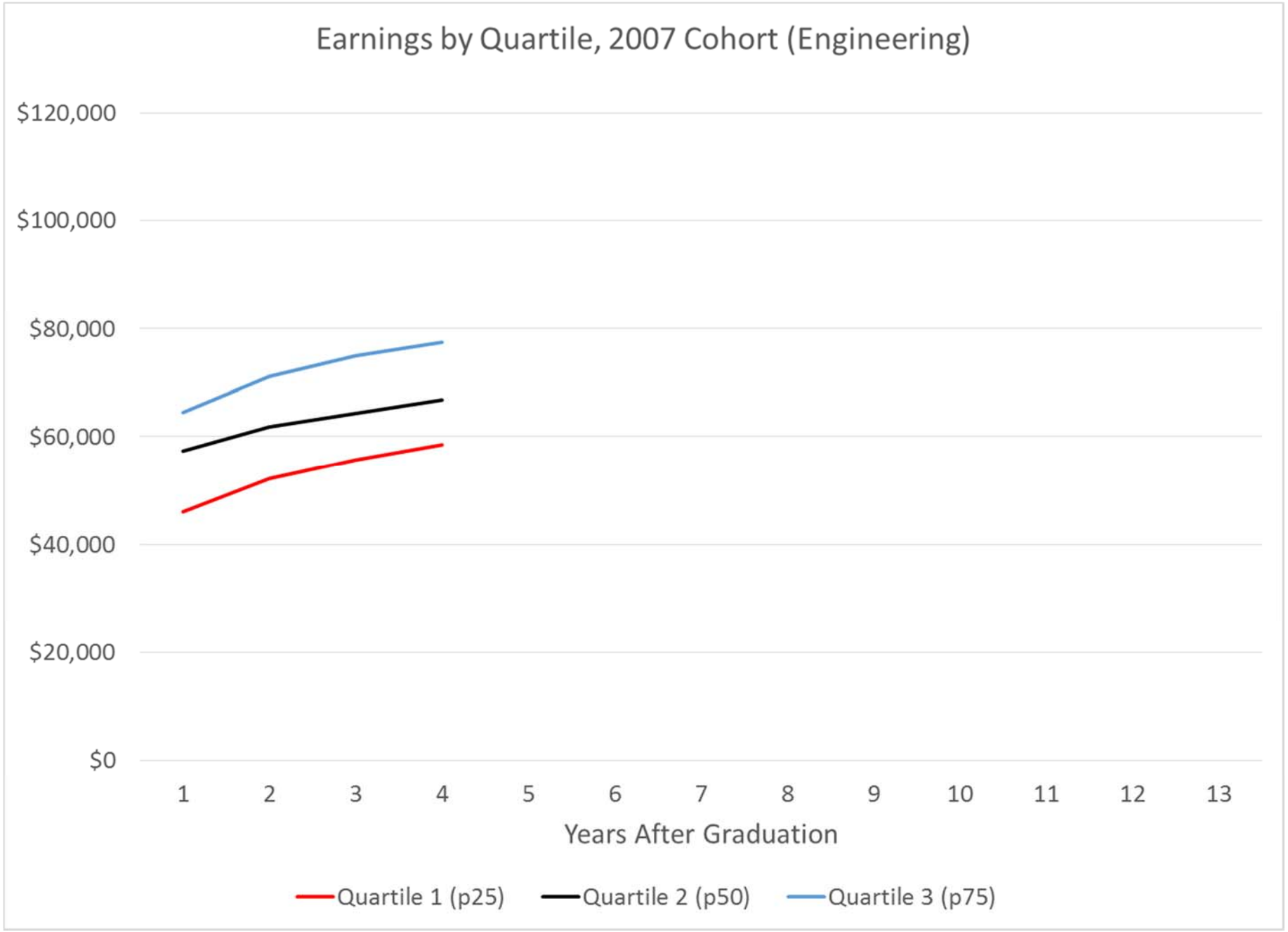
Earnings by Quartile, 2007 Cohort (Engineering)
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Years After Graduation
Quartile 1 (p25)
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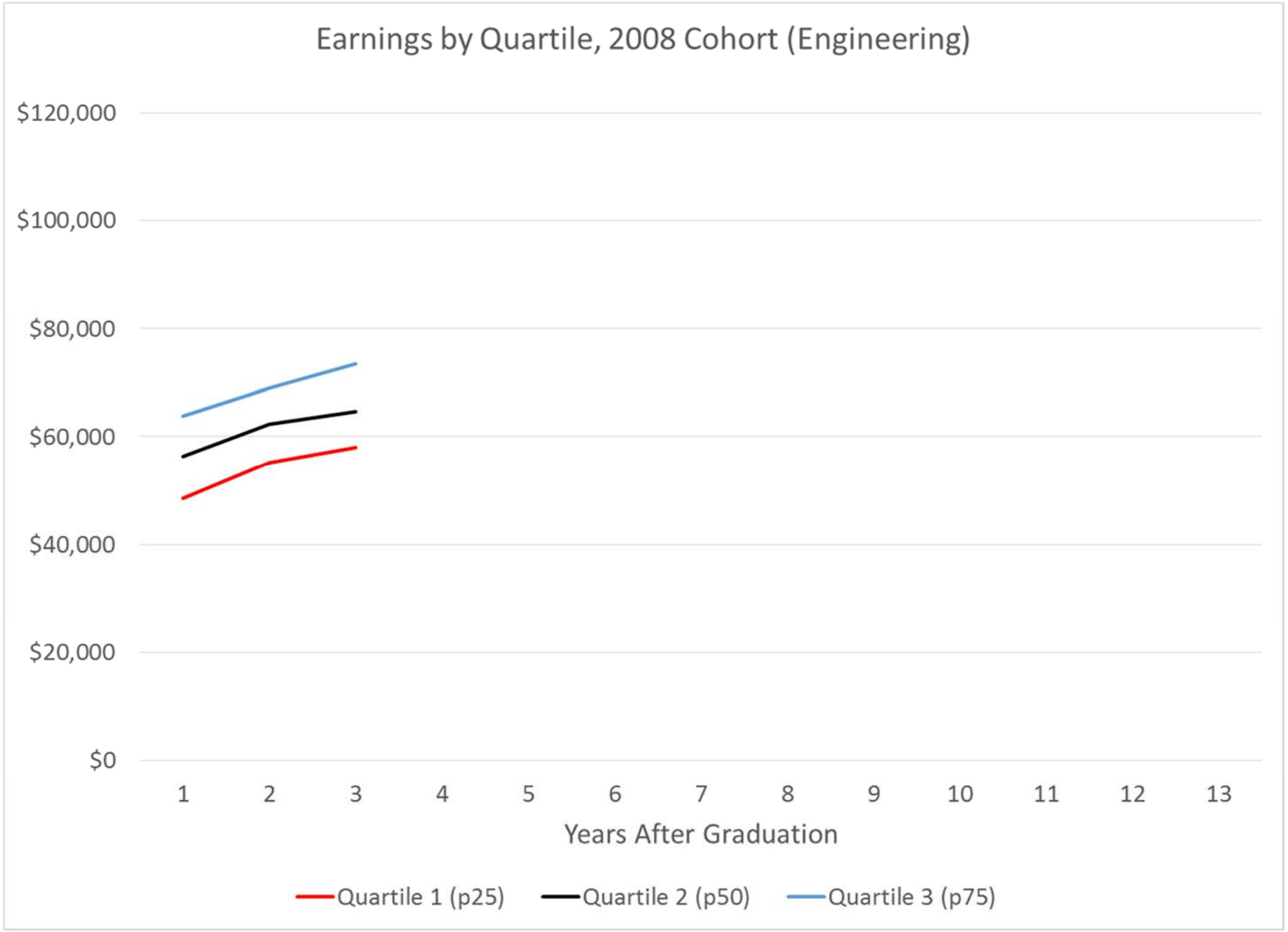
Earnings by Quartile, 2008 Cohort (Engineering)
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Years After Graduation
Quartile 1 (p25)
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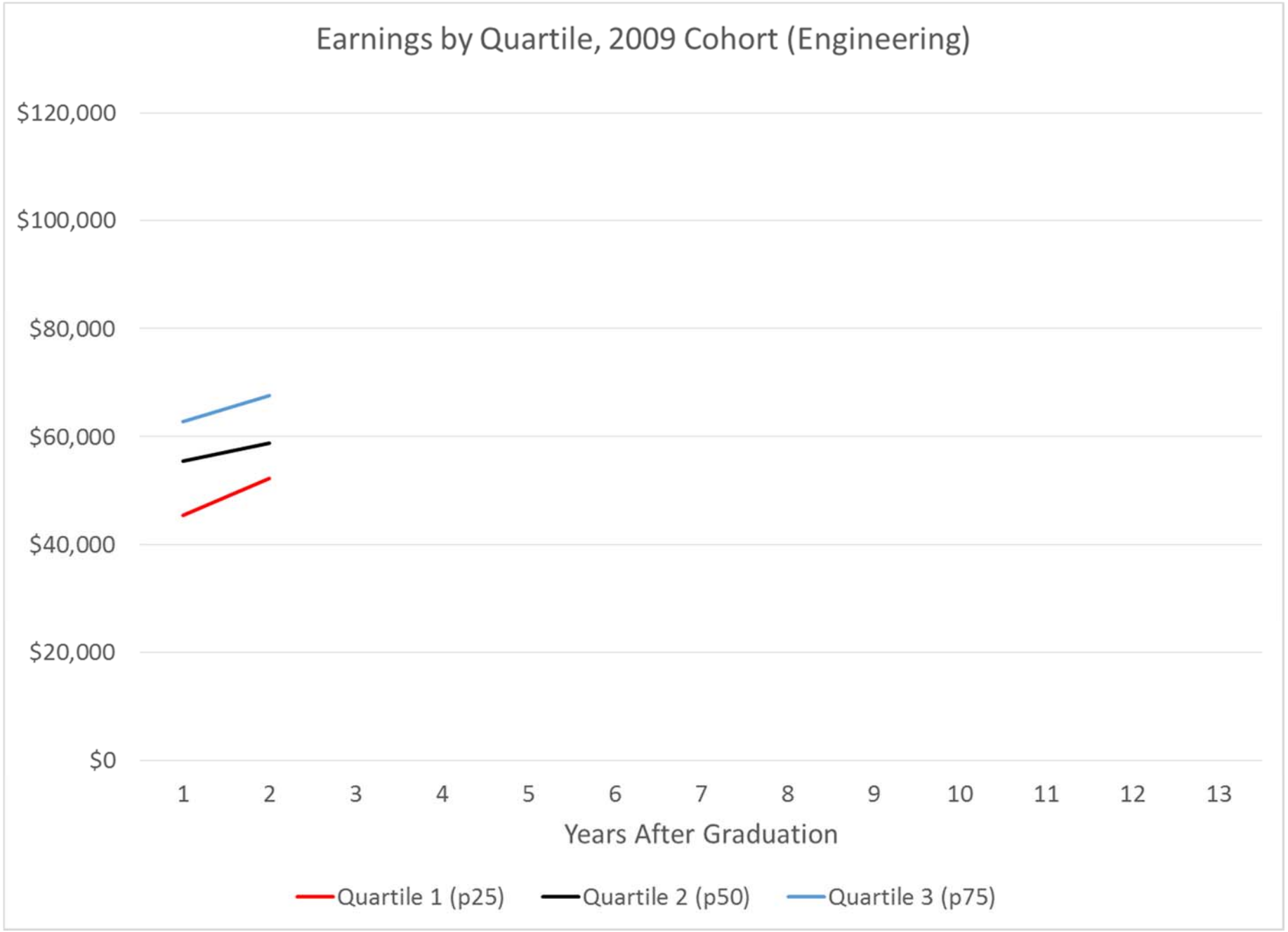
Earnings by Quartile, 2009 Cohort (Engineering)
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Years After Graduation
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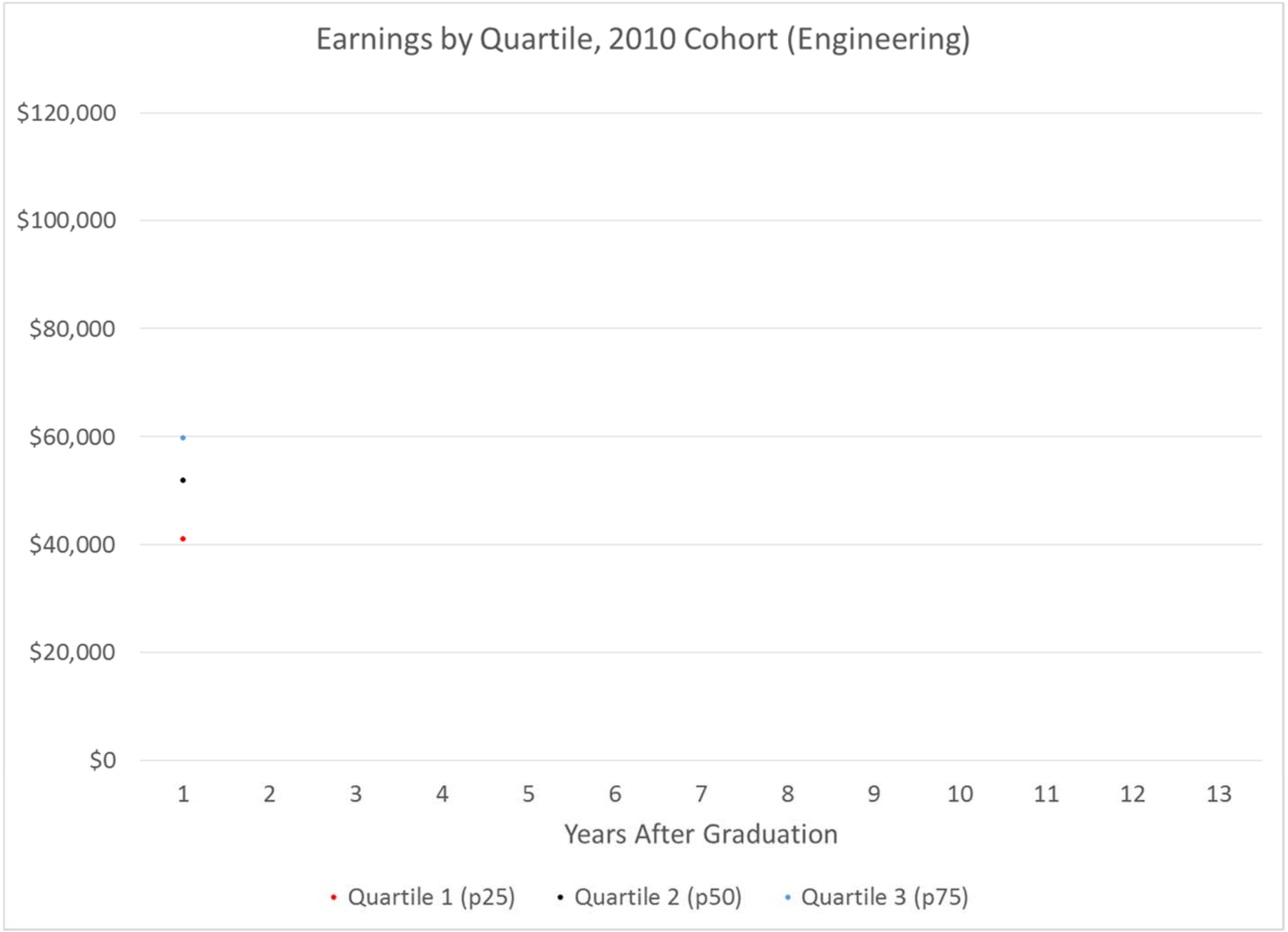
Earnings by Quartile, 2010 Cohort (Engineering)
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Years After Graduation
Quartile 1 (p25)
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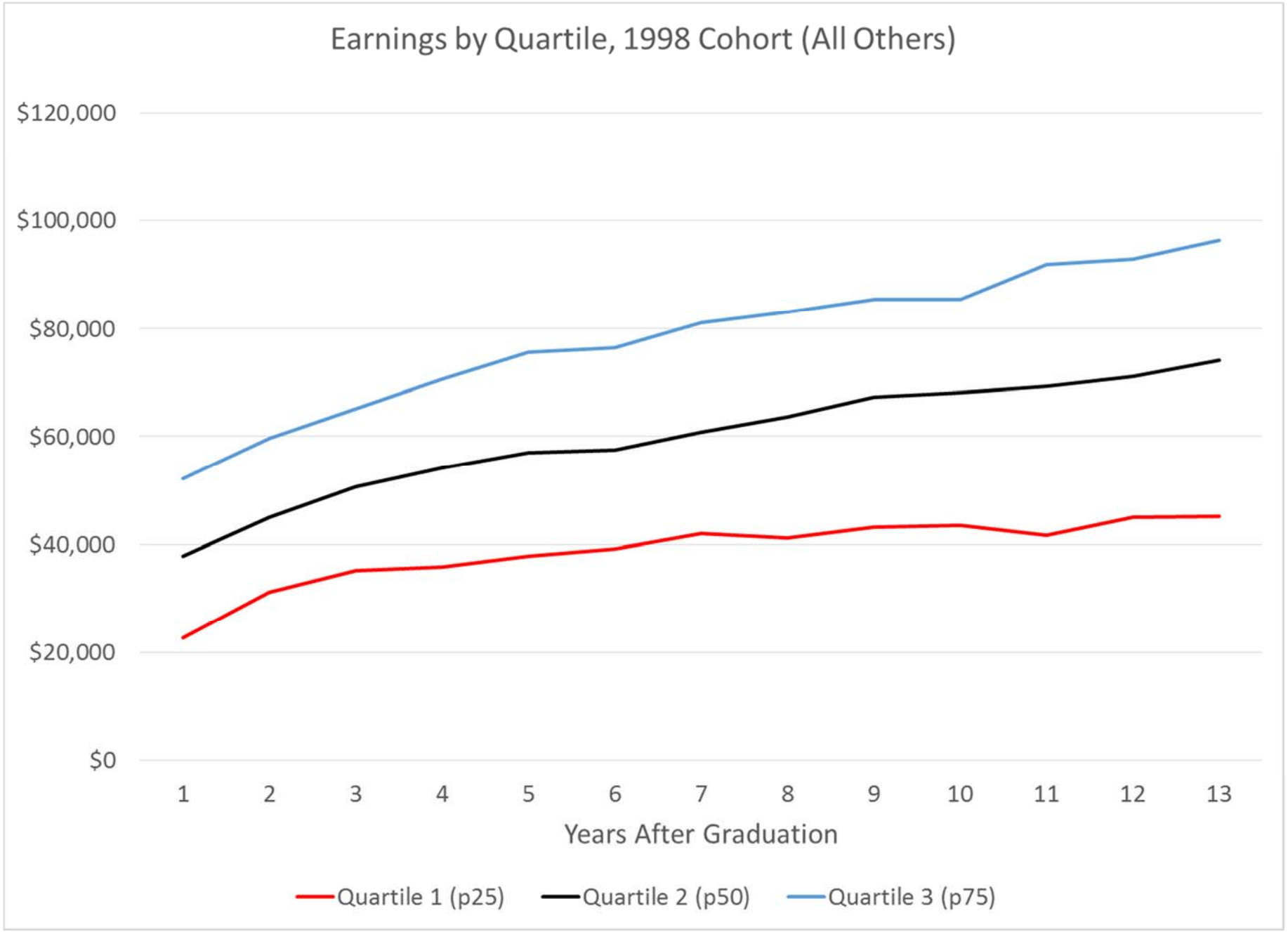
Earnings by Quartile, 1998 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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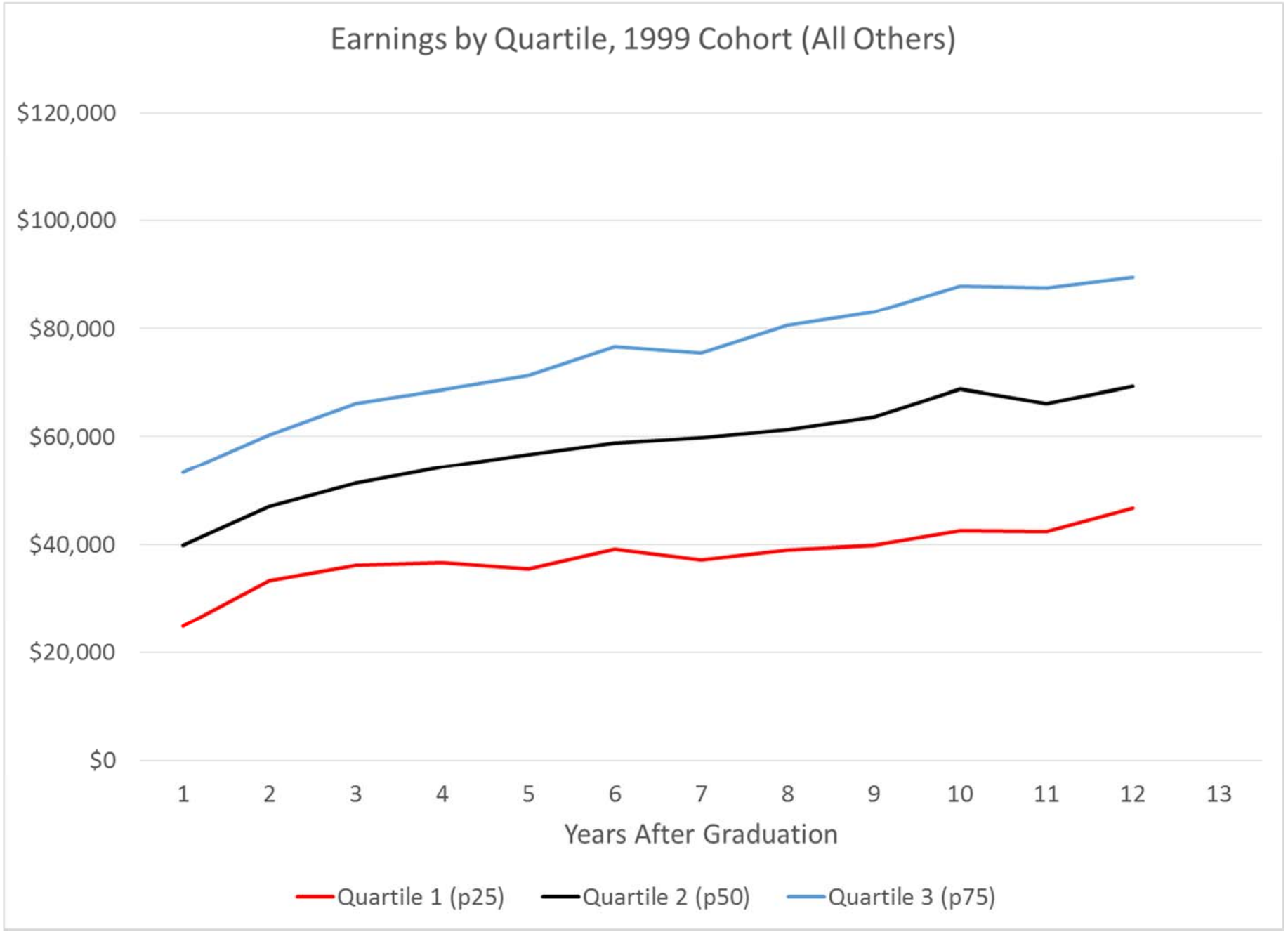
Earnings by Quartile, 1999 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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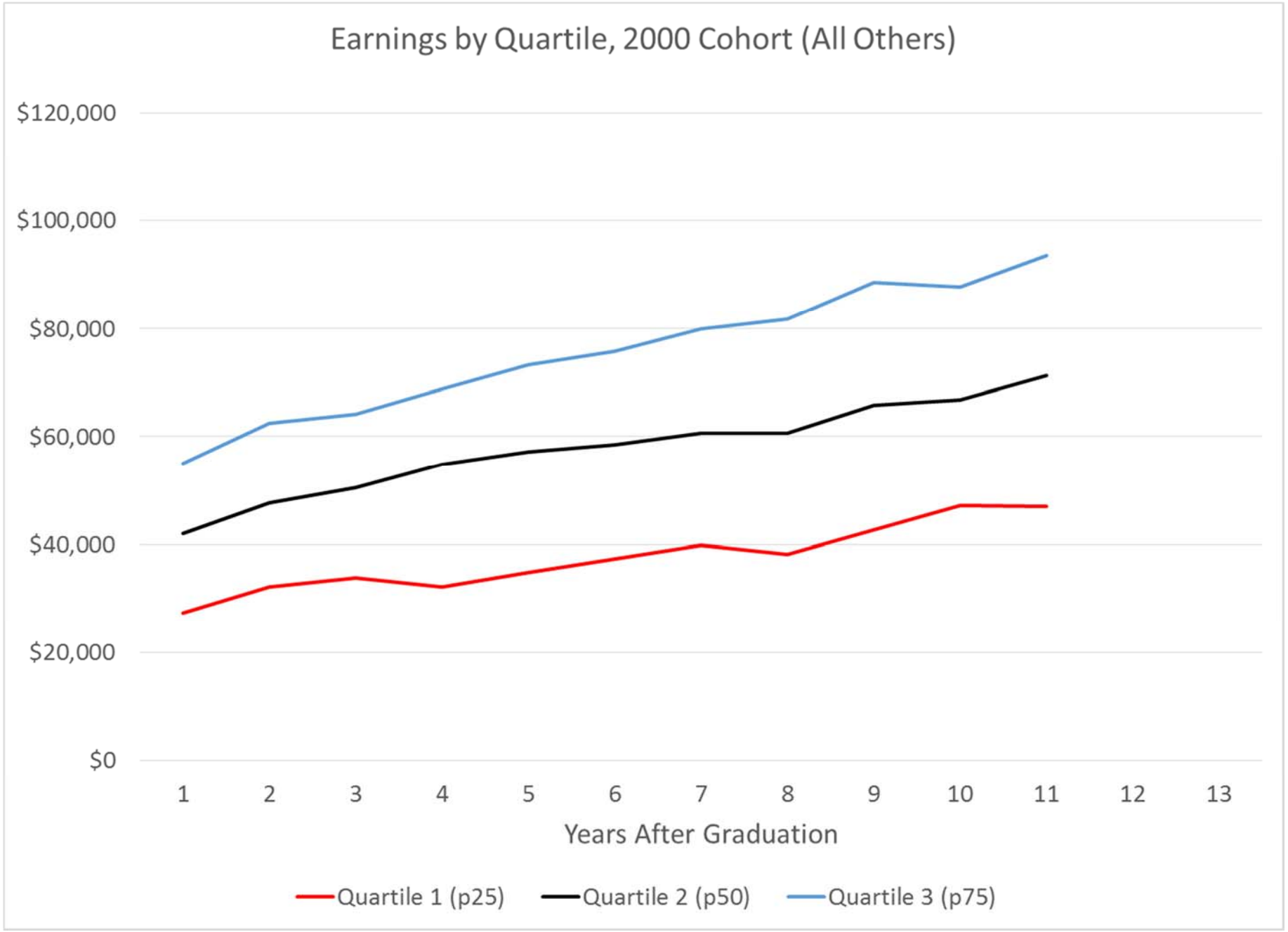
Earnings by Quartile, 2000 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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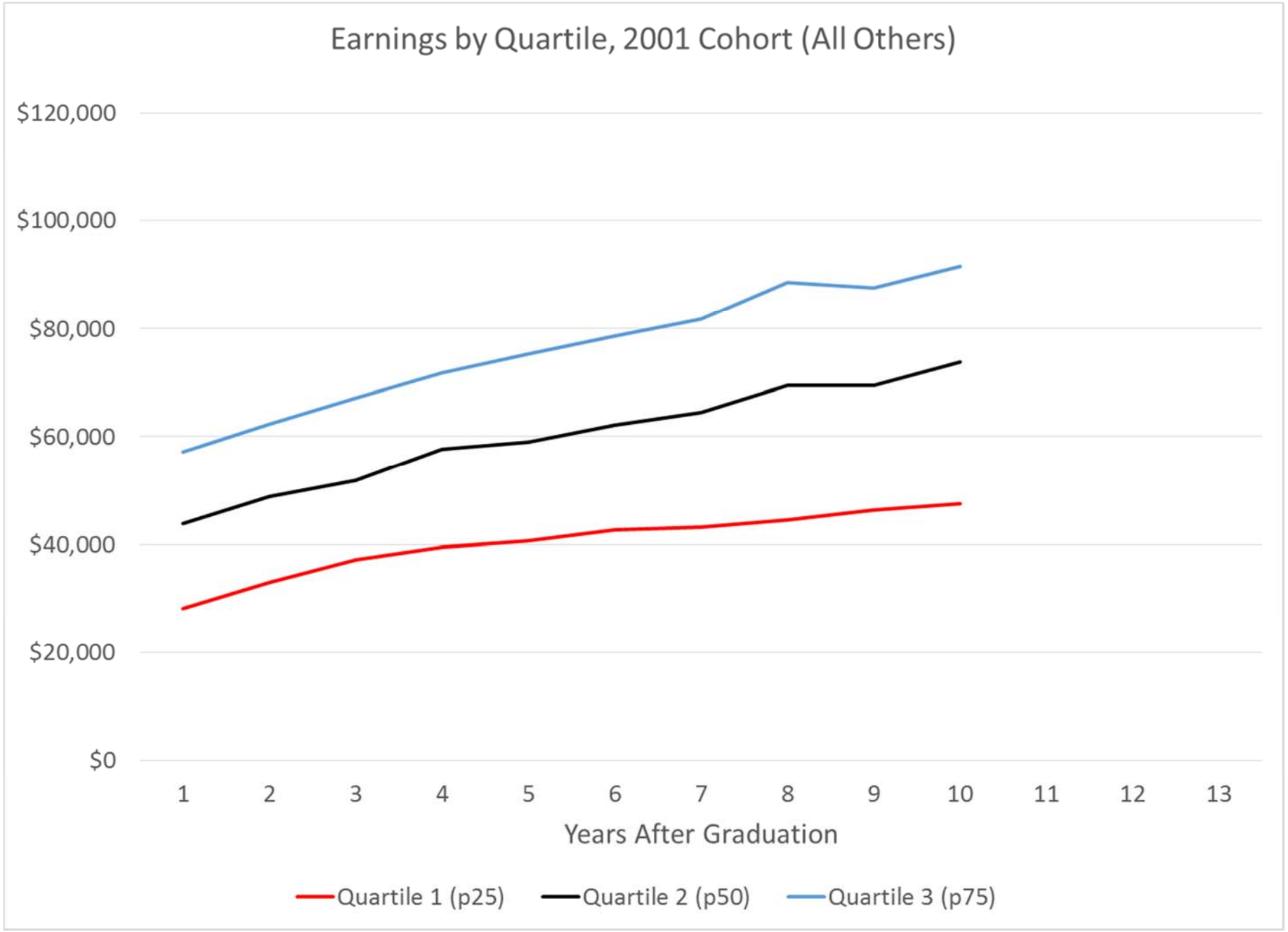
Earnings by Quartile, 2001 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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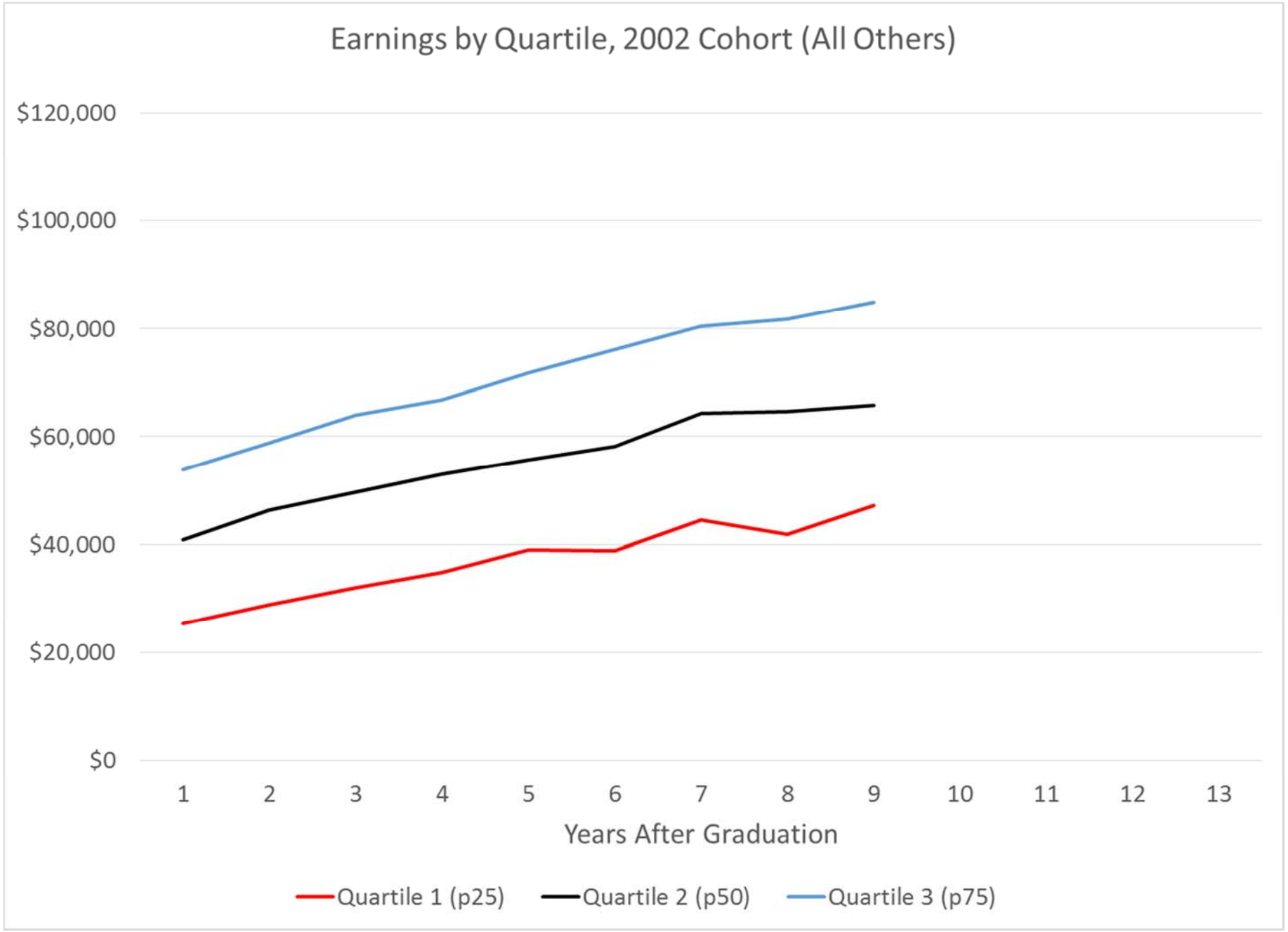
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Years After Graduation
Quartile 1 (p25)
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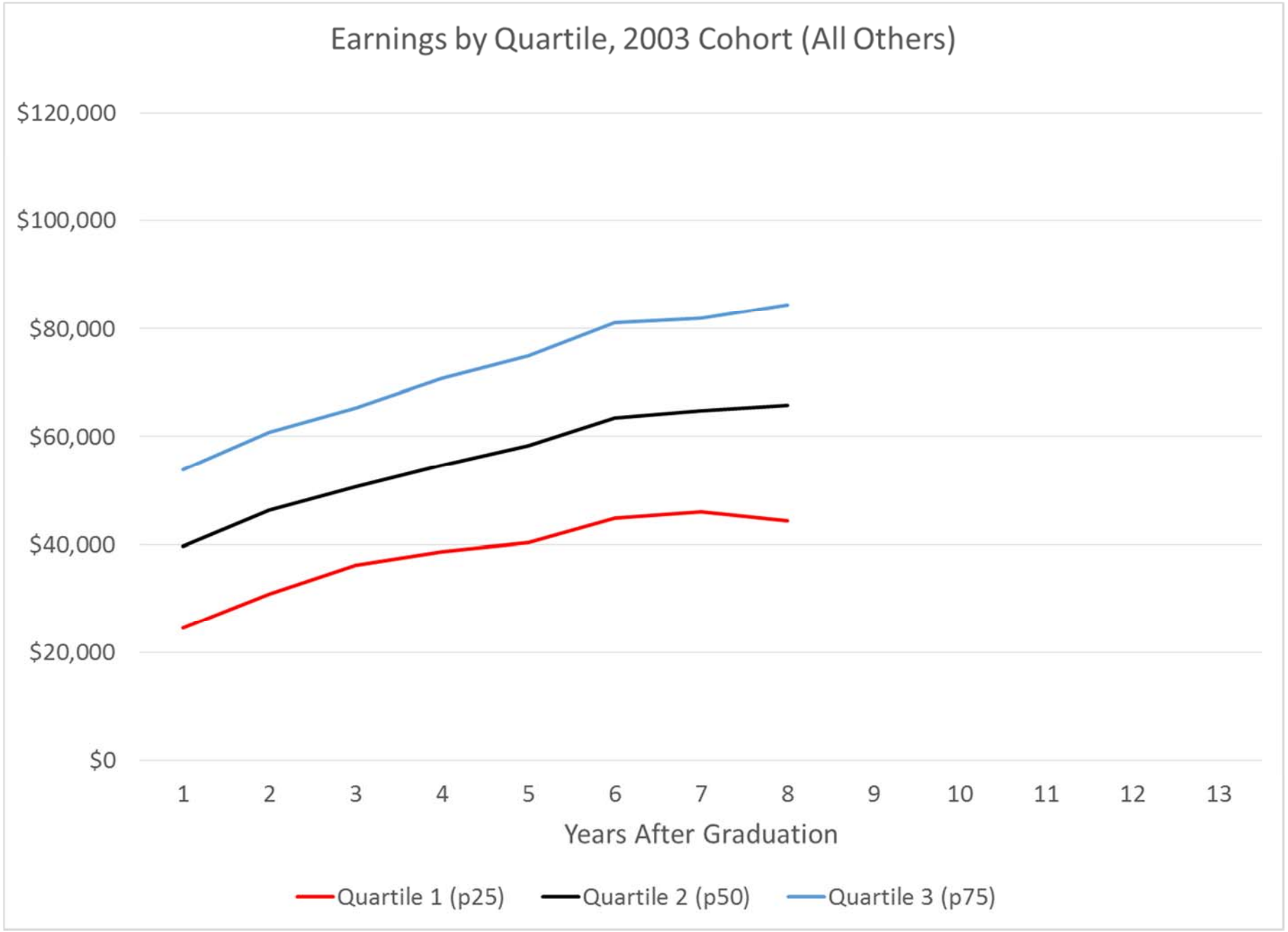
Earnings by Quartile, 2003 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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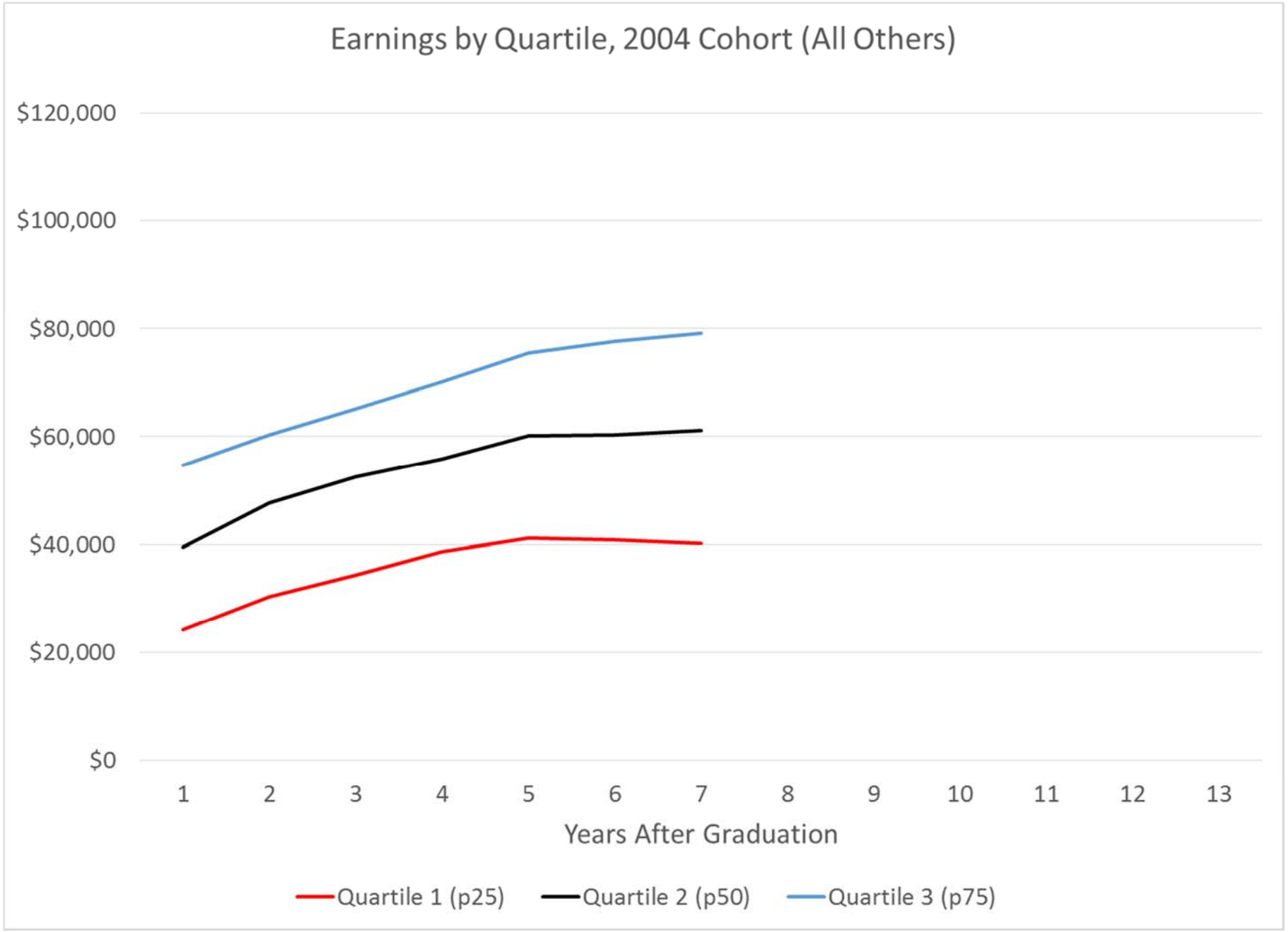
Earnings by Quartile, 2004 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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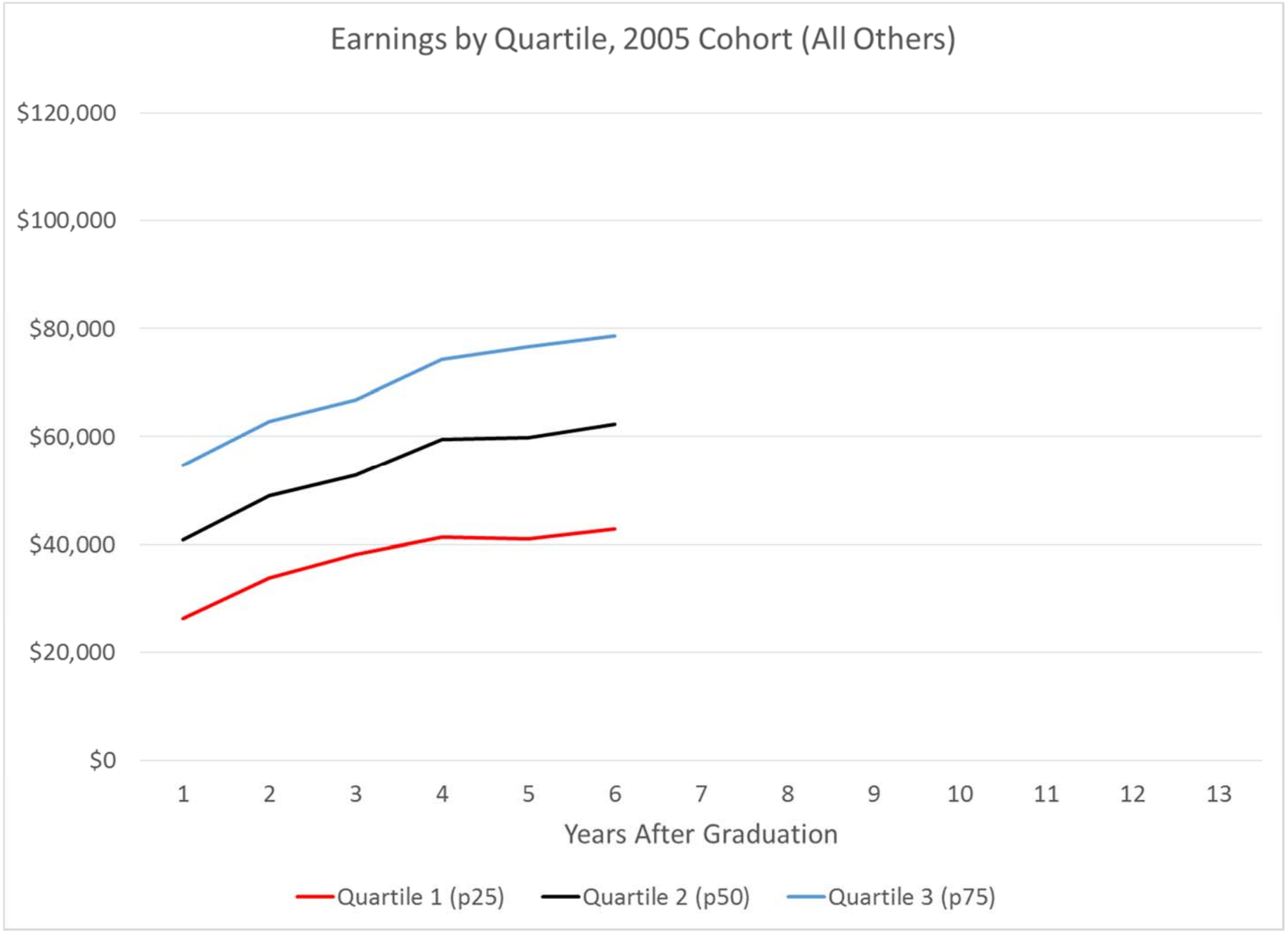
Earnings by Quartile, 2005 Cohort (All Others)
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Years After Graduation
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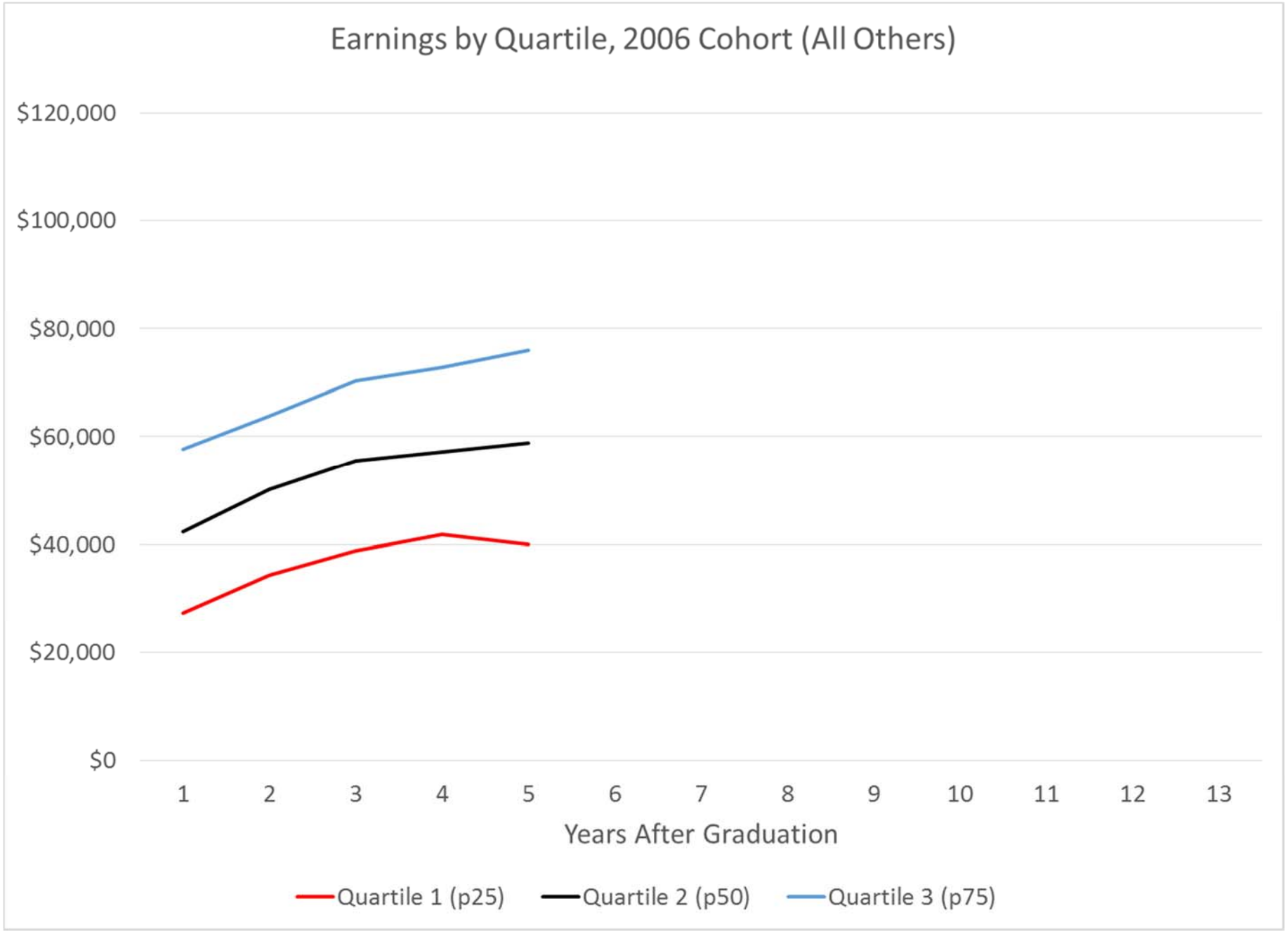
Earnings by Quartile, 2006 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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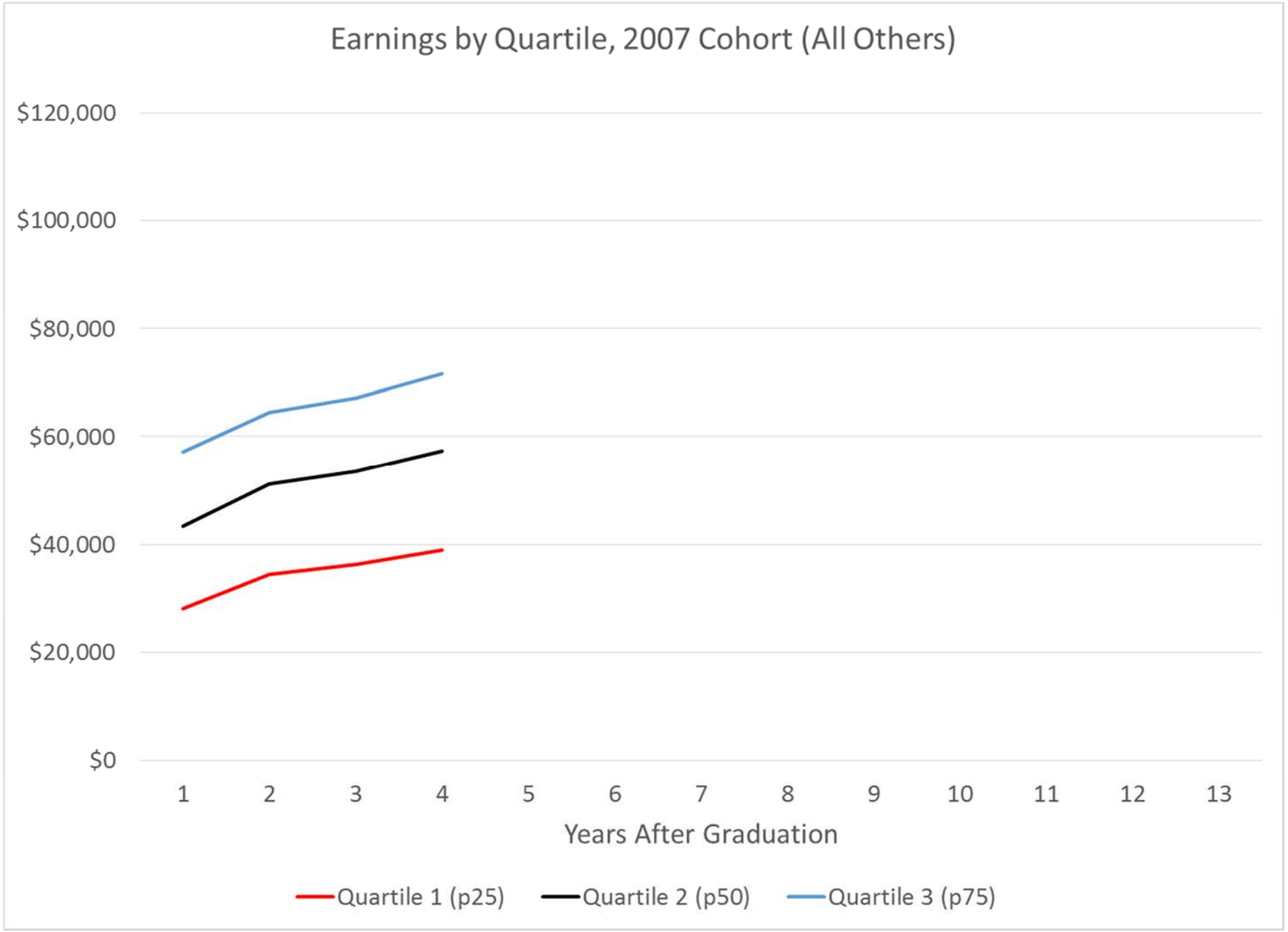
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Years After Graduation
Quartile 1 (p25)
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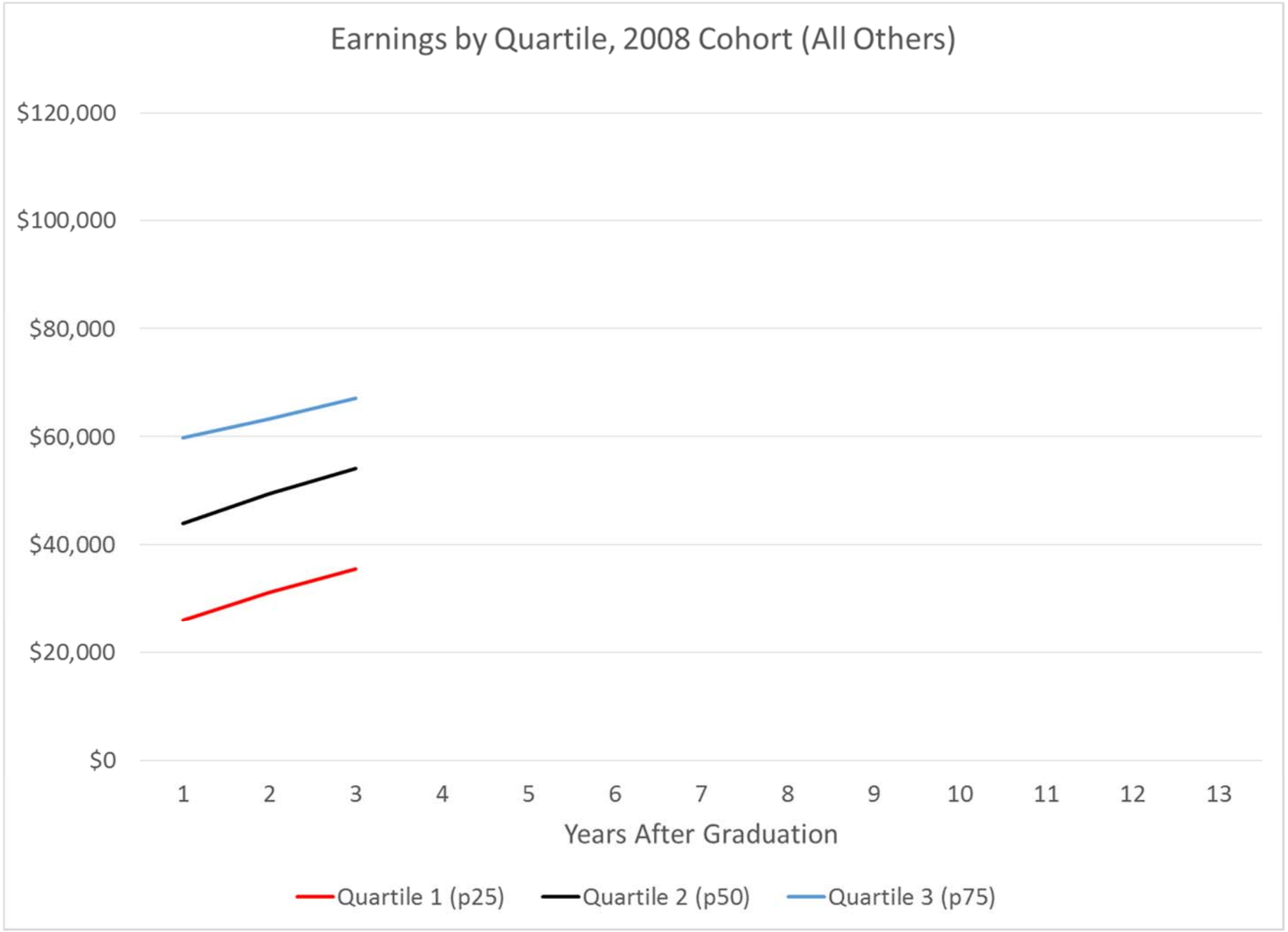
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Years After Graduation
Quartile 1 (p25)
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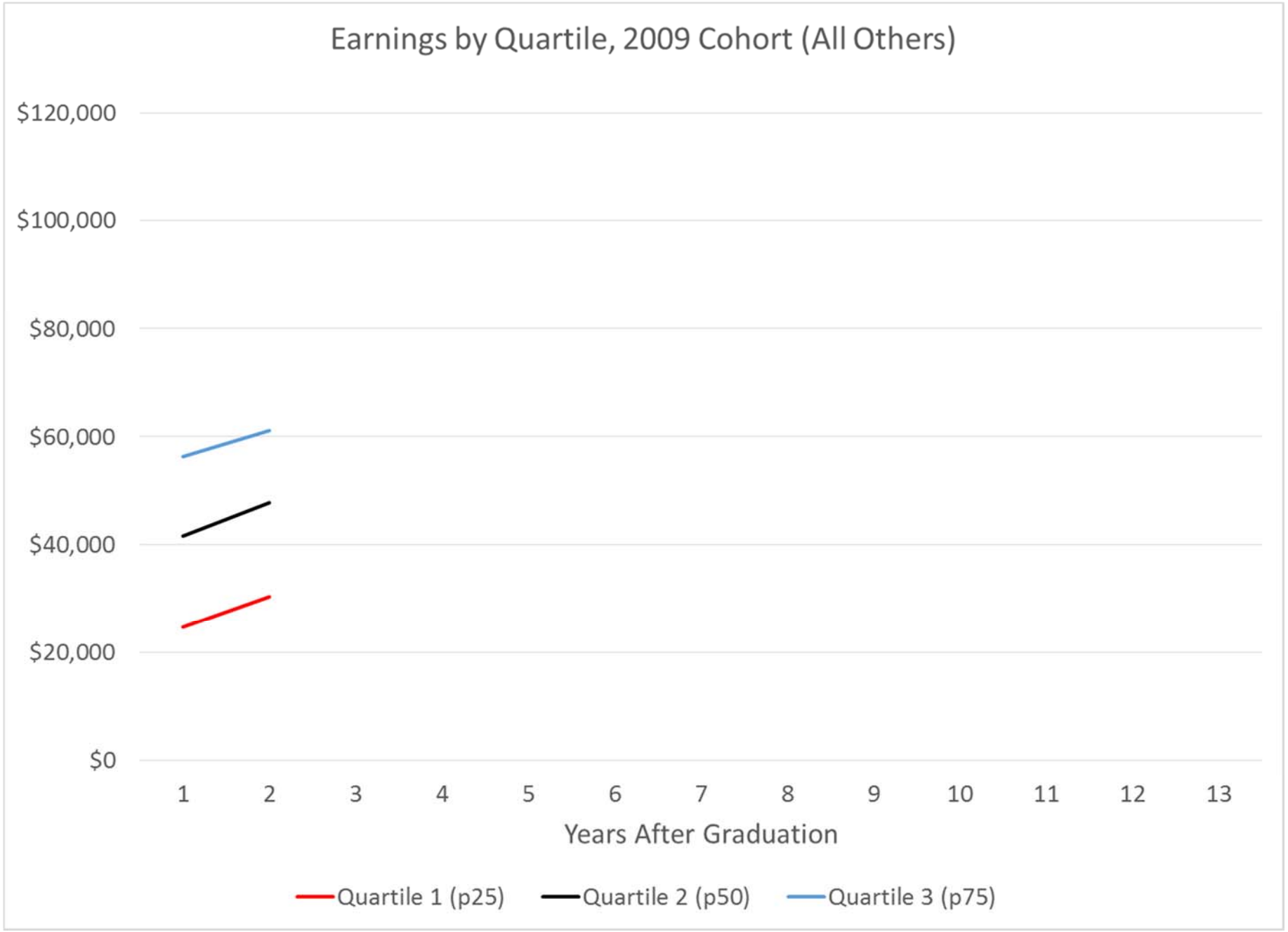
Earnings by Quartile, 2009 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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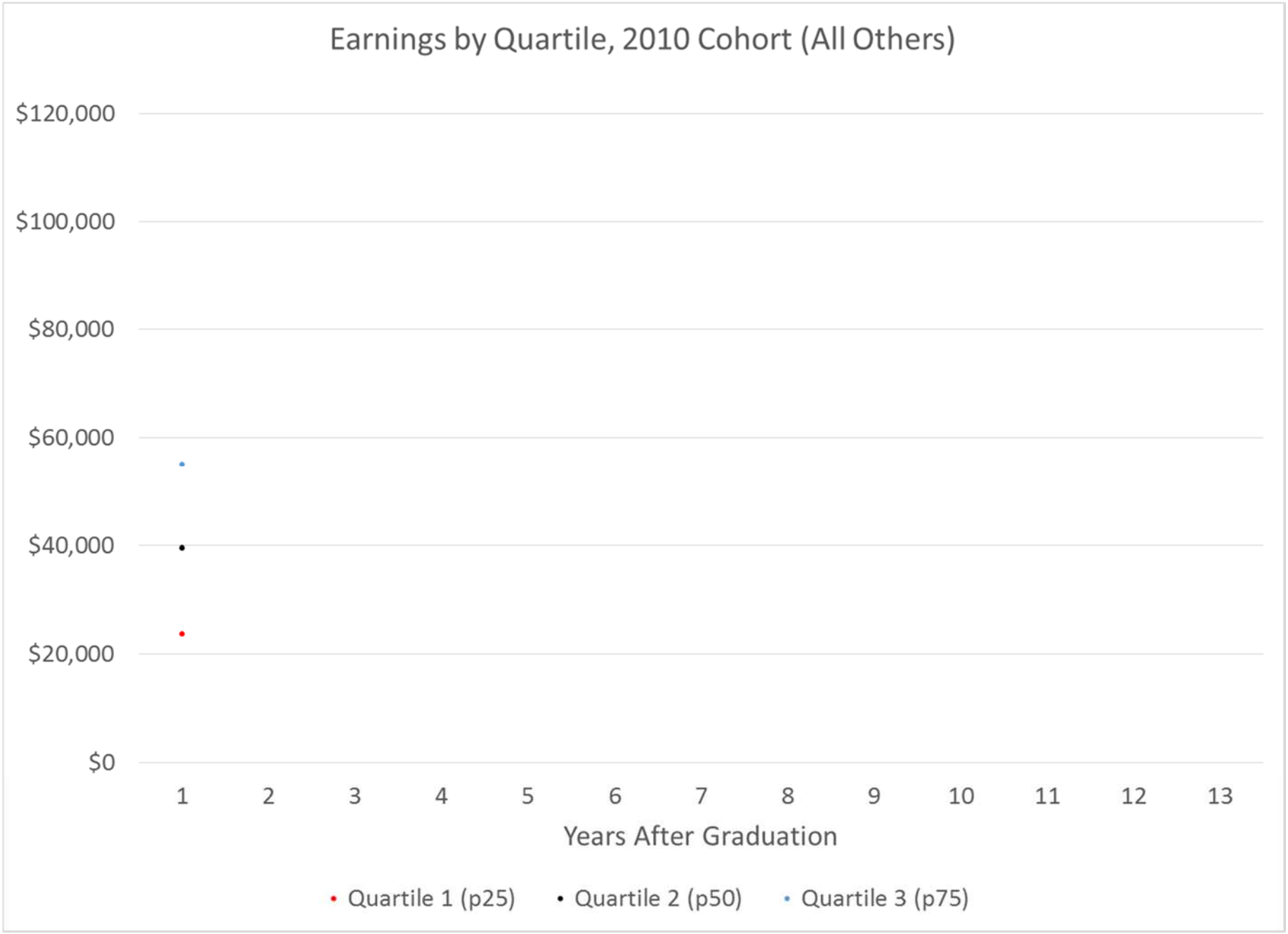
Earnings by Quartile, 2010 Cohort (All Others)
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Years After Graduation
Quartile 1 (p25)
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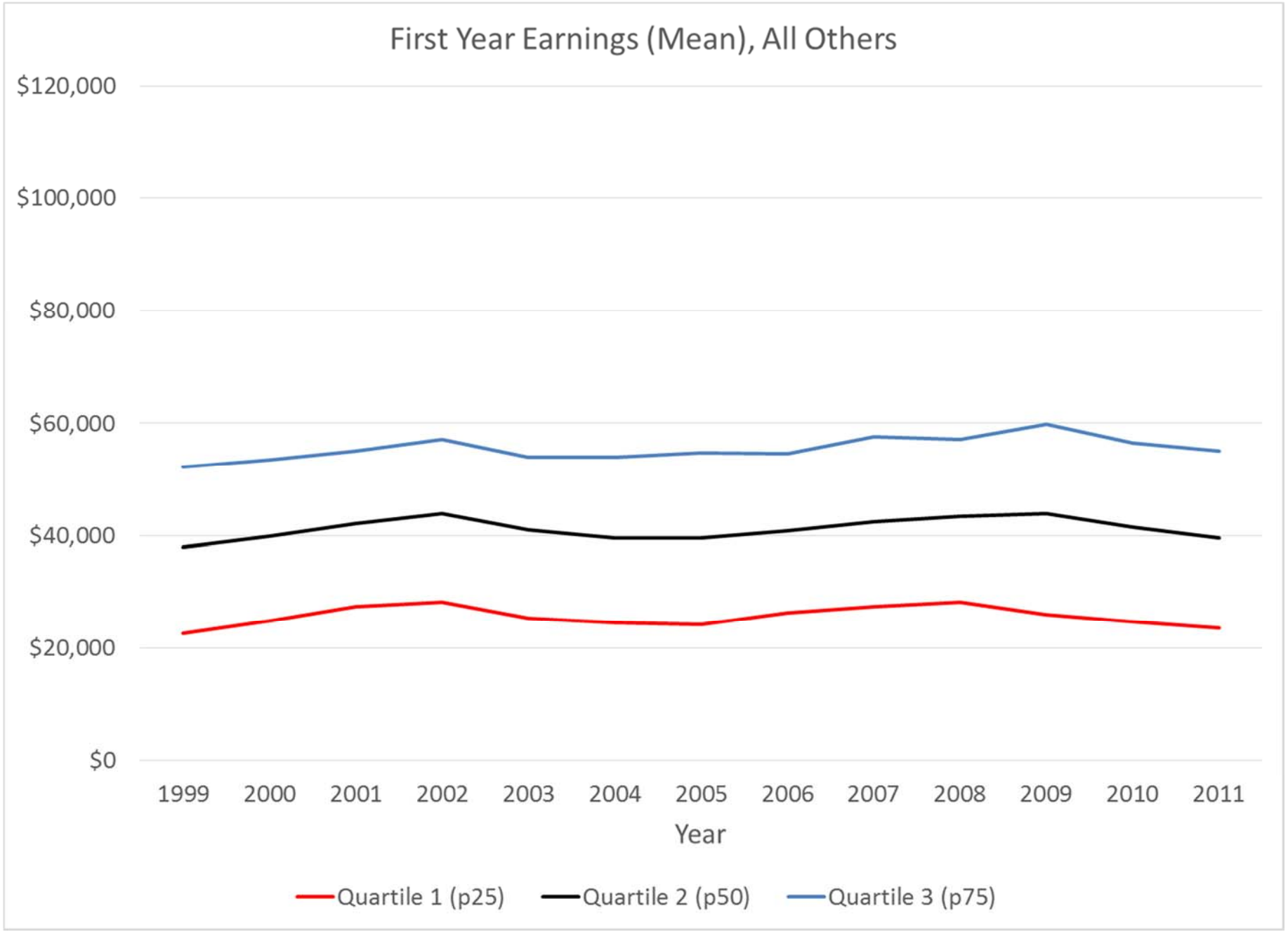
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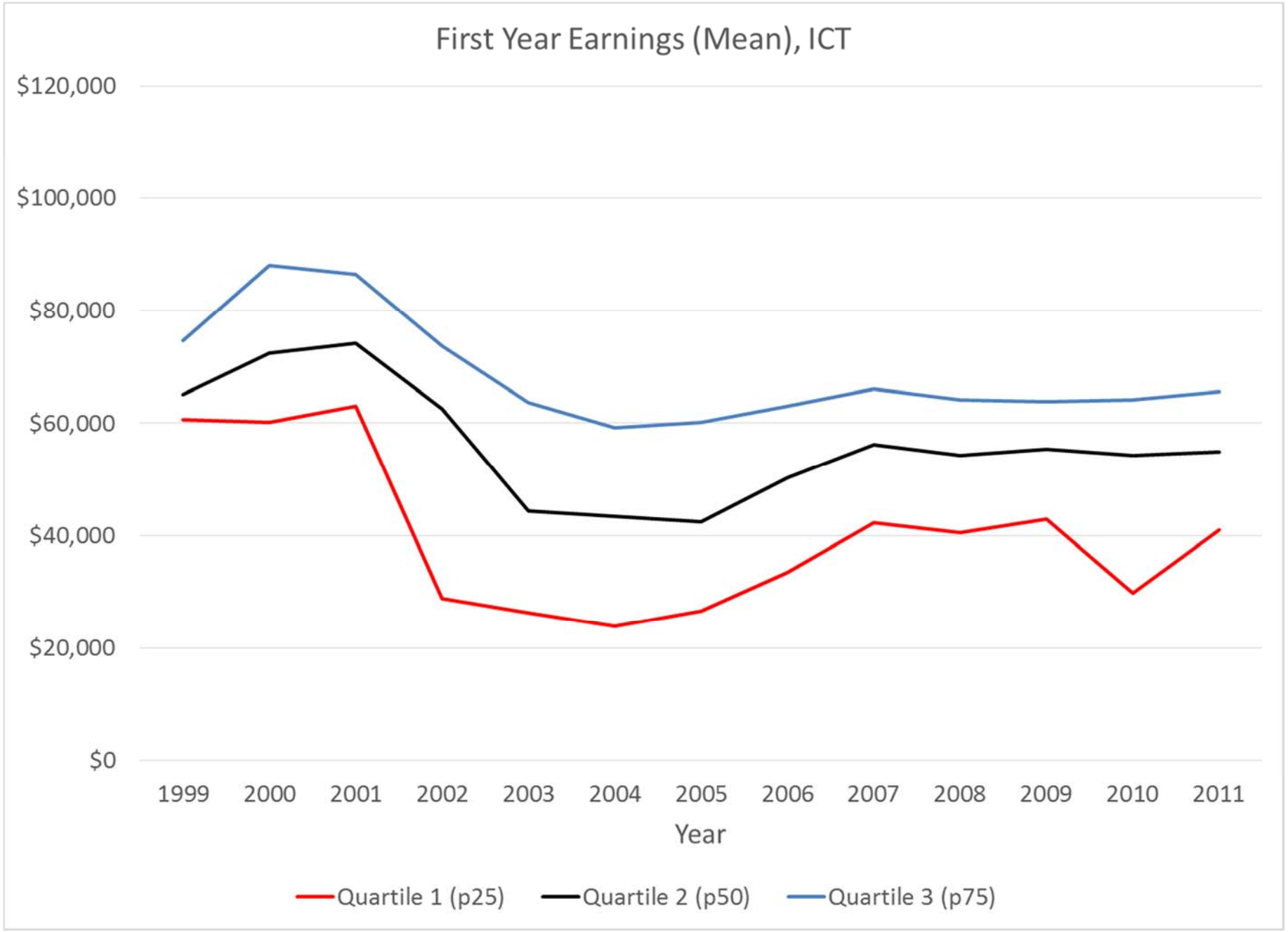
Quartile 2 (p50)
Quartile 3 (p75)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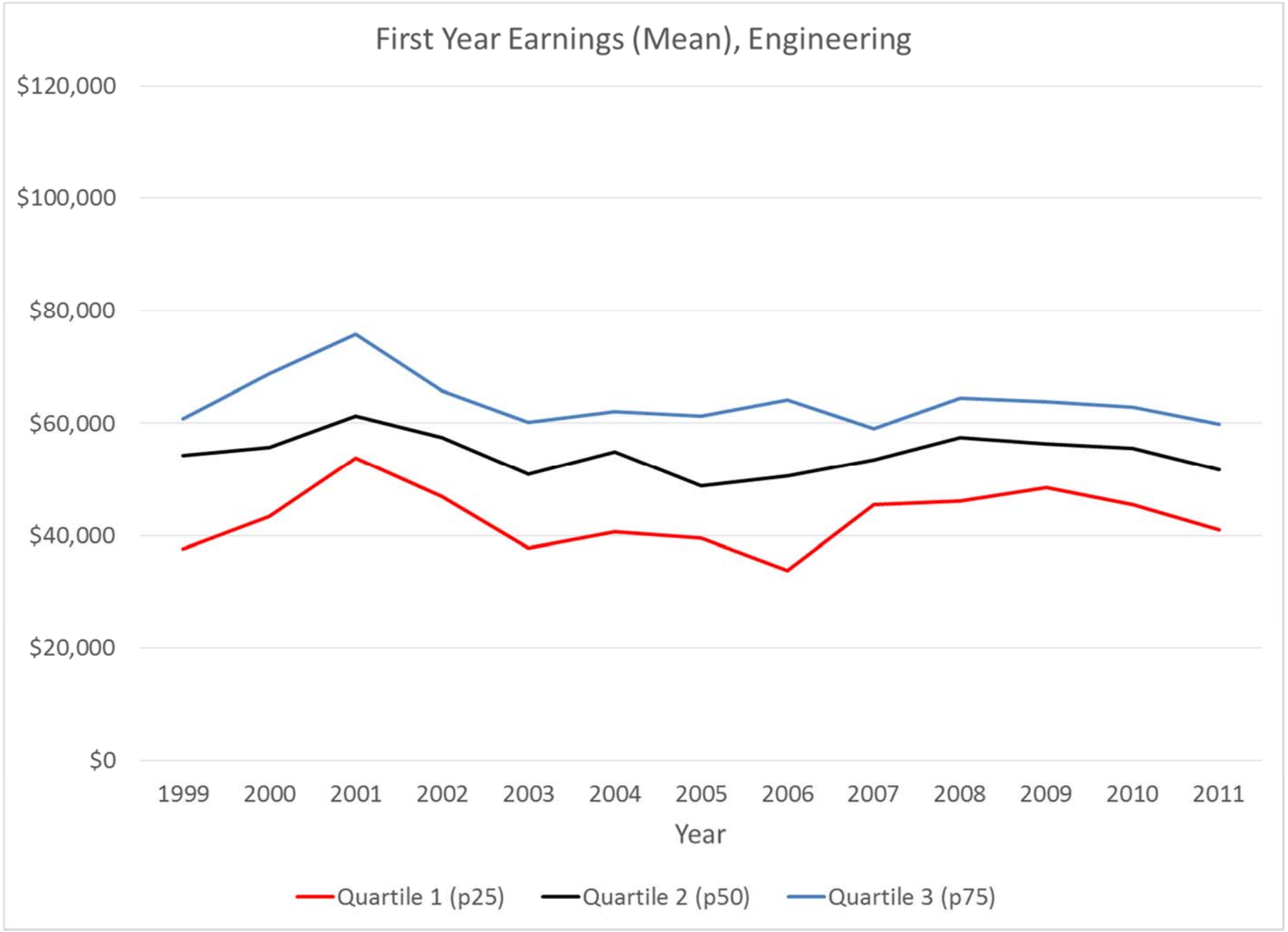
First Year Earnings (Mean), Engineering
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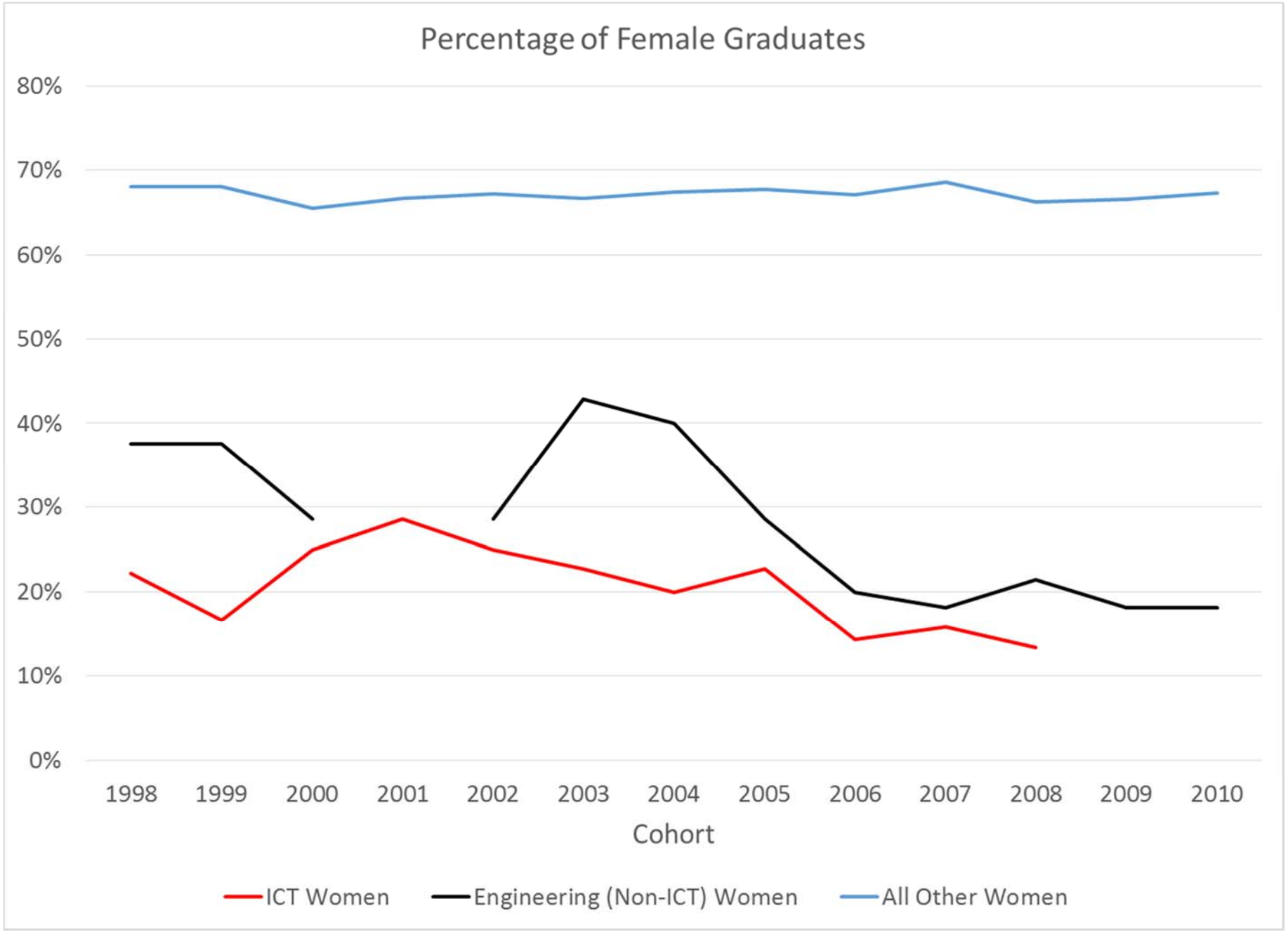
Quartile 2 (p50)
Quartile 3 (p75)


Percentage of Female Graduates
80%
70%
60%
50%
40%
30%
20%
10%
0%
1998
1999
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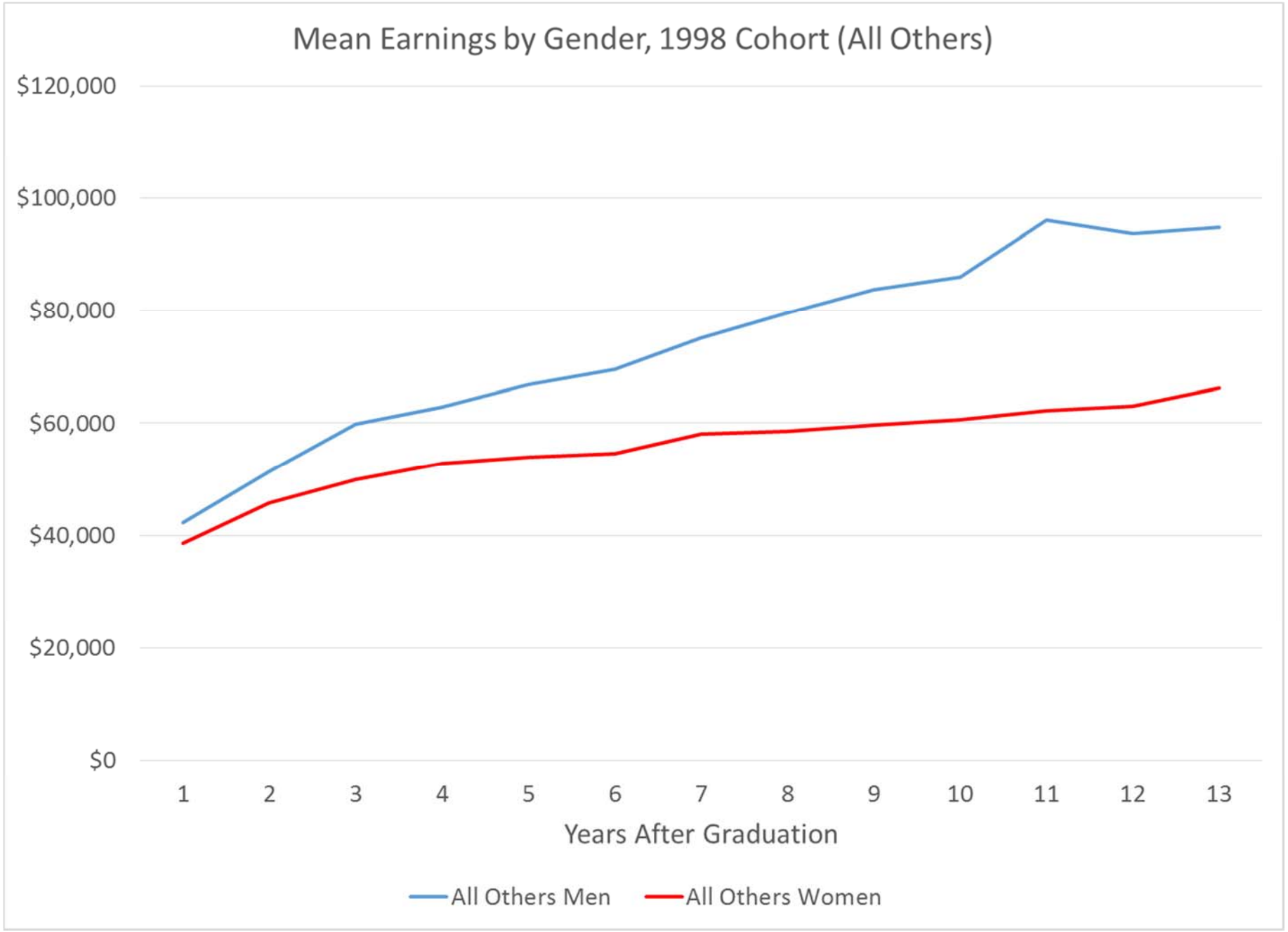
2002
2003
2004
2005
2006
2007
2008
2009
2010
Cohort
ICT Women
Engineering (Non-ICT) Women
All Other Women


Mean Earnings by Gender, 1998 Cohort (All Others)
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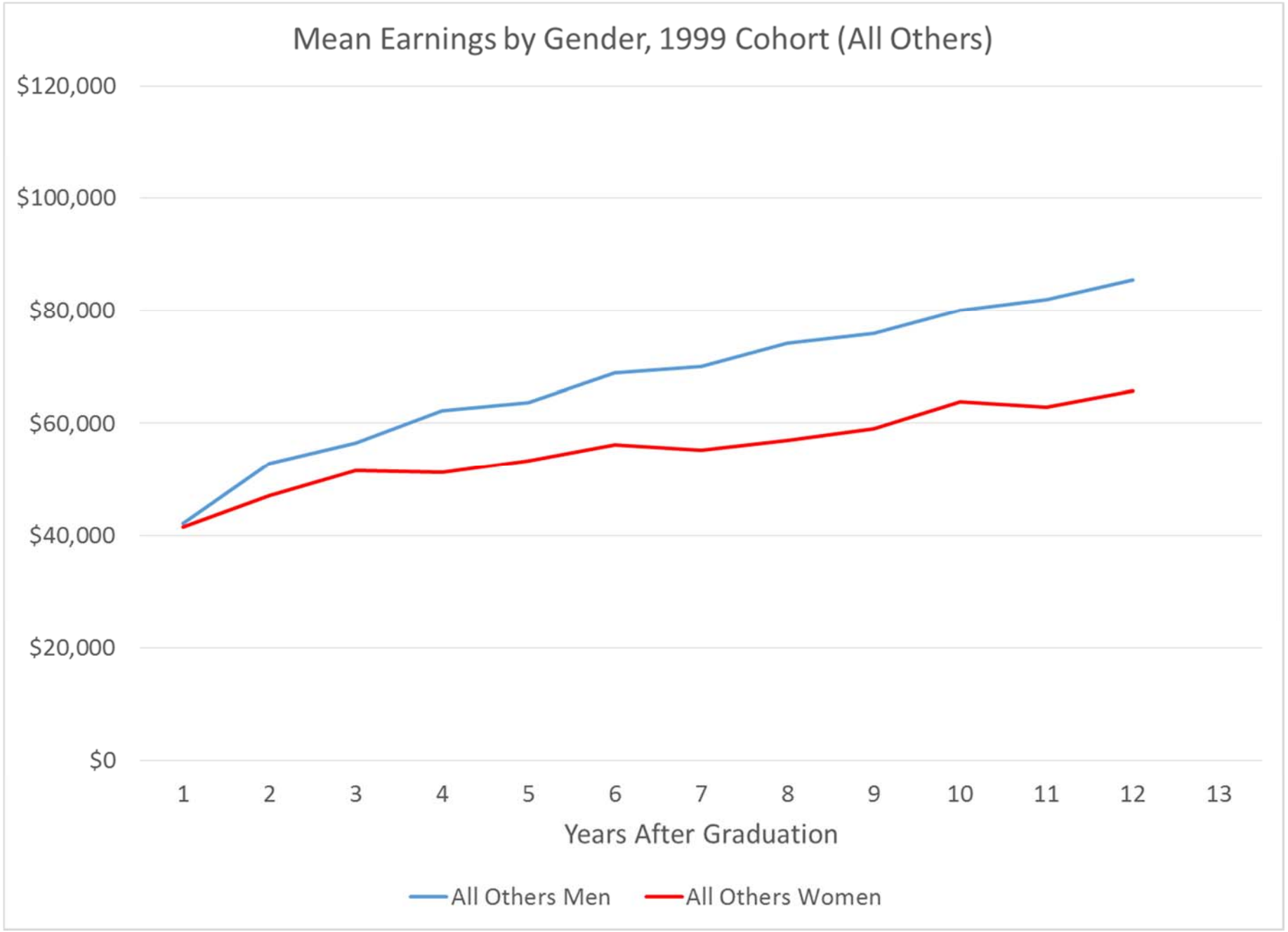
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 1999 Cohort (All Others)
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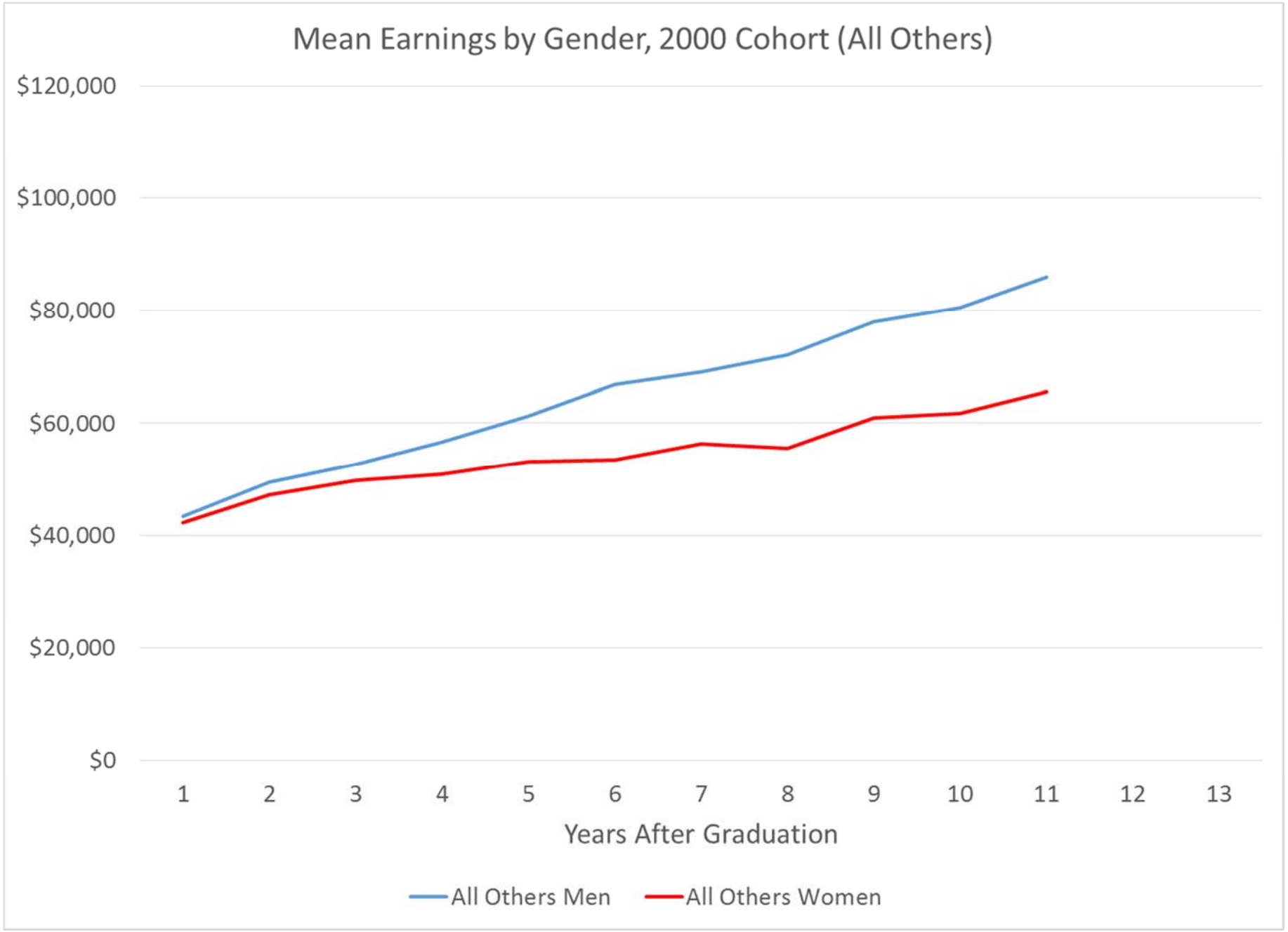
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2000 Cohort (All Others)
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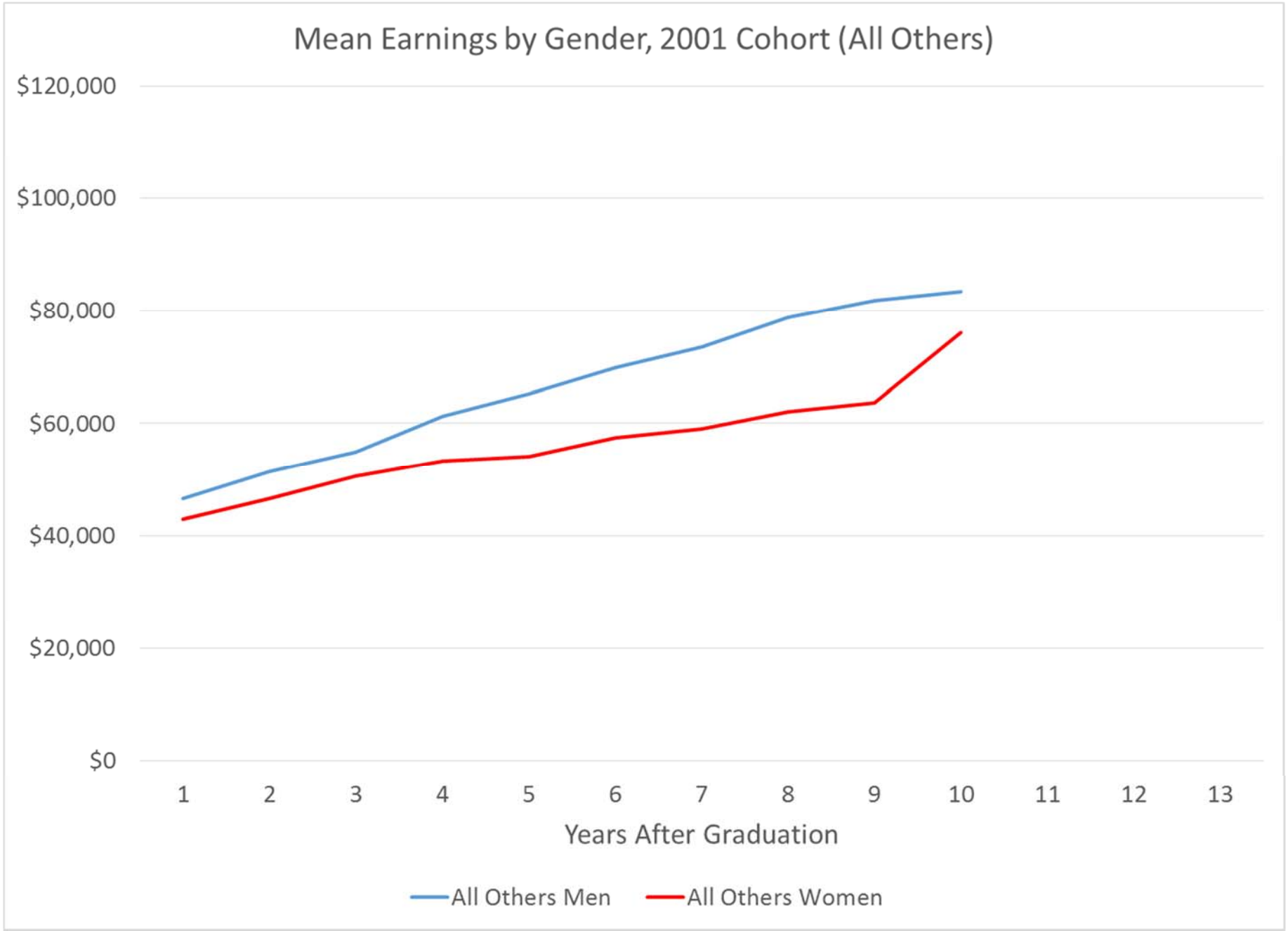
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2001 Cohort (All Others)
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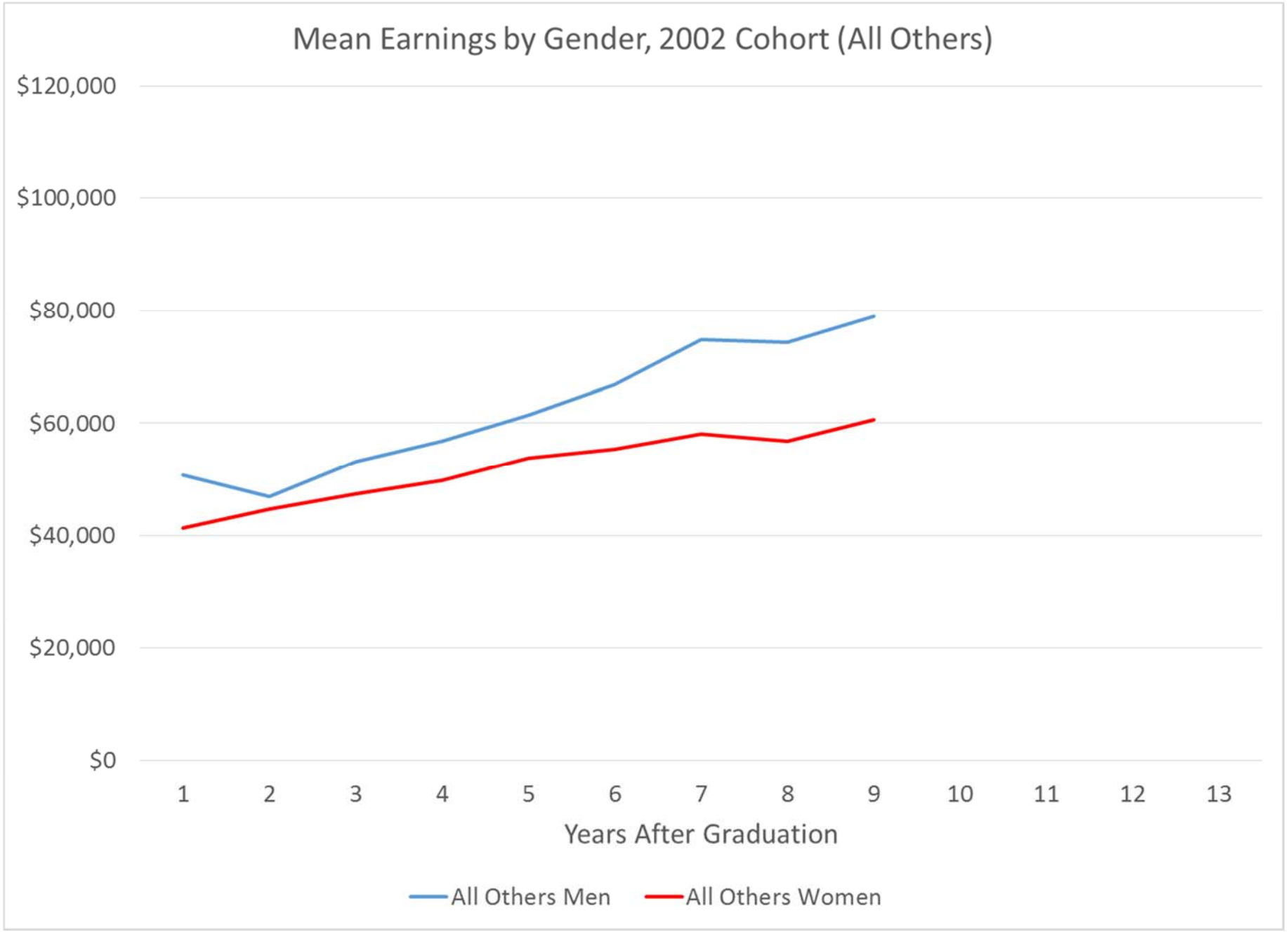
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2002 Cohort (All Others)
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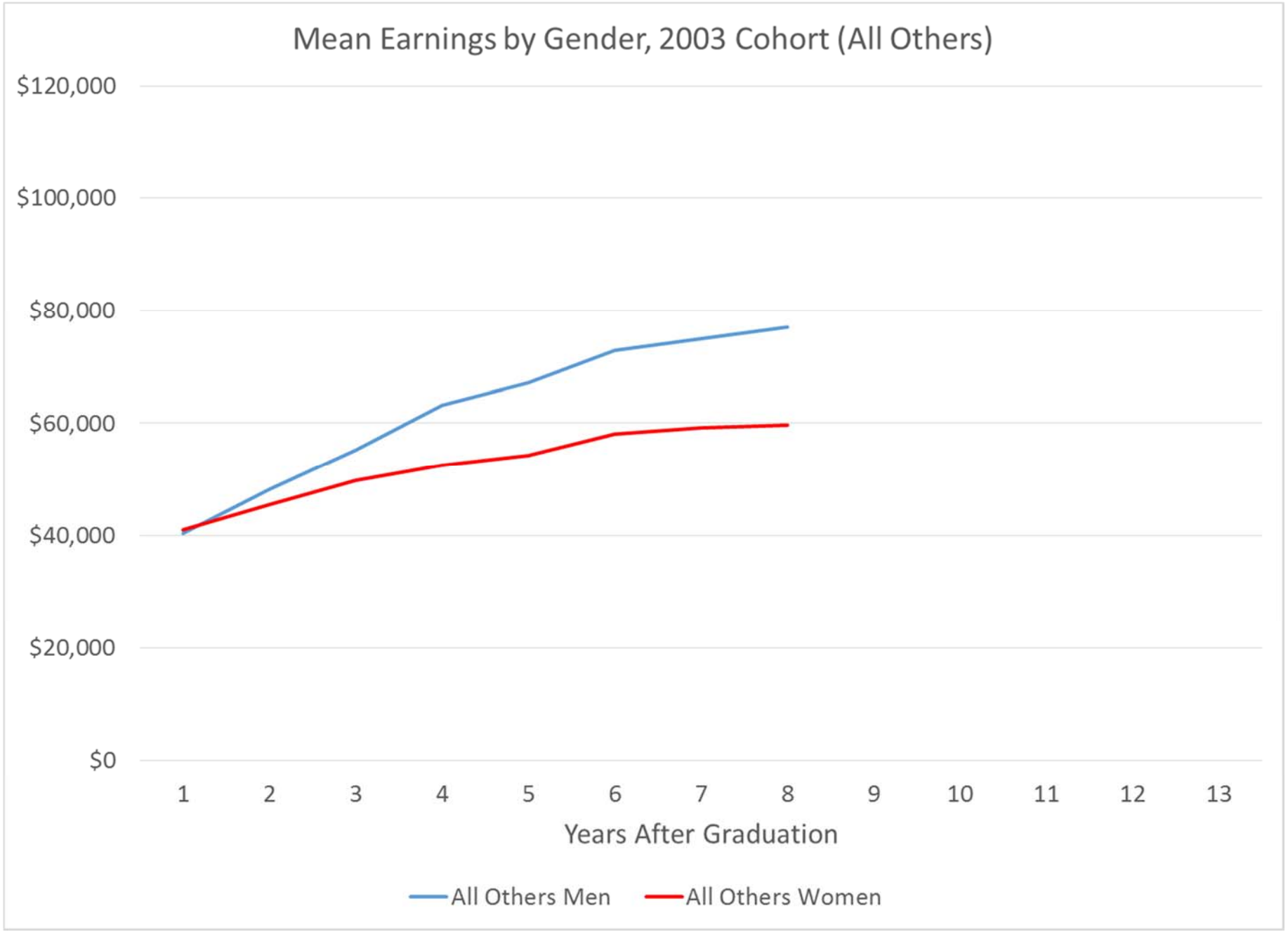
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2003 Cohort (All Others)
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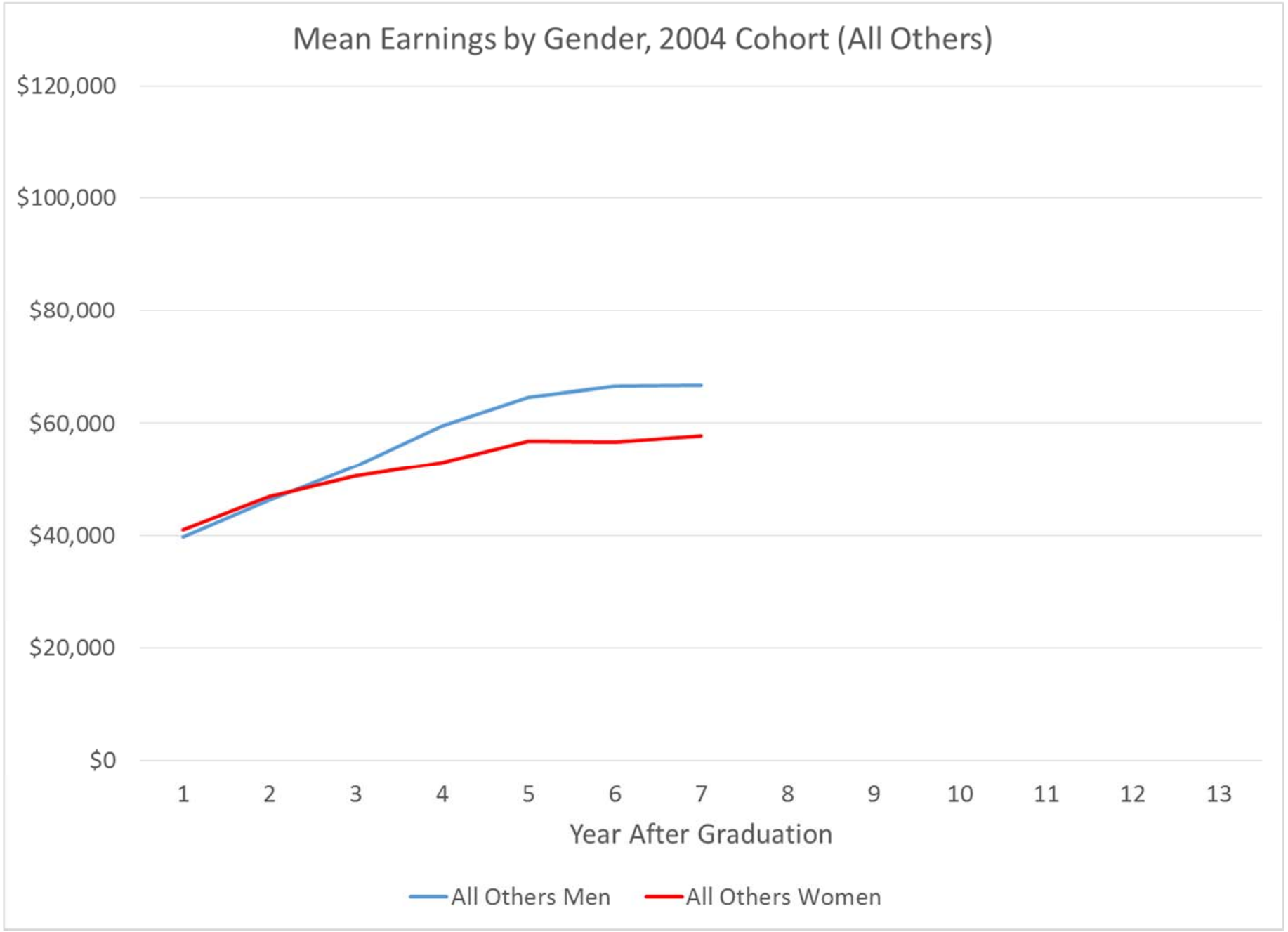
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2004 Cohort (All Others)
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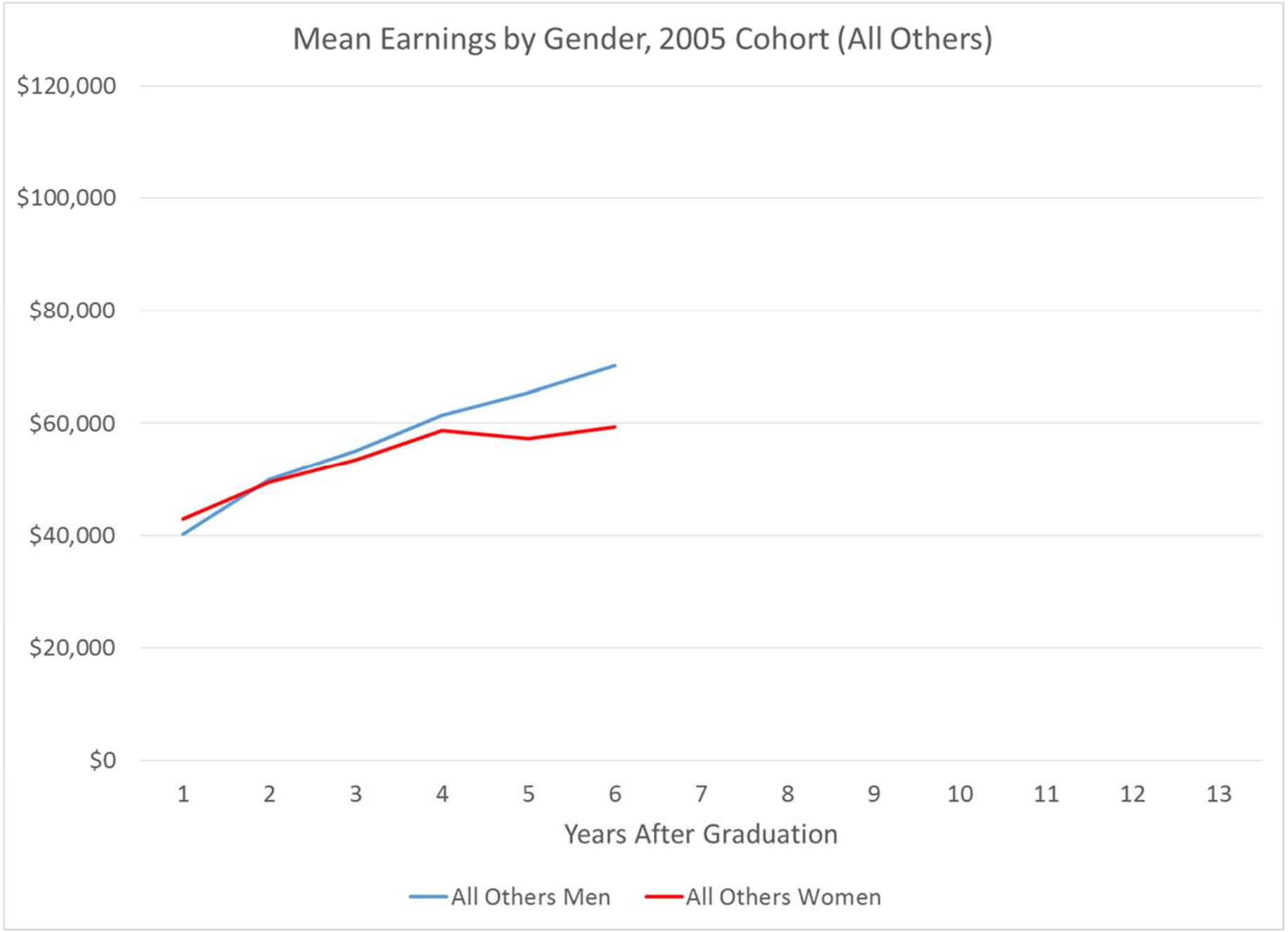
Year After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2005 Cohort (All Others)
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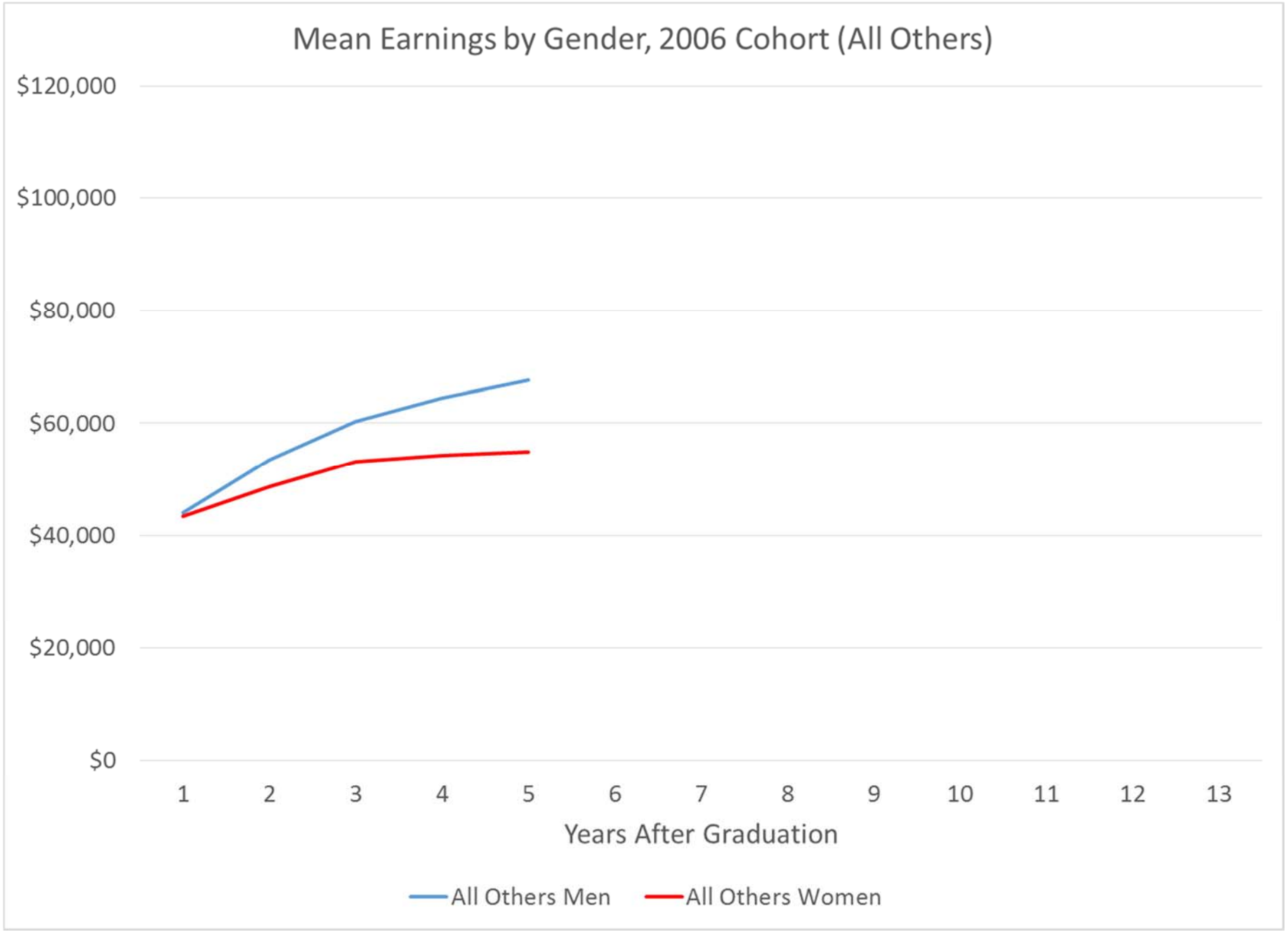
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2006 Cohort (All Others)
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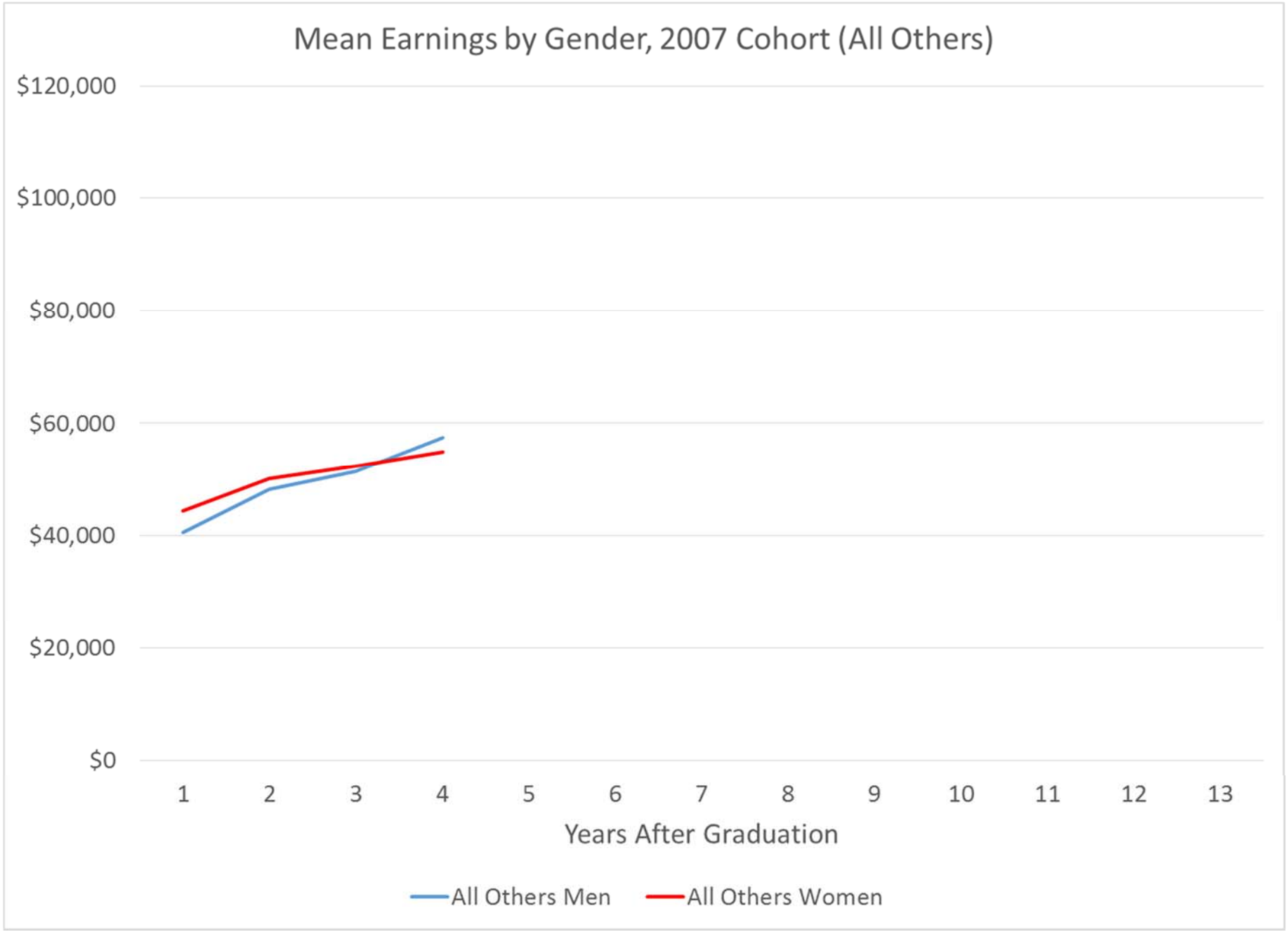
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2007 Cohort (All Others)
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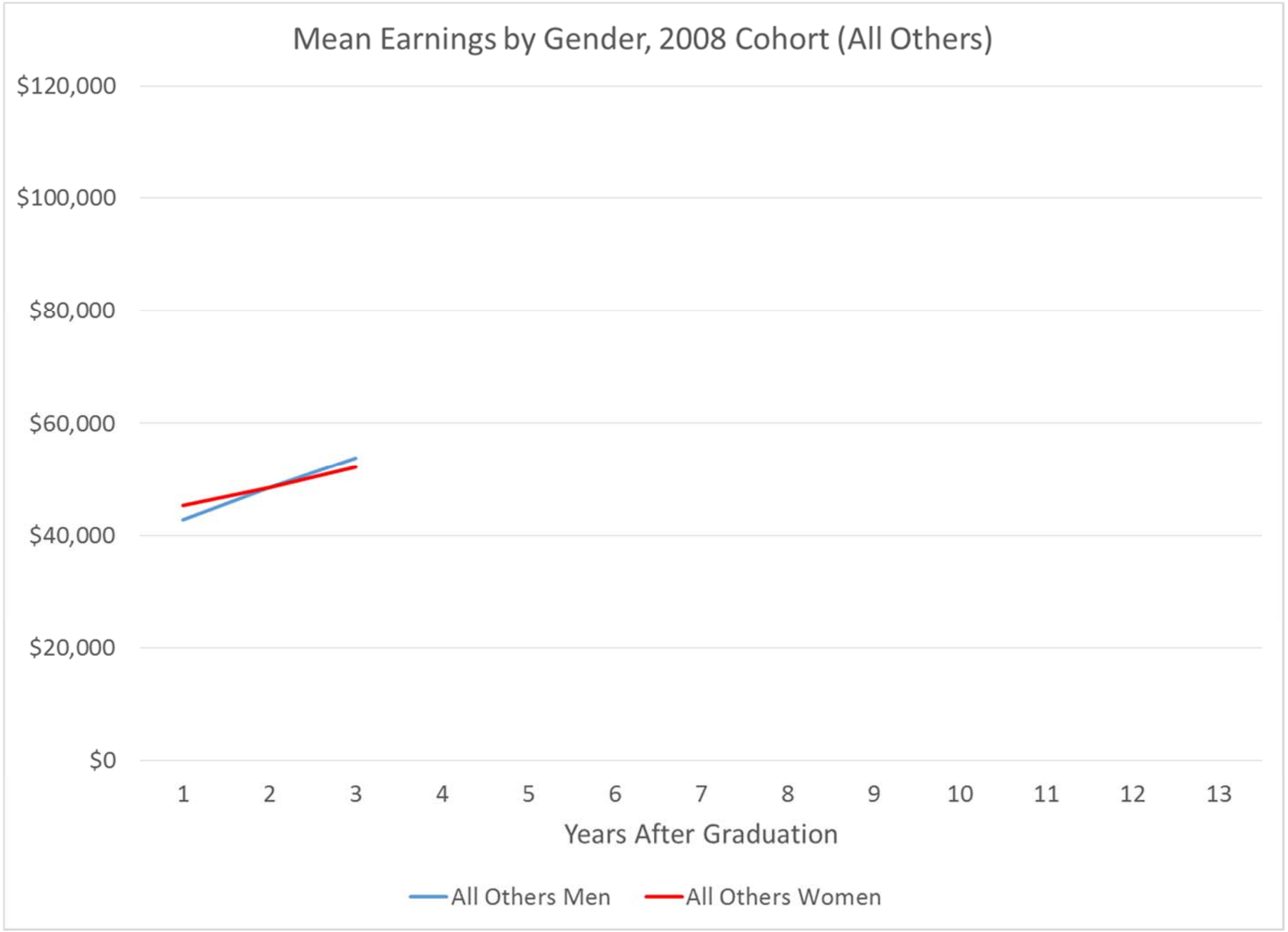
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2008 Cohort (All Others)
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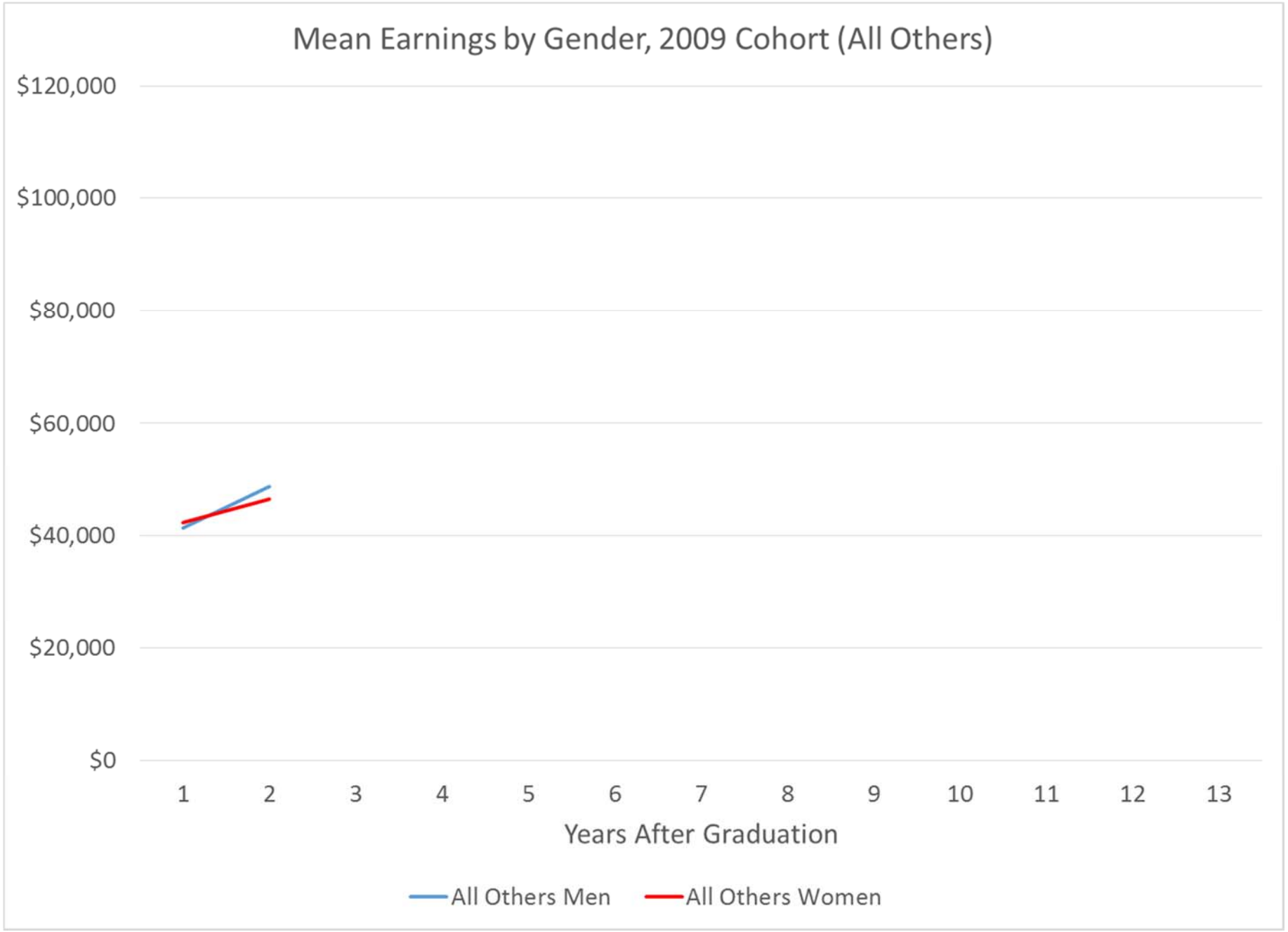
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2009 Cohort (All Others)
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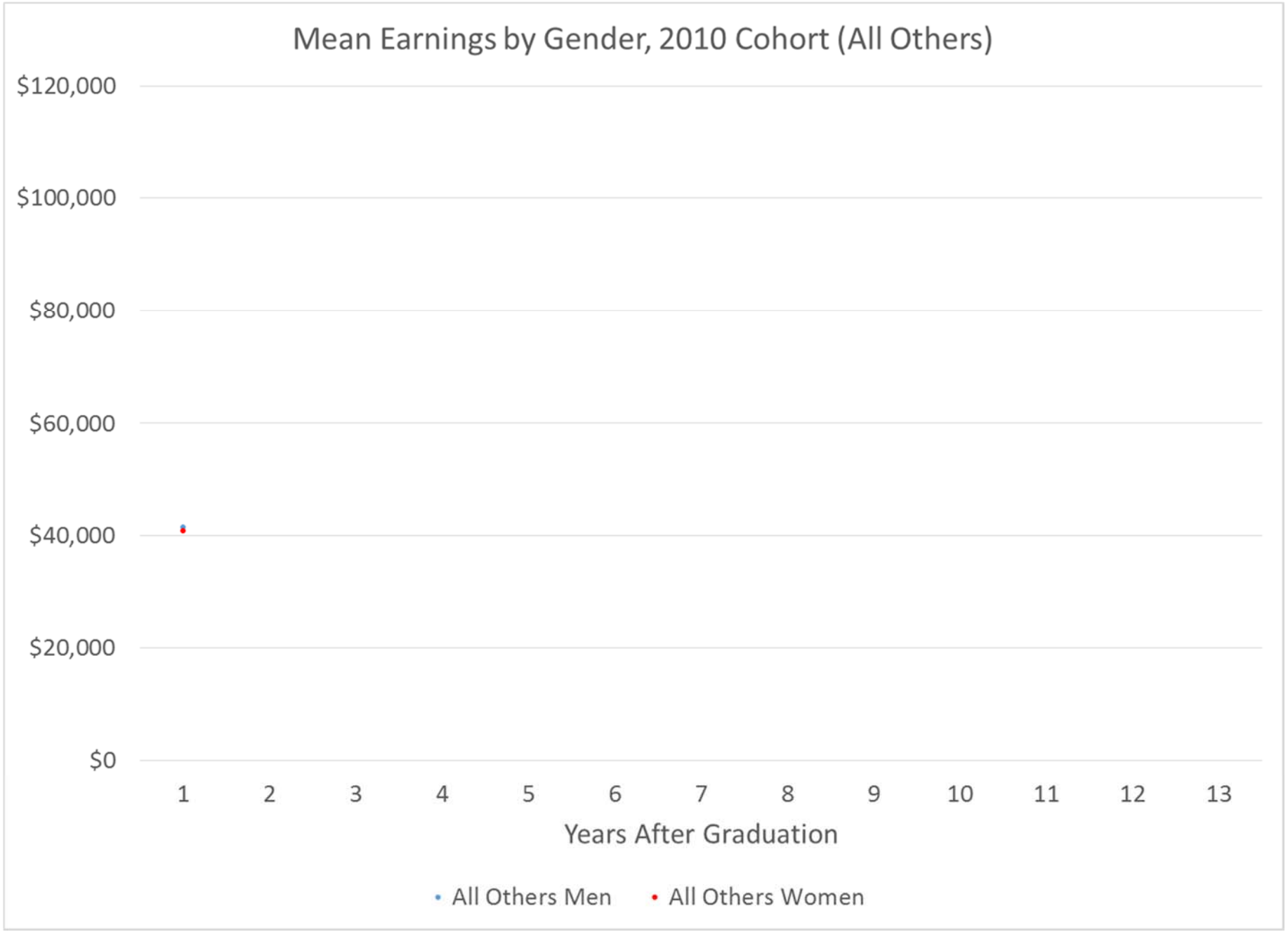
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 2010 Cohort (All Others)
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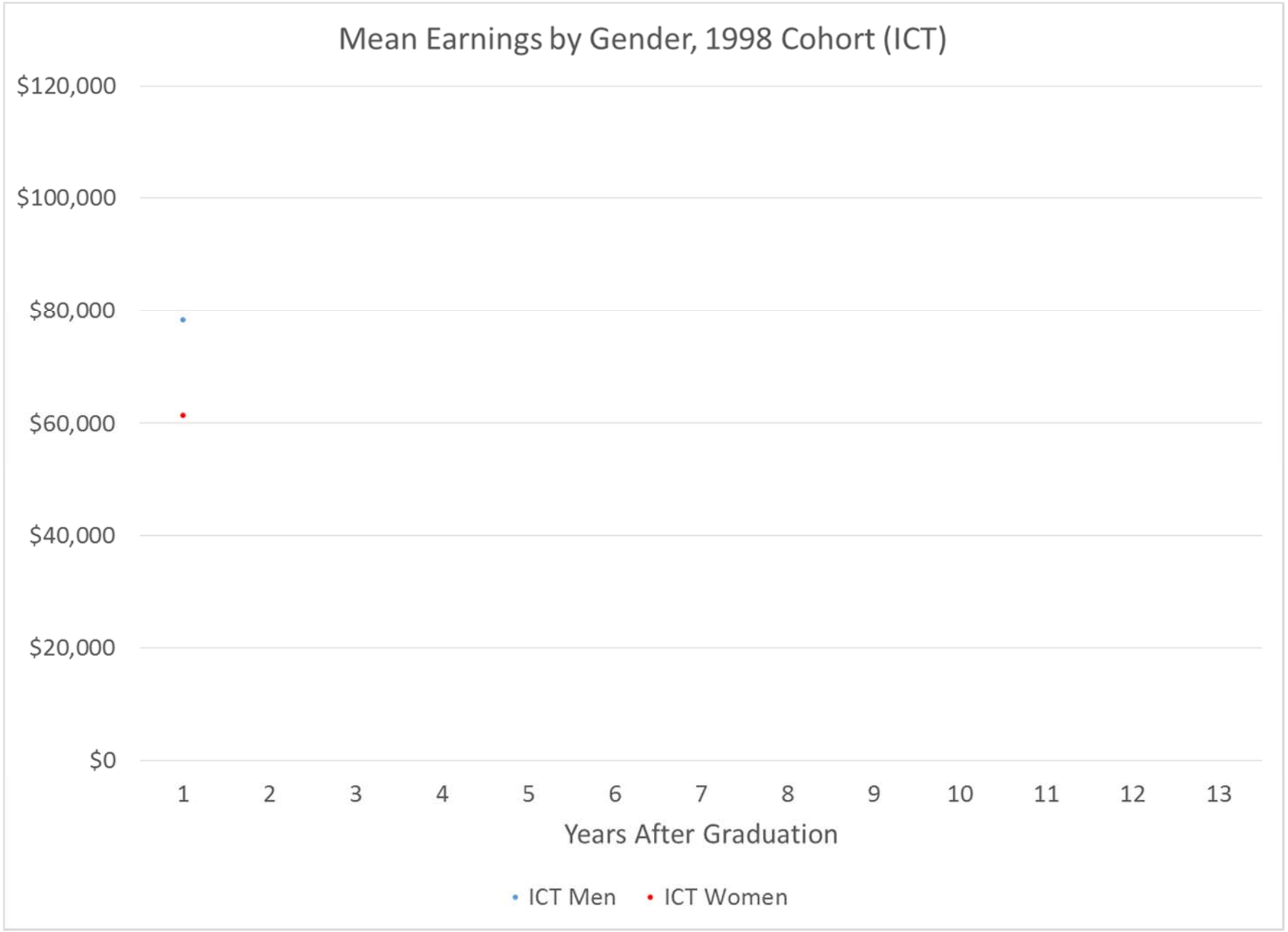
Years After Graduation
All Others Men
All Others Women


Mean Earnings by Gender, 1998 Cohort (ICT)
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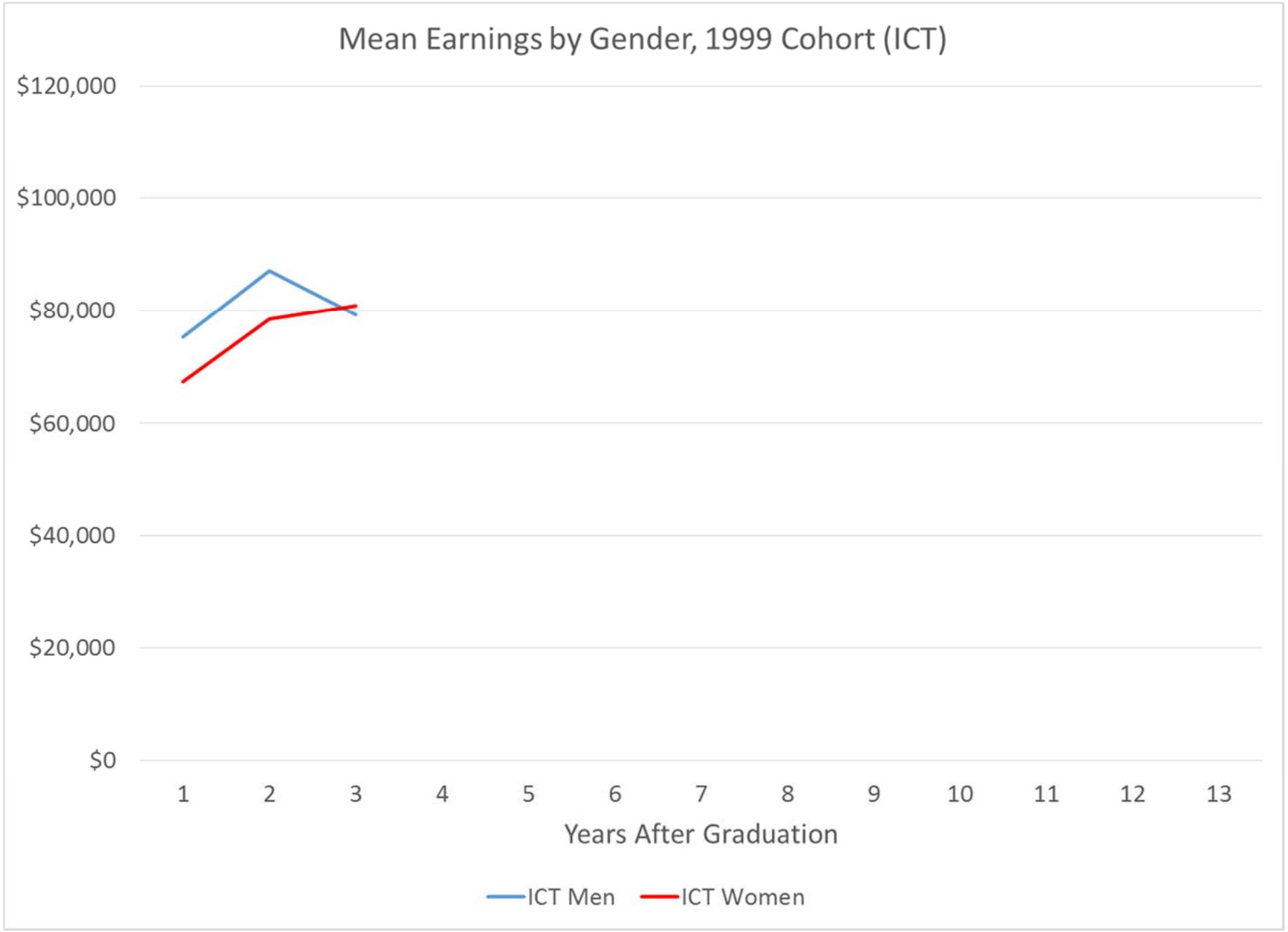
Years After Graduation
ICT Men
ICT Women


Mean Earnings by Gender, 1999 Cohort (ICT)
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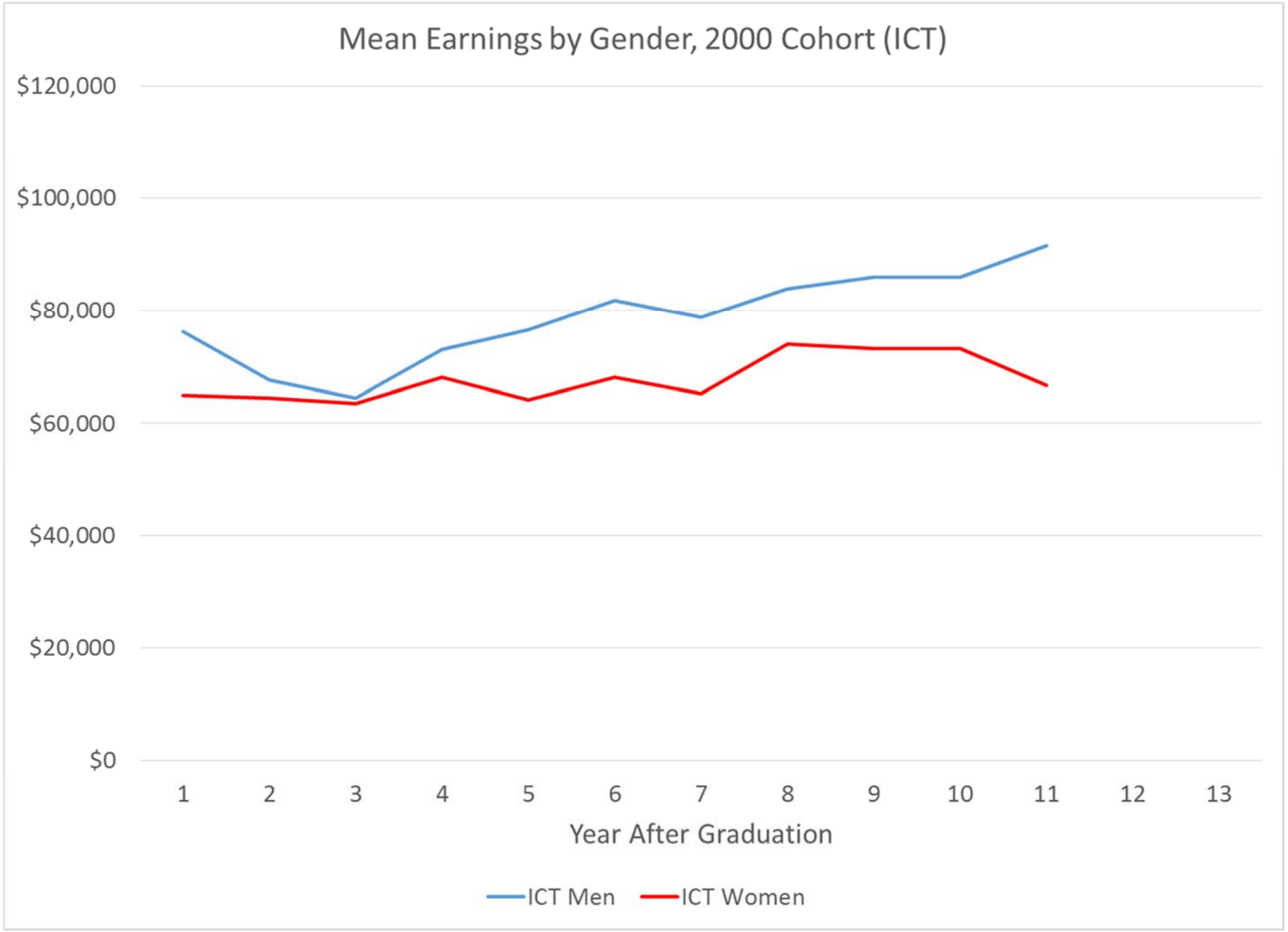
Years After Graduation
ICT Men
ICT Women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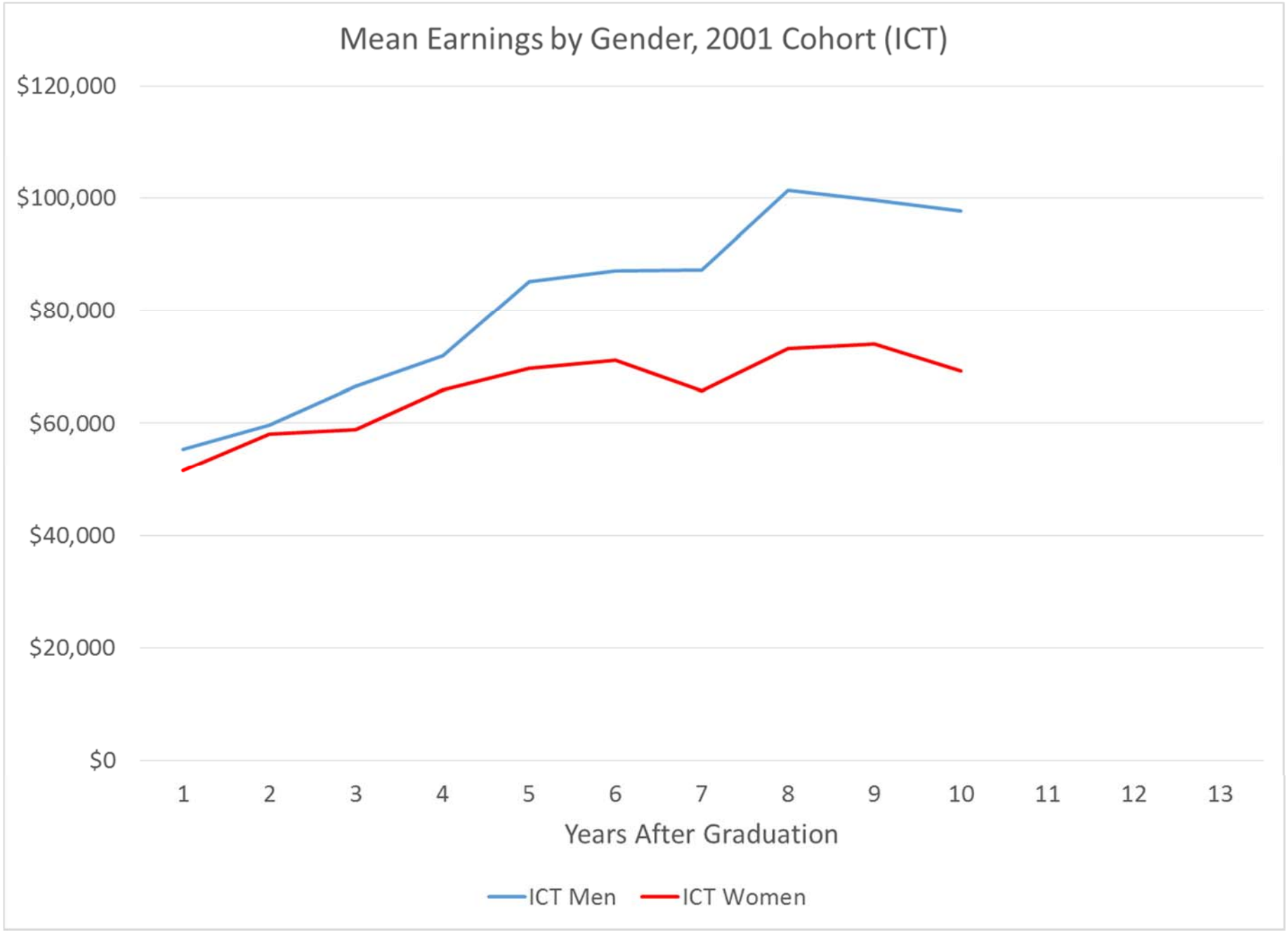
Year After Graduation
ICT Men
ICT Women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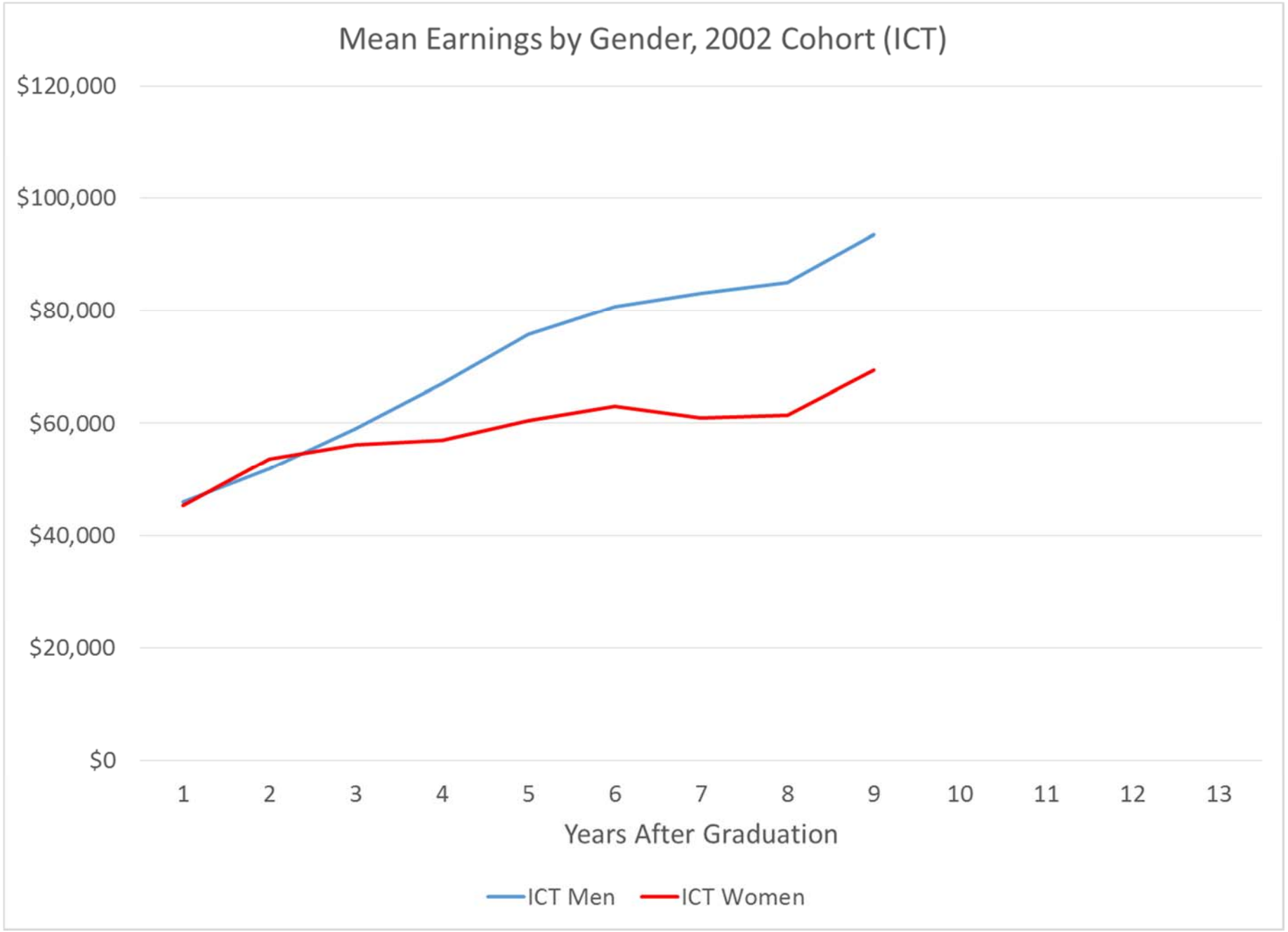
Years After Graduation
ICT Men
ICT Women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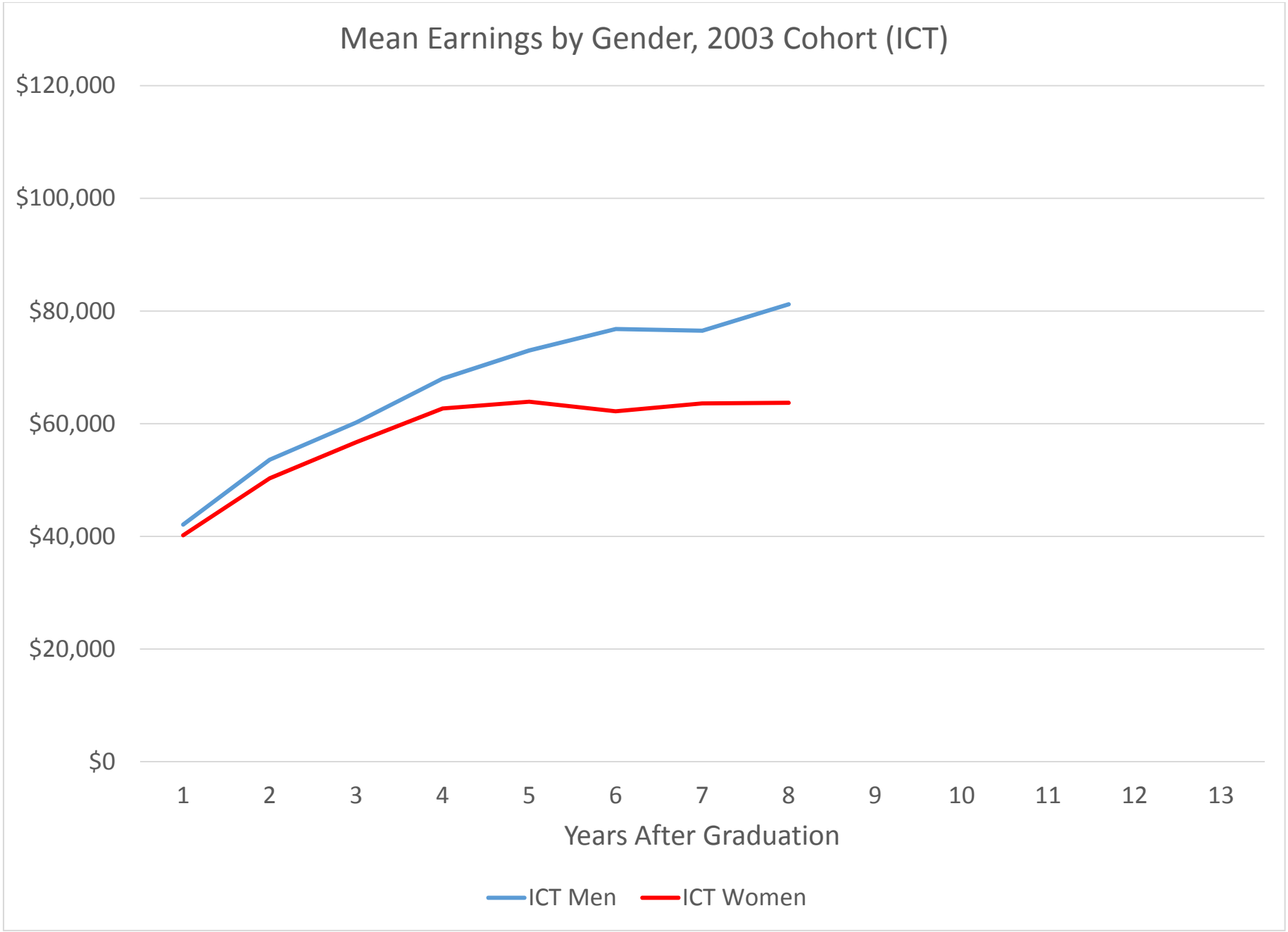
Years After Graduation
ICT Men
ICT Women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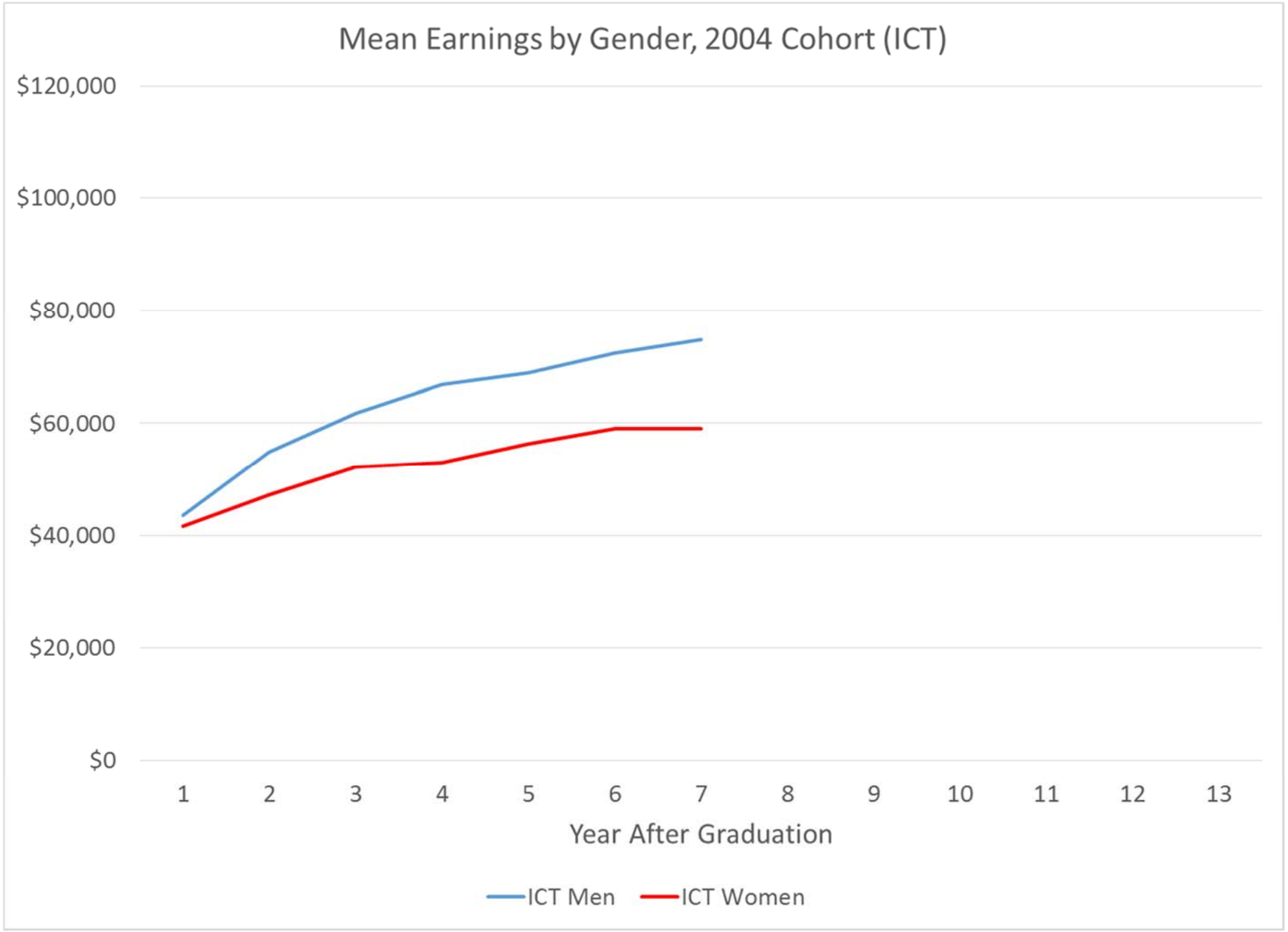
Years After Graduation
ICT Men
ICT Women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Year After Graduation
ICT Men
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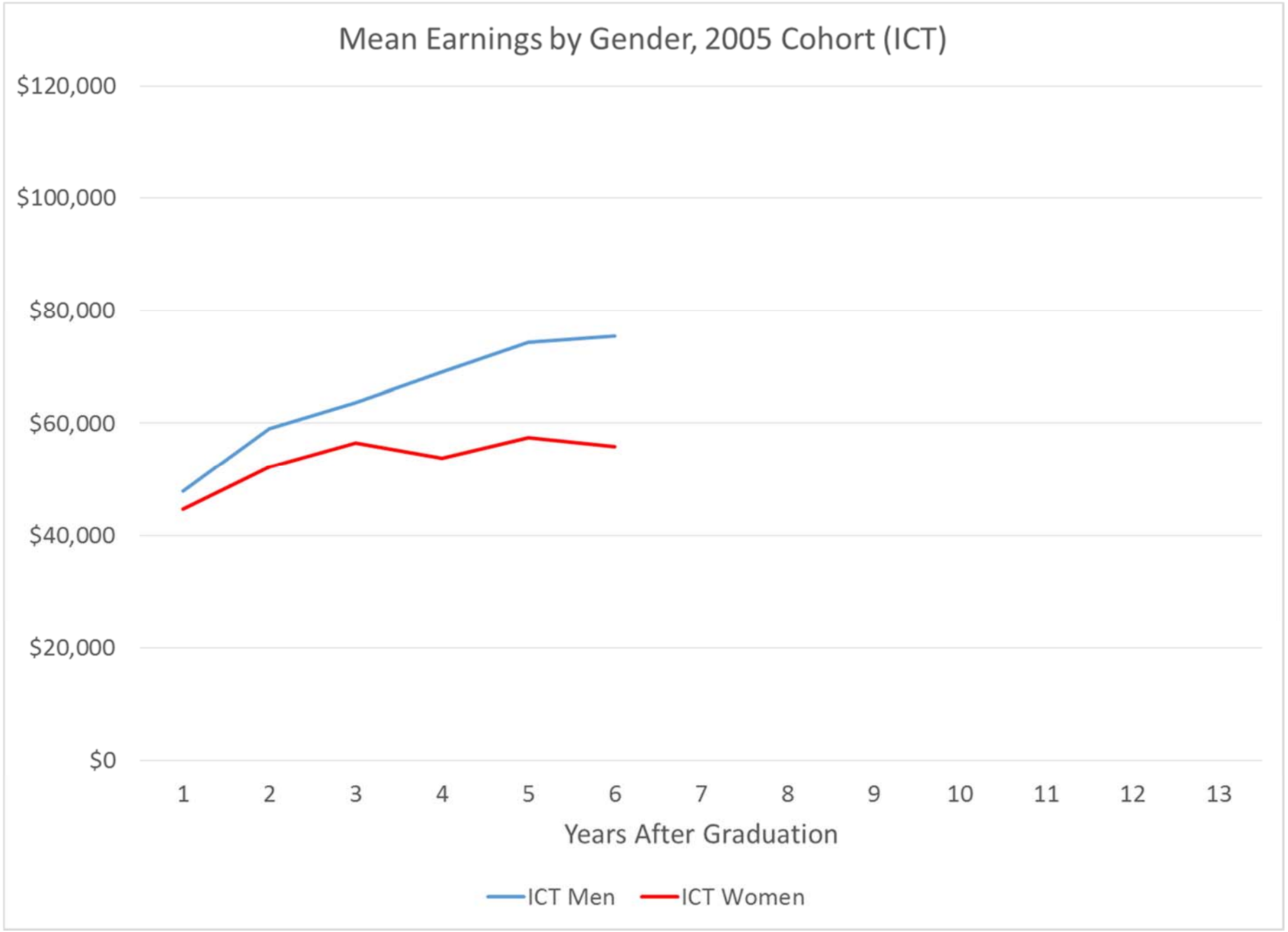
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Years After Graduation
ICT Men
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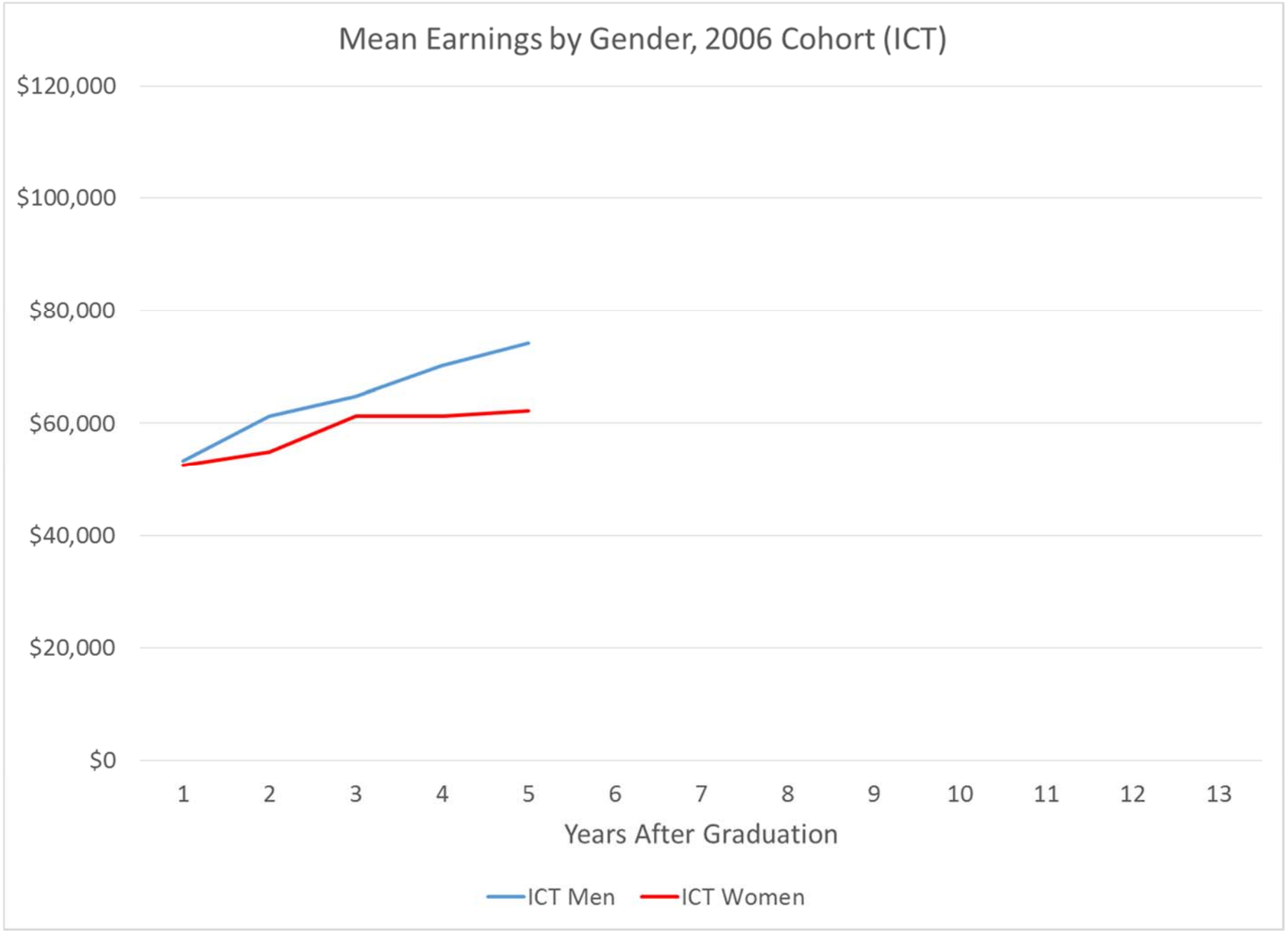
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Years After Graduation
ICT Men
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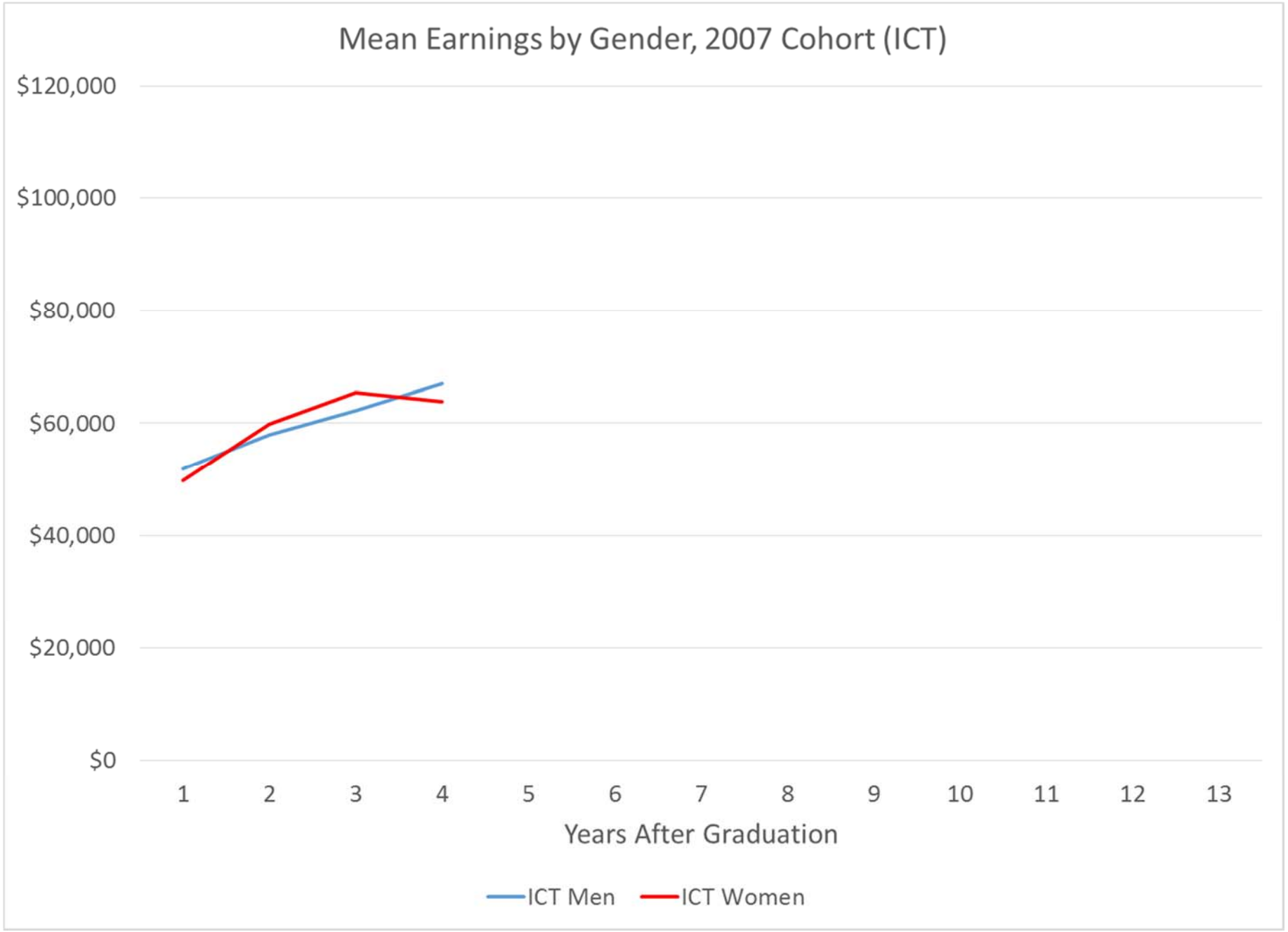
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Years After Graduation
ICT Men
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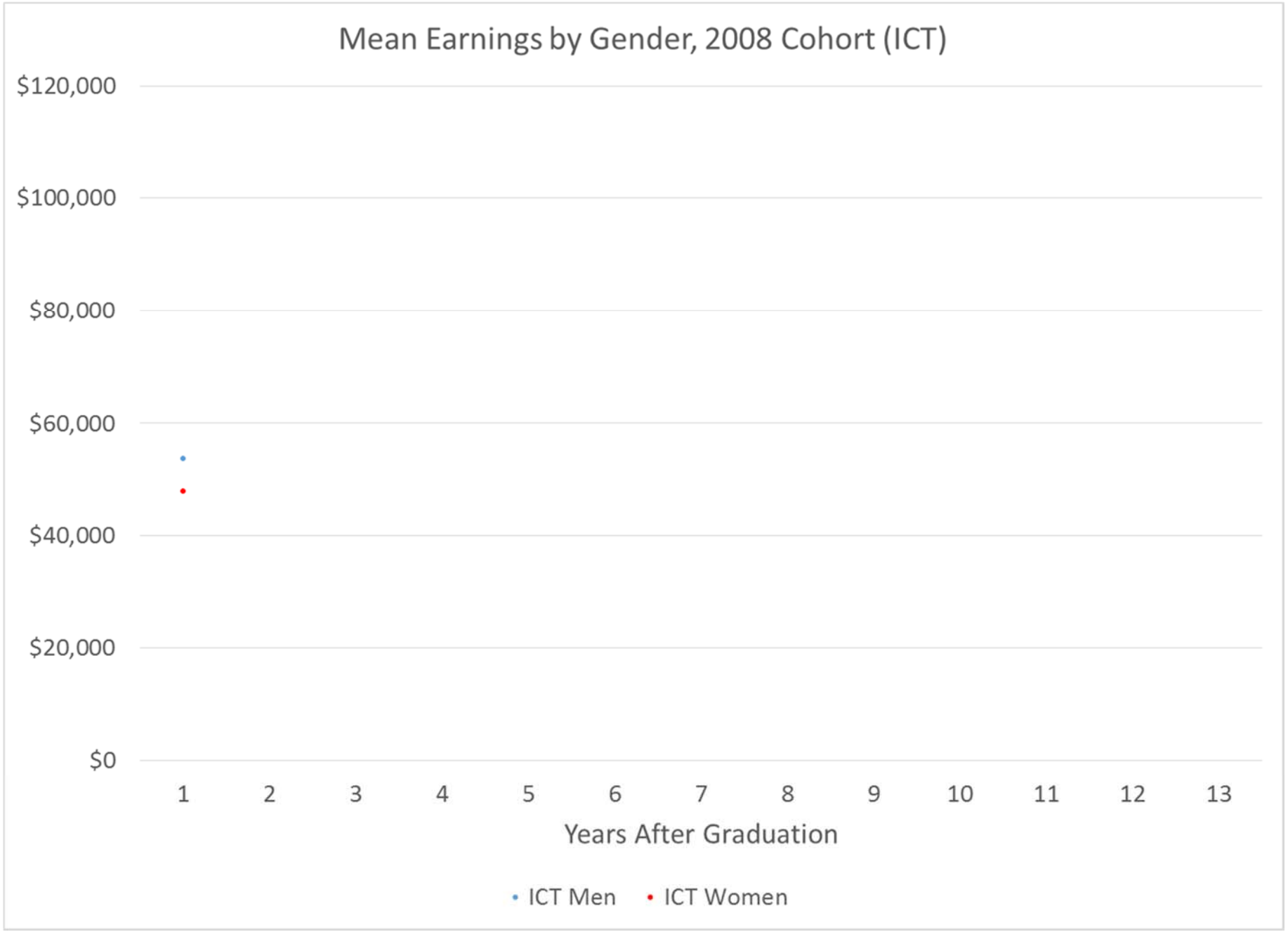
Mean Earnings by Gender, 2008 Cohort (ICT)
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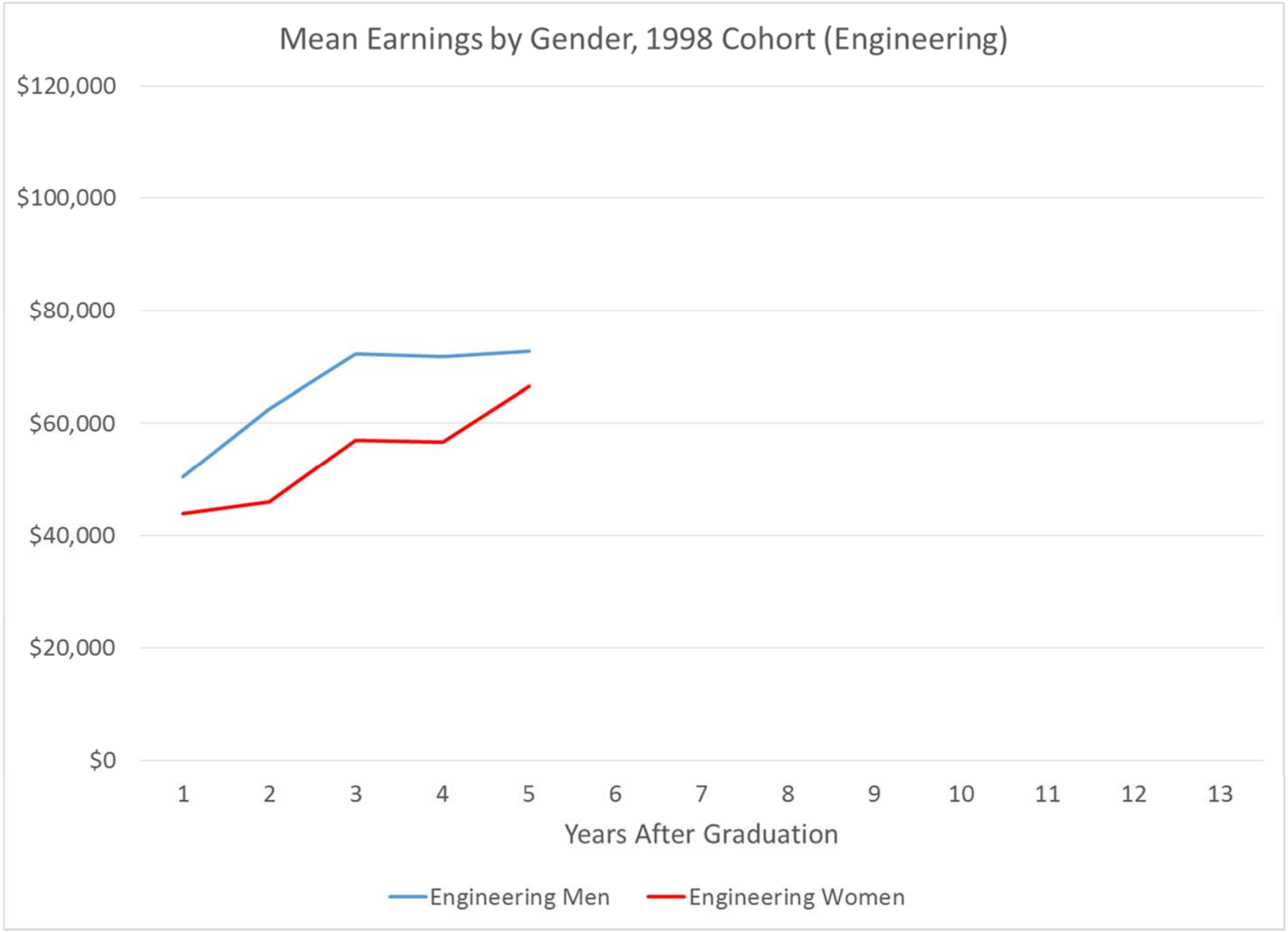
Years After Graduation
ICT Men
ICT Women


Mean Earnings by Gender, 1998 Cohort (Engineering)
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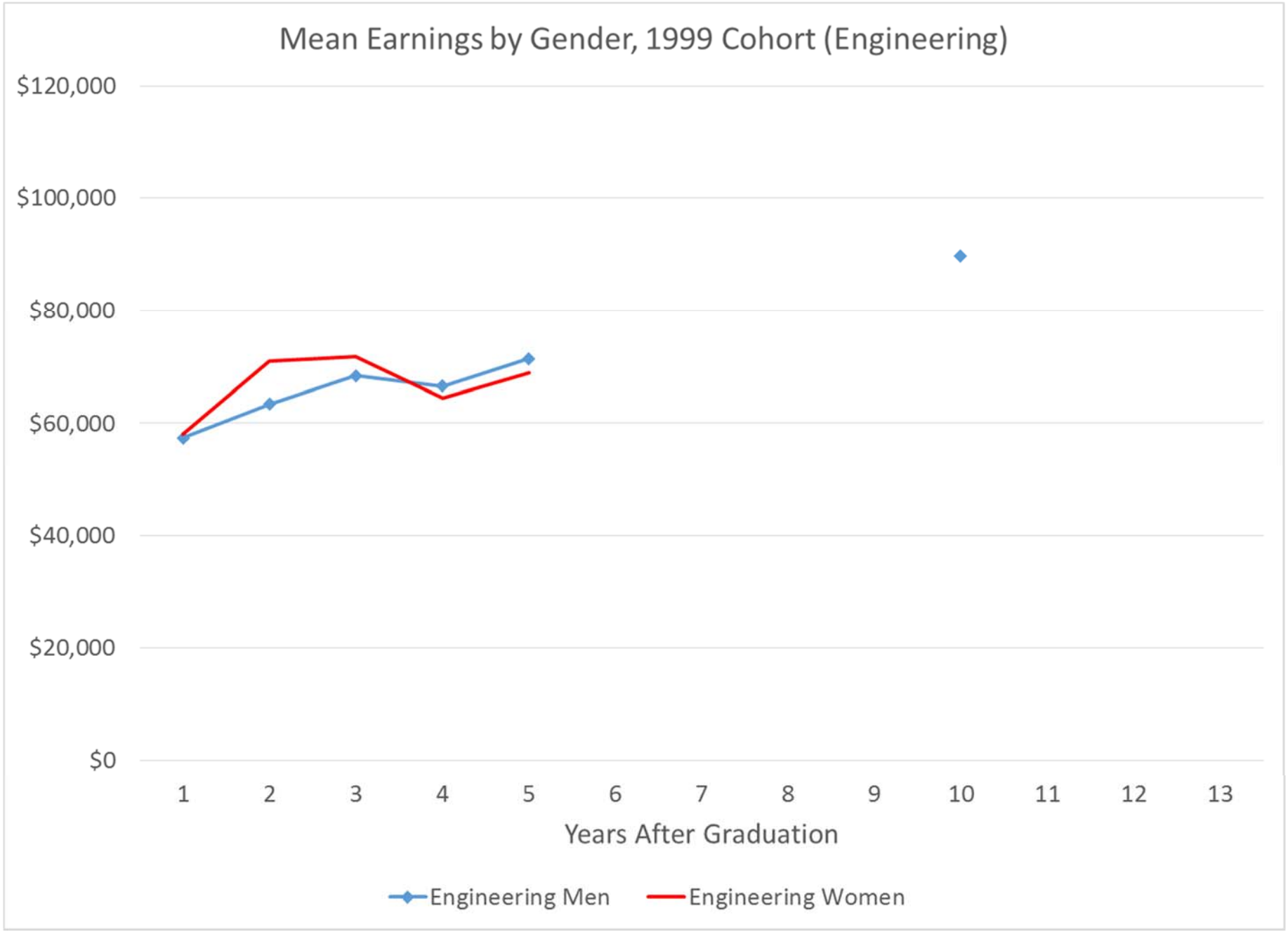
Years After Graduation
Engineering Men
Engineering Women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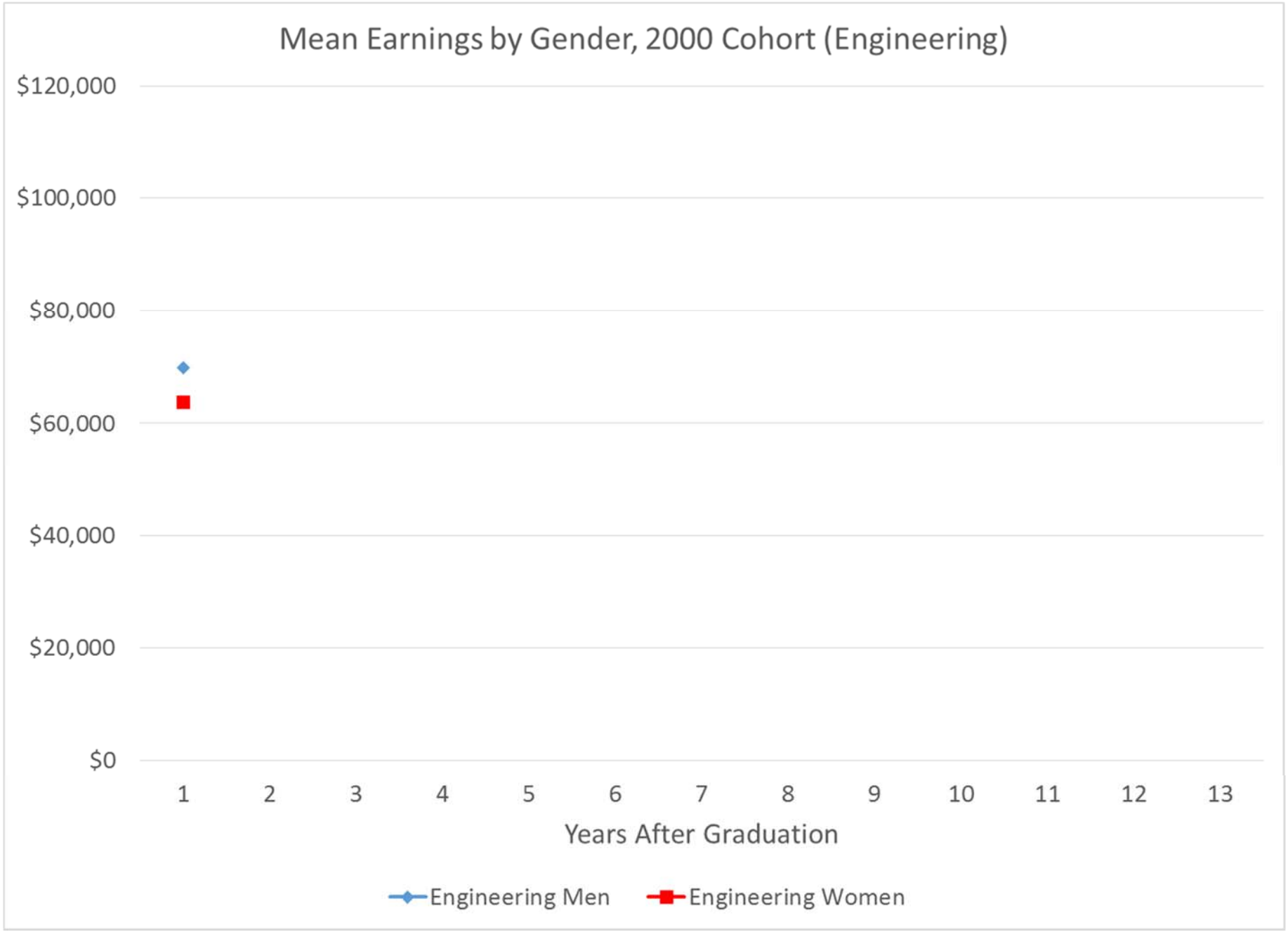
Years After Graduation
Engineering Men
Engineering Women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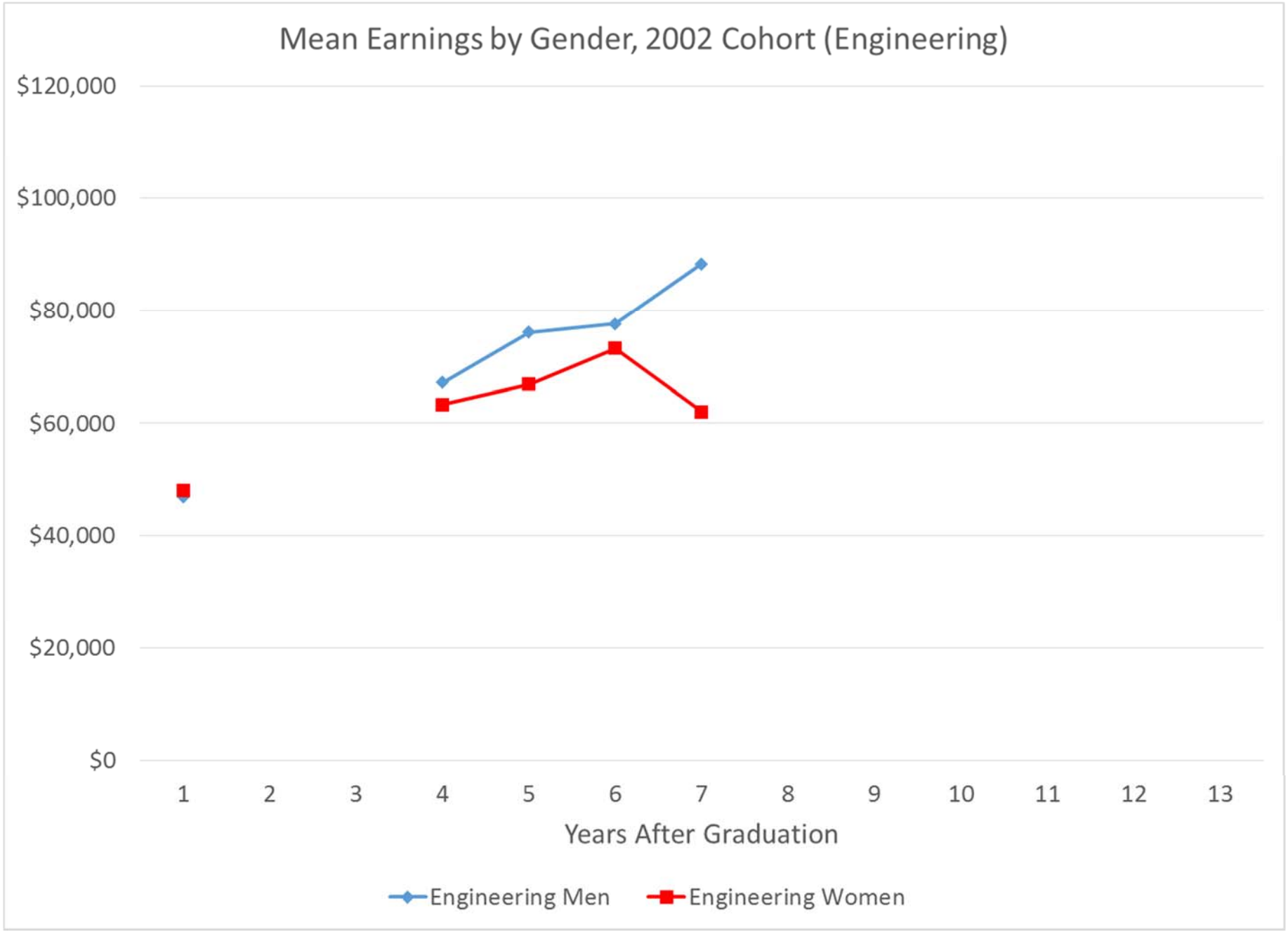
Years After Graduation
Engineering Men
Engineering Women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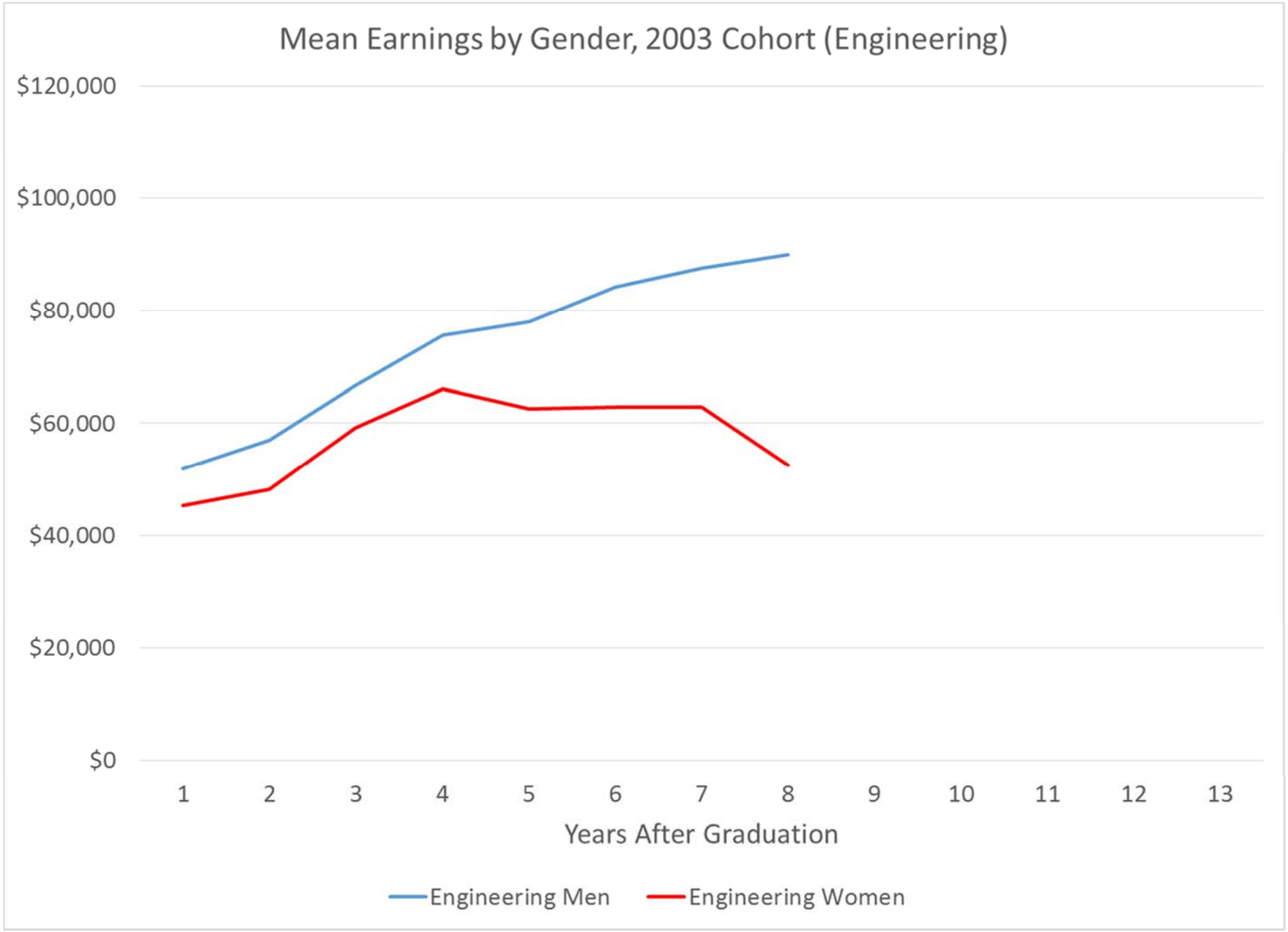
Years After Graduation
Engineering Men
Engineering Women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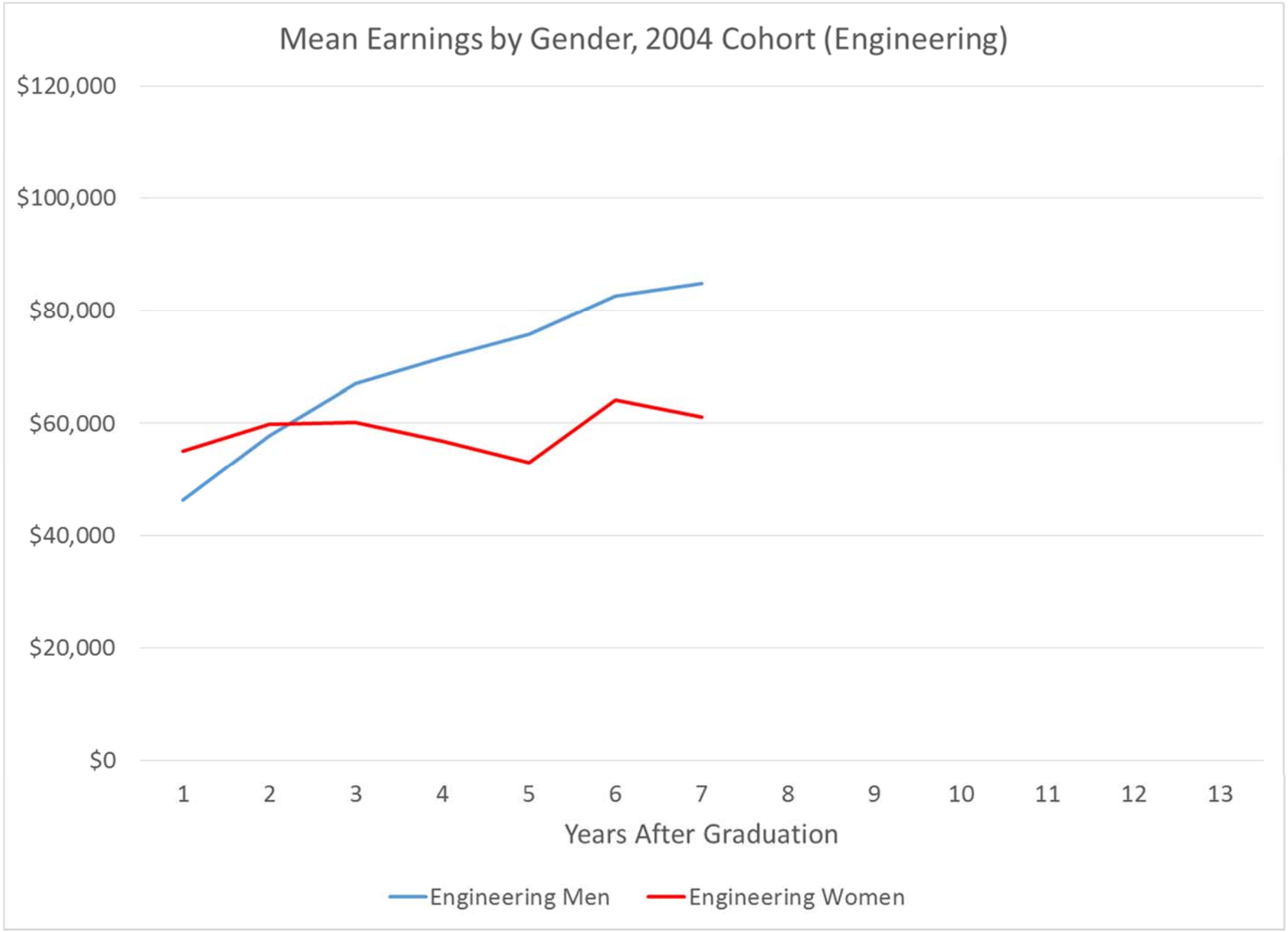
Years After Graduation
Engineering Men
Engineering Women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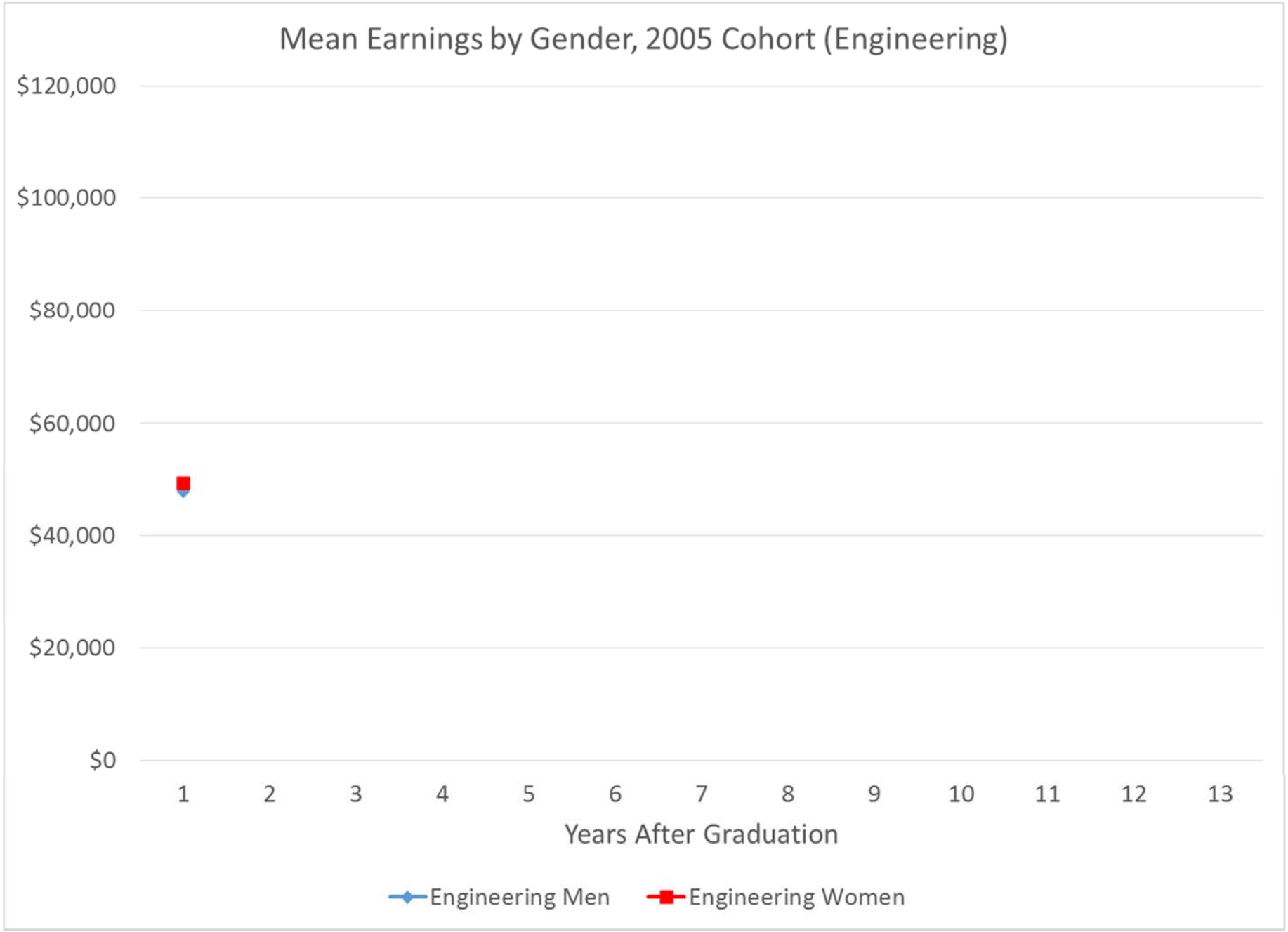
Years After Graduation
Engineering Men
Engineering Women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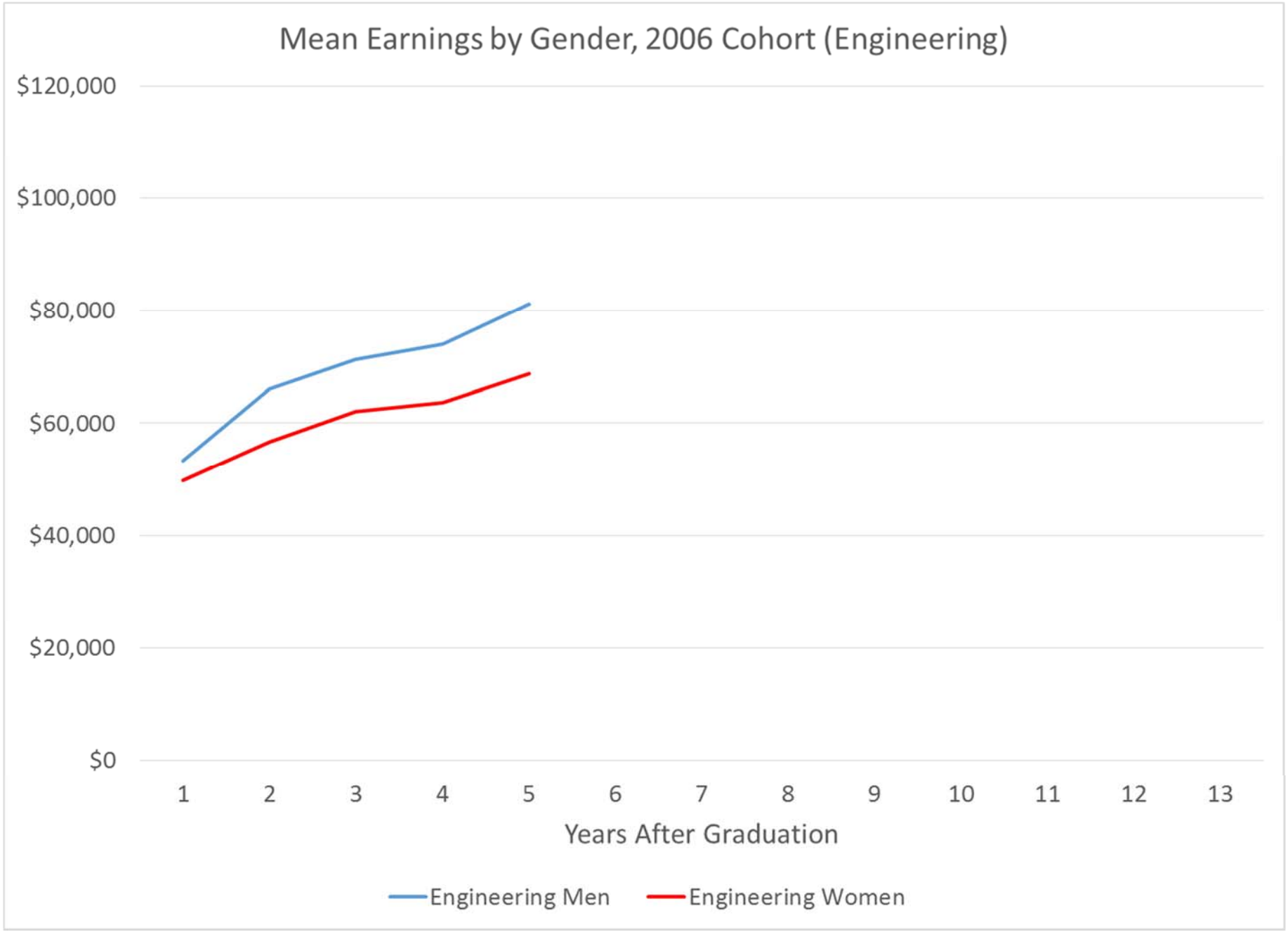
Years After Graduation
Engineering Men
Engineering Women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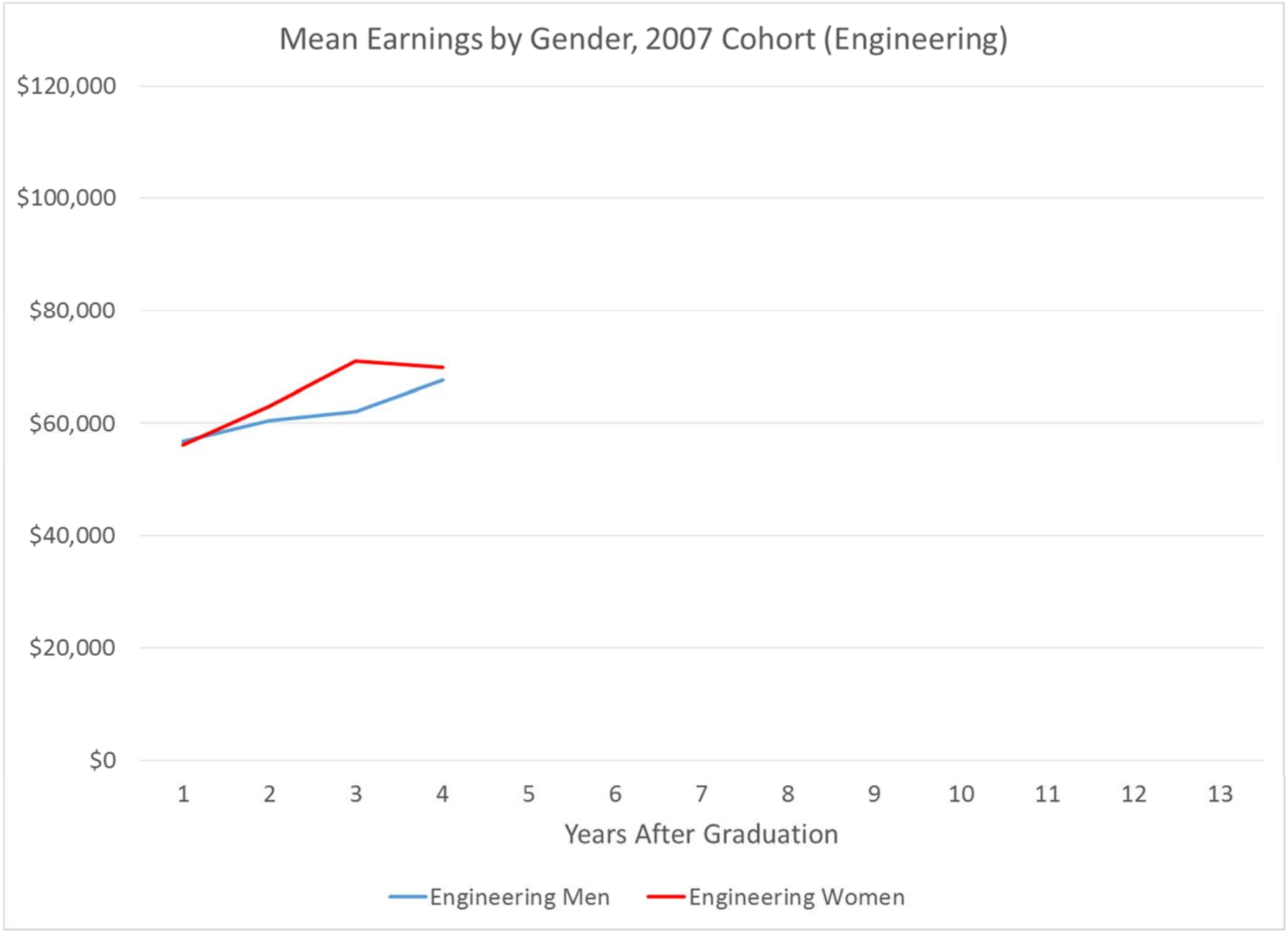
Years After Graduation
Engineering Men
Engineering Women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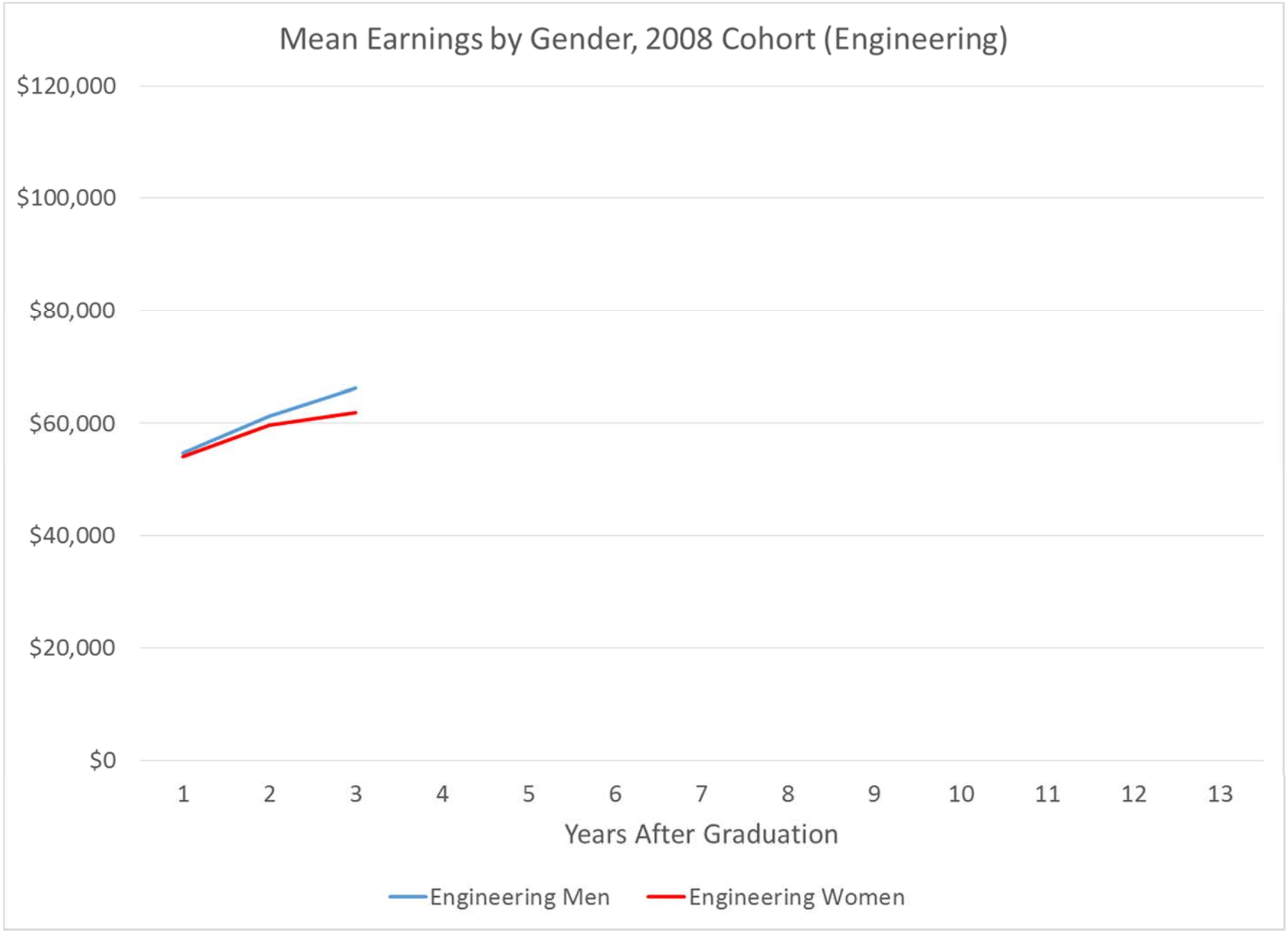
10
11
12
13
Years After Graduation
Engineering Men
Engineering Women


Mean Earnings by Gender, 2008 Cohort (Engineering)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1
2
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4
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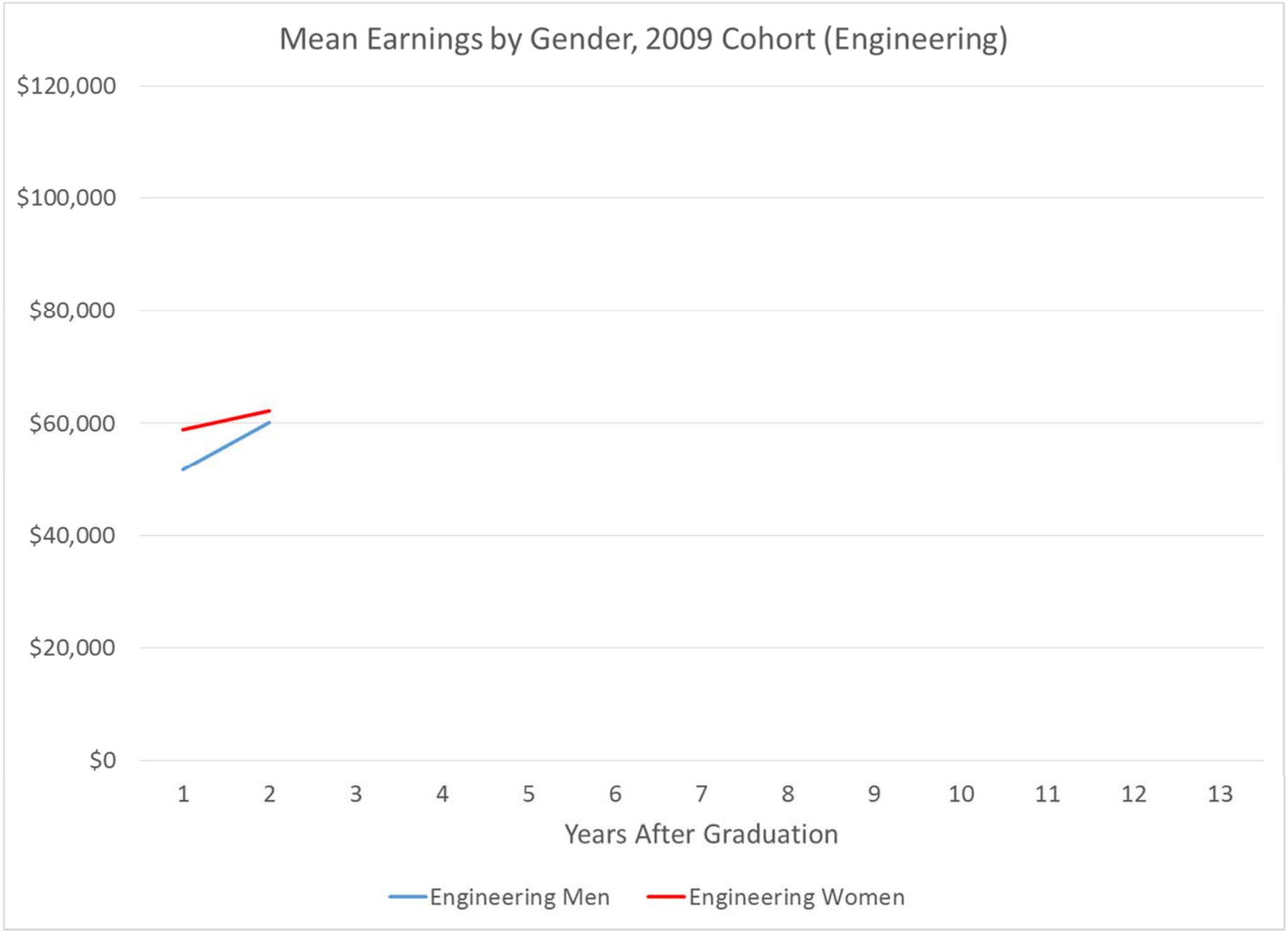
11
12
13
Years After Graduation
Engineering Men
Engineering Women


Mean Earnings by Gender, 2009 Cohort (Engineering)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1
2
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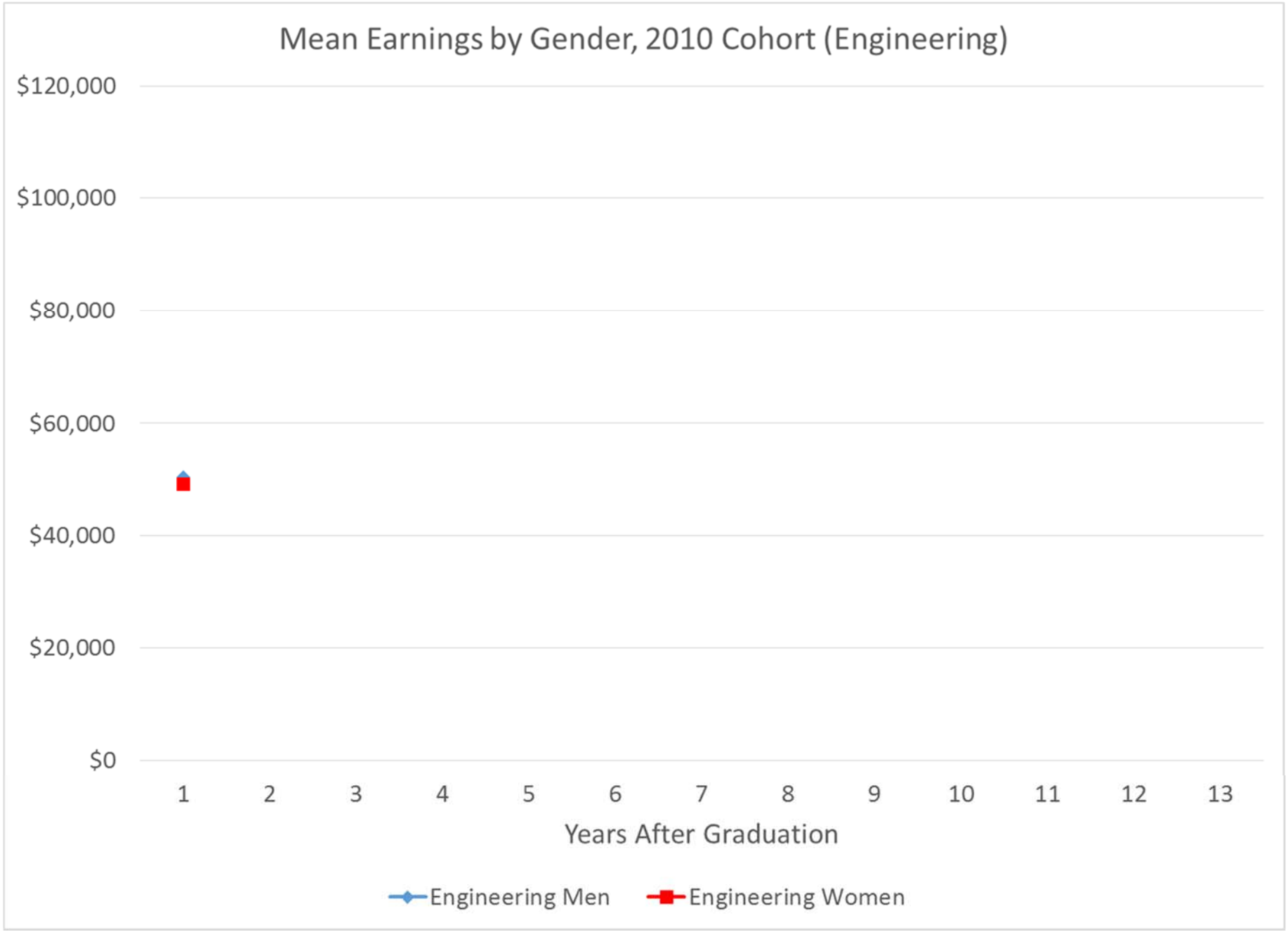
Years After Graduation
Engineering Men
Engineering Women


Mean Earnings by Gender, 2010 Cohort (Engineering)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1
2
3
4
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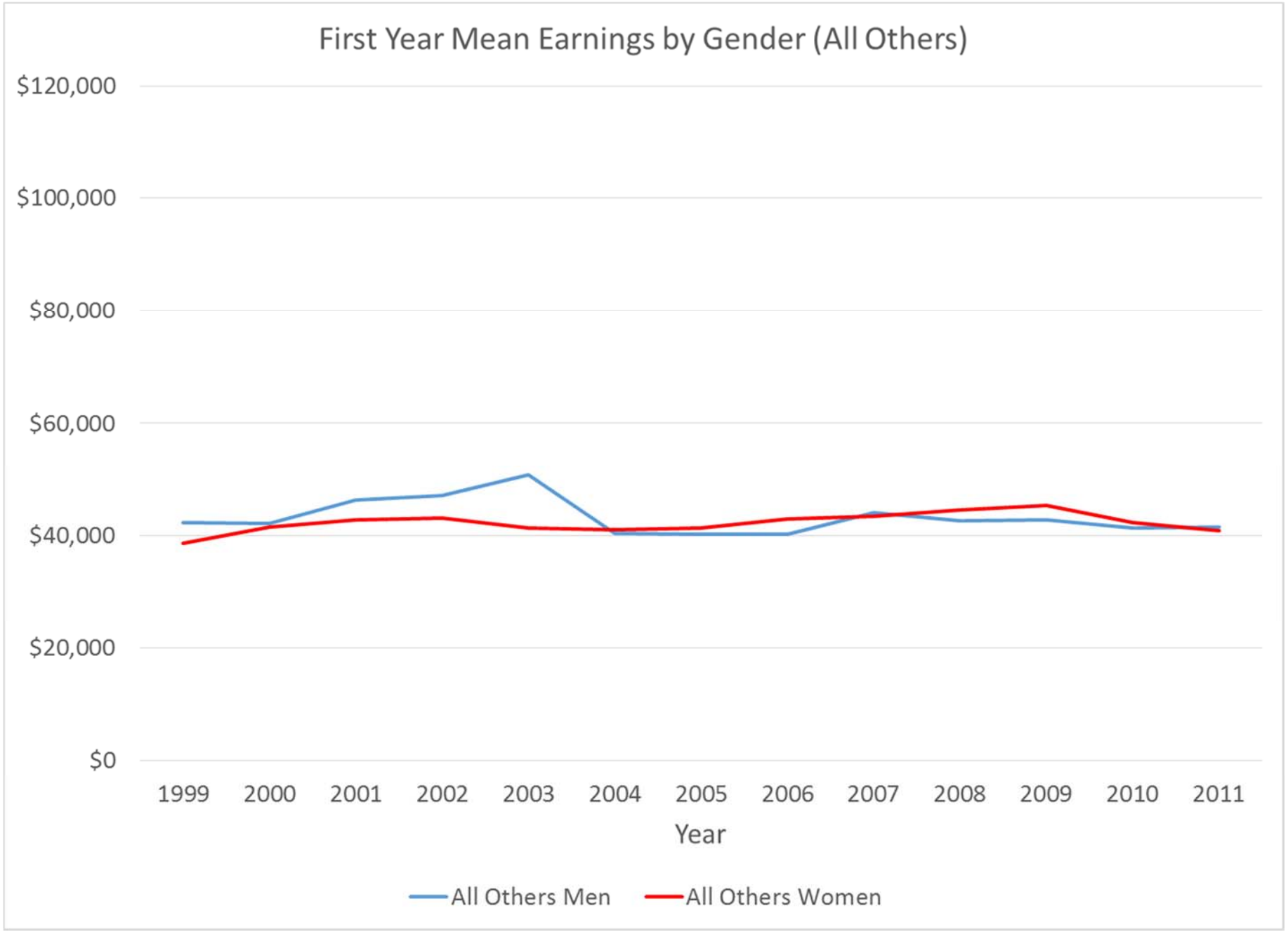
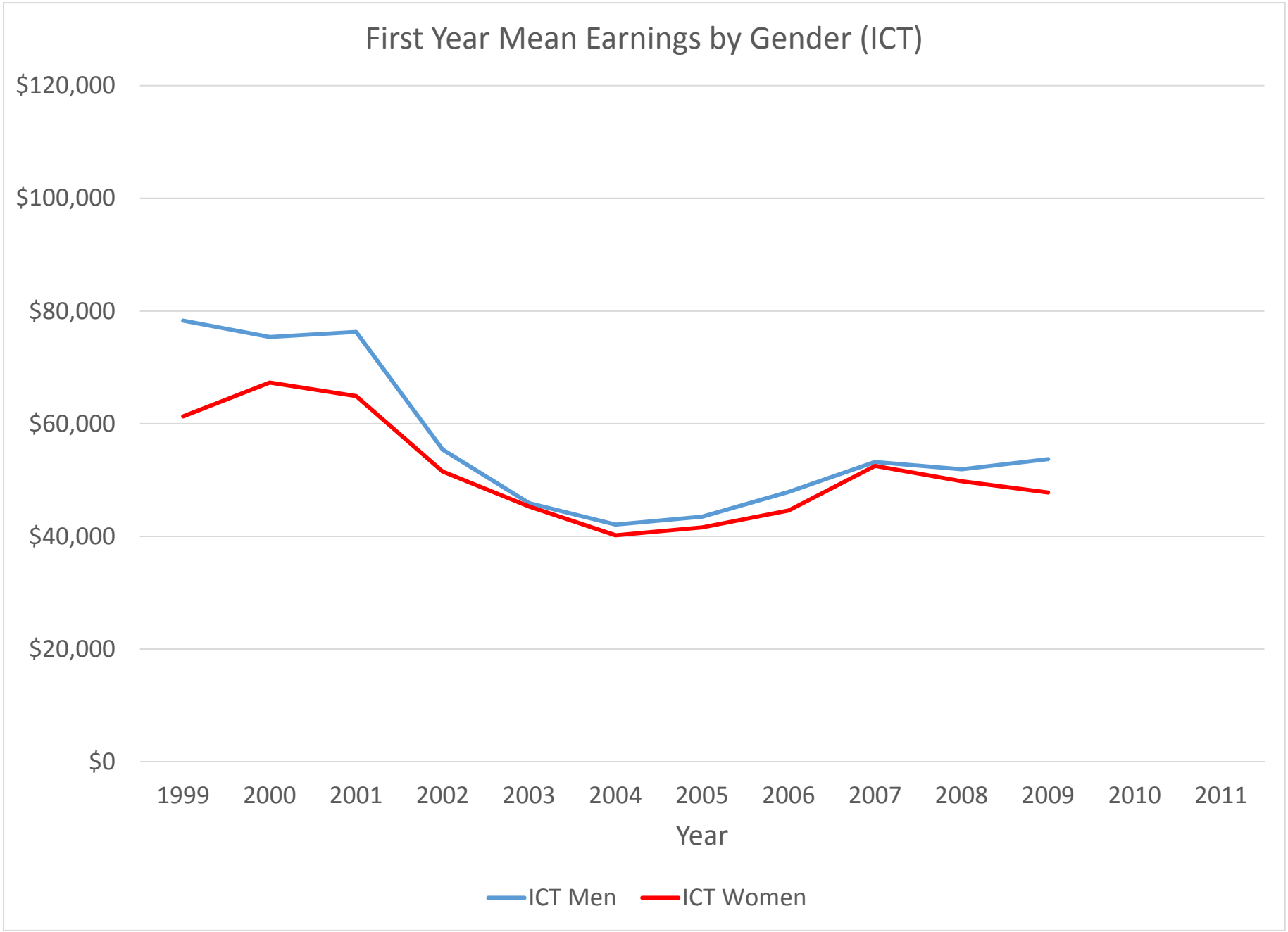
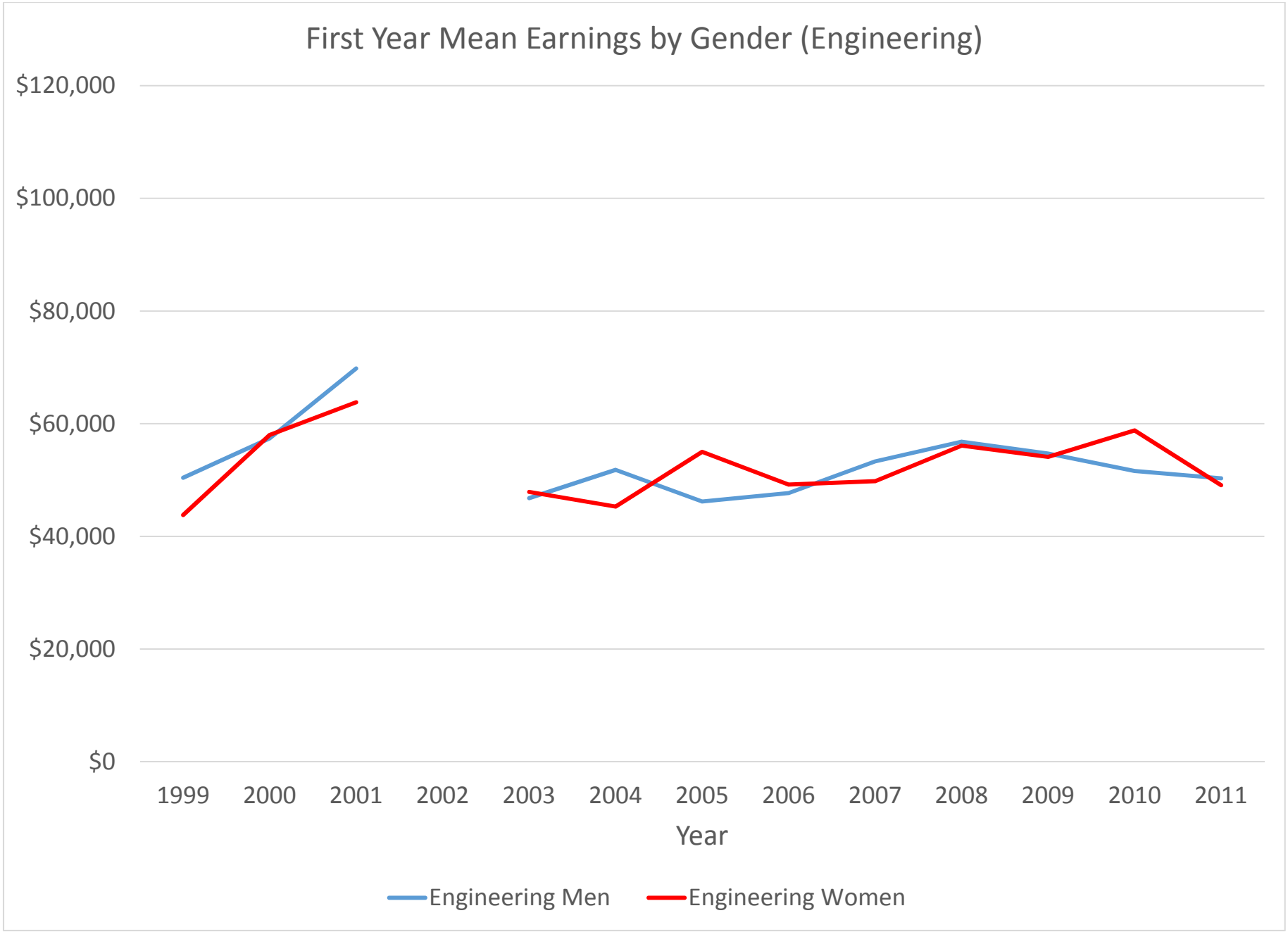
13
Years After Graduation
Engineering Men
Engineering Women

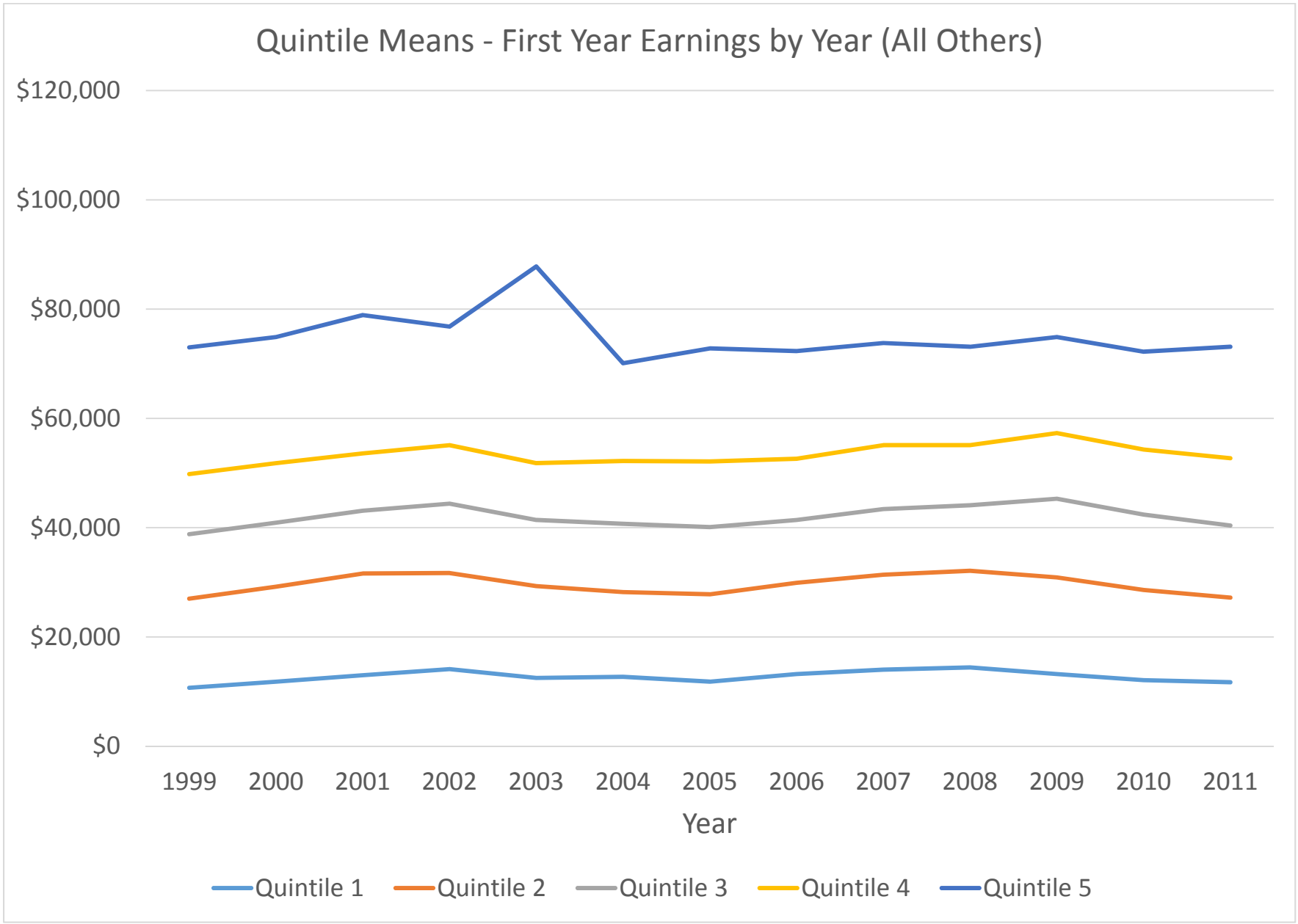

First Year Mean Earnings by Gender (All Others)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
All Others Men
All Others Women

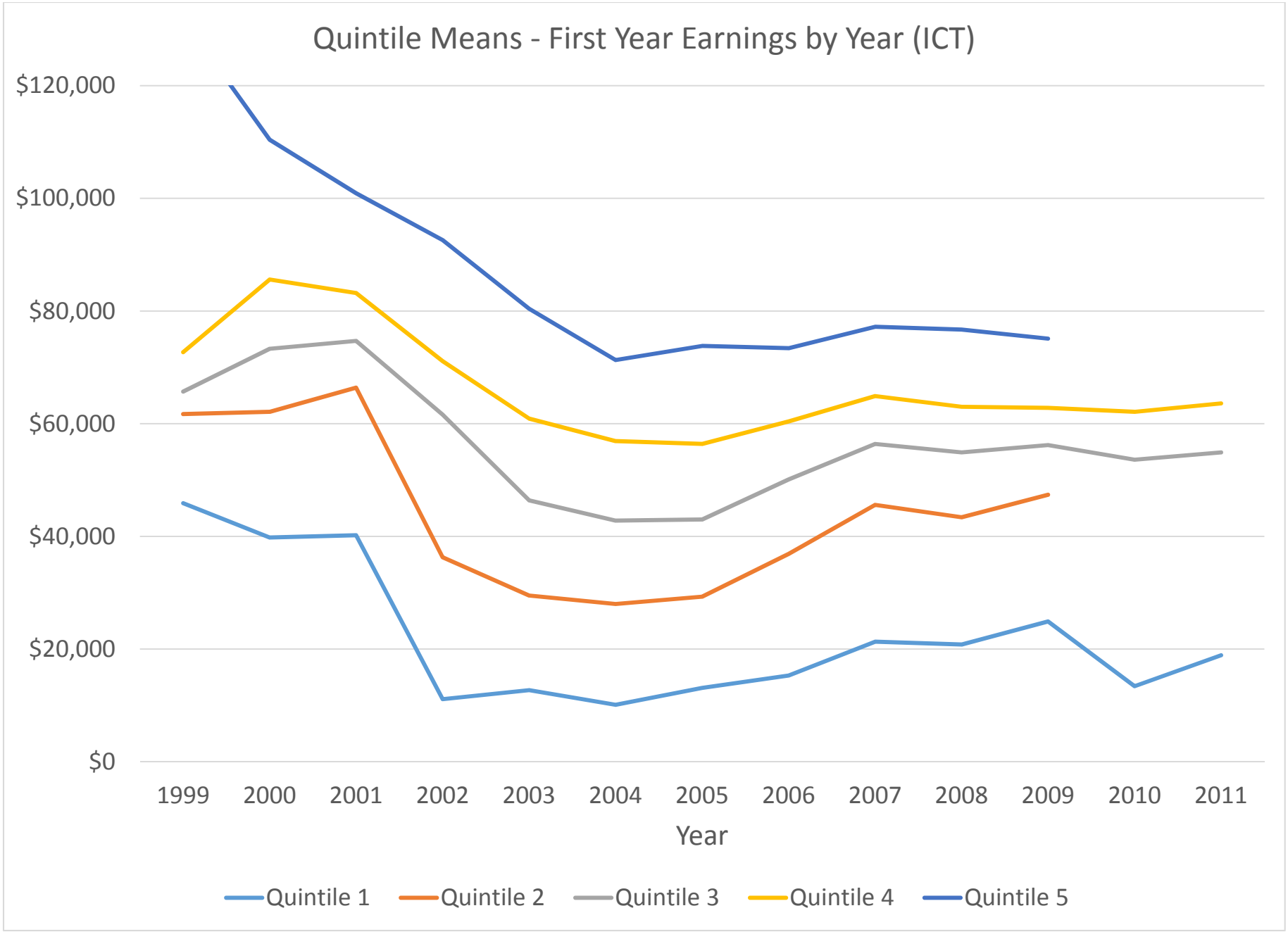

First Year Mean Earnings by Gender (ICT)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
ICT Men
ICT Women

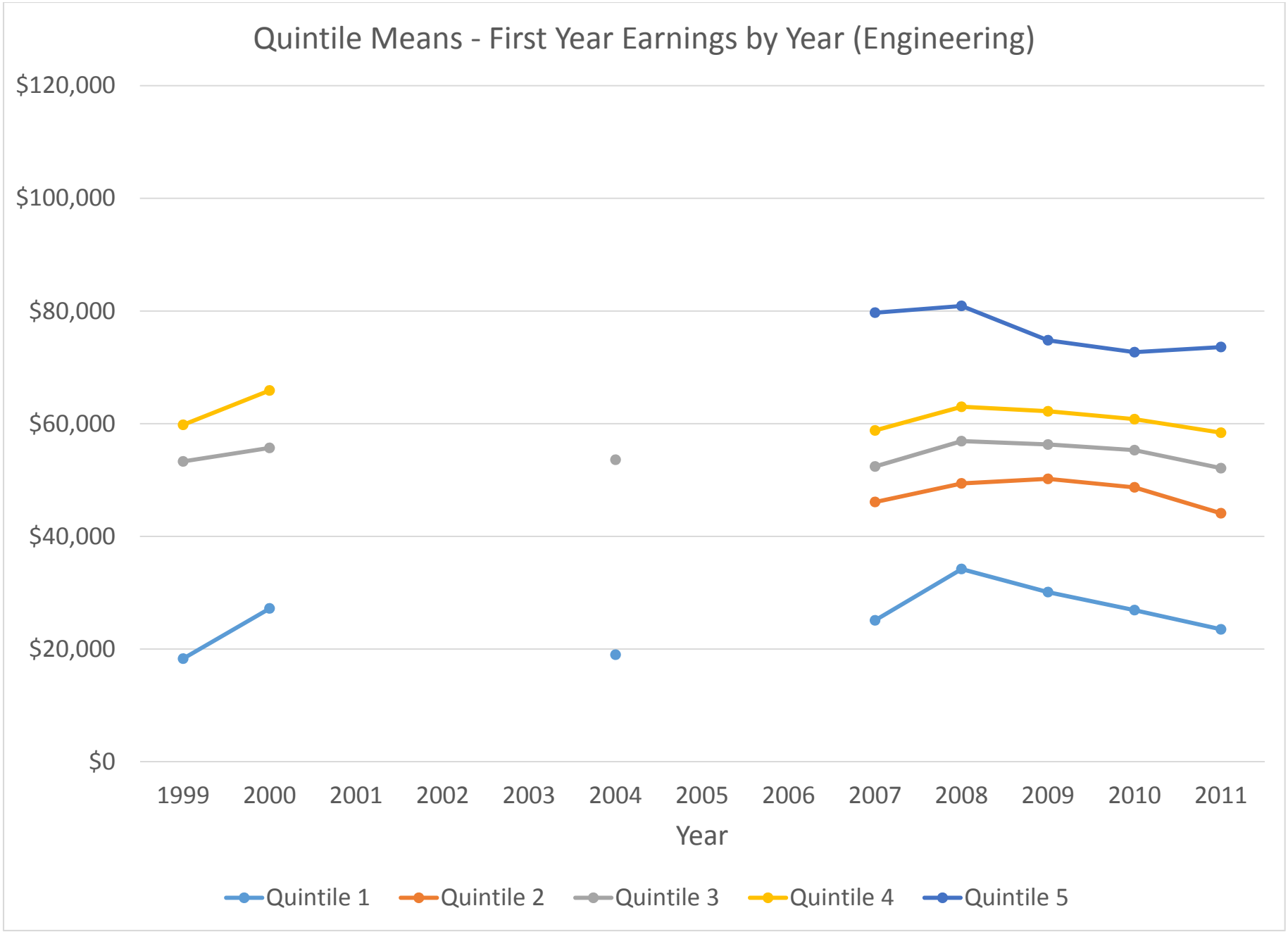

First Year Mean Earnings by Gender (Engineering)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
Engineering Men
Engineering Women

Appendix 3 – Earnings Distribution by Quintile

This appendix presents the distribution of first year earnings by quintile. The earnings amounts below do not represent quintile thresholds, but rather quintile means.




Quintile Means - First Year Earnings by Year (ICT)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
Quintile 1
Quintile 2
Quintile 3
Quintile 4
Quintile 5


Quintile Means - First Year Earnings by Year (Engineering)
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
Quintile 1
Quintile 2
Quintile 3
Quintile 4
Quintile 5