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1. Introduction

The COVID-19 pandemic has rapidly upended modern life, tested the infrastructure of higher education globally, and pushed professors and administrators to their productive limits. While there is now hope that effective vaccines will bring an end to the current state of chaos, there still may be long-term consequences for faculty in higher education. One concern is that the impact of the pandemic on faculty productivity varies systematically with faculty characteristics such as seniority, gender and family structure. If true, there can be long-lasting shifts in the representation of various groups in the faculty population.

Our agenda builds on recent evidence that women and women with children in the STEM fields (including economics) were particularly affected by COVID-19 (e.g., Myers et al., 2020). In STEM, Frederickson (2020), Sugimoto (2020), and Andersen (2020) all report significant declines in research by female authors relative to men since the onset of the pandemic. Amano-Patino et al. (2020) report that women economists are vastly underrepresented in the new and flourishing area of COVID research. Kruger, Maturana, and Nickerson (2020) show the gender gap in the posting of working papers online increased during the pandemic.

We add to this literature in three ways. First, we delve into not just the effect of gender and children, but we also ask how these pre-determined family structure variables relate to time allocation decisions during the pandemic. The approach is in the spirit of Myers et al. (2020) but we examine changes in time allocated to a richer set of activities (including childcare, chores, leisure and sleep) to help us understand the mechanisms driving changes in time allocated to research. Unlike Myers et al. (2020), we examine respondents' concerns about their own physical or mental health, isolation, and ability to obtain timely feedback on their work; these factors likely hinder the exchange of ideas and feedback that is crucial to the production of impactful research. Thus, we explore a rich set of potential drivers of changes in research productivity during the pandemic. Second, in addition to senior faculty, our data include a large sample of junior faculty and Ph.D. students. This variation in rank allows us to understand differential effects of gender and family as well as concerns about health, isolation and to highlight potentially important implications for junior scholars. Third and finally, we study the effect of the university's financial condition and decision to extend tenure clocks on research productivity outcomes.

To understand the extent to which COVID-19 has impacted research productivity in the academic finance profession, we administered a voluntary survey to the membership of the American Finance Association (AFA). We asked members to evaluate the impact of the pandemic on their own research productivity and on the time spent on research and related activities. Because individuals with university-related positions comprise 85.4% of the 1,440 responses, we focus the analysis solely on this group. Most of the survey responses are reported in Likert scales (from 1 to 5). As such, the formal regression analyses

estimate ordered logistic models so that the dependent variable can be viewed as intervals (from 1 to 5) that are condensed from a latent underlying variable that is continuous. The empirical approach allows us to examine the impact of predetermined variables (gender and family structure), rank (senior, junior, student), and mechanisms (time allocations, health, isolation, feedback and institutional factors), holding other things constant and allows for formal analyses of potentially important interactions.

The starting point is an average research decline. We find that faculty respondents report a negative research effect, which manifests itself in less time allocated to research and lower self-assessed research productivity outcomes.

We then study this decline as it relates to predetermined factors – family structure and gender. We find that the research productivity of women and faculty with children, especially very young ones (ages 0 to 5), is particularly harmed by the pandemic. The effect of children is independent of gender, and there is no interaction effect of gender and children on research. Thus, the effect of children on research during the pandemic is the same for men and women. The career and professional implications of these effects are important. Women, in particular senior women, are already an underrepresented group within the academic finance profession, and thus any efforts to ameliorate the disparity have been set back by the pandemic. Also set back are junior faculty of both genders, as they are more likely to have young children and experience professional isolation. Junior faculty are the group for whom current research productivity will have the greatest impact on future career outcomes. Thus, on both counts, the impact of the magnitudes of distortions may have profound effects on research and on the profession as a whole.

We next turn the mechanisms, which could drive the gender or family structure effects or residual heterogeneities. There are several potential mechanisms which may be hindering research productivity. For example, faculty may be devoting more time to teaching, as they work to adopt entirely new models of remote and hybrid teaching. Professional conferences and traditional opportunities to disseminate and obtain feedback may not be as effective in remote formats. Faculty with children may spend more of their time navigating school and day care closures or they may have increased responsibilities when their adult children return home. Finally, like the general public, faculty may feel isolated or overwhelmed by concerns about their own health and well-being. To shed light on the mechanisms driving the negative research effects, we asked respondents to report the changes in time allocation to tasks other than research. The time allocation questions are particularly telling, given the daily budget constraint of 24 hours. We also asked whether opportunities for feedback on research, feelings of isolation, or concerns about physical or mental health were worrying with the onset of the COVID-19 crisis.

Of the potential time allocation mechanisms that we identify, the time spent on childcare has a particularly strong negative effect on research – measured both in output assessment and time use in research. This finding is consistent with the mounting evidence from other fields that young children are

associated with significant reductions in productivity (e.g., Krukowski, 2020; Myers et al., 2020). Another explanatory time factor in the decline in research productivity is that of time devoted to domestic chores.

In addition to childcare and chores, faculty are spending more time on their teaching. This might be expected, given the rapid transition to online instruction. What is more surprising is that we observe a strong gender effect in teaching time reactions to the crisis. Women report that they are spending much more time on teaching-related activities following the onset of the pandemic. Prior evidence shows that female faculty already spend more of their time teaching and less time on research than men (e.g., Winslow, 2010). Our findings suggest that the pandemic exacerbated this gap. Importantly, gender differences in the increased time spent teaching do not explain the gender effect that we are observe in research productivity. Also of note from our time allocation findings is that the productivity loss due to children stems from more time being allocated to childcare, chores, and teaching rather than potential unobserved heterogeneity between faculty with and without children.

The effects of time spent on childcare, chores and teaching on research are similar across junior and senior faculty in our sample; however, junior faculty are more likely to have young children (48.4% of junior men and 37.3% of junior women report having children ages 0 to 5, compared to 23.9% of senior women and 22.2% of senior men). This implies a more negative research effect of the pandemic for junior faculty. Senior women are more likely than senior men to have young children (e.g., 45.9% report having children aged 6-12 versus 32.4% of senior men), while junior women are less likely to have children than their male counterparts (45.5% of junior women report having children from 0 to 18 versus 60.3% of junior men).[1] Both senior and junior women are less likely than men to have a non-working spouse than their male counterparts. Overall, 14.2% of female faculty report a non-working spouse versus 29.3% of men.

Beyond the time allocation mechanisms, other inputs into research production may matter during the pandemic. We study wellbeing (concerns about physical and mental health) and two characteristics capturing the development process of research – feedback and, its opposite, isolation. We find that both women and junior faculty report larger declines in the ability to receive timely feedback, and are more concerned about their own health. In addition, junior faculty report more intense feelings of isolation than their senior colleagues. Both women and junior faculty are less likely to have a non-working spouse, which might explain the steeper decline in pandemic-period research as well as emotional support for these groups.

We examine students separate from faculty and, while we do not observe differences in reported research productivity or time spent on research as a result of the pandemic, we find that students are reporting greater concerns about isolation and health than faculty. This is consistent with Woolston (2020),

[1]This finding could be due to delayed fertility. Despite the flexibility in hours and work afforded many academics, the profession may not be compatible with children early in a woman's career. Women who have children early in their careers are less likely to have tenure than women who delay or do not have children (e.g., Mason and Goulden, 2002).

who reports that, between May and July 2020, 39% of graduate students screened positive for anxiety and 32% screened positive for depression.[2] To be sure, graduate students (and faculty) are privileged in that they are generally able to enjoy intellectual freedom and work flexibility that can afford a healthier work-life balance in normal times compared to those in other professions. However, the survey reveals that, like the general population, those in the academic life are very vulnerable to isolation and concerns about health as a result of COVID-19, especially those earliest in the career trajectory, the students.

Finally, we turn to factors driving heterogeneities among research production coming from the pandemic reactions of the universities themselves. Institutions introduced a variety of policies in response to the COVID-19 pandemic. Some imposed salary and hiring freezes in attempts to preserve their financial health; some offered tenure clock extensions to junior faculty in efforts to address career concerns and to support the mental health of untenured faculty; and almost all have required new models of instruction in efforts to maintain academic continuity.

We find that the negative research effects that we document in the paper are larger for faculty employed by institutions with more serious financial concerns. It may be that teaching becomes paramount as universities struggle to retain students. We also find evidence that faculty who are more concerned about the financial health of their employers are also feeling more isolated, more concerned about their own health, and are receiving less timely feedback on their research.

Tenure clock extensions offered to junior faculty appear to be counterproductive. Junior faculty employed by institutions that have extended the tenure clock report decreased research productivity and less time teaching relative to their peers at institutions without such extensions. Thus, clock extensions may have unintended consequences on the dispersion of productivity within a particular PhD cohort year. Moreover, these policies do not appear to help alleviate pandemic-related stress: junior faculty at institutions with tenure clock extensions are no less likely to report feelings of isolation, reduced ability to receive timely feedback, or overall health concerns.

The disparate effects of COVID-19 that we document have implications that extend beyond finance academia. Many of the professional responsibilities of finance faculty and the research criteria by which they are evaluated are shared across a wide range of disciplines. If administrators are not deliberate in their policy responses to the pandemic, the sharp decline in research productivity reported by faculty with children and female faculty will have lasting impacts on careers and the diversity of individuals contributing to knowledge production.

[2] These are increases from 26% and 15% (respectively) in the prior year, and suggests that the mental health of graduate students is suffering as a result of the pandemic.

2. Data

2.1. Survey Overview

We designed the survey with two goals: (i) to collect a large sample less likely to be affected by selection and (ii) to obtain a statistically powerful observation count to allow us to explore mechanisms driving the effects of COVID on individual researchers. Toward that aim, we designed a very short survey (less than 5 minutes) with no tracking of locations or information that could reveal location. The American Finance Association (AFA) kindly agreed to implement the survey.

After obtaining requisite IRB clearances and signing data use agreements, we sent an invitation to take the voluntary survey to 8,421 members of the AFA via email on October 26, 2020, with a deadline of November 4, 2020. Two reminders were sent out, on October 31 and on November 4, 2020.[3] A total of 1,440 responses were received by the deadline, for a response rate of 17.1%.[4]

Given the importance of research productivity to institutions and to individual career outcomes, we solicited information on how research productivity and time allocated to research were affected by the pandemic. We also asked questions about changes in research support, specifically financial resources and feedback from colleagues. The survey was anonymous, and we did not collect IPs or other identifiers; however, we collected demographic information on gender, professional role, tenure status (for faculty), household structure (spouse/partner, children), and continent location. The surveyed individuals were also asked about their institution's response to the pandemic such as extensions of tenure-clocks and elimination/optionality of student evaluations of instruction. Finally, we asked how concerned survey respondents were about a number of emerging issues related to the pandemic, such as isolation, online teaching, in-person teaching, children's' education, employer and personal finances, and personal health. The survey questions are summarized in the Online Appendix.

2.2. Descriptive Statistics

The respondents are distributed across geographic regions as follows: 51.9% work in the U.S.; 24.6% work in the European Economic Area (EEA); and 23.4% in the Rest of the World (RoW). Respondents with university-related positions comprise 85.4% of the sample and our main analysis focuses on this group. Among respondents who identify as male or female, 66.8% identify as male and 33.2% female.[5]

In the main analyses, we focus on the respondents with university-related positions who identified themselves as male or female. We delete an additional 42 observations where all responses to time allocations are blank or all responses to concerns/worries are blank. The main sample consists of 1008

[3] A copy of the invitation is in the Online Appendix.
[4] Typical response rates for voluntary surveys without incentives (such as gift cards, etc.) ranges from 10-20% in recent years (Pedersen and Nielsen (2016)).
[5] 226 individuals chose "prefer not to answer", "other", or do not answer the question about gender identity.

university respondents: 731 faculty (402 senior faculty and 329 junior faculty) and 277 students. The geographic representation of the final sample is very similar to that of all respondents (55% US, 25% EEA, 20% RoW).

This sample selection is driven by the objectives of the study, the relatively low number of responses from non-university researchers, and heterogeneity in their career demands. Non-university researchers face different trade-offs than faculty, as they typically do not teach. They also do not have a tenure-track process. We do not consider the group without disclosed gender information since their responses would not allow us to uncover potential disparate effects on female researchers. We nevertheless reproduced the main analyses on the full sample and the non-tenure-track researchers in the Online Appendix.

[Insert Table 1 here.]

Table 1 reports the summary statistics for our sample, and the subsamples of senior faculty, junior faculty, and Ph.D. students. The average response to the question "How did the COVID-19 pandemic affect your research productivity?" (*Research_Productivity*) is 1.94 for faculty, based on a Likert scale from 1=significantly negative to 5=significantly positive (where 3 is the neutral value). Senior faculty report less of a negative effect than junior faculty (a difference of 0.35, t=4.06). By contrast, the reported research productivity of students is less adversely affected than either faculty group (a difference of 0.18, t=2.26).

The decline in self-reported research productivity that we observe seems contrary to very recent findings in Kruger, Maturana, and Nickerson (2020), who report a 35% increase in new finance and economics working papers posted to SSRN following the pandemic.[6] There are several potential explanations for why the average survey respondent reports adverse research effects while working paper postings increase. First, while many scholars are reporting decreases in productivity, not all of them do. Indeed, 14.5% of our sample reports that the pandemic has had a "slightly positive" or "very positive" impact on their research productivity. COVID-19 has steepened the productivity curve, where more productive researchers may become even more productive. Second, COVID-19 acts a natural experiment for many settings and has attracted a lot of research. Such research has more urgency than usual and might push researchers to post on SSRN in an earlier stage. Third, outside of such "topical" research, SSRN postings might capture a part of the research process that has suffered less from the crisis (e.g., later stage work on revisions or very new projects). This would be expected if the time required to prepare an initial draft of already up-and-running project is less than the investment one makes when starting something new or revising existing work for publication. Finally, it could also be that survey respondents are those who

[6] Cui, Ding, and Zhu (2020) report a similar increase for social science researchers more generally. They report that total research productivity increased by 35% 10 weeks after the lockdown in the U.S.; however, female researchers' productivity dropped by 13.9% relative to that of male researchers. Within their sample, they report that increases in gender differences were particularly large in Finance (along with Criminal, Economics, Health Economics, Political Science, and Sustainability).

are most negatively affected by the pandemic; importantly even if this is the case, it would not explain the cross-sectional variation (i.e., role of family structure, seniority and gender) that we observe in the data.

The variable that captures changes in time spent on specific activities (*Time_Activity*) is based on a Likert scale from 1=much less time to 5=much more time during compared to before the pandemic. The stay-at-home measures to help curb the spread of COVID-19 thrust faculty into rapid transitions to online teaching. At the same time, many faculty took on at-home tasks such as childcare, home schooling, and domestic chores that may have been outsourced under normal circumstances. This forced researchers to reallocate their time significantly. Faculty in our sample report spending significantly less time on research, leisure, and sleep while spending more time on teaching, childcare/schooling, and household chores than before the pandemic. The effects of COVID-19 on time allocation are similar for senior and junior faculty (none of the differences between the two groups are statistically significant). Interestingly, unlike faculty, Ph.D. students do not report a significant decline in time allocated to research or teaching; they sleep more during the pandemic. Compared to faculty, students also report a smaller increase in time devoted to childcare and schooling and a smaller decline in leisure.

Thirty percent of the faculty respondents in our final sample are female (*fem_ind*). This fraction is higher among junior faculty (33.4%) and is even higher among students (45.5%) than among senior faculty (27.1%). The lower representation of women among the most senior faculty is consistent with the faculty population in economics and related fields. For example, CSWEP (2019) reports that women comprise: 14.6% of full professors; 25.9% of associate professors; 30.3% of assistant professors; and 32.3% of graduating Ph.D. students. The percent female finance faculty respondents to our survey are larger than some of the estimates that appear in the current literature and suggests greater response rates from women.[7] Over-sampling women should not impact the estimated gender effects if the males and females who do respond do not have pandemic-period experiences that differ systematically from those who do not.

Family structure is a variable of interest in any analysis of how the COVID-19 pandemic affects researchers. The need to spend additional time on childcare and schooling as well as on domestic chores is likely to depend on the size of the household, age of the dependents, and whether or not those tasks can be shared with partners. We gather several variables to capture household characteristics. In light of evidence from other fields that young children reduce productivity (e.g., Krukowski, 2020; Myers et al. 2020), we focus the analysis on the ages of children (if any) and whether a respondent has a non-working spouse or partner (*nonwork_spouse*). On average 24.9% of our faculty respondents have a non-working spouse, and senior faculty are more likely to have a non-working spouse than either junior faculty or students.

[7] Sherman and Tookes (2020) report that women comprise 16% of their sample of female faculty at top 100 business schools. Chari and Goldsmith-Pinkham (2018) report 14.6% female representation on the finance programs at the NBER Summer Institute.

In terms of children, 62.4% of senior faculty and 55.3% of junior faculty have children between the ages of 0 and 18, while only 19.9% of students have children. The age distribution of children varies predictably for senior and junior faculty. Among all respondents, 32.6% have children between the ages of 0 to 5 years, and another 30.2% have children in the 6-12 year category. Junior faculty tend to have younger children than senior faculty. To facilitate interpretation of our results, we construct a cardinal variable to capture the ages of children (*childcardinal*), corresponding to the level of required parental care. It constructed as follows: 0 for no children or children 18 and over; 1 for children ages 13-18; 2 for children ages 6-12; and 3 for children ages 0-5.

The pandemic has caused many people to shelter at home, which has reduced the ability of faculty to interact, both professionally and socially. This lack of social connection affects the ability of faculty to receive feedback on their work, can create social isolation, and induce worry about one's physical or mental health. All such factors might affect research productivity. We construct three variables to measure these dimensions of the pandemic experience: *Feedback*, *Isolation* and *Health*.

We ask survey participants about the impact of COVID-19 on a researcher's ability to receive timely feedback (*Feedback*) on their research projects, working papers, or other work. We again use a Likert scale from 1=strong positive impact to 5=strong negative impact.[8] The average reports a negative impact on the ability to receive timely feedback, and it is particularly junior faculty that feel they do not get timely feedback during the pandemic (a difference of 0.33 compared to senior faculty, t=5.26). Students appear somewhat better off than junior faculty in terms of getting timely feedback (a difference of 0.36, t=4.97).

We also ask respondents about their well-being in the wake of COVID-19. For this study, we focus on two concerns: isolation due to working from home (*Isolation*) and physical and mental health (*Health*). These variables are reported on a Likert scale where 1=strongly disagree and 5=strongly agree. We find widespread self-reported worry among faculty and students about isolation and health. The means for all groups are significantly above the neutral value of 3. Comparing senior and junior faculty, we find that junior faculty worry more about isolation and health than their senior colleagues (differences of 0.23, t=2.75, and 0.45, t=5.53, respectively). Students and junior faculty have similar concerns about isolation, but students reveal even greater concerns about physical and mental health (a differences of 0.26, t=3.30). This finding is consistent with Woolsen (2020), who reports a doubling of signs of depression among graduate students during the pandemic.

Apart from personal characteristics, university policies and institutional resilience also impact faculty members' personal experiences. To investigate institutional effects, we focus on two variables: *ExtendClock* and *Employer_Finances*. The *ExtendClock* variable is based on responses to a number of

[8] For ease of interpretation, this variable is rescaled so that an answer of a "strong positive" impact is assigned a 1 and a "strong negative" impact a 5.

questions about how institutional policy has changed in response to the COVID-19 pandemic. For ease of interpretation, we define the dummy variable (*ExtendClock)* to be one if the institution either gave the option to extend the tenure clock or automatically extended the tenure clock, and zero if no such policy is in place. On average 68.9% of faculty respondents say their institutions have policies that enable junior faculty to extend the tenure clock.

Similar to the worry about isolation or physical/mental health, we ask respondents if they are worried about their employer's finances (1=strongly disagree and 5=strongly agree). We use the response to this question to identify institutions that are likely more affected financially by the pandemic. The basic idea is that variation in responses to this question can capture variation in the financial resilience of universities to the crisis (e.g., endowment fluctuations, exposure to international students, etc.). Faculty report some worry about employer finances. While the mean worry for senior faculty is slightly larger in magnitude than for the other groups, *Employer_Finances* is not statistically different across senior faculty, junior faculty, and students.

2.3. Family Structure by Gender and Rank

A burgeoning literature (e.g., Schiebinger et al., 2008; Minello, 2020) on the impact of COVID-19 on working professionals has naturally identified the important role played by family structure. For example, the pandemic kept children home who would otherwise be in school or daycare during most working hours. To set the stage for more analytical empirical testing, Table 2 shows descriptive statistics on the key family structure variables, by rank and gender.

[Insert Table 2 here.]

Among faculty, women are significantly (at the 1% level) less likely to have a nonworking spouse than men (14.2% vs. 29.5%). The difference is also increasing with seniority: from 9.9% among Ph.D. students to 16.1% among senior faculty. The gap is significant across all ranks, and is consistent with survey evidence in Schiebinger et al. (2008), who report that male academics are more likely to have stay-at-home partner than women. Senior women are somewhat more likely to have children between the ages of 0 and 18, but the difference is only statistically significant for children between the ages of 6 and 12. In contrast, junior women are much less likely to have children at all age groups except children over 13. Note that children at this age range were likely born prior to the commencement of the academic career. The fact that senior women are significantly more likely than men to have young children and junior women are less likely to have children confirms the documented delaying childbirth among female scholars (e.g., Mason and Goulden (2002); Armenti, 2004; Antecol et al., 2018). There are no notable differences among Ph.D. students.

3. Empirical Results

3.1. Allocation of Time

COVID-19 had disrupted normal life and impacts the way people allocate their time. To characterize the effect on researchers, we ask respondents to report changes in their time allocation pre- versus post-pandemic across six categories of activities. We then analyze how the changes in time allocation vary with gender and family structure. The six categories included in our analysis are time spent on: research (*Time_Research*), teaching (*Time_Teaching*), domestic chores (*Time_Chores*), caring for children (*Time_Childcare*), leisure activities (*Time_Leisure*), and sleep (*Time_Sleep*).

Allocation of time inherently reflects trade-offs and hence time spent in each of the six categories (these are the dependent variables in the regressions) represent a joint decision made for time spent in the others. For this reason, we adopt the seemingly unrelated equation system model so that all six equations representing the six categories are jointly estimated in that the error disturbances in the equations are allowed to be correlated in arbitrary ways. Moreover, because the dependent variables are coded on Likert scale from 1 to 5 (where a higher number indicates more time spent compared to a normal time), we use an ordered logistic model in all equations so that the dependent variable can be viewed as intervals (from 1 to 5) that are condensed from a latent underlying variable that is continuous. The independent variables are the pre-determined family structure and gender variables. The full equation system is as follows for *i = 1, 2, 3, 4, 5, 6* where *i* is the index for categories:

$$Time_i = a_i + \beta_{1i} female + \beta_{2i} nonwork\_spouse + \beta_{3i} childcardinal + \beta_{4i}(female * childcardinal) + e_i \quad (1)$$

The coefficients in equation (1) are "log odds ratios" in an ordered logit model and carry a subscript *i*, as they are equation specific. In addition to equation (1), we also explored the role of the interaction of *fem_ind* with *nonwork_spouse* and the triple interaction of the explanatory variables. These extra interactions did not have sufficient power to identify statistically significant time allocation patterns here or the research patterns in subsequent tables; thus, we excluded them and use the parsimonious model with variables that are most central to our interest. Table 3 reports the results.

[Insert Table 3 here.]

The qualitative interpretation of the coefficients in Table 3 is similar to a linear regression model in that a positive (negative) coefficient suggests a correlation in the same sign between the covariate and the dependent variable, holding other covariates constant. The same is true for interpretation of the statistical significance.

Table 3 shows striking gender effects in how the pandemic has changed researchers' time allocation. The estimated coefficients on *fem_ind* implies that women allocate significantly (at the 5% level) less time to research, and significantly (at the 1% level) more time to teaching following the onset of the pandemic.

The magnitude of these two coefficients are comparable, and changes in time allocated to all other categories exhibit little disparity along the gender dimension. A non-working spouse/partner (*nonwork_spouse*), as expected, decreases time allocated in childcare (significant at the 10% level), but most of the time saved seems to go into teaching (significant at the 10% level). On balance, and somewhat surprisingly, the research time advantage of researchers with a non-working spouse is insignificant.

The presence of children in the family, especially young children (*childcardinal*), significantly (at the 1% level) increases time spent on child care and domestic chores. The extra time has to be diverted from other activities, resulting in reduced allocation in research, sleep, and leisure activities (in that order). All of these negative effects are significant at the 1% level. The coefficients on the interaction term between *fem_ind* and *childcardinal* indicate that presence of children, especially young ones, has an incremental impact on female researchers such that they spend even more time on childcare and even less time on leisure activities than their male counterparts. Both effects are significant at the 5% level. The estimated coefficient on the *fem_ind* **childcardinal* interaction term in the *Time_Research* regression is insignificant, implying that women with children maintain roughly the same research time compared to men with similar family structure.

The quantitative magnitudes of the coefficients in an ordered logit model are not straightforward. The coefficients are "log odds ratios," and therefore, the coefficients exponentiated become the odds ratio. Take the coefficient of –0.420 on *fem_ind* in *Time_Research* as an example. Suppose the probability that a researcher responds that time allocated to research has changed in a particular way, such as "much less time" (i.e., level 1 out of 5) is $(1 - p)$. Then the odds ratio for the researcher to end up in any level higher than the current one is $p/(1 - p)$. The value of the coefficient suggests that, if the gender of the researcher is changed from male to female while keeping other variables constant, the odds ratio that the researcher could go to a higher level is reduced by 34.3% (*exp(-0.42) = 0.657*, or 34.3% below the reference level).[9]

A more intuitive way to present the gender disparity result in Table 3 from the ordered logit model is to show the predicted probabilities of a subject to end up in each of five levels (from "much less time" to "much more time") separately for men and women, assuming that they both have the same family structure imputed with the sample average values of *nonwork_spouse* and *childcardinal*. Figure 1, which contains six subfigures, compares the predicted probabilities that an average woman and an average man would respond in one of the five levels of time allocation for each the six time categories (with other covariates measured at their sample averages). For *Time_Research* (top left subfigure), women lead men in reporting "much less" (24.3% vs. 18.5%) and "less" (41.7% vs. 39.3%) time spent in research compared to pre-

[9] The ordered logit model assumes that the sensitivity of the odds ratio of going to higher level(s), from any given level below the top level, has constant elasticity with respect to the covariates. The model does allow differential base-level probabilities for each level, which are captured by the intercept estimates associated with different levels.

pandemic levels, and trail men in all three higher levels. As for time spent in teaching (top middle subfigure), women are less likely to report the three lowest levels (1.0%, 6.2%, and 26.6% for "much less," "less," and "about the same" respectively) than men (1.4%, 8.6%, and 32.2%), and more likely to be in the "more" and "much more" levels. For domestic chores (top right subfigure), very few men and women report less work than before, but women are less likely to remain "about the same" than men (33.2% vs. 36.8%) and are correspondingly more represented in the two higher levels. A very similar pattern applies to time allocated to child care (bottom left subfigure). For leisure activities (bottom middle subfigure), proportionally more women report "much less" than men (37.3% vs. 32.8%). Finally, proportionally fewer women report that they have kept the same amount of sleep time (57.1% vs. 59.3%), with the difference mostly offset by the "less time" category (bottom right subfigure).

[Insert Figure 1 here.]

We apply the same method to show the predicted probabilities being in any of the five reported time allocation categories, where we sort researchers in increasing order of demands for child care using the presence of children and their ages: No child at home; children 13-18 years; children 6-12 years, and children 0-5 years. It is clear from Figure 2, top left subfigure, that the probabilities or answering "much less time" allocated to research increases monotonically with the demand of child care: 10.9%%, 17.8%, 28.1%, and 41.1%. The pattern for the "less time" category is similar but less steep. The three higher-level categories all show a reverse order. For example, predicted probabilities for reporting "more time" in research are 26.2%, 17.8%, 11.1%, and 6.6%. The steepest contrast in this sorting, not surprisingly, occurs in time allocation to childcare (bottom right subfigure). The predicted probabilities of being in the "much more time" categories are 2.8%, 14.4%, 49.8%, and 85.3% from no-child to at least one child being in the 0-5 year age range. A similar, but less steep, pattern prevails in time spent in domestic chores and reverse patterns are observed in time spent in leisure and sleep. Interestingly, there is very little difference in time spent teaching as we vary child care demands. More likely this could reflect that time required for teaching is less flexible than research time and has to be put in regardless of other constraints; indeed the pandemic with the move to online classes may have imposed a uniform learning time cost on all.

[Insert Figure 2 here.]

We would like to note that the ultimate effects of a non-working spouse and children on men versus women is more nuanced than what the regressions and corresponding figures indicate. This is because the coefficients represent estimates conditional on a particular state, but they ignore the differential unconditional probabilities of being in the state for men and women. The summary statistics in Table 2 show that non-working spouse is much more common for men, while junior women are less likely to have children. Hence, the total impact of COVID-19 will vary accordingly.

3.2. Research Productivity

The time allocation changes reported in Table 3 capture tradeoffs for the scarce resource of time. Research time is a pre-requisite for research output, but is also just one of many inputs into research productivity. To understand how the pandemic is affecting research productivity as an output, we turn to our output measure of self-assessed research productivity. We first look at how research productivity varies according to predetermined variables, gender and family structure. We then add time inputs (of time spent on non-research activities), which reflect how people are allocating time differently during the pandemic. We then layer in variables that measure concerns regarding social interactions, which also affect people differentially.

We begin by estimating an ordered logistic regression analogous to the time allocation estimations of Table 3, but the dependent variable is now the effect of the pandemic on research productivity, ranging from 1 (strong negative effect) to 5 (strong positive effect). Results are reported in Table 4. In Table 5, we run the same regressions as in Table 4, but we separate the subjects into three groups according to seniority: senior (i.e., tenured) scholars, junior scholars, and Ph.D. students. This allows us to examine potentially differential impacts of COVID-19 at different stages of the research career.

[Insert Table 4 & 5 here.]

Column (1) of Table 4, and Columns (1), (3), and (5) of Table 5 include in the regressors only exogenous factors, including the gender the family structure variables. Table 4 Column (1) shows that having a non-working spouse helps research productivity (at the 10% significance level). The breakdown of subjects into three groups based on seniority rank (Table 5) reveals that the non-working spouse effect is driven by junior faculty, not tenured faculty nor by Ph.D. students. Young children negatively impacted research productivity during the pandemic for all faculty; the effect is highly significant (at the 1% level) for senior and junior faculty but not at all significant for Ph.D. students. Even after controlling for family structure, however, women are still significantly (at the 1% level) more negatively impacted by COVID-19. Moreover, the magnitude of the impact increases as faculty become more senior, it goes from insignificant for Ph.D. students, to marginally significant (at the 10% level) for junior faculty, to highly significant (at the 1% level) for senior faculty. It may be that senior women took on disproportionately more service during the pandemic (e.g., Guarino and Borden (2017) document that women, especially senior women, shoulder disproportionately more service work such as serving on committees and mentoring students). The volume of such work ballooned during the pandemic as most schools set up many task forces to address the challenges created by the pandemic. As such, female scholars, especially senior women, in the profession may have faced disproportionately more administrative "taxes" on their research productivity.

Similar to Figures 1 and 2, Figure 3 presents the predicted probabilities of changes in research productivity. The left subfigure shows a sizable gender gap in the predicted reporting of "much less"

research productivity, 53.9% for women and 43.0% for men. The right subfigure shows the impact of children. Consistent with the patterns in Figure 2, the impact of children is the steepest in the "much less" category. The predicted probability for a researcher to feel "much less" productivity than before is 31.8% for those without children at home, 42.7% with children of age 13-18 years, 55.4% with children of age 6 to 12; and 67.4% with children of age 0 to 5. Importantly, the predicted probabilities that researchers will report "more" or "much more" productivity range from 5.8% for faculty with children ages 0 to 5 to 21.6% for faculty with no children. This highlights the positive productivity shocks for a segment of the faculty population.

[Insert Figure 3 here.]

In Columns (2) and (3) of Table 4, we further explore potential mechanisms underlying the relationship between research productivity and both gender and family structure, including the role played by the time inputs. For this analysis, we include progressively the time allocation variables in Table 4. Columns (2) shows that the negative effect on research that is associated with having young children comes from more time allocated to child care and chores. Column (3) shows an additional negative effect on research associated with time devoted to teaching. These effects all significantly hurt research productivity (at the 1% level).

In the last column of Table 4, we add three new variables that characterize the professional environment and social-psychological state of faculty. *Feedback*, *Isolation*, and *Health* measure concern about timely feedback on research, isolation, and physical/mental health on a Likert scale ranging from "Not Concerned" (value of one) to "Very Concerned" (value of five). Column (4) of Table 4 shows that perceived lack of feedback on research and concerns for health are highly significantly (at the 1%) level correlated with research productivity; and the feeling of isolation also contributes negatively (significant at the 10% level) to research productivity.

Returning to Table 5, the breakdown by seniority rank further reveals that the time consumed by childcare affects junior scholars more than seniors (both are significant at the 1% level), but it does not significantly impact Ph.D. students (who are less likely to have children). The impact of time allocated to teaching varies similarly across rank as what we observe with childcare: Domestic chores affect all groups roughly evenly. Time required by teaching affects faculty research productivity (seniors slightly more than juniors) significantly (at the 1% level). Ph.D. students are not notably affected, as they are lightly involved in teaching. Lack of feedback on research and concern for personal health also affects self-reported research productivity of all groups similarly, but perceived isolation hit the Ph.D. students the hardest (this is the only group with a significant effect of isolation, and is consistent with the increased rates of depression and anxiety among graduate students reported in Woolston, 2020).

Several interactive effects are worth noting. First, comparing the different specifications in Tables 4 and 5 sheds light on whether and to what extent time choices absorb the effect of family structure. The time choices only slightly offset the effect from a nonworking spouse. However, the inclusion of changes in time allocated to childcare, chores and teaching render the coefficients on *childcardinal* insignificant, both economically and statistically, and for all groups of subjects. Such an absorption implies that the variable *childcardinal,* in this context, is not picking up heterogeneity between households with and without children outside of the parental time commitment required to childcare during a time when the usual help (day care, babysitters, housekeepers etc.) were not available. The contrast between the baseline and extended regressions in Tables 4 and 5 suggests that the impact of family structure on research productivity during the COVID-19 pandemic was more likely to be causal than being the outcome of unobserved heterogeneity across households that are correlated with children.

Second, the coefficient on the interaction term *fem_ind* and *childcardinal* is positive and significant (at the 1% level) when time allocation is controlled for (Table 4, Columns 3 and 4). This is true for the subsamples of faculty (Table 5, Columns 2 and 4), but not Ph.D. students (Table 5, Column 6). Moreover, the inclusion of the interaction term does not notably change the magnitude of the coefficients of *fem_ind.* Therefore, women seem to be managing the loss of research time due to time spent with children in a more research-productive way than men. This is a novel finding not documented before, and is consistent with the idea that women may have already learned, more than men, how to adapt to multitasking and managing work-life balance.

Finally, the inclusion of social psychological variables reduces the gender effect: The coefficient on *fem_ind* changes from – 0.718 to –0.514 from columns (3) to (4) in Table 4, suggesting that part of the gender disparity might be driven by differential impact of COVID-19 on the environment and psychology of women and men. The next section will explore this mechanism in more detail.

3.3. Intensity of Mechanisms that Affected Research Productivity

Building on the previous results, this section further explores the various mechanisms that reduce research productivity, and how such mechanisms vary with gender and seniority rank. More specifically, we estimate a regression of the following form:

$$Mech_i = a + \beta_1 junior + \beta_2 female + \beta_3 (junior * female) + e_i. \quad (2)$$

In equation (2), the dependent variable, *Mech,* is a group of variables that are potential mechanisms through which COVID-19 impacts research productivity. The mechanisms that we consider include concerns about feedback, isolation, and physical/mental health (*Feedback*, *Isolation*, and *Health*). We also include the family structure variables, *nonworking_spouse* and *childcardinal*. The independent variables include gender, seniority ranks (dummy variables for junior faculty and students), and the interaction of the two.

We focus on junior faculty and Ph.D. students because their long-term career outcomes are potentially more vulnerable to the pandemic shock. In these regressions, senior faculty serves as the omitted category. Table 6 reports the results.

[Insert Table 6 here.]

In Table 6, all of the odd columns report regressions results for the faculty subsample only; all the even columns include both faculty and Ph.D. students. Overall, the results in Table 6 show that junior faculty are in a significantly weaker position to withstand the COVID-19 shock compared to senior faculty: They are more likely to express concerns for the lack of feedback on their research, to feel isolated, and to worry about their own health (physical or mental). Moreover, they are less likely to have the help of a non-working spouse and are more like to have young children. All of these factors, significant at the 5% level or less, have a negative effect on research productivity, contributing to the overall lower research productivity reported by juniors in Table 1. In sum, despite the fact that the mechanisms affecting productivity impact junior and senior faculty similarly (Table 5, Columns 2, 4 and 6), the intensity of the mechanisms is consistently greater for junior faculty.

Focusing on gender, we find that women are also more concerned about feedback than their male peers (significant at the 1% level) possibly due to the relatively narrow professional network and the relative scarcity of other senior female scholars in the field.[10] The network issue was only exacerbated during the COVID-19 pandemic, as conferences and seminars went virtual and other opportunities to interact with colleagues were dramatically reduced. While women express similar feelings of increased isolation relative to men, they also expressed more concerns over their own health (significant at the 5% level) than men. They are also less likely to have a nonworking spouse though the presence of children does not differ significantly. In short, the mechanisms affecting research productivity tend to be more intense for women than men.

Several interaction terms reveal additional nuances. For example, the reliably negative interaction of *junior*female* in the *Feedback* regression (Columns 1 and 2) indicates that concerns regarding feedback are similar for male and female junior faculty (which are significantly higher than for senior faculty), but they are significantly stronger for senior women compared to senior men. Analogously, the reliably negative coefficient on *junior*female* interaction term in the regression where *childcardinal* is the dependent variable (Column 9) suggests that junior men are more likely than junior women to have a childcare issue (consistent with Table 2, which shows that junior women are less likely than junior men to have children).

[10] Sherman and Tookes (2020) report that women represent only 14.8% of tenured faculty in 2017, and their sample of recent graduates is 20.4% female. Santos and Phu (2019) document a similar pattern among 24 Russell Group universities in the UK.

Table 6 also extends the analyses to include students. Though students do not express increased concerns about feedback (perhaps because many are not at the stage to have a product requiring feedback), they do report significantly heightened concerns about isolation (at the 5% level) and health (at the 10% level) compared to faculty. Due to the stage in their lives in which many students attend graduate school, students are less likely to have a nonworking spouse and are less likely to have children. Connecting results in Table 6 with those in Table 5, we learn that Ph.D. students are not only more likely to feel isolated and are concerned about their health, but also that a given level of such a state exerts a stronger effect on their research productivity. The coefficients of the interaction between *female* and *student* in Table 6 all point to a negative impact on research productivity, but only the effect on health is significant (at the 5% level). That is, female Ph.D. students are more likely to be concerned about their own health compared to their male classmates. The combined results from the student subsample demand more awareness on the physical and social conditions on the next-generation of scholars as a result of COVID-19 lockdowns.

4. Institutional Variation and Responses

In this section, we explore variation in the effect of COVID-19 on research productivity across institutions. We focus on differences in financial strength and the tenure accommodation policies introduced as a result of the pandemic.

4.1. Institution Financial Strength

Research requires resources and the institutional financial situation impacts research productivity. Not only do universities differ hugely in terms of their endowments, revenues, and gifts, but they were also affected by the COVID-19 shock differently. For example, schools relying more heavily on tuition from international students are hit harder (Fischer, 2019). We attempt to capture faculty members' assessments of their institutions' financial health by using the responses to a question about employer finances. Specifically, we use responses to "I worry about the finances of my employer," where responses measured on a 5-point Likert scale from (1) to (5).

To quantify the impact of employer finances on employee research productivity, we estimate an ordered logistic regression where the dependent variable is *Research_Productivity*. We also estimate regressions where the dependent variable is a factor that affects research output and likely varies across institutions (*Time_Research, Time_Teaching, Feedback, Isolation,* and *Health*). The key independent variable is *Employer_Finance*, the self-reported concern for employer finances from "strongly disagree" (value of one) to "strongly agree" (value of five), where a lower value indicates a better financial situation. All variables are in the original 5-point scale.

[Insert Table 7 here.]

Table 7 reports the results. We find that heightened concern about employer finances and vulnerability to the COVID-19 shock is significantly (at the 1% level) associated with lower research productivity. In the remaining columns of Table 7, we also observe all of the mechanisms that affect research productivity are stronger at financially insecure institutions. Heightened concern about employer finances is associated with less time spent in research, more time spent in teaching (as teaching became incrementally more demanding in schools with poor financial cushions), more worries about feedback on research, more intense feeling of isolation, and more concerns about own health.

Figure 4 shows the relationship between worry about employer financial health and changes in research productivity and time spent on teaching (the two most important job activities of faculty), using the same method to predict probabilities as in the earlier figures. The left subfigure shows that the predicted probability in the "much less" research productivity category increases monotonically and steeply with the worry for the financial conditions of their institutions (30.0%, 35.8%, 43.2%, 50.9%, and 58.6% from "strongly disagree" to "strongly agree," respectively). The patterns in all higher levels of research productivity manifest a reverse order, but the steepest ascendances are in the "more" and "much more" research productivity categories.

[Insert Figure 4 here.]

One mechanism driving the impact of institutional financial well-being on research productivity could be teaching. Universities with financial constraints may be imposing more teaching burdens on faculty. These burdens could be in the form of more preparations, more course loads, and/or inadequate support for faculty to transition to online teaching. As a result, faculty at less well-endowed institutions and institutions that experience more revenue drops lose more research productivity due to more time spent on teaching (O'Meara et al., 2003; Hanlon, 2019). The right subfigure of Figure 4 confirms this hypothesis. It shows that the predicted probability that subjects spend "much less," "less," and "about the same" time in teaching is monotonically decreasing in their worry for employer financial condition; and the order is reversed for the predicted probability that subjects spend "more" or "much more" time in teaching. For subjects that "strongly disagree" that they worry about employer finance, the predicted probability that they have to spend "much more" time in teaching is 12.1%, the same figure is more than doubled at 29.4% for subjects that "strongly agree" with the statement regarding worry about their employer.

Overall, COVID-19, already a negative shock, has the unfortunate additional impact of exacerbating the existing unequal resources and support for researchers due to variation in the financial conditions of their universities. We anticipate the gap in research productivity between researchers in well-endowed institutions and those in the less resourceful schools will increase in the coming years.

4.2. Clock Extensions

One prompt policy response to the pandemic was the decision by many universities to extend the tenure clock, either automatically or optionally. This action acknowledged the fact that research would suffer considerable delays due to direct forces such as limited or suspended access to labs and data, and indirect ones such as hiring freezes on research assistants. To explore the effect of these clock extensions on research productivity, we construct an indicator variable, *ExtendClock*, that equals one if the respondent affirms the presence of an automatic or optional clock extension for untenured faculty at their institution. About 70% of respondents indicate the presence of such a policy (see Table 1). The clock extension policy may also be a proxy for an institution's overall willingness and preparedness to support employees during an unusually difficult time. In this analysis, we restrict the analysis to junior faculty since it is among this group that we would expect to observe changing behavior in response to tenure clock changes. Results are reported in Panel B of Table 7.

Interestingly, clock extension, if anything, reduces research productivity (significant at 10%), and also reduces time allocated to research (not significant) and teaching (significant at 10%). While it is plausible that junior faculty reduce research in response to a clock extension because they no longer feel an impending deadline, we find it surprising that we observe a similar effect for teaching. None of the remaining mechanisms are affected by the clock extensions in a statistically significant way.

We emphasize that clock extension policies are one-size-fits-all and temporary accommodations. Clock extensions do not address the differential mechanisms that are affecting productivity (e.g., variation in teaching responsibilities, family structure, and gender). Given that different groups are differentially impacted by the pandemic as we report here, sweeping clock extension policies may exacerbate rather than address disparities that have emerged during the crisis. The outcome could well be analogous to the unintended consequence of the gender-neutral parental clock-stopping which ended up creating a new advantage for men relative to women, as analyzed in Antecol, Bedard, & Stearns (2018). For example, 14.5% of the faculty respondents to our survey responded that their research productivity increased during the pandemic. Our analyses have shown that this outcome is significantly correlated with gender and family structure.

In institutions giving the same length of clock extension within the sample of clock-extending institutions, those whose research productivity is more negatively impacted by COVID-19 due to pre-existing situations are expected to lag behind. And, given the "cohort comparison" method commonly adopted in the tenure review process, male faculty and faculty without young children may catapult above the rest as a result of the current public health crisis. In their call for new solutions to support equity in academia, Malisch et al. (2020) encourage institutions to develop strategic action plans to account for differential changes in faculty productivity due to COVID-19.

Our survey results support the need for such action plans. We welcome discussions on how to incorporate the differential effects of the pandemic on individual faculty research. Such guidance will be particularly important for letter writers, who are often asked for a cohort comparison when assessing a candidate's merit for tenure.

5. Conclusion

COVID-19 has upended normal life and dramatically changed the working environment for most researchers. To understand the impact of COVID-19 on research productivity in the academic finance profession, we administered a survey to the membership of the American Finance Association (AFA).

In the survey, we asked members to evaluate the impact of the pandemic on their own research productivity and on the time spent on research and related activities. Overall, faculty respondents report a negative research effect. But there is also heterogeneity in the response, with 14.5% of our faculty respondents reporting an increase in research productivity. We analyze how effects on research productivity differ by seniority, gender and family structure.

We find that there is a significant overall decline in research productivity but there are marked differences by family structure and gender. In particular, research productivity of women and faculty with young children are affected more adversely. Further, while faculty are spending more time on their teaching, we observe a strong gender effect, with women reporting spending more time on teaching-related activities, Our results suggest that the pandemic has the effect of widening the gap for women and for faculty with young children.

We further examine the underlying mechanism for differentials in research productivity by examining changes in time allocation of different tasks. Here we find that the productivity loss of faculty with young children stems from time being allocated to childcare and chores.

Our survey results suggest that, like the general population, faculty are also vulnerable to isolation and concerns about health as a result of COVID-19. We find that perceived lack of feedback on research, concerns for health, and feelings of isolation are highly correlated with reduced research productivity. These concerns are particularly strong for junior faculty, and for faculty in institutions with serious financial concerns. Ph.D. students are particularly vulnerable to feelings of isolation.

Many institutions have responded to the pandemic with blanket uniform extensions of the tenure clock for junior faculty. Our results suggests that there are heterogeneous effects of the pandemic with systematic patterns for different groups. As such, one size fits all clock extension policies may exacerbate rather than address disparities that have emerged during the crisis. We hope that the findings reported here generate discussion and awareness among university administrations about the potentially disparate impact of a well-intentioned uniform policy.

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Table 1. Summary Statistics: Means (Standard Deviation)

Fem_ind, nowork_spouse, Child_0to5 (etc.), ExtendClock, Europe and United States are indicator variables. *Research Productivity* is effect of COVID on research on a Likert: (1) Strong Negative Effect to (5) Strong Positive Effect. Time varuables are time spent on an activity during the pandemic measured on a Likert scale: (1) much less to (5) much more. *childcardinal* is 0 for respondents with no children, 1 for those with children over 13, 2 for those with children between 5 and 13, and 3 for those with children under 5. *Feedback, Isolation, Health* , and *Employer_Finances* measure concerns on a Likert scale: (1) Not Concerned to (5) Very Concerned.

VARIABLES	All Faculty (N=731)	Senior Faculty (N=402)	Junior Faculty (N=329)	PhD Students (N=277)
Research_Productivity	1.943	2.100	1.751	2.126
	(1.169)	(1.239)	(1.047)	(1.104)
Time_Research	2.427	2.478	2.365	2.957
	(1.141)	(1.154)	(1.124)	(1.132)
Time_Teaching	3.714	3.761	3.657	2.928
	(0.942)	(0.928)	(0.957)	(0.873)
Time_Childcare	3.841	3.808	3.881	3.271
	(0.935)	(0.910)	(0.963)	(0.734)
Time_Chores	3.752	3.714	3.799	3.603
	(0.778)	(0.744)	(0.817)	(0.799)
Time_Leisure	1.929	1.893	1.973	2.466
	(0.857)	(0.833)	(0.885)	(1.065)
Time_Sleep	2.713	2.736	2.684	3.162
	(0.742)	(0.688)	(0.802)	(0.900)
Female	0.300	0.271	0.334	0.455
	(0.458)	(0.445)	(0.472)	(0.499)
Nonwork_spouse	0.249	0.301	0.185	0.173
	(0.433)	(0.459)	(0.389)	(0.379)
Child_0to18	0.592	0.624	0.553	0.199
	(0.492)	(0.485)	(0.498)	(0.400)
Child_0to5	0.326	0.226	0.447	0.152
	(0.469)	(0.419)	(0.498)	(0.359)
Child_6to12	0.302	0.361	0.231	0.069
	(0.460)	(0.481)	(0.422)	(0.253)
Child_13to18	0.140	0.236	0.021	0.025
	(0.347)	(0.425)	(0.145)	(0.157)
Childcardinal	1.249	1.124	1.401	0.487
	(1.188)	(1.042)	(1.331)	(1.031)
Feedback	4.001	3.853	4.182	3.823
	(0.855)	(0.855)	(0.821)	(0.937)
Isolation	3.702	3.597	3.830	3.783
	(1.140)	(1.140)	(1.130)	(1.205)
Health	3.658	3.455	3.906	4.170
	(1.118)	(1.149)	(1.027)	(0.923)
ExtendClock	0.689	0.679	0.702	0.058
	(0.463)	(0.467)	(0.458)	(0.234)
Employer_Finances	3.446	3.505	3.374	3.437
	(1.121)	(1.079)	(1.167)	(1.084)

Table 2. Family Structure by Gender and Rank

The table presents mean values by gender and faculty rank with tests for differences. N*onworking Spouse* and *Child_0to5* (6to12, 13to18) are indicator variables. C*hildcardinal* is 0 for respondents with no children, 1 for those with children over 13, 2 for those with children between 5 and 13, and 3 for those with children under 5.

	All Faculty (N=731)			Senior Faculty (N=402)			Junior Faculty (N=329)			PhD Students (N=277)		
	Men	Women	Men - Women	Men	Women	Men - Women	Men	Women	Men - Women	Men	Women	Men - Women
NonworkingSpouse	0.295	0.142	0.153***	0.345	0.183	0.161***	0.228	0.100	0.128***	0.219	0.119	0.099**
Child_0to5	0.334	0.306	0.028	0.222	0.239	-0.017	0.484	0.373	0.111*	0.159	0.143	0.016
Child_6to12	0.301	0.306	-0.005	0.324	0.459	-0.134**	0.269	0.155	0.115**	0.060	0.079	-0.020
Child_13to18	0.141	0.137	0.004	0.229	0.257	-0.028	0.023	0.018	0.005	0.026	0.024	0.003
Child_0to18	0.605	0.562	0.044	0.608	0.670	-0.062	0.603	0.455	0.148**	0.199	0.198	0.000
Childcardinal	1.275	1.187	0.088	1.102	1.183	-0.081	1.507	1.191	0.316**	0.490	0.484	0.006

*** p<0.01, ** p<0.05, * p<0.1

Table 3. COVID Time Effects and Family Structure

The sample includes research faculty in tenure-track university positions. The dependent variable is time spent on an activity during the pandemic measured on a Likert scale that ranges from (1) much less to (5) much more. The independent variables include a gender indicator, a nonworking spouse indicator, and cardinal child variable. The child variable is 0 for respondents with no children, 1 for those with children over 13, 2 for those with children between 5 and 13, and 3 for those with children under 5. Models are estimated as ordered logistic regressions in a seemingly unrelated regression framework.

VARIABLES	(1) Time_ Research	(2) Time_ Teaching	(3) Time_ Chores	(4) Time_ Childcare	(5) Time_ Leisure	(6) Time_ Sleep
Female	-0.420**	0.499**	-0.0337	-0.308	0.0572	-0.0544
	[0.199]	[0.221]	[0.211]	[0.213]	[0.202]	[0.236]
Nonwork_spouse	0.124	0.262*	-0.125	-0.360*	-0.210	-0.0787
	[0.165]	[0.158]	[0.153]	[0.189]	[0.159]	[0.157]
Childcardinal	-0.596***	-0.00674	0.427***	1.631***	-0.272***	-0.539***
	[0.0740]	[0.0680]	[0.0736]	[0.112]	[0.0697]	[0.0740]
*Female*Childcardinal*	0.0320	-0.0916	0.173	0.442**	-0.282**	-0.141
	[0.121]	[0.132]	[0.133]	[0.203]	[0.136]	[0.140]
Observations	731	731	731	731	731	731

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 4. COVID Research Effects

The sample includes research faculty in tenure-track university positions. The dependent variable is research productivity during the pandemic measured on a Likert scale ranging from (1) Strong Negative Effect to (5) Strong Positive Effect. The independent variables include indicators for gender, nonworking spouse, and a cardinal child variable. The independent time variables measure time spent on an activity during the pandemic measured on a Likert scale that ranges from (1) much less to (5) much more. Feedback, Isolation, and Health measure concern about timely feedback on research, isolation, and physical/mental health on a Likert scale ranging form (1) Not Concerned to (5) Very Concerned. Models are estimated as ordered logistic regressions.

VARIABLES	(1) Research_ Productivity	(2) Research_ Productivity	(3) Research_ Productivity	(4) Research_ Productivity
Female	-0.650***	-0.794***	-0.718***	-0.514**
	[0.213]	[0.217]	[0.219]	[0.223]
Nonwork_spouse	0.305*	0.208	0.277	0.197
	[0.163]	[0.167]	[0.168]	[0.171]
Childcardinal	-0.550***	-0.00796	-0.0617	-0.117
	[0.0740]	[0.0931]	[0.0940]	[0.0989]
*Female*childcardinal*	0.192	0.378***	0.378***	0.382***
	[0.134]	[0.135]	[0.138]	[0.142]
Time_Childcare		-1.000***	-0.951***	-0.920***
		[0.126]	[0.128]	[0.134]
Time_Chores		-0.404***	-0.456***	-0.319***
		[0.108]	[0.110]	[0.113]
Time_Teaching			-0.600***	-0.514***
			[0.0820]	[0.0840]
Feedback				-0.577***
				[0.0979]
Isolation				-0.128*
				[0.0748]
Health				-0.385***
				[0.0760]
Observations	731	731	731	730

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 5. COVID Research Effects by Rank (Senior Faculty, Junior Faculty, or Student)

The subsamples includes research tenured faculty in university positions (senior faculty), untenured faculty in university positions (junior faculty), and students. The dependent variable is research productivity during the pandemic measured on a Likert scale ranging from (1) Strong Negative Effect to (5) Strong Positive Effect. The independent variables include indicators for gender, nonworking spouse, and a cardinal child variable. The independent time variables measure time spent on an activity during the pandemic measured on a Likert scale that ranges from (1) much less to (5) much more. Feedback, Isolation, and Health measure concern about timely feedback on research, isolation, and physical/mental health on a Likert scale ranging form (1) Not Concerned to (5) Very Concerned. Models are estimated as ordered logistic regressions.

	Senior Faculty		Junior Faculty		Students	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Research_ Productivity	Research_ Productivity	Research_ Productivity	Research_ Productivity	Research_ Productivity	Research_ Productivity
Female	-0.733**	-0.471	-0.399	-0.584*	-0.0666	0.0505
	[0.311]	[0.333]	[0.305]	[0.321]	[0.243]	[0.250]
Nonwork_spouse	0.0473	-0.0300	0.538*	0.491	-0.228	-0.0772
	[0.204]	[0.214]	[0.283]	[0.301]	[0.299]	[0.310]
Childcardinal	-0.618***	-0.183	-0.474***	-0.0144	-0.148	-0.0559
	[0.109]	[0.139]	[0.106]	[0.146]	[0.154]	[0.186]
*Female*childcardinal*	0.142	0.494**	0.175	0.341*	-0.326	-0.239
	[0.214]	[0.234]	[0.176]	[0.188]	[0.233]	[0.246]
Time_Childcare		-0.875***		-1.064***		-0.215
		[0.178]		[0.209]		[0.220]
Time_Chores		-0.332**		-0.319**		-0.293*
		[0.160]		[0.162]		[0.155]
Time_Teaching		-0.608***		-0.441***		-0.193
		[0.114]		[0.129]		[0.140]
Feedback		-0.587***		-0.548***		-0.522***
		[0.134]		[0.151]		[0.134]
Isolation		-0.106		-0.150		-0.272***
		[0.100]		[0.115]		[0.102]
Health		-0.427***		-0.267**		-0.392***
		[0.101]		[0.122]		[0.130]
Observations	402	401	329	329	277	277

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Mechanism Intensity by Rank and Gender

The dependent variables are Feedback, Isolation, Health, and childcardinal. Odd columns use the sample of tenure-track faculty with independent indicator variables for gender and junior rank. Even columns use the sample of tenure-track faculty plus students and add indicators for student and its interaction with gender. Models are estimated as ordered logit regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Feedback	Feedback	Isolation	Isolation	Health	Health	Nonwork_ spouse	Nonwork_ spouse	Child cardinal	Child cardinal
Junior	1.033***	1.012***	0.357**	0.344**	0.852***	0.850***	-0.576***	-0.576***	0.594***	0.555***
	[0.172]	[0.169]	[0.162]	[0.160]	[0.168]	[0.167]	[0.203]	[0.203]	[0.166]	[0.164]
Female	0.885***	0.864***	0.0786	0.0770	0.525**	0.524**	-0.851***	-0.851***	0.126	0.120
	[0.211]	[0.209]	[0.205]	[0.203]	[0.208]	[0.207]	[0.276]	[0.276]	[0.192]	[0.190]
*Junior*Female*	-0.831***	-0.812***	0.199	0.190	-0.338	-0.337	-0.129	-0.129	-0.693**	-0.652**
	[0.305]	[0.304]	[0.302]	[0.298]	[0.298]	[0.298]	[0.451]	[0.451]	[0.303]	[0.299]
Student		0.00210		0.423**		1.460***		-0.632***		-1.436***
		[0.189]		[0.184]		[0.191]		[0.232]		[0.229]
*Student*Female*		-0.372		-0.119		-0.551*		0.123		-0.126
		[0.307]		[0.303]		[0.307]		[0.437]		[0.358]
Sample	Faculty	Faculty + Students	Faculty	Faculty + Students	Faculty	Faculty + Students	Faculty	Faculty + Students	Faculty	Faculty + Students
Observations	730	1,007	731	1,008	731	1,008	731	1,008	731	1,008

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Institution Finances and Policy Responses

In Panel A, the sample is all tenure-track university faculty and *Employer_Finances* measure concerns on a Likert scale: (1) Not Concerned to (5) Very Concerned. In Panel B, *ExtendClock* is an indicator that takes a value of one when respondent indicates institution had an automatic or optional clock extension in response to the pandemic.

VARIABLES	(1) Research_ Productivity	(2) Time_ Research	(3) Time_ Teaching	(4) Feedback	(5) Isolation	(6) Health
Panel A. Employer Finances						
Employer_Finances	-0.307***	-0.216***	0.272***	0.282***	0.313***	0.378***
	[0.0621]	[0.0610]	[0.0606]	[0.0632]	[0.0630]	[0.0641]
Observations	731	731	731	730	731	731
Panel B. Clock Extensions						
ExtendClock	-0.388*	-0.319	-0.376*	0.325	0.269	0.286
	[0.232]	[0.221]	[0.220]	[0.228]	[0.221]	[0.219]
Observations	329	329	329	329	329	329

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

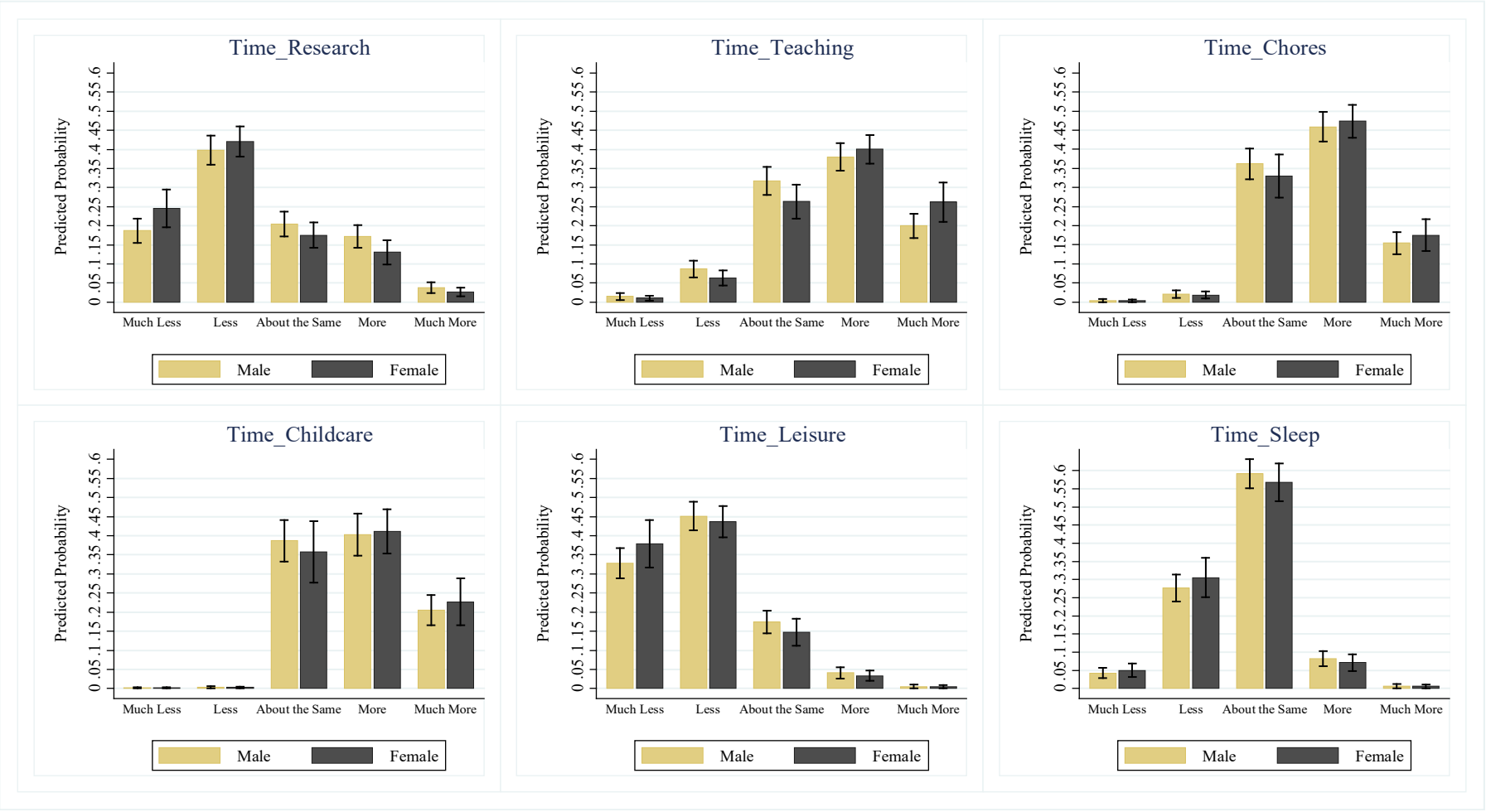

Figure 1: Predicted Probabilites of Time Usage with the Marginal Effects of Gender

Plotted in each of the figures above is the marginal effect of gender on the predicted probability of a time-use level ("much less", "less", "about the same", "more", and "much more") from each of the respective estimation of columns (1) - (6) of Table 3. In Table 3, the dependent variable for a column is a time-use variable -- research, teaching, chores, childcare, leisure, or sleep. The estimation is an ordered logit. Independent variables are non-working spouse, the cardinal child variable, the female indicator, and an interaction between female and the cardinal child variable. We take the marginal effect on the predicted probabily of a response bucket by gender, at the mean of the other independent variables. The confidence bands shown are at the 95% level.

Figure 2: Predicted Probabilites of Time Usage with the Marginal Effects of Children

Plotted in each of the figures above is the marginal effect of the levels of the cardinal child variable on the predicted probability of a time-use level ("much less", "less", "about the same", "more", and "much more") from each of the respective estimation of columns (1) - (6) of Table 3. The levels of the child variable -- the ages of children, if any -- are given in the legend. In Table 3, the dependent variable for a column is a time use variable -- research, teaching, chores, childcare, leisure, or sleep. The estimation is an ordered logit. Independent variables are non-working spouse, the cardinal child variable, the female indicator, and an interaction between female and the cardinal child variable. We take the marginal effect on the predicted probabily of a response bucket by the cardinal child variable, at the mean of the other independent variables. The confidence bands shown are at the 95% level.

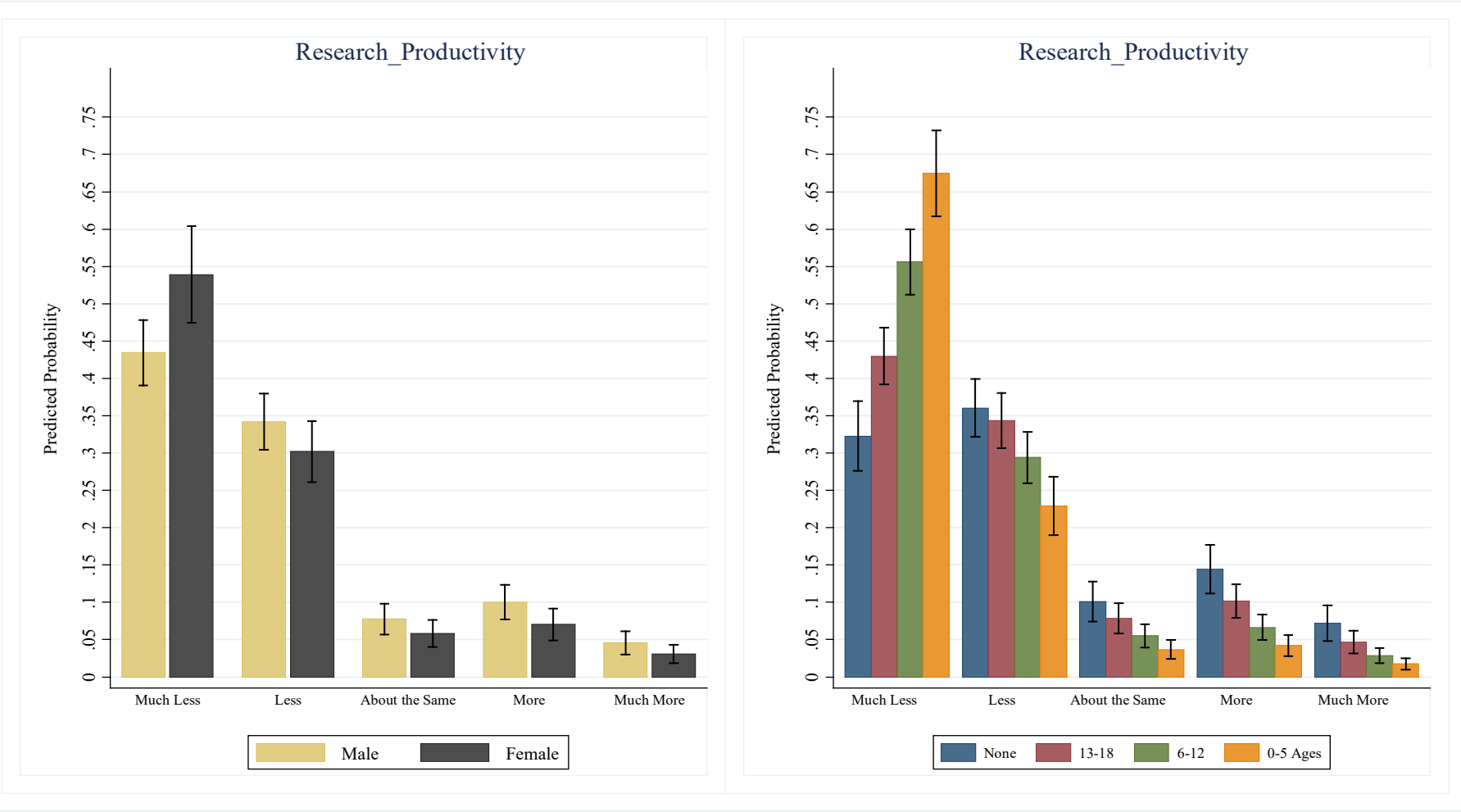

Figure 3: Predicted Probabilites of Research Productivity with Marginal Effects of Gender and Chlidren

Plotted in each of the figures above is the marginal effect of gender on the predicted probability of Research Productivity response being in one if the five choices ("much less", "less", "about the same", "more", and "much more"), from Table 4, column 1. The estimation is an ordered logit of answers to the Research Productivity level. Independent variables are non-working spouse, the cardinal child variable, the female indicator, and an interaction between female and the cardinal child variable. For the left figure, we take the marginal effect on the predicted probabily of a response bucket by gender, at the mean of the other independent variables. For the right figure, we take the marginal effect on the predicted probabily of a response bucket by the cardinal child variable, at the mean of the other independent variables.The confidence bands shown are at the 95% level.

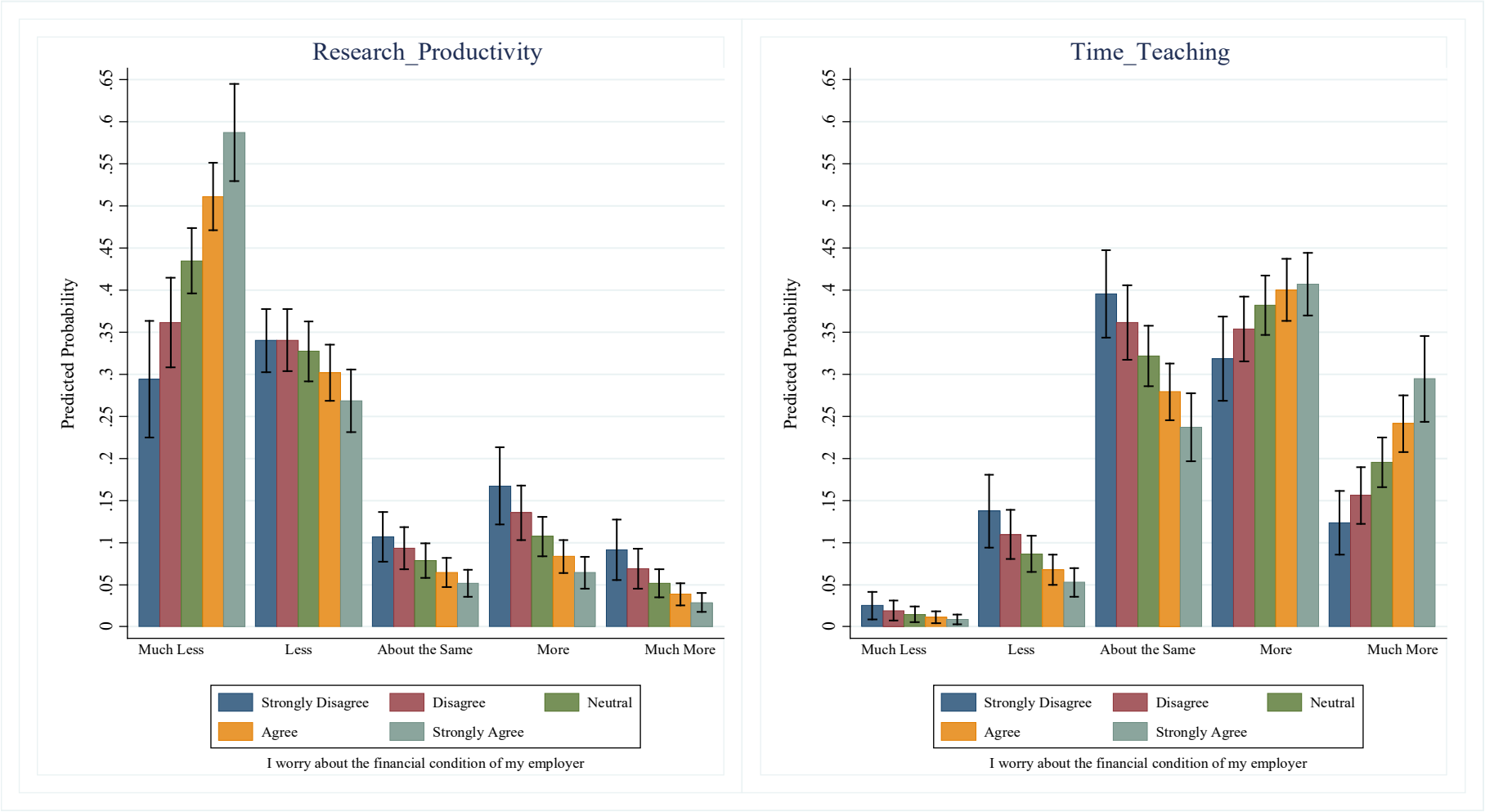

Figure 4: Predicted Probabilites of Research Productity and Teaching with Marginal Effects of the Financial Condition of Employer

Plotted in each of the figures above is the marginal effect of gender on the predicted probability of Research Productivity response being in one if the five choices ("much less", "less", "about the same", "more", and "much more"), from Table 4, column 1. The estimation is an ordered logit of answers to the Research Productivity level. Independent variables are non-working spouse, the cardinal child variable, the female indicator, and an interaction between female and the cardinal child variable. For the left figure, we take the marginal effect on the predicted probabily of a response bucket by gender, at the mean of the other independent variables. For the right figure, we take the marginal effect on the predicted probabily of a response bucket by the cardinal child variable, at the mean of the other independent variables.The confidence bands shown are at the 95% level.