Author's response to reviews

Title: Does salary affect the choice of residency in non-university teaching hospitals? A panel analysis of Japan Residency Matching Program data

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Author's response to reviews: see over
Title: Does salary affect the choice of residency in non-university teaching hospitals? A panel analysis of Japan Residency Matching Program data

Dear Dr. Mario Dal Poz

We would like to thank the reviewers for carefully reading our manuscript and for their helpful comments. In response to these comments, we have revised our manuscript (reference number: 1568953252664357) as follows below. We apologize for our delayed resubmission. We hope that our revisions have sufficiently addressed the comments and have improved the paper to be suitable for publication in *Human Resources for Health.*
Response to reviewer 1's comments:

We thank the reviewer for carefully reading our manuscript and for making useful comments and suggestions. Our responses to the reviewer's comments are as follows below.

- **P5: provide some explanation (one or two sentences) why income for university hospital residents being lower.**

  We appreciate the reviewer's suggestion and we would like to explain the situation of working conditions of physicians in Japan. Since the introduction of Western medicine in the late 19th century, universities have been central figures in medical education and training in Japan (1). The career path of Japanese physicians was under a strong influence by the authorities in medical schools because they had the power to allocate fellow physicians in affiliated hospitals, and were also monopolistically entitled to award academic degrees required for higher positions in hospitals (2)(3). However, because university tertiary hospitals were underfinanced by the government, the authorities in medical schools used young trainees as cheap labor for clinical practice and research, while providing them with authoritarian reward for future career paths in affiliated hospitals. The situation changed since the introduction of the new residency matching program in 2004 that weakened the authoritarian power over affiliated hospitals, and opened up career paths free from authoritarian influence by medical schools. This is the basis of the current study, which tested the impact of economic incentives on a resident's choice of training hospitals. However, slightly more than half (51.7%) of the trainees chose a training site outside of the university hospitals as of 2005 (4). Because medical graduates who sought an early career in university hospitals were likely to be under the traditional influence of university authorities, with a distinct set of incentives for career choice, we limited our analysis to non-university hospitals. We have added this argument to better justify why we tested the effect of salary on residents' choices over non-university hospitals.

However, it is premature to conclude from Kawamura’s study [17] that the effect of payment conditions for residency choice was limited among those residents in non-university hospitals. The annual incomes of residents at university hospitals were much lower than those at non-university hospitals. The salary in 2-years was 6478 thousand yen ($80,975) compared with 9115 thousand yen ($113,938) [17]. Therefore, it is possible that the choice of non-university hospitals was already affected by annual salary.

Revised

However, it is premature to conclude from Kawamura’s study [16] that the effect of payment conditions for residency choice is limited to those residents in university hospitals. In fact, according to Kawamura, the salary in 2 years in university hospitals was 6,478,000 yen ($80,975) on average, compared with 9,115,000 yen ($113,938) in non-university hospitals [16]. Lower salaries in university hospitals were often attributed to authoritarian influence by clinical departments in Japanese medical schools on young trainees’ future career paths in affiliated hospitals [4,17]. Therefore, it is possible that a young graduate’s choice of non-university hospitals in his/her early career is already affected by incentives other than authoritative reasons, including economic incentives related to annual salary.
• *p6 should be "improved payments conditions..."

We have changed the phrase slightly to “improved payment conditions” on the advice of a native-speaking English editor.

**Original (page 6, line 8)**

The objective of the current study was to identify whether the improved payment condition affected a medical graduate’s choice of residency program.

**Revised**

The objective of the current study was to identify whether the improved payment conditions affected a medical graduate’s choice of residency program.

• *p6 final sentence – suggest should be re written as "....by an endogenously determined annual salary, and by controlling this we aimed to determine the actual effect on a new graduate’s choice of residency program" [or similar].

We appreciate the suggestion and have revised the sentence as follows.

**Original (page 6, line 19)**

Thus, we hoped to overcome any bias caused by an endogenously determined annual salary, and with controlling those interference, we aimed to get true effect onto a new graduate’s choice of residency program [19].

**Revised**

Therefore, we hoped to overcome any bias caused by an endogenously determined annual salary, and *by controlling this*, we aimed to determine the actual effect of salary on a new graduate’s choice of residency program [21].
• **p7 first sentence - is it "issues interim and final annual reports".**

  We appreciate the suggestion to clarify what we mean.

**Original (page 7, line 4)**

  The JRMP issues the interim and final reports.

**Revised**

  The JRMP issues the interim and final **annual** reports.

• **p9 "was not reliable to discriminatingly reflect the size.." requires a re writing as "was not reliable as an indicator of size"??**

  We appreciate the reviewer’s suggestion for clarifying our intention.

**Original (page 9, line 15)**

  Additionally, the number of departments was not reliable to discriminatingly reflect the size and function of hospitals because of non-standardized categorization of subspecialties under the current legal regulation of hospital administration in Japan [23].

**Revised**

  Additionally, the number of departments was not reliable **as an indicator of** size and function of hospitals because of non-standardized categorization of subspecialties under the current legal regulation of hospital administration in Japan [26].

• **p11, second top line "Over the studied period of 3 years salary in 2 years was increased...". Not clear and requires a re- write**

  We have revised the sentence as follows.

**Original (page 11, line 2)**

  Over the studied period of 3 years, salary in 2 years was increased by
1.03 million yen ($12,875, p<0.001).

Revised
Over the studied period of 3 years, the salary of the 2-year residency was increased by 1.03 million yen ($12,875, p<0.001).

Original (page 12, line 9)
Since the ratio in a smaller quota program is more susceptible to a change in applicants, we also conducted least square regression weighted by hospital size, and first difference estimation with dummy variables for hospital size, only to find significant coefficients of salary (data not shown).

Revised
Because the ratio in a smaller quota program is more susceptible to a change in the number of applicants, we also conducted least squares regression weighted by hospital size, and first difference estimation with dummy variables for hospital size, and found significant coefficients of salary (data not shown).

Original (page 13 paragraph beginning "According to.."
In accordance with the reviewer’s suggestion, we have moved the paragraph to the Background section as follows.

Revised (Background section)
However, it is premature to conclude from Kawamura’s study [16] that

p12 second para first line- add “the number” so reads “Since the ratio in a smaller quota program is more susceptible to a change in the number of applicants..”

We appreciate the reviewer’s suggestion for clarifying our meaning.
the effect of payment conditions for residency choice is limited to those residents in university hospitals. In fact, according to Kawamura, the salary in 2 years in university hospitals was 6,478,000 yen ($80,975) on average, compared with 9,115,000 yen ($113,938) in non-university hospitals [16]. Lower salaries in university hospitals were often attributed to authoritarian influence by clinical departments in Japanese medical schools on young trainees’ future career paths in affiliated hospitals [4,17]. Therefore, it is possible that a young graduate’s choice of non-university hospitals in his/her early career is already affected by incentives other than authoritative reasons, including economic incentives related to annual salary.

According to a questionnaire survey conducted by the Ministry of Health, Labour, and Welfare (MHLW), 27.1% of residents who chose non-university hospitals answered that salary and work environment affected their choice of training hospitals [6]. Nomura et al. also conducted a questionnaire survey among second-year residents, and reported that those who chose non-university hospitals were more satisfied with a higher income [4].
Response to reviewer 2’s comments:

We thank the reviewer for carefully reading our manuscript and for making useful comments on concepts that we used in the paper. Our responses to the comments are given below.

- Residents who wish to obtain DMSc may choose non-university hospitals in their first 2 year residency period and they will go back to university after 2-year residency rotation. Hence, I would like to recommend authors to perform further analyses by including university teaching hospitals as well as university affiliated hospitals.

  → We recognize that the authoritarian influence on the award of a DMSc degree by clinical departments in medical schools still occurs, as suggested by the questionnaire survey by Nomura et al. (1). Previous studies (1,2) have also suggested that the incentives to choose university hospitals are distinct from those to choose non-university hospitals.

  The objective in our study was to test the effect of economic incentives on a resident’s choice of training facilities, and it was beyond the scope of our study to identify all the reasons for a resident’s choice of training facilities. For our specific purpose, we believe that we should limit our study sample to non-university hospitals for several reasons as follows below.

  A previous study by Kawamura failed to detect economic incentive as a significant predictor of a resident’s choice of hospitals in non-university hospitals. Although the model by Kawamura included a dummy variable for university/non-university status and its interaction term with salary, his estimation would have been biased by a distinct distribution of salaries between university and non-university hospitals. In fact, the variance in salaries among university hospitals is much smaller compared with that in non-university hospitals. The annual salaries in university hospitals have also been constant since the introduction of the new residency program: 3.18 million yen ($39,750) in 2005 and 3.10 million yen ($38,750) in 2011 (3).

  If data on residents’ individual preferences for DMSc and an academic career path had been available, we could have distinguished between the effect of a resident’s distinct preference and distinct distribution of salaries between university and non-university hospitals.
Without such micro data, we do not believe that a combined dataset of university and non-university hospitals could precisely identify the effect of salary among non-university hospitals. In addition, because university hospitals often change their quota for residents according to the expected number of applicants, the ratio of the number of applicants to the quota, which was our target variable, is endogenously determined in the case of university hospitals, and does not necessarily reflect residents’ preferences. This also prevented us from including university hospitals in our dataset.

We have revised our text to more explicitly state our rationale to exclude university hospitals from our dataset as described above. We hope to address university hospitals in a future study.


Original (page 6, line 11)

First, we limited our analysis to non-university hospitals, because salaries paid in university hospitals are homogenous across institutes because of regulatory reasons due to the governmental subsidy. Furthermore, the choice of university hospitals is supposedly influenced by a distinctive set of factors other than salary, such as a preference for an academic career path [5].

Revised

First, we limited our analysis to non-university hospitals, because the
distribution of salaries is different between university and non-university hospitals. In fact, salaries paid in university hospitals are homogenous across institutes because of regulatory reasons due to the governmental subsidy. The salaries in university hospitals have also been almost constant over time since the introduction of the new residency program [20]. Furthermore, the choice of university hospitals is supposedly influenced by a distinctive set of individual preferences, such as a preference for an academic career path and for home location [5,6]. Because data on individual preferences were not available, exclusion of university hospitals from our study sample was necessary to discriminate the effect of salary and distinctive sets of individual preferences. Additionally, because university hospitals often change their quota for residents according to the expected number of applicants, the ratio of the number of applicants to the quota, which was our target variable, is endogenously determined, and does not necessarily reflect residents’ preferences in the case of university hospitals.

- **In the manuscript on page 5, authors mentioned “In general, rural hospitals tend to pay a higher salary to compensate for the disadvantage of conditions.” This is not always true.**
  →We have removed the corresponding sentence from the text.

- **Analyses may be different if it is stratified between major cities and the other, or between areas where larger numbers of people reside and the other areas. It would be nice to see if the result will remain same in these stratifications.**
  →We are grateful for this suggestion from the reviewer. In accordance with the reviewer’s advice, we additionally conducted an analysis stratified by city size. We stratified hospitals into two groups by the median of the population size of local municipalities (i.e., municipalities < 279,127 vs. those ≥ 279,127).

  In small cities, the results were the same as the original main result: the effect of salary was not statistically significant in the OLS model, but an effect was observed in the fixed effect model. In large cities, the
magnitude of the coefficient of the salary variable was similar to that in the small cities, but this did not reach statistical significance because of a large standard error (please note that in the revised table, we have presented elasticity, not the coefficients for comparative reasons). This led us to doubt that salary might have a statistical interaction with other variables in the model.

When we added an interaction term between salary and the number of teaching physicians, salary became significant and with the same magnitude in both population groups. The interaction term was also statistically significant and negative in both groups, suggesting that the effects of salary and the number of teaching physicians were antagonistic. Therefore, the effect of salary was diminished when the number of teaching physicians was large. Interestingly, the magnitude of the interaction was larger in large cities than that in small cities, suggesting that the antagonistic effect of teaching physicians was larger in the urban setting.

This newly added analysis greatly helped us to improve our understanding of how salary and teaching physicians contribute to attract residents in urban and rural conditions. Accordingly, we made a major revision of the Methods, Results, and Discussion sections as follows.

Revised (Method section in the Abstract [page 2])

We further performed panel data analysis to better control for unobserved heterogeneity across hospitals, which could be confounded by the amount of salary. We also performed stratified analysis by the population size of the hospital location.

Revised (Results section in the Abstract [page 2])

In ordinary least squares regression, salary showed a positive, but not significant association with the ratio of the number of applicants to the program quota, while the results of a fixed effect model exhibited a positive and significant effect of salary \((\varepsilon=0.4995, \ p=0.015)\) on the ratio. Analysis stratified by city size showed that the elasticity of salary was
comparable (ε=1.918, p=0.008 in large cities vs. ε=1.9090, p=0.016 in small cities), while that of the number of teaching physicians was larger in large cities (ε=1.9857, p=0.009) compared with that in small cities (ε=1.6253, p=0.033). The number of teaching physicians had a significant and negative effect modification on salary, implying an antagonistic effect between these two attributes (ε=−1.5223, p=0.038).

**Revised (Data collection part of the Methods section)**

We were able to match 475 pairs of programs for further analysis. Population data of the municipalities of hospital locations were obtained from the national censuses held in 2010 [25].

**Revised (Statistical analysis part of the Methods section)**

…where $D_t$ is a vector reflecting time-consistent observed characteristics and unobserved heterogeneity of hospitals, and $\varepsilon_t$ is the error term.

Because the urbanicity of hospital location would affect the impact of income, as well as hospital size and educational environments, we also performed stratified analysis by the population size of a city where the hospital was located. We divided hospitals into two groups by the median (i.e., 279,123) of the population size. We also conducted ad hoc analysis with interaction terms as described in the results section. We first obtained ordinary least square (OLS) estimation for comparative purposes with previous studies. We then additionally conducted panel data analyses with fixed and random effect models to evaluate misspecification bias. The estimated results are presented as elasticity for comparison purposes across the strata and models.

We conducted the F-test, Hausman test, and Breusch-Pagan test for model specification, or to identify the best model to address the effect of unobserved heterogeneity and within-hospital variance [27].
Revised (Results section)

Table 3 shows the results of analyses stratified by the city size of the hospital location. The elasticity of the salary in the OLS ($\varepsilon=0.5787$, $p=0.027$), the fixed effect model ($\varepsilon=0.6498$, $p=0.036$), and the random effect model ($\varepsilon=0.5470$, $p=0.004$), was positive and statistically significant in the small cities, but not significant in the large cities. When including an interaction term with the number of teaching physicians (second and fourth columns of Table 3), however, the elasticity of the salary became statistically significant and positive in the fixed effect model ($\varepsilon=1.9090$, $p=0.016$) and in the random effect model ($\varepsilon=1.7051$, $p=0.004$) in large cities, and the magnitude of the elasticity was comparable with that in small cities. The effect of the number of teaching physicians in the fixed effect model was positive and statistically significant, and larger in the large cities ($\varepsilon=1.9857$, $p=0.009$) compared with that in small cities ($\varepsilon=1.6253$, $p=0.033$). Finally, the elasticity of the interaction term was negative and statistically significant in the fixed effect model ($\varepsilon=-1.5223$, $p=0.038$) and in the random effect model ($\varepsilon=-1.7012$, $p=0.003$) in large cities. The elasticity of the interaction term in small cities was also negative and marginally significant ($\varepsilon=-1.4133$, $p=0.052$ for the fixed effect model; $\varepsilon=-0.9690$, $p=0.065$ for the random effect model).

The result of the F-test, the Breusch-Pagan test, and the Hausman test in all four models suggested that the results of the fixed effect model were more relevant than those in the OLS and the random effect model.

Revised (Discussion section)

In the current study, in the analysis stratified by city size, the interaction term was statistically significant and negative in both groups, which suggested that the effect of salary and the number of teaching physicians
were antagonistic. Therefore, the effect of salary was diminished when the number of teaching physicians was large. In addition, the magnitude of elasticity of the interaction and the number of teaching physicians were larger in large cities than those in small cities, suggesting that the antagonistic effect by teaching physicians is larger in the urban setting. These results suggest that an increase in the number of teaching physicians may be a more effective strategy to attract residents in the urban setting than an increase in salary, while the reverse is more likely in rural areas where teaching physicians are in short supply. [30].
Table 3 - Elasticity of the stratified analysis by the population size of the hospital location

<table>
<thead>
<tr>
<th>Model</th>
<th>Population</th>
<th>&lt;279,127</th>
<th>≥279,127</th>
<th>&lt;279,127</th>
<th>≥279,127</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Elasticity</td>
<td>Elasticity</td>
<td>Elasticity</td>
<td>Elasticity</td>
</tr>
<tr>
<td>Salary</td>
<td>0.5787 *</td>
<td>1.0390</td>
<td>0.0278</td>
<td>1.3582</td>
<td>1.9154 *</td>
</tr>
<tr>
<td>Number of teaching physicians</td>
<td>0.5905 **</td>
<td>1.0740</td>
<td>0.5724 **</td>
<td>1.9154 *</td>
<td></td>
</tr>
<tr>
<td>Closed program within a single institution</td>
<td>0.1052 **</td>
<td>0.1042 **</td>
<td>0.0537 **</td>
<td>0.0513 **</td>
<td></td>
</tr>
<tr>
<td>Number of hospital beds</td>
<td>0.5751 **</td>
<td>0.5707 **</td>
<td>0.3919 **</td>
<td>0.3821 **</td>
<td></td>
</tr>
<tr>
<td>Average number of emergency patients</td>
<td>0.1163</td>
<td>0.1182</td>
<td>0.0315</td>
<td>0.0319</td>
<td></td>
</tr>
</tbody>
</table>
| Salary 
Number of teaching physicians | (1) | -0.5059 | -1.3296 |

OLS

| Salary                     | 0.6498 *   | 1.9185 ** | 0.3842   | 1.9089 * |
| Number of teaching physicians | 0.1985   | 1.6253 *   | 0.4521 ** | 1.9857 ** |
| Closed program within a single institution | 0.0043 | 0.0056 | -0.0152 | -0.0114 |
| Number of inpatients       | 0.2155     | 0.1951     | 1.5433 ** | 1.5960 ** |
| Average number of emergency patients | 0.0303 | 0.0053 | 0.0338 | 0.0370 |
| Salary 
Number of teaching physicians | (1) | -1.4133 | -1.5223 * |

Fixed effect model

| Salary                     | 0.5470 ** | 1.4538 ** | 0.0083   | 1.7051 ** |
| Number of teaching physicians | 0.5900 ** | 1.5453 ** | 0.6793 ** | 2.3981 ** |
| Closed program within a single institution | 0.0505 * | 0.0488 * | 0.0277 | 0.0307 |
| Number of inpatients       | 0.8792 ** | 0.8692 ** | 0.5482 ** | 0.5413 ** |
| Average number of emergency patients | 0.1226 | 0.1231 | 0.0573 | 0.0585 * |
| Salary 
Number of teaching physicians | (1) | -0.9690 | -1.7013 ** |

Random effect model

| n (hospitals)              | 237        | 237        | 238        | 238        |

* p<0.05  
** p <0.01  
† Interaction term: Salary times number of teaching physicians
Because a half of teaching hospitals designated by the Ministry in 2006 failed to provide same program in 2009, the 475 pairs might have already been selected as good teaching hospitals. This means that authors selected hospitals in which may be difficult to prove the significant effect of salary. If authors want to prove the effect of salary, they may not need to stick to panel-data analyses.

→ The reviewer appears to consider that our selection of sample hospitals for panel analysis may be biased towards teaching hospitals with excellence. Because approximately 1000 teaching hospitals recruit residents every year, the number of teaching hospitals included in our panel analysis (n=475) accounted for less than half of them. Although hospitals with excellence were not necessarily included in the Guidebook that we referred to, we agree with the reviewer in that the results of our analysis may be limited in generalizability. However, we argue that panel analysis is necessary and relevant to obtain an unbiased estimation of the effect of salary. Additionally, as we have shown in our tables, panel analysis showed the effect of salary on residents' choice of hospitals for training, irrespective of hospital location, in contrast to the reviewer's suspicion, but ordinary least squares estimation did not show this effect.

Our justification to use panel data analysis is two-fold: one is theoretical, and the other is empirical. Theoretically, panel analysis is superior to ordinary regression analysis in handling biases because of unobserved confounders, or misspecification bias (4). In our case, we have to consider that salary may be related to resident's choice of training hospitals, but salary should also be related to other attributes of hospitals, such as location, size, ownership, functions and prestige in its serving local area, relationship with local medical schools, and/or quality of training other than the number of supervising physicians. Salary also might be related to surrounding local conditions, such as the regional average wage, the degree of physician shortage, and access to public facilities that may influence physicians’ choice of residence with their family. Some of these factors were measurable and obtainable for analysis, but the rest of the factors were difficult to obtain or even to quantitatively measure.
As we already cited in the text, previous studies (5) have presented a strong argument that consideration of confounders that endogenously determine salary makes a difference in the estimation of the effect of salary on a physician's career choice. We also conducted Hausman test and other specification tests to determine which model is most relevant in the estimation of the effect of salary. Our results indicated that the results of the fixed-effect model panel analysis were the most relevant and unbiased.

We agree and accept that our estimation may be limited in generalizability, and we have additionally mentioned this limitation in the Discussion section as follows.


Original
Otherwise the characteristics were comparable between the two datasets. In our study, the descriptive statistics of the number of hospital beds or doctors were similar to those of Kawamura’s study that had a cross-sectional and larger sample than in our study [17]. Therefore, we believe that bias caused by sample selection would be minimal.

Revised (Discussion section)
Otherwise the characteristics were comparable between the two datasets. In our study, the descriptive statistics of the number of hospital beds or doctors were similar to those of Kawamura’s study, which had a cross-sectional and larger sample than in our study [16]. However, the average number of beds of the university affiliated hospitals was 596 in 2009, that of the outpatients was 977 per day, and that of doctors was 47 doctors per 100 hospital beds [32], which were much larger than those in our sample. Therefore, we acknowledge that our estimation of the effect of salary in non-university hospitals may not necessarily hold true in the
university hospitals. We also cannot deny the possibility that our results may be limited in generalizability, and these should be confirmed with longer and larger panel data of teaching hospitals in the country.

- *It may be easier for readers to understand if the number is compared to those of university hospitals and an average of total hospitals in Japan. Average of number of inpatients and emergency patients also requires an interpretation in the same manner.*

→ We appreciate the reviewer’s suggestion. We have referred to the governmental census of hospitals (Hospital Reports 2009) to obtain the descriptive statistics for comparison. However, the recent survey only included “Iiku-kikan” or hospitals affiliated with medical schools, while it did not contain a category corresponding to teaching hospitals for residency (or “rinsho-shitei byoin”). Therefore, we provided the average number of inpatients and emergency cases in the total number of hospitals and university-affiliated hospitals, for a rough comparison.

**Original (page 15, line 7)**

Otherwise the characteristics were comparable between the two datasets. In our study, the descriptive statistics of the number of hospital beds or doctors were similar to those of Kawamura’s study that had a cross-sectional and larger sample than in our study [17]. Therefore, we believe that bias caused by sample selection would be minimal.

**Revised (Discussion section)**

Please see the reply to the previous comment (after the references).
Response to reviewer 3's comments:
We appreciate the reviewer’s thoughtful comments for helping us improve our manuscript. Please find our responses to these comments below.

- **I have some concerns on how the sample size was selected, and on the statistical analysis performed,**
  → The same comment was made by reviewer 2. Please refer to our response to reviewer 2’s third comment. We believe that the panel analysis we used was theoretically and empirically the best available choice for identifying the effect of salary on the resident’s choice of training hospitals. Our sample of 475 teaching hospitals accounted for approximately half of the teaching hospitals in Japan. Although the characteristics of these sample hospitals were almost comparable with the national average of hospitals, we cannot deny that the results that we obtained may be limited in their generalizability. Accordingly, we have added some sentences to justify our use of panel analysis, and to mention the limitation of generalizability.

- **I also believe the paper needs "internationalise" and broadening its focus and take the discussion to a broader international audience,**
  → We appreciate the reviewer’s advice to make our discussion more suitable in the global context.

Revised (Discussion section)
Our findings suggested that salary, as well as conditions for the training curriculum and environment, could make a significant contribution to attract young residents. Our results of stratified analysis also suggested that the effect of monetary incentives and that of the teaching environment were different in urban and rural conditions. An increase in the number of teaching physicians may be a difficult alternative under the current shortage of physicians [30], especially in rural areas. Offering a higher salary for young residents may be more feasible instead. A shortage of physicians in the rural setting is a common social issue
across countries and regions [31], and our results imply that monetary incentives provide an effective countermeasure, although it may not solve the entire issue.