

# Specialized Roles and Task Allocation in Organizations

## ONLINE APPENDIX

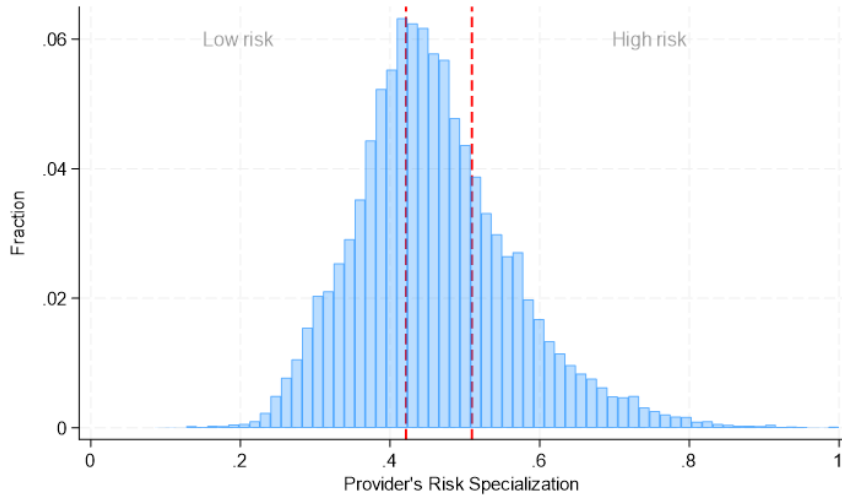
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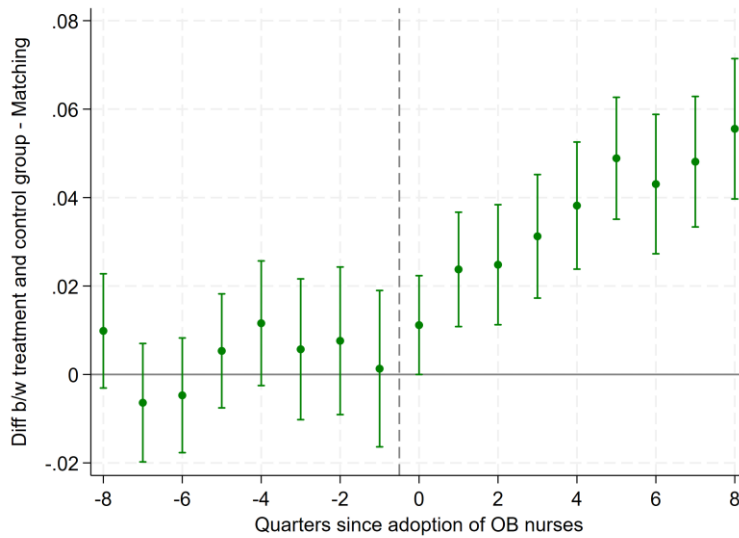
APPENDIX A: ADDITIONAL FIGURES AND TABLES

Figure A1. Distribution of Provider’s Risk Specialization for All Providers

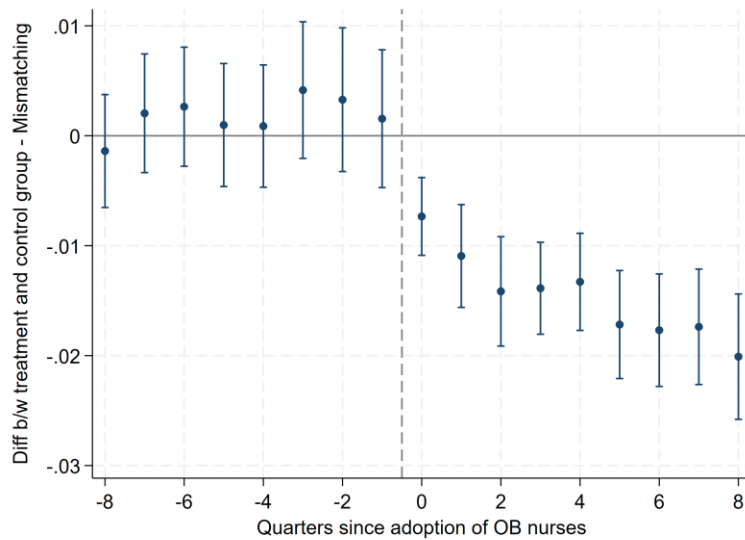


Notes: This figure plots the distribution of Provider's Risk Specialization for all providers (physicians and OB nurses) in the sample. Provider's Risk Specialization is time-varying and calculated based on the cumulative prior case mix up to each birth. Vertical dashed lines indicate tercile cutoffs.

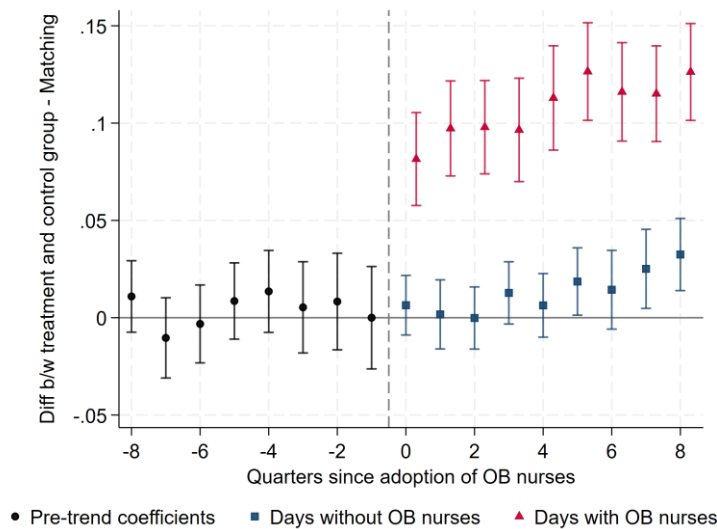
Figure A2. Event-Study Plot of OB Nurse Adoption on Matching (Quintile-Based)



Notes: This figure shows regression coefficients with 95% confidence intervals, based on robust standard errors clustered by hospital. The dependent variable is Professional-Client Matching defined based on quintiles of Client Complexity. The model is estimated using Borusyak et al.’s (2024) imputation method—commands *did\_imputation* and *event\_plot* in Stata.

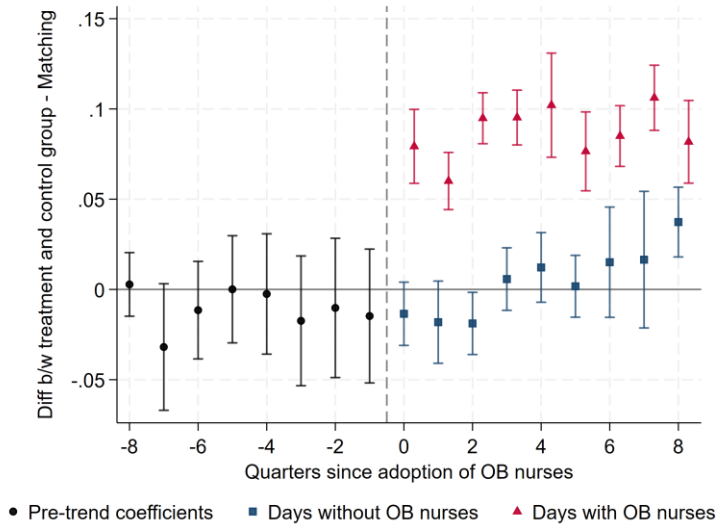
**Figure A3. Event-Study Plot of OB Nurse Adoption on Mismatch (Continuous)**

Notes: This figure shows regression coefficients with 95% confidence intervals, based on robust standard errors clustered by hospital. The dependent variable is Professional-Client Mismatching. The model is estimated using Borusyak et al.'s (2024) imputation method—commands *did\_imputation* and *event\_plot* in Stata.

**Figure A4. OB Nurse Adoption and Matching: Days With vs. Without OB Nurses**

Notes: This figure shows regression coefficients with 95% confidence intervals, based on robust standard errors clustered by hospital. The model is estimated using Borusyak et al.'s (2024) imputation method. The model distinguishes between days when OB nurses are present and days when they are not, with post-adoption coefficients estimated separately for each case.

**Figure A5. OB Nurse Adoption and Matching: Days With vs. Without OB Nurses (Two-Provider Days)**



Notes: This figure shows regression coefficients with 95% confidence intervals, based on robust standard errors clustered by hospital. The model is estimated using Borusyak et al.'s (2024) imputation method. The model distinguishes between days when OB nurses are present and days when they are not, with post-adoption coefficients estimated separately for each case. The sample is limited to days in which the hospital has exactly two providers on staff.

**Table A1. Logit Model Predicting C-section (Full Table Including Morbidity Indicators)**

|   | (1)          |         | (2)        |         |
|---|--------------|---------|------------|---------|
|   | Coefficients |         | Odds ratio |         |
| Mother's age: Less than 18yr                                      | -0.192**     | (0.005) | 0.825**    | (0.004) |
| Mother's age: 21-25yr   | 0.241**      | (0.004) | 1.272**    | (0.005) |
| Mother's age: 26-30yr   | 0.502**      | (0.004) | 1.651**    | (0.007) |
| Mother's age: 31-35yr   | 0.732**      | (0.005) | 2.079**    | (0.010) |
| Mother's age: More than 35yr                                      | 0.989**      | (0.006) | 2.688**    | (0.017) |
| Mother's prior pregnancies: Second pregnancy                      | -0.983**     | (0.004) | 0.374**    | (0.001) |
| Mother's prior pregnancies: Third pregnancy                       | -1.481**     | (0.005) | 0.227**    | (0.001) |
| Mother's prior pregnancies: Fourth+ pregnancy                     | -1.909**     | (0.005) | 0.148**    | (0.001) |
| Mother's prior pregnancies: Missing                               | -0.189**     | (0.010) | 0.828**    | (0.009) |
| Mother's prior C-section: One prior C-section                     | 2.184**      | (0.004) | 8.884**    | (0.034) |
| Mother's prior C-section: Two+ prior C-section                    | 4.638**      | (0.011) | 103.337**  | (1.130) |
| Mother's prior C-section: Missing                                 | 0.084**      | (0.008) | 1.087**    | (0.009) |
| Pregnancy type: Twins   | 1.116**      | (0.040) | 3.052**    | (0.123) |
| Pregnancy type: Three+ babies                                     | 1.102**      | (0.270) | 3.010**    | (0.813) |
| Pregnancy type: Missing   | -0.084*      | (0.042) | 0.920*     | (0.039) |
| Fetal position: Pelvic  | 2.412**      | (0.010) | 11.160**   | (0.116) |
| Fetal position: Transverse  | 3.658**      | (0.072) | 38.801**   | (2.796) |
| Fetal position: Missing   | 0.757**      | (0.011) | 2.131**    | (0.024) |
| Pregnancy term: 28-31 weeks                                       | -0.071**     | (0.019) | 0.932**    | (0.018) |
| Pregnancy term: 32-36 weeks                                       | 0.040**      | (0.011) | 1.041**    | (0.011) |
| Pregnancy term: 37-41 weeks                                       | 0.250**      | (0.010) | 1.285**    | (0.012) |
| Pregnancy term: 42+ weeks   | 0.493**      | (0.012) | 1.637**    | (0.019) |
| Pre-existing hypertension complicating pregnancy                  | 2.311**      | (0.021) | 10.080**   | (0.212) |
| Pre-eclampsia superimposed on chronic hypertension                | 2.528**      | (0.150) | 12.525**   | (1.873) |
| Gestational oedema and proteinuria without hypertension           | -0.813**     | (0.100) | 0.444**    | (0.044) |
| Gestational hypertension  | 2.062**      | (0.019) | 7.863**    | (0.148) |
| Pre-eclampsia   | 3.294**      | (0.019) | 26.956**   | (0.501) |
| Eclampsia   | 3.759**      | (0.067) | 42.910**   | (2.880) |
| Unspecified maternal hypertension                                 | 1.126**      | (0.023) | 3.085**    | (0.071) |
| Haemorrhage in early pregnancy                                    | 0.585*       | (0.292) | 1.795*     | (0.524) |
| Excessive vomiting in pregnancy                                   | 0.836*       | (0.426) | 2.308*     | (0.983) |
| Venous complications and haemorrhoids in pregnancy                | -0.746**     | (0.047) | 0.474**    | (0.022) |
| Infections of genitourinary tract in pregnancy                    | -0.684**     | (0.071) | 0.505**    | (0.036) |
| Diabetes mellitus in pregnancy                                    | 1.680**      | (0.018) | 5.367**    | (0.095) |
| Maternal care for other conditions related to pregnancy           | 1.371**      | (0.037) | 3.939**    | (0.147) |
| Abnormal findings on antenatal screening of mother                | 1.350*       | (0.589) | 3.856*     | (2.271) |
| Complications of anaesthesia during pregnancy                     | 0.789*       | (0.378) | 2.202*     | (0.831) |
| Maternal care for known or suspected malpresentation of fetus     | 3.215**      | (0.024) | 24.899**   | (0.601) |
| Maternal care for known or suspected disproportion                | 4.553**      | (0.032) | 94.910**   | (3.043) |
| Maternal care for known or suspected abnormality of pelvic organs | 4.351**      | (0.041) | 77.528**   | (3.146) |
| Maternal care for known or suspected fetal abnormality and damage | 3.232**      | (0.090) | 25.329**   | (2.274) |
| Maternal care for other known or suspected fetal problems         | 3.639**      | (0.028) | 38.051**   | (1.075) |
| Polyhydramnios  | 1.868**      | (0.134) | 6.473**    | (0.868) |
| Other disorders of amniotic fluid and membranes                   | 3.581**      | (0.025) | 35.902**   | (0.898) |

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| Premature rupture of membranes                  | 1.255**    | (0.007) | 3.508**    | (0.025)  |
| Placental disorders                             | 4.555**    | (0.235) | 95.071**   | (22.385) |
| Placenta praevia                                | 5.709**    | (0.246) | 301.420**  | (74.210) |
| Abruptio placenta                               | 3.543**    | (0.043) | 34.572**   | (1.476)  |
| Antepartum haemorrhage not elsewhere classified | 2.997**    | (0.300) | 20.022**   | (6.009)  |
| Constant  | -0.908**   | (0.010) | 0.403**    | (0.004)  |
| Observations                                    | 3,698,535  |         | 3,698,535  |          |
| Pseudo R-squared                                | 0.284      |         | 0.284      |          |
| Log pseudolikelihood                            | -2549776.7 |         | -2549776.7 |          |

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Robust standard errors reported in parentheses. +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: Omitted categories are Mother's age: 18-20 years, Mother's prior C-Sections: 0, Pregnancy type: Single, Fetal position: Head down.

**Table A2. Correlation Coefficients**

|  | (1)   | (2)   | (3)   | (4)   | (5)   | (6)   | (7)   | (8)   | (9)   | (10) | (11) | (12) | (13) | (14) |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|
| (1) Client complexity                          | 1.00  |       |       |       |       |       |       |       |       |      |      |      |      |      |
| (2) Provider's risk specialization             | 0.34  | 1.00  |       |       |       |       |       |       |       |      |      |      |      |      |
| (3) Professional-Client Matching               | 0.02  | -0.04 | 1.00  |       |       |       |       |       |       |      |      |      |      |      |
| (4) Hospital ever adopted OB nurses (0/1)      | -0.00 | 0.01  | 0.02  | 1.00  |       |       |       |       |       |      |      |      |      |      |
| (5) Post-adoption of OB nurses (0/1)           | 0.02  | 0.04  | 0.05  | 0.66  | 1.00  |       |       |       |       |      |      |      |      |      |
| (6) High client demand (0/1)                   | 0.00  | 0.06  | -0.02 | 0.26  | 0.20  | 1.00  |       |       |       |      |      |      |      |      |
| (7) High workflow predictability (0/1)         | 0.08  | 0.24  | -0.06 | 0.07  | 0.05  | 0.06  | 1.00  |       |       |      |      |      |      |      |
| (8) High organizational experience (0/1)       | -0.02 | -0.04 | 0.02  | 0.18  | 0.16  | 0.36  | -0.05 | 1.00  |       |      |      |      |      |      |
| (9) Baby APGAR 1-min (0-10)                    | -0.05 | -0.01 | 0.01  | -0.01 | 0.01  | 0.00  | 0.00  | 0.00  | 1.00  |      |      |      |      |      |
| (10) Baby APGAR 1-min below 7 (0/1)            | 0.04  | 0.02  | -0.01 | 0.01  | 0.00  | 0.01  | 0.01  | -0.01 | -0.78 | 1.00 |      |      |      |      |
| (11) Complications of labor and delivery (0/1) | 0.02  | 0.07  | -0.05 | 0.04  | 0.05  | 0.02  | 0.02  | 0.01  | -0.03 | 0.02 | 1.00 |      |      |      |
| (12) Length of stay (in days)                  | 0.12  | 0.10  | -0.01 | 0.07  | 0.06  | 0.11  | 0.05  | -0.03 | -0.06 | 0.06 | 0.05 | 1.00 |      |      |
| (13) Log cost                                  | 0.47  | 0.38  | 0.01  | 0.08  | 0.08  | 0.15  | 0.15  | 0.01  | -0.07 | 0.07 | 0.17 | 0.34 | 1.00 |      |
| (14) C-section (0/1)                           | 0.59  | 0.27  | -0.01 | -0.04 | -0.02 | -0.06 | 0.06  | -0.02 | -0.05 | 0.02 | 0.21 | 0.17 | 0.65 | 1.00 |

N = 7,981,843

Notes: This table shows correlation coefficients between variables used in the empirical analysis.

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**Table A3. Correlation Coefficients (Continuous Measures of Client Demand, Workflow Predictability, and Organizational Experience)**

|  | (1)   | (2)   | (3)   | (4)   | (5)   | (6)   | (7)   | (8)   | (9)   | (10) | (11) | (12) | (13) | (14) |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|
| (1) Client complexity                          | 1.00  |       |       |       |       |       |       |       |       |      |      |      |      |      |
| (2) Provider's risk specialization             | 0.34  | 1.00  |       |       |       |       |       |       |       |      |      |      |      |      |
| (3) Professional-Client Matching               | 0.02  | -0.04 | 1.00  |       |       |       |       |       |       |      |      |      |      |      |
| (4) Hospital ever adopted OB nurses (0/1)      | -0.00 | 0.01  | 0.02  | 1.00  |       |       |       |       |       |      |      |      |      |      |
| (5) Post-adoption of OB nurses (0/1)           | 0.02  | 0.04  | 0.05  | 0.66  | 1.00  |       |       |       |       |      |      |      |      |      |
| (6) Client demand                              | -0.01 | 0.03  | -0.03 | 0.26  | 0.24  | 1.00  |       |       |       |      |      |      |      |      |
| (7) Workflow predictability                    | 0.10  | 0.30  | -0.03 | -0.01 | 0.01  | -0.01 | 1.00  |       |       |      |      |      |      |      |
| (8) Organizational experience                  | 0.00  | 0.00  | -0.00 | 0.16  | 0.11  | 0.24  | -0.11 | 1.00  |       |      |      |      |      |      |
| (9) Baby APGAR 1-min (0-10)                    | -0.05 | -0.01 | 0.01  | -0.01 | 0.01  | 0.02  | 0.01  | -0.01 | 1.00  |      |      |      |      |      |
| (10) Baby APGAR 1-min below 7 (0/1)            | 0.04  | 0.02  | -0.01 | 0.01  | 0.00  | -0.00 | 0.00  | 0.01  | -0.78 | 1.00 |      |      |      |      |
| (11) Complications of labor and delivery (0/1) | 0.02  | 0.07  | -0.05 | 0.04  | 0.05  | 0.03  | 0.04  | 0.01  | -0.03 | 0.02 | 1.00 |      |      |      |
| (12) Length of stay (in days)                  | 0.12  | 0.10  | -0.01 | 0.07  | 0.06  | 0.11  | 0.02  | 0.04  | -0.06 | 0.06 | 0.05 | 1.00 |      |      |
| (13) Log cost                                  | 0.47  | 0.38  | 0.01  | 0.08  | 0.08  | 0.17  | 0.15  | 0.12  | -0.07 | 0.07 | 0.17 | 0.34 | 1.00 |      |
| (14) C-section (0/1)                           | 0.59  | 0.27  | -0.01 | -0.04 | -0.02 | -0.07 | 0.10  | -0.01 | -0.05 | 0.02 | 0.21 | 0.17 | 0.65 | 1.00 |

N = 7,981,843

Notes: This table shows correlation coefficients between underlying measures (e.g., Client demand) used to construct the binary variables employed in the empirical analysis (e.g., High client demand (0/1)).

**Table A4. Obstetric Nurse Adoption and Professional-Client Matching (Only Adopting Hospitals)**

|                            | (1)                          | (2)               | (3)                | (4)                         | (5)                          | (6)                           | (7)                            |
|----------------------------|------------------------------|-------------------|--------------------|-----------------------------|------------------------------|-------------------------------|--------------------------------|
|                            | Professional-Client Matching |                   |                    |                             |                              |                               |                                |
|                            | All                          | Low Client Demand | High Client Demand | Low Workflow Predictability | High Workflow Predictability | Low Organizational experience | High Organizational experience |
| Post-adoption of OB nurses | 0.042**<br>(0.015)           | -0.002<br>(0.028) | 0.046**<br>(0.017) | 0.032<br>(0.019)            | 0.053*<br>(0.023)            | 0.037+<br>(0.020)             | 0.040*<br>(0.020)              |
| Hospital FE                | Yes                          | Yes               | Yes                | Yes                         | Yes                          | Yes                           | Yes                            |
| Quarter FE                 | Yes                          | Yes               | Yes                | Yes                         | Yes                          | Yes                           | Yes                            |
| Day of Week FE             | Yes                          | Yes               | Yes                | Yes                         | Yes                          | Yes                           | Yes                            |
| Observations               | 2,434,037                    | 262,157           | 2,171,880          | 1,166,274                   | 1,267,763                    | 608,326                       | 1,825,711                      |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table presents OLS estimates of the relationship between OB nurse adoption and professional-client matching, along with how this relationship varies based on client demand, workflow predictability, and organizational experience. The sample is restricted to hospitals that adopted OB nurses ( $n = 100$ ). Hospitals are classified into “Low” and “High” categories for each moderator, where “Low” indicates values below the sample median and “High” indicates values above it. The estimates are obtained using a split-sample approach (i.e., separate regressions are run for hospitals in each category).

**Table A5. OB Nurse Adoption and Professional-Client Matching (Control Group with No Cross-Hospital Provider Linkages)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.099**<br>(0.011)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | -0.000<br>(0.020)  |                    |                    |
| Post-adoption (High client demand)             |                              | 0.108**<br>(0.011) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.041**<br>(0.012) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.152**<br>(0.013) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.069**<br>(0.011) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.107**<br>(0.011) |
| Difference (High - Low)                        |                              | 0.108**<br>(0.021) | 0.110**<br>(0.015) | 0.038**<br>(0.013) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 5,121,898                    | 5,121,898          | 5,121,898          | 5,121,898          |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, as well as how this relationship varies with client demand, workflow predictability, and organizational experience. The sample is restricted to treatment hospitals ( $n = 100$ ) and the subset of control hospitals ( $n = 410$ ) that do not share any providers with treatment hospitals, to reduce the potential for cross-hospital spillovers that could violate SUTVA. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A6. OB Nurse Adoption and Professional-Client Matching (Quintile-Based)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.065**<br>(0.007)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | -0.002<br>(0.011)  |                    |                    |
| Post-adoption (High client demand)             |                              | 0.071**<br>(0.007) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.026**<br>(0.007) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.099**<br>(0.009) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.043**<br>(0.007) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.070**<br>(0.007) |
| Difference (High - Low)                        |                              | 0.073**<br>(0.012) | 0.073**<br>(0.010) | 0.027**<br>(0.008) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 7,981,843                    | 7,981,843          | 7,981,843          | 7,981,843          |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, constructed based on quintiles (rather than terciles) of client complexity. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A7. OB Nurse Adoption and Professional-Client Mismatching (Continuous)**

|  | (1)                             | (2)                 | (3)                 | (4)                 |
|--|---------------------------------|---------------------|---------------------|---------------------|
|  | Professional-Client Mismatching |                     |                     |                     |
| Post-adoption                                  | -0.022**<br>(0.003)             |                     |                     |                     |
| Post-adoption (Low client demand)              |                                 | -0.005+<br>(0.002)  |                     |                     |
| Post-adoption (High client demand)             |                                 | -0.023**<br>(0.003) |                     |                     |
| Post-adoption (Low workflow predictability)    |                                 |                     | -0.012**<br>(0.003) |                     |
| Post-adoption (High workflow predictability)   |                                 |                     | -0.030**<br>(0.003) |                     |
| Post-adoption (Low organizational experience)  |                                 |                     |                     | -0.017**<br>(0.002) |
| Post-adoption (High organizational experience) |                                 |                     |                     | -0.023**<br>(0.003) |
| Difference (High - Low)                        |                                 | -0.018**<br>(0.003) | -0.018**<br>(0.003) | -0.006*<br>(0.003)  |
| Hospital FE                                    | Yes                             | Yes                 | Yes                 | Yes                 |
| Quarter FE                                     | Yes                             | Yes                 | Yes                 | Yes                 |
| Day of Week FE                                 | Yes                             | Yes                 | Yes                 | Yes                 |
| Observations                                   | 7,981,843                       | 7,981,843           | 7,981,843           | 7,981,843           |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client mismatching (continuous measure). Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A8. OB Nurse Adoption and Professional-Client Matching (Including Middle-Tercile Matches)**

|  | (1)  | (2)                | (3)                | (4)                |
|--|--|--------------------|--------------------|--------------------|
|  | Professional–Client Matching<br>(including middle-tercile matches) |                    |                    |                    |
| Post-adoption                                  | 0.066**<br>(0.007)   |                    |                    |                    |
| Post-adoption (Low Client Demand)              |  | 0.002<br>(0.007)   |                    |                    |
| Post-adoption (High Client Demand)             |  | 0.071**<br>(0.007) |                    |                    |
| Post-adoption (Low Workflow Predictability)    |  |                    | 0.026**<br>(0.007) |                    |
| Post-adoption (High Workflow Predictability)   |  |                    | 0.102**<br>(0.007) |                    |
| Post-adoption (Low Organizational Experience)  |  |                    |                    | 0.043**<br>(0.005) |
| Post-adoption (High Organizational Experience) |  |                    |                    | 0.072**<br>(0.007) |
| Difference (High - Low)                        |  | 0.069**<br>(0.009) | 0.076**<br>(0.009) | 0.029**<br>(0.008) |
| Hospital FE                                    | Yes  | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes  | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes  | Yes                | Yes                | Yes                |
| Observations                                   | 7,981,844  | 7,981,844          | 7,981,844          | 7,981,844          |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional–client matching, using the measure which includes middle-tercile matches. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A9. OB Nurse Adoption and Professional-Client Matching (Cosine Similarity; Full History)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.024**<br>(0.003)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.016**<br>(0.003) |                    |                    |
| Post-adoption (High client demand)             |                              | 0.024**<br>(0.003) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.016**<br>(0.003) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.030**<br>(0.003) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.026**<br>(0.002) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.023**<br>(0.003) |
| Difference (High - Low)                        |                              | 0.008*<br>(0.004)  | 0.014**<br>(0.004) | -0.003<br>(0.003)  |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 7,959,023                    | 7,959,023          | 7,959,023          | 7,959,023          |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, calculated using the cosine similarity between a provider's experience with specific patient types and the profile of the current patient. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A10. OB Nurse Adoption and Professional-Client Matching (Cosine Similarity; Last 90 Days)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.020**<br>(0.003)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.007*<br>(0.004)  |                    |                    |
| Post-adoption (High client demand)             |                              | 0.021**<br>(0.003) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.015**<br>(0.004) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.024**<br>(0.003) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.021**<br>(0.003) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.019**<br>(0.003) |
| Difference (High - Low)                        |                              | 0.014**<br>(0.004) | 0.010*<br>(0.004)  | -0.002<br>(0.004)  |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 7,938,429                    | 7,938,429          | 7,938,429          | 7,938,429          |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, calculated using the cosine similarity between the patients a provider treated in the last 90 days and the profile of the current patient. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A11. OB Nurse Adoption and Matching Based on Condition-Specific Clinical Experience**

|                            | (1)       | (2)       | (3)      |
|----------------------------|-----------|-----------|----------|
|                            | Membranes | Eclampsia | Placenta |
| Post-adoption of OB nurses | 0.026*    | 0.034*    | 0.017    |
|                            | (0.012)   | (0.014)   | (0.016)  |
| Hospital FE                | Yes       | Yes       | Yes      |
| Quarter FE                 | Yes       | Yes       | Yes      |
| Day of Week FE             | Yes       | Yes       | Yes      |
| Observations               | 394,681   | 159,222   | 33,661   |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and condition-specific professional-client matching. Each column restricts the sample to births involving the specified clinical condition (membrane complications, eclampsia, or placental disorders). The dependent variable equals one if the provider has previously managed at least one case involving the same condition and zero otherwise. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024).

**Table A12: Number of Physician-Led Births by Provider Risk Specialization Tercile, Before and After Adoption (Adopting Hospitals Only)**

| Provider Risk Specialization | Before Adoption    | After Adoption     | Total              |
|------------------------------|--------------------|--------------------|--------------------|
| Low                          | 386,792<br>33.9%   | 272,177<br>25.8    | 658,969<br>30.0    |
| Medium                       | 424,694<br>37.3    | 349,515<br>33.1    | 774,209<br>35.3    |
| High                         | 327,967<br>28.8    | 433,936<br>41.1    | 761,903<br>34.7    |
| Total                        | 1,139,453<br>100.0 | 1,055,628<br>100.0 | 2,195,081<br>100.0 |

Notes: Percentages are calculated relative to births overseen by physicians in each period (excluding births handled by OB nurses). Provider risk specialization is time-varying and calculated based on cumulative prior case mix up to each birth. The sample is restricted to adopting hospitals, with “before” and “after” defined relative to each hospital’s adoption date.

**Table A13. OB Nurse Adoption and Professional-Client Matching (Only Physicians)**

|  | (1)                          | (2)       | (3)       | (4)       |
|--|------------------------------|-----------|-----------|-----------|
|  | Professional-Client Matching |           |           |           |
| Post-adoption                                  | 0.043**                      |           |           |           |
|  | (0.011)                      |           |           |           |
| Post-adoption (Low client demand)              |                              | -0.049**  |           |           |
|  |                              | (0.019)   |           |           |
| Post-adoption (High client demand)             |                              | 0.051**   |           |           |
|  |                              | (0.011)   |           |           |
| Post-adoption (Low workflow predictability)    |                              |           | -0.007    |           |
|  |                              |           | (0.012)   |           |
| Post-adoption (High workflow predictability)   |                              |           | 0.088**   |           |
|  |                              |           | (0.011)   |           |
| Post-adoption (Low organizational experience)  |                              |           |           | 0.027*    |
|  |                              |           |           | (0.011)   |
| Post-adoption (High organizational experience) |                              |           |           | 0.047**   |
|  |                              |           |           | (0.011)   |
| Difference (High - Low)                        |                              | 0.099**   | 0.096**   | 0.020     |
|  |                              | (0.020)   | (0.015)   | (0.014)   |
| Hospital FE                                    | Yes                          | Yes       | Yes       | Yes       |
| Quarter FE                                     | Yes                          | Yes       | Yes       | Yes       |
| Day of Week FE                                 | Yes                          | Yes       | Yes       | Yes       |
| Observations                                   | 7,742,887                    | 7,742,887 | 7,742,887 | 7,742,887 |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching for the sample of physicians (i.e., sample excludes OB nurses). Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A14. OB Nurse Adoption and Professional-Client Matching by Patient Complexity**

|                            | (1)<br>Low-risk patient<br>matching | (2)<br>High-risk patient<br>matching |
|----------------------------|-------------------------------------|--------------------------------------|
| Post-adoption of OB nurses | 0.161**<br>(0.022)                  | 0.104**<br>(0.019)                   |
| Hospital FE                | Yes                                 | Yes                                  |
| Quarter FE                 | Yes                                 | Yes                                  |
| Day of Week FE             | Yes                                 | Yes                                  |
| Mean(DV)                   | 0.478                               | 0.438                                |
| Observations               | 3,269,959                           | 2,285,589                            |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching for the sample of low- and high-risk patients. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024).

**Table A15. OB Nurse Adoption and Professional-Client Matching (Additional Control Variables)**

|  | (1)                          | (2)                 | (3)                 | (4)                 |
|--|------------------------------|---------------------|---------------------|---------------------|
|  | Professional-Client Matching |                     |                     |                     |
| Post-adoption                                  | 0.095**<br>(0.010)           |                     |                     |                     |
| Post-adoption (Low client demand)              |                              | -0.002<br>(0.019)   |                     |                     |
| Post-adoption (High client demand)             |                              | 0.104**<br>(0.010)  |                     |                     |
| Post-adoption (Low workflow predictability)    |                              |                     | 0.037**<br>(0.011)  |                     |
| Post-adoption (High workflow predictability)   |                              |                     | 0.148**<br>(0.012)  |                     |
| Post-adoption (Low organizational experience)  |                              |                     |                     | 0.064**<br>(0.011)  |
| Post-adoption (High organizational experience) |                              |                     |                     | 0.103**<br>(0.011)  |
| Number of patients in the day                  | -0.002**<br>(0.001)          | -0.002**<br>(0.001) | -0.002**<br>(0.001) | -0.002**<br>(0.001) |
| Number of providers in the day                 | 0.002<br>(0.002)             | 0.002<br>(0.002)    | 0.002<br>(0.002)    | 0.002<br>(0.002)    |
| Difference (High - Low)                        |                              | 0.106**<br>(0.021)  | 0.110**<br>(0.015)  | 0.039**<br>(0.013)  |
| Hospital FE                                    | Yes                          | Yes                 | Yes                 | Yes                 |
| Quarter FE                                     | Yes                          | Yes                 | Yes                 | Yes                 |
| Day of Week FE                                 | Yes                          | Yes                 | Yes                 | Yes                 |
| Observations                                   | 7,981,843                    | 7,981,843           | 7,981,843           | 7,981,843           |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, as well as how this relationship varies with client demand, workflow predictability, and organizational experience. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. All models include controls for the number of patients and providers in the day. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A16. OB Nurse Adoption and Professional-Client Matching: Mechanism: Allocative Infrastructure Versus Adding Staff**

|  | (1)<br>All births  | (2)<br>Births on days<br>with exactly 2<br>providers |
|--|--------------------|--|
| Post-adoption (Days without OB nurses) | 0.036**<br>(0.009) | 0.026**<br>(0.009)                                   |
| Post-adoption (Days with OB nurses)    | 0.144**<br>(0.011) | 0.092**<br>(0.008)                                   |
| Difference                             | 0.109**<br>(0.010) | 0.066**<br>(0.008)                                   |
| Hospital FE                            | Yes                | Yes  |
| Quarter FE                             | Yes                | Yes  |
| Day of Week FE                         | Yes                | Yes  |
| Observations                           | 7,981,843          | 1,868,784  |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table reports estimates of the relationship between OB nurse adoption and professional-client matching, comparing days with OB nurses versus days without OB nurses. Model 1 presents separate estimates for days with and without OB nurses present in the maternity ward. Model 2 repeats this analysis in a sample restricted to days with exactly two providers on staff. All models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command `xlincom` to the output of `did_imputation` with the `hetby` option in Stata.

**Table A17. OB Nurse Adoption and Professional-Client Matching (With State × Year Fixed Effects)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.104**<br>(0.012)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.002<br>(0.016)   |                    |                    |
| Post-adoption (High client demand)             |                              | 0.113**<br>(0.012) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.042**<br>(0.012) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.160**<br>(0.014) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.068**<br>(0.011) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.113**<br>(0.011) |
| Difference (High - Low)                        |                              | 0.111**<br>(0.019) | 0.118**<br>(0.018) | 0.046**<br>(0.014) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| State × Year FE                                | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 7,981,843                    | 7,981,843          | 7,981,843          | 7,981,843          |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, as well as how this relationship varies with client demand, workflow predictability, and organizational experience. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. All models include state × year fixed effects, in addition to hospital, quarter, and day-of-week fixed effects. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A18. OB Nurse Adoption and Professional-Client Matching (Exclude Planned C-sections)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.091**<br>(0.011)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | -0.028+<br>(0.017) |                    |                    |
| Post-adoption (High client demand)             |                              | 0.102**<br>(0.011) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.035**<br>(0.012) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.149**<br>(0.010) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.059**<br>(0.010) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.100**<br>(0.012) |
| Difference (High - Low)                        |                              | 0.130**<br>(0.018) | 0.115**<br>(0.013) | 0.041**<br>(0.013) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 6,631,938                    | 6,631,938          | 6,631,938          | 6,631,938          |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching for the sample that excludes planned C-sections. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A19. OB Nurse Adoption and Professional-Client Matching (Small Municipalities)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.165**<br>(0.013)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.059**<br>(0.010) |                    |                    |
| Post-adoption (High client demand)             |                              | 0.176**<br>(0.013) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.110**<br>(0.012) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.209**<br>(0.014) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.078**<br>(0.009) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.176**<br>(0.013) |
| Difference (High - Low)                        |                              | 0.116**<br>(0.014) | 0.099**<br>(0.016) | 0.098**<br>(0.013) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 4,360,447                    | 4,360,447          | 4,360,447          | 4,360,447          |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching for the sample of municipalities with only one hospital. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A20. OB Nurse Adoption and Professional-Client Matching (Mothers with Lower Education)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.106**<br>(0.012)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.010<br>(0.016)   |                    |                    |
| Post-adoption (High client demand)             |                              | 0.116**<br>(0.012) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.045**<br>(0.013) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.176**<br>(0.011) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.080**<br>(0.011) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.112**<br>(0.012) |
| Difference (High - Low)                        |                              | 0.106**<br>(0.018) | 0.131**<br>(0.015) | 0.032*<br>(0.014)  |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 1,859,969                    | 1,859,969          | 1,859,969          | 1,859,969          |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching for the sample of mothers with less than high-school education. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A21. OB Nurse Adoption and Professional-Client Matching (Sample including births in the Training and Testing Sample)**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.097**<br>(0.011)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | -0.004<br>(0.019)  |                    |                    |
| Post-adoption (High client demand)             |                              | 0.106**<br>(0.010) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.039**<br>(0.011) |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.150**<br>(0.012) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.066**<br>(0.011) |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.105**<br>(0.011) |
| Difference (High - Low)                        |                              | 0.110**<br>(0.021) | 0.110**<br>(0.015) | 0.039**<br>(0.013) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 11,680,378                   | 11,680,378         | 11,680,378         | 11,680,378         |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching in the full sample (i.e., this includes the random sample used to estimate client complexity).

Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata.

**Table A22. Intensive Margin of Obstetric Nurse Adoption and Professional-Client Matching (Share of Births Attended by OB Nurses)**

|   | (1)                          | (2)       | (3)       | (4)       |
|---|------------------------------|-----------|-----------|-----------|
|   | Professional-Client Matching |           |           |           |
| Share of births by OB nurses                                  | 0.321**                      | 0.182**   | 0.195**   | 0.303**   |
|   | (0.033)                      | (0.049)   | (0.037)   | (0.056)   |
| Share of births by OB nurses × High client demand             |                              | 0.164**   |           |           |
|   |                              | (0.062)   |           |           |
| Share of births by OB nurses × High workflow predictability   |                              |           | 0.261**   |           |
|   |                              |           | (0.052)   |           |
| Share of births by OB nurses × High organizational experience |                              |           |           | 0.022     |
|   |                              |           |           | (0.069)   |
| Hospital FE   | Yes                          | Yes       | Yes       | Yes       |
| Quarter FE  | Yes                          | Yes       | Yes       | Yes       |
| Day of Week FE  | Yes                          | Yes       | Yes       | Yes       |
| Observations  | 7,981,843                    | 7,981,843 | 7,981,843 | 7,981,843 |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table presents OLS estimates of the relationship between the share of births attended by OB nurses in a given day and professional-client matching, along with how this relationship varies based on client demand, workflow predictability, and organizational experience.

**Table A23. Intensive Margin of Obstetric Nurse Adoption and Professional-Client Matching (OB Nurse Share of Providers)**

|   | (1)                          | (2)       | (3)       | (4)       |
|---|------------------------------|-----------|-----------|-----------|
|   | Professional-Client Matching |           |           |           |
| Share of OB nurses                                  | 0.273**                      | 0.169**   | 0.152**   | 0.278**   |
|   | (0.036)                      | (0.049)   | (0.036)   | (0.056)   |
| Share of OB nurses × High client demand             |                              | 0.121+    |           |           |
|   |                              | (0.064)   |           |           |
| Share of OB nurses × High workflow predictability   |                              |           | 0.281**   |           |
|   |                              |           | (0.055)   |           |
| Share of OB nurses × High organizational experience |                              |           |           | -0.007    |
|   |                              |           |           | (0.071)   |
| Hospital FE   | Yes                          | Yes       | Yes       | Yes       |
| Quarter FE  | Yes                          | Yes       | Yes       | Yes       |
| Day of Week FE                                      | Yes                          | Yes       | Yes       | Yes       |
| Observations  | 7,981,843                    | 7,981,843 | 7,981,843 | 7,981,843 |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table presents OLS estimates of the relationship between the share of OB nurses among all providers in a given day and professional-client matching, along with how this relationship varies based on client demand, workflow predictability, and organizational experience.

**Table A24. Professional-Client Matching and Patient Outcomes**

|                               | (1)                | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|-------------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                               | APGAR              | Low APGAR           | Complications       | Length of stay      | Log cost            | C-section           |
| Professional-Client Matching  | 0.025**<br>(0.004) | -0.004**<br>(0.001) | -0.013**<br>(0.003) | -0.057**<br>(0.010) | -0.007**<br>(0.002) | -0.040**<br>(0.004) |
| Mother and pregnancy controls | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Hospital FE                   | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Quarter FE                    | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Day of Week FE                | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Observations                  | 7,867,374          | 7,867,374           | 7,981,843           | 7,981,843           | 7,981,843           | 7,981,843           |
| Adjusted R-squared            | 0.088              | 0.036               | 0.125               | 0.148               | 0.532               | 0.378               |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows OLS regressions analyzing the relationship between professional-client matching and outcomes for mothers, newborns, and hospitals.

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**Table A25. Professional-Client Matching (Quintile-Based) and Patient Outcomes**

|                               | (1)                | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
|-------------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|                               | APGAR              | Low APGAR           | Complications       | Length of stay      | Log cost            | C-section           |
| Professional-Client Matching  | 0.037**<br>(0.004) | -0.006**<br>(0.001) | -0.014**<br>(0.003) | -0.066**<br>(0.010) | -0.007**<br>(0.002) | -0.043**<br>(0.004) |
| Mother and pregnancy controls | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Hospital FE                   | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Quarter FE                    | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Day of Week FE                | Yes                | Yes                 | Yes                 | Yes                 | Yes                 | Yes                 |
| Observations                  | 7,867,374          | 7,867,374           | 7,981,843           | 7,981,843           | 7,981,843           | 7,981,843           |
| Adjusted R-squared            | 0.088              | 0.036               | 0.125               | 0.148               | 0.532               | 0.378               |

Standard errors clustered at the hospital level in parentheses + p < .10 \* p < .05 \*\* p < .01

Notes: This table shows OLS regressions analyzing the relationship between professional-client matching (based on quintiles of client complexity) and outcomes for mothers, newborns, and hospitals.

**Table A26. Professional-Client Mismatching and Patient Outcomes**

|                                 | (1)                | (2)                 | (3)                | (4)                | (5)                | (6)                |
|---------------------------------|--------------------|---------------------|--------------------|--------------------|--------------------|--------------------|
|                                 | APGAR              | Low APGAR           | Complications      | Length of stay     | Log cost           | C-section          |
| Professional-Client Mismatching | 0.099**<br>(0.016) | -0.019**<br>(0.003) | 0.036**<br>(0.011) | 0.106**<br>(0.035) | 0.048**<br>(0.008) | 0.230**<br>(0.015) |
| Mother and pregnancy controls   | Yes                | Yes                 | Yes                | Yes                | Yes                | Yes                |
| Hospital FE                     | Yes                | Yes                 | Yes                | Yes                | Yes                | Yes                |
| Quarter FE                      | Yes                | Yes                 | Yes                | Yes                | Yes                | Yes                |
| Day of Week FE                  | Yes                | Yes                 | Yes                | Yes                | Yes                | Yes                |
| Observations                    | 7,867,374          | 7,867,374           | 7,981,843          | 7,981,843          | 7,981,843          | 7,981,843          |
| Adjusted R-squared              | 0.088              | 0.036               | 0.125              | 0.148              | 0.533              | 0.380              |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows OLS regressions analyzing the relationship between professional-client mismatching (continuous measure) and outcomes for mothers, newborns, and hospitals.

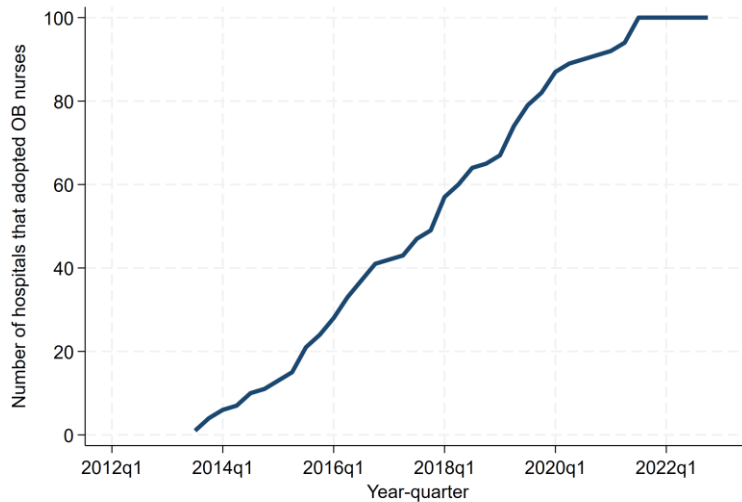
## APPENDIX B: GEOGRAPHIC DISPERSION AND TIMING OF OB NURSE ADOPTION

This appendix provides descriptive information on the geographic distribution and timing of OB nurse adoption in our sample. These patterns help characterize the scope and pace of OB nurse adoption across hospitals during the study period.

The 100 adopting hospitals in our sample are located in 24 of Brazil's 27 states and spread across 88 municipalities (similar to counties in the United States). This broad distribution reflects adoption in diverse regions rather than concentration in a small number of areas.

Adoption occurred gradually over time. The first hospital in our sample adopted OB nurses in the first quarter of 2013, and the last adoption took place in the third quarter of 2021. The median adoption date is the first quarter of 2018. Figure B1 presents the cumulative number of adopting hospitals by quarter, illustrating the steady and staggered pattern of adoption over nearly a decade.

**Figure B1. OB Nurse adoption over time (adopting hospitals, 2012q1-2023q4)**



## APPENDIX C: CALCULATION OF CLIENT COMPLEXITY

This section discusses various models considered in our study to predict C-section risk and calculate the variable *Client Complexity*. Building on the approach outlined by Currie and MacLeod (2017), we use our data to model the underlying propensity of each mother to undergo a C-section rather than a vaginal delivery, considering the observable characteristics of the mother and her pregnancy.

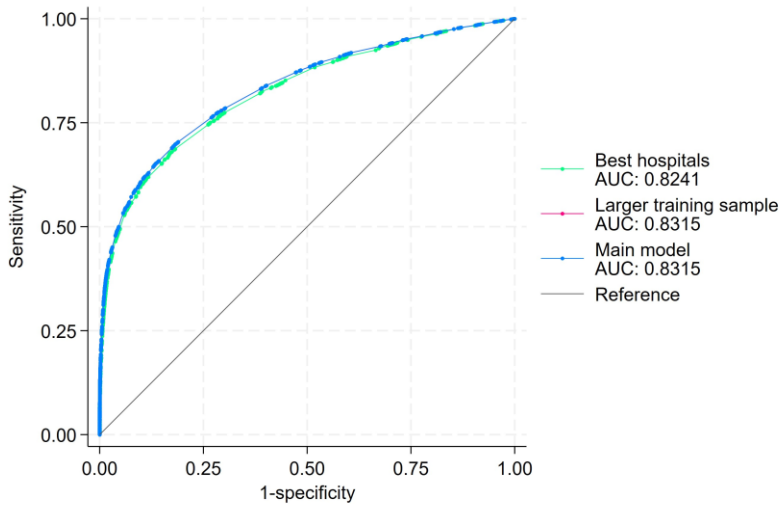
To compute *Client Complexity*, we use a random sample encompassing 40% of births from hospitals that do not adopt OB nurses (i.e., the training sample). We employ a logit model to predict whether a given birth will result in a C-section. These estimates are then used to predict the likelihood of a C-section based on the mother's and the pregnancy's characteristics, representing our variable *Client Complexity*.

Our main regression model includes indicators for various risk factors related to the mother and the pregnancy, such as age group, number of prior pregnancies and C-sections, type of delivery (single, twins, or 3+ babies), fetal position, gestational length groups, and indicators for morbidities and maternal disorders associated with higher risk and delivery complications. Regression results are presented in Table 1 of the paper.

In addition to our main model, we explore alternative models, including one using a larger sample and another using births from top-rated hospitals in the country. We evaluate the goodness of fit of these different logistic regression models by considering their sensitivity (the probability of correctly predicting a positive outcome) and specificity (the probability of correctly predicting a negative outcome). To visualize and compare these metrics, we construct ROC curves, which plot sensitivity against 1-specificity. An ideal model with high sensitivity and high specificity exhibits an ROC curve close to the top left corner of the plot, while a model with low sensitivity and low specificity approximates the 45-degree diagonal line. The AUC (area under the curve) provides a measure of the model's ability to differentiate between positive and negative outcomes, ranging from 0 to 1. A higher AUC indicates better classification performance. Figure C1 presents the ROC curves of these different models and their corresponding AUC values. Our main model achieves the highest AUC of 0.8315, though all models show similar fit.

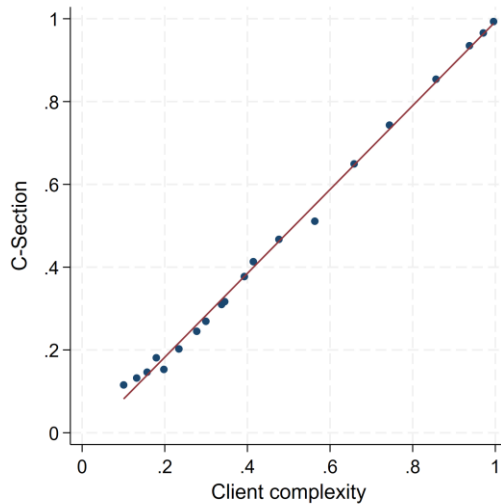
Using the estimates from our main model, we calculate *Client Complexity* for each expectant mother in the sample. As expected, *Client Complexity* is positively correlated with the likelihood of undergoing a C-section, indicating that higher predicted values are associated with more complex or higher-risk births. Figure C2 illustrates this relationship through binned scatterplots based on Ordinary Least Squares regressions, demonstrating that *Client Complexity* serves as a good predictor of C-section. This correlation provides support for interpreting *Client Complexity* as a meaningful proxy for the clinical risk of a delivery. By summarizing a wide range of maternal and pregnancy characteristics into a single measure, it allows us to systematically capture variation in underlying birth risk across patients.

**Figure C1. ROC curves of various models predicting C-section**



Notes: This figure shows ROC curves of various logistic regression models predicting C-section. The blue line represents our main model, while the pink line represents the model using a 50% random sample of births from hospitals that do not adopt obstetric nurses, and the green line represents the model using births from top-rated hospitals in the country. This figure shows that our main model has the highest area under the ROC curve (AUC), indicating the best classification performance among these models.

**Figure C2. Binned Scatterplot of Client Complexity Predicting C-section**



Notes: This figure shows a binned scatterplot of the relationship between Client Complexity and C-section. This binned scatterplot is created using an Ordinary Least Squares regression of C-section as a function of Client Complexity (results not shown, but available upon request). This figure shows a strong positive association between Client Complexity and C-section, indicating that Client Complexity serves as a meaningful proxy for the clinical risk of a delivery.

## APPENDIX D: ADDRESSING ENDOGENEITY OF OB NURSE ADOPTION

A potential concern with our empirical design is that hospitals' adoption of OB nurses may be endogenous. In particular, hospitals that choose to adopt OB nurses might differ systematically from those that do not in ways correlated with our outcomes of interest. For example, adoption could be related to hospitals' organizational form, size, or patient mix, raising concerns that our estimates capture these underlying differences rather than the role of OB nurse adoption. We share this concern and therefore conduct a robustness analysis to mitigate potential biases arising from such endogeneity.

To address this issue, we implement a matching strategy based on observable hospital characteristics prior to adoption. Specifically, we employ coarsened exact matching (CEM), which improves covariate balance between adopting (treatment) and non-adopting (control) hospitals by exactly or coarsely matching on pre-treatment variables (Blackwell et al. 2009; Iacus et al. 2012). We match hospitals on organizational attributes (general, private, for-profit, and teaching status), measures of capacity and demand (number of obstetric beds, providers, and patients), and patient case mix (average client complexity). All variables are measured in the quarter before adoption for treated hospitals and in the quarter before the first adoption for control hospitals. After constructing the matched samples, we apply CEM weights in our difference-in-differences regressions estimated using the method of Borusyak et al. (2024).

We implement two versions of this procedure. One version matches adopting and non-adopting hospitals using the attributes described above. The other applies the same matching criteria but further restricts comparisons to hospitals within the same state, thereby strengthening comparability by ensuring that hospitals are embedded in similar regulatory, institutional, and demographic environments. Below we present the balance tests and regression results for each version.

### 1. Matching on Observable Hospital Characteristics

We begin by matching hospitals on organizational form (general, private, for-profit, teaching), measures of capacity and demand (number of obstetric beds, number of providers, and number of births per quarter), and on patient case mix (average client complexity).

**Balance on organizational and capacity characteristics.** Table D1 shows that adopting and non-adopting hospitals are broadly similar. The average number of obstetric beds, providers, and births per quarter is essentially the same across groups. The distribution of general, private, for-profit, and teaching hospitals is also very similar, with only modest differences in the share of private and teaching hospitals. Hospitals are also comparable in their likelihood of operating a neonatal unit. Overall, the groups are nearly indistinguishable in organizational form and capacity, and the small differences that do exist do not suggest systematic imbalance.

**Balance on maternal, pregnancy, and newborn characteristics.** Table D2 reports balance on maternal, pregnancy, and newborn characteristics. Adopters and non-adopters are similar in terms of client demographics, parity, prior C-section history, gestational term, and newborn health indicators. Importantly, hospitals are balanced on professional-client matching and on the three moderating variables central to our analysis (high client demand, high workflow predictability, and high organizational experience). Some individual covariates exhibit statistically significant differences. For example, adopting hospitals have slightly older maternal age distributions, and in the within-state matched sample the share of head-down fetal position differs by approximately 5–6 percentage points. While these differences are detectable given the large sample sizes, their absolute magnitudes are modest. Because our difference-in-differences design relies on within-hospital changes over time and includes hospital fixed effects, identification does not require perfect cross-sectional balance in levels. Taken together, Tables D1

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3 and D2 indicate that adopters and non-adopters are broadly comparable on hospital characteristics and  
4 patient case mix prior to adoption, and that any remaining imbalances are unlikely to pose a material  
5 threat to our inferences.  
6

7 **Regression results.** Table D3 presents estimates using the CEM-weighted sample. Results replicate our  
8 main findings: adoption of OB nurses significantly improves professional-client matching, particularly in  
9 contexts of high client demand, high workflow predictability, and high organizational experience. These  
10 findings indicate that our main results are not driven by pre-existing differences in hospital or patient  
11 characteristics.  
12

## 13 **2. Matching restricted within states**

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15 We next apply the same matching procedure but restrict comparisons to hospitals within the same state.  
16 This approach narrows comparability by holding constant state-level institutional factors such as  
17 regulatory, institutional, and demographic environments.  
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20 **Balance on organizational and capacity characteristics.** Table D4 shows that adopting and non-  
21 adopting hospitals remain closely matched on organizational form and capacity. The distributions of  
22 general, private, for-profit, and teaching hospitals are similar, and adopters and non-adopters average  
23 nearly the same number of obstetric beds, providers, and births per quarter. The presence of neonatal units  
24 also differs only modestly across groups. In short, the state-restricted procedure yields highly comparable  
25 hospitals across organizational and capacity-related dimensions.  
26

27 **Balance on maternal, pregnancy, and newborn characteristics.** Table D5 presents the balance of  
28 maternal, pregnancy, and newborn characteristics under this design. As in the sample above, adopters and  
29 non-adopters are similar in terms of parity, prior C-sections, pregnancy type, gestational term, and  
30 newborn health. They are also balanced on professional-client matching and the moderating variables  
31 central to our analysis. A few small differences remain—for example, in maternal age distribution or fetal  
32 presentation—but these are minor and do not follow a consistent pattern. Overall, the matched groups are  
33 substantively similar.  
34

35  
36 **Regression results.** Table D6 reports regression results from the state-restricted matched sample. This  
37 specification reduces the number of adopting hospitals to 18. In this subsample, adoption of OB nurses  
38 remains positively and statistically significantly associated with professional–client matching. The  
39 estimated effect (0.212) is larger than in the main specification, which we interpret as reflecting a local  
40 average treatment effect for this selected group of hospitals rather than a directly comparable average  
41 effect. Importantly, the qualitative pattern of results—including stronger effects in high-demand, high-  
42 predictability, and high-experience settings—remains consistent with the main analysis.  
43

## 44 **3. Summary**

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46 Across both matching procedures, adopting and non-adopting hospitals are highly comparable on  
47 organizational characteristics, capacity, and patient populations. Importantly, they are balanced on  
48 professional-client matching prior to adoption and on the moderating variables central to our theoretical  
49 framework. The few differences that emerge are small and not systematic. The regression analyses  
50 consistently confirm that adoption of OB nurses improves professional-client matching, especially in  
51 contexts characterized by high demand, predictable workflows, and greater organizational experience.  
52 These robustness checks strengthen confidence that our results reflect the role of OB nurse adoption  
53 rather than underlying differences between hospitals.  
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**Table D1. Hospital Characteristics by Adoption of OB Nurses**

|                            | Did Not Adopt (0) | Adopted (1)       | Total             | p-value |
|----------------------------|-------------------|-------------------|-------------------|---------|
| Number of hospitals        | 293 (83.5%)       | 58 (16.5%)        | 351 (100.0%)      |         |
| General hospital (0/1)     | 0.138 (0.345)     | 0.172 (0.381)     | 0.143 (0.351)     | 0.491   |
| Private hospital (0/1)     | 0.560 (0.497)     | 0.448 (0.502)     | 0.542 (0.499)     | 0.118   |
| For-profit hospital (0/1)  | 0.045 (0.209)     | 0.017 (0.131)     | 0.041 (0.198)     | 0.323   |
| Teaching hospital (0/1)    | 0.178 (0.383)     | 0.086 (0.283)     | 0.162 (0.369)     | 0.085   |
| Has neonatal unit (0/1)    | 0.654 (0.477)     | 0.690 (0.467)     | 0.660 (0.474)     | 0.600   |
| # Obstetric beds           | 27.434 (13.614)   | 27.379 (13.341)   | 27.425 (13.551)   | 0.977   |
| # Providers in the quarter | 11.604 (7.841)    | 11.069 (7.673)    | 11.516 (7.805)    | 0.634   |
| # Births in the quarter    | 408.642 (235.627) | 420.638 (239.172) | 410.624 (235.914) | 0.724   |

Notes: Values are means with standard deviations in parentheses. p-values are from two-sided tests of differences in means.

**Table D2. Maternal, Pregnancy, and Newborn Characteristics by Adoption of OB Nurses**

|  | Did Not Adopt<br>(0) | Adopted (1)   | Total         | p-value |
|--|----------------------|---------------|---------------|---------|
| Number of hospitals                                | 293 (83.5%)          | 58 (16.5%)    | 351 (100.0%)  |         |
| Client complexity                                  | 0.431 (0.067)        | 0.433 (0.064) | 0.431 (0.067) | 0.893   |
| Provider's risk specialization                     | 0.439 (0.067)        | 0.432 (0.062) | 0.438 (0.066) | 0.438   |
| Professional-Client Matching                       | 0.290 (0.193)        | 0.303 (0.181) | 0.292 (0.191) | 0.620   |
| High client demand (0/1)                           | 0.622 (0.486)        | 0.672 (0.473) | 0.630 (0.483) | 0.466   |
| High workflow predictability (0/1)                 | 0.511 (0.501)        | 0.466 (0.503) | 0.504 (0.501) | 0.525   |
| High organizational experience (0/1)               | 0.614 (0.488)        | 0.672 (0.473) | 0.624 (0.485) | 0.406   |
| Mother's age: Less than 18yr                       | 0.118 (0.043)        | 0.104 (0.030) | 0.116 (0.042) | 0.015   |
| Mother's age: 18-20yr                              | 0.186 (0.041)        | 0.169 (0.035) | 0.183 (0.041) | 0.004   |
| Mother's age: 21-25yr                              | 0.284 (0.040)        | 0.286 (0.031) | 0.284 (0.038) | 0.743   |
| Mother's age: 26-30yr                              | 0.206 (0.042)        | 0.212 (0.027) | 0.207 (0.040) | 0.320   |
| Mother's age: 31-35yr                              | 0.130 (0.042)        | 0.144 (0.033) | 0.132 (0.041) | 0.013   |
| Mother's age: More than 35yr                       | 0.076 (0.033)        | 0.085 (0.025) | 0.077 (0.032) | 0.040   |
| Mother's pregnancies: First pregnancy              | 0.352 (0.116)        | 0.354 (0.111) | 0.352 (0.115) | 0.885   |
| Mother's pregnancies: Second pregnancy             | 0.272 (0.049)        | 0.291 (0.032) | 0.276 (0.047) | 0.005   |
| Mother's pregnancies: Third pregnancy              | 0.168 (0.035)        | 0.161 (0.029) | 0.167 (0.034) | 0.137   |
| Mother's pregnancies: Fourth+ pregnancy            | 0.171 (0.054)        | 0.158 (0.035) | 0.169 (0.051) | 0.090   |
| Mother's C-section: No prior C-section             | 0.710 (0.201)        | 0.727 (0.199) | 0.713 (0.201) | 0.552   |
| Mother's C-section: One prior C-section            | 0.158 (0.056)        | 0.154 (0.040) | 0.158 (0.053) | 0.559   |
| Mother's C-section: Two+ prior C-section           | 0.061 (0.030)        | 0.057 (0.035) | 0.060 (0.031) | 0.395   |
| Pregnancy type: Single                             | 0.997 (0.007)        | 0.998 (0.004) | 0.997 (0.006) | 0.309   |
| Pregnancy type: Twins                              | 0.001 (0.003)        | 0.001 (0.003) | 0.001 (0.003) | 0.759   |
| Pregnancy type: Three+ babies                      | 0.000 (0.001)        | 0.000 (0.000) | 0.000 (0.001) | 0.764   |
| Fetal position: Head down                          | 0.929 (0.159)        | 0.968 (0.042) | 0.936 (0.147) | 0.070   |
| Fetal position: Breach                             | 0.029 (0.040)        | 0.027 (0.040) | 0.029 (0.040) | 0.716   |
| Fetal position: Transverse                         | 0.002 (0.007)        | 0.001 (0.002) | 0.002 (0.007) | 0.255   |
| Pregnancy term: 28-31 weeks                        | 0.008 (0.008)        | 0.006 (0.006) | 0.008 (0.008) | 0.231   |
| Pregnancy term: 32-36 weeks                        | 0.095 (0.040)        | 0.081 (0.038) | 0.093 (0.040) | 0.013   |
| Pregnancy term: 37-41 weeks                        | 0.830 (0.089)        | 0.850 (0.062) | 0.833 (0.085) | 0.104   |
| Pregnancy term: 42+ weeks                          | 0.041 (0.029)        | 0.045 (0.033) | 0.042 (0.029) | 0.409   |
| Outcome: Baby APGAR 1-min (0-10)                   | 8.352 (0.370)        | 8.213 (0.346) | 8.329 (0.369) | 0.009   |
| Outcome: Baby Low APGAR 1-min (0/1)                | 0.056 (0.031)        | 0.059 (0.034) | 0.057 (0.032) | 0.597   |
| Outcome: Complications of labor and delivery (0/1) | 0.022 (0.037)        | 0.050 (0.082) | 0.026 (0.048) | <0.001  |
| Outcome: Length of stay (in days)                  | 2.245 (0.505)        | 2.221 (0.587) | 2.241 (0.518) | 0.750   |
| Outcome: Log cost                                  | 6.444 (0.121)        | 6.454 (0.151) | 6.445 (0.127) | 0.577   |
| Outcome: C-section (0/1)                           | 0.437 (0.166)        | 0.422 (0.125) | 0.435 (0.160) | 0.515   |

Notes: Values are means with standard deviations in parentheses. p-values are from two-sided tests of differences in means.

**Table D3. CEM Estimates: OB Nurse Adoption and Professional-Client Matching**

|  | (1)                          | (2)                | (3)                | (4)                |
|--|------------------------------|--------------------|--------------------|--------------------|
|  | Professional-Client Matching |                    |                    |                    |
| Post-adoption                                  | 0.101**<br>(0.016)           |                    |                    |                    |
| Post-adoption (Low client demand)              |                              | 0.006<br>(0.030)   |                    |                    |
| Post-adoption (High client demand)             |                              | 0.114**<br>(0.015) |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                    | 0.013<br>(0.013)   |                    |
| Post-adoption (High workflow predictability)   |                              |                    | 0.183**<br>(0.016) |                    |
| Post-adoption (Low organizational experience)  |                              |                    |                    | 0.052*<br>(0.021)  |
| Post-adoption (High organizational experience) |                              |                    |                    | 0.114**<br>(0.015) |
| Difference (High - Low)                        |                              | 0.108**<br>(0.030) | 0.171**<br>(0.014) | 0.062**<br>(0.020) |
| Hospital FE                                    | Yes                          | Yes                | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                | Yes                | Yes                |
| Observations                                   | 3,084,817                    | 3,084,817          | 3,084,817          | 3,084,817          |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, as well as how this relationship varies with client demand, workflow predictability, and organizational experience. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata. Regressions are estimated using CEM weights generated by matching adopting and non-adopting hospitals on organizational attributes (general, private, for-profit, and teaching status), measures of capacity and demand (number of obstetric beds, number of providers, and number of births), and patient case mix (average client complexity), measured in the quarter prior to adoption.

**Table D4. Hospital Characteristics by Adoption of OB Nurses**

|                            | Did Not Adopt (0) | Adopted (1)       | Total             | p-value |
|----------------------------|-------------------|-------------------|-------------------|---------|
| Number of hospitals        | 29 (61.7%)        | 18 (38.3%)        | 47 (100.0%)       |         |
| General hospital (0/1)     | 0.019 (0.137)     | 0.111 (0.323)     | 0.054 (0.228)     | 0.180   |
| Private hospital (0/1)     | 0.600 (0.499)     | 0.444 (0.511)     | 0.540 (0.504)     | 0.309   |
| For-profit hospital (0/1)  | 0.028 (0.167)     | 0.000 (0.000)     | 0.017 (0.131)     | 0.486   |
| Teaching hospital (0/1)    | 0.111 (0.320)     | 0.111 (0.323)     | 0.111 (0.318)     | 1.000   |
| Has neonatal unit (0/1)    | 0.534 (0.508)     | 0.667 (0.485)     | 0.585 (0.498)     | 0.381   |
| # Obstetric beds           | 23.328 (11.369)   | 21.722 (11.313)   | 22.713 (11.251)   | 0.640   |
| # Providers in the quarter | 10.290 (6.618)    | 10.778 (5.816)    | 10.477 (6.262)    | 0.798   |
| # Births in the quarter    | 313.182 (189.074) | 329.722 (181.742) | 319.517 (184.481) | 0.769   |

Notes: Values are means with standard deviations in parentheses. p-values are from two-sided tests of differences in means.

**Table D5. Maternal, Pregnancy, and Newborn Characteristics by Adoption of OB Nurses**

|  | Did Not Adopt<br>(0) | Adopted (1)   | Total         | p-value |
|--|----------------------|---------------|---------------|---------|
| Number of hospitals                                | 29 (61.7%)           | 18 (38.3%)    | 47 (100.0%)   |         |
| Client complexity                                  | 0.425 (0.051)        | 0.439 (0.058) | 0.431 (0.053) | 0.388   |
| Provider's risk specialization                     | 0.425 (0.062)        | 0.435 (0.055) | 0.429 (0.059) | 0.558   |
| Professional-Client Matching                       | 0.290 (0.149)        | 0.258 (0.167) | 0.278 (0.155) | 0.499   |
| High client demand (0/1)                           | 0.528 (0.508)        | 0.556 (0.511) | 0.538 (0.504) | 0.857   |
| High workflow predictability (0/1)                 | 0.675 (0.477)        | 0.556 (0.511) | 0.629 (0.488) | 0.421   |
| High organizational experience (0/1)               | 0.508 (0.509)        | 0.500 (0.514) | 0.505 (0.505) | 0.957   |
| Mother's age: Less than 18yr                       | 0.114 (0.066)        | 0.091 (0.024) | 0.105 (0.055) | 0.177   |
| Mother's age: 18-20yr                              | 0.187 (0.036)        | 0.165 (0.026) | 0.178 (0.034) | 0.032   |
| Mother's age: 21-25yr                              | 0.293 (0.043)        | 0.297 (0.030) | 0.295 (0.038) | 0.749   |
| Mother's age: 26-30yr                              | 0.210 (0.054)        | 0.213 (0.024) | 0.211 (0.045) | 0.811   |
| Mother's age: 31-35yr                              | 0.123 (0.041)        | 0.146 (0.031) | 0.132 (0.039) | 0.043   |
| Mother's age: More than 35yr                       | 0.074 (0.031)        | 0.088 (0.020) | 0.079 (0.028) | 0.112   |
| Mother's pregnancies: First pregnancy              | 0.350 (0.114)        | 0.340 (0.128) | 0.346 (0.119) | 0.789   |
| Mother's pregnancies: Second pregnancy             | 0.263 (0.060)        | 0.304 (0.029) | 0.279 (0.054) | 0.010   |
| Mother's pregnancies: Third pregnancy              | 0.173 (0.043)        | 0.161 (0.027) | 0.169 (0.038) | 0.314   |
| Mother's pregnancies: Fourth+ pregnancy            | 0.168 (0.054)        | 0.148 (0.032) | 0.160 (0.048) | 0.171   |
| Mother's C-section: No prior C-section             | 0.736 (0.155)        | 0.683 (0.244) | 0.716 (0.193) | 0.368   |
| Mother's C-section: One prior C-section            | 0.149 (0.048)        | 0.171 (0.041) | 0.157 (0.046) | 0.122   |
| Mother's C-section: Two+ prior C-section           | 0.061 (0.032)        | 0.060 (0.030) | 0.060 (0.031) | 0.909   |
| Pregnancy type: Single                             | 0.995 (0.011)        | 0.999 (0.002) | 0.997 (0.009) | 0.121   |
| Pregnancy type: Twins                              | 0.002 (0.006)        | 0.001 (0.002) | 0.002 (0.005) | 0.326   |
| Pregnancy type: Three+ babies                      | 0.000 (0.000)        | 0.000 (0.000) | 0.000 (0.000) | .       |
| Fetal position: Head down                          | 0.917 (0.076)        | 0.973 (0.014) | 0.938 (0.066) | 0.003   |
| Fetal position: Breach                             | 0.058 (0.074)        | 0.024 (0.012) | 0.045 (0.061) | 0.058   |
| Fetal position: Transverse                         | 0.002 (0.003)        | 0.000 (0.001) | 0.001 (0.003) | 0.083   |
| Pregnancy term: 28-31 weeks                        | 0.009 (0.010)        | 0.006 (0.006) | 0.008 (0.009) | 0.217   |
| Pregnancy term: 32-36 weeks                        | 0.102 (0.040)        | 0.091 (0.046) | 0.098 (0.042) | 0.383   |
| Pregnancy term: 37-41 weeks                        | 0.791 (0.135)        | 0.845 (0.062) | 0.812 (0.115) | 0.119   |
| Pregnancy term: 42+ weeks                          | 0.050 (0.032)        | 0.049 (0.030) | 0.050 (0.031) | 0.841   |
| Outcome: Baby APGAR 1-min (0-10)                   | 8.383 (0.432)        | 8.275 (0.319) | 8.341 (0.393) | 0.364   |
| Outcome: Baby Low APGAR 1-min (0/1)                | 0.055 (0.040)        | 0.057 (0.029) | 0.055 (0.036) | 0.867   |
| Outcome: Complications of labor and delivery (0/1) | 0.043 (0.082)        | 0.051 (0.074) | 0.046 (0.079) | 0.732   |
| Outcome: Length of stay (in days)                  | 2.014 (0.367)        | 2.233 (0.590) | 2.098 (0.471) | 0.122   |
| Outcome: Log cost                                  | 6.425 (0.142)        | 6.427 (0.095) | 6.426 (0.125) | 0.970   |
| Outcome: C-section (0/1)                           | 0.445 (0.131)        | 0.449 (0.111) | 0.446 (0.122) | 0.921   |

Notes: Values are means with standard deviations in parentheses. p-values are from two-sided tests of differences in means.

**Table D6. CEM Estimates: OB Nurse Adoption and Professional-Client Matching**

|  | (1)                          | (2)                 | (3)                | (4)                |
|--|------------------------------|---------------------|--------------------|--------------------|
|  | Professional-Client Matching |                     |                    |                    |
| Post-adoption                                  | 0.212**<br>(0.031)           |                     |                    |                    |
| Post-adoption (Low client demand)              |                              | -0.040**<br>(0.015) |                    |                    |
| Post-adoption (High client demand)             |                              | 0.293**<br>(0.013)  |                    |                    |
| Post-adoption (Low workflow predictability)    |                              |                     | 0.069**<br>(0.015) |                    |
| Post-adoption (High workflow predictability)   |                              |                     | 0.277**<br>(0.020) |                    |
| Post-adoption (Low organizational experience)  |                              |                     |                    | 0.046**<br>(0.017) |
| Post-adoption (High organizational experience) |                              |                     |                    | 0.297**<br>(0.021) |
| Difference (High - Low)                        |                              | 0.333**<br>(0.004)  | 0.208**<br>(0.017) | 0.251**<br>(0.019) |
| Hospital FE                                    | Yes                          | Yes                 | Yes                | Yes                |
| Quarter FE                                     | Yes                          | Yes                 | Yes                | Yes                |
| Day of Week FE                                 | Yes                          | Yes                 | Yes                | Yes                |
| Observations                                   | 502,616                      | 502,616             | 502,616            | 502,616            |

Standard errors clustered at the hospital level in parentheses +  $p < .10$  \*  $p < .05$  \*\*  $p < .01$

Notes: This table shows estimates of the relationship between OB nurse adoption and professional-client matching, as well as how this relationship varies with client demand, workflow predictability, and organizational experience. Model 1 presents the average treatment effect, while Models 2 to 4 provide separate estimates for hospitals classified as low (0) and high (1) on client demand, workflow predictability, and organizational experience. These models are estimated using the imputation-method difference-in-differences estimator developed by Borusyak, Jaravel, and Spiess (2024). Differences in estimates across groups are computed using linear combinations of coefficients, applying the post-estimation command *xlincom* to the output of *did\_imputation* with the *hetby* option in Stata. Regressions are estimated using CEM weights generated by matching adopting and non-adopting hospitals within the same state on organizational attributes (general, private, for-profit, and teaching status), capacity measures (number of obstetric beds, number of providers, and number of births), and patient case mix (average client complexity).

## APPENDIX E: ALTERNATIVE MATCHING MEASURE BASED ON COSINE SIMILARITY

Our main measure of professional–client matching is based on whether a patient's risk level falls within the tercile of complexity in which their provider specializes. This approach captures whether the allocation system channels patients to providers whose caseload concentrates in the relevant risk stratum. However, it relies on discrete categorization and does not account for the full range of clinical characteristics that shape a provider's experience. To assess whether our findings are robust to a fundamentally different operationalization of match quality, we develop an alternative measure based on cosine similarity that captures how closely a patient's clinical profile aligns with the breadth of a provider's prior experience.

This approach builds on the cosine similarity method in Ching et al. (2021) and the experience-based matching framework in Epstein et al. (2010). Following these approaches, we represent each provider's expertise and each patient's characteristics as vectors and quantify the similarity between them. For each provider, we construct a time-varying experience vector indicating which patient characteristics the provider has previously encountered. These characteristics mirror those used in the estimation of client complexity, including demographic factors (e.g., mother's age group, prior pregnancies, prior C-sections), pregnancy characteristics (e.g., plurality, fetal position, gestational length), and medical conditions (e.g., preeclampsia, hypertension, diabetes, and other pregnancy-related complications). For each patient, we create a corresponding characteristics vector using the same set of indicators. We then compute the cosine similarity between the provider's experience vector and the patient's characteristics vector, producing a continuous measure between 0 and 1, where higher values indicate a closer alignment between a patient's clinical profile and the provider's prior experience with similar cases. We also create a variant in which the provider's experience vector is restricted to patients treated in the preceding 90 days, capturing more recent and potentially more clinically relevant experience.

Results for both variants are reported in Appendix A, Tables A9 and A10. Across both, results are consistent with our main findings for H1–H3, while evidence for H4 is somewhat weaker. This may reflect the fact that cosine similarity captures gradual accumulation of provider experience with specific patient types, rather than the categorical sorting between provider roles that organizational experience most directly facilitates. Because the cosine approach captures a conceptually distinct dimension of match quality—breadth of clinical experience rather than risk-level specialization—convergence with our main results strengthens confidence that the findings reflect genuine allocative improvements rather than artifacts of a particular measurement choice.

## APPENDIX F: RANDOM-ASSIGNMENT SIMULATION

### Characterizing the Allocation Mechanism: A Random-Assignment Simulation

Our main results establish that OB nurse adoption improves professional–client matching. In this section, we develop a random-assignment simulation to characterize the mechanism through which this improvement occurs. The simulation allows us to assess how the allocation system performs relative to a benchmark in which patients are assigned to providers at random, and to identify whether matching gains operate through the role-enabled channel—routing patients between provider types—or through improved sorting among individual physicians. The results reveal that the OB nurse role functions as a first-stage routing mechanism in the allocation process, creating an institutionally legible and actionable pathway that channels cases to appropriately specialized providers.

#### Simulation Design

For each hospital-day in our sample, we observe the actual set of patients who delivered, the actual set of providers on shift, and each provider's caseload. We simulate what matching would look like if patients had been randomly assigned to providers, holding the staffing composition and each provider's caseload fixed. Specifically, we construct a set of provider "slots"—one for each birth on a given hospital-day, labeled with the provider who performed it—and randomly permute which patients fill those slots. This preserves the number of patients each provider sees while breaking any systematic link between patient characteristics and provider assignment.<sup>1</sup>

We repeat this permutation 1000 times for each hospital-day and compute the mean simulated matching rate across repetitions. This yields a random-assignment benchmark for each hospital-day: the matching rate that would obtain if the allocation system assigned patients to available providers at random, given the observed staffing and caseload structure. The difference between the actual matching rate and this benchmark—which we term *excess matching*—captures the extent to which the allocation system actively sorts patients to appropriately specialized providers, beyond what the composition of the available pool alone would produce.

We conduct the simulation on two samples: the full sample (including all providers) and the physician-only sample (excluding OB nurses). Comparing results across the two samples allows us to locate the source of any allocative gains—whether they arise from the system's ability to route patients between provider types or from improved sorting among physicians.

### Results

#### *Pre-Adoption Baseline*

Table 5 (in the main paper) reports mean matching rates from the random-assignment simulation for adopting and non-adopting hospitals. Before OB nurse adoption, the allocation system barely outperformed random assignment: pre-adoption excess matching in adopting hospitals was just 1.6 percentage points. This pattern is identical in both samples (all providers and physician-only), as expected, since no OB nurses are present before adoption. Non-adopting hospitals exhibit a similarly

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<sup>1</sup> In our primary specification, we hold each provider's caseload fixed and permute only which patients they see. Results are virtually identical using an alternative specification in which patients are assigned to providers with equal probability, without preserving caseloads. This indicates that the findings are not sensitive to assumptions about the distribution of workload across providers.

1  
2  
3 small level of excess matching (0.8 percentage points), consistent with the pattern in adopting hospitals  
4 prior to adoption.  
5

### 6 ***Post-Adoption: Matching Gains Through Structural Channeling*** 7

8 After OB nurse adoption, the allocation system's performance improves substantially. Table 5 shows that  
9 excess matching in adopting hospitals rises from 1.6 to 5.5 percentage points in the full sample after  
10 adoption. Table 6 presents formal difference-in-differences estimates (using Borusyak et al.'s (2024)  
11 imputation estimator), decomposing the matching improvement into compositional effects and role-  
12 enabled allocative gains.  
13

14 In the full sample, OB nurse adoption is associated with a 9.6 percentage point increase in actual  
15 matching ( $p < 0.01$ ). The random-assignment benchmark increases by 5.8 percentage points ( $p < 0.01$ ),  
16 reflecting compositional changes in the patient–provider pool. The introduction of OB nurses and the shift  
17 in patient mix would improve matching even under random assignment. However, excess matching also  
18 increases by 3.9 percentage points ( $p < 0.01$ )—approximately 40% of the total effect—indicating that  
19 after adoption the allocation system routes patients to providers substantially better than random (Figure  
20 F1, Panel A).  
21  
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23 The physician-only sample clarifies the source of this improvement. Actual matching among physicians  
24 improves by 4.6 percentage points ( $p < 0.01$ ) after adoption, but the random-assignment benchmark rises  
25 by an identical 4.6 percentage points ( $p < 0.01$ ). Excess matching does not change—the allocation system  
26 sorts patients among physicians no better than random, either before or after adoption (Figure F1, Panel  
27 B). Role-enabled allocative gains operate through structural channeling between provider types (OB nurse  
28 versus physician), not through improved sorting within the physician group.  
29

### 30 **Interpretation** 31

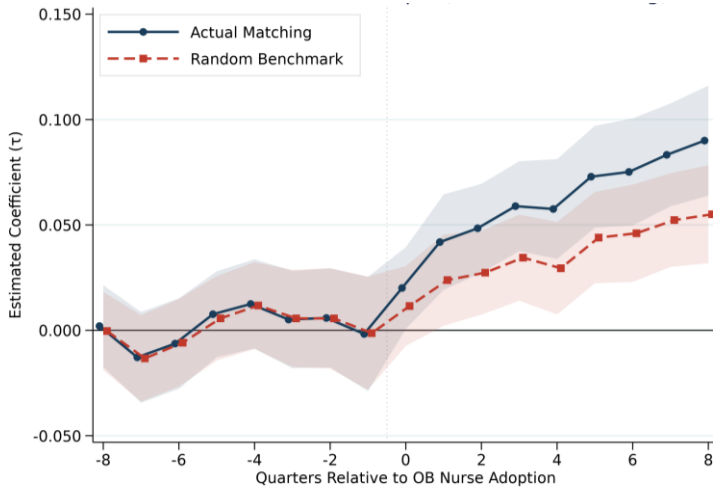
32 The contrast between the full-sample and physician-only results identifies precisely where the allocative  
33 improvement occurs. Within-physician allocation was approximately random before adoption and  
34 remains so afterward. This finding is especially striking given the pre-adoption physician workforce. One-  
35 third of physician-led births before adoption were performed by physicians in the lowest tercile of risk  
36 specialization (Table A12). The system had substantial low-risk expertise but no formal mechanism to act  
37 on it. Without a recognized organizational category encoding providers' specialization, the allocation  
38 system had no systematic basis for leveraging available expertise.  
39  
40

41 The OB nurse role addresses this by introducing a formally defined provider category that makes  
42 expertise more legible and actionable. Before adoption, triage staff chose among formally undifferentiated  
43 physicians. After adoption, the allocation process gains a first stage—routing patients into OB nurse or  
44 physician pathways—before any within-category assignment occurs. It is this first-stage routing that  
45 drives the role-enabled allocative gains documented in Table 6.  
46

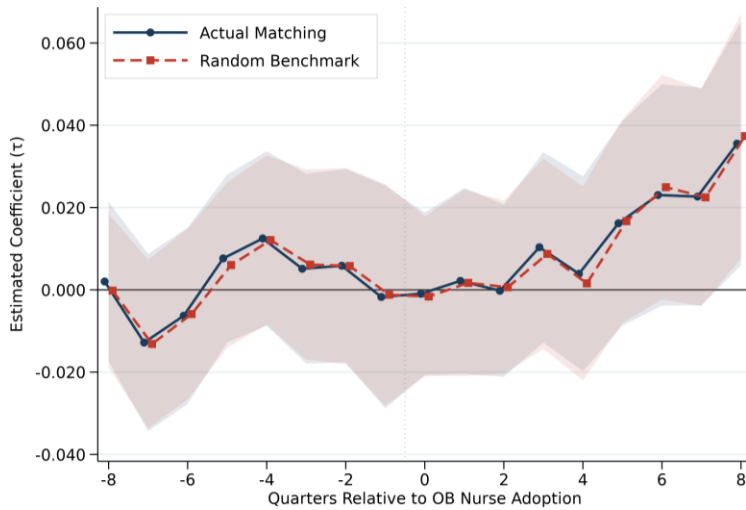
47 This clarifies the relationship between compositional and allocative effects. The two are not competing  
48 explanations but complementary facets of the same organizational mechanism: encoding expertise into  
49 formal structures simultaneously restructures the composition of each provider type's caseload and gives  
50 the triage system a legible signal it can act on. Both channels reflect allocative infrastructure at work.  
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**Figure F1. Actual vs. Simulated Matching Over Time Relative to OB Nurse Adoption**

**Panel A: All Providers**



**Panel B: Physicians Only**



Notes: This figure plots event-study coefficients for actual matching rates and random-assignment benchmarks over time relative to OB nurse adoption. The random-assignment benchmark is computed by permuting patient assignments across providers within each hospital-day, holding provider caseloads fixed (1000 permutations). The gap between the lines represents excess matching—the extent to which the allocation system outperforms random assignment. Panel A includes all providers; Panel B restricts to physician-led births. Estimates are from Borusyak et al.'s (2024) imputation estimator with hospital and year-quarter fixed effects. Shaded areas indicate 95% confidence intervals based on standard errors clustered at the hospital level.

## APPENDIX G: IMPLICATIONS FOR POLICY AND HEALTHCARE PRACTICE

We show that obstetric nurse adoption is associated with improved professional–client matching in Brazilian public hospitals and that improved matching is associated with better maternal and neonatal outcomes. These clinical effects are modest in absolute terms but comparable to other maternity care interventions. These findings have implications for how policymakers and healthcare managers evaluate specialized role adoption.

### Interpreting the Magnitude of Clinical Effects

The estimated clinical effects of improved matching are modest but nontrivial. A one–standard deviation increase in professional–client matching is associated with a 1.9 percentage point decline in C-sections. This magnitude is comparable to other maternity care interventions, including the 2 percentage point reduction documented in the Cochrane review of midwife-led continuity models (Sandall et al. 2024), the 1.1 percentage point decrease following obstetric unit closures in rural U.S. counties (Fischer et al. 2024), and the 1.6 percentage point decline associated with Brazil’s 2016 “Cesarean Policy” (Melo and Menezes Filho 2023).

Associations for neonatal outcomes are smaller. A one–standard deviation increase in matching is linked to a 0.2 percentage point reduction in low APGAR scores and a 1.2 percentage point increase in 1-minute APGAR scores—effects similar in scale to those reported in related policy settings. OB nurse adoption should therefore be understood as one lever among several for improving maternal and neonatal health, rather than as a standalone solution.

### Efficiency and the Deployment of Scarce Expertise

Although effects on clinical outcomes are modest, OB nurse adoption meaningfully alters how expertise is deployed. By channeling low-risk deliveries to OB nurses, hospitals enable physicians to concentrate more consistently on higher-complexity cases. This reallocation improves alignment across the risk spectrum rather than simply expanding staffing capacity.

From a policy perspective, efficiency gains may represent the central benefit of OB nurse adoption. In systems characterized by physician shortages or uneven distribution, assigning routine cases to appropriately trained OB nurses can be a cost-effective way to preserve quality while improving the use of scarce physician expertise. Reforms such as Rede Cegonha may therefore generate value primarily by improving how professional resources are allocated, even if aggregate clinical indicators shift incrementally.

### Organizational Conditions and Implementation

The benefits of OB nurse adoption are not uniform across hospitals. Improvements in professional–client matching are strongest in hospitals with higher patient volume and more predictable workflows, and somewhat stronger in hospitals with greater organizational experience, particularly in the early post-adoption period.

These findings suggest that implementation context matters. Hospitals with sufficient volume can sustain narrower scopes of practice, and predictable workflows facilitate deliberate allocation. In lower-volume or highly volatile environments, specialized roles may be more difficult to deploy effectively. Policymakers seeking to expand OB nurse adoption may therefore benefit from considering

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3 organizational factors—particularly patient volume and workflow structure—rather than assuming  
4 uniform returns across settings.  
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6 **Formal and Informal Structures of Organizations**  
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8 Our study complements related work in Brazil’s maternal care system showing how peer influence among  
9 physicians shapes C-section decisions (Chown and Inoue 2025). Together, these studies reveal how both  
10 social dynamics (peer influence) and structural interventions (role design) shape professional practice. For  
11 managers and policymakers, this perspective highlights that improving system performance requires  
12 attention to the social and structural features that govern how expertise is deployed.  
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