Supplementary Material for "Modeling First-Year Engineering Student Performance During the Pandemic"

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Additional content for this article can be accessed online. In Section Web Appendix A:, we present information regarding the Moran index. The form of the matrix Λ is outlined in Section Web Appendix B:. Section Web Appendix C: specifies the posterior density of the estimates. Section Web Appendix D: displays the data utilized in the study along with the model covariates. Section Web Appendix E: offers supplementary tables pertaining to the estimation and mapping results. Finally, Section Web Appendix F: reports a sensitivity analysis under a sample-size-weighted likelihood.

Web Appendix A: Moran Index

$$I = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \left(Y_i - \overline{Y}\right) \left(Y_j - \overline{Y}\right)}{\left(\sum_{i \neq j} w_{ij}\right) \sum_{i=1}^{n} \left(Y_i - \overline{Y}\right)^2},$$

where w_{ij} are spatial weights between sites, and $\overline{Y}$ denotes the average of the observations. Under normality and assuming a constant mean of the process, it follows that $\mathbb{E}[I] = -\frac{1}{n-1}$. In practice, it is considered that if $I > \mathbb{E}[I]$, then a site tends to connect to sites with similar attributes. Spatial correlation is positive and increases as the value of $|I - \mathbb{E}[I]|$ increases. If $I < \mathbb{E}[I]$, the values of sites connected to a particular site tend to be dissimilar. In these instances, $E[I] = -0.0285$ in the Valparaiso region and $E[I] = -0.0196$ in the Santiago

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Metropolitan area. The empirical values of the Moran index in Table 1 have been summarized to observe whether there is spatial association in each case.

	MAT021			**FIS100**		
	2018	2020	2022	2018	2020	2022
Valparaíso	-0.1008	-0.0779	0.0176	0.1338	0.0864	-0.0660
Santiago MR	0.1340	-0.1357	-0.0079	0.0845	-0.1736	-0.1076

	IWI131			**QUI010**		
	2018	2020	2022	2018	2020	2022
Valparaíso	0.2822	-0.0662	0.0797	-0.0341	0.0815	0.0815
Santiago MR	0.0188	-0.0502	-0.1050	0.1139	-0.0858	-0.1962

Table 1: Moran Index values by subject and year in the Valparaíso Region and Santiago Metropolitan Region.

Web Appendix B: Matrix $\mathbf{\Lambda}^{-1}$

$$\mathbf{\Lambda}^{-1} = \begin{bmatrix} 1/\tau_1 & \varrho_{12}/\sqrt{\tau_1\tau_2} & \cdots & \cdots & \varrho_{1p}/\sqrt{\tau_1\tau_p} \\ \varrho_{12}/\sqrt{\tau_1\tau_2} & 1/\tau_2 & \varrho_{23}/\sqrt{\tau_2\tau_3} & & \vdots \\ \vdots & \varrho_{23}/\sqrt{\tau_2\tau_3} & \ddots & \ddots & \vdots \\ \vdots & & \ddots & \ddots & \varrho_{(p-1)p}/\sqrt{\tau_{p-1}\tau_p} \\ \varrho_{1p}/\sqrt{\tau_1\tau_p} & \cdots & \cdots & \varrho_{(p-1)p}/\sqrt{\tau_{p-1}\tau_p} & 1/\tau_p \end{bmatrix}.$$

Here, ϱ_{ij} represents the correlation coefficient between variables i and j, while $\tau_i := 1/\sigma_i^2$ is the precision of the i-th variable.

Web Appendix C: Bayesian Estimation

In the three models presented, every autocorrelation parameter is transformed to logit scale as follows

$$\rho_i^* = \text{logit}(\rho_i), \quad \rho_i \sim U(0,1),$$

and $\boldsymbol{\beta}$ is assumed to follow a Gaussian prior with mean $\mathbf{0}$ and precision equal to $\tau_\beta \boldsymbol{I}$, where $\tau_\beta = 0.001$.

For both the IMCAR and MCAR models, the covariance matrices are $\mathbf{\Sigma}_{\text{IMCAR}} = \mathbf{\Lambda^{-1}} \otimes (\mathbf{D} - \mathbf{W})^{-1}$ and $\mathbf{\Sigma}_{\text{MCAR}} = \mathbf{\Lambda^{-1}} \otimes (\mathbf{D} - \rho\mathbf{W})^{-1}$, respectively. Given $\mathbf{\Lambda}^{-1}$ defined previusly, a joint prior distribution is considered for $\mathbf{\Lambda}$ instead of setting a prior distribution for each hyperparameter. Consequently, $\mathbf{\Lambda}$ follows a Wishart distribution as $\mathbf{\Lambda} \sim \text{Wishart}_p\left(r, \boldsymbol{R}^{-1}\right)$ where r is the number of degrees of freedom and $\boldsymbol{R}^{-1}$ is a fixed symmetric positive definite matrix of size $p \times p$. In our implementation, r is equal to p (following Banerjee et al. 2003) and $\boldsymbol{R}$ is the $p \times p$ identity matrix. Therefore, the posterior distributions for these models are:

$$p(\boldsymbol{\beta}, \mathbf{\Lambda}.\rho \mid \boldsymbol{Y}, \boldsymbol{X}) \propto L(\boldsymbol{Y}|\boldsymbol{X}, \boldsymbol{\beta}, \mathbf{\Lambda}) p(\boldsymbol{\beta}) p(\mathbf{\Lambda}),$$

$$p(\boldsymbol{\beta}, \boldsymbol{\Lambda}, \rho \mid \boldsymbol{Y}, \boldsymbol{X}) \propto L(\boldsymbol{Y}|\boldsymbol{X}, \boldsymbol{\beta}, \boldsymbol{\Lambda}, \rho) p(\boldsymbol{\beta}) p(\boldsymbol{\Lambda}) p(\rho).$$

For the $\mathcal{M}$ model, $\boldsymbol{\Sigma}_{\mathcal{M}} = \left(\boldsymbol{M}^\top \otimes \boldsymbol{I}\right) \text{diag}\left(\left(\boldsymbol{\Sigma}_w\right)_1, \ldots, \left(\boldsymbol{\Sigma}_w\right)_p\right) \left(\boldsymbol{M} \otimes \boldsymbol{I}\right)$. Here, matrices $\left(\boldsymbol{\Sigma}_w\right)_i$ represent the variance matrices for the p underlying proper CAR spatial effects, i.e.,

$$\left(\boldsymbol{\Sigma}_w\right)_i = \left(\boldsymbol{D} - \rho_i \boldsymbol{W}\right)^{-1}, \quad i = 1, \ldots, p.$$

The prior of this model is on $\boldsymbol{M}^\top \boldsymbol{M}$, and it follows a Wishart with parameters p and $\tau \boldsymbol{I}$. Parameter τ is a fixed precision which was set to 0.001. Finally, the posterior distribution in this case is

$$p(\boldsymbol{\beta}, \boldsymbol{M}, \boldsymbol{\rho} \mid \boldsymbol{Y}, \boldsymbol{X}) \propto L(\boldsymbol{Y}|\boldsymbol{X}, \boldsymbol{\beta}, \boldsymbol{M}, \boldsymbol{\rho}) p(\boldsymbol{\beta}) p(\boldsymbol{M}) \prod_{i=1}^{p} p(\rho_i).$$

Web Appendix D: Data and indices

	MAT021			FIS100			IWI131			QUI010		
	2018	2020	2022	2018	2020	2022	2018	2020	2022	2018	2020	2022
Algarrobo	-	72.0	33.3	-	89.5	42.8	-	74.0	29.5	-	79.0	50.5
Cabildo	47.7	83.7	58.5	59.3	74.6	60.0	64.0	69.5	49.0	58.5	63.0	46.3
La Calera	55.7	78.3	48.2	61.4	79.7	57.1	42.1	67.9	60.8	64.3	66.3	46.2
Calle Larga	39.4	74.4	57.5	45.3	83.0	68.0	8.0	76.5	44.5	13.0	72.0	-
Cartagena	32.6	77.0	37.2	47.3	73.6	56.6	29.3	67.5	78.8	38.0	57.0	46.6
Casablanca	54.0	84.3	53.8	62.5	76.2	72.0	31.0	90.0	18.5	65.0	68.0	60.0
Catemu	22.0	71.0	42.5	-	86.0	59.7	-	95.0	-	-	-	51.8
Concón	55.2	78.2	44.7	62.2	81.6	53.2	36.7	87.8	75.8	62.6	73.2	51.6
El Quisco	25.0	59.0	50.0	49.8	88.0	70.0	41.0	85.0	-	45.5	-	55.0
El Tabo	30.0	-	20.0	52.5	-	50.5	50.0	-	-	-	-	43.0
Hijuelas	52.6	73.0	25.0	63.6	84.7	55.7	67.0	55.0	53.7	44.5	70.8	49.7
La Cruz	51.3	79.0	50.1	58.3	87.5	59.1	52.7	86.8	57.0	36.0	74.8	55.2
La Ligua	40.8	78.8	47.4	57.1	80.7	64.0	75.0	79.5	78.5	51.8	63.3	49.7
Limache	45.4	72.4	65.6	59.1	77.3	63.1	56.7	62.8	75.1	44.0	69.3	49.0
Llay Llay	54.4	72.8	43	55.3	77.5	63.5	31.8	74.7	-	38.0	68.6	51.8
Los Andes	47.4	74.1	56.1	53.6	78.5	62.2	31.5	69.6	54.0	55.3	68.2	54.6
Nogales	61.5	61.0	46.7	56.6	88.0	61.0	39.4	-	8.0	57.8	67.0	57.7
Olmué	37.3	77.7	60.0	58.0	69.0	58.7	67.0	71.5	-	58.5	-	60.0
Panquehue	39.5	-	-	60.3	-	-	65.0	-	-	51.0	-	-
Papudo	87.0	72.0	-	-	85.5	-	-	98.0	-	-	72.0	-
Petorca	19.0	83.0	61.0	49.0	52.7	66.0	-	72.0	78.0	55.0	65.0	48.0
Puchuncaví	40.0	82.0	39.0	53.2	77.0	49.8	50.5	78.0	16.5	63.0	-	43.0
Putaendo	38.5	78.0	37.0	52.0	84.5	37.6	-	-	-	51.5	68.8	39.3
Quillota	51.2	79.0	38.7	61.9	82.7	60.1	57.7	77.6	48.9	49.9	65.7	48.2
Quilpué	59.1	73.3	45.6	64.2	80.1	60.6	54.8	73.0	59.7	62.3	62.5	52.6
Quintero	51.7	76.1	53.8	61.4	83.3	61.1	55.4	81.2	84.8	60.7	63.3	53.3
Rinconada	38.5	-	18.0	43.0	-	68.0	16.0	-	-	39.0	-	43.0
San Antonio	47.8	73.4	46.7	59.0	73.6	59.1	47.9	52.0	51.8	59.4	59.4	50.9
San Esteban	66.0	84.0	35.3	65.0	78.3	68.2	68.0	76.5	-	-	56.0	58.4
San Felipe	51.4	78.4	56.2	56.5	78.4	56.2	20.1	68.9	62.0	56.9	64.5	45.1
Santa María	32.0	-	7.0	47.6	60.0	33.0	32.3	47.0	-	18.0	-	41.0
Santo Domingo	42.0	69.3	60.0	55.0	82.5	73.5	56.0	85.5	89.0	-	64.0	60.0
Valparaíso	51.2	74.5	46.0	56.5	78.0	60.4	44.8	69.3	59.6	56.3	66.9	47.4
Villa Alemana	53.1	80.4	52.7	59.1	82.1	61.9	56.0	72.4	55.6	54.6	72.1	57.0
Viña del Mar	54.7	76.6	51.5	63.8	82.0	62.6	50.4	80.1	57.3	60.3	66.7	51.5
Zapallar	24.5	-	13.0	60.3	85.0	35.3	-	-	28.3	56.0	69.0	-

Table 2: Courses, year of study, and averages by counties in the Valparaíso Region.

	MAT021			FIS100			IWI131			QUI010		
	2018	2020	2022	2018	2020	2022	2018	2020	2022	2018	2020	2022
Colina	50.9	72.6	59.8	66.6	67.9	64.6	71.3	65.0	82.8	59.5	64.3	51.0
Lampa	49.8	71.2	40.6	64.4	76.3	46.2	56.3	69.0	27.1	61.1	64.7	48.0
Tiltil	-	-	-	-	-	-	-	-	-	-	-	-
Pirque	37.8	93.0	52.5	39.7	81.5	69.5	3.0	95.0	79.0	48.0	-	42.0
Puente Alto	48.8	74.5	46.1	59.1	76.7	56.0	60.0	80.6	72.3	54.1	65.0	46.3
San José de Maipo	-	59.0	-	-	65.0	41.0	-	-	51.5	-	45.0	-
Buín	41.2	73.9	48.6	56.2	74.8	46.5	72.0	91.6	70.0	51.3	60.5	54.0
Calera de Tango	55.5	79.0	47.8	47.3	77.0	47.4	65.0	69.0	84.5	67.5	70.5	42.7
Paine	41.0	62.7	-	54.8	62.1	-	2.0	84.0	-	65.7	59.8	-
San Bernardo	47.8	75.0	62.1	61.9	72.6	60.8	56.3	73.9	64.6	56.9	67.0	55.1
Alhué	41.0	87.0	-	35.5	83.0	-	-	77.0	-	47.0	-	-
Curacaví	28.5	77.8	47.8	62.3	76.7	52.4	37.0	78.0	56.0	56.0	72.6	49.9
María Pinto	68.5	78.0	57.0	71.0	81.5	66.0	73.0	-	-	40.0	69.5	29.0
Melipilla	43.0	65.3	52.8	58.3	81.7	52.6	40.3	92.0	76.8	48.9	66.3	64.0
San Pedro	-	86.0	-	-	79.0	-	-	-	-	-	75.5	-
Cerrillos	55.3	78.8	68.3	58.0	75.4	61.0	58.0	78.7	91.0	62.7	66.3	60.0
Cerro Navia	42.3	65.6	58.0	60.6	75.3	55.0	62.2	53.0	93.0	59.7	63.0	-
Conchalí	55.3	61.7	49.9	59.1	72.2	57.7	32.3	88.0	59.0	62.8	52.8	45.3
El Bosque	34.0	66.8	38.0	51.3	75.7	50.7	48.8	81.6	67.5	53.5	63.5	38.0
Estación Central	48.0	71.0	49.9	57.9	80.3	51.9	55.4	73.6	56.2	57.5	65.2	46.0
Huechuraba	53.2	75.2	43.5	58.9	78.4	51.3	39.6	89.2	93.0	56.8	67.1	45.9
Independencia	62.2	66.2	53.8	65.8	76.2	38.2	53.0	50.7	64.5	61.7	66.6	41.0
La Cisterna	47.7	69.7	65.4	60.7	67.9	66.4	50.8	63.9	84.3	57.6	55.1	63.8
La Granja	51.7	73.7	53.3	61.1	77.6	63.1	36.8	-	88.7	63.5	63.5	49.8
La Florida	54.2	72.3	48.0	59.3	77.9	52.2	54.7	80.9	63.1	60.0	65.8	47.3
La Pintana	51.8	47.8	52.3	63.2	75.4	54.4	44.7	50.5	56.3	55.5	67.5	49.0
La Reina	54.8	72.3	51.5	63.0	74.7	59.3	52.0	79.3	70.6	62.4	61.5	49.3
Las Condes	51.2	75.1	51.7	62.8	75.6	61.8	67.8	81.2	65.6	58.4	67.9	51.9
Lo Barnechea	48.5	73.4	41.3	55.0	81.0	55.7	38.5	92.5	71.0	59.5	69.8	48.5
Lo Espejo	42.8	70.0	55.0	58.6	74.8	57.3	37.5	-	-	57.0	60.7	40.0
Lo Prado	55.00	75.2	50.5	58.1	81.2	48.0	56.4	96.0	32.5	63.0	64.0	56.5
Macul	48.9	70.1	50.9	58.6	73.2	56.5	63.7	87.3	72.1	52.0	63.6	48.9
Maipú	49.6	74.5	56.2	56.7	75.2	62.1	47.6	83.1	68.2	59.1	67.8	51.1
Ñuñoa	49.2	74.5	49.9	58.5	75.8	55.8	53.5	80.0	65.1	56.9	65.7	51.7
Pedro Aguirre Cerda	60.6	77.9	57.3	66.7	78.6	53.3	69.0	60.0	69.3	70.0	64.7	45.5
Peñalolén	56.6	70.6	49.4	61.3	76.6	61.0	60.1	85.5	67.0	60.1	67.0	52.0
Providencia	53.0	72.7	41.0	63.1	76.0	53.8	67.2	85.4	70.2	62.3	64.4	43.4
Pudahuel	56.0	72.9	54.9	60.4	78.0	57.2	58.4	60.5	52.1	59.6	65.9	48.1
Quilicura	50.9	74.7	51.4	60.9	72.3	55.0	48.6	68.3	74.1	63.5	68.6	49.4
Quinta Normal	56.6	72.8	43.7	64.7	74.8	50.7	48.4	64.0	65.3	61.6	64.9	45.6
Recoleta	48.3	77.9	60.8	52.5	76.5	55.2	42.9	81.9	56.8	59.2	70.2	50.4
Renca	55.7	75.8	49.8	50.8	76.6	52.5	56.4	83.0	45.3	60.9	65.1	49.5
San Miguel	53.6	73.7	63.1	62.4	74.1	63.6	58.7	64.9	86.0	57.1	63.8	49.7
San Joaquín	36.3	71.7	48.6	45.7	76.1	53.8	25.5	79.3	61.5	48.0	63.0	49.3
San Ramón	39.0	77.5	53.2	57.0	81.7	52.8	60.5	88.0	46.3	-	66.6	53.5
Santiago	54.2	73.5	36.8	56.3	77.6	50.4	44.2	83.6	72.0	60.7	65.6	46.2
Vitacura	49.5	64.2	52.7	59.1	77.0	62.5	70.8	57.0	51.2	46.9	64.3	50.4
El Monte	36.0	73.0	9.5	56.5	68.7	51.4	61.0	68.0	16.5	59.0	67.0	35.0
Isla de Maipo	39.0	74.4	57.3	54.0	79.2	60.5	15.0	81.0	73.0	63.3	60.8	63.0
Padre Hurtado	37.2	67.3	69.5	22.0	64.8	58.0	52.7	-	73.5	60.7	55.3	60.0
Peñaflor	43.9	74.9	48.3	56.1	74.9	54.5	59.6	76.0	71.0	53.2	57.5	52.0
Talagante	46.2	70.7	46.6	55.5	77.9	59.0	56.8	72.0	82.7	60.0	63.3	45.3

Table 3: Courses, year of study, and averages by counties in the metropolitan Santiago Region.

	PI	MDI	USC	RPS		PI	MDI	USC	RPS
Algarrobo	0.097	0.412	443.6	0.000	Panquehue	0.107	0.382	497.9	0.279
Cabildo	0.086	0.392	463.6	0.000	Papudo	0.135	0.360	426.1	0.000
La Calera	0.133	0.476	472.6	0.042	Petorca	0.115	0.308	441.4	0.000
Calle Larga	0.115	0.356	454.3	0.145	Puchuncaví	0.133	0.351	428.7	0.000
Cartagena	0.184	0.357	453.1	0.000	Putaendo	0.135	0.326	451.1	0.000
Casablanca	0.096	0.435	458.8	0.017	Quillota	0.109	0.512	495.6	0,171
Catemu	0.110	0.325	412.0	0.000	Quilpué	0.093	0.552	486.6	0.069
Concón	0.082	0.587	544.2	0.291	Quintero	0.136	0.381	458.0	0.001
El Quisco	0.119	0.364	438.7	0.000	Rinconada	0.121	0.399	440.5	0.000
El Tabo	0.151	0.346	395.3	0.000	San Antonio	0.116	0.478	470.0	0.005
Hijuelas	0.132	0.361	444.5	0.000	San Esteban	0.108	0.392	411.6	0.000
La Cruz	0.086	0.447	419.7	0.000	San Felipe	0.110	0.515	483.7	0.087
La Ligua	0.132	0.384	471.7	0.008	Santa María	0.123	0.360	422.6	0.000
Limache	0.105	0.455	457.2	0.008	Santo Domingo	0.083	0.506	491.8	0.000
Llay Llay	0.125	0.374	452.9	0.000	Valparaíso	0.133	0.560	470.5	0.073
Los Andes	0.103	0.543	476.9	0.125	Villa Alemana	0.093	0.508	519.0	0.116
Nogales	0.125	0.380	432.2	0.000	Viña del Mar	0.110	0.676	520.7	0.202
Olmué	0.152	0.337	433.2	0.000	Zapallar	0.086	0.491	516.6	0.000

Table 4: Indices by counties in the Valparaíso Region.

	PI	MDI	USC	RPS		PI	MDI	USC	RPS
Colina	0.086	0.518	509.1	0.257	La Reina	0.047	0.607	574.3	0.488
Lampa	0.103	0.446	444.0	0.053	Las Condes	0.028	0.875	595.5	0.705
Tiltil	0.101	0.374	402.4	0.000	Lo Barnechea	0.055	0.677	611.8	0.581
Pirque	0.093	0.376	445.4	0.273	Lo Espejo	0.144	0.391	444.1	0.000
Puente Alto	0.080	0.539	484.4	0.036	Lo Prado	0.137	0.406	439.5	0.000
San José de Maipo	0.092	0.373	457.9	0.000	Macul	0.070	0.545	508.0	0.103
Buin	0.085	0.479	465.9	0.208	Maipú	0.070	0.597	497.9	0.050
Calera de Tango	0.092	0.442	506.4	0.286	Ñuñoa	0.040	0.660	524.0	0.363
Paine	0.110	0.419	472.7	0.026	Pedro Aguirre Cerda	0.117	0.469	457.1	0.000
San Bernardo	0.107	0.520	473.3	0.044	Peñalolén	0.106	0.530	510.0	0.214
Alhue	0.072	0.295	433.2	0.000	Providencia	0.036	0.876	574.6	0.512
Curacaví	0.096	0.383	450.4	0.100	Pudahuel	0.089	0.552	456.9	0.016
María Pinto	0.103	0.308	414.3	0.000	Quilicura	0.085	0.577	481.1	0.050
Melipilla	0.091	0.423	469.3	0.062	Quinta Normal	0.092	0.538	468.1	0.000
San Pedro	0.133	0.260	414.5	0.000	Recoleta	0.132	0.538	468.2	0.029
Cerrillos	0.090	0.489	467.8	0.000	Renca	0.102	0.478	466.9	0.000
Cerro Navia	0.129	0.373	421.3	0.000	San Miguel	0.053	0.608	477.1	0.067
Conchalí	0.125	0.466	465.7	0.051	San Joaquín	0.118	0.472	431.5	0.000
El Bosque	0.126	0.454	481.5	0.011	San Ramón	0.132	0.439	443.7	0.000
Estación Central	0.117	0.530	471.0	0.051	Santiago	0.084	0.778	514.9	0.121
Huechuraba	0.083	0.563	527.8	0.222	Vitacura	0.033	0.764	623.3	0.842
Independencia	0.139	0.540	459.8	0.081	El Monte	0.118	0.352	437.2	0.000
La Cisterna	0.078	0.551	469.4	0.031	Isla de Maipo	0.115	0.363	452.9	0.059
La Granja	0.119	0.427	468.8	0.000	Padre Hurtado	0.090	0.440	451.5	0.091
La Florida	0.080	0.589	503.7	0.081	Peñaflor	0.090	0.485	459.7	0.054
La Pintana	0.153	0.360	451.8	0.000	Talagante	0.089	0.471	486.0	0.157

Table 5: Indices by counties in the Santiago Metropolitan Region.

	2018	2020	2022		2018	2020	2022
Algarrobo	0	2	4	Panquehue	3	0	0
Cabildo	16	6	5	Papudo	1	2	0
La Calera	28	19	18	Petorca	1	3	2
Calle Larga	8	7	3	Puchuncaví	7	5	5
Cartagena	7	5	9	Putaendo	2	5	5
Casablanca	3	6	6	Quillota	31	29	38
Catemu	1	1	6	Quilpué	67	86	62
Concón	35	22	10	Quintero	15	9	9
El Quisco	4	1	1	Rinconada	6	0	1
El Tabo	4	0	2	San Antonio	25	23	31
Hijuelas	5	6	7	San Esteban	2	3	5
La Cruz	14	9	10	San Felipe	32	19	22
La Ligua	8	7	11	Santa María	5	1	1
Limache	15	14	13	Santo Domingo	3	4	2
Llay Llay	15	10	4	Valparaíso	99	111	90
Los Andes	25	24	13	Villa Alemana	47	54	49
Nogales	13	2	5	Viña del Mar	133	116	112
Olmué	3	4	3	Zapallar	3	1	3

Table 6: Frequency of first-year students by year in the Valparaíso Region.

	2018	2020	2022		2018	2020	2022
Colina	18	10	11	La Reina	20	18	30
Lampa	14	12	19	Las Condes	51	50	43
Tiltil	0	2	2	Lo Barnechea	14	9	15
Pirque	4	2	2	Lo Espejo	5	4	3
Puente Alto	81	99	80	Lo Prado	11	6	4
San José de Maipo	0	1	2	Macul	21	18	27
Buin	10	8	8	Maipú	65	74	69
Calera de Tango	4	3	5	Ñuñoa	53	45	62
Paine	4	9	0	Pedro Aguirre Cerda	6	8	12
San Bernardo	26	43	25	Peñalolén	42	41	43
Alhue	2	1	0	Providencia	25	31	25
Curacaví	4	7	11	Pudahuel	25	24	29
María Pinto	2	4	1	Quilicura	33	35	30
Melipilla	16	10	10	Quinta Normal	12	12	12
San Pedro	0	4	0	Recoleta	15	22	19
Cerrillos	6	7	5	Renca	13	14	6
Cerro Navia	8	8	3	San Miguel	15	23	21
Conchalí	9	10	11	San Joaquín	7	10	13
El Bosque	7	20	6	San Ramón	2	9	6
Estación Central	19	10	11	Santiago	36	39	31
Huechuraba	16	33	20	Vitacura	14	8	12
Independencia	7	12	7	El Monte	2	3	5
La Cisterna	12	21	7	Isla de Maipo	4	6	4
La Granja	14	9	7	Padre Hurtado	6	5	9
La Florida	73	111	86	Peñaflor	14	16	16
La Pintana	5	11	5	Talagante	9	13	8

Table 7: Frequency of first-year students by year in the Santiago Metropolitan Region.

Web Appendix E: Results

	MAT021			FIS100		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
2018 - PI	1.893 (-3.581, 7.529)	1.682 (-5.269, 6.753)	0.323 (-1.928, 2.569)	-1.395 (-2.889, 0.939)	-1.253 (-3.019, 1.067)	-1.005 (-3.245, 1.069)
2020 - PI	-0.774 (-2.889, 0.939)	-0.511 (-3.019, 1.067)	-1.565 (-3.396, 0.267)	-0.290 (-2.889, 0.939)	-0.456 (-3.019, 1.067)	-0.520 (-3.245, 1.069)
2022 - PI	0.154 (-4.500, 0.525)	-0.878 (-4.229, 1.115)	-1.336 (-5.723, 3.051)	-0.525 (-4.500, 0.525)	-0.324 (-4.229, 1.115)	-0.242 (-3.746, 0.560)
2018 - MDI	1.756 (0.229, 4.162)	1.895 (-0.180, 3.608)	0.729 (0.167, 1.291)	0.294 (-0.969, 0.481)	0.375 (-0.873, 0.506)	0.531 (-0.897, 0.505)
2020 - MDI	-0.179 (-0.969, 0.481)	-0.117 (-0.873, 0.506)	-0.149 (-0.621, 0.322)	0.209 (-0.969, 0.481)	0.112 (-0.873, 0.506)	0.261 (-0.897, 0.505)
2022 - MDI	-0.115 (-1.181, 0.663)	0.265 (-0.855, 0.905)	-0.115 (-1.168, 0.938)	0.155 (-1.181, 0.663)	0.222 (-0.855, 0.905)	0.209 (-0.577, 0.824)
2018 - log(USC)	-0.079 (-1.040, 0.303)	-0.078 (-1.011, 0.445)	-0.322 (-1.072, 0.426)	-0.130 (-1.040, 0.303)	-0.119 (-1.011, 0.445)	-0.234 (-0.885, 0.508)
2020 - log(USC)	0.196 (-0.736, 0.550)	0.189 (-0.776, 0.627)	-0.156 (-0.907, 0.593)	-0.089 (-0.736, 0.550)	-0.061 (-0.776, 0.627)	-0.169 (-0.642, 0.696)
2022 - log(USC)	0.066 (-0.765, 0.527)	0.062 (-0.828, 0.579)	-0.221 (-0.978, 0.535)	-0.132 (-0.765, 0.527)	-0.125 (-0.828, 0.579)	-0.224 (-0.700, 0.639)
2018 - RPS	-0.035 (-1.654, 1.408)	-0.159 (-2.114, 1.225)	-0.083 (-0.472, 0.307)	0.144 (-1.654, 1.408)	0.048 (-2.114, 1.225)	0.032 (-2.016, 1.073)
2020 - RPS	0.029 (-0.384, 0.781)	0.037 (-0.444, 0.793)	-0.017 (-0.357, 0.323)	0.065 (-0.384, 0.781)	0.034 (-0.444, 0.793)	0.041 (-0.517, 0.815)
2022 - RPS	0.866 (-0.641, 0.820)	0.647 (-0.812, 0.744)	-0.059 (-0.751, 0.634)	-0.048 (-0.641, 0.820)	0.052 (-0.812, 0.744)	0.188 (-0.769, 0.564)

	IWI131			QUI010		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
2018 - PI	-1.140 (-7.269, 4.989)	-1.347 (-8.003, 5.309)	-1.362 (-9.723, 7.051)	1.975 (-3.581, 7.529)	0.744 (-5.269, 6.753)	0.877 (-4.631, 6.385)
2020 - PI	-2.023 (-5.148, 1.102)	-2.074 (-5.375, 1.227)	-1.739 (-4.396, 0.918)	-0.975 (-2.889, 0.939)	-0.977 (-3.019, 1.067)	-1.088 (-3.245, 1.069)
2022 - PI	4.119 (-5.991, 14.229)	4.068 (-6.684, 14.820)	4.213 (-6.746, 15.172)	-1.988 (-4.500, 0.525)	-1.557 (-4.229, 1.115)	-1.593 (-3.746, 0.560)
2018 - MDI	-0.508 (-2.833, 1.817)	-0.327 (-2.896, 2.242)	-0.290 (-3.186, 2.606)	2.194 (0.229, 4.162)	1.705 (-0.180, 3.608)	1.730 (-0.037, 3.497)
2020 - MDI	-0.210 (-1.421, 1.001)	-0.291 (-1.495, 0.913)	-0.212 (-0.989, 0.565)	-0.244 (-0.969, 0.481)	-0.181 (-0.873, 0.506)	-0.196 (-0.897, 0.505)
2022 - MDI	1.804 (-1.793, 5.401)	1.548 (-1.862, 4.958)	1.389 (-1.739, 4.517)	-0.257 (-1.181, 0.663)	0.032 (-0.855, 0.905)	0.123 (-0.577, 0.824)
2018 - log(USC)	-0.683 (-1.895, 0.529)	-0.470 (-2.024, 1.084)	-0.261 (-1.491, 0.969)	-0.368 (-1.040, 0.303)	-0.283 (-1.011, 0.445)	-0.187 (-0.885, 0.508)
2020 - log(USC)	-0.599 (-1.791, 0.593)	-0.375 (-1.992, 1.242)	-0.175 (-1.173, 0.823)	-0.094 (-0.736, 0.550)	-0.076 (-0.776, 0.627)	0.028 (-0.642, 0.696)
2022 - log(USC)	-0.915 (-2.161, 0.331)	-0.693 (-2.209, 0.823)	-0.474 (-1.510, 0.562)	-0.119 (-0.765, 0.527)	-0.125 (-0.828, 0.579)	-0.029 (-0.700, 0.639)
2018 - RPS	0.643 (-1.174, 2.460)	0.125 (-2.083, 2.333)	-0.100 (-2.377, 2.177)	-0.125 (-1.654, 1.408)	-0.448 (-2.114, 1.225)	-0.472 (-2.016, 1.073)
2020 - RPS	0.627 (-0.355, 1.609)	0.513 (-0.534, 1.560)	0.306 (-0.456, 1.068)	0.199 (-0.384, 0.781)	0.176 (-0.444, 0.793)	0.149 (-0.517, 0.815)
2022 - RPS	0.286 (-2.523, 3.095)	0.713 (-2.312, 3.738)	0.779 (-1.930, 3.488)	0.091 (-0.641, 0.820)	-0.033 (-0.812, 0.744)	-0.103 (-0.769, 0.564)

Table 8: Posterior summaries of covariate coefficients in the Valparaíso Region, with 95% credible intervals shown in parentheses.

	MAT021			FIS100		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
2018 - PI	-0.749 (-6.484, 5.052)	0.271 (-6.019, 6.561)	0.323 (-5.190, 5.835)	0.745 (-2.048, 3.516)	1.132 (-1.162, 3.935)	1.433 (-1.188, 4.027)
2020 - PI	-1.012 (-3.168, 1.144)	-1.248 (-3.537, 1.041)	-1.565 (-3.789, 0.659)	0.499 (-0.923, 1.920)	0.539 (-0.850, 1.928)	0.401 (-1.320, 2.122)
2022 - PI	-1.913 (-5.948, 2.122)	-1.219 (-5.097, 2.659)	-1.336 (-5.720, 3.048)	-1.108 (-3.166, 0.950)	-1.339 (-3.663, 0.985)	-1.500 (-3.207, 0.207)
2018 - MDI	0.409 (-0.285, 1.103)	0.771 (0.147, 1.395)	0.729 (0.167, 1.291)	0.464 (-0.267, 1.195)	0.560 (-0.075, 1.195)	0.621 (0.047, 1.195)
2020 - MDI	-0.001 (-0.534, 0.532)	-0.013 (-0.470, 0.444)	-0.149 (-0.623, 0.325)	-0.011 (-0.404, 0.382)	0.027 (-0.315, 0.369)	-0.037 (-0.446, 0.372)
2022 - MDI	-0.394 (-1.416, 0.628)	-0.113 (-1.035, 0.809)	-0.115 (-1.152, 0.922)	-0.072 (-0.625, 0.481)	-0.143 (-0.615, 0.329)	-0.211 (-0.632, 0.210)
2018 - log(USC)	-0.187 (-0.945, 0.571)	-0.304 (-1.033, 0.425)	-0.322 (-1.071, 0.427)	0.000 (-0.582, 0.582)	-0.083 (-0.669, 0.503)	-0.079 (-0.649, 0.491)
2020 - log(USC)	-0.087 (-0.853, 0.679)	-0.151 (-0.933, 0.631)	-0.156 (-0.932, 0.620)	0.084 (-0.494, 0.662)	0.014 (-0.569, 0.597)	0.035 (-0.543, 0.613)
2022 - log(USC)	-0.101 (-0.867, 0.665)	-0.201 (-0.991, 0.589)	-0.221 (-0.977, 0.535)	0.064 (-0.516, 0.644)	0.007 (-0.571, 0.585)	0.028 (-0.543, 0.599)
2018 - RPS	-0.173 (-0.614, 0.268)	-0.115 (-0.544, 0.314)	-0.083 (-0.471, 0.305)	-0.099 (-0.567, 0.369)	-0.055 (-0.492, 0.382)	-0.052 (-0.472, 0.368)
2020 - RPS	0.023 (-0.327, 0.373)	-0.025 (-0.391, 0.341)	-0.017 (-0.357, 0.323)	0.147 (-0.113, 0.407)	0.086 (-0.161, 0.333)	0.076 (-0.205, 0.357)
2022 - RPS	-0.010 (-0.689, 0.669)	-0.071 (-0.702, 0.560)	-0.059 (-0.741, 0.623)	0.091 (-0.267, 0.449)	0.047 (-0.284, 0.378)	0.046 (-0.299, 0.391)

	IWI131			QUI010		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
2018 - PI	-4.609 (-13.196, 3.978)	-2.027 (-11.019, 6.965)	-2.738 (-11.158, 5.682)	0.963 (-0.693, 2.619)	1.068 (-0.692, 2.828)	1.384 (-0.196, 2.964)
2020 - PI	0.135 (-2.561, 2.831)	-0.839 (-3.481, 1.803)	-1.221 (-3.446, 1.004)	1.522 (-0.095, 3.139)	1.048 (-0.352, 2.448)	0.840 (-0.481, 2.161)
2022 - PI	-3.134 (-7.706, 1.438)	-3.060 (-7.526, 1.406)	-3.124 (-7.438, 1.190)	-1.146 (-3.654, 1.362)	-1.467 (-3.756, 0.822)	-1.329 (-3.591, 0.933)
2018 - MDI	0.264 (-2.112, 2.640)	1.255 (-0.910, 3.420)	1.073 (-1.092, 3.238)	0.119 (-0.327, 0.565)	0.237 (-0.163, 0.637)	0.345 (-0.161, 0.851)
2020 - MDI	0.043 (-0.703, 0.789)	-0.306 (-0.970, 0.358)	-0.333 (-0.890, 0.224)	0.209 (-0.229, 0.647)	0.102 (-0.286, 0.490)	0.004 (-0.376, 0.384)
2022 - MDI	-0.143 (-1.355, 1.069)	-0.215 (-1.134, 0.704)	-0.133 (-1.041, 0.775)	-0.095 (-0.724, 0.534)	-0.211 (-0.731, 0.309)	-0.089 (-0.540, 0.362)
2018 - log(USC)	0.762 (-0.338, 1.862)	0.729 (-0.312, 1.770)	0.505 (-0.407, 1.417)	0.440 (-0.100, 0.980)	0.310 (-0.336, 0.956)	0.219 (-0.371, 0.809)
2020 - log(USC)	0.783 (-0.277, 1.843)	0.914 (-0.134, 1.962)	0.672 (-0.170, 1.514)	0.435 (-0.105, 0.975)	0.334 (-0.310, 0.978)	0.269 (-0.303, 0.841)
2022 - log(USC)	0.820 (-0.230, 1.870)	0.917 (-0.123, 1.957)	0.661 (-0.161, 1.483)	0.463 (-0.089, 1.015)	0.361 (-0.185, 0.907)	0.270 (-0.230, 0.770)
2018 - RPS	-0.679 (-2.200, 0.842)	-0.799 (-2.348, 0.750)	-0.704 (-2.264, 0.856)	-0.205 (-0.497, 0.087)	-0.174 (-0.455, 0.107)	-0.149 (-0.419, 0.121)
2020 - RPS	-0.355 (-0.845, 0.135)	-0.256 (-0.776, 0.264)	-0.196 (-0.592, 0.200)	0.093 (-0.193, 0.379)	0.015 (-0.259, 0.289)	0.035 (-0.241, 0.311)
2022 - RPS	-0.253 (-1.034, 0.528)	-0.399 (-1.105, 0.307)	-0.329 (-1.016, 0.358)	-0.260 (-0.664, 0.144)	-0.226 (-0.587, 0.135)	-0.209 (-0.517, 0.099)

Table 9: Posterior summaries of covariate coefficients in the Santiago Metropolitan Region, with 95% credible intervals shown in parentheses.

	MAT021			FIS100		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
DIC	-597.50	-607.60	-83.58	-625.12	-631.23	-135.32
WAIC	-612.65	-628.58	-97.29	-646.77	-650.69	-133.40

	IWI131			QUI010		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
DIC	-577.83	-581.53	-42.02	-623.64	-629.57	-135.64
WAIC	-595.35	-600.26	-58.93	-643.57	-650.11	-146.53

Table 10: Model comparison using WAIC and DIC statistics in the Valparaiso Region.

	MAT021			FIS100		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
DIC	-858.39	-890.10	-162.10	-900.70	-920.87	-234.34
WAIC	-894.52	-922.97	-175.89	-934.16	-955.26	-234.15

	IWI131			QUI010		
	IMCAR	MCAR	$\mathcal{M}$	IMCAR	MCAR	$\mathcal{M}$
DIC	-836.63	-852.61	-86.70	-900.32	-919.32	-256.60
WAIC	-865.97	-886.21	-102.54	-934.43	-952.51	-255.47

Table 11: Model comparison using WAIC and DIC statistics in the Santiago Metropolitan Region.

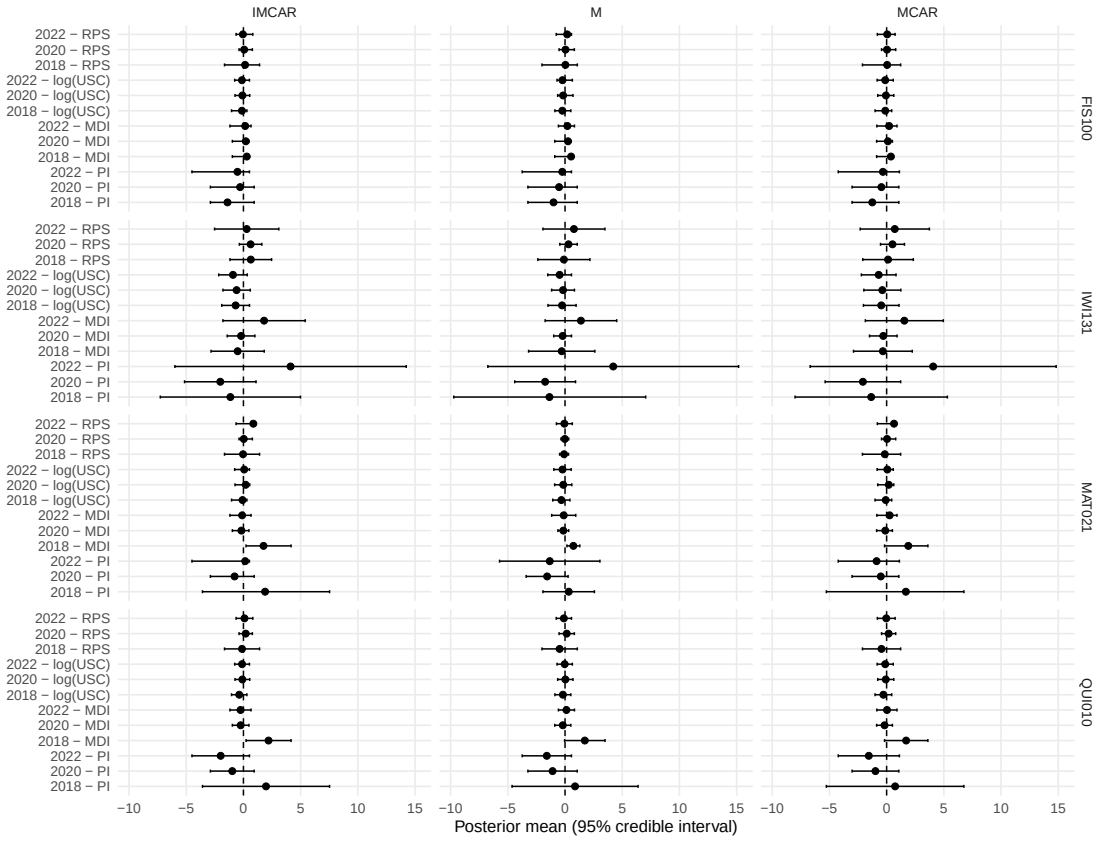

Figure 1: Forest plot for Valparaiso Region.

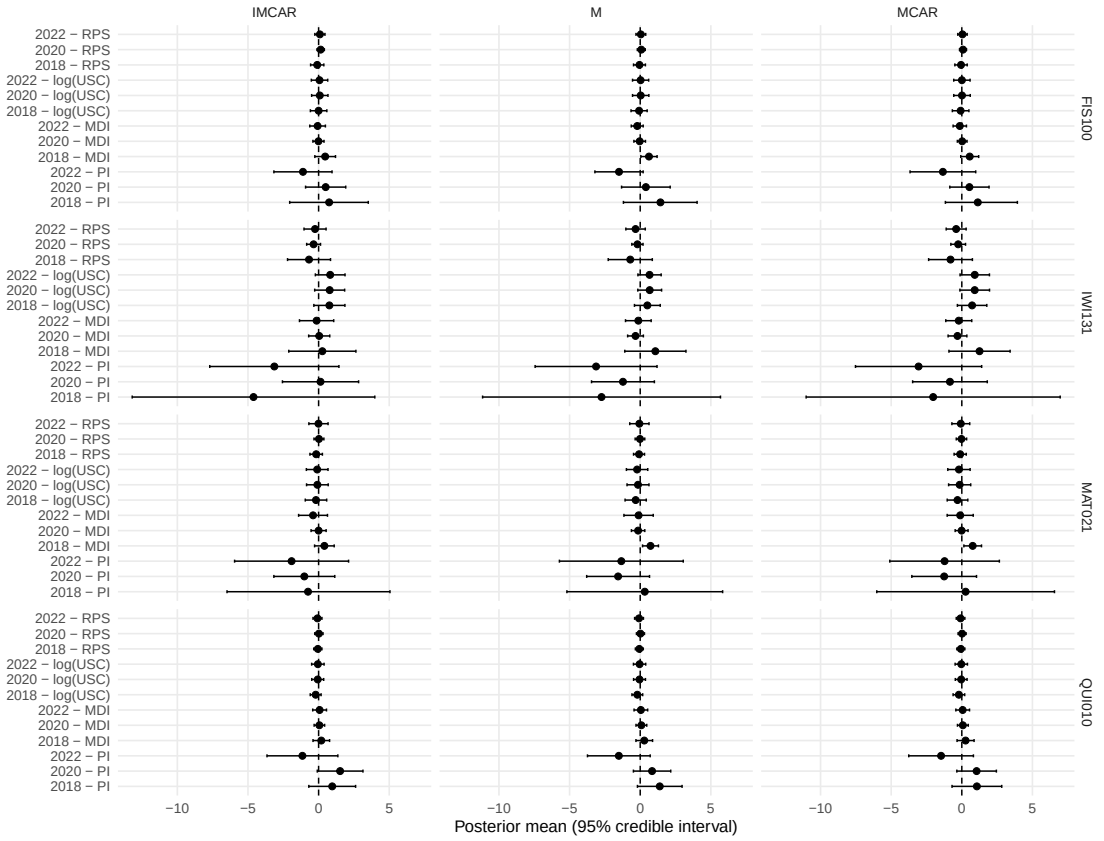

Figure 2: Forest plot for Santiago Metropolitan Region.

Web Appendix F: Sensitivity to sample-size weighting

Let n_{it} denote the number of first-year students in county i during year t (Tables 6 and 7). Since Y_{it} is the average grade over n_{it} individual scores, its sampling variance is inversely proportional to n_{it}, whereas the Gaussian likelihood used in Section 3.3 of the main paper,

$$\log(Y_{it}) \sim \mathcal{N}(\mu_{it}, \tau^{-1}),$$

assigns the same precision τ to every county–year average. We therefore refitted the MCAR model under the scaled likelihood

$$\log(Y_{it}) \sim \mathcal{N}(\mu_{it}, (\tau n_{it})^{-1}), \tag{F1}$$

so that τ^{-1} represents the residual variance per individual student. Imputed cells (those with $n_{it} = 0$, as described in Section 3.1 of the main paper) are assigned a nominal weight equal to the smallest observed positive count.

Tables 12 and 13 report the posterior means of the fixed effects under the unweighted ($\hat{\beta}_{\mathrm{UW}}$) and weighted ($\hat{\beta}_{\mathrm{W}}$) specifications, their difference $\Delta = \hat{\beta}_{\mathrm{W}} - \hat{\beta}_{\mathrm{UW}}$, and the ratio of the corresponding 95% credible-interval widths. Across all covariates, years, and courses, posterior means differ by at most 0.06 on the

log scale and credible-interval widths differ by less than 2%, with no coefficient changing sign or crossing zero between specifications. The conclusions reported in the main paper are therefore robust to sample-size weighting.

	FIS100				**MAT021**			
	$\hat{\beta}_{\mathrm{UW}}$	$\hat{\beta}_{\mathrm{W}}$	Δ	Ratio	$\hat{\beta}_{\mathrm{UW}}$	$\hat{\beta}_{\mathrm{W}}$	Δ	Ratio
2018 - PI	-1.253	-1.252	0.001	1.003	1.682	1.654	-0.028	0.998
2020 - PI	-0.456	-0.450	0.007	1.000	-0.511	-0.525	-0.014	1.001
2022 - PI	-0.324	-0.328	-0.004	0.998	-0.878	-0.872	0.005	0.999
2018 - MDI	0.375	0.376	0.001	1.003	1.895	1.886	-0.009	0.999
2020 - MDI	0.112	0.112	0.000	1.003	-0.117	-0.125	-0.008	1.006
2022 - MDI	0.222	0.221	-0.001	1.001	0.265	0.265	0.000	1.001
2018 - log(USC)	-0.119	-0.120	-0.001	1.005	-0.078	-0.082	-0.004	1.009
2020 - log(USC)	-0.061	-0.062	-0.001	1.005	0.189	0.184	-0.004	1.010
2022 - log(USC)	-0.125	-0.126	-0.001	1.005	0.062	0.057	-0.005	1.009
2018 - RPS	0.048	0.048	0.000	1.003	-0.159	-0.157	0.002	0.998
2020 - RPS	0.034	0.038	0.004	1.009	0.037	0.042	0.005	1.016
2022 - RPS	0.052	0.052	0.000	1.003	0.647	0.649	0.002	1.001

	IWI131				**QUI010**			
	$\hat{\beta}_{\mathrm{UW}}$	$\hat{\beta}_{\mathrm{W}}$	Δ	Ratio	$\hat{\beta}_{\mathrm{UW}}$	$\hat{\beta}_{\mathrm{W}}$	Δ	Ratio
2018 - PI	-1.347	-1.348	-0.001	1.001	0.744	0.757	0.013	0.999
2020 - PI	-2.074	-2.058	0.017	0.998	-0.977	-0.983	-0.006	1.003
2022 - PI	4.068	4.069	0.002	1.000	-1.557	-1.562	-0.005	0.997
2018 - MDI	-0.327	-0.332	-0.006	1.001	1.705	1.711	0.006	1.000
2020 - MDI	-0.291	-0.299	-0.008	1.001	-0.181	-0.187	-0.006	1.007
2022 - MDI	1.548	1.543	-0.005	1.001	0.032	0.031	-0.001	1.002
2018 - log(USC)	-0.470	-0.458	0.012	1.005	-0.283	-0.286	-0.003	1.006
2020 - log(USC)	-0.375	-0.363	0.012	1.005	-0.076	-0.078	-0.002	1.006
2022 - log(USC)	-0.693	-0.681	0.012	1.005	-0.125	-0.127	-0.002	1.006
2018 - RPS	0.125	0.120	-0.005	1.001	-0.448	-0.444	0.004	0.999
2020 - RPS	0.513	0.524	0.011	1.009	0.176	0.183	0.007	1.014
2022 - RPS	0.713	0.708	-0.005	1.002	-0.033	-0.033	0.000	1.005

Table 12: Sensitivity of MCAR fixed-effect posteriors in the Valparaíso Region. Columns report posterior means under the unweighted ($\hat{\beta}_{\mathrm{UW}}$) and weighted ($\hat{\beta}_{\mathrm{W}}$) specifications, their difference $\Delta = \hat{\beta}_{\mathrm{W}} - \hat{\beta}_{\mathrm{UW}}$, and the ratio of the corresponding 95% credible-interval widths.

	FIS100				MAT021			
	$\hat{\beta}_{\text{UW}}$	$\hat{\beta}_{\text{W}}$	Δ	Ratio	$\hat{\beta}_{\text{UW}}$	$\hat{\beta}_{\text{W}}$	Δ	Ratio
2018 - PI	1.132	1.130	-0.001	1.002	0.271	0.289	0.018	1.000
2020 - PI	0.539	0.527	-0.012	1.001	-1.248	-1.265	-0.017	0.993
2022 - PI	-1.339	-1.355	-0.016	1.002	-1.219	-1.219	0.001	1.000
2018 - MDI	0.560	0.558	-0.002	1.003	0.771	0.773	0.002	0.999
2020 - MDI	0.027	0.023	-0.004	1.000	-0.013	-0.014	-0.002	0.993
2022 - MDI	-0.143	-0.146	-0.004	1.001	-0.113	-0.114	-0.002	0.999
2018 - log(USC)	-0.083	-0.074	0.009	0.994	-0.304	-0.299	0.005	0.998
2020 - log(USC)	0.014	0.023	0.009	0.993	-0.151	-0.145	0.006	0.998
2022 - log(USC)	0.007	0.016	0.009	0.993	-0.201	-0.195	0.006	0.998
2018 - RPS	-0.055	-0.057	-0.002	1.000	-0.115	-0.115	0.000	0.998
2020 - RPS	0.086	0.081	-0.005	0.998	-0.025	-0.032	-0.007	0.994
2022 - RPS	0.047	0.042	-0.005	0.998	-0.071	-0.073	-0.002	0.999

	IWI131				QUI010			
	$\hat{\beta}_{\text{UW}}$	$\hat{\beta}_{\text{W}}$	Δ	Ratio	$\hat{\beta}_{\text{UW}}$	$\hat{\beta}_{\text{W}}$	Δ	Ratio
2018 - PI	-2.027	-2.013	0.014	1.001	1.068	1.071	0.003	1.009
2020 - PI	-0.839	-0.839	0.000	1.002	1.048	0.987	-0.061	0.981
2022 - PI	-3.060	-3.061	0.000	1.000	-1.467	-1.477	-0.010	1.001
2018 - MDI	1.255	1.256	0.001	1.000	0.237	0.242	0.004	1.006
2020 - MDI	-0.306	-0.308	-0.003	1.001	0.102	0.090	-0.011	0.982
2022 - MDI	-0.215	-0.218	-0.003	1.000	-0.211	-0.216	-0.005	0.999
2018 - log(USC)	0.729	0.738	0.009	1.001	0.310	0.305	-0.005	0.993
2020 - log(USC)	0.914	0.923	0.009	1.001	0.334	0.332	-0.002	0.993
2022 - log(USC)	0.917	0.926	0.009	1.001	0.361	0.357	-0.004	0.993
2018 - RPS	-0.799	-0.802	-0.002	1.000	-0.174	-0.172	0.001	1.002
2020 - RPS	-0.256	-0.258	-0.002	1.001	0.015	0.009	-0.006	0.982
2022 - RPS	-0.399	-0.403	-0.004	1.000	-0.226	-0.224	0.002	0.997

Table 13: Sensitivity of MCAR fixed-effect posteriors in the Santiago Metropolitan Region. Columns as in Table 12.

References

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