

Timing restriction and information provision effects on birth type choice

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5th of December 2019



- 56% of deliveries are C-section (SINASC 2015 and 2016).
14% are Scheduled C-section: CS's with low observed risk that happened before labor has started.
- Scheduled CS (SCS), Spontaneous CS and Natural Delivery (ND).
- Brazilian policy enacted in June, 2016 demands SCS's to be performed after the 39th week of gestation.
- How birth type decision making was changed?
- Working Paper available at <http://bibliotecadigital.fgv.br>



- The resolution keeps the woman's right to choose for CS, but it is restricted to be done only after the begin of the 39th week. (Only when the woman chooses the procedure).
- Further: it requires a document signed by the patient declaring that she was fully informed in a clear language about the risks and benefits of the CS and that she freely chooses to adopt this procedure.
- In general, the resolution:
 - Changes patients' informational set.
 - Imposes a cost to the obstetrician.
 - Restricts the delivery timing.



- SCS ratio dropped 2% at the 37th week and 5% at the 38th week.
- SCS ratio increased up to 4% at the 39th week.
- ND ratio increased up to 8.6% (in all weeks).
- It can be inferred from above that:
 - There was a postponement effect
 - Not only potential Scheduled CS, but also spontaneous CS have changed to ND.



- SCS before 39 weeks frequently associated with respiratory and adverse neonatal outcomes (Tita et al., 2009).
- Brazilian doctors persuade patients to accept a SCS based on medical conditions that did not exist or did not justify it (Potter et al., 2008).
- Doctors manipulate birth-time and/or type without clinical reasons (Rocha and Spinola, 2016).
- Lower distance to high c-section rates hospitals leads to higher Apgar scores, lower likelihood to be readmitted, but higher likelihood of visiting a hospital for a respiratory-related problem in the year after birth (Card, et al. 2019).

[References page](#)



- SINASC 2015 and 2016.
- Available at DATASUS and Github: LUCASBRMELO
- Procedure, gestation, pregnancy, and maternal socio-economic characteristics; newborn health outcomes and characteristics.
- Living Childbirthsbetween January 2015 and December 2016: 5,872,098 births.
- Conditioning on low observable risky births, there remains 3,627,842.¹

¹ Risky births definition



- Ideal experiment: implement the policy, observe each birth outcome $Y(1)$, come back in time, do not implement the policy, observe each outcome $Y(0)$ for the same births and time period.
- Actual approach: DiD and DiDiD Regressions.

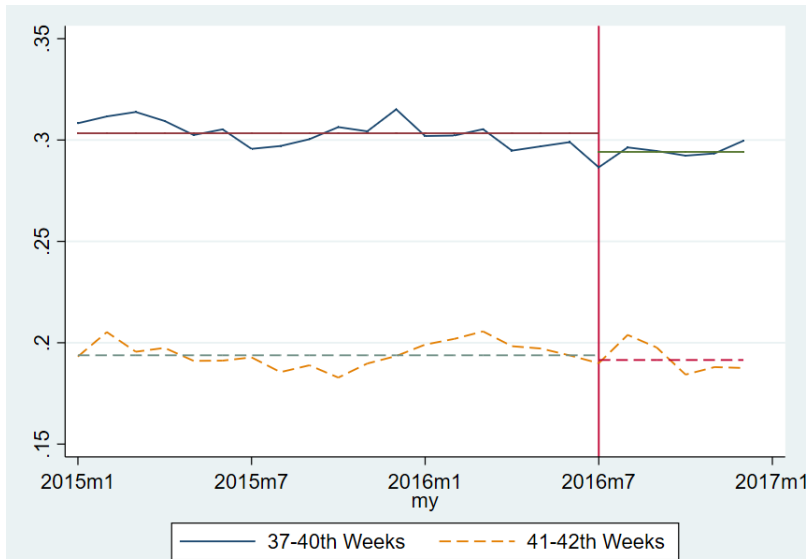


- Control Group 1 - Treatment: births at the 37-40 weeks. Control: births at the 41th and 42th weeks.
- Control Group 2 - Treatment: Private Hospitals. Control: Public Hospitals.
- Control Group 3 - Treatment: births at 37-40th weeks that happened in private hospitals. Control group A: births at the 41-42th weeks and control group B: births at public hospitals.



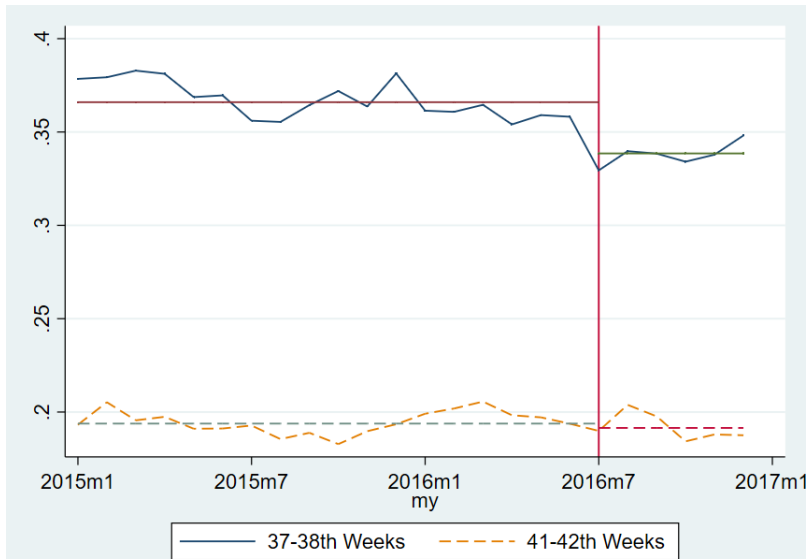
Control Group 1

Figure 1 Scheduled CS Ratio 37-40th vs. 41-42th weeks



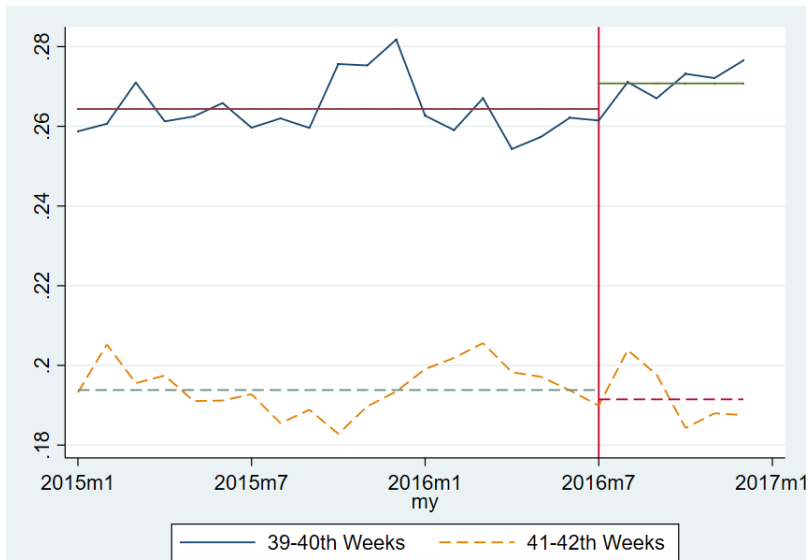
Control Group 1

Figure 2 Scheduled CS Ratio 37-38th vs. 41-42th weeks



Control Group 1

Figure 3 Scheduled CS Ratio 39-40th vs. 41-42th week



Control Group 1

DiD Regressions

$$Y_{iwt} = c + \delta_1 pol_t + \delta_2 treat_w + \beta_\tau pol_t * treat_w + \gamma X_{iwt} + \epsilon_{iwt} \quad (1)$$

- Indexes: i childbirth, h hospital, w week: $\tau \in \{37, 38, 39, 40\}$, t time period.
- Y assume 1 if SCS and 0 otherwise.
- X is a vector of controls: race *mothers_race*; educational attainment *mothers_school*; dummy if twins *type_preg*; marital status; number of previous pregnancy *n_prev_preg* and its square, *mothers_age* and its square.
- First without any F.E. Second with hospital's F.E., third: monthly-hospital F.E.



Control Group 1

DiD Regressions Results

Table 5: Policy effect: no F.E.

	(1)	(2)	(3)	(4)	(5)
	Whole Sample	37th Week	38th Week	39th Week	40th Week
pol*treat	-0.00420*	-0.0171***	-0.0195***	0.0116***	0.00183
	(0.00177)	(0.00261)	(0.00212)	(0.00195)	(0.00199)
<i>N</i>	3198121	641104	1091410	1394811	1045643
adj. <i>R</i> ²	0.116	0.104	0.141	0.110	0.058

Table 6: Policy effect: hospital F.E.

	(1)	(2)	(3)	(4)	(5)
	Whole Sample	37th Week	38th Week	39th Week	40th Week
pol*treat	-0.00308	-0.0119***	-0.0144***	0.00668***	0.000334
	(0.00160)	(0.00235)	(0.00190)	(0.00175)	(0.00181)
<i>N</i>	3198121	641104	1091410	1394811	1045643
adj. <i>R</i> ²	0.331	0.290	0.357	0.327	0.233

Table 7: Policy effect: monthly hospital F.E.

	(1)	(2)	(3)	(4)	(5)
	37-40th Week	37th Week	38th Week	39th Week	40th Week
pol*treat	-0.00132	-0.00725**	-0.0105***	0.00751***	0.00127
	(0.00162)	(0.00249)	(0.00197)	(0.00180)	(0.00185)
<i>N</i>	3198121	641104	1091410	1394811	1045643
adj. <i>R</i> ²	0.339	0.298	0.365	0.335	0.242

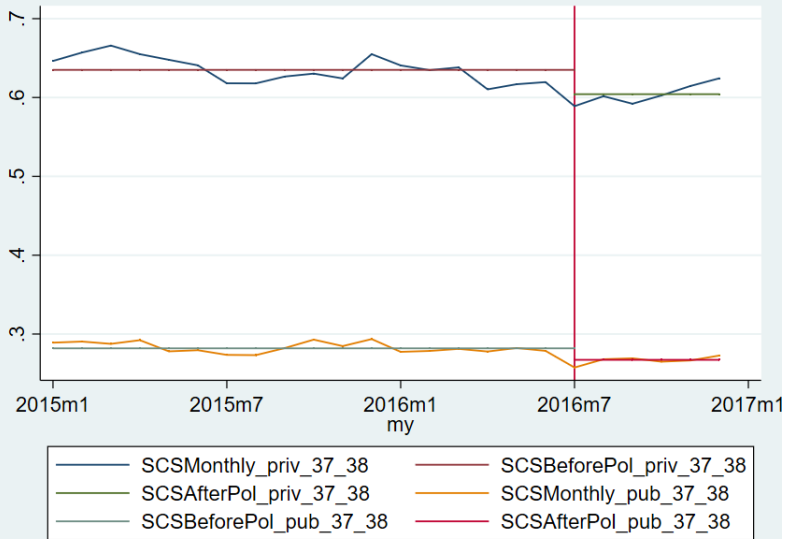
Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



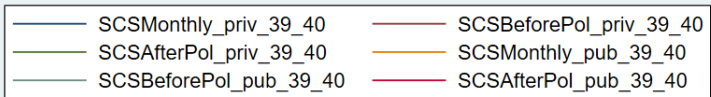
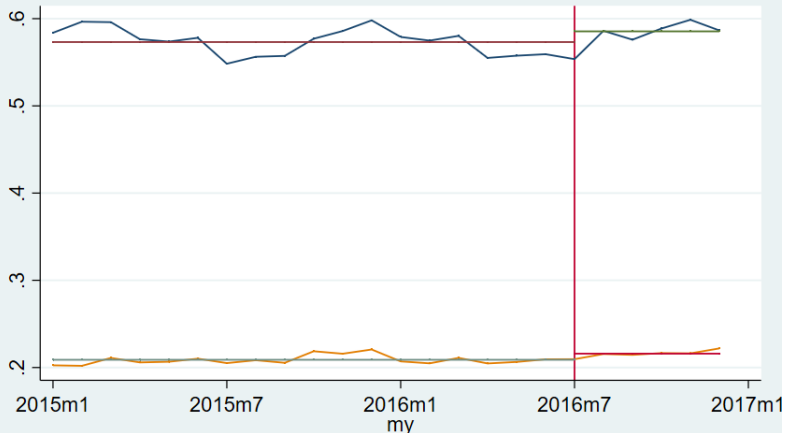
Control Group 2

Private vs. Public Hospitals: childbirths between 37-38th week



Control Group 2

Private vs. Public Hospitals:childbirths between 39-40th week



$$\begin{aligned}\beta_{ddd}^- = & \{[\bar{Y}_{\tau,priv,2} - \bar{Y}_{\tau,priv,1}] - [\bar{Y}_{\tau,public,2} - \bar{Y}_{\tau,public,1}]\} \\ & - \{[\bar{Y}_{41-42,priv,2} - \bar{Y}_{41-42,priv,1}] - [\bar{Y}_{41-42,public,2} - \bar{Y}_{41-42,public,1}]\}\end{aligned}$$

Where $\bar{Y}_{w,h,t}$ is the average of Y conditioning in gestational week $W = w$ which can be treatment group of weeks $w = \tau \in \{37 - 40, 37, 38, 39, 40\}$ or control group of weeks $w = 41 - 42$; hospital status h , which can be private, *priv*, or public, *public*; and period



Control Group 2 and 3

DiD e DiDiD Regressions

$$Y_{ihwt} = c + \delta_1 pol_t + \phi_{hm} + \beta_{\tau} pol_t * priv_h + \gamma X_{iwt} + \nu_{ihwt} \quad (2)$$

$$Y_{ihwt} = c + \kappa_1 pol_t + \kappa_2 treat_w + \phi_{hm} \\ + \mu_1 pol_t * treat_w + \mu_2 priv_h * treat_w + \mu_3 priv_h * pol_t \\ + \beta priv_h * pol_t * treat_w + \gamma X_{iwt} + u_{ihwt} \quad (3)$$

- Where $priv_h$ is hospital status.
- Note: Equation 2 excludes childbirths at the 41-42th week.



Control Group 2 and 3

DiD e DiDiD Regressions

Policy effect on private hospital: monthly hospital F.E.

	(1)	(2)	(3)
	37-40th Weeks	37-38th Weeks	39-40th Weeks
pol*priv	-0.00473* (0.00211)	-0.0143*** (0.00330)	0.00537 (0.00283)
<i>N</i>	2744970	1034767	1710203
adj. R^2	0.349	0.372	0.324

DiDiD Regression: monthly hospital F.E.

	(1)	(2)	(3)	(4)	(5)
	37-40th Weeks	37th Week	38th Week	39th Week	40th Week
treat*priv*pol	0.000116 (0.00843)	-0.0234* (0.0104)	-0.00645 (0.00910)	0.0112 (0.00886)	0.00691 (0.00956)
<i>N</i>	3056991	614519	1044290	1334379	999866
adj. R^2	0.341	0.300	0.368	0.338	0.244

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



Natural Delivery

DiD Regressions

$$ND_{iwt} = \lambda_t + \gamma_w + \mu_{wt} * t + \beta_{37,38} D1_{wt} + \beta_{39,40} D2_{wt} + \alpha X_i + e_{iwt} \quad (4)$$

- Where ND_{iwt} assumes 1 if ND and 0 if CS.



$$ND_{iwh t} = c + \lambda_t + \gamma_w + \theta_h + \psi_{tw} + \pi_{w,priv} + \rho_{t,priv} + \beta_{37-40} treat_w * pol_t * priv_h + X_i' \alpha + \epsilon_{ihwt} \quad (5)$$

$$ND_{iwh t} = c + \lambda_t + \gamma_w + \theta_h + \psi_{tw} + \pi_{w,priv} + \rho_{t,priv} + \beta_{37} D37_{ht} + \beta_{38} D38_{ht} + \beta_{39} D39_{ht} + \beta_{40} D40_{ht} + X_i' \alpha + v_{ihwt} \quad (6)$$

- Where $\pi_{w,priv}$ are gestational weeks specific effects interacted with private hospital indicator.
- ψ_{tw} are specific effects of gestational week interacted with time specific effects.



Natural Delivery

DiD and DiDiD Regressions

	Policy effect on ND probability					
	(1)	(2)	(3)	(4)	(5)	(6)
	-	Week time (wt)	wt + cov	Hosp	Hosp+wt	Hosp+wt+cov
D1 _{wt}	0.0331*** (0.00198)	0.0212*** (0.00499)	0.0172*** (0.00485)	0.0168*** (0.00178)	0.0158*** (0.00430)	0.0129** (0.00440)
D2 _{wt}	-0.00267 (0.00182)	0.0215*** (0.00379)	0.0175*** (0.00377)	-0.000269 (0.00166)	0.0111*** (0.00336)	0.00980** (0.00346)
N	3627842	3627842	3331517	3627842	3627842	3331517
adj. R ²	0.014	0.014	0.113	0.237	0.238	0.259

	DiDiD Regression: monthly hospital F.E.	
	(1)	(2)
	37-40th Weeks	Each week
treat_priv_pol	0.00648 (0.00448)	
D37_priv_pol		0.0207*** (0.00606)
D38_priv_pol		0.00514 (0.00486)
D39_priv_pol		0.00148 (0.00478)
D40_priv_pol		0.0121* (0.00586)
N	3195551	3195551
adj. R ²	0.260	0.260

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



- Placebo tests [Click Here](#)
- Specification Robustness tests [Click here](#)
- Heterogeneity [Click here](#)



- The resolution 2,144 successfully increased the average pregnancy term of Scheduled CS's.
 - Decreases of 2% and 5% in the total number of SCS at the 37th and 38th week.
 - Increases of 4% at the 39th week.
- It changed potential CS's to ND's, probably through the information provision obligation, but it could also be through the cost imposed to the physician.
- Future research: disentangle mechanisms - costs vs. information effects.



- Weak points:
 - Resolution approved by the CFM in 17, March 2016, but published by National Congress in 22, June 2016.
 - Polluted control groups.
 - Increases at the 39-40th week are not robust to specifications.
- Strong points:
 - Decreases at the 38th and 37th weeks are robust to specifications and Placebo Tests.
 - Easy to extend the analysis to measure the resolution effects in others births outcomes.
 - Causal Interpretation of Dif-in-Dif identification.



References

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- Rocha and Spinola, 2016. Rocha, R. and Spinola, P. (2016). Convenience effect on birth timing manipulation.
- Tita et al., 2009 Tita, A. T., Landon, M. B., Spong, C. Y., Lai, Y., Leveno, K. J., Varner, M. W., Moawad, A. H., Caritis, S. N., Meis, P. J., Wapner, R. J., et al. (2009). Timing of elective repeat cesarean delivery at term and neonatal outcomes. *New England Journal of Medicine*, 360(2):111–120.
- Potter et al., 2008. Potter, J. E., Hopkins, K., Fagundes, A., and Perp etuo, I. (2008). Women's autonomy and scheduled cesarean sections in brazil: a cautionary tale. *Birth* , 35(1):33–40

Literature page



- Risky births are those with any of the following seven conditions: (1) triplets or more pregnancy type; (2) newborn with congenital anomaly; (3) newborn in breech or shoulder (transverse) positions before birth; (4) birth weight below 2000gs or above 4500gs; (5) APGAR of one minute score lower than 2 and APGAR of five minutes score lower than 5; (6) mother's age below 17 or above 36 years old; (7) births before the 37th and after the 42th gestational week.

Previous slide



$$Y_{iwt} = c + \lambda_t + \gamma_w + \mu_{wt} * t + \beta_{37,38}^f FD1_{tw} + \beta_{39,40}^f FD2_{tw} \\ + \beta_{37,38} D1_{tw} + \beta_{39,40} D2_{tw} + X_i' \alpha + \epsilon_{iwt} \quad (7)$$

- λ_t are time fixed effects, γ_w gestational weeks specific effects, $\mu_{wt} * t$ interaction between the last two variables multiplied by t .
- $D1_{tw}$ treatment status for births at the 37-38th week.
- $D2_{tw}$ 39-40th week.
- $F1_{tw}$ Fake treatment status for births at the 37-38th week that happened between January 2015 and March 2015.
- $F2_{tw}$ 39-40th week.
- (1) Without control and interaction term, (2) with interaction term, (3) with both.

Placebo

Results

Extra

Table 9: Placebo and actual policy effects

	(1)	(2)	(3)	(4)	(5)	(6)
	-	Week time (wt)	wt+cov	Hosp	Hosp + wt	Hosp + wt + cov
FD1	0.0120*** (0.00250)	0.00639 (0.0110)	0.00296 (0.0112)	0.00947*** (0.00217)	0.0130 (0.00945)	0.0144 (0.00990)
FD2	-0.00738** (0.00234)	-0.0303** (0.0102)	-0.0268* (0.0104)	-0.00143 (0.00207)	-0.00519 (0.00889)	-0.00624 (0.00934)
D1	-0.0261*** (0.00179)	-0.0115* (0.00485)	-0.00753 (0.00475)	-0.0135*** (0.00154)	-0.00647 (0.00402)	-0.00369 (0.00416)
D2	0.00563*** (0.00158)	-0.0132*** (0.00336)	-0.0100** (0.00335)	0.00248 (0.00137)	-0.00707* (0.00284)	-0.00629* (0.00295)
<i>N</i>	3470410	3470410	3198121	3470410	3470410	3198121
adj. R^2	0.022	0.022	0.123	0.323	0.323	0.332

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



Specification Test

DiD Regressions

$$Y_{iwt} = c + \lambda_t + \gamma_w + \mu_{wt} * t + \beta_{37,38} D1_{tw} + \beta_{39,40} D2_{tw} + X_i' \alpha + \epsilon_{iwt} \quad (8)$$

- λ_t time fixed effects, γ_w gestational weeks specific effects, $\mu_{wt} * t$ interaction between the last two variables multiplied by t .
- $D1_{tw}$ treatment status dummy for births at the 37-38th week.
- $D2_{tw}$ 39-40th week.
- First without control and interaction term, second with interaction term, third with both.

Extra



Specification test

Results of DiD Regressions

Extra

Joint estimation: grouped weeks

	(1)	(2)	(3)	(4)	(5)	(6)
	-	Week time (wt)	wt+cov	Hosp	Hosp + wt	Hosp + wt + co
D1	-0.0281*** (0.00177)	-0.0115* (0.00485)	-0.00753 (0.00475)	-0.0149*** (0.00151)	-0.00647 (0.00402)	-0.00369 (0.00416)
D2	0.00680*** (0.00156)	-0.0132*** (0.00336)	-0.0100** (0.00335)	0.00286* (0.00136)	-0.00707* (0.00284)	-0.00629* (0.00295)
<i>N</i>	3470410	3470410	3198121	3470410	3470410	3198121
adj. R^2	0.022	0.022	0.123	0.323	0.323	0.332

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



Heterogeneity

DiD Regressions

$$Y_{ihwt} = c + \delta_1 pol_t + \delta_2 hs_i + \delta_3 treat_i + \beta_1 pol_t * treat_w + \omega_1 hs_i * treat_w + \omega_3 hs_i * pol_t + \sigma_1 hs_i * pol_t * treat_w + \gamma X_{ihwt} + \phi_{hm} + \eta_{ihwt} \quad (9)$$

- hs_i is a dummy assuming unit if the mother has 12 years of education or more and 0 if she has none, 1 to 3 years, 4 to 7 or 8 to 11 years of education;
- $treat_w$ is a dummy that indicates treatment week: 37-38th and 0 for 41-42th weeks;

Extra



Heterogeneity

Results

The last row refers to the p-value of a

Wald test with $H_0 : \beta_j + \sigma_j = 0$ and $H_1 : \beta_j + \sigma_j \neq 0$ for $j = \{1, 2\}$.

Table 10: Policy effect by educational level

	(1)	(2)	(3)
	37-38th Weeks	37th Week	38th Week
pol*treat	-0.00617** (0.00193)	-0.00378 (0.00262)	-0.00706*** (0.00207)
hs*pol*treat	-0.0208** (0.00640)	-0.0180* (0.00778)	-0.0220*** (0.00660)
hs*pol*treat+pol*treat	-0.02697***	-0.02178**	-0.02906***
$P > F $	0.000	0.0032	0.0000
N	1402305	638710	1087587
adj. R^2	0.359	0.302	0.369

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Extra

