Is the pandemic fast-tracking automation in developing countries?

Preliminary evidence from Colombia

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1. Motivation & Lit:

- Automation has accelerated over the last decades, mainly driven by the growing use of robotics and information technologies (Acemoglu and Autor, 2011; Autor et al, 2003; Autor and Dorn, 2013; Brynjolfsson and McAfee, 2014; Frey and Osborne, 2017).
- Recent evidence specially for developed economies suggests that the Covid-19 pandemic may have accelerated the automation process. Occupations with a greater probability of being automated experienced a larger drop in employment and also a moderate demand for new jobs with lower-skill occupations during the recovering (Ling and Sáenz, 2020; Chem, 2020; Costa Dias, 2020; Dolado et al. 2020; Chernoff and Warman, 2020).

1. Motivation & Lit:

- One of the few studies assessing the effect of the pandemic on automation in developing countries is Egaña del Sol et al (2021) for the case of Chile. The authors show that the recovery has been considerably slower in sectors with a greater availability of technologies that facilitate automation.
- We contribute to the evidence for developing countries characterized by high informality and unemployment rates. We assess whether the pandemic had a differential impact on the demand of occupations that are more prone to automation, using the online vacancies from the Colombian Public Employment Services Bureau (SPE) and information from GEIH.

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1. Motivation & literature review
2. Conceptual framework
3. Data & Labor market during covid-19
4. Empirical strategy & results
5. Final remarks

2. Conceptual framework:

- Following Acemoglu and Restrepo (2018a), innovation replaces tasks previously performed by labor with robots (automation) and creates new tasks for which labor has a comparative advantage.
- There is a technological constraint on automation, such that task $i > I$ are not technologically automated, and they should be produced with labor.
- $i \leq I$ are technologically automated (i.e. these are feasible to be produced with capital).

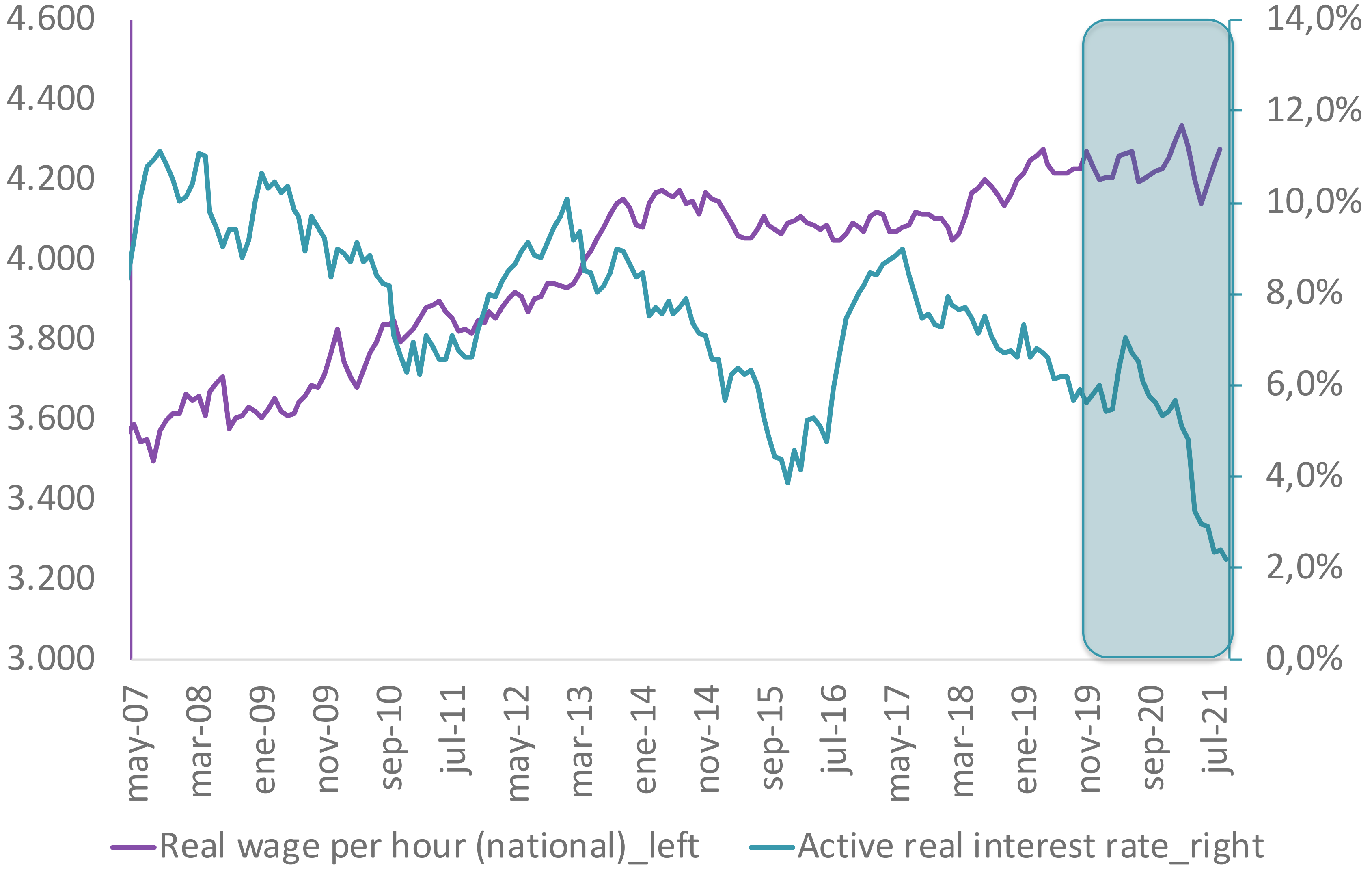
2. Conceptual framework:

$$p(i) = \begin{cases} min\left\{R, \frac{W}{\gamma(i)}\right\}^{1-\eta} & if\ i \leq I \\ \left(\frac{W}{\gamma(i)}\right)^{1-\eta} & if\ i > I \end{cases} \qquad (1)$$

For $i \leq I$, firms will choose to produce the task with labor or capital depending on which factor has the lower effective cost: R or $\frac{W}{\gamma(i)}$.

The covid-19 pandemic directly affects the optimal allocation of tasks through a sudden increase in labor cost relative to capital (mobility restrictions, fear of contagion & job uncertainty (Bloom and Prettner, 2020; Leduc and Liu, 2020; Hershbein and Kahn, 2018; Jaimovich and Siu, 2020).

Real interest rate vs. real wages.



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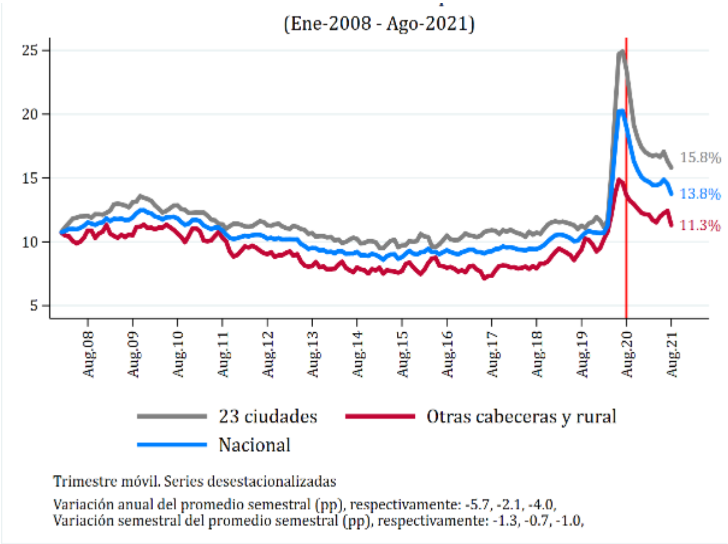
3. Data and Labor market during covid-19

- GDP shrank by 6.8 percent in 2020, the economy's largest decline in its modern history, but the contraction in employment was even larger.

Figure 1:

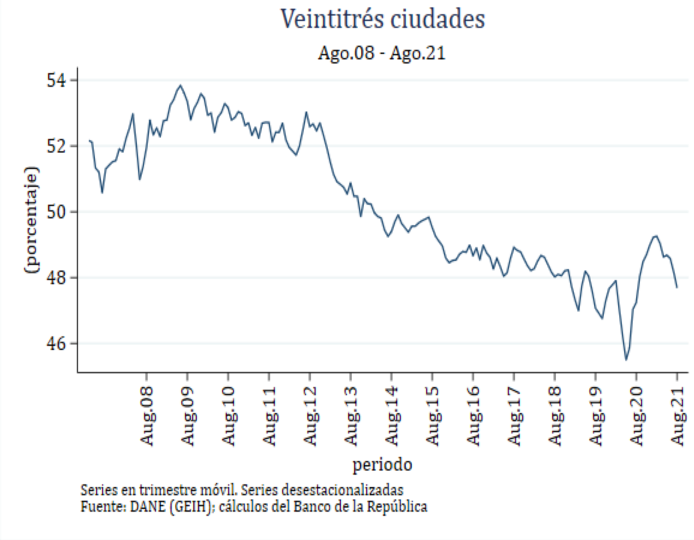
Panel A:

Unemployment rate



Panel B:

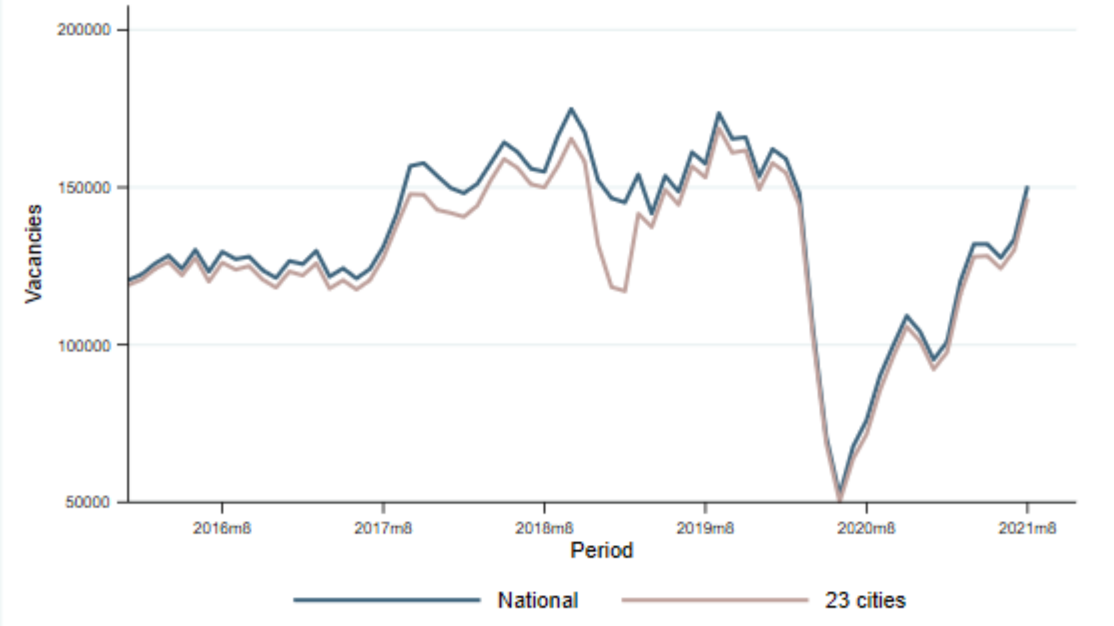
Informality rate



3. Data and Labor market during covid-19

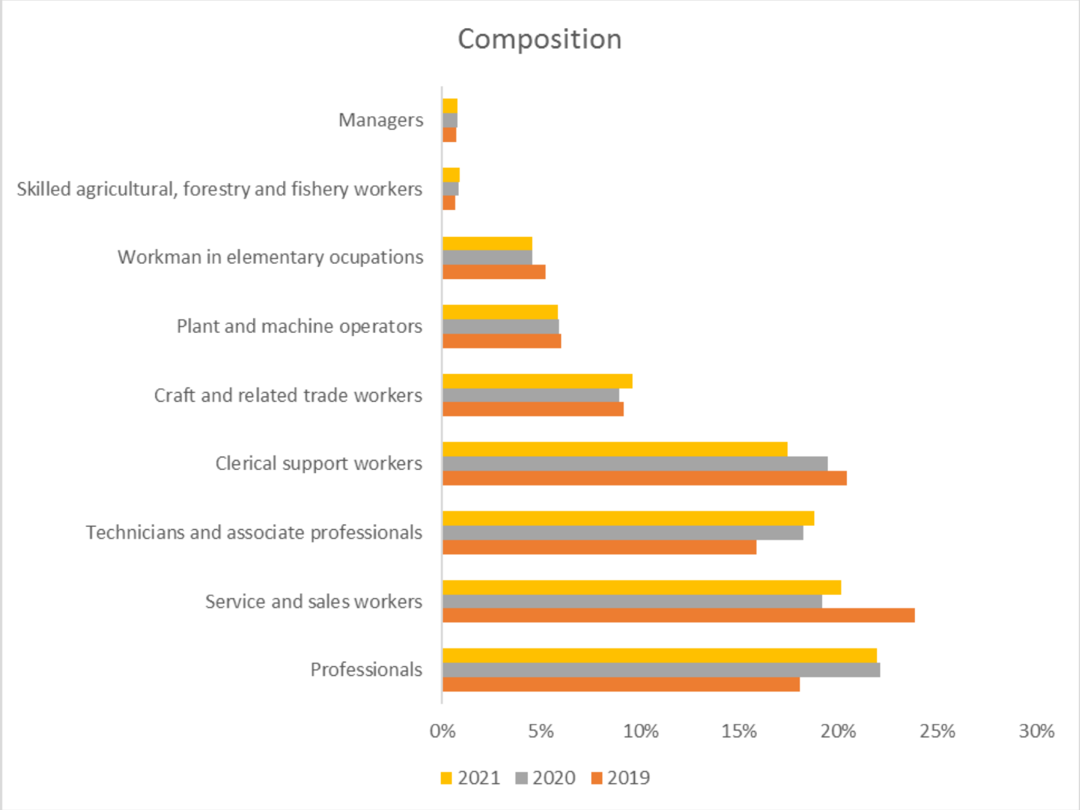
Figure 2:

Panel A:
Job opening



Seasonally adjusted series. Three-month moving average.
Annual variation (%), respectively: 97.92, 104.74
Semiannual variation (%), respectively: 49.05, 50.08

Panel B:
Job openings by occupations

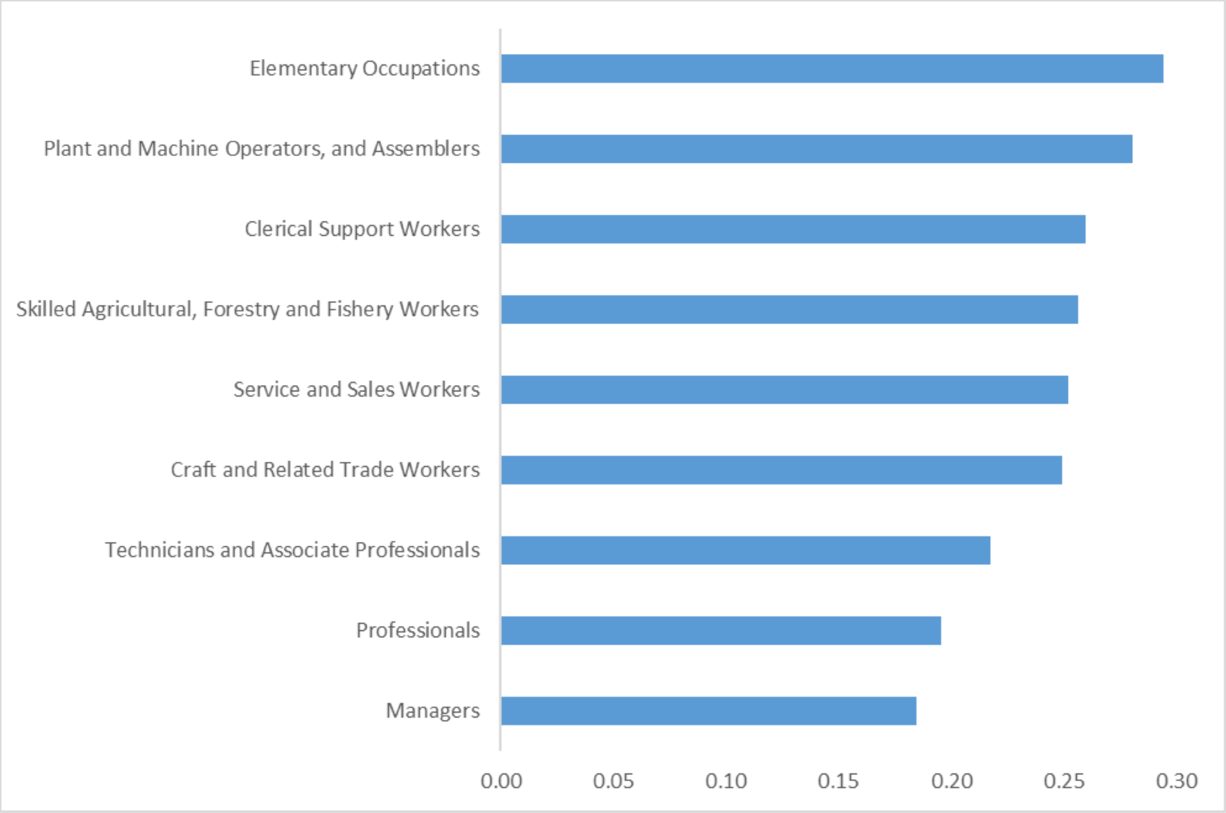


Note: All job openings from January-August.

3. Data and Labor market during covid-19

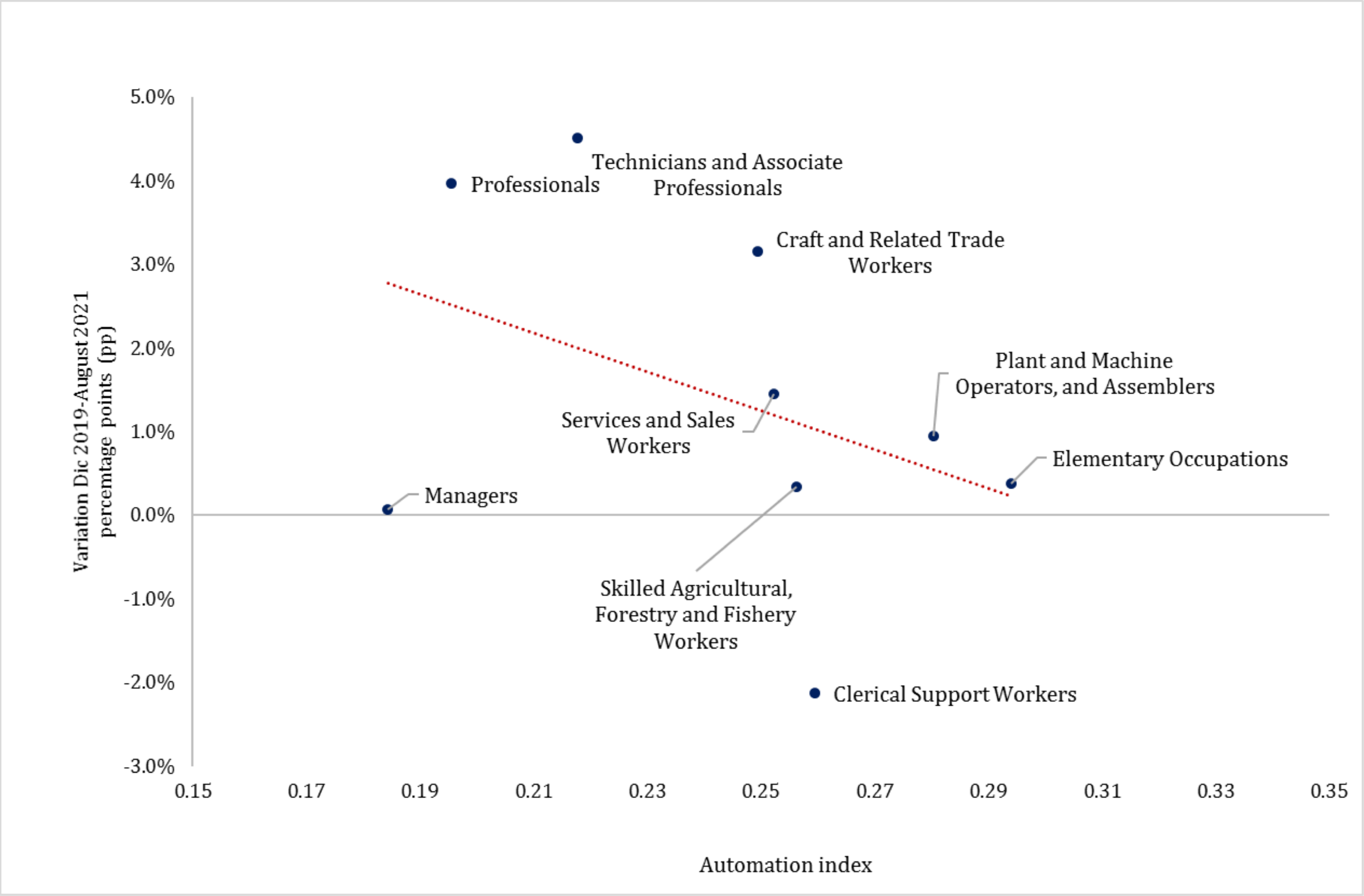
We measure the probability of automation of each occupation in Colombia following Nedelkoska and Quintini (2018) base on the PIACC, who in turn build on Frey and Osborne (2017).

Figure 3: Automation index



3. Data and Labor market during covid-19

Figure 4: Automation and job opening



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4. Empirical strategy and results

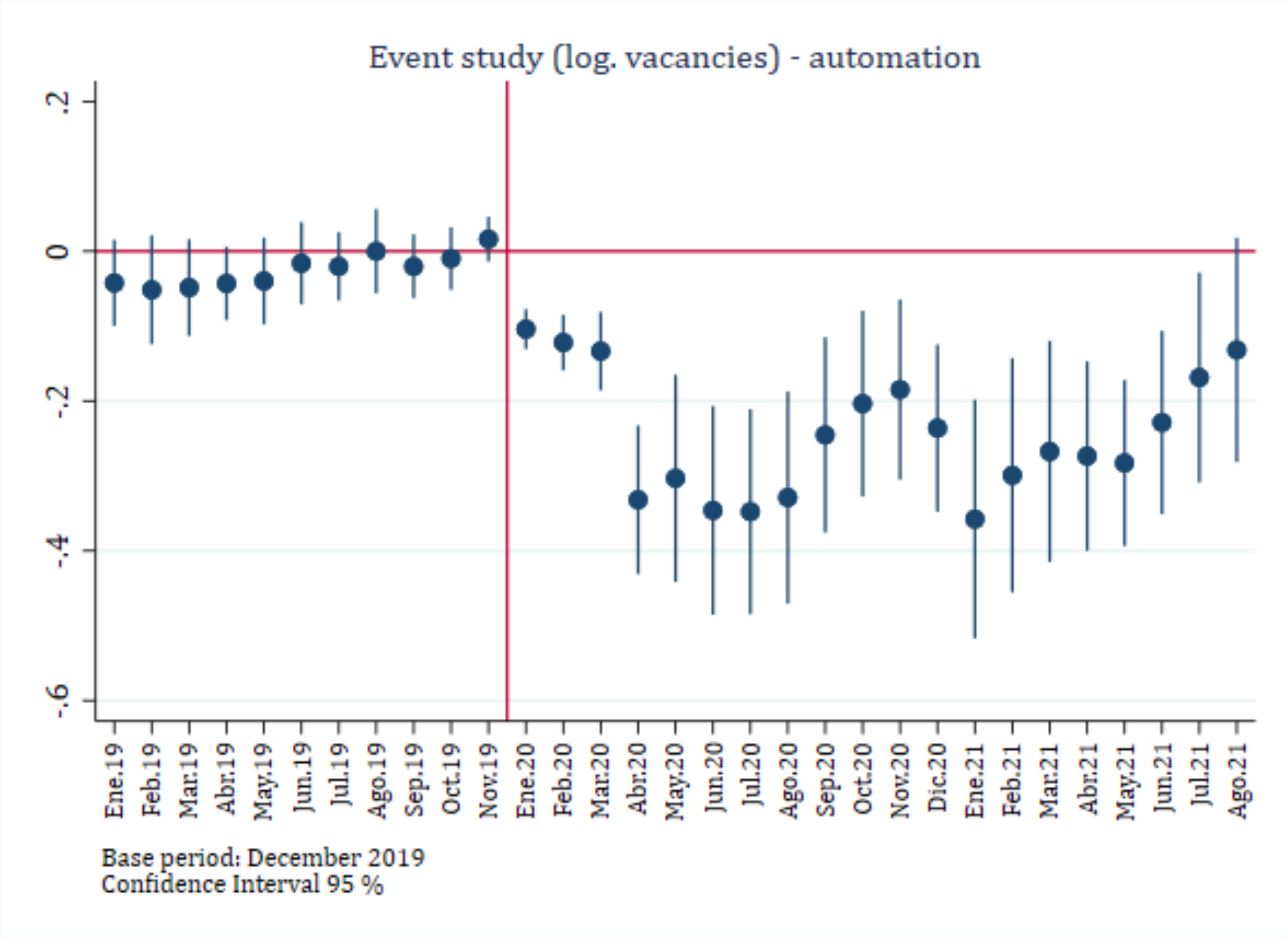
We assess whether the pandemic had a differential impact on demand of occupations that are more or less prone to automation, using an Event Study (ES) design.

$$ln(V_{jct}) = \sum_{\tau=1}^{T} \beta_\tau \, auto_{cj} \times D_\tau + \gamma\theta_{ct} + \delta_{jc} + \delta_t + \varepsilon_{jct} \qquad (2)$$

The reference period is December 2019, when WHO declared the covid-19 outbreak as a public health emergency of international concern. The dependent variable is the natural log of job posting offers in the profession *j*, in a city *c*, at the time *t*. We control for individual effects for each combination of city-profession and by month fixed effects. The model also controls for the disease propagation at each city θ_{ct} (measured as the number of death per million people of working age).

4. 1 Results in job posting vacancies (SPE)

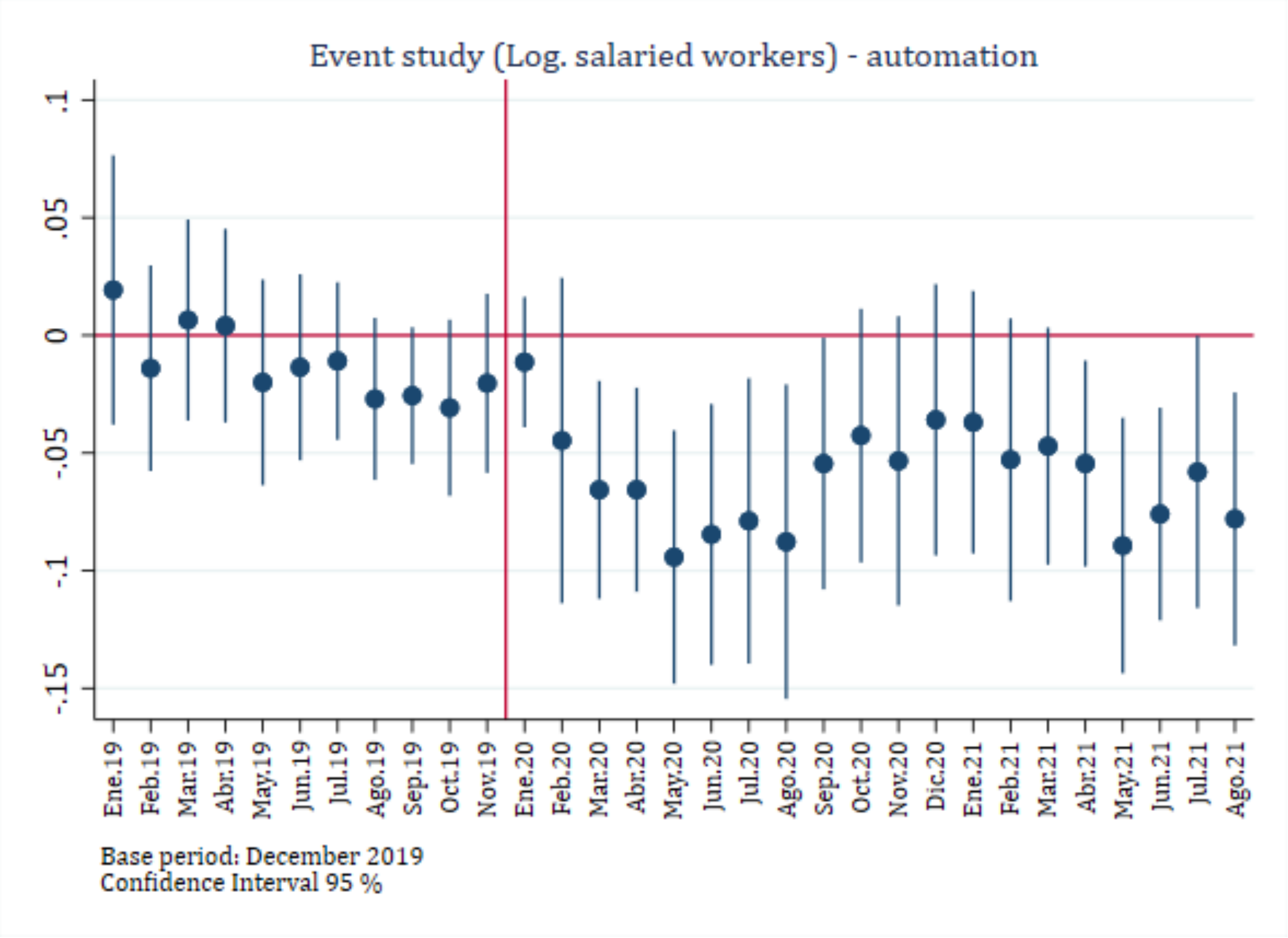
Figure 5



Source: Author's calculations.

4. 1 Results in employment (GEIH)

Figure 6

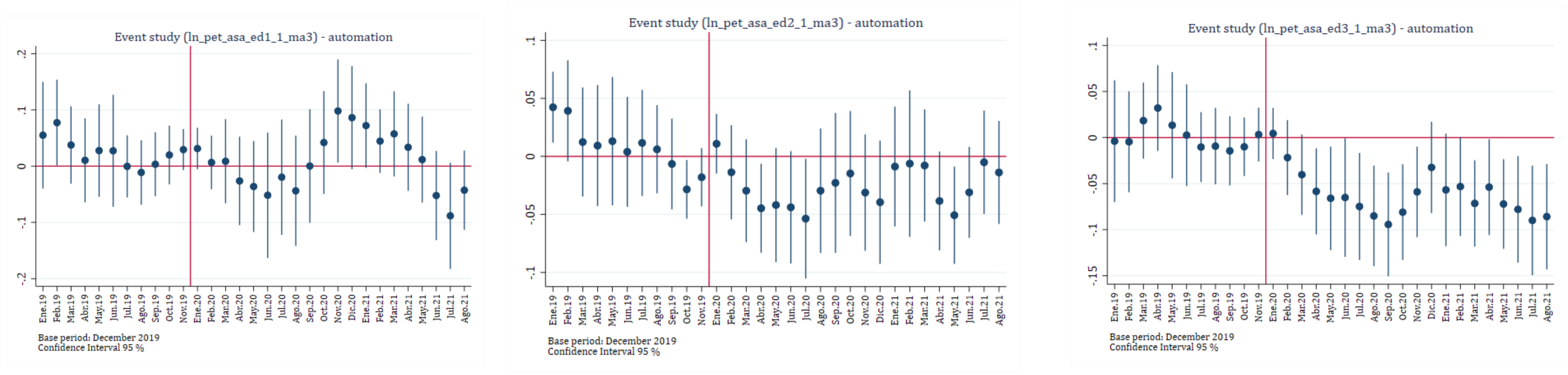


Source: Author's calculations.

4.2 Heterogeneous effects by age and gender (GEIH)

Figure 7

Panel A. Under 25 — Panel B. 25-40 — Panel C. Over 40

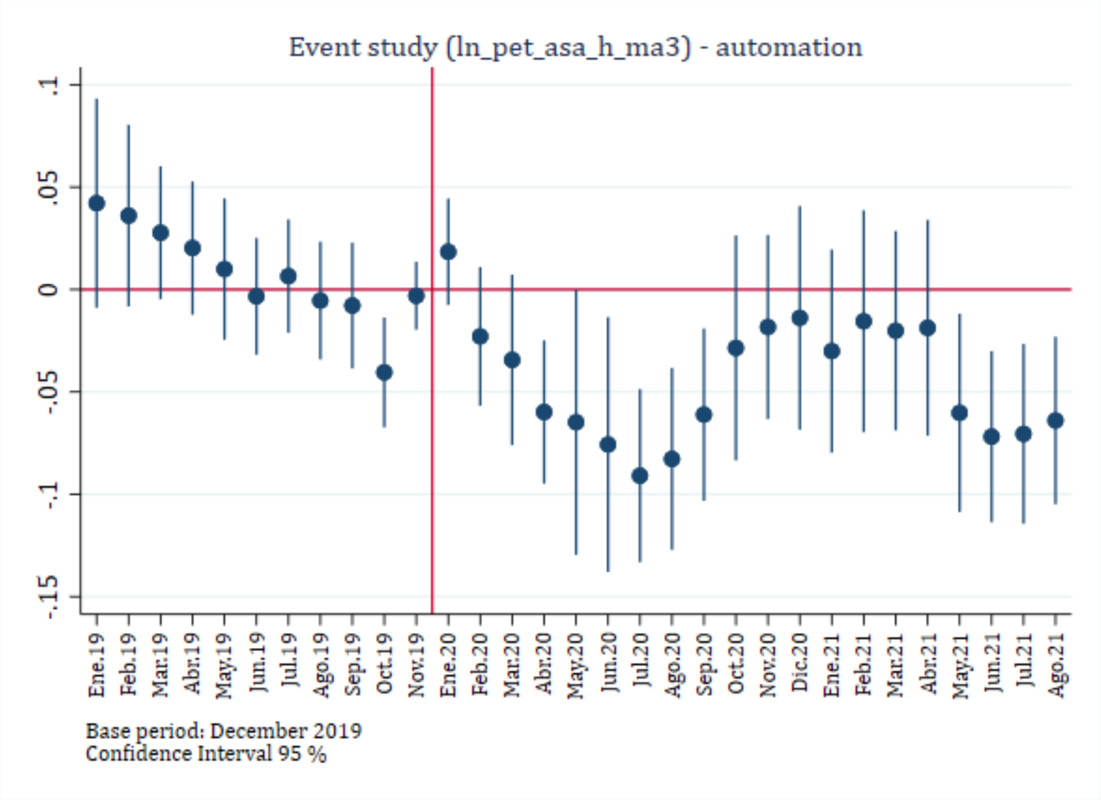


Source: Author's calculations.

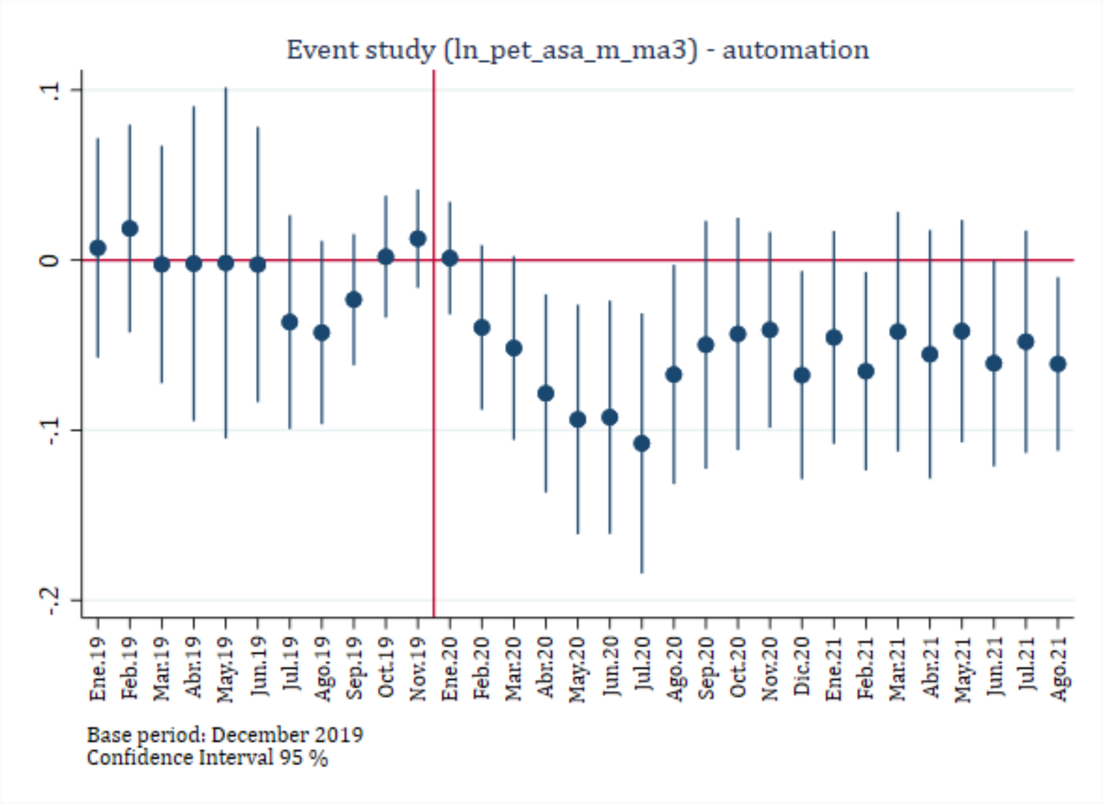
4.2 Heterogeneous effects by age and gender (GEIH)

Figure 8

Panel A. Male



Panel B. Female

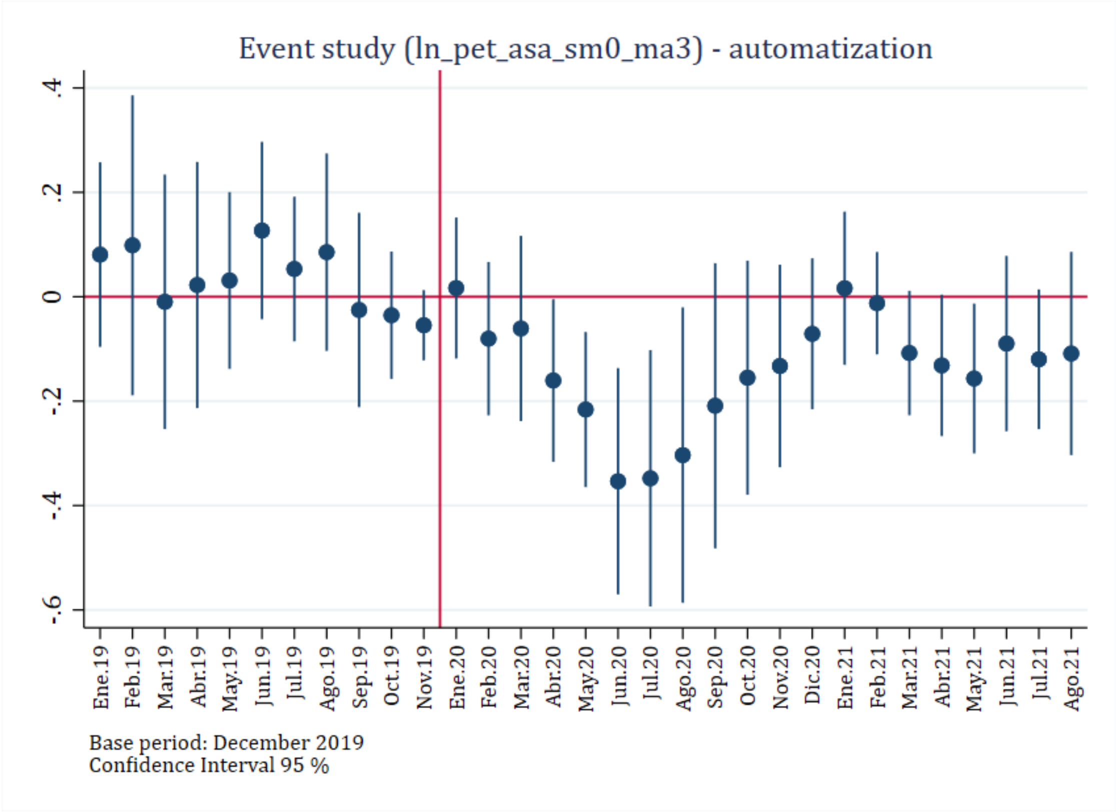


Source: Author’s calculations.

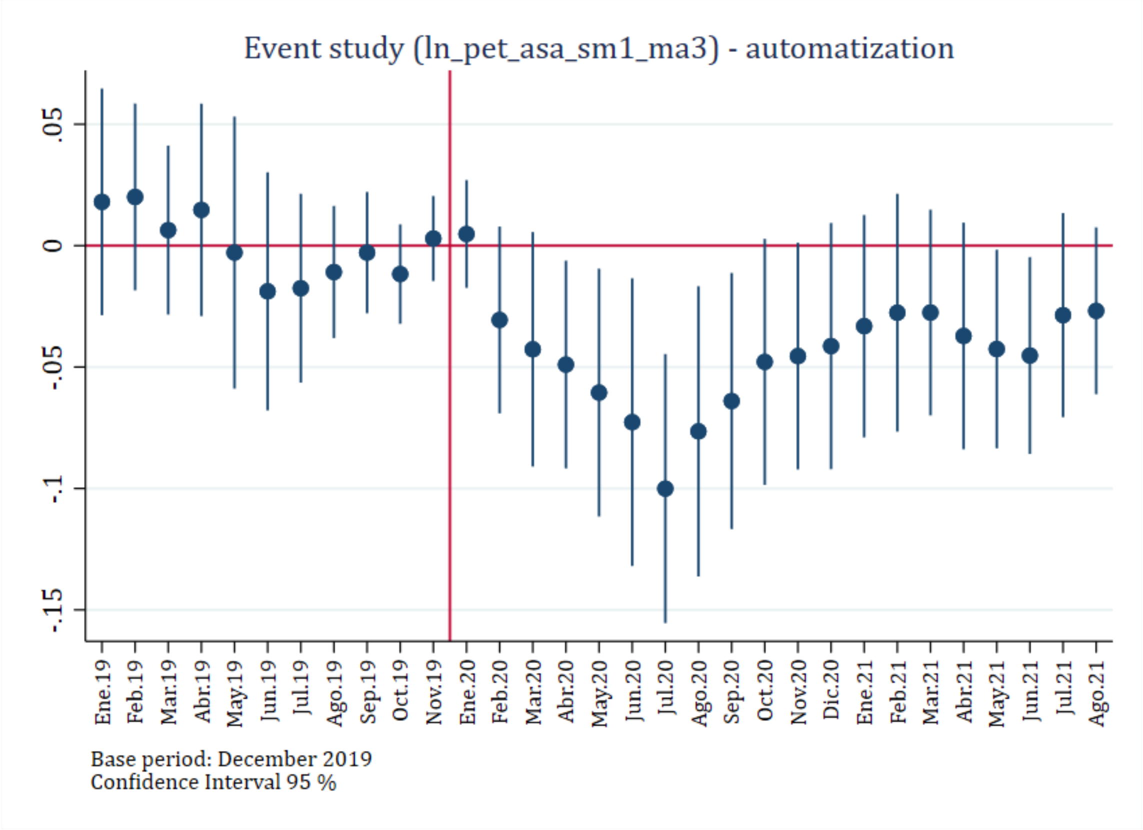
4.3 Heterogeneous by wages (GEIH)

Figure 9

Panel A. Minimum wage



Panel B. More than minimum wage

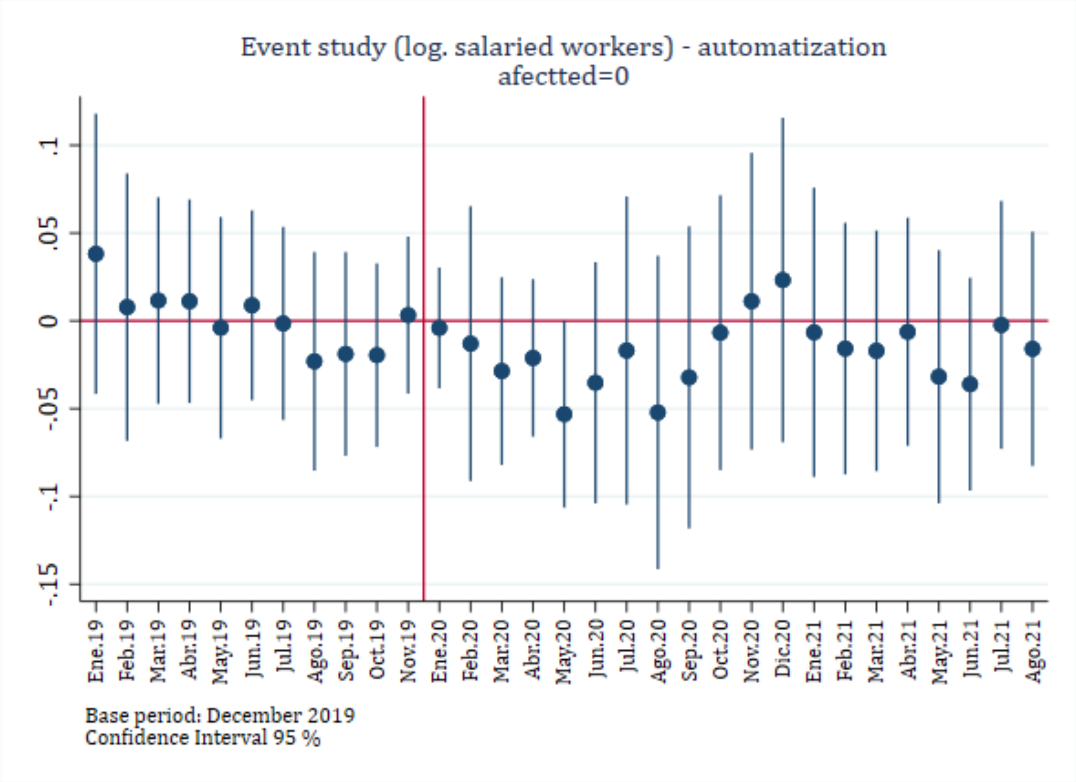


Source: Author's calculations.

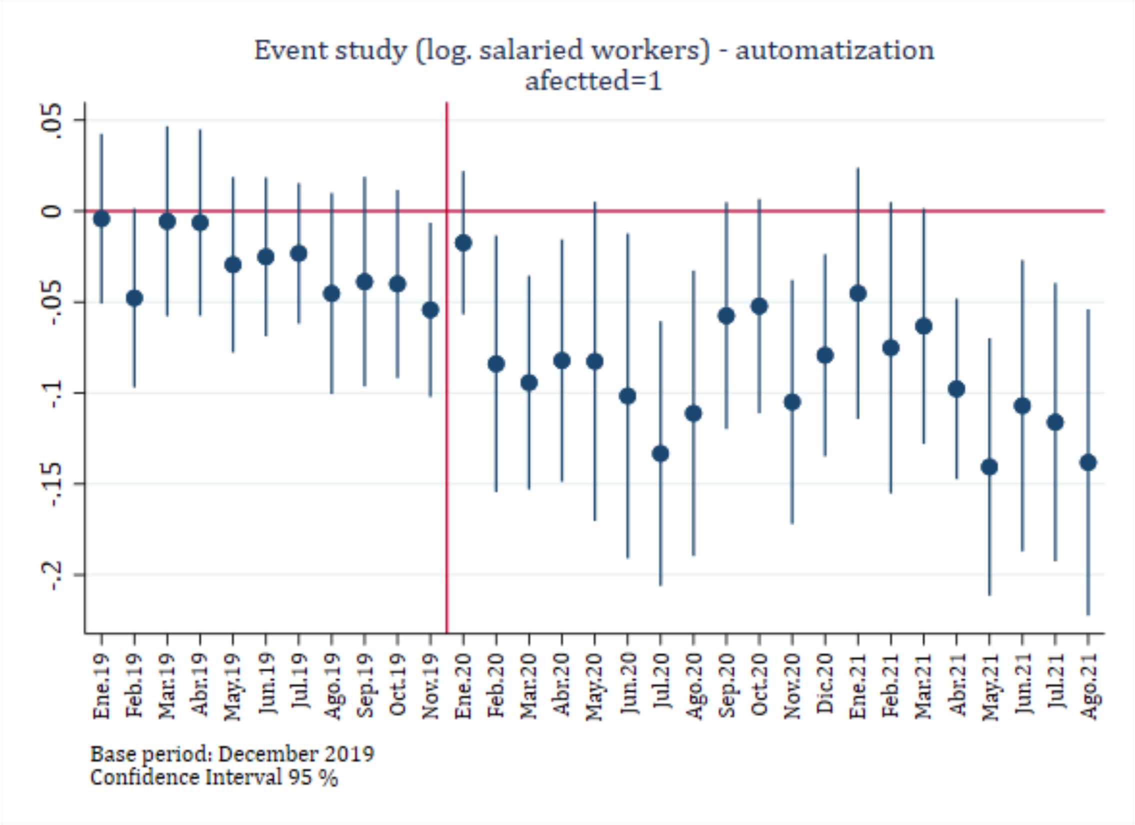
4.3 Heterogeneous by mobility restrictions (GEIH)

Figure 10

Panel A. Excluded



Panel B. Non-excluded

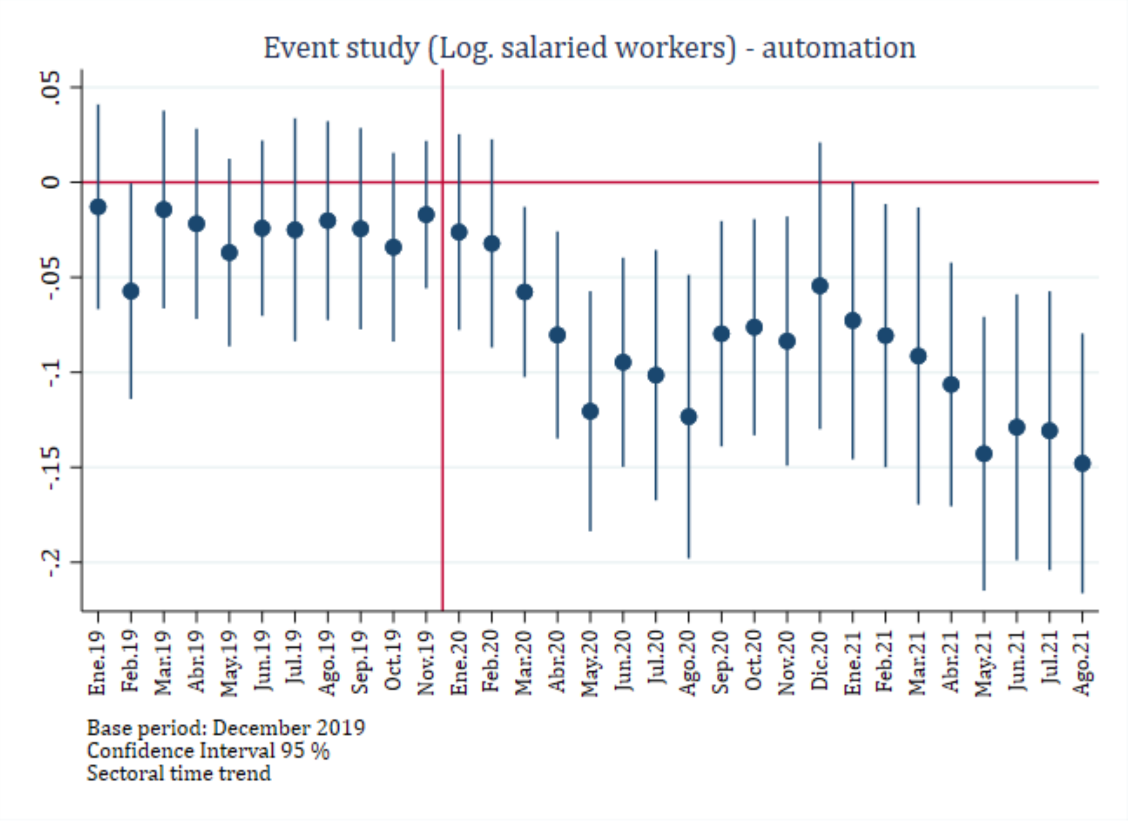


Source: Author's calculations.

4.3 Heterogeneous by economic sectors (GEIH)

Figure 11

Panel A. City – Occupation – Sector (time trends)



Source: Author's calculations.

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5. Final remarks

- We find that during the pandemic, there has been a significantly lower job opening for occupations with greater potential of automation than those that are less automatable.
- We also explore whether our results are heterogeneous by demographic characteristics such as age and gender. We found that the negative effects on employment are mostly driven by the negative effects on workers over 40.
- In terms of gender, we found that the magnitude of the effects is consistently larger for females (Chernoff and Warman, 2020; Egaña del Sol et al., 2021).

5. Final remarks

- In terms of wages, as proxy of productivity, we found that the differential effect on automation was higher among those occupations with lower wages.
- Finally, we found that there is a significant differential effect by the likelihood of automation, mainly in sectors with mobility restrictions. Meaning that mobility restrictions, imposed at the beginning of the pandemic, increased the cost of labor relative to capital, where automation could have been an alternative to compensate the cost of future mobility restrictions, and also a mechanism to control the disease himself.

5. Final remarks

- Aditionally, we want to explore the mechanisms in which such automation is taking place:
- In the first place, we are exploring how imports of machinery and equipment behave during the same period using also event-study methods. A second channel is through the acceleration of the automation process of a key trading partner such as US, that can also affect the automation process in Colombia (Kugler et al, 2020).

Thanks

Appendix

Source: Author's calculations.

Table A: Summary statistics:

Panel A. Annual vacancies 2015-2020

Year	Total vacancies (SPE)	Hirings (GEIH-DANE)	Vacancies / Hirings
2015	748644	7068081	0.106
2016	1369279	6924380	0.198
2017	1334234	6521437	0.205
2018	1523996	6256743	0.244
2019	1482686	6404943	0.231
2020	1004085	NA	NA
Total 2015 -2019	6458839	33175584	0.195
Total 2015 -2020	7462924	NA	NA
Annual average	1243821	6635117	0.197

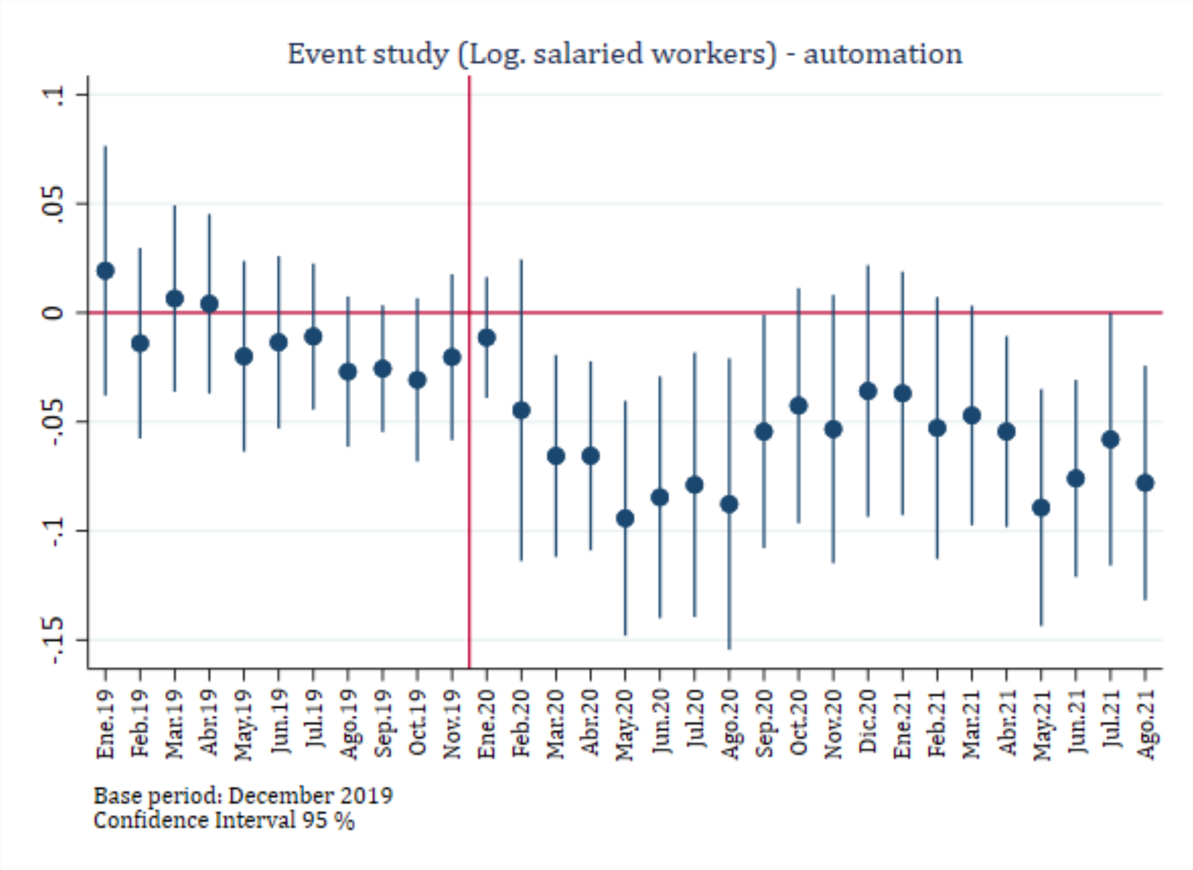
Panel B. Total vacancies 2015-2019

Major occupation	Total vacancies (SPE)	Hirings (GEIH-DANE)	Vacancies / Hirings
Managers	63562	841714	0.076
Professionals	1209152	2381206	0.508
Technicians and Associate Professionals	976386	1783482	0.547
Clerical Support Workers	1360939	4109964	0.331
Services and Sales Workers	1654398	11380537	0.145
Skilled Agricultural, Forestry and Fishery Workers	38651	184841	0.209
Craft and Related Trade Workers	546712	8544794	0.064
Plant and Machine Operators and Assemblers	297142	2935281	0.101
Elementary Occupations	311897	1013767	0.308
Average by occupation	717649	3686176	0.195

Source: Author's calculations.

Controlling by fixed effect on restricted and non restricted sectors

Panel A. Main specification



Panel B. Controls by affectation