

Project Report

An Investigation into How the Declining Fertility Problem Featured in Taiwan's 2022 Mayoral Election

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1. Introduction

1.1 In 2022, Taiwan registered a record low fertility rate of 0.87. It is projected that by 2035, Taiwan will have the lowest fertility rate in the world (Tzu-Ti, H., 2022). The issue has also become one of the hot topics during the mayoral election last year. The 2022 mayoral candidates have put forward various strategies and policy proposals to tackle the issue.

1.2 This project seeks to ascertain how the issue of low fertility rates factored into the 2022 local elections. Of which, we aim to better understand the candidates' outlooks relating to the issue and their proposed solutions to how Taiwan can address the decreasing fertility problem. Focusing on Taiwan's six special municipalities (i.e. Taipei, New Taipei, Taoyuan, Taichung, Tainan, and Kaohsiung) , we ask the following three research questions.

- a) How frequently did the candidates mention the issue on Facebook?
- b) What policy ideas did they propose to resolve the issue?
- c) How does this compare to discussions and perceptions in the media?

1.3 Initially, we also planned to employ ChatGPT (3.5) for our analysis. However, after manually labelling 300 posts, we found that ChatGPT's accuracy is not high enough (See **Appendix A** for details). Therefore, we adjusted our methodology to include informed keyword searches of the candidate posts, in addition to a word cloud of the candidate posts and news articles.

1.4 We have written this report so that it can be read in tandem with the [GitHub](#) repository, and have also embedded the direct links to the relevant files and folders in GitHub within the report for easier reference.

2. Methodology and Data Source

2.1 Data Source

2.1.1 In the study, we have chosen to further study the content that was posted by fifteen leading candidates from the six special municipalities. This includes candidates from the Kuomintang (KMT) and Democratic Progressive Party (DPP)¹, as well as Taiwan People's Party (TPP)'s Taoyuan candidate Lai Hsiang-ling(賴香伶) and Taipei's independent candidate Huang Shan-shan(黃珊珊). In addition, we looked at the online news articles that relate to the issue of declining birth rate. The data sources are summarised as follow:

- a) **Facebook Posts** - The Facebook posts were obtained from the verified Facebook accounts of the 15 mayoral candidates via Crowdtangle. Based on the respective party's public announcements and available reports, the period of posts covered the candidates' nomination dates to the date after the election i.e. 2022/02/11 to 2022/11/27², totaling 5,825 posts. The candidate periods are included in [Appendix B](#).
- b) **Online News Articles from Wisenews** - To get a sensing of the issues discussed in association with the declining birth rate in Taiwan, we used the keywords “台灣” “生育率” OR “少子化” “台灣”. The period covered the nomination date of the first candidate until the day after the election: 2022/02/11 to 2022/11/27. Using this, we obtained 4,197 news articles from the wisenews dataset. After data cleaning, 3,917 articles remained. The news articles can be found on the [repository](#).

¹ In Taoyuan, Cheng Yun-peng replaced Lin Chih-chien as DPP's candidate in August 2022. For completeness, we have taken into account both candidates in the study.

² We have included the day after the elections as some of the candidates may also reiterate some of their election promises and immediate priorities upon the release of the election results.

- c) **Additional Supplementary Information** - To refine the keywords used for the analysis, we referred to both the official election bulletin (選舉公報) that contained the policy proposals of the candidates published from Central Election Commission (中選會), as well as the official policy documents and announcements from the National Development Council (國發會), Executive Yuan (行政院) and Six Municipal Governments (市政府). The keyword determination will be explained further in Section 2.3.

2.2 Data Cleaning

2.2.1 For the **Facebook posts**, we downloaded a single CSV file containing all of the fifteen candidate' Facebook posts using Crowdtangle. We first downloaded all the candidates' posts from 2022/02/11 to 2022/11/27. The data preprocessing and data cleaning process reduced the number of articles from 8,073 to 5,802. We deleted so many posts because our initial csv file ([FB_All_Candidates.csv](#)) also included candidates' posts from *before* they started running; these had to be deleted. We preprocessed and cleaned the data with the following steps³:

Data Pre-processing

- Rbind the dataframe with candidates another dataframe that contains more information about each candidate (e.g. Party, City, Started Running Date, English name, etc.). We collected this additional data manually. The excel sheet can be found [here](#).

³ The codes can be found in [main_code.r](#), line 22-91.

- Delete all the posts from the period before a certain candidate started running. For example, Huang Shan-shan (黃珊珊) announced that she was running for mayor on August 28, so we deleted all of her posts from 2022/02/11 until August 27. We did this for each candidate.
- Delete the posts after 2022/08/17 for candidate Lin Chih-chien (林智堅) who was replaced by Cheng Yun-peng (鄭運鵬) in Taoyuan on that day. After these first few steps, we saved the df as a new master file so these lengthy steps can be skipped in the future. See [master_candidate_posts.csv](#).

Data cleaning

- Select the important columns e.g. (Page.Name, Message, Image.Text, Description).
- Merge all the columns that may contain the candidates' posts into a single 'Content' column. The candidates' posts usually appear in the Message column. However, they may sometimes also appear in the Image.Text or Description column. By adding the contents of these columns into a single 'Content' column we can be certain we will not miss anything important.
- Clean the rows that contained 'NA's, including those that had videos or photos without text.

2.2.2 For the **news articles**, we downloaded the 4197 news articles in pdf format⁴ from 2022/02/11 to 2022/11/27. The data preprocessing and data cleaning process reduced the number of articles from 4197 to 3917. We used the following steps to preprocess and clean the data.⁵

⁴ The PDF file was the cleanest data compared to the other formats.

⁵ The codes can be found in [WiseneWS.R](#), line 13-69.

- Convert to text with the R package ‘pdftools’.
- Split text based patterns “文章編號:” and put the list into a dataframe. This pattern can be found at the end of each article so this will return a dataframe with a separate article in each row.
- Create a date column and extract the date of each article by using the publication data that is located between “|” and “網站”.
- We removed the unnecessary information (e.g. disclaimer text, links) at the start of each article by first deleting everything up to the pattern that introduces the link “文字快照”, and then by deleting everything up to the first Chinese character (because the links are in letters). This was easier than writing several regexes for different link formats.
- Remove empty rows and compressed articles. We discovered that there were several articles that had been compressed to ~150 characters. We decided to delete all of the articles that contain three periods at the end ‘. . .’ AND contain less than 200 characters. In addition we also deleted the empty rows.

2.3 Identifying Keywords For Analysis

2.3.1 Keywords for Cross-Topic Comparison

2.3.1.1 There were two important sets of keywords that were used for the analysis, with the first being the keywords for the different issues that were mentioned by the candidates on Facebook. To establish the topics, we took reference from an article by Taiwan Reporter 報導者 published on 17 November 2022. In the article, the author studied the policy

proposal of leading candidates from the six direct municipalities (嚴文廷, 2022). Through consultation and interviews with various NGOs, the author identified four key long-term issues that are most relevant and of interest to the six municipalities including public housing (社會住宅), child and infant care (幼托政策), eldercare (長照) and green transportation (綠色運輸). Taking this into consideration, we identified the following categories that we will use for the comparison - **(1) Eldercare; (2) Public Housing; (3) Fertility; (4) Transport and (5) Economy**. The last topic was added as economic issues remain an important topic that is discussed as well.

2.3.1.2 Next, we derived the keywords by taking reference to the specific terms relating to the issue or policy that are mentioned in the respective candidates' election bulletin ([選舉公報](#)), which captures both commonly-used terminologies, as well as the terms that take into account the local context (e.g. local projects or initiatives). We also added other more common terms that we have found from our observations from the candidates facebook posts when they mention the related issues. The keywords are in [Appendix C](#).

2.3.2 Keywords for Comparing Specific Policy Directions to Increase the Fertility Rate

2.3.2.1 The second set of keywords pertained to the specific policy directions or sub-topics relating to fertility that were mentioned by the candidates. In our study on fertility solutions, we conducted a keyword search using terms extracted from the policy terminology found in official government policy planning reports. The primary documents we referred to were the "Enhancing the Parenting Environment Program" (國發會, 2016) published in 2016 and the "National Care for 0-6 Years" (行政院, 2023) by the Executive Yuan (行政院) in 2023. In order to ensure comprehensive coverage, we also included keywords from the "National Together for 0-6 Years - Encouraging Youth to Marry, Embrace Parenthood" report.

2.3.2.2 Our objective in the fertility solution keyword search was to gain insights into how the Wisenews dataset and Facebook posts primarily discussed fertility solutions. Here, we had adjusted the policy categories that were originally included in the National Development Council's document from three to four. This takes into account that a keyword search using the original category may result in an overlap in posts. For example, a keyword search using the term “公托” or “托育” may results in both supply side policies to expand the number of childcare centres, as well as demand side policies such as subsidies given to the second or third child to offset the parent's childcare costs. As such, we adjusted the policy directions into four categories - **(1) Childcare; (2) Financial Aid; (3) Infertility; and (4) Workplace.** Broadly, the keywords, which are included in [Appendix D](#), cover the following issues:

- **Childcare** - Includes both supply-side targeted at expanding centre-based or home-based childcare services, and demand-side childcare subsidies for parents.
- **Financial Aid** - Includes other types of subsidies or financial incentives to encourage parenthood such as maternity allowances, contributions to future education accounts, etc.
- **Infertility** - Includes measures that are related to pregnancy and infertility such as in vitro fertilisation, egg freezing etc.
- **Workplace** - Includes measures that help to create a family-friendly workplace, such as provision of maternity and paternity leave, creating a corporate childcare and lactation room within the workplace etc.

2.3.3 Establishing the Word Cloud, Stop Words and Custom Dictionary

2.3.3.1 For the word clouds, we followed the [tutorial provided by NTNU](#). Our code uses the Jiebar package for tokenization, a stopwords list from the [stopwords-zh](#) repository (converted to traditional), and a [custom dictionary](#) that we compiled ourselves. It contains all of our keywords and other important words such as political parties. Furthermore, we also added custom stopwords that we believed not to be very informative. Firstly, words like 少子化 (ageing population) do not tell you much about what the candidates or the news think about these subjects. Secondly, common forms of address used by politicians like 市民 (residents) or names of cities are also not very informative. Thirdly, even though we conducted thorough data cleaning, some of the wisenews articles still contained words that denoted to what category the article belongs, like 經濟 (economy) or 科技 (technology); we removed these terms. Finally, every text will always include words that slipped through the stopwords list, like 今天 (today) or 指出 (point out). The full additional stop word list can be found [here](#).

3. Analysis and Findings

3.1 How frequently did the candidates mention the fertility topic?

3.1.1 In our analysis of the Facebook posts made by candidates from six municipalities using our Keywords for Cross-Topic Comparison, we discovered that the economy and transport issues were the most prominent topics, followed by fertility issues as depicted in Figure 1. This

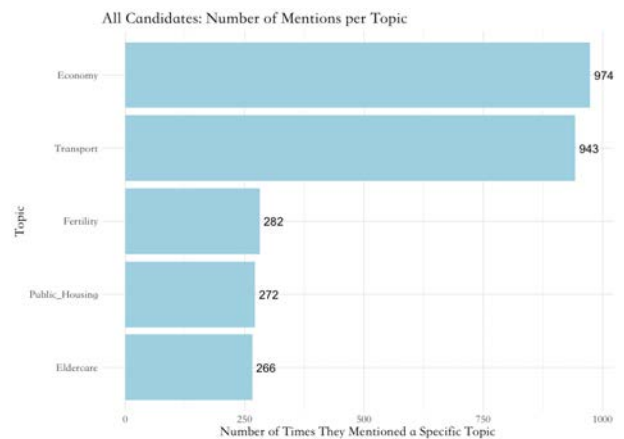


Fig. 1 All Candidate Number of Mention per Topic

finding raises an interesting observation that despite the strategic importance of the fertility problem, candidates might prioritise addressing economic and transport concerns to garner voter attention. Delving deeper into our primary focus on fertility problems, we further examined the candidates' total number of posts specifically related to this issue. As illustrated in Figure 2 and Figure 3, DPP's Taoyuan and Kaohsiung candidates Cheng Yun-peng(鄭運鵬) and Chen Chi-mai (陳其邁) ranked amongst the top three both in terms of the total number of posts and the average daily mentions, with KMT's Hou You-yi (侯友宜) ranking the lowest in both. The average daily mentions also considers the duration of a candidate's campaign.

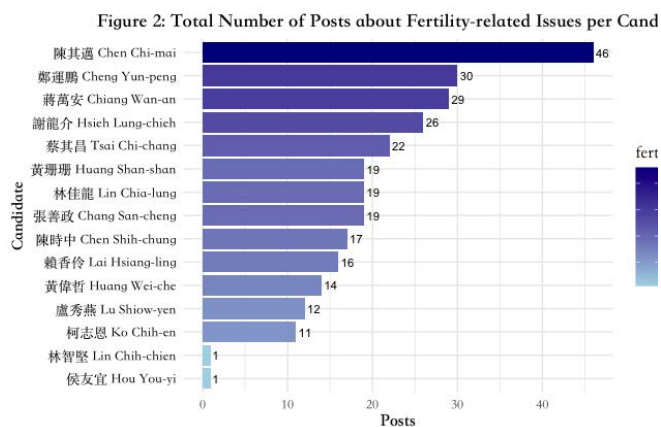


Fig. 2 Total Number of Fertility Post by Candidates

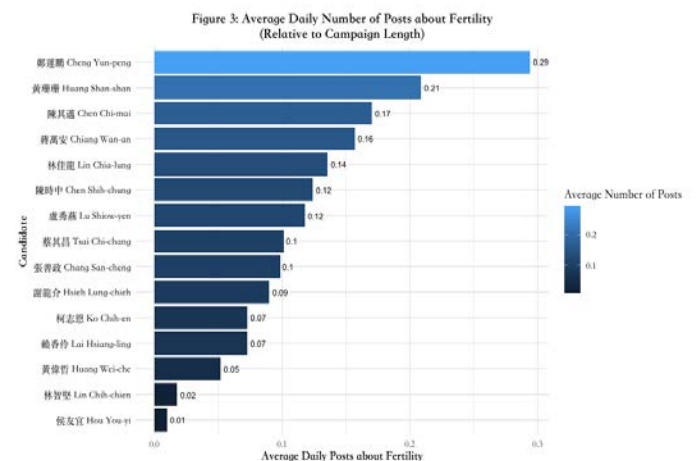


Fig. 3 Average Daily Fertility Post by Candidates

3.1.2 The ranking of **Cheng Yun-peng of Taoyuan City** can be attributed to the prominence of Taoyuan City during the 2022 elections, especially as both the incumbent DPP mayor Cheng Wen-tsan (鄭文燦) and original DPP candidate Lin Chih-chien were both

embroiled in plagiarism controversies in the lead-up to the elections. In addition to profiling the DPP Government and incumbent Taoyuan mayor's policies positively, Cheng Yun-peng often emphasises how he has received strong support from President Tsai Ing-wen (蔡英文), Vice-President Lai Ching-te (賴清德) and then-Premier Su Tseng-chang (蘇貞昌), and will continue to work for the people of Taoyuan if he is elected. Notably, pro-family and fertility-related policies were among the key issues that Cheng Yun-peng had focused on for his campaign. He often emphasised the achievements made by then-mayor Cheng Wen-tsan that had enabled Taoyuan to become the special municipality with the highest fertility rate.



Fig. 4: Emphasis of Strong Support from the DPP Top Leadership in Cheng Yun-peng's Facebook Posts



Fig. 5: Highlights of the incumbent's DPP mayor's achievements, especially fertility, was a key feature

3.1.3 In the context of Kaohsiung City, the mayoral election featured incumbent candidate **Chen Chi-mai** seeking re-election. An intriguing observation arose regarding the level of

engagement demonstrated by Chen Chi-mai in addressing the issue of fertility problems, which significantly surpassed that of his opponent, Ko Chih-en (柯志恩) from the KMT party. While Chen Chi-mai mentioned the issue numerous times, Ko Chih-en only made 11 references to fertility problems. This notable discrepancy highlights a substantial difference in the candidates' prioritisation of addressing fertility problems within their respective campaigns.

3.1.4 Figure 6 provides further insights into Chen Chi-mai's approach to the topic. One of his posts specifically highlighted the establishment of a new childcare centre and promoted the fertility allowance and policy offered in Kaohsiung City. This post stands out as a direct and explicit reference to fertility policy. In contrast, Ko Chih-en, although posting less frequently on Facebook, contributed by participating in a live stream video addressing fertility problems. This demonstrates a difference in the candidates' strategies, as Chen Chi-mai did not engage in a live show specifically dedicated to fertility policy. Additionally, it is noteworthy that Chen Chi-mai's posts often contained detailed policy information, while Ko Chih-en primarily shared her personal sentiments and emotions regarding various events.

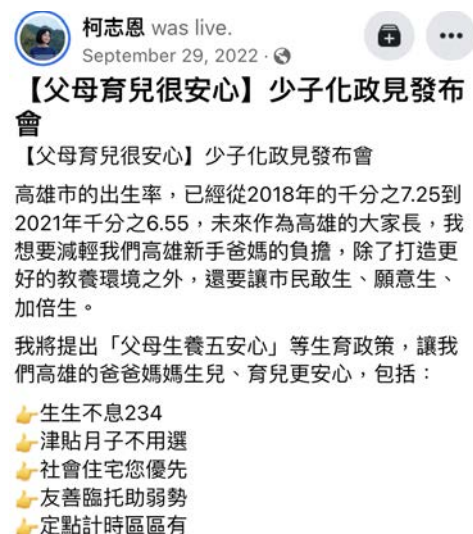
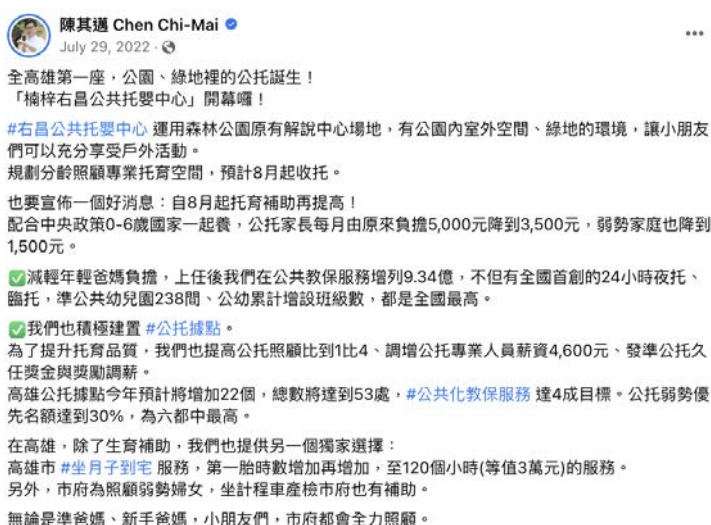


Fig. 6: Post on further insights into Chen Chi-mai and Ko Chih-en's fertility policy approach



Fig. 7: Post on family-friendly park evening attended by Hou You-yi

3.1.5 For Hou You-yi of New Taipei

City who had the least post amongst all

candidates, we observe that he was

generally not as active as the rest of the

candidates on Facebook, with his posts

usually associated with the events that

he attended, the major festivals or

incidents that occurred. Of which, the

only post that was related to family and

fertility was related to the opening of a

family-friendly park which he attended

in October 2022. As Hou had

consistently enjoyed a high rating over his

DPP candidate in the lead-up to the

elections, this could be a reason for the lower post count for Hou on Facebook, as there may

be less need to articulate the policies given his high ratings (黃韋銓, 2022).

3.2 What policy ideas did the candidates offer to solve the declining fertility problem?

3.2.1 The issue of low fertility is of significant importance, and addressing this problem requires considering various potential policies that may vary based on the background, demographics, and population situation of each city. In this study, we employed the Keywords for Comparing Sub-Topics on Fertility Policy to analyze the Facebook post data we collected. Overall, we observe that childcare-related policies were the most mentioned policies by all candidates (and in turn all cities). The exception was Tainan, where issues relating childcare and financial aid were discussed almost in the same volume.

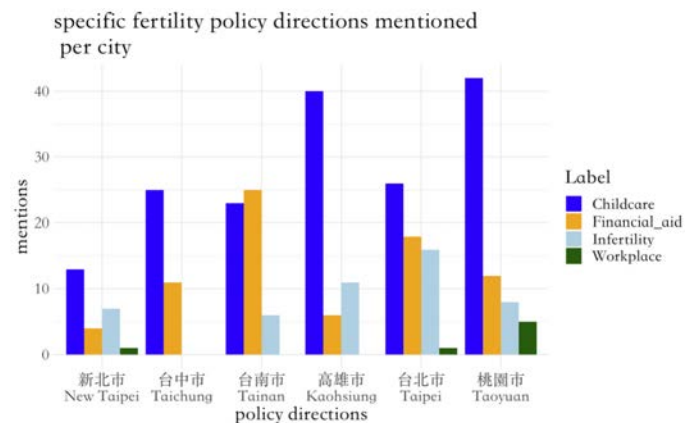


Fig. 8 Fertility Policy Post Number by City

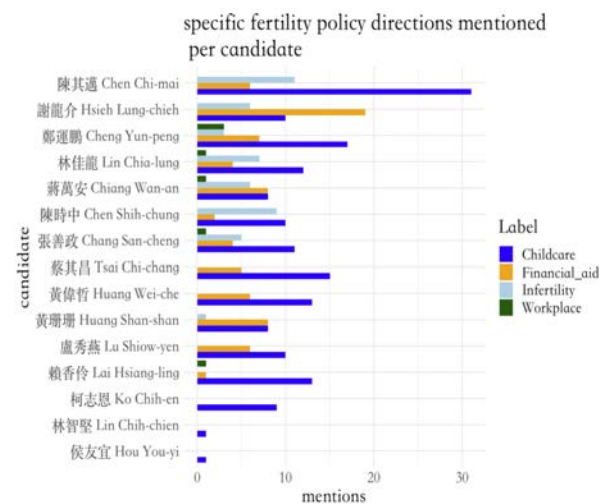


Fig. 9 Fertility Policy Mention by Candidate

3.2.2 The high mention of **childcare related policies** reflects the longstanding issue of the under supply of childcare services and high childcare costs that is prevalent in Taiwan (陳星穎, 2021). We observe that candidates have used dedicated posts to highlight the achievements and public spending towards childcare related policies that have been made over the previous term (e.g. by incumbent candidates such as Lu Shiow-yen, Chen Chi-mai, Huang Wei-che), as well as the policy plans going forward, such as increasing the ratio of public childcare services and subsidies to make the services more affordable for parents.



Fig.10 Dedicated Posts by both Incumbent Candidates (e.g. Chen Chi-mai , Lu Shioh-yen) and Contenders (e.g. Cheng Yun-peng, Lin Chia-lung, Lai Hsiang-ling, Chang San-cheng) on childcare-related policies and achievements

3.2.3 Here, we also investigated the anomaly results of findings where **financial aid** was mentioned significantly in Tainan. The focus on financial aid issues is mainly attributed by Hsieh Lung-chieh (謝龍介)'s posts, where we observed that the provision of subsidies across various issues (e.g. eldercare, education, school bento boxes, childcare, diapers) was a major policy promise that he had put out during his campaign. Emphasising how Tainan had the ageing population and the lowest birth rate amongst the six municipalities, Hsieh Lung-chieh has often criticised the incumbent DPP mayor and pushed hard to attract support from the electorate.

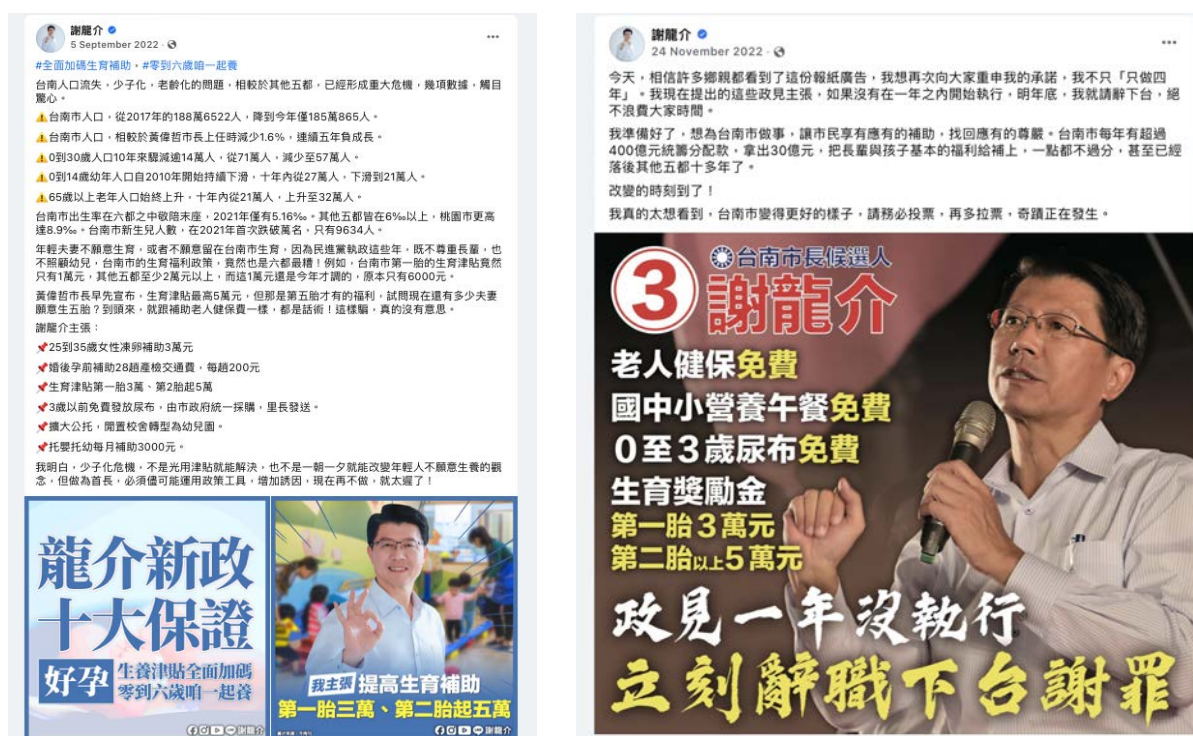


Fig. 11 Emphasis of Subsidies and the low birth rate in Tainan as a major campaign theme by KMT candidate 謝龍介

3.2.4 With regard to the categories of **infertility and workplace policy**, we observed a lower frequency of mentions compared to the aforementioned categories. One possible

explanation for this could be attributed to the limited authority of local governments in amending labor laws. This notion is supported by the [我國少子女化對策107-111年](#) (Measures to Address the Decline in Birth Rate in Taiwan, 2018-2022) report published by the Executive Yuan. According to the report, workplace policy falls under the jurisdiction of the Ministry of Labor and the Ministry of Technology, both of which are controlled by the Central Government. This may account for the relatively fewer posts related to workplace policies by candidates, as they may have limited influence in this area. Additionally, the Ministry of Health and Welfare is responsible for infertility policy, indicating that although potential fertility policies may vary, mayoral candidates have limited authority in directly promoting workplace and infertility policies, resulting in a lower number of mentions in these areas. Conversely, childcare-related policies and financial aid policies are directly linked to local governments, and candidates can more readily engage with these topics as well as allocate funding at the local government level.

3.2.5 Nonetheless, we still observe that some of the candidates have mentioned these two issues. One possible reason could potentially be related to the ageing population in Taiwan, one that may result in an increase in the incidence of infertility and hence the need for the necessary diagnosis and treatment. At the same time, women candidates such as Huang Shan-shan have also touched on the promotion of greater gender equity in Taiwan, including through implementation of paternity leave to encourage fathers to be able to take up responsibility in taking care of the children.

蔣萬安
27 July 2022 · 🌐

成功推動「#擴大不孕症人工生殖補助」初步成果出爐！

擴大不孕症補助方案上路已經滿一年，已經看到初步的成果，超過3,000名試管嬰兒出生，年底將達萬名。迎接新生兒誕生是父母最開心的時刻，對現在面臨少子化危機的臺灣，稍微鬆一口氣。

從接獲民眾陳情、調閱資料發現，每7對夫妻就有一對不孕症，一次療程費用約15至17萬元，對於一般家庭來說，是一筆不小的負擔，但過去政策只補助中低收入戶，不但成效不彰，也喪失政策催生的目的。

經過我在立法院質詢、提案，成功推動擴大不孕症人工生殖補助，只要符合要件，一般民眾也可以申請。感謝行政院從善如流採納我的方案，到目前已有4萬4,803件通過審查，2萬7,853件已完成療程，並於日前喜迎第3070名新生兒。

有媽媽私下跟我說，她一路走來，承受外人的異樣眼光，當決定接受不孕療程，接踵而來的是經濟、身體的負擔，萬一結果失敗，心理的難過跟辛酸，以前只能默默承擔，現在至少感受到政府的協助，很感謝我注意到問題，並且堅持推動衛福部放寬，讓她們可以減輕一點經濟壓力，不再只有獨自一人面對。

市民的需求，永遠是我在乎的事情，未來我將透過都市規劃，幫助新手爸媽安居，打造台北成一個讓父母安心生養的環境，除了助孕，更能安心生養，對於生產前、生產後1個月內回診的媽媽，都給予計程車費的補助。

除了既有的友善職場認證，市政府更要擴大表揚友善職場企業，期待未來在台北的職業婦女，不再有工作、小孩之間二選一的情形發生。未來還會有更多的政策要公布，還請市民朋友們拭目以待。

#萬安談政事
#安心生養友善育兒
#你加台北就是無限
#TeamTaipei
#蔣萬安

成功推動
「擴大不孕症人工生殖補助」
初步成果出爐！

舊制
2015-2021/3
誕生 7 名寶貴

新制
2021/7-2022/7
誕生 3070 名寶貴

蔣萬安

持續努力！打造
安心生養，友善育兒的台北

黃珊珊
26 October 2022 · 🌐

社福願景，就是城市對市民幸福的承諾，這是最在乎的事情。

很榮幸能參加台北市立福利聯盟的社福政策白皮書發表會，我擔任副市長時，就主政社會局相關業務，作為首都市長候選人，我必須向各位社福界的前輩，報告我對社福的未來方針。

◎長者福利上，我們更要讓長者更加健康，才能降低失能失智的風險，從根源上減輕長照的負擔。所以，我計劃興建 **#高齡運動中心**，讓長輩可以用敬老卡的點數去請年輕教練。

此外，台北地狹人稠，我們會透過都更，以及盤點空閒市有地，努力興建 **#住宿型長照機構**，例如即將展開都更的水源二三期，就會增設長照機構，去照顧社區的所有長輩。

◎青年成家的部分，除了居住正義，持續興建住宅並推動高齡換屋，我的目標是讓青年「樂婚、願生、能養」。除了給予第三胎最高3萬的生育獎勵金，幼教公共化比例提升至80%，如果抽不到公托，我們也有每年54640的學費補助。

爸媽把小孩送托，最擔心的還是小孩的安全。所以我們非常注重幼教環境與師資品質，計畫將師生比降到1:12，讓小孩有更好的照顧，也減輕老師的負擔。

◎婦女政策上，我自己就是單親職業婦女，明白育兒與工作上的拉扯，以及女性為了家庭的掙扎與犧牲。第一個，我認為台北必須要有更多平價托嬰中心，同時鼓勵民間企業讓男性育嬰留停，讓父親一起分擔親職工作。

此外，針對中高齡與身心障礙婦女，我們也會推動12區聯醫產檢無障礙空間，以及各公私立場館友善托育哺乳的環境。最後，也會繼續落實月經平權，補助國中生女性生理用品。

最後，我必須強調，社福是高度專業的產業，台灣面臨高齡少子化的挑戰，為了讓長者有尊嚴地樂活，為了讓青年揚眉吐氣，同時為了給下一代更好的未來，我希望與所有前輩一同繼續努力，我準備好了！

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#TaipeiK33PGong
#偉大市民齊步共贏

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黃珊珊

市社會福利聯盟

打針，吃排卵藥，然後取卵

陳時中 · 愛的期待 | 擴大不孕症補助，我最在乎

Like Comment Share

7K · 139 comments · 25K views

陳時中
6 November 2022 · 🌐

Overview Comments

讓政策照顧到更多需要被照顧的人，就是我最從政的初心。#擴大不孕症補助 從去年7月開始施行，至今已達32,300人獲補助，並成功誕生約4,600名寶貴，累計到今年年底，可望誕生近萬名新生兒。

許多朋友想要生孕的熱切期待，以及求子過程中的辛酸，我能理解，因為每個孩子對父母來說，都是愛的希望象徵。讓政府和我們一起來幫忙，你不必再孤單的努力。我在擔任衛福部長期間，就積極研議並推動不孕症補助，希望能實際滿足一些想要生孕，又沒有辦法達成目的的朋友。

此外，我們也針對經濟弱勢給予協助，擴大不孕症補助不排...

See more

Most relevant

Ruby Hsu Follow
哈哈，部長真的是「誠實中」...帶小孩是會有很煩和很虛心的對照時刻...就像很多爸媽形容的「天使與惡魔之間」...阿中加油，一定要當選！❤️❤️❤️
Like Reply 32w 49

2 replies

焦龍哥-陳嘉行 Follow
阿中擴大不孕症補助，他在當衛福部長時已經造福了很多家庭。❤️❤️❤️
Like Reply 32w 64

Write a comment...

Fig. 12 Mention of support for couples facing infertility problems by Chiang Wan-an and Chen Shih-chung, and advocating for greater gender equality including through paternity leave by Huang Shan-shan

3.3 How did the candidates' perception of the declining fertility issue compare to the media perceptions and discussions?

3.3.1 We compared the candidate's Facebook posts to the broader media discussions in relation to Taiwan's declining fertility rate. This can help us to better understand the underlying narratives surrounding the issue, and assess the role of media in shaping public perceptions.

3.3.2 Figures 13-17 shows the word clouds and the 20 most frequent words in the fertility-related posts by Candidates, as well as the news articles. Broadly, we can observe that the media mostly considered how Taiwan's declining fertility rate may impact different aspects of society, such as education (e.g. university closures), labour shortages, and industrial development. The candidates, however, focused more on the achievements and policies that they have put forward to address the declining fertility problem, such as expanding child and infant care services, and related subsidies. This corresponds with the observations that we have found in the previous sections on the posts by candidates.



Fig. 13 Wordcloud showing to the most common terms that are within the fertility-related Facebook posts of candidates



Fig. 14 Wordcloud showing to the most common terms that are within the fertility-related media articles

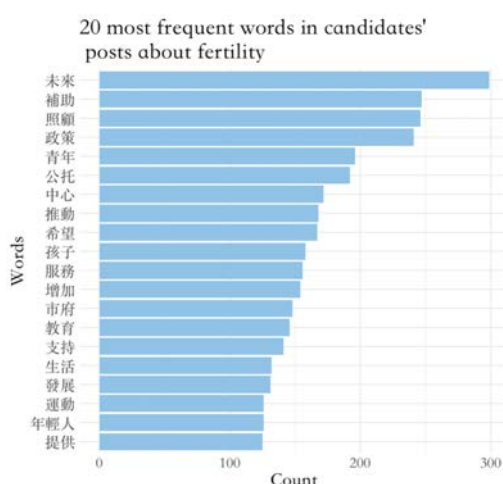


Fig. 15 Top 20 most Frequent Words on Candidate Posts

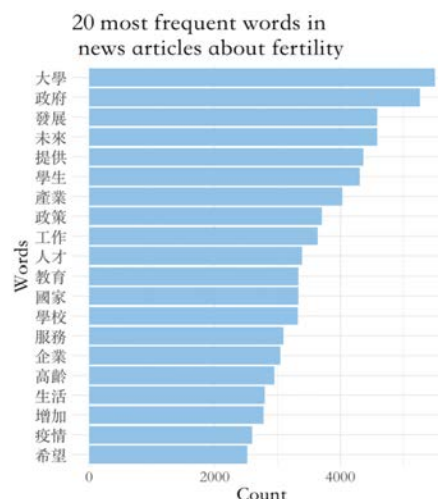


Fig. 16 Top 20 most Frequent Words in Media

Comparison of the top 20 most frequent words from the news articles and candidates' facebook posts		
1	Common words	未來、提供、希望、發展、教育、生活、增加
2	Wiseneeds articles only	Education-related: 大學、學生、學校 Industry-related: 產業、工作、人才、企業 Ageing population related: 高齡 Policy-related: 政府、政策、國家、服務 Others: 疫情
3	Candidate posts only	Target audience: 年輕人、青年、孩子 Subsidies: 補助 Care service: 公托、中心、照顧、服務、 Policy implementers or pushers: 市府、政策、推動、支持 Others: 運動

Fig. 17 Categorisation of the Top 20 Words

3.3.3 Another interesting observation that we found was that childcare policies (e.g. expansion of public infant care, providing childcare subsidies) were the most mentioned issues by both candidates on Facebook and the media. However, financial incentives (e.g.

incentives to encourage child bearing) were mentioned in the same frequency as that of child-care policies within the media. There was also a significant mention of infertility-related issues by both candidates and media.

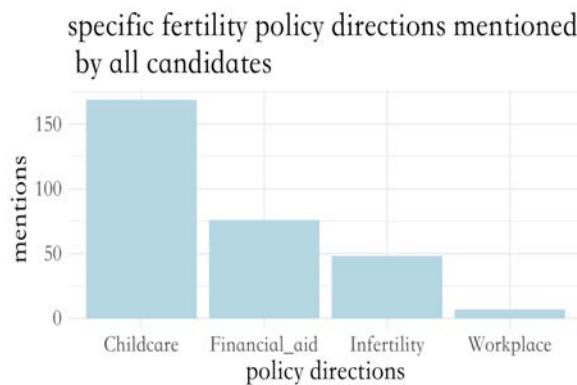


Fig. 18 Comparison of the mentions of issues within the candidates' fertility-related Facebook posts

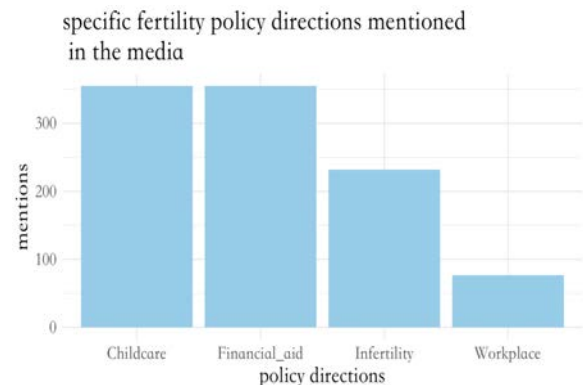


Fig. 19 Comparison of the mentions of issues within the fertility-related news articles

4. Project Limitation and Future Research Possibilities

4.1 Project Limitations

4.1.1 For consistency purposes, the project has analysed only the Facebook posts that took place during the candidature period of the individual candidates. As such, this may skew the results as some candidates may appear to have a larger quantity of policy mentions due to the fact that he/she have started the election campaign at an earlier date. Within the study, we have tried to make a fairer comparison by using the average data (e.g. average daily post by candidate) or to compare the different mentions of topics within the same candidate. Nonetheless, due to the differences in the candidature periods, there may still be a chance that we may not fully capture the complete picture of all of the policies put forth by the candidates, some of which may take place prior to the candidature announcements. Also, it is

important to remember that our analysis is limited to candidates' Facebook posts. Some candidates are more active than others, and some candidates might not put all of their policy ideas on Facebook. This research should therefore be considered as a research into how candidates engaged with the low fertility rate issue on Facebook, not in their entire campaign.

4.1.2 Due to the limitations of the keyword search, we have had to combine the keywords such as those relating to both the demand-side and supply-side policies for the childcare services so as to minimise the double-counting of results. Hence, we were unable to break down the findings into the finer categories. Also, the keyword search results were very much dependent on the qualitative research that we had done and the quality of keywords used. Here, we have tried our best to include a comprehensive list of keywords that pertain to the issues and policies analysed, nonetheless there could still be a possibility that some of the keywords may be missed out. Hence, we will need to continually update the list if we were to undertake the study over a longer term period.

4.2 Future Research Possibilities

4.2.1 There are several ways that we can further extend the research. First, we can extend the analysis beyond the six special municipalities to cover all of the entire of Taiwan. The bigger dataset could allow us to analyse the data in more ways, such as to do a comparison between urban-rural areas, or between incumbents-contenders, or even to undertake a deeper analysis into the content of the candidates vis-a-vis the political party lines. For the latter, we could even go further to look at multiple election cycles to look at the different factors that may influence the type of posts, issues and even the angling that are used by the different candidates. Second, during the poster presentation, one of the feedback that we received from the industry experts was how the data could potentially be translated into the data-driven

articles that are published. Here, we could further supplement the data with additionally qualitative information such as through interviews with the candidates to better understand their policy positions, or with experts to better understand the context behind some of the observations that we have obtained. Third, as our study had only focused on fertility-related issues, we could also do a deeper dive into some of the other issues that have not been discussed in detail, such as economy, transport and public housing, which are important issues that people in Taiwan are also concerned about today.

5. Conclusion

5.1 The project has provided insights into the discussion and proposed solutions put forth by the leading candidates of the six special municipalities in relation to the declining fertility issue faced by Taiwan. Despite the strategic importance of the declining fertility problem in Taiwan, we noted that the amount of mentions by candidates ranked lower than that of economy and transportation. Within fertility-issues, childcare-related policies received the highest mention amongst the different fertility-related policies, which also reflects the long standing nature of the issue in Taiwan.

5.2 The study has also provided additional insights to other factors that may affect how significant the issue is discussed by the various candidates, such as the role of the candidate (as the contender and incumbent), the prominence of the city during the elections (such as in the case of Taoyuan which was among the most discussed), as well as the other issues that may be discussed. We hope that the study can be useful to both (i) readers or organisations who are interested in the policies and solutions that could tackle the issue of declining fertility; (ii) readers who may be interested in understanding the social media strategies and

campaigns in candidates in Taiwan; as well as (iii) students who are interested in using data tools for policy and social media analysis.

6. Appendix

6.1 Appendix A: Initial Feasibility Study Relating to the Use of ChatGPT (3.5)

6.1.1 We tested ChatGPT (3.5) ability to assist us in our tasks and found that its accuracy was below standards. It appears that ChatGPT is unable to process long Chinese Facebook posts. We ran some manual tests with the GPT-4 web edition, which returned much more impressive results. However, we had no access to the GPT-4 API, which made large-scale, systematic testing unfeasible. We tested ChatGPT on the three different tasks outlined below:

Assessing if specific posts are about fertility or not

6.1.2 Since our initial keyword search returned some posts that were actually unrelated to fertility, we decided to test if ChatGPT would be able to verify if posts were actually related to fertility or not. Because we could not rely on ChatGPT to do this task for us. We ended up taking out the word 孕育 and 育 because they returned too many results that were not related to our topic.

Manually labelled: 105 Accuracy: 0.514

Prompt:

```
"system", content = "you are a researcher that judges whether a bunch of posts mention a certain topic. You only respond with 1 and 0"),
"user", content = paste0("judge wether the following posts are related to the eageing population, childbirth, policies related to small children
or any other policies aimed at creating a better environment to raise children, like subsidies or improved daycare.
if yes, give me 1. if it is completely unrelated. give me 0. do not give me anything else.

this is the post:" , fertcheck$message[i]))
```

Finding relevant importance vis-a-vis other topics

6.1.3 We used the same five categories as we employed in the report above and added the category 'other'. We then asked ChatGPT to conduct text classification.

Manually labelled: 106

Accuracy: 0.481

Prompt:

```
"system", content = "you are a researcher that does text classification in facebook posts related to the elections, you only respond with numbers"),
"user", content = paste0("categorize the following posts based on the following labels only give me the numbers. if there are multiple labels,
note it like this 1, 3, 5
'社會住宅': '1' anything related to public housing or making housing more affordable
'幼托政策': '2' anything related to creating a better environment for little children and ideas
that aim to boost the birth rate by encouraging people to have kids (subsidies, medical treatments, etc.)
'長照政策': '3', anything related to care for the elderly
'運輸': '4', anything related to transportation (public transport, but also traffic)
'經濟發展': '5', anything related to companies that are trying
'other': '6' literally anything else. this is the post:" , topics_df$Message[1]))
```

Differentiating between different specific policy directions

6.1.4 *Disclaimer: At the start of this project we initially settled upon three other labels to further analyse the specific policy directions. We decided to change these into four different labels later in the project and decided not to do a manual labelling again because we are already certain that ChatGPT's results would not be good enough to use. Nevertheless, we still decided to include this test with ChatGPT because it may be useful for others who wish to use it for similar purposes.*

6.1.5 After an elaborate review of government websites we set upon the following three policy directions. These are in line with the policy directions that the government uses. This appeared to be the most difficult task for ChatGPT to solve because there is some overlap between policies. We tried several different prompts but none of them yielded any proper results.

Manually labelled: 90

Accuracy: 0.233

Prompt:

```

"system", content = "you are a researcher that does text classification in facebook posts related to 生育率. you only answer with numbers"),
"user", content = paste0("what kind of policy direction does the following post offer to solve the problem.

label 1 友善職場: examples include: 安胎假、產檢假, 產假、陪產假, 育嬰留職停薪, 家庭照顧假, 企業托育設施或措施。

label 2 經濟支持: examples include: 妊娠生產醫療給付, 各類保險生育給付, 地方政府生育津貼, 地方政府低收入戶生, 育補助+
育嬰留職停薪津貼, 就業者家庭部分托育, 費用補助, 特殊境遇家庭兒童托育津貼補助,
未就業家庭育兒津貼, 幼兒學前特別扣除額, 中低收入戶幼兒就學補助+
5 歲幼兒免, 學費就學補助, 兒童與少年未來教育及發展帳戶(0~未滿 18 歲), 特殊境遇家庭子女生活津貼補助(0-15 歲以下),
弱勢家庭兒童及少年緊急生活扶助(0~未滿 18 歲)+
弱勢兒童及少年生活扶助, 3 歲以下兒童醫療補助, 發展遲緩兒童療育及交通費補助發展, 中低收入戶兒童及少年健保費補助(0~未滿 18 歲)。

label 3 教保環境: examples include : 孕產婦關懷中心, 產前健康檢查, 公立幼兒園、非營利幼兒園, 公私協力托嬰中心, 托育資源中心, 居家式托育服務,
兒童預防保健服務(0~未滿 7 歲), 收出養媒合及寄養安置, 兒童三級預防措施、防治兒虐事件。

label 4: other: anything else

label 5 no specific policy mentioned: only mentions the problem of 少子化 but does not offer a specific solution
only answer the right numbers, like this: 1. if there are two labels give me something like: 2, 3. do not write anything else.
this is the post:", fertsolutions$message[i]))

```

Costs

6.1.6 We ended up making 485 requests. This cost us \$1.33. If we had used the GPT4-8k api these costs would have been multiplied by 15 (\$19.95). We would need to make a total of roughly 6300 requests in order to label all of the data in our dataset. This means that using ChatGPT for the whole project would have cost \$15.96. GPT4-8k would have cost \$259.

Conclusion

6.1.7 It appears that ChatGPT (3.5) is unable to perform reliable classification tasks on long Chinese texts. GPT4 will likely perform better but the costs are simply not worth it. It may be better to rely on more reliable, faster, and cheaper models like BERT.

6.2 Appendix B: Candidature Periods for Candidates

SN	Municipality	Party	Candidate	English Name	Date Started Running
1	Taipei	KMT	蔣萬安	Chiang Wan-an	26-05-2022
2	Taipei	INDP	黃珊珊	Huang Shan-shan	28-08-2022
3	Taipei	DPP	陳時中	Chen Shih-chung	13-07-2022
4	New Taipei	DPP	林佳龍	Lin Chia-lung	10-07-2022
5	New Taipei	KMT	侯友宜	Hou You-yi	17-08-2022
6	Taoyuan	KMT	張善政	Chang San-cheng	18-05-2022
7	Taoyuan	DPP	林智堅*	Lin Chih-chien*	22-06-2022
8	Taoyuan	DPP	鄭運鵬	Cheng Yun-peng	17-08-2022
9	Taoyuan	TPP	賴香伶	Lai Hsiang-ling	21-04-2022
10	Taichung	KMT	盧秀燕	Lu Shiow-yen	17-08-2022
11	Taichung	DPP	蔡其昌	Tsai Chi-chang	24-04-2022
12	Tainan	DPP	黃偉哲	Huang Wei-che	02-03-2022
13	Tainan	KMT	謝龍介	Hsieh Lung-chieh	11-02-2022
14	Kaohsiung	DPP	陳其邁	Chen Chi-mai	02-03-2022
15	Kaohsiung	KMT	柯志恩	Ko Chih-en	29-06-2022

* Cheng Yun-peng replaced Lin Chih-chien as DPP's mayoral candidate for Taoyuan before the elections. As such, we have only taken Lin Chih-chien's posts during the period of running.

6.3 Appendix C: Keywords used for comparison of fertility with other issues

SN	Category
1	keywords_Eldercare <- c("銀髮族", "長照", "在地安老", "在地老化", "不老城", "重陽敬老金", "老人健保", "無障礙公車", "日照", "銀髮樂活", "敬老卡", "高齡運動")
2	keywords_Public_Housing <- c("居住正義", "社會住宅", "社宅", "租屋", "青銀共居", "捷運社宅", "台中好宅", "老屋翻新", "包租代管", "囤房特別稅", "社宅")
3	keywords_Fertility <- c("少子化", "生育率", "生育", "生孩子", "懷孕", "育兒", "育嬰", "新生兒", "托嬰", "公托", "臨托", "產檢安胎假", "陪產假", "產檢假", "育嬰留職停薪", "生理假", "企業托育", "聯合托育", "企業哺乳室", "生育獎勵", "嬰兒補助", "育兒津貼", "育兒補助", "生養津貼", "生養補助", "生育津貼", "生育補助", "育嬰留職停薪津貼", "就學補助", "就寫津貼", "幼兒學前特別扣除額", "免學費", "育嬰留職停薪津貼", "未來教育及發展帳戶", "公托", "公幼", "托育", "收托", "送托", "托嬰", "夜托", "臨托", "教保服務", "教保人員", "社區保母", "在校安親班", "準公共機制", "平價就學場域", "平價名額", "兒童預防保健服務0-未滿 7 歲", "收出養媒合", "養安置", "兒童三級預防措施", "防治兒虐事件", "懷孕以及孕婦相關", "不孕症", "試管嬰兒", "不孕夫", "凍卵", "坐月子", "產檢", "孕產婦關懷中心", "產前健康檢查")
4	keywords_Transport <-c("鐵路", "鐵路地下化", "Youbike", "YouBike", "捷運", "腳踏車", "自行車", "公車", "車禍", "幸福里程", "通勤", "大眾運輸", "步行", "國道", "客運轉運站", "公車", "交通", "運輸套票", "智慧交通", "機車路權", "軌道捷運", "iBike", "幹道", "輕軌", "台中大環", "鬧道", "不塞車", "Tbike", "人行道", "電動公車", "自行車質量", "聯外道路", "人行安全", "行人安全", "人性化路牌", "智慧街道", "四橫三路", "道路壅塞", "外環道路", "鐵路立體化", "行人地獄")

5	keywords_Economy<- c("智慧城市", "製造業", "產業", "物流", "金融", "科技", "引擎", "醫材", "工業4.0", "數位升級", "智慧升級", "創業", "數位新科技", "在地工作", "產業帶", "轉型", "新創轉型", "都心發展", "機能區", "藍色經濟圈", "海洋經濟", "海空雙港", "低碳產業", "產業高值化", "觀光", "旅客", "旅行社", "商圈", "招商引資", "拼經濟", "產業園區", "中科2.0", "新苗計劃", "創業孵化器", "航空城", "產學訓用", "青創基地", "高科技產業", "優質就業", "國際廠商", "高階製造中心")
---	---

6.4 Appendix D: Keywords used for comparison of sub-topics relating to fertility

SN	Category
1	keywords_Workplace <- ("安胎假 陪產假 產檢假 育嬰留職停薪 生理假 企業托育 聯合托育 企業哺乳室")
2	keywords_Financial Aid <- ("生育獎勵 嬰兒補助 育兒津貼 育兒補助 生養津貼 生養補助 生育津貼 生育補助 育嬰留職停薪津貼 就學補助 就寫津貼 幼兒學前特別扣除額 免學費 育嬰留職停薪津貼 未來教育及發展帳戶")
3	keywords_Childcare <- ("公托 公幼 托育 收托 送托 托嬰 夜托 臨托 教保服務 教保人員 社區保母 在校安親班 準公共機制 平價就學場域 平價名額 兒童預防保健服務0-未滿 7 歲 收出養媒合 養安置 兒童三級預防措施 防治兒虐事件")
4	keywords_Infertility <- (懷孕以及孕婦相關 不孕症 試管嬰兒 不孕夫 凍卵 坐月子 產檢 孕產婦關懷中心 產前健康檢查)

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