Impacts of Third-Party Entry to a Polarized Two-Party Political System: A Structural Analysis of Taiwan General Elections[*]

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Abstract

Leveraging both voting and polling data and employing estimation methods similar to Petrin (2002) and Berry et al. (2004), we estimate a discrete choice model to examine the impacts of third-party entry in the 2024 Taiwan presidential election. We find that such entry exacerbated political polarization because it strengthened the two major parties' incentives to further polarize. First, a stronger competitor (the third party) for central voters makes each major party's effort to gain such voters less effective; second, each major party would become less worried that its further polarization would shift all its central voters to the other major party because these voters would be split by the third party. Additional analyses show that for the third party, the help obtained from strategically adjusting its ideological position is limited because moving toward either side will make gaining voters on one side and losing voters on the other side offset each other. Ko's (the third-party leader) endorsement of Democratic Progressive Party (DPP) has little effect on voters' perceptions of DPP's ideological position, whereas Ko's endorsement of Kuomintang can substantially alter voters' perceptions of Kuomintang's ideological position. In contrast, through his endorsement, Ko's nonideological effect can be substantially transmitted to DPP but not to Kuomintang.

Keywords: Entry, Political Duopoly, Third Party, Political Polarization, Vote, Alliance, Endorsement, Two-Party System

JEL Codes: D72, D74, L1, L2, P16

[*] The result in this paper is generated from econometric models fed with publicly available data. It does not necessarily represent the author's stance.

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"The time is basically ripe for a third-party challenge, and, largely, the reason is because of the level of polarization in American politics."

— Bernard Tamas, author of *The Demise and Rebirth of American Third Parties*

1. Introduction

Many countries in the free world with a two-party political system have recently experienced a trend of increasingly intense partisan polarization. Political polarization within a country usually results in a divided society, isolated groups, an inefficiently squabbling Congress, and a restrained government. It is of great importance to reunite a divided society, heal breaches among isolated groups, accelerate Congress's ability to reach a consensus, and improve governmental efficiency for any such country in the free world, especially in an era with crucial threats coming from authoritarian regimes.

In this context, could the entry of a third party be a cure for political polarization? Aside from being labeled as a spoiler, could a third party perform as an effective alternative to the two dominant parties for central voters? Could third-party entry mitigate the two dominant parties' incentives to move toward polarization and essentially alter the two parties' political stances? Could a seemingly viable third party generate long-term impacts instead of being short-lived after achieving limited success? These open questions are of interest to not only academics but also practitioners working within the political battlefield.

In this study, we examine the impacts of a seemingly viable third-party entry in the 2024 Taiwan general election. Taiwan plays the most critical role in the relationship between the U.S. and China, the two largest economies in the world. Meanwhile, as the home of Taiwan Semiconductor Manufacturing Co., Ltd., Taiwan serves as the most important link in the supply chain of the semiconductor and AI industries. Moreover, Taiwan shares the same language and culture as Mainland China, with a population of 1.4 billion people. The performance of the modern democratic system in Taiwan will substantially affect the Chinese mainland people's perception and comprehension of universal values and shed light on Mainland China's potential further reform and

opening-up. Therefore, studying Taiwan's presidential elections is important.

Before 2024, the general elections in Taiwan were dominated by two parties: Kuomintang (KMT, with blue as the party color) and Democratic Progressive Party (DPP, with green as the party color). DPP unequivocally advocates Taiwanese nationalism, firmly opposes the notion of "One China," and actively promotes the increase in military expenditures to prevent military intimidation from the People's Republic of China (PRC). In contrast, KMT opposes irritating the PRC government and favors strategically maintaining a peaceful relationship with China to promote economic growth in Taiwan.

Taiwan People's Party (TPP, with white as the party color) was founded in 2019 and is currently the third-largest party in Taiwan. It is considered a rising third force in Taiwan's political system and seeks to "become an alternative" to both the Pan-Green Coalition headed by DPP and the Pan-Blue Coalition headed by KMT. TPP argues that under the previous two-party political system, regardless of which of DDP and KMT was in office, the two dominant parties were keen on manipulating the green-blue ideologies, splitting the society, and stirring up hatred, which essentially sacrificed Taiwan people's interest in their own parties' interest. TPP advocates that Taiwan ought to step out of the mud of the green-blue ideologies and have a rational, pragmatic, and scientific government. In the 2024 presidential election, TPP obtained 26.46% of the popular votes, compared to 40.05% for DDP and 33.49% for KMT. The election outcome indicates that Taiwan is no longer dominated by the two major parties.

Although it is commonly believed that a viable third-party entry would mitigate political polarization, we find that such entry in fact can exacerbate political polarization by increasing the two major parties' incentives to further polarize. First, a stronger competitor (the third party) for central voters makes a major party's effort to gain such voters less effective. Second, each major party would become less worried that its further polarization would give away all of its central voters to the other major party because these voters would be split by the third party.

We first estimate a discrete choice mode of voters' voting decisions to recover the

two major parties' ideological positions in the 2020 and 2024 presidential elections. We leverage both voting and polling (survey) data and employ methods similar to Petrin (2002) and Berry et al. (2004, micro-BLP) for the structural estimation. We find that the ideological gap between the two major parties was enlarged in 2024 with the third-party entry compared to that in 2020 without the entry. However, the enlarged gap may be caused by other differences between 2020 and 2024 instead of the third-party entry. Therefore, based on the structural estimates obtained from the 2024 data, we conduct the counterfactual analyses for the scenario of no third-party entry in 2024. We find that the third-party entry can increase the two major parties' incentives to further polarize, which can at least partially explain the enlarged ideological gap in 2024.

Moreover, we find that for the third party, the help obtained from strategically adjusting its ideological position is limited. If TPP moves toward the green (blue) side, then gaining green (blue) voters and losing blue (green) voters will offset each other, making the total changes in its vote share limited. Therefore, an appropriate strategy for the third party to win an election in the future may be to focus on enhancing dimensions other than the ideological dimension, which fundamentally distinguishes it from the two major parties. We also find that although the third party cannot make itself win the election through adjusting its ideological position, it can "determine" which of the two dominant parties will win the election. The reason is that TPP can absorb green voters from DPP (blue voters from KMT) and return blue voters to KMT (green voters to DPP) by moving toward the green (blue) side in the ideological dimension. Therefore, TPP has the potential to act as a disrupter. Our counterfactual analyses indicate that if TPP had not entered the 2024 presidential election, instead of DPP winning the election, KMT would have marginally won.

In addition, we examine how voters' preferences would have changed if TPP and KMT successfully formed an alliance before presidential candidate registration or if TPP endorsed one major party before the election. In mid-November 2023, KMT and TPP reached a consensus to form a "blue-white alliance" and split the president, vice-president, and officials in the central government. However, the potential "blue-white

alliance" officially broke down at the deadline for presidential candidate registration. After registration, KMT continued to seek TPP's endorsement before the election. KMT publicly announced that if elected, it would set up a coalition government and appoint the premier, vice-premier, and other officials jointly with TPP.[1] However, by election day, the TPP candidate had not publicly announced that he would endorse the KMT candidate.

We find that regardless of which party's leader within the alliance ran as the presidential candidate and which one ran as the vice-presidential candidate, Ko (the third-party leader) could influence the perceived ideology of the alliance by a fraction greater than 80%, while approximately 60% of Ko's valence in the nonideological dimension could be transmitted to the alliance. Location-level shocks to voters' preference toward Ko would play no role in location-level shocks to voters' preference toward the alliance. The reason is that KMT has strong local factions, whereas TPP heavily relies on online propaganda (referred to as "air forces") and does not have many local organizations (referred to as "ground troops") to serve local voters.

Alternatively, Ko's endorsement of the green candidate could have little effect on the green candidate's ideological position as perceived by voters, whereas Ko's endorsement of the blue candidate could substantially alter voters' perception of the blue candidate's ideological position. In contrast, through his endorsement, Ko's valence in the nonideological dimension could be substantially transmitted to the green candidate but could not be transmitted to the blue candidate.

Our study links two distinct strands of literature. One end of the link is the political economy literature on voting. Existing studies have structurally examined voters' voting behavior either in two-party political systems (e.g., Kawai et al., 2021; Kawai and Sunada, 2022; Shachar and Nalebuff, 1999; Gordon and Hartmann, 2013; Degan and Merlo, 2011; Waldfogel, 2023) or in multiparty political systems (e.g., Rekkas, 2007; Montero, 2016; Merlo and de Paula, 2017; Ujhelyi et al., 2021; Iaryczower et al., 2022). However, little research has structurally examined the impacts

[1] Taiwan has a semi-presidential system: the president is elected by people; the premier (head of Executive Yuan) is nominated by the president.

of third-party entry to a two-party political system. There is reduced-form research on the influence of third-party entry on voters' decisions and election outcomes (turnout and vote shares of incumbent parties), such as Pons and Tricaud (2018) and Hillygus (2007). In contrast, we examine the impact of third-party entry on incumbent major parties' choices of ideological positions.

The other end of the link is the industrial organization literature on entry, competition, and product differentiation. Many studies examined entries by firms into either a market, a product line, an industry, or a country.[2] However, little research has examined entries by a third political party to a two-party political system (political duopoly). Examining whether a third-party entry into a political duopoly would mitigate political polarization is, in some sense, an analog of analyzing whether a firm entry would reduce product differentiation, but the involved mechanisms are different.

Whether firm entry or rises in market competitiveness will increase product differentiation remains an open question in the industrial organization literature because firms' product differentiation is determined by two competing forces: the market-share effect and the market-power effect. The former effect induces firms to move closer to their competitors to capture more consumers (Hotelling, 1929), leading to minimum differentiation. The second effect prompts firms to move away from their competitors to soften price competition (d'Aspremont et al., 1979; Economides, 1986), thereby causing maximum differentiation.[3]

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[2] For example, Jia (2008), Goolsbee and Syverson (2008), Prince and Simon (2015), Ma (2019), and Sweeting et al. (2020).

[3] Theoretical studies did not reach a consensus on which effect dominates the other. Such domination depends crucially on the particular assumptions of the model. For example, the first effect can dominate if consumers are sufficiently heterogeneous in terms of their taste parameter (de Palma et al., 1985) or have a nonuniform distribution (Eaton and Lipsey, 1975); in contrast, Smithies (1941) and Eaton (1972) showed that the assumption of inelastic demand can make the second effect dominate. Several theoretical studies examined differentiation in multiple dimensions and found that firms maximally differentiate on one dimension (that from which customers derive the most utility), while minimally differentiating on the others (e.g., Ben-Akiva et al., 1989; Irmen and Thisse, 1998; Tabuchi, 1994; Ansari, 1998). Empirical research also provided mixed results. Some empirical studies found that entries or increases in competition lead to more product differentiation (e.g., Prince and Simon (2015) on airline on-time performance; Netz and Taylor (2002) on the spatial differentiation of gasoline stations; Kerkhof (2024) on content differentiation among YouTube channels). Other empirical studies found that entries or increases in competition reduce product differentiation (e.g., Borenstein

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This study also contributes to the literature on political polarization. Existing research in political science and economics has explored a variety of causes of political polarization, such as social media (Gentzkow and Shapiro, 2011), individual donors (Barber, 2016; Waldfogel, 2023), political action committees (Bonica, 2013), gerrymandering (McCarty et al., 2009), primary voters (Kujala, 2020; McGhee et al., 2014), and college experience (Strother et al., 2021). In contrast, we examine whether third-party entry can mitigate political polarization in a two-party system.

Our study is also related to the literature that extended the traditional Berry et al. (1995) (BLP for short) model, a seminal method widely used in the empirical industrial organization literature to estimate consumer demand for differentiated products.[4] Our study is not the first to apply the BLP framework in analyzing voters' choices. However, we find new patterns and interpretations of the unobserved random preference shocks at the location-choice level (ξ) in voting contexts. In typical industrial organization

and Netz (1999) and Salvanes et al. (1997) on the departure-time differentiation of airlines; Pinske and Slade (1998) on the spatial differentiation of gasoline stations; Stavins (1995) on personal computers; Goolsbee and Petrin (2004) on cable television).

[4] To name a few, Berry et al. (2004) derived the asymptotic property for the BLP model. Nevo (2000a, 2000b, 2001) extended the BLP model to include brand dummies. Dube et al. (2012) developed a new computational algorithm for implementing the BLP estimator (a mathematical program with equilibrium constraints, known as MPEC). Petrin (2002) and Berry et al. (2004) combined market share data with microlevel consumer survey data to estimate demand for differentiated products (known as micro-BLP). Fan (2013) and Eizenberg (2014) extended the BLP model to allow for endogenous product attributes. Gentzkow (2007) and Berry and Jia (2010) allowed dependence between taste parameters. Goeree (2008) allowed that different consumers have different choice sets. Lu et al. (2019) allowed for nonparametric specification of preference heterogeneity. Gandhi et al. (2022) allowed for products with zero sales in the data. Ma (2024) extended the BLP framework to financial markets and allowed that different consumers with different demographic characteristics face different prices for the same product (individual-risk-based pricing).

contexts, the ξ in the BLP framework is supposed to capture unobserved product characteristics and market-product-specific demand shocks. In contrast, we find that the ξ in voting contexts essentially capture the power of a party's local factions and local organizations. The cross-location variation in the third party TPP's ξ is substantially smaller than that of the two major parties' ξ. The reason is that compared to the two major parties, the newly established third party lacks a strong local party branch system at the grassroots level (referred to as "ground troops") and hence heavily relies on online propaganda (referred to as "air forces"). Moreover, we find that if TPP forms an alliance with or endorses KMT (a party with strong local factions), then TPP's ξ could hardly be transmitted to the alliance or KMT, respectively.

The rest of the paper is organized as follows. Section 2 introduces the background of the political system in Taiwan. Section 3 describes the data. In Section 4, we develop the structural model, estimation procedure, and identification strategies. Section 5 presents the estimation results. Section 6 examines whether the green and blue parties became less polarized in the 2024 election with the entry by TPP than in the 2020 election without the entry by TPP and whether the two major parties' incentives to move toward polarization were mitigated by TPP's entry. Section 7 analyzes the benefits for the third party (TPP) to move toward the green or blue side in the ideological dimension. Section 8 analyzes a counterfactual scenario in which there was no entry by TPP in the 2024 election. Section 9 examines how voters' preferences would have changed if TPP and KMT successfully formed an alliance before presidential candidate registration, while Section 10 examines how voters' preferences would have changed if the TPP candidate endorsed the green party candidate or the blue party candidate before the election. Then, we conclude in Section 11.

2. Background

2.1. Democratic Progressive Party and Pan-Green Coalition

DPP won the 2000 presidential election of Taiwan, ending 91 years of KMT rule in the Republic of China (ROC). Thereafter, DPP was the ruling party in Taiwan from 2000

to 2008 and from 2016 to the present. The party unequivocally advocates Taiwanese nationalism, firmly opposes the notion of “One China,” and actively promotes the increase in military expenditures to prevent military intimidation from the PRC. DPP is considered to represent the interests of Island Taiwanese more than that of Mainland Taiwanese.[5] The party is frequently accused by the PRC government of being a primary force in Taiwan that aims to “prevent the Chinese nation from achieving complete reunification" and "halt the process of national rejuvenation.” As the party color of DPP is green, DPP and other parties sharing similar ideologies and political positions (e.g., Taiwan Solidarity Union) are referred to as the Pan-Green Coalition, with DPP as the dominant party.

2.2. Kuomintang and Pan-Blue Coalition

KMT was the ruling party in Taiwan before 2000 and from 2008-2016. While supporting the maintenance of the present status quo and rejecting immediate unification with Mainland China, KMT opposes irritating the PRC government and favors strategically maintaining a peaceful relationship with Mainland China to promote economic growth in Taiwan. KMT is considered to represent the interests of Mainland Taiwanese more than those of Island Taiwanese. KMT is frequently accused by DPP of “selling out Taiwan to the PRC.” As the party color of KMT is blue, KMT and other parties that share similar ideologies and political positions (e.g., People First Party and New Party) are referred to as the Pan-Blue Coalition, with KMT as the dominant party.

2.3. Taiwan People's Party and its founder Wen-je Ko

Taiwan People's Party is currently the third largest party in Taiwan and is considered a rising third force in Taiwan’s political system. The party was founded by Wen-je Ko in

[5] Mainland Taiwanese include people who migrated to Taiwan in 1949 with the failing of the KMT government in Mainland China and their later generations. In contrast, Island Taiwanese include people who had been living in Taiwan before 1949 and their later generations. Mainland Taiwanese and Island Taiwanese are becoming less divided among young generations.

2019 and seeks to "become an alternative" to both the Pan-Green Coalition headed by DPP and the Pan-Blue Coalition headed by KMT. The party colors are cyan and white: the color cyan signifies an end to the longtime green-blue political divide in Taiwan, and the color white represents calling for an open and transparent government.

TTP's founder and current chairperson, Wen-je Ko, is a nontypical politician in contrast to many political figures within the Pan-Green and Pan-Blue Coalitions. Before 2014, Ko was a physician at National Taiwan University Hospital and a professor at National Taiwan University College of Medicine. In both the 2014 and 2018 Taipei (capital of Taiwan) Mayoral Elections, Ko ran as an independent candidate and won the election.

In 2019, Ko established the Taiwan People's Party and was elected as the party chairperson at the founding assembly. In the 2024 Taiwan presidential election, Ko ran the campaign as the candidate nominated by TPP. As a newly established party, TPP does not possess local faction networks or mainstream media. However, given his distinct policy orientations and presentation of great personal charisma to younger generations and highly educated citizens, Ko eventually obtained 26.46% of the popular votes, compared to 40.05% for the DDP candidate and 33.49% for the KMT candidate. It was the first time since the 2000 election that the winning candidate obtained less than 50% of the votes. After the 2024 election, Ko stated that the popular vote achieved by TPP shows that Taiwan is no longer dominated by the Pan-Blue or Pan-Green coalitions.

In the early stages of his political career, Ko espoused positions closer to those of the Pan-Green coalition. He endorsed Tsai Ing-wen (the DDP candidate) in both the 2012 and 2016 presidential elections. In the 2014 Taipei Mayoral Election, DPP agreed not to put forward a candidate for the election and to support Ko as the representative of the Pan-Green Coalition, without forcing Ko to join any political party. After 2016, Ko's political stance started shifting toward the Pan-Blue coalition. Regarding Taiwan's political status, Ko is generally seen as favoring the status quo but does not explicitly

accept the 1992 Consensus as KMT does.[6] Since his term as Taipei mayor, Ko has used the wording "two sides of the Strait, one family" to express his opinion about Cross-Strait relations. Regarding economic policies, Ko supports enhancing economic and trade relations with Mainland China. In the 2018 Taipei Mayoral Election, DPP nominated its own candidate and did not endorse Ko as it did in 2014. However, Ko still narrowly won the election as an independent candidate.

Ko argues that under the previous two-party political system, regardless of which of DDP and KMT was in office, the two dominant parties were keen on manipulating the green-blue ideologies, splitting the society, and stirring up hatred, which essentially sacrificed Taiwan people's interest in their own parties' interest. Ko advocates that Taiwan ought to step out of the mud of the green-blue ideologies and turn to a solidary and harmonious society, and Taiwan's government ought to be rational, pragmatic, and scientific. Ko claims that, unlike the green and blue candidates, he is free of coercion by factions and constraint by consortiums, which enables him to appoint government officials according to their abilities instead of their green-blue ideologies. Ko argues that Taiwan ought to play a role as the bridge of communication between the U.S. and China instead of a chess piece in their confrontation.

To summarize, the entry by TPP in the 2024 presidential election has two characteristics: centrist party ideology and high candidate valence. These two characteristics could be an equilibrium outcome for a viable third-party entry to a polarized two-party system, although the emergence of such a party or politician may be exogenous. This type of entry came to the stage for the first time in Taiwan's history of direct presidential elections since 1996. On the one hand, although there are small extremist parties in Taiwan that are either bluer than KMT (such as New Party) or greener than DPP (such as Taiwan Solidarity Union), their influences are very limited and have been marginalized. A viable third party needs to be ideologically centrist to fill the large gap between the two polarized major parties. On the other hand, compared

[6] The 1992 Consensus is "one China, different interpretations." The meaning is that while both the ROC and the PRC agree that there is one China, they disagree about who is the sole legitimate representative of China (i.e., the ROC vs. the PRC).

to the two major parties, one crucial disadvantage of a new party is that it usually lacks a strong local party branch system at the grassroots level. Consequently, it has to rely on the high valence of a star candidate to effectively penetrate the two major parties' voter bases.[7]

3. Data

We obtain the district/township-level vote data from the Central Election Commission (CEC) in Taiwan. For each district in a city or each township in a county, the data include the number of votes for each candidate and the number of eligible voters. We divide the votes by the eligible voters to obtain the district/township-level vote shares for each candidate.[8] There are 368 districts/townships in Taiwan and approximately 14 million eligible voters for the 2024 election.

We also download statistical tables based on the Population and Housing Census from the Statistical Bureau of Taiwan and the Statistical Yearbook from the Ministry of the Interior. Based on these data, we construct empirical distributions of eligible voters' demographic characteristics for each district in a city and each township in a county.[9]

We also collect the polling data from my-formosa.com, which is one of the major polls in Taiwan and is operated by Formosa Publishing Co., Ltd. The sample size of each wave is above 1,000, similar to the sample size of the survey data of the American National Election Studies (970) used by Degan and Merlo (2011) examining the U.S. presidential election. Given that the population of Taiwan (approximately 23 million) is significantly smaller than that of the U.S. (approximately 330 million), the sample used should be sufficiently representative.[10] We use the data from the last wave before

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[7] See Kawai and Sunada (2022) for how candidates' valences influence voters' voting decisions in a two-party system with each party horizontally differentiated in the ideological dimension.

[8] We calculate a candidate's vote share as the ratio between the votes obtained by the candidate and the eligible voters instead of as the ratio between the votes obtained by the candidate and the total votes. The reason is that this ratio will be directly used in the estimation of the BLP-style model. The typical BLP models in the industrial organization literature require the market shares of each product and the outside option, which add up to one. The percentage of eligible voters who do not turn out is analogous to the market share of the outside option.

[9] Eligible voters in Taiwan need to be at least 20 years old.

[10] Also note that in Petrin (2002), which examined the vehicle purchase choice problem of the U.S. consumers, the data from Consumer Expenditure Survey were used to construct micro

the voting date of the election.[11] Formosa's estimated popular vote intervals based on its last wave are 38.9%~41.3%, 33.0%~36.0%, and 24.5%~27.0%, respectively, for the green, blue, and white candidates (the votes for a candidate divided by the total votes), very close to the actual outcomes on the election date (January 13, 2024), i.e., 40.05%, 33.49%, and 26.46%, respectively.

Table 1 provides descriptive statistics.

4. Structural model

In Section 4.1, we build a discrete choice model for voters' voting decisions. Then, we propose moment conditions that leverage both the voting and polling data in Section 4.2 and discuss the identification of the structural parameters in Section 4.3. In Section 4.4, we address the potential concern of strategic voting. Finally, in Section 4.5, we discuss the validity of employing a pivotal-voter model for a large-scale election.

4.1. A discrete choice model for voting

Suppose the ideological positions of DPP (green), KMT (blue), and TPP (white) are x_g, x_b, and $x_w \in R$, respectively. We normalize x_g to zero because only the distance between a pair of positions matters. Given that DPP is more liberal than KMT and that TPP's supporters are mainly central voters, we assume that $0 = x_g < x_w < x_b$.

Assume that the ideological position of a voter i is $\mu(D_i) + \eta_i$. $\mu(D_i)$ captures how a voter's ideological position in the green-blue ideological dimension varies as a function of observed individual demographic characteristics D_i, while η_i captures

moment conditions in addition to macro-BLP moment conditions. There were 2,660 observations of consumers purchasing new vehicles, of which 337 observations were of principal interest to the author's research questions (including purchasers of minivans, station wagons, sport-utility vehicles, and full-size vans).

[11] There are long-version questionnaires and short-version questionnaires. The poll with long-version questionnaires was conducted every month before the election, whereas the poll with short-version questionnaires was conducted every three days in 2023 and every two days in 2024 before the election. With January 13, 2024 as the 2024 election date, the last wave of the short version was conducted during January 11-12, 2024, and the last wave of the long version was conducted during December 20-21, 2023. For survey questions that appear in both the long and short versions, we use the last wave of the short version because it is closer to the election date. For other survey questions, we use the last wave of the long version.

unobserved demographic characteristics that are correlated with voter i's green-blue ideological position. The utility of having the green candidate in office for voter i at district/township k is as follows:

$$u_{ig} = |\mu(D_i) + \eta_i| + \varsigma_{kg} = \bar{u}_{ig} + \varsigma_{kg} \quad (4.1)$$

The term ς_{kg} is the location-level unobserved random preference shock. The utility of having the blue candidate in office for voter i at location k is as follows:

$$u_{ib} = |\mu(D_i) + \eta_i - x_b| + \varsigma_{kb} = \bar{u}_{ib} + \varsigma_{kb} \quad (4.2)$$

The utility of having the white candidate in office for voter i at location k is as follows:

$$u_{iw} = |\mu(D_i) + \eta_i - x_w| + \lambda(D_i) + \zeta_i + \varsigma_{kw} = \bar{u}_{iw} + \varsigma_{kw} \quad (4.3)$$

$\lambda(D_i)$ in equation (4.3) captures how a voter's preference toward the third party in a dimension other than the green-blue ideological dimension varies as a function of observed individual demographic characteristics D_i, while ζ_i captures unobserved demographic characteristics that are correlated with voter i's preference toward the third party. This dimension is referred to as the effect of Ko's valence, which fundamentally distinguishes TPP from the two dominant parties.

In typical consumers' product-choice problems, choosing the outside option results in the outcome of not obtaining any product in the choice set. In contrast, in voter choice problems, choosing the outside option (not to vote) still results in a certain candidate winning the election. Therefore, for a voter, the utility of having a certain candidate in office is different from the utility of voting for the candidate. Following the calculus of the voting framework (originally formulated by Downs (1957) and later developed by Tullock (1967) and Riker and Ordeshook (1968)),[12] voter i's utilities of voting for the green, blue, and white candidates and the utility of not turning out, V_{ig}, V_{ib}, V_{iw}, V_{i0}, respectively, can be expressed as follows:

$$V_{ig} = p\left(2u_{ig} - u_{ib} - u_{iw}\right) + \epsilon_{ig}$$

$$V_{ib} = p\left(2u_{ib} - u_{ig} - u_{iw}\right) + \epsilon_{ib}$$

[12] The calculus of voting model has been applied by multiple empirical studies on voting, such as Kawai et al. (2021).

$$V_{iw} = p\left(2u_{iw} - u_{ig} - u_{ib}\right) + \epsilon_{iw}$$

$$V_{i0} = \varphi + \varrho_k + \epsilon_{i0}$$

The derivation of the equations above linking the utility of voting for a candidate to the utility of having the candidate in office can be found in Appendix A. φ captures the mean cost of turning out to vote (e.g., traveling to a polling place and waiting in line) net the mean utility that a voter derives from fulfilling her civic duty of voting. ϱ_k and ϵ_{i0} represent unobserved random shocks to φ, respectively, at the location level and the individual level.[13] If voter i choose not to vote, she will save the net voting cost. ϵ_{ig}, ϵ_{ib}, and ϵ_{i0} are idiosyncratic shocks to voter i's preferences for the three voting choices. Because only the difference between the utilities of two choices matters, we can normalize V_{i0} to ϵ_{i0}, and hence we have:

$$V_{ig} = p\left(2u_{ig} - u_{ib} - u_{iw}\right) - \varphi - \varrho_k + \epsilon_{ig} \tag{4.4}$$

$$V_{ib} = p\left(2u_{ib} - u_{ig} - u_{iw}\right) - \varphi - \varrho_k + \epsilon_{ib} \tag{4.5}$$

$$V_{iw} = p\left(2u_{iw} - u_{ig} - u_{ib}\right) - \varphi - \varrho_k + \epsilon_{iw} \tag{4.6}$$

$$V_{i0} = \epsilon_{i0} \tag{4.7}$$

The idiosyncratic shocks ϵ_{ig}, ϵ_{ib}, ϵ_{iw}, and ϵ_{i0} are assumed to follow the type-I extreme value distribution to generate the logit vote probabilities.

In equations (4.4) through (4.6), p is the probability in the voter's belief that she is pivotal. It can also be broadly interpreted as the voter's perception of voting efficacy. Unlike some studies on the U.S. presidential elections in the literature (e.g., Kawai et al. 2021), we do not assume that the pivotal probability p differs across different

[13] The heterogeneity of voting costs across individuals should be small in Taiwan. Unlike the U.S. with a population density of only 96 people per square mile, Taiwan is a small area with a high population density (1,680 per square mile). It is convenient for voters to travel to their polling places. The density of polling places for the 2024 presidential election in Taiwan was 1.28 per square mile (17,795 polling places in total), compared to 0.03 per square mile for the 2016 presidential election in the U.S. Moreover, during election day, candidates' campaign teams solicit votes door to door. The voter turnout in Taiwan (74.9% for 2020 and 71.9% for 2024) is substantially higher than that in the U.S. (60.1% for 2016). Note that we do not compare Taiwan's turnout rates to the statistics for the 2020 U.S. presidential election because it was conducted during the COVID-19 pandemic.

locations within Taiwan. The reason is that the winner of the Taiwan presidential election is determined directly by the popular votes of entire Taiwan, in contrast to the Electoral College system used in the U.S.[14] If the pivotal probability is only a constant, it will be implicitly captured by the structural parameters in u_{ig}, u_{ib}, and u_{iw} and cannot be separately identified. Given that this research does not need to identify and estimate p separately from other structural parameters, we rewrite equations (4.4), (4.5), and (4.6) as follows, being aware that the effect of p on voters' choices is completely embedded in the structural parameters in u_{ig}, u_{ib}, and u_{iw}:[15]

$$V_{ig} = 2u_{ig} - u_{ib} - u_{iw} - \varphi - \varrho_k + \epsilon_{ig} \tag{4.8}$$

$$V_{ib} = 2u_{ib} - u_{ig} - u_{iw} - \varphi - \varrho_k + \epsilon_{ib} \tag{4.9}$$

$$V_{iw} = 2u_{iw} - u_{ig} - u_{ib} - \varphi - \varrho_k + \epsilon_{iw} \tag{4.10}$$

Equations (4.8) through (4.10) can be further written as follows:[16]

$$V_{ig} = 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} - \varphi + 2\varsigma_{kg} - \varsigma_{kb} - \varsigma_{kw} - \varrho_k + \epsilon_{ig}$$

$$V_{ib} = 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{iw} - \varphi + 2\varsigma_{kb} - \varsigma_{kg} - \varsigma_{kw} - \varrho_k + \epsilon_{ib}$$

$$V_{iw} = 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ig} - \varphi + 2\varsigma_{kw} - \varsigma_{kb} - \varsigma_{kg} - \varrho_k + \epsilon_{iw}$$

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[14] Under the Electoral College system, in each state of the U.S. (except Maine and Nebraska), the winner of the plurality of its constituent statewide popular vote shall receive all of that state's electors ("winner-takes-all"). The candidate who receives an absolute majority of electoral votes is then elected to office. Consequently, a voter's pivotal probability in swing states (e.g., Ohio) should be much higher than that in other states.

[15] Unlike Kawai et al. (2021), we do not explicitly assume that the pivotal probability p varies according to individual voters' demographic characteristics D_i. The reason is that $p(D_i)$ cannot be separately identified from $\mu(D_i)$ and $\lambda(D_i)$. Our research does not need to identify $p(D_i)$, as the effect of D_i on $p(D_i)$ can be captured by the parameters in $\mu(D_i)$ and $\lambda(D_i)$. Moreover, accurately estimating the pivotal probability does not necessarily lead to precisely capturing voters' voting behavior. The reason is that people can derive utility from expressing their political preferences while voting even if they know that their vote does not count (Riker and Ordeshook, 1968; Blais and Young, 1999; Frey and Stutzer, 2001). Citizens feel a moral obligation to vote because using their vote to self-express their preference is essential to the survival of democracy (Downs, 1957).

[16] For the counterfactual scenarios in which KMT and TPP form a blue-white alliance or TPP does not enter the election, we need to explicitly put p back into the equations. The reason is that these counterfactual experiments reduce the number of candidates from three to two and hence should substantially alter voters' perceived pivotal probabilities. We need to rescale the structural parameters obtained from the baseline estimation by $\frac{p_1}{p_0}$, where p_0 is the unidentified pivotal probability in the actual voting that scales the structural parameters in equations (4.8) through (4.10) and p_1 is the new pivotal probability in those counterfactual scenarios. See Sections 8 and 9 for detailed discussions. Note that allowing the pivotal probability to vary across states in the U.S., Kawai et al. (2021) normalized the pivotal probability in one state and estimated pivotal probabilities in other states.

We denote the following:

$$\xi_{kg} = 2\varsigma_{kg} - \varsigma_{kb} - \varsigma_{kw} - \varrho_k \tag{4.11}$$

$$\xi_{kb} = 2\varsigma_{kb} - \varsigma_{kg} - \varsigma_{kw} - \varrho_k \tag{4.12}$$

$$\xi_{kw} = 2\varsigma_{kw} - \varsigma_{kb} - \varsigma_{kg} - \varrho_k \tag{4.13}$$

Then, we have: [17] [18]

$$V_{ig} = 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} - \varphi + \xi_{kg} + \epsilon_{ig} = \bar{V}_{ig} + \xi_{kg} + \epsilon_{ig} \tag{4.14}$$

$$V_{ib} = 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{iw} - \varphi + \xi_{kb} + \epsilon_{ib} = \bar{V}_{ib} + \xi_{kb} + \epsilon_{ib} \tag{4.15}$$

$$V_{iw} = 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ig} - \varphi + \xi_{kw} + \epsilon_{iw} = \bar{V}_{iw} + \xi_{kw} + \epsilon_{iw} \tag{4.16}$$

Each eligible voter in 2024 faces four available choices: vote for the green, blue, or white candidate or not turn out to vote (the outside option), denoted as g, b, w, and o, respectively. Denote the choice of voter i at location k as y_{ik}. For $j \in \{g, b, w\}$,

$$Prob\{y_{ik} = j\} = \frac{exp\left(\bar{V}_{ij} + \xi_{kj}\right)}{1 + exp\left(\bar{V}_{ig} + \xi_{kg}\right) + exp(\bar{V}_{ib} + \xi_{kb}) + exp(\bar{V}_{iw} + \xi_{kw})} \tag{4.17}$$

The probability of not turning out to vote is:

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[17] The reason why we can allow that the cost of turning out to vote net the utility of fulfilling one's civic duty of voting differs across locations (i.e., allow the existence of ϱ_k) in the model is that ξ_{kg}, ξ_{kb}, and ξ_{kw} only have two degrees of freedom if without ϱ_k (without ϱ_k, $\xi_{kg} + \xi_{kb} + \xi_{kw} = 0$). However, there are three available choices besides the outside option.

[18] Our model can be extended to a nested logit distribution for the individual-level unobserved random preference shocks in equations (4.14) through (4.16). Voter i's utilities of voting for the green, blue, and white candidates and the utility of not turning out, V_{ig}, V_{ib}, V_{iw}, V_{i0}, respectively, can be expressed as follows

$$V_{ig} = 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} + \varphi + \xi_{kg} + \nu_i(\vartheta) + \vartheta\epsilon_{ig}$$
$$V_{ib} = 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{iw} + \varphi + \xi_{kb} + \nu_i(\vartheta) + \vartheta\epsilon_{ib}$$
$$V_{iw} = 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ig} + \varphi + \xi_{kw} + \nu_i(\vartheta) + \vartheta\epsilon_{iw}$$
$$V_{i0} = \epsilon_{i0}$$

ν_i is a "nested logit" random variable that is constant across voting choices and differentiates voting from the outside option (not vote). ϵ_{ij}, $j \in \{g, b, w, 0\}$ is an independently and identically distributed (across choices and individuals) "logit error." ϑ is the nested logit parameter that varies between 0 and 1. If $\vartheta = 1$, then $\nu_i(\vartheta) \equiv 0$, and the vote choice probability of a voter takes the simple multinomial logit form. If $\vartheta = 0$, then the independently and identically distributed ϵ_{ij}s have no effect. Under the nested logit assumption, we obtain similar results, which are available upon request. The estimation procedure follows Berry and Jia (2010).

$$Prob\{y_{ik} = o\} = \frac{1}{1 + exp\left(\bar{V}_{ig} + \xi_{kg}\right) + exp(\bar{V}_{ib} + \xi_{kb}) + exp(\bar{V}_{iw} + \xi_{kw})}$$

The two equations above yield individual choice probabilities.[19] The vote share for candidate j at location k is given by the following:

$$s_{jk} = \int Prob\{y_{ik} = j\}\, dF_k(D_i, \eta_i, \zeta_i) \tag{4.18}$$

where $F_k(D_i, \eta_i, \zeta_i)$ represents the cumulative density function for the joint distribution of (D_i, η_i, ζ_i).

With abuse of notation, we parametrize function $\mu(D_i)$ as a linear function in D_i with parameters μ and function $\lambda(D_i)$ as a linear function in D_i with parameters λ. Given the location-level unobserved random preference shocks $\xi_k = \{\xi_{kg}, \xi_{kb}, \xi_{kw}\}$ and the numerical values for the structural parameters $\theta = \{\mu, \lambda, \sigma_1, \sigma_2, \rho, x_b, x_w, \varphi\}$, we can simulate vote shares as follows:

$$s_{jk}(\xi_k; \theta) = \frac{1}{ns} \sum_{i=1}^{ns} \frac{exp\left(\bar{V}_{ij} + \xi_{kj}\right)}{1 + \sum_{j' \in \{g,b,w\}} exp\left(\bar{V}_{ij'} + \xi_{kj'}\right)} \tag{4.19}$$

To simulate $s_{jk}(\xi_k; \theta)$ in equation (4.19), we first randomly draw D_i, $i = 1, \ldots, ns$, from the empirical distribution of observed demographic characteristics at location k, $F_{D,k}(D)$. Next, we randomly draw e_{i1} and e_{i2}, $i = 1, \ldots, ns$, from the standard normal distribution $N(0,1)$. Then, let

$$\eta_i = e_{i1}\sigma_1 \tag{4.20}$$

---

[19] Unlike Kawai et al. (2021) that used a pivotal-voter model and assumed that voters compare utilities of voting for a candidate (V_{ij}), another group of studies used ethical-voter models and assumed that voters directly compare utilities of having a candidate in office (u_{ij}) when making discrete voting choices. This group of studies includes Rekkas (2007), Gordon and Hartmann (2013), Montero (2016), Ujhelyi et al. (2021), Iaryczower et al. (2022), and Waldfogel (2023). The probability of being pivotal was abstracted from their models. We also follow this alternative model specification and thereby the choice probability of voting for $j \in \{g, b, w\}$ is

$$Prob\{y_{ik} = j\} = \frac{exp\left(u_{ij}\right)}{1 + exp\left(u_{ig}\right) + exp(u_{ib}) + exp(u_{iw})}$$

and the choice probability of not voting is

$$Prob\{y_{ik} = o\} = \frac{1}{1 + exp\left(u_{ig}\right) + exp(u_{ib}) + exp(u_{iw})}$$

The empirical results are similar and they are available upon request.

$$\zeta_i = \left(\rho e_{i1} + \sqrt{1-\rho^2} e_{i2}\right) \sigma_2 \tag{4.21}$$

Consequently, (η_i, ζ_i) follows the bivariate normal distribution $N(0,0,\sigma_1^2,\sigma_2^2,\rho)$.

Let $s_k(\xi_k;\theta) = \{s_{jk}(\xi_k;\theta)\}_{j\in\{g,b,w\}}$ (simulated market shares) and $S_k = \{S_{jk}\}_{j\in\{g,b,w\}}$ (observed market shares in the data). Given a set of values for the structural parameters θ, the unobserved random preference shocks at the location level ξ_k can be solved from the following implicit system of equations:

$$s_k(\xi_k;\theta) = S_k \tag{4.22}$$

Based on the contraction mapping suggested by BLP, ξ_k can be numerically solved by the following iteration:

$$\xi_k^{h+1} = \xi_k^h + lnS_k - lns_k(\xi_k;\theta) \tag{4.23}$$

4.2. Moment conditions and estimation methods

Leveraging both polling (survey) and actual voting data, we construct three types of moment conditions: BLP moments, micro moments based on voters' choices, and micro moments based on voters' political positions.

Given that voting is anonymous, we cannot observe voters' demographic characteristics other than their locations. Thus, actual voting data, though accurate, are essentially aggregate-level market share data. Accordingly, we construct BLP moments based on the actual voting data. The Formosa poll asks about both voters' voting choices and their demographic characteristics and political positions. Accordingly, we construct micro moments based on the polling data. The estimation methods are similar to Petrin (2002) and Berry et al. (2004).

BLP moments

We use only one BLP moment as follows:

$$E\xi_{kj} = 0 \tag{4.24}$$

Typically, the BLP framework is employed for product markets with price as an endogenous variable. In contrast, the voting context does not have a price variable. Therefore, we do not need to find instrumental variables (IV) for endogenous prices

and construct moment conditions like $E\xi_{kj}IV_{kj} = 0$. One may argue that x_b and x_w are endogenous because candidates endogenously choose their political stances to gain more votes. However, x_b and x_w are parameters to be estimated instead of variables constructed from data.[20] [21]

Although we use only one BLP moment, the BLP procedure is important because ξ_{kj} recovered from the contraction mapping will be used to calculate micro moments to be discussed below.

Micro moments based on choices

Micro moments match predictions by the structural model to their counterparts in the polling data. The first set of moments in this type matches the average probability of voting for a candidate conditional on that the l th dimension of demographic characteristics D_{il} equals a certain value $\overline{D}_{ls}$. The moments are given by the following:

$$Prob[y_i = j | D_{il} = \overline{D}_{ls}], \qquad j \in \{g, b, w\} \tag{4.25}$$

The demographic characteristics have three dimensions, including age, gender, and education, denoted as $l = 1,2,3$, respectively. For the age dimension, $\overline{D}_{1s}$ has six possible values: 20~29, 30~39, 40~49, 50~59, 60~69, and 70+. For the gender dimension, $\overline{D}_{2s}$ has two possible values: female and male. For the education dimension, $\overline{D}_{3s}$ has four possible values: elementary, junior high, senior high, and college and above.

The second and third sets of moments in this type leverage one Formosa poll

[20] This treatment is similar in spirit to Waldfogel (2023), which fully controlled for the endogeneity of ideology by including candidate-election fixed effects. Other studies constructed ideology scores for candidates based on campaign data (Iaryczower et al., 2022) or roll call vote data (Degan and Merlo, 2011; Merlo and de Paula, 2017). Iaryczower et al. (2022) further found instrumental variables for candidates' ideology scores.

[21] Another potential endogenous variable in this context is the location-level efforts made by candidates' campaign teams, including calls, visits, advertisement expenditure, etc. However, the efforts are generally not observable at the location level. They will be captured by ξ_{kj}s (unobserved random shocks to voters' preferences). Many studies in the literature did not explicitly model candidates' efforts. Shachar and Nalebuff (1999) employed the state-level calls and visits as a proxy for the U.S. presidential candidates' efforts in campaigns. Gordon and Hartmann (2013) analyzed the effect of market-level advertising on county-level vote shares in the U.S. presidential elections. Huang and He (2021) studied candidates' spending in the U.S. House of Representatives elections instead of presidential elections.

question: "Which of the three candidates do you dislike most and would definitely not vote for?" The second set of moments matches the average probability of having the least inclination to vote for candidate j' conditional on voting for j. The moments are given by the following:

$$Prob\left[\underset{\sim}{y_i} = j' | y_i = j\ \right], j \in \{g, b, w\}, j' \in \{g, b, w\} \backslash j \tag{4.26}$$

The probability predicted by the structural model can be calculated as follows:

$$\begin{aligned} & Prob\left[\underset{\sim}{y_i} = j' | y_i = j\ \right] \\ & = \frac{exp\left(\bar{V}_{ij} + \xi_{kj}\right)}{1 + \sum_{j'' \in \{g,b,w\}} exp\left(\bar{V}_{ij''} + \xi_{kj''}\right)} \\ & \times \frac{exp\left(\bar{V}_{i,\{g,b,w\}\backslash\{j,j'\}} + \xi_{k,\{g,b,w\}\backslash\{j,j'\}}\right)}{\sum_{j'' \in \{g,b,w\}\backslash j} exp\left(\bar{V}_{ij''} + \xi_{kj''}\right)} \end{aligned} \tag{4.27}$$

The third set of moments matches the average probability of having the least inclination to vote for candidate j' conditional on turning out and the lth dimension of demographic characteristics D_{il} being equal to a certain value $\bar{D}_{ls}$. The moments are given by the following:

$$\begin{aligned} & Prob\left[\underset{\sim}{y_i} = j' | y_i \neq o \ and \ D_{il} = \bar{D}_{ls}\right] \\ & = Prob\left[\underset{\sim}{y_i} = j' | y_i \in \{g, b, w\} \backslash j' \ and \ D_{il} = \bar{D}_{ls}\right] \\ & = \sum\nolimits_{j'' \in \{g,b,w\} \backslash j'} Prob\left[\underset{\sim}{y_i} = j' | y_i = j'' \ and \ D_{il} = \bar{D}_{ls}\right] \end{aligned} \tag{4.28}$$

Micro moments based on political positions

The Formosa poll classifies respondents into nine grades representing their green-blue ideological positions based on their answers to the questions of how much they like or dislike DPP or KMT, with "grade one" representing the greenest and "grade nine" representing the bluest.[22] The Formosa poll reports the percentage of each grade in its sample. For each percentage, we can calculate the corresponding percentile of $\mu(D_i) +$

[22] Actually, the raw data of the Formosa poll code the greenest as "grade nine" and the bluest as "grade one." We recode the grades to be consistent with the direction of the green-blue ideological dimension in our model.

η_i, given a set of values for the structural parameters $\{\mu, \sigma_1\}$. Then, conditional on the lth dimension of demographic characteristics D_{il} equal to a certain value $\bar{D}_{ls}$, we can match the percentage of voters falling into grade $\mathbb{g}_{gb}$ predicted by the structural model to its counterpart in the poll.[23] The moments are given by the following:

$$Prob\left[grade_{gbi} = \mathbb{g}_{gb} | D_{il} = \bar{D}_{ls}\right],\ \mathbb{g}_{gb} \in \{1, 2, \dots, 9\} \tag{4.29}$$

Another set of moments matches the average probability of voting for a candidate conditional on that the voter falls into grade $\mathbb{g}_{gb}$. The moments are given by the following:

$$Prob\left[y_i = j \middle| grade_{gbi} = \mathbb{g}_{gb}\right], \qquad j \in \{g, b, w\}, \mathbb{g}_{gb} \in \{1, 2, \dots, 9\} \tag{4.30}$$

Similarly, the Formosa poll classifies respondents into five grades representing their favoritism for TPP based on their answers to the questions of how much they like or dislike TPP, with "grade one" representing "strongly favor" and "grade five" representing "strongly dislike." The Formosa poll reports the percentage of each grade in its sample. For each percentage, we can calculate the corresponding percentile of $\lambda(D_i) + \zeta_i$, given a set of values for the structural parameters $\{\lambda, \sigma_2\}$. Then, conditional on the lth dimension of demographic characteristics D_{il} equal to a certain value $\bar{D}_{ls}$, we can match the percentage of voters falling into grade $\mathbb{g}_w$ predicted by the structural model to its counterpart in the poll. The moments are given by the following:

$$Prob[grade_{wi} = \mathbb{g}_w | D_{il} = \bar{D}_{ls}],\ \mathbb{g}_w \in \{1, 2, 3, 4, 5\} \tag{4.31}$$

Another set of moments matches the average probability of voting for a candidate conditional on that the voter falls into grade $\mathbb{g}_w$. The moments are given by the

[23] In addition to the three dimensions of the demographic characteristics (age, gender, and education) used in choice-based micro moments (e.g., equation (4.25)), herein, we employ the location group as the fourth dimension, denoted as $\bar{D}_{ls}$. The Formosa poll groups cities and counties in Taiwan into 7 regions and provides region-level statistics for their polling data. Therefore, $\bar{D}_{ls}$ has 7 possible values. Region 1 includes New Taipei City; region 2 includes Taipei City; region 3 includes Taoyuan City, Hsinchu County, Hsinchu City, and Miaoli County; region 4 includes Taichung City, Changhua County, and Nantou County; region 5 includes Yunlin County, Chiayi County, Chiayi City, and Tainan City; region 6 includes Kaohsiung City and Pingtung County; region 7 includes Keelung City, Yilan County, Hualien County, Taitung County, Penghu County, Kinmen County, and Lienchiang County. The reason why we do not match the location-level vote shares predicted by the structural model to their counterparts in the Formosa poll for equation (4.25) is that the contraction mapping in the BLP procedure has already exactly matched the predicted ones to their counterparts in the actual voting data.

following:

$$Prob[y_i = j|grade_{wi} = \mathbb{g}_w], \qquad j \in \{g, b, w\}, \mathbb{g}_w \in \{1, 2, 3, 4, 5\} \tag{4.32}$$

The final set of moments matches the model-predicted percentage of voters falling into grade $\mathbb{g}_w$ in the dimension of the effect of Ko's valence conditional on they falling into grade $\mathbb{g}_{gb}$ in the ideological dimension to its counterpart in the poll. The moments are given by the following:

$$Prob\left[grade_{wi} = \mathbb{g}_w \middle| grade_{gbi} = \mathbb{g}_{gb}\right], \ \mathbb{g}_w \in \{1, 2, 3, 4, 5\}, \mathbb{g}_{gb} \in \{1, 2, \dots, 9\} \tag{4.33}$$

GMM

Denote the BLP and micro moments as $G_1(\theta)$ and $G_2(\theta)$, respectively. Let $G(\theta) = \begin{bmatrix} G_1(\theta) \\ G_2(\theta) \end{bmatrix}$. The structural parameters are estimated by solving the following minimization problem:

$$\min_{\theta} G(\theta)' W G(\theta) \tag{4.34}$$

4.3. Identification

The BLP moment (equation (4.24)) can identify φ. The moments in equations (4.25) can identify μ and λ.

The moments in equation (4.29) can identify σ_1; the reason is that in the green-blue ideological dimension, more voters will fall into grades at the two ends if σ_1 is greater. Similarly, the moments in equation (4.31) can identify σ_2; the reason is that in the dimension of the effect of Ko's valence, more voters will fall into grades at the two ends if σ_2 is greater. The moments represented by equation (4.26) can help identify ρ. Given that a voter votes for the white candidate, she will be more likely to most dislike the green candidate instead of the blue candidate if ρ is greater.

The moments represented by equation (4.30) can help identify x_b and x_w.

The discussion presented above provides sufficient identification for all the structural parameters in the model. Given that we have many moment conditions, our

model is overidentified. Some structural parameters can also be identified from other sources. For example, the variation in the distributions of demographic characteristics across locations and the variation in location-level vote shares of the candidates can help identify μ and λ. Equation (4.33) can help identify ρ.

4.4. Concerns about strategic voting

One underlying assumption for the structural model developed in Section 4 is that voters do not vote strategically. Strategic voting means that, for instance, voters favoring the third party and meanwhile having a strong will to unseat the ruling party may vote for KMT to concentrate the votes if they believe that the approval rate for KMT is much higher than that for the third party.

In fact, the strategic voting effect did not occur in the 2024 presidential election, though KMT advocated blue voters who support Ko to strategically vote for KMT. Ko's vote share in the election was close to the approval rates reported by many polls from several weeks to immediately before the election date. The number of popular votes for Ko in the presidential election (26.46%) was even greater than that for TPP (22.07%) in the simultaneous election of legislators-at-large, which should not suffer from the strategic voting effect.[24] TPP's party vote share in the election of legislators-at-large was also close to the party approval rates reported by many polls from several weeks to immediately before the election date.[25]

Multiple reasons contributed to the absence of a strategic voting effect in the 2024 presidential election. First, TPP strategically published its polling results, showing a higher approval rate for Ko than the polling results published by most other entities,

[24] If there was any strategic voting effect present in the election of legislators-at-large, then TPP's popular vote should be elevated by strategic voters' switching from small parties to TPP instead of being reduced by strategic voters' switching from TPP to KMT. Because a party needs to have its popular vote surpass the 5% threshold to be qualified to split the at-large seats proportionally, TPP absorbed many voters who inherently supported other small parties but desired to have some representatives in the Legislative Yuan. For example, the New Power Party obtained 7.7% of the popular vote in the 2020 election of legislators-at-large and was allocated 3 at-large seats accordingly, but it only obtained 2.6% of the popular vote in 2024 and was thus allocated zero at-large seats.

[25] There are 34 seats of legislators-at-large in the Legislative Yuan, which are split by parties according to their party vote shares in the election.

thereby making Ko's supporters believe that Ko had a chance to win. Second, on the night before the election date, TTP held a campaign rally with over 300,000 participants on Ketagalan Boulevard in front of the presidential office building in Taipei, which dramatically strengthened the supporters' belief. Third, unlike in the U.S., poll entities are prohibited by laws in Taiwan from publishing polling results during the ten days right before the election date (the blackout period on polling), which brings in some ambiguity regarding each candidate's current approval rate for voters' decision making on the election date.[26] Fourth, against KMT's advocates that blue voters supporting Ko should strategically vote for KMT, Ko's campaign team insistently urged that voters ought to truthfully express their preferences in voting. Fifth, most of Ko's supporters belong to the young generation, who care more about expressing their stances by voting (expressive voting) and are less "instrumentally rational" than the old generation. Meanwhile, young people can be easily attracted by Ko's personal charisma and follow his advocates.

Even if some blue voters who supported Ko strategically voted for KMT's candidate, we would underestimate the ideological gap between the two major parties because we would treat those voters as supporting KMT's candidate. Accordingly, given that TPP is in the middle between KMT and DPP in the ideological dimension, we need to move KMT's ideological position in the model toward the center to fit the enlarged share of voters supporting KMT. However, our estimates still indicate that the ideological gap between the two major parties ($x_b - x_g$) is larger in the 2024 election with the third-party entry than in the 2020 election without the entry.

Moreover, if KMT expected that there would be many voters strategically switching from TPP to KMT, KMT's incentive to polarize should be weaker because the third-party entry would not essentially reduce KMT's effectiveness in gaining central voters. Correspondingly, the increase in the ideological gap between the two major parties caused by a third-party entry without triggering strategic voting should be even larger than our current estimates.

[26] During the blackout period, poll entities can still conduct surveys but can only publish the poll results after the election.

In the literature, Pons and Tricaud (2018) studied elections in France and provided evidence that is inconsistent with strategic voting. Additionally, multiple survey-based studies found that the percentage of voters voting strategically rather than expressively is very small (e.g., Alvarez and Nagler, 2000; Blais et al., 2001; Hillygus, 2007; Kiewiet, 2013).

4.5. Discussions on the validity of employing a pivotal-voter framework for a large-scale election

The literature mainly has two types of theoretical models of voting: pivotal-voter models (e.g., Riker and Ordeshook, 1968; Ledyard, 1984; Palfrey and Rosenthal, 1983 & 1985) and ethical-voter models (Feddersen and Sandroni, 2006); each type has its own advantages and disadvantages; a canonical model actually does not yet exist (see discussions in Feddersen, 2004).[27] We employ a pivotal-voter framework because empirically, with certain adjustments of the interpretation of some model parameters, the disadvantages of pivotal-voter models can be overcome while some merits of ethical-voter models can be carried (e.g., voters are motivated to vote not only by their own concerns on election outcomes but also by a sense of civic duty).

While the pivotal probability is not our focus, we need to point out that one potential drawback of theoretical pivotal-voter models is that the pivotal probabilities in large-scale elections are close to zero and hence voters theoretically should not turn out given a positive voting cost. However, first, what affect voters' turnout decisions are their subjective pivotal probabilities, and experimental studies have found that voters' subjective pivotal probabilities are much higher than the actual pivot probability (e.g., Duffy and Tavits, 2008).

Second, if a voter's preferences across candidates are highly differential (such as in a polarized two-party system) and the election outcome is important (such as in presidential elections), the utility difference from having her preferred candidate in office relative to another one will be huge and hence the product of the pivotal

[27] The literature also has other types of models, such as uncertain-voter models (Degan and Merlo, 2011) and mobilization models (Uhlaner, 1989; Shachar and Nalebuff, 1999).

probability and the utility difference will not be small. Third, following the spirit of ethical models, a voter's utility of an election outcome may include not only her own benefit but also her perception of the entire society's benefit (though different voters have different perceptions). Therefore, the utility difference can be even huger. On the one hand, KMT advocated that the choice between DPP and KMT in the 2024 election is a choice between war and peace; on the other hand, DPP advocated that DPP is the best protector of democracy and freedom in Taiwan. Many voters are educated in a way such that "if it turns out you are the pivotal voter and you did not turn out, then you will become a guilty person in history."

Using a maximum likelihood approach, Coate et al. (2008) estimated a pivotal-voter model with an assumption that voters have rational expectations on the actual pivotal probability; the actual pivotal probability in equilibrium depends on the number of eligible voters and the distribution of their preferences. The simulation exercises in Coate et al. (2008) showed that the pivotal-voter model's prediction could well match the true data for the levels of turnout but not for the size of the winning margins.

Different from Coate et al. (2008) and similar to Kawai et al. (2021), the pivotal probability in our model is a parameter to be gauged (which captures voters' subjective perceptions) instead of the actual pivotal probability in equilibrium that is calculated from other parameters. Moreover, we employ the BLP-style generalized method of moments (GMM), which is widely used in the industrial organization literature for consumers' discrete choices over differentiated products. In this method, the moments matching between the model prediction and the real data for the levels of turnout and the ones matching for the size of winning margins (vote shares of each candidate) are both included.[28]

Similar to Kawai et al. (2021), the pivotal probability parameter in our model can be broadly interpreted as voters' subjective perception of voting efficacy. Moreover, following the spirit of rule-utilitarian models, if a voter's utility of an election outcome includes not her own benefit but her perception of the entire society or a certain group's

[28] In the literature, there are other defenses for the pivotal-voter framework, such as in Levine and Palfrey (2007).

benefit, the "pivotal probability" parameter in our model can be interpreted even more broadly as voters' tendency to follow a voting rule that they believe, if followed by all in their group, would maximize aggregate utility or a certain group's utility.[29] Although our study employs a pivotal-voter framework, the main results do not depend on the interpretation of the "pivotal probability" parameter because our focus is on how third-party entry affects the two major incumbent parties' ideological positions. We fit a pivotal-voter model using the voting and polling data to recover the two major parties' ideological positions.

Other studies employing the pivotal-voter framework without interpreting the pivotal probability parameter as the actual pivot probability in equilibrium include Kanazawa (1998), Bendor et al. (2003), Minozzi (2013), and Esponda and Pouzo (2017).

5. Estimation Results

Tables 2 and 3 report the estimation results using the data on the 2024 and 2020 presidential elections, respectively.[30] Comparing the two tables, the gap between the two major parties' ideological stances ($x_b - x_g$) became wider in the 2024 election with

[29] The rule-utilitarian model in Feddersen and Sandroni (2006) assumed that individuals follow a voting rule that they believe maximizes aggregate utility (altruism). In contrast, the rule-utilitarian model in Coate and Conlin (2004) assumed that individuals follow a voting rule that they believe maximizes the payoff of a group (collectivism).

[30] In fact, the 2020 presidential election also had three candidates: namely, Kuo-yu Han, Ing-wen Tsai, and Chu-yu Soong, nominated by KMT, DPP, and People First Party (PFP), respectively. Born to a KMT military family, Soong was originally a member of KMT and began his political career as a secretary to Ching-kuo Chiang. After failing to gain KMT's nomination for the 2000 presidential election, Soong ran as an independent candidate and hence was expelled from KMT. Even though he obtained 36.84% of the popular vote, his candidacy split the pan-Blue vote between himself and the KMT candidate, leading to the victory of DPP candidate Shui-bian Chen (39.30% of the popular vote). Immediately after the election, Soong founded PFP, a party in the Pan-Blue Coalition. For the 2020 election, first, we do not treat Soong as a third-party candidate because he originated from KMT and his ideological stance is even bluer than that of a typical KMT candidate. Second, we aggregate the votes of Han and Soong together as the votes of one blue candidate because Soong only obtained 4.26% of the popular vote and PFP did not win any legislative seats. In 2004, Soong ran as vice-presidential candidate jointly with the KMT candidate (presidential candidate) and lost to Shui-bian Chen by a narrow margin of 0.22%. Afterward, as the PFP candidate without allying with KMT, he ran in multiple Taiwan presidential elections and Taipei Mayoral Elections. However, because most blue voters voted strategically to concentrate their votes on KMT candidates, the vote shares Soong obtained were ignorable and could not affect the election outcomes.

TPP's entry than in the 2020 election without TPP's entry.[31]

However, we cannot indiscreetly conclude that the third-party entry exacerbated political polarization merely based on the enlarged $x_b - x_g$. One possible reason for the wider gap between the two major parties' ideological stances is that voters' ideological positions became more dispersed in 2024 (see Figure 3) than in 2020 (see Figure 4). The standard deviation of $\mu(D_i) + \eta_i$ in 2024 is 1.0623, greater than that in 2020 (0.5761). This result is consistent with the pattern of the Formosa poll: the standard deviation of the green-blue ideological grades of respondents in the 2024 poll is 9.89, greater than that in the 2020 poll (7.96).

Multiple forces may play substantial roles in diverging voters' ideological positions. First, Beijing made increasingly tougher policies regarding Cross-Strait relations, such as more intensive military exercises surrounding Taiwan. On the one hand, these policy changes may make some blue voters become more aware of the importance of strategically maintaining a peaceful relationship with China and hence turn bluer. On the other hand, the policy changes may trigger some green voters' reverse psychology and hence make them become greener. Second, the increasingly fierce conflicts between China and the U.S. may strengthen some green voters' belief that the U.S. will help defend Taiwan once the Cross-Strait war occurs and hence make these voters become greener. Third, the increasingly stronger controls over Hong Kong may

[31] TPP's ideological position (x_w) is between DPP's (x_g) and KMT's (x_b), and it is closer to KMT's than to DPP's. The estimates on demographic characteristics are consistent with the well-known facts that TPP is favored by younger generations and highly educated citizens, that DPP is favored by low-educated people, and that KMT is favored by older generations. The estimate of φ is positive, indicating that the mean cost of turning out to vote (e.g., traveling to a polling place and waiting in line) surpasses the mean utility that a voter derives from fulfilling her civic duty of voting. It is consistent with the literature on voting turnouts (e.g., Kawai et al., 2021).

make voters in Taiwan become greener.[32] [33] [34]

Given the possible changes in the distribution of voters' ideological positions, we also examine the gap between the two major parties' ideological positions based on relative measures. In 2020, 52.95% of voters with their ideological positions ($\mu(D_i) + \eta_i$) fell between x_g and x_b, whereas in 2024, this percentage increased to 56.40%. This 3.45% increase is nontrivial, given that the gap between the two major parties' popular votes in the 2024 presidential election is 6.56%.

To further discreetly analyze the effect of the third-party entry on political polarization, we conduct a counterfactual experiment in which TPP did not enter the 2024 election and examine changes in the two major parties' incentives to further polarize in the next section (Section 6).

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[32] One may argue that the enlarging of the gap between the two major parties' ideological stances ($x_b - x_g$) was mainly driven by the polarization of the green party because some signs indicated that the blue party was trying to be less polarized to gain more central voters. For example, different from what had occurred previously, KMT nominated an Island Taiwanese instead of a Mainland Taiwanese, as the presidential candidate for the 2024 election. However, first, many political observers believed that, due to his status in KMT, the presidential candidate Hou did not have sufficient power to determine policies regarding Cross-Strait affairs after being in office. Ying-jeou Ma, the former Taiwan president from 2008 to 2016 and the former Chairperson of KMT from 2005 to 2007 and from 2009 to 2014, and Shaw-kong Jaw, the vice-president candidate nominated by KMT for the 2024 election, are influential on policies regarding Cross-Strait affairs. During an interview by Deutsche Welle three days before the 2024 election data, Ying-jeou Ma stated that regarding Cross-Strait relations, we must trust Xi. Many political observers believed that this statement substantially altered voters' perception of the blue party's green-blue ideological position. Second, as KMT was frequently labeled by DPP as "the agent of the Chinese Communist Party (CCP) in Taiwan," Taiwan voters' perception of the blue party's ideological position can also be influenced by Beijing's political stance. If Beijing becomes tougher regarding Cross-Strait relations, the blue party's perceived ideological position will become more polarized even if KMT does not intentionally further polarize.

[33] As the structural parameter estimates are scaled by the pivotal probability, one possible concern is that the different gaps between the two major parties' ideological positions and different dispersions of voters' ideological positions across 2024 and 2020 could be due to different pivotal probabilities across the two elections. However, the pivotal probability of an election with two candidates should be greater than that of an election with three candidates (see discussion in Sections 8 and 9 on counterfactual analyses on the scenarios in which TPP does not enter the election or TPP and KMT form an alliance). If the results are driven by pivotal probabilities, the 2020 election should have a wider gap between x_b and x_g and a more dispersed $\mu(D_i) + \eta_i$ than the 2024 election because the 2020 election only has two effective candidates instead of three. In fact, based on either the Formosa polls or our structural estimates, voters' ideological positions are found to be more dispersed in 2024 than in 2020.

[34] Many factors can affect people's ideological positions, such as social media (Gentzkow and Shapiro, 2011) and even college roommates (Strother et al., 2021).

6. The third-party entry increased the two dominant parties' incentives to polarize

Based on the structural estimates reported in Section 5, we conduct counterfactual experiments in which we make one of the two major parties in the elections further polarized than their actual ideological positions. We examine the effect of this deviation in both the scenario in which TPP entered the 2024 election and the scenario in which TPP did not. The results show that the third-party entry can strengthen the two major parties' incentives to further polarize.

The first incentive change for a major party caused by such entry is that a stronger competitor (the third party) for central voters makes a major party's effort to gain these voters less effective. As shown in Table 4, in the 2024 election, if the green party went further polarized by 0.1 (x_g decreased by 0.1), it would lose only 0.55% of the popular vote; if the blue party went further polarized by 0.1 (x_b increased by 0.1), it would lose only 0.65% of the popular vote. In contrast, in the counterfactual scenario of the 2024 election without the third-party entry, if the green party went further polarized by 0.1, it would lose more votes (1.02%>0.55%); if the blue party went further polarized by 0.1, it would also lose more votes (1.09%>0.65%).[35] Given that a major party has already lost many central voters to the third party, additional drains of central voters caused by the major party's further polarization should be moderate.

The second incentive change caused by such entry is that each major party would become less worried that its further polarization would give away all of its central voters to the other major party because these voters would be split by the third party. As shown in Table 4, in the 2024 election, if the green party went further polarized by 0.1 (x_g decreased by 0.1), the blue and white parties' vote shares would be increased by 0.78%

[35] The changes in the three candidates' vote shares caused by further polarization by one candidate do not necessarily add up to zero because the vote share of a candidate is defined as the votes of the candidate divided by eligible voters. Instead, as shown in Table 4, the changes add up to a positive number because further polarization by one candidate can increase the turnouts of eligible voters supporting any of the three candidates. Further polarization by a candidate toward one end can increase the turnout rates of eligible voters at both ends in the ideological dimension. Such further polarization can enlarge the difference between the utilities of either of the two major parties in office for eligible voters at both ends and hence enhance their incentives to turn out given their voting costs unchanged (captured by φ).

and 0.61%, respectively; if the blue party went further polarized by 0.1 (x_b increased by 0.1), the green and white parties' vote shares would be increased by 0.89% and 0.60%, respectively. In contrast, in the counterfactual scenario of the 2024 election without the third-party entry, if the green party went further polarized by 0.1, the blue party's vote share would be increased by 1.90%; if the blue party went further polarized by 0.1, the green party's vote share would be increased by 2.05%.[36]

The empirics-based evidence that the third-party entry strengthened the two major parties' incentives to further polarize can partially explain the enlarged ideological gap between the two major parties. However, a natural question is whether the third-party entry mitigated the polarization of the entire politics in Taiwan, given that central voters now have an alternative to better represent their political stance. While it is difficult to provide a definite answer, we can at lease propose the following two statements. First, the third party did not win the presidential election; therefore, it will play almost no role in centralizing the policy orientation of the central government. Second, the third party only won eight seats in the Legislative Yuan, but legislative bills proposed to the Legislative Yuan need at least ten legislators to cosign. Therefore, TPP has to collaborate with a major party (most likely to be KMT) to propose a legislative bill. Therefore, it is highly likely that TPP will act as a small blue party in the Legislative Yuan instead of an independent centrist party.

Another natural question is whether candidates optimally choose their ideological positions to maximize their vote shares in elections. The answer is no because a candidate's objective function does not only consider the vote share. Although standing in a polarized position would generally reduce a candidate's votes in a presidential election, a candidate may not essentially move toward the center. Incentives other than the votes obtained in the final election matter.

[36] Another pattern shown in Table 4 is that a 0.1 further polarization by KMT would cause a greater drop in its own votes (0.65% in panel A and 1.28% in panel B) than that by DPP (0.55% in panel A and 1.02% in panel B), regardless of whether the third party entered. The reason is that, as shown in Figure 3, KMT's ideological position is more distant from the center of the distribution of voters' ideological positions than DPP's; accordingly, a further polarization by KMT would make more people disappointed (voters to the left of x_b) than that by DPP (voters to the right of x_g).

First, running campaigns requires donations and donors' political positions are more polarized than ordinary voters'. Candidates choose their political positions not only to gain voters but also to attract funds from donors. Barber (2016) and Waldfogel (2023) have documented donors' effects on political polarization. Waldfogel (2023) built a model in which a candidate's objective function (winning probability) to be maximized partially depends on her fundraising.

Second, candidates with central stances usually cannot win their parties' primaries and get nominated (Kujala, 2020). Moreover, the growing path of a presidential candidate in Taiwan usually requires local executive experience in her early political career. A candidate with central stances usually cannot win the election of a city mayor or county head because the population in a city or a county is usually more biased toward one ideological color than the national average. For example, Hou has been the mayor of New Taipei City (a "deep blue" city), while Lai has been the mayor of Tainan City (a "deep green" city).[37]

Third, after a primary, a nominated candidate cannot effectively move to a central position by a large degree because voters' perception of a candidate's stance is based not only on her current speech but also on her past speech. For example, Lai's mild statements such as "support for 'the cross-strait status quo'" during his campaign after the primary did not substantially offset his label as a "pragmatic worker for Taiwan independence," which he called himself many years ago.

Fourth, to rule the country smoothly after winning the presidential election, a candidate must integrate factions within the party to form an executive team and gain the support of her party's members in the Legislative Yuan.

To summarize, shifting political positions is costly for a candidate regardless of whether it is toward the center or a pole. However, a candidate from a third party can be exceptional, which will be discussed in the next section (Section 7).

[37] One exception is Kuo-yu Han, a blue party member who won the mayoral election of Kaohsiung City, the largest green city in Taiwan, in 2018. The main reason for his winning is that voters gave vent to their disappointment over the two-year ruling of DPP in the central government. In 2020, Han was recalled by a Kaohsiung mayoral recall election. The number of votes agreeing to the recall even outnumbered the votes that favored Han two years before.

7. Should the white party go green or blue?

An emerging third party may have dramatically greater freedom than the two dominant parties to adjust its ideological position for the purpose of increasing its vote share in the final election. The reason is that the emergence of a third party mainly relies on the founding person's personal charisma rather than the power of factions within the party. As Ko has claimed, unlike the green and blue candidates, he is free of coercion by factions and constraint by consortiums, which enables him to appoint government officials according to their abilities instead of their green-blue ideologies.[38]

In fact, Ko dramatically changed his ideological position during his political career before the 2024 election and is currently swinging his position after the 2024 election. As mentioned in Section 2, in the early stages of his political career, Ko espoused positions closer to the Pan-Green coalition; after 2016, Ko's political stance started shifting toward the Pan-Blue coalition. After the 2024 election, Ko first made TPP members in the Legislative Yuan corporate with KMT members to jointly elect Kuo-yu Han (a KMT member) as Speaker of the Legislative Yuan. However, on March 14, 2024, Ko met Ing-wen Tsai (the outgoing president) in the Office of the President and had a two-hour talk, seeking potential white-green collaborations.

In Table 5, we report the results of counterfactual analyses regarding the white candidate's gains in the percentage of votes by deviating from his current ideological stance in different directions and by different magnitudes. The pattern indicates that, on the one hand, Ko will lose more votes as he moves toward the blue candidate's position; on the other hand, Ko's votes will first increase and then decrease as he moves toward the green candidate's position. While Ko can maximize his votes by deviating from his current position toward the green end by 0.3, the resulting increase in his votes is limited (only 0.70%).

Therefore, the help obtained from strategically adjusting its ideological position is limited for the third party, although it has a large freedom to do so. Correspondingly,

[38] On the other hand, relying too much on the founder's personal charisma can also be a disadvantage for a third party because if the founder falls, the party will fall.

an appropriate strategy for the third party to win an election in the future may be to focus on enhancing Ko's nonideological effect on eligible voters' preferences, which fundamentally distinguishes it from the two major parties, rather than strategically adjusting its ideological position. The distribution of Ko's nonideological effect on voters' preferences in the 2024 election (the distribution of $\lambda(D_i) + \zeta_i$) is displayed in Figure 5.

One interesting phenomenon shown in Table 5 is that while the third party cannot effectively affect its own vote shares by strategically adjusting its ideological position, it can substantially alter the other two parties' vote shares. For example, if the third party copies the green party's position, while its own vote share will drop by 1.05%, the green party's vote share will fall by 8.34%, and the blue party's vote share will rise by 10.60%. The reason is that when moving toward the green party's position, the third party can absorb many green voters from the green party and lose many blue voters to the blue party. However, the absorbed green voters and the lost blue voters offset each other, making the change in the third party's own votes limited.

To summarize, through strategically adjusting its ideological position, the third party cannot make itself win the election but can "determine" which of the two dominant parties will win the election.

Another question is whether the third party has absorbed more blue voters from KMT than green voters from DPP at its current position. Given that the third party's actual position ($x_w = 1.0847$) is closer to the blue party's position ($x_b = 1.6585$) than to the green party's position ($x_g = 0$) (see structural estimates in Table 4), the third party should have absorbed more from KMT. Two patterns shown in Table 5 can further confirm this answer. First, if the third party moves toward the blue party's position from its current position, the green party's vote share will substantially increase, whereas the blue party's vote share will decrease by only a limited amount. Second, if the third party moves toward the blue side by 0.1, the green party's vote share will only increase by 1.11%; in contrast, if the third party moves toward the green side, the blue party's vote share can increase by 1.73%. The third party could have more green supporters than

blue supporters after it moves toward the green side by more than 0.3,

8. What if there was no third party in the 2024 presidential election?

In this section, we discuss in more detail the analyses for the counterfactual scenario in which there was no third-party entry in the 2024 presidential election.

As mentioned in Section 4.1, the structural parameters generated by the baseline estimation for 2024 (reported in Table 2) are scaled by p_0, i.e., the unidentified perception of the pivotal probability or voting efficacy in the actual 2024 election. In the counterfactual scenario in which TPP did not enter the 2024 election, the corresponding pivotal probability (denoted as p_1) should be different from p_0. The reason is that this counterfactual experiment reduces the number of candidates from three to two and hence should substantially alter voters' perceived pivotal probabilities.

Correspondingly, given the estimates in Table 2, the resulting ξ, and a numerical value of $\frac{p_1}{p_0}$, we can construct the utilities of voting for DPP or KMT without TPP's entry as follows (see Appendix B.1 for derivations from the first line to the last line of equations (8.1) and (8.2)):

$$\begin{aligned} V_{ig} &= \frac{p_1}{p_0}\left(u_{ig} - u_{ib}\right) - \varphi - \varrho_k + \epsilon_{ig} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ig} - \bar{u}_{ib} + \varsigma_{kg} - \varsigma_{kb}\right) - \varrho_k - \varphi + \epsilon_{ig} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ig} - \bar{u}_{ib}\right) + \frac{1}{3}\left[\left(1 + \frac{p_1}{p_0}\right)\xi_{kg} + \left(1 - \frac{p_1}{p_0}\right)\xi_{kb} + \xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{ig} \end{aligned} \tag{8.1}$$

$$\begin{aligned} V_{ib} &= \frac{p_1}{p_0}\left(u_{ib} - u_{ig}\right) - \varphi - \varrho_k + \epsilon_{ib} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ib} - \bar{u}_{ig} + \varsigma_{kb} - \varsigma_{kg}\right) - \varrho_k - \varphi + \epsilon_{ib} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ib} - \bar{u}_{ig}\right) + \frac{1}{3}\left[\left(1 - \frac{p_1}{p_0}\right)\xi_{kg} + \left(1 + \frac{p_1}{p_0}\right)\xi_{kb} + \xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{ib} \end{aligned} \tag{8.2}$$

Then, we can calculate individual-level choice probabilities and aggregate them up to the national level. Correspondingly, the aggregated national-level turnout rate is a function of $\frac{p_1}{p_0}$. If we do not make any adjustment to the pivotal probability in this

counterfactual scenario (i.e., assuming $\frac{p_1}{p_0} = 1$), as shown in the first row of Table 6, the resulting turnout rate is only 48.67%, dramatically lower than the actual turnout rates in the 2024 and 2020 elections (71.86% and 74.90%, respectively).[39]

Therefore, we first pin down $\frac{p_1}{p_0}$ that can make the turnout rate match a reasonable percentage. Then, given $\frac{p_1}{p_0}$, we calculate the vote shares for DPP and KMT. We match the turnout rate to multiple percentages ranging from 65% to 80%. As shown in Table 6, while the two parties' vote shares substantially change across different adjustments and no adjustment to $\frac{p_1}{p_0}$, the relative order (voting outcome) is quite robust; i.e., KMT should have marginally won the 2024 election if TPP had not entered.

This result indicates that although TPP's ideological position is closer to KMT's than to DPP's and TPP also advocated ruling party alternation, TPP actually played the role of a disrupter in the 2024 presidential election. This result generated from counterfactual analyses based on structural estimates is consistent with the reduced-form evidence provided by Pons and Tricaud (2018) on the elections in France.

Based on the $\frac{p_1}{p_0}$ that makes the national turnout rate match 72% (a percentage very close to the actual turnout rate in 2024), we calculate individual-level choice probabilities and aggregate them up to the location level. Figure 6 displays the district-/township-level voting results in this counterfactual scenario. Comparing them with Figure 1 (actual votes), the results flip in 71 districts/townships. Among them, all the four districts/townships in which TPP won the largest vote share in the actual election switch to KMT; and the remaining 67 districts/townships switch from DPP to KMT. There is no district/township that switches from KMT to DPP.

When we conducted counterfactual experiments in which one of the two major parties go further polarized than their actual ideological positions in Section 6, we examined the effect in a scenario in which TPP did not enter the 2024 election (see

[39] If we do not adjust the pivotal probability in the counterfactual experiment but allow a nested logit assumption for the idiosyncratic shocks at the estimation stage (with ϵ_{ig}, ϵ_{ib}, and ϵ_{iw} as one nest and ϵ_{i0} as the other nest), the resulting turnout rate is still only slightly above 50%.

panel B of Table 4). Those analyses are also based on the $\frac{p_1}{p_0}$ that makes the national turnout rate match 72% (see results in Panel B of Table 4). The results are robust to changes in the matched turnout rate (or the pivotal probability).

9. Alliance

In October and November 2023, KMT and TPP conducted intensive negotiations on forming a blue-white alliance against DPP for the 2024 election. They reached a six-point consensus in mid-November. The consensus included that the decision on whether to nominate Hou as the presidential candidate and Ko as the vice-presidential candidate or vice versa will be determined according to polling results; if the alliance won the election, then officials in the Department of Defense, Ministry of Foreign Affairs, and Mainland Affairs Council would be nominated by the president, and officials in the other parts of the central government would be determined according to the two parties' seats in Legislative Yuan.

However, after drawn-out negotiations, the potential "blue-white alliance" officially broke down at the deadline for presidential candidate registration. On November 24, KMT and TPP each had their own presidential and vice-presidential candidates registered at the CEC. The major controversy is which of Hou and Ko within the alliance should be the presidential candidate rather than the vice-presidential candidate.

The long-version Formosa poll conducted from October 24-25 asked two relevant questions. The first question was as follows: "If KMT and TPP successfully form an alliance and nominate Hou as the presidential candidate and Ko as the vice-presidential candidate to compete against the presidential and vice-presidential candidates Lai and Hsiao nominated by DPP, for whom will you vote?" The second question was as follows: "If the alliance nominates Ko as the presidential candidate and Hou as the vice-presidential candidate to compete against Lai and Hsiao, for whom will you vote?"

In this section, we examine how the Blue-White alliance and the order of Hou and Ko within the alliance would have altered voters' preferences over available choices.

9.1. Hou-Ko alliance

If Hou had run as the presidential candidate and Ko had run as the vice-presidential candidate, the utility of having the blue-white alliance in office for voter i at location k is assumed to be as follows:

$$\begin{aligned} u_{ibw} &= |\mu(D_i) + \eta_i - [\varpi_{bw1}x_b + (1-\varpi_{bw1})x_w]| \\ &\quad + (1-\varpi_{bw2})[\lambda(D_i) + \zeta_i] + \varpi_{bw3}\varsigma_{kb} + (1-\varpi_{bw3})\varsigma_{kw} \\ &= \bar{u}_{ibw} + \varpi_{bw3}\varsigma_{kb} + (1-\varpi_{bw3})\varsigma_{kw} \end{aligned} \tag{9.1}$$

$\varpi_{bw1}x_b + (1-\varpi_{bw1})x_w$ is the expected stance of the blue-white alliance in the green-blue ideological dimension. It is a weighted average of the blue candidate's stance and the white candidate's stance. $1-\varpi_{bw2}$ is the expected proportion of Ko's nonideological effect that will transmit to the blue-white alliance. $\varpi_{bw3}\varsigma_{kb} + (1-\varpi_{bw3})\varsigma_{kw}$ is the location-level unobserved random shock to voters' preferences for the blue-white alliance. It is a weighted average of the shock to voters' preference for the blue candidate and that for the white candidate. The weights ϖ_{bw1}, ϖ_{bw2}, and ϖ_{bw3} are parameters to be estimated. The utility of having the green candidate in office for voter i at location k remains unchanged (represented by equation (4.1)).

Voter i's utilities of voting for the green candidate and the blue-white alliance, respectively, are as follows:

$$\begin{aligned} V_{ig} &= \frac{p_2}{p_0}(u_{ig} - u_{ibw}) - \varphi - \varrho_k + \epsilon_{ig} \\ &= \frac{p_2}{p_0}(\bar{u}_{ig} - \bar{u}_{ibw}) \\ &\quad + \frac{1}{3}\left[\left(1+\frac{p_2}{p_0}\right)\xi_{kg} + \left(1-\frac{p_2}{p_0}\varpi_{bw3}\right)\xi_{kb}\right. \\ &\quad \left. + \left(1-\frac{p_2}{p_0}+\frac{p_2}{p_0}\varpi_{bw3}\right)\xi_{kw}\right] - \varphi + \epsilon_{ig} \end{aligned} \tag{9.2}$$

$$\begin{aligned} V_{ibw} &= \frac{p_2}{p_0}(u_{ibw} - u_{ig}) - \varphi - \varrho_k + \epsilon_{ibw} \\ &= \frac{p_2}{p_0}(\bar{u}_{ibw} - \bar{u}_{ig}) \\ &\quad + \frac{1}{3}\left[\left(1-\frac{p_2}{p_0}\right)\xi_{kg} + \left(1+\frac{p_2}{p_0}\varpi_{bw3}\right)\xi_{kb}\right. \\ &\quad \left. + \left(1+\frac{p_2}{p_0}-\frac{p_2}{p_0}\varpi_{bw3}\right)\xi_{kw}\right] - \varphi + \epsilon_{ibw} \end{aligned} \tag{9.3}$$

We assume that the idiosyncratic shocks ϵ_{ig}, ϵ_{ibw} and ϵ_{i0} follow the Type-I extreme value distribution. Derivations from the first line to the second line of equations (9.2) and (9.3) are presented in Appendix B.2.

Given the structural parameter estimates generated from the baseline estimation for 2024 (reported in Table 2) and the resulting ξ, the structural parameters $\theta_{bw\_alliance} = \left\{\varpi_{bw1}, \varpi_{bw2}, \varpi_{bw3}, \frac{p_2}{p_0}\right\}$ can be estimated by the following two sets of moments. The first set of moments matches the average probability of voting for the green candidate (or the blue-white alliance) conditional on that the lth dimension of demographic characteristics D_{il} equals a certain value $\overline{D}_{ls}$. The moments are given by the following:

$$Prob[y_i' = j' | D_{il} = \overline{D}_{ls}], \qquad j' \in \{g, bw\} \tag{9.4}$$

The demographic characteristics have four dimensions, including age, gender, education, and region.

The second set of moments matches the average probability of voting for $j' \in \{g, bw\}$ in the situation with the Hou-Ko alliance conditional on voting for $j \in \{g, b, w\}$ in the situation of no alliance. The moments are given by the following:

$$Prob[y_i' = j' | y_i = j\ ], j \in \{g, b, w\}, j' \in \{g, bw\} \tag{9.5}$$

The weight parameters ϖ_{bw1}, ϖ_{bw2}, and ϖ_{bw3} can be identified by the first set of moments. The variation in voters' choices over $\{g, bw\}$ across age, gender, and education groups can identify ϖ_{bw1} and ϖ_{bw2} because the average ideological positions and the average favoritism toward Ko are different across these groups. The variation in voters' choices across regions can identify ϖ_{bw3} because ξ are different across regions.

The voting efficacy parameter $\frac{p_2}{p_0}$ can be identified by the second set of moments. Conditional on that a voter votes for candidate j in the scenario of no alliance, the higher $\frac{p_2}{p_0}$ is, the less likely the voter is to choose not to turn out in the scenario with the blue-white alliance.

The structural parameters in this scenario $\left\{\varpi_{bw1}, \varpi_{bw2}, \varpi_{bw3}, \frac{p_2}{p_0}\right\}$ are estimated

given the estimates of $\{\mu, \lambda, \sigma_1, \sigma_2, \rho, x_b, x_w, \varphi\}$ in Section 5, and these estimates have errors. Therefore, the standard errors of $\left\{\varpi_{bw1}, \varpi_{bw2}, \varpi_{bw3}, \frac{p_2}{p_0}\right\}$ are adjusted using the correction methods developed by Murphy and Topel (1985).

9.2. Ko-Hou alliance

If Ko had run as the presidential candidate and Hou had run as the vice-presidential candidate, the utility of having the blue-white alliance in office for voter i at location k is assumed to be as follows:

$$\begin{aligned} u_{iwb} &= |\mu(D_i) + \eta_i - [\varpi_{wb1} x_w + (1 - \varpi_{wb1}) x_b]| + \varpi_{wb2}[\lambda(D_i) + \zeta_i] \\ &\quad + \varpi_{wb3}\varsigma_{kw} + (1 - \varpi_{wb3})\varsigma_{kb} + \varepsilon_{wb} \\ &= \bar{u}_{iwb} + \varpi_{wb3}\varsigma_{kw} + (1 - \varpi_{wb3})\varsigma_{kb} \end{aligned} \tag{9.6}$$

The weight parameters to be estimated are now denoted as ϖ_{wb1} ϖ_{wb2}, and ϖ_{wb3}. The utility of having the green candidate in office for voter i at location k remains unchanged (represented by equation (4.1)).

Voter i's utilities of voting for the green candidate and the blue-white alliance can be derived similarly following the logic of equations (9.2) and (9.3) in Section 9.1. The structural parameters $\theta_{wb\_alliance} = \left\{\varpi_{wb1}, \varpi_{wb2}, \varpi_{wb3}, \frac{p_2}{p_0}\right\}$ can be identified and estimated by two sets of moments similar to equations (9.4) and (9.5).

9.3. Estimation results and discussion

Columns 1 and 2 in Table 7 report the estimation results for the Hou-Ko alliance and the Ko-Hou alliance, respectively. In voters' belief, Ko has a dominant influence on the ideology of the alliance: Ko's influence weight is 0.8094 as vice president and is 1 as president. One possible reason is that Hou is a "light blue" member of KMT. Unlike typical KMT politicians at the central stage, Hou was born and grew up in Chiayi County in Southern Taiwan, a typical DPP stronghold. During his early political career, Hou was even invited to join DPP.[40] The formation of the blue-white alliance would

[40] Some DPP members have even claimed that Hou once joined DPP, and Hou has denied that he ever joined DPP.

be perceived as a signal that KMT has loosened its insistence on its ideological doctrines.[41]

According to the second row of Table 7, as vice president, 0.5446 of Ko's nonideological effect can be transmitted to the alliance. In contrast, as president, 0.6842 of Ko's nonideological effect can be transmitted to the alliance.

As shown in the third row of Table 7, location-level shocks to voters' preference toward Ko would play no role in location-level shocks to voters' preference toward the alliance if Ko ran as vice president and would play a limited role (0.2268) if Ko ran as president. The reason is that KMT has strong local factions. In contrast, TPP heavily relies on online propaganda (referred to as "air forces") and does not have many local organizations (referred to as "ground troops") to serve local voters. TPP currently has no electoral district legislators in the Legislative Yuan beside eight legislators-at-large. Meanwhile, TTP only has a small number of local administrative heads and councilors in some cities and counties.

From the KMT perspective, its weight on location-level shocks would have decreased slightly from 1 to 0.7732 (=1-0.2268) if Hou ran as vice president instead of president. The reason is that KMT would have had less power in determining the assignment of officials to the central government, which would have hurt the interest of KMT's local factions and hence decrease their level of support.

10. Endorsement

Although the potential blue-white alliance eventually broke on November 24, 2023, KMT continued to seek Ko's endorsement before the election. KMT publicly announced that if elected, it would set up a coalition government and appoint the premier, vice-premier, and other officials jointly with TPP. KMT advocated that voters supporting Ko should vote for Hou in order to concentrate the votes and accomplish ruling party alternation. However, by election day, Ko had not publicly announced that

[41] In fact, the potential blue-white alliance broke down before the candidate registration date. Instead, Hou chose Shaw-kong Jaw (a "deep blue" KMT member) as his partner (vice-president candidate) to complement him in order to gain supports from "deep blue" voters.

he would endorse Hou. Rather, Ko advocated that voters ought to truthfully express their preferences in voting.

The long-version Formosa poll conducted from December 20-21 in 2023 asked two relevant questions. The first question was as follows: "If Ko publicly endorses Lai several days before the election, for whom will you vote?" The second question was as follows: "If Ko publicly endorses Hou several days before the election, for whom will you vote?"

In this section, we examine how Ko's public endorsements could have altered voters' preferences over available choices.

10.1. Ko endorses the green candidate

If Ko had publicly endorsed Lai (the green candidate), the utility of having the green candidate in office for voter i at location k is assumed to be as follows:

$$\begin{aligned} u_{ig} &= \left|\mu(D_i) + \eta_i - \left[\kappa_{g1}x_g + \left(1-\kappa_{g1}\right)x_w\right]\right| + \left(1-\kappa_{g2}\right)[\lambda(D_i) + \zeta_i] \\ &\quad + \kappa_{g3}\varsigma_{kg} + \left(1-\kappa_{g3}\right)\varsigma_{kw} = \bar{u}_{ig} + \kappa_{g3}\varsigma_{kg} + \left(1-\kappa_{g3}\right)\varsigma_{kw} \end{aligned} \tag{10.1}$$

The utilities of having the blue candidate or the white candidate in office for voter i at location k remain unchanged (represented by equations (4.2) and (4.3)).

Voter i's utilities of voting for the green, blue, and white candidates, respectively, are as follows:

$$\begin{aligned} V_{ig} &= 2u_{ig} - u_{ib} - u_{iw} - \varphi - \varrho_k + \epsilon_{ig} \\ &= 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} + \frac{1}{3}\left[\left(1+2\kappa_{g3}\right)\xi_{kg} + \left(2-2\kappa_{g3}\right)\xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{ig} \end{aligned} \tag{10.2}$$

$$\begin{aligned} V_{ib} &= 2u_{ib} - u_{ig} - u_{iw} - \varphi - \varrho_k + \epsilon_{ib} \\ &= 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{ig} \\ &\quad + \frac{1}{3}\left[\left(1-\kappa_{g3}\right)\xi_{kg} + 3\xi_{kb} + \left(\kappa_{g3}-1\right)\xi_{kw}\right] - \varphi + \epsilon_{ib} \end{aligned} \tag{10.3}$$

$$\begin{aligned} V_{iw} &= 2u_{iw} - u_{ig} - u_{ib} - \varphi - \varrho_k + \epsilon_{iw} \\ &= 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ib} + \frac{1}{3}\left[\left(1-\kappa_{g3}\right)\xi_{kg} + \left(2+\kappa_{g3}\right)\xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{iw} \end{aligned} \tag{10.4}$$

Derivations from the first line to the last line of equations (10.2), (10.3), and (10.4) are presented in Appendix B.3.

The structural parameters $\theta_{K\_endorse\_g} = \{\kappa_{g1}, \kappa_{g2}, \kappa_{g3}\}$ can be identified and estimated by the following two sets of moments. The first set of moments matches the average probability of voting for $j \in \{g, b, w\}$ conditional on that the lth dimension of demographic characteristics D_{il} equals a certain value $\bar{D}_{ls}$. The moments are given by the following:

$$Prob[y_i' = j' | D_{il} = \bar{D}_{ls}], \quad j' \in \{g, b, w\} \tag{10.5}$$

The demographic characteristics have four dimensions, including age, gender, education, and region.

The second set of moments matches the average probability of voting for $j' \in \{g, b, w\}$ in the situation of endorsing the green candidate conditional on voting for $j \in \{g, b, w\}$ in the situation of no endorsement. The moments are given by the following:

$$Prob[y_i' = j' | y_i = j \ ], \qquad j \in \{g, b, w\}, j' \in \{g, b, w\} \tag{10.6}$$

10.2. Ko endorses the blue candidate

If Ko had publicly endorsed Hou (the blue candidate), the utility of having the blue candidate in office for voter i at location k is assumed to be as follows:

$$\begin{aligned} u_{ib} = |\mu(D_i) + \eta_i - [\kappa_{b1} x_b + (1 - \kappa_{b1}) x_w]| + (1 - \kappa_{b2})[\lambda(D_i) + \zeta_i] \\ + \kappa_{b3} \varsigma_{kb} + (1 - \kappa_{b3}) \varsigma_{kw} = \bar{u}_{ib} + \kappa_{b3} \varsigma_{kb} + (1 - \kappa_{b3}) \varsigma_{kw} \end{aligned} \tag{10.7}$$

The utilities of having the green candidate or the white candidate in office for voter i at location k remain unchanged (represented by equations (4.1) and (4.3)).

Voter i's utilities of voting for the green, blue, and white candidates can be derived similarly following the logic of equations (10.2) through (10.4) in Section 10.1. The structural parameters $\theta_{K\_endorse\_b} = \{\kappa_{b1}, \kappa_{b2}, \kappa_{b3}\}$ can be identified and estimated by two sets of moments similar to equations (10.5) and (10.6).

10.3. Estimation results and discussion

Columns 1 and 2 in Table 8 report the estimation results for Ko's endorsements of the green and blue candidates, respectively. Ko's endorsement of the green candidate would have had little effect on the green candidate's ideological position as perceived by voters, whereas Ko's endorsement of the blue candidate could have substantially altered voters' perception of the blue candidate's ideological position. The reason is that Ko's position is closer to the blue candidate's than to the green candidate's and many green party members firmly insist on their doctrines.

Through his endorsement, Ko's nonideological effect could have been substantially transmitted to the green candidate (0.5265) but could not have been transmitted to the blue candidate. One possible reason is that a large proportion of KMT supporters are elderly people, who are unlikely to be abstracted by a candidate's personal charisma. In contrast, both TPP and DPP have many young supporters.

Similarly, through Ko's endorsement, location-level shocks to voters' preference for Ko could have dramatically transmitted to voters' preference for the green candidate (0.9367), whereas the shocks could not have transmitted to voters' preference for the blue candidate. One possible reason is that TPP is stronger in online propaganda than both DPP and KMT and is weak in local organizations. TPP's "air forces" can influence young supporters of DPP but cannot influence the elderly supporters of KMT. Moreover, location-level shocks to voters' preference for the blue candidate should be mainly driven by KMT's ground troops because KMT is strong in local organizations.

11. Conclusion

The two-party political systems (political duopoly) present in many countries have recently experienced a trend of increasingly intense partisan polarization, leading to more divided societies. One open question is whether the entry of a third party could be a cue for political polarization.

In this study, we examine the impacts of a third-party entry to the 2024 presidential election in Taiwan, a society previously dominated by two parties being increasingly polarized in the green-blue ideological dimension. Taiwan plays the most

critical role in the relationship between the U.S. and China, the two largest economies in the world. Meanwhile, as the home of Taiwan Semiconductor Manufacturing Co., Ltd., Taiwan serves as the most important link in the supply chain of the semiconductor and AI industries. Therefore, studying Taiwan's presidential elections is important.

Leveraging both voting and polling (survey) data and employing estimation methods similar to Petrin (2002) and Berry et al. (2004), we estimate a discrete choice model to recover the distributions of the distances between eligible voters' ideological positions and the two major parties' ideological stances and the distribution of eligible voters' preferences for the third party (TPP).

Although it is commonly believed that a viable third-party entry would mitigate political polarization, we find that such entry in fact can exacerbate political polarization by increasing the two major parties' incentives to further polarize. First, a stronger competitor (the third party) for central voters makes a major party's effort to gain these voters become less effective. Second, each major party would become less worried that its further polarization would give away all its central voters to the other major party because these voters would be split by the third party.

Moreover, we find that for the third party, the help obtained from strategically adjusting its ideological position is limited. If TPP moves toward the green (blue) side, then the gain in green (blue) voters and the lose of blue (green) voters will offset each other, thereby making the total changes in its vote share limited. Therefore, an appropriate strategy for the third party to win an election in the future may be to focus on enhancing dimensions other than the ideological dimension, which fundamentally distinguishes it from the two major parties. We also find that although the third party cannot make itself win the election through strategically adjusting its ideological position, it can "determine" which of the two dominant parties will win the election. The reason is that TPP can absorb green voters from DPP (blue voters from KMT) and return blue voters to KMT (green voters to DPP) by moving toward the green (blue) side. Therefore, TPP has the potential to act as a disrupter. Our counterfactual analyses indicate that if TPP had not entered the 2024 presidential election, KMT would have

marginally won.

We also examine how voters' preferences would have changed if the third party formed an alliance with KMT or if the third party endorsed one major party. We find that regardless of who between Hou and Ko within the alliance had run as the presidential candidate and who had run as the vice-presidential candidate, the third-party candidate Ko could have influenced the ideology of the alliance by a fraction greater than 80%, and approximately 60% of Ko's valence in the nonideological dimension could have been transmitted to the alliance. Location-level shocks to voters' preference toward Ko would play no role in location-level shocks to voters' preference toward the alliance. The reason is that KMT has strong local factions, whereas TPP heavily relies on online propaganda (referred to as "air forces") and does not have many local organizations (referred to as "ground troops") to serve local voters.

Alternatively, Ko's endorsement of the green candidate would have had little effect on the green candidate's ideological position perceived by voters, whereas Ko's endorsement of the blue candidate could have substantially altered voters' perception of the blue candidate's ideological position. In contrast, through his endorsement, Ko's valence in the nonideological dimension could have been substantially transmitted to the green candidate but could not have been transmitted to the blue candidate.

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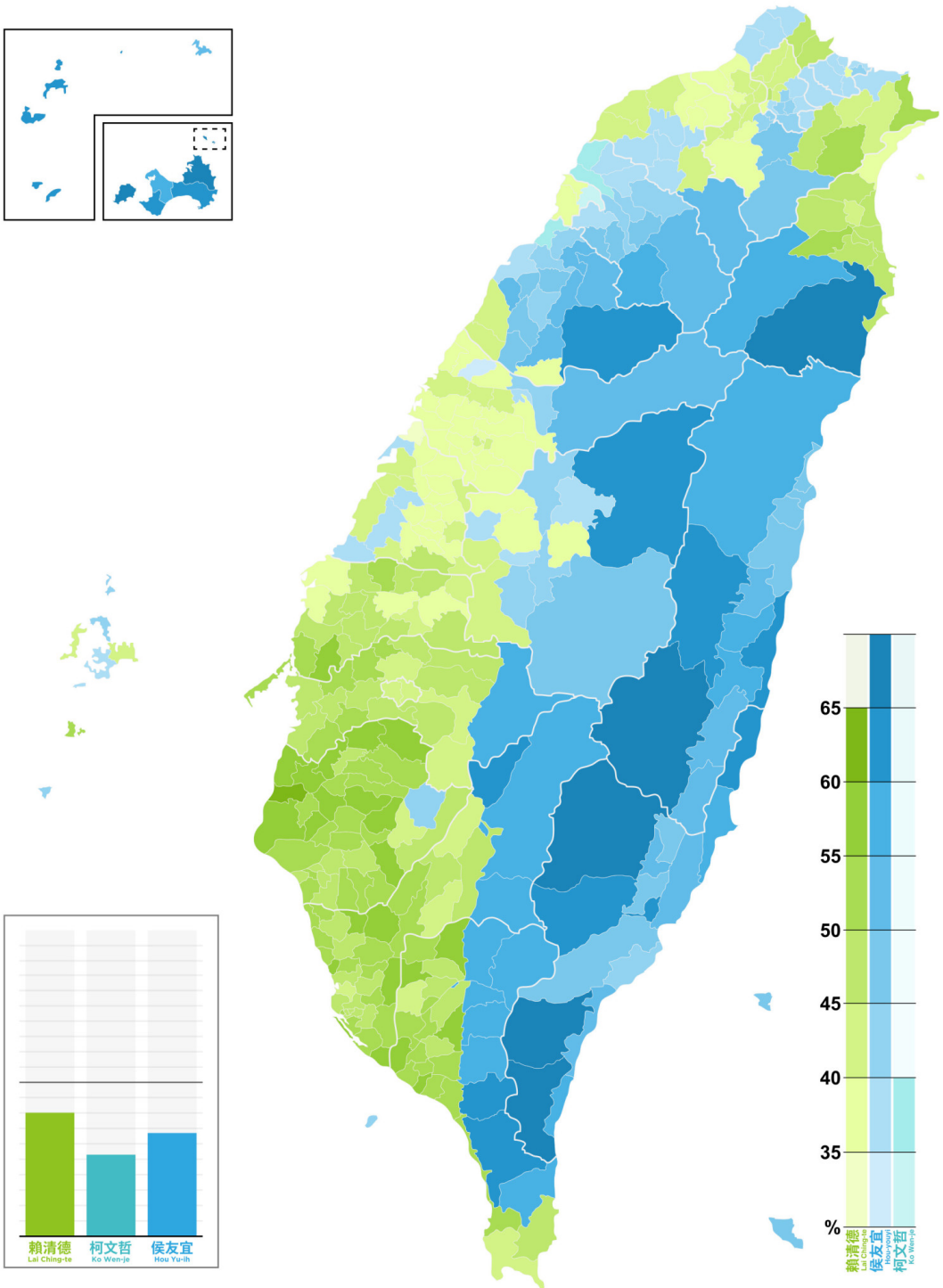

Figure 1. 2024 Taiwan presidential election results at the district/township level.

(Downloaded from

https://en.wikipedia.org/wiki/2024_Taiwanese_presidential_election)

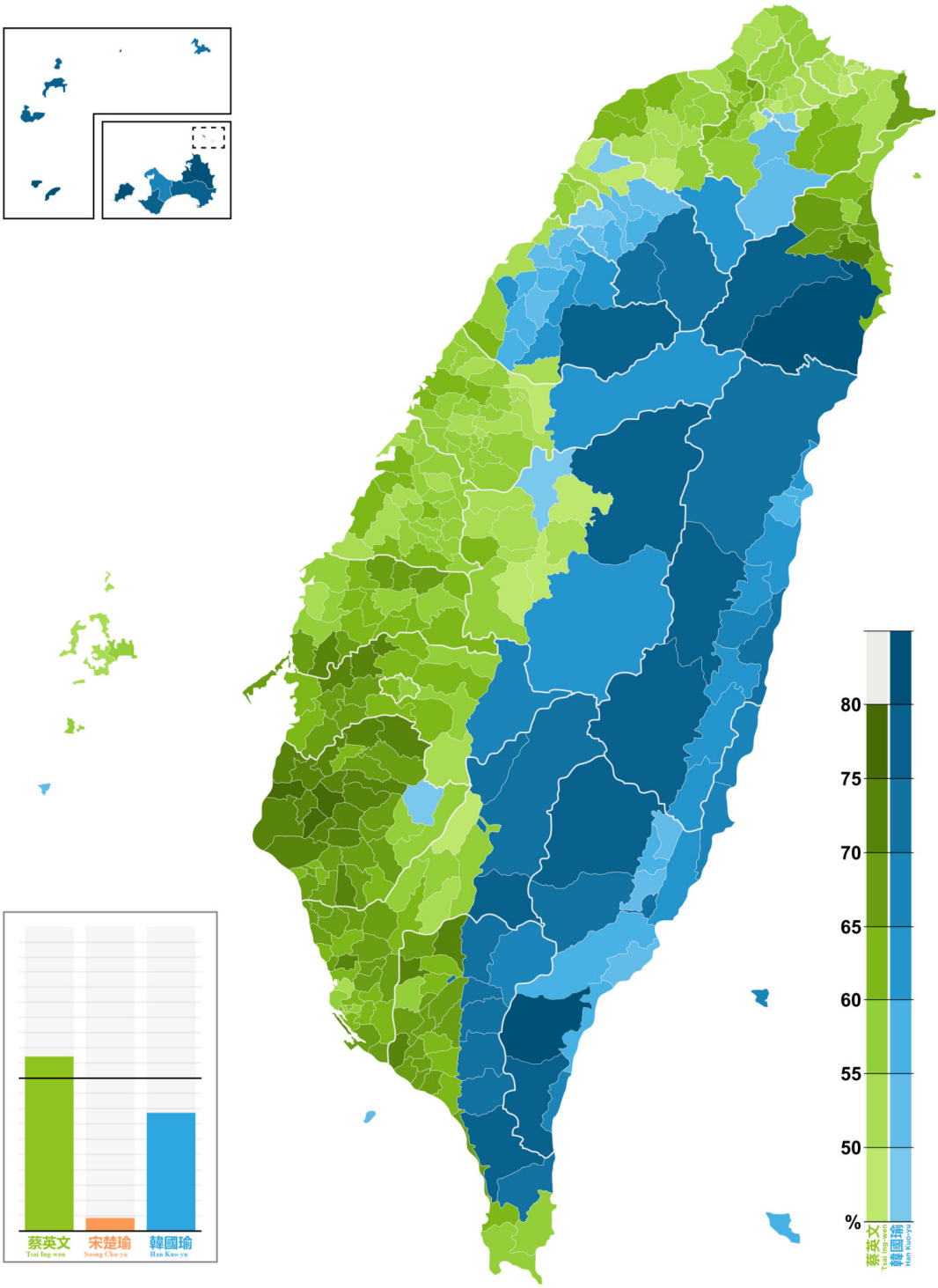

Figure 2. 2020 Taiwan presidential election results at the district/township level.

(Downloaded from

https://en.wikipedia.org/wiki/2024_Taiwanese_presidential_election)

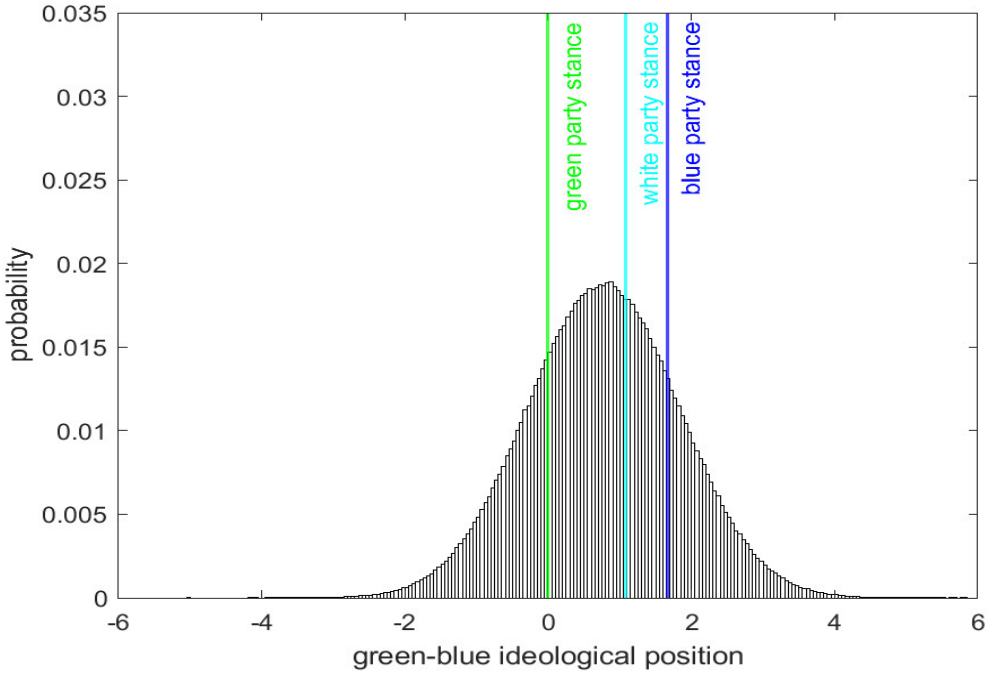

Figure 3. Distribution of eligible voters' ideological positions in 2024. The histogram shows the distribution of eligible voters' green-blue ideological positions ($\mu(D_i) + \eta_i$). The vertical green, cyan, and blue lines represent the positions of the DPP, TPP, and KMT candidates, respectively (x_g, normalized at zero, x_w, and x_b).

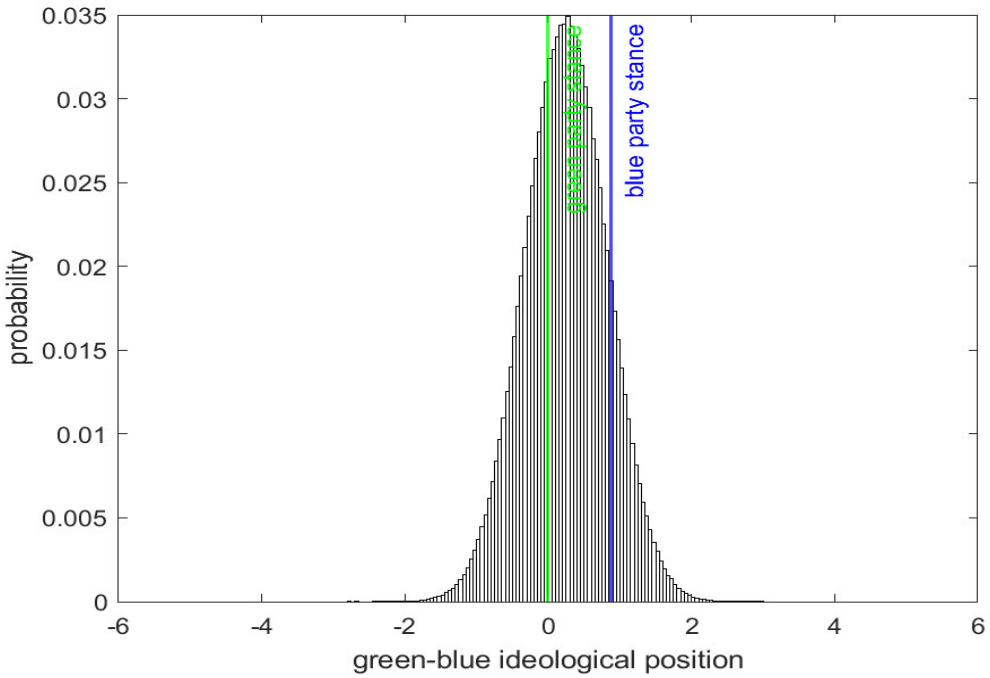

Figure 4. Distribution of eligible voters' ideological positions in 2020. The histogram shows the distribution of eligible voters' green-blue ideological positions ($\mu(D_i) + \eta_i$). The vertical green and blue lines represent the positions of the DPP and KMT candidates, respectively (x_g, normalized at zero, and x_b).

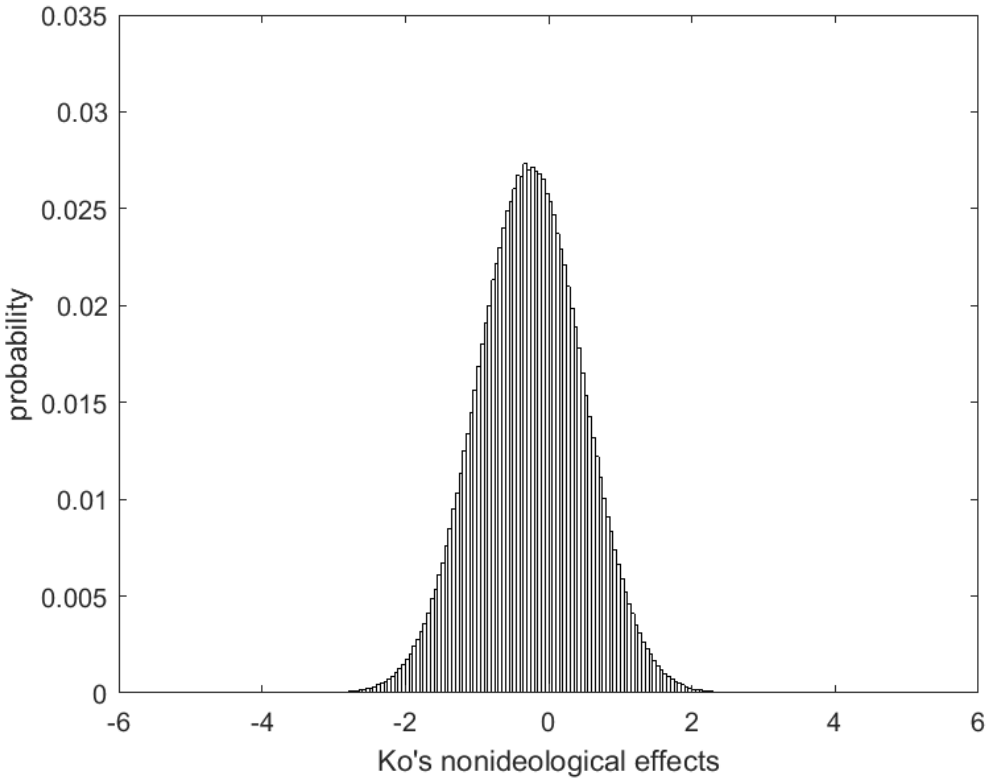

Figure 5. Distribution of the effect of Ko's valence on eligible voters' preferences in 2024. The histogram shows the distribution of Ko's (the third-party candidate's) effects on eligible voters' preferences other than the green-blue ideological dimension ($\lambda(D_i) + \zeta_i$).

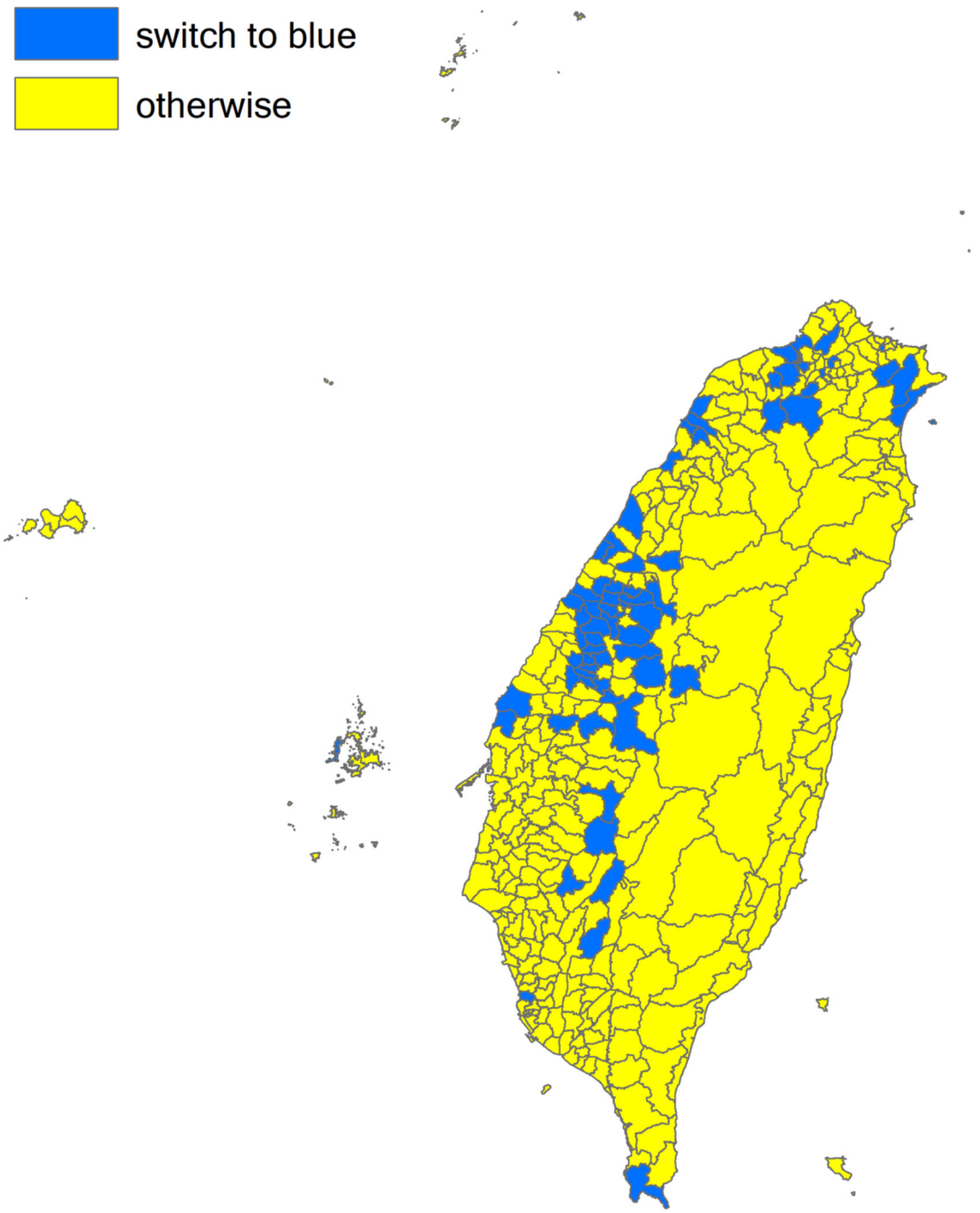

Figure 6. Counterfactual results of the 2024 Taiwan presidential election results at the district/township level without the white candidate. The results flip in 71 districts/townships (indicated by blue areas). Among them, all the four districts/townships in which TPP won the largest vote share in the actual election switched to KMT, while the remaining 67 districts/townships switched from DPP to KMT. There is no district/township that switched from KMT to DPP.

Table 1. Descriptive statistics

	N	Mean	Std Dev
Panel A: 2024 election			
District/township-level variables			
Eligible voters	368	53121.01	69077.06
Vote share of DPP	368	0.1685	0.0395
Vote share of KMT	368	0.2674	0.0918
Vote share of TPP	368	0.2426	0.0679
Share of not voting	368	0.3216	0.0788
$20 \leq age < 29$	368	0.1183	0.0446
$30 \leq age < 39$	368	0.1373	0.0383
$40 \leq age < 49$	368	0.1688	0.0315
$50 \leq age < 59$	368	0.1688	0.0185
$60 \leq age < 69$	368	0.1825	0.0276
$70 \geq age$	368	0.2243	0.0675
$Male$	368	0.5098	0.0254
$Female$	368	0.4902	0.0254
$Elementary$	368	0.1730	0.0822
$Junior - high$	368	0.1527	0.0527
$Senior - high$	368	0.3241	0.0489
$College$	368	0.3502	0.1393
Panel B: 2020 election			
District/township-level variables			
Eligible voters	368	52475.83	67742.20
Vote share of DPP	368	0.3872	0.1185
Vote share of KMT	368	0.3227	0.0898
Share of not voting	368	0.2900	0.0761
$20 \leq age < 29$	368	0.1615	0.0227
$30 \leq age < 39$	368	0.1715	0.0249
$40 \leq age < 49$	368	0.1826	0.0198
$50 \leq age < 59$	368	0.1935	0.0134
$60 \leq age < 69$	368	0.1584	0.0171
$70 \geq age$	368	0.1325	0.0390
$Male$	368	0.5112	0.0246
$Female$	368	0.4888	0.0246
$Elementary$	368	0.1424	0.0395
$Junior - high$	368	0.1291	0.0287
$Senior - high$	368	0.2806	0.0291
$College$	368	0.4479	0.0822

Table 2. Structural estimation results for the 2024 election

Parameter	Est.	Parameter	Est.
x_b	1.6585***	x_w	1.0847***
	(0.2950)		(0.0669)
φ	1.5830***	ρ	0.0076
	(0.0206)		(0.1139)
σ_1	1.0404***	σ_2	0.7228***
	(0.1810)		(0.0658)
$\mu(D_i)$		$\lambda(D_i)$	
$constant$	1.0109***	$constant$	-0.4493**
	(0.2037)		(0.2570)
$20 \leq age < 29$	0.0177	$20 \leq age < 29$	0.2509
	(0.1428)		(0.2986)
$30 \leq age < 39$	0.1213**	$30 \leq age < 39$	0.1998
	(0.0554)		(0.1732)
$40 \leq age < 49$	-0.0615***	$40 \leq age < 49$	0.1389***
	(0.0100)		(0.0596)
$50 \leq age < 59$	0.0367	$50 \leq age < 59$	0.0333
	(0.1926)		(0.0807)
$60 \leq age < 69$	0.0715***	$60 \leq age < 69$	0.0339
	(0.0117)		(0.1914)
$70 \geq age$	Omitted	$70 \geq age$	Omitted
$Male$	-0.1635***	$Male$	0.0780
	(0.0061)		(0.1611)
$Elementary$	-0.5018***	$Elementary$	0.2335**
	(0.0141)		(0.1384)
$Junior-high$	-0.3533***	$Junior-high$	0.2497***
	(0.0866)		(0.0483)
$Senior-high$	-0.2974***	$Senior-high$	-0.0452***
	(0.0555)		(0.0045)
$College$	Omitted	$College$	Omitted

Standard errors are reported in parentheses. * denotes significance at a 10% level. ** denotes significance at a 5% level. *** denotes significance at a 1% level.

Table 3. Structural estimation results for the 2020 election

Parameter	Est.
x_b	0.8788***
	(0.0211)
φ	0.0281
	(0.0250)
σ_1	0.5735***
	(0.0174)
$\mu(D_i)$	
$constant$	0.2925***
	(0.0569)
$20 \leq age < 29$	-0.0011
	(0.0668)
$30 \leq age < 39$	-0.0263
	(0.1567)
$40 \leq age < 49$	-0.0397
	(0.0712)
$50 \leq age < 59$	0.0029
	(0.1283)
$60 \leq age < 69$	0.0042
	(0.0944)
$70 \geq age$	Omitted
$Male$	-0.0452
	(0.3847)
$Elementary$	-0.0366
	(0.1347)
$Junior - high$	-0.1310**
	(0.0745)
$Senior - high$	0.0231*
	(0.0170)
$College$	Omitted

Standard errors are reported in parentheses. * denotes significance at a 10% level. ** denotes significance at a 5% level. *** denotes significance at a 1% level.

Table 4. The two major parties' incentives to further polarize

Counterfactual scenarios	Votes for green	Votes for blue	Votes for white
Panel A: 2024 election			
x_g decreases by 0.1	**-0.55%**	+0.78%	+0.61%
x_b increases by 0.1	+0.89%	**-0.65%**	+0.60%
x_g decreases by $0.1 \cdot std(\mu(D_i) + \eta_i)$	**-0.59%**	+0.82%	+0.65%
x_b increases by $0.1 \cdot std(\mu(D_i) + \eta_i)$	+0.95%	**-0.69%**	+0.64%
Panel B: 2024 election if without the third-party entry			
x_g decreases by 0.1	**-1.02%**	1.90%	NA
x_b increases by 0.1	2.05%	**-1.28%**	NA
x_g decreases by $0.1 \cdot std(\mu(D_i) + \eta_i)$	**-1.09%**	2.02%	NA
x_b increases by $0.1 \cdot std(\mu(D_i) + \eta_i)$	2.18%	**-1.36%**	NA

Table 5. The third party's gains from adjusting its ideological position

Counterfactual scenarios	Votes for green	Votes for blue	Votes for white
x_w copies x_g	-8.34%	10.60%	**-1.05%**
x_w decreases by 0.5	-6.23%	5.81%	**0.56%**
x_w decreases by 0.4	-5.36%	4.77%	**0.67%**
x_w decreases by 0.3	-4.38%	3.73%	**0.70%**
x_w decreases by 0.2	-3.34%	2.70%	**0.65%**
x_w decreases by 0.1	-2.24%	1.73%	**0.51%**
x_w remains the same (baseline)			
x_w increases by 0.1	1.11%	-0.70%	**-0.37%**
x_w increases by 0.2	2.21%	-1.25%	**-0.80%**
x_w increases by 0.3	3.27%	-1.65%	**-1.29%**
x_w increases by 0.4	4.30%	-1.88%	**-1.84%**
x_w increases by 0.5	5.29%	-1.92%	**-2.43%**
x_w copies x_b	6.00%	-1.85%	**-2.89%**

Table 6. Counterfactual analyses: No third-party entry in the 2024 presidential election

Matched turnout rate	Corresponding p_1/p_0	Vote share for green	Vote share for blue
No matching	1	23.77%	24.90%
65%	1.7331	31.97%	33.03%
66%	1.7877	32.49%	33.51%
67%	1.8445	33.00%	34.00%
68%	1.9037	33.52%	34.48%
69%	1.9654	34.04%	34.96%
70%	2.0301	34.56%	35.44%
71%	2.0981	35.08%	35.92%
72%	2.1697	35.61%	36.39%
73%	2.2456	36.13%	36.87%
74%	2.3262	36.65%	37.35%
75%	2.4122	37.18%	37.82%
76%	2.5045	37.71%	38.29%
77%	2.6038	38.23%	38.77%
78%	2.7114	38.76%	39.24%
79%	2.8287	39.29%	39.71%
80%	2.9572	39.82%	40.18%

Given the structural estimates reported in Table 2, the resulting ξ, and a numerical value of $\frac{p_1}{p_0}$ (in column 2), using equations (8.1) and (8.2), we construct the utilities of voting for DPP or KMT without TPP's entry. Then, we calculate individual-level choice probabilities and aggregate them up to the national level (columns 3 and 4).

Table 7. Ko's influence on the blue-white alliance

	Hou as president Ko as vice-president		Ko as president Hou as vice-president	
	Parameter	**Est.**	**Parameter**	**Est.**
Weights for **ideological stance**	$1-\varpi_{bw1}$	0.8094*** (0.1323)	ϖ_{wb1}	1.0000*** (0.0637)
Weights for **Ko's nonideological effect**	$1-\varpi_{bw2}$	0.5446*** (0.1114)	ϖ_{wb2}	0.6842*** (0.0535)
Weights for **location-level shock**	$1-\varpi_{bw3}$	0.0000 (0.3287)	ϖ_{wb3}	0.2268*** (0.0231)
Perceived voting efficacy	$\frac{p_2}{p_0}$	8.4847*** (0.2496)	$\frac{p_2}{p_0}$	14.3729*** (1.9056)

Given the estimates of $\{\mu, \lambda, \sigma_1, \sigma_2, \rho, x_b, x_w, \varphi\}$ reported in Table 2, $\{\varpi_{bw1}, \varpi_{bw2}, \varpi_{bw3}, p_2/p_0\}$ or $\{\varpi_{wb1}, \varpi_{wb2}, \varpi_{wb3}, p_2/p_0\}$ are estimated accordingly. The standard errors in parentheses are adjusted using the correction methods developed by Murphy and Topel (1985). * denotes significance at a 10% level. ** denotes significance at a 5% level. *** denotes significance at a 1% level.

Table 8. Ko's influence through endorsement

	Ko endorses green		Ko endorses blue	
Weights for	**Parameter**	**Est.**	**Parameter**	**Est.**
Ideological stance	$1-\kappa_{g1}$	0.0358*** (0.0130)	$1-\kappa_{b1}$	0.3615** (0.1744)
Ko's nonideological effect	$1-\kappa_{g2}$	0.5265*** (0.0637)	$1-\kappa_{b2}$	0.0000 (0.0019)
Location-level shock	$1-\kappa_{g3}$	0.9367*** (0.1502)	$1-\kappa_{b3}$	0.0000 (0.5134)

Given the estimates of $\{\mu, \lambda, \sigma_1, \sigma_2, \rho, x_b, x_w, \varphi\}$ reported in Table 2, $\{\kappa_{g1}, \kappa_{g2}, \kappa_{g3}\}$ or $\{\kappa_{b1}, \kappa_{b2}, \kappa_{b3},\}$ are estimated accordingly. The standard errors in parentheses are adjusted using the correction methods developed by Murphy and Topel (1985). * denotes significance at a 10% level. ** denotes significance at a 5% level. *** denotes significance at a 1% level.

Online Appendix

Appendix A. Derivation from u_j to V_j

A.1. Two-party political system

Suppose that there are only two candidates g and b. Denote the numbers of votes for candidates g and b without voter i's vote as N_g and N_b, respectively. The situations facing voter i are classified into five mutually exclusive events: $N_g = N_b$, $N_g - N_b = 1$, $N_b - N_g = 1$, $N_g - N_b > 1$, and $N_b - N_g > 1$. After voter i makes her choice, if the number of votes for g is greater than that for b, then voter i obtains a utility u_g; if the number of votes for b is greater than that for b, then voter i obtains a utility u_b; if there is a tie, voter i's expected utility is $\frac{u_g+u_b}{2}$. The cost of turning out is φ. The utilities associated with voter i's different choices in different events are summarized in the following table:

	Mutually exclusive events				
Without voter i	$N_g = N_b$	$N_g - N_b = 1$	$N_b - N_g = 1$	$N_g - N_b > 1$	$N_b - N_g > 1$
Vote for g	u_g	u_g	$\frac{u_g + u_b}{2}$	u_g	u_b
Vote for b	u_b	$\frac{u_g + u_b}{2}$	u_b	u_g	u_b
Not vote	$\frac{u_g + u_b}{2}$	u_g	u_b	u_g	u_b

Without knowing other voters' choices, the expected utilities of voter i for voting for candidates g and b and the expected utility of not voting are as follows:

$$\begin{aligned}\tilde{V}_g = {} & Prob(N_g = N_b)u_g + Prob(N_g - N_b = 1)u_g \\ & + Prob(N_b - N_g = 1)\frac{u_g + u_b}{2} + Prob(N_g - N_b > 1)u_g \\ & + Prob(N_b - N_g > 1)u_b - \varphi\end{aligned} \tag{A.1}$$

$$\begin{aligned}\tilde{V}_b = {} & Prob(N_g = N_b)u_b + Prob(N_g - N_b = 1)\frac{u_g + u_b}{2} \\ & + Prob(N_b - N_g = 1)u_b + Prob(N_g - N_b > 1)u_g \\ & + Prob(N_b - N_g > 1)u_b - \varphi\end{aligned} \tag{A.2}$$

$$\tilde{V}_o = Prob(N_g = N_b)\frac{u_g + u_b}{2} + Prob(N_g - N_b = 1)u_g + Prob(N_b - N_g = 1)u_b + Prob(N_g - N_b > 1)u_g + Prob(N_b - N_g > 1)u_b \quad \text{(A.3)}$$

Given that only the differences among these utilities matter, we can normalize the utility of the outside option as $V_o = 0$. Correspondingly, we have the following:

$$V_g = \tilde{V}_g - \tilde{V}_o = Prob(N_g = N_b)\frac{u_g - u_b}{2} + Prob(N_b - N_g = 1)\frac{u_g - u_b}{2} - \varphi \quad \text{(A.4)}$$

$$V_b = \tilde{V}_b - \tilde{V}_o = Prob(N_g = N_b)\frac{u_b - u_g}{2} + Prob(N_g - N_b = 1)\frac{u_b - u_g}{2} - \varphi \quad \text{(A.5)}$$

Assuming that $Prob(N_g = N_b) = Prob(N_b - N_g = 1) = Prob(N_g - N_b = 1) = p$, then we have the following:

$$V_g = p(u_g - u_b) - \varphi \quad \text{(A.6)}$$

$$V_b = p(u_b - u_g) - \varphi \quad \text{(A.7)}$$

A.2. Three-party political system

Suppose that there are three candidates g, b, and w. Denote the numbers of votes for candidates g, b, and w without voter i's vote as N_g, N_b, and N_w, respectively. The situation facing voter i can be classified into three types of mutually exclusive events: voter i's choice is either pivotal for all three candidates, pivotal for only two candidates, or not pivotal at all. Given that the number of eligible voters is large, the probability of voter i's choice being pivotal for all three candidates is a higher-order small amount than that of being pivotal for only two candidates and hence can be ignored. Consequently, we need to consider only the latter two types.

The latter two types of mutually exclusive events can be further classified into three categories: N_w is sufficiently smaller than N_g and N_b; N_b is sufficiently smaller than N_g and N_w; or N_g is sufficiently smaller than N_b and N_w. Denote these three categories as {I}, {II}, and {III}, respectively. The utilities associated with

voter i's different choices in different events are summarized in the following table:

	Events in category I (N_w is sufficiently smaller than N_g and N_b)				
Choice	$N_g = N_b$	$N_g - N_b = 1$	$N_b - N_g = 1$	$N_g - N_b > 1$	$N_b - N_g > 1$
Vote for g	u_g	u_g	$\frac{u_g + u_b}{2}$	u_g	u_b
Vote for b	u_b	$\frac{u_g + u_b}{2}$	u_b	u_g	u_b
Vote for w	$\frac{u_g + u_b}{2}$	u_g	u_b	u_g	u_b
Not vote	$\frac{u_g + u_b}{2}$	u_g	u_b	u_g	u_b
	Events in category II (N_b is sufficiently smaller than N_g and N_w)				
Choice	$N_g = N_w$	$N_g - N_w = 1$	$N_w - N_g = 1$	$N_g - N_w > 1$	$N_w - N_g > 1$
Vote for g	u_g	u_g	$\frac{u_g + u_w}{2}$	u_g	u_w
Vote for b	$\frac{u_g + u_w}{2}$	u_g	u_w	u_g	u_w
Vote for w	u_w	$\frac{u_g + u_w}{2}$	u_w	u_g	u_w
Not vote	$\frac{u_g + u_w}{2}$	u_g	u_w	u_g	u_w
	Events in category III (N_g is sufficiently smaller than N_b and N_w)				
Choice	$N_b = N_w$	$N_b - N_w = 1$	$N_w - N_b = 1$	$N_b - N_w > 1$	$N_w - N_b > 1$
Vote for g	$\frac{u_b + u_w}{2}$	u_b	u_w	u_b	u_w
Vote for b	u_b	u_b	$\frac{u_b + u_w}{2}$	u_b	u_w
Vote for w	u_w	$\frac{u_b + u_w}{2}$	u_w	u_b	u_w
Not vote	$\frac{u_b + u_w}{2}$	u_b	u_w	u_b	u_w

Without knowing other voters' choices, the expected utilities of voter i for voting for candidates g, b, or w and the expected utility of not voting are as follows:

$$
\begin{aligned}
\tilde{V}_g = {} & Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)u_g + Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big)\frac{u_g + u_b}{2} \\
& + Prob\big(N_g - N_b > 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g > 1 \; and \; \{\mathrm{I}\}\big)u_b \\
& + Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big)\frac{u_g + u_w}{2} \\
& + Prob\big(N_g - N_w > 1 \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_w - N_g > 1 \; and \; I\{\mathrm{II}\}\big)u_w \\
& + Prob(N_b = N_w \; and \; \{\mathrm{I}I\mathrm{I}\})\frac{u_b + u_w}{2} \\
& + Prob(N_b - N_w = 1 \; and \; \{\mathrm{II}I\})u_b \\
& + Prob(N_w - N_b = 1 \; and \; \{\mathrm{II}I\})u_w \\
& + Prob(N_b - N_w > 1 \; and \; \{\mathrm{II}I\})u_b \\
& + Prob(N_w - N_b > 1 \; and \; \{\mathrm{II}I\})u_w - \varphi
\end{aligned}
\tag{A.8}
$$

$$\tilde{V}_b = Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)u_b + Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big)\frac{u_g + u_b}{2}$$
$$+ Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big)u_b$$
$$+ Prob\big(N_g - N_b > 1 \; and \; \{\mathrm{I}\}\big)u_g$$
$$+ Prob\big(N_b - N_g > 1 \; and \; \{\mathrm{I}\}\big)u_b$$
$$+ Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)\frac{u_g + u_w}{2}$$
$$+ Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big)u_g$$
$$+ Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big)u_w \qquad \text{(A.9)}$$
$$+ Prob\big(N_g - N_w > 1 \; and \; \{\mathrm{II}\}\big)u_g$$
$$+ Prob\big(N_w - N_g > 1 \; and \; I\{\mathrm{II}\}\big)u_w$$
$$+ Prob(N_b = N_w \; and \; \{\mathrm{III}\})u_b$$
$$+ Prob(N_b - N_w = 1 \; and \; \{\mathrm{III}\})u_b$$
$$+ Prob(N_w - N_b = 1 \; and \; \{\mathrm{III}\})\frac{u_b + u_w}{2}$$
$$+ Prob(N_b - N_w > 1 \; and \; \{\mathrm{III}\})u_b$$
$$+ Prob(N_w - N_b > 1 \; and \; \{\mathrm{III}\})u_w - \varphi$$

$$
\begin{aligned}
\tilde{V}_w = {} & Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)\frac{u_g + u_b}{2} + Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big)u_b \\
& + Prob\big(N_g - N_b > 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g > 1 \; and \; \{\mathrm{I}\}\big)u_b \\
& + Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)u_w \\
& + Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big)\frac{u_g + u_w}{2} \\
& + Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big)u_w \\
& + Prob\big(N_g - N_w > 1 \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_w - N_g > 1 \; and \; I\{\mathrm{II}\}\big)u_w \\
& + Prob(N_b = N_w \; and \; \{\mathrm{III}\})u_w \\
& + Prob(N_b - N_w = 1 \; and \; \{\mathrm{III}\})\frac{u_b + u_w}{2} \\
& + Prob(N_w - N_b = 1 \; and \; \{\mathrm{III}\})u_w \\
& + Prob(N_b - N_w > 1 \; and \; \{\mathrm{III}\})u_b \\
& + Prob(N_w - N_b > 1 \; and \; \{\mathrm{III}\})u_w - \varphi
\end{aligned}
\tag{A.10}
$$

$$
\begin{aligned}
\tilde{V}_o = {} & Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)\frac{u_g + u_b}{2} + Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big)u_b \\
& + Prob\big(N_g - N_b > 1 \; and \; \{\mathrm{I}\}\big)u_g \\
& + Prob\big(N_b - N_g > 1 \; and \; \{\mathrm{I}\}\big)u_b \\
& + Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)\frac{u_g + u_w}{2} \\
& + Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big)u_w \\
& + Prob\big(N_g - N_w > 1 \; and \; \{\mathrm{II}\}\big)u_g \\
& + Prob\big(N_w - N_g > 1 \; and \; I\{\mathrm{II}\}\big)u_w \\
& + Prob(N_b = N_w \; and \; \{\mathrm{III}\})\frac{u_b + u_w}{2} \\
& + Prob(N_b - N_w = 1 \; and \; \{\mathrm{III}\})u_b \\
& + Prob(N_w - N_b = 1 \; and \; \{\mathrm{III}\})u_w \\
& + Prob(N_b - N_w > 1 \; and \; \{\mathrm{III}\})u_b \\
& + Prob(N_w - N_b > 1 \; and \; \{\mathrm{III}\})u_w
\end{aligned}
\tag{A.11}
$$

Given that only the differences among these utilities matter, we can normalize the utility of the outside option as $V_o = 0$. Correspondingly, we have the following

$$
\begin{aligned}
V_g = \tilde{V}_g - \tilde{V}_o = {} & Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)\frac{u_g - u_b}{2} \\
& + Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big)\frac{u_g - u_b}{2} \\
& + Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)\frac{u_g - u_w}{2} \\
& + Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big)\frac{u_g - u_w}{2} - \varphi
\end{aligned}
\tag{A.12}
$$

$$
\begin{aligned}
V_b = \tilde{V}_b - \tilde{V}_o \; &= Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big)\frac{u_b - u_g}{2} \\
&+ Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big)\frac{u_b - u_g}{2} \\
&+ Prob(N_b = N_w \; and \; \{\mathrm{III}\})\frac{u_b - u_w}{2} \\
&+ Prob(N_w - N_b = 1 \; and \; \{\mathrm{III}\})\frac{u_b - u_w}{2} - \varphi \\
V_w = \tilde{V}_w - \tilde{V}_o \; &= Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big)\frac{u_w - u_g}{2} \\
&+ Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big)\frac{u_w - u_g}{2} \\
&+ Prob(N_b = N_w \; and \; \{\mathrm{III}\})\frac{u_w - u_b}{2} \\
&+ Prob(N_b - N_w = 1 \; and \; \{\mathrm{III}\})\frac{u_w - u_b}{2} - \varphi
\end{aligned}
\tag{A.13, A.14}
$$

For simplicity, we assume that the subjective probability of voter i's vote being pivotal for any two parties is identical, i.e.:

$$
\begin{aligned}
Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big) &= Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big) \\
&= Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big) \\
&= Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big) \\
&= Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big) \\
&= Prob(N_b = N_w \; and \; \{\mathrm{III}\}) \\
&= Prob(N_w - N_b = 1 \; and \; \{\mathrm{III}\}) \\
&= Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big) \\
&= Prob(N_b - N_w = 1 \; and \; \{\mathrm{III}\}) = p
\end{aligned}
\tag{A.15}
$$

Given this assumption, we have the following:

$$V_g = p\big(2u_g - u_b - u_w\big) + \varphi \tag{A.16}$$

$$V_b = p\big(2u_b - u_g - u_w\big) + \varphi \tag{A.17}$$

$$V_w = p\big(2u_w - u_g - u_b\big) + \varphi \tag{A.18}$$

The assumption represented by equation (A.15) requires that the subjective probabilities that voter i's choice is pivotal for candidates g and b, for g and w, or

for b and w are indifferent to each other. However, one may argue that the subjective pivotal probability for the two candidates ranking first and second in the poll before the election may be greater than that for the two candidates ranking first and third and that for the two candidates ranking second and third.

At least, there are three rationales behind that assumption. First, the vote shares of the three candidates are not far different from each other both in the actual election (40.05%, 33.49%, and 26.46%) and in the ex-ante polls (38.9%~41.3%, 33.0%~36.0%, and 24.5%~27.0%). Second, many entities conducted polls and published different results in Taiwan. Polls predicting the blue candidate or the white candidate as the winner also existed; meanwhile, voters in favor of a certain candidate are more likely to trust the polls that are biased toward that candidate. Second, unlike the U.S., poll entities are prohibited by laws in Taiwan from publishing polling results during the ten days right before the election date (the blackout period on polling), which introduces some ambiguity of each candidate's current approval rate for voters' decision making on the election date.[42]

A.3. Relaxing the assumption represented by equation (A.15)

As robustness checks, we allow the subjective probabilities that voter i's choice is pivotal for candidates g and b, for g and w, or for b and w are different from each other. Let

$$Prob\big(N_g = N_b \; and \; \{\mathrm{I}\}\big) = Prob\big(N_b - N_g = 1 \; and \; \{\mathrm{I}\}\big) = Prob\big(N_g - N_b = 1 \; and \; \{\mathrm{I}\}\big) = \mathbb{p}_1 \tag{A.19}$$

$$Prob\big(N_g = N_w \; and \; \{\mathrm{II}\}\big) = Prob\big(N_w - N_g = 1 \; and \; \{\mathrm{II}\}\big) = Prob\big(N_g - N_w = 1 \; and \; \{\mathrm{II}\}\big) = \mathbb{p}_2 \tag{A.20}$$

[42] This prohibition and the resulting ambiguity of each candidate's current approval rate on the election date may partially explain why the turnout rate is greater in Taiwan than in the U.S. Within the ten days right before the election date, entities in Taiwan can still conduct polls but can only publish the results after the election.

$$Prob(N_b = N_w \; and \; \{\text{III}\}) = Prob(N_w - N_b = 1 \; and \; \{\text{III}\}) \\ = Prob(N_b - N_w = 1 \; and \; \{\text{III}\}) = \mathbb{p}_3 \tag{A.21}$$

Then, we have the following:

$$V_g = (\mathbb{p}_1 + \mathbb{p}_2)u_g - \mathbb{p}_1 u_b - \mathbb{p}_2 u_w - \varphi \tag{A.22}$$

$$V_b = (\mathbb{p}_1 + \mathbb{p}_3)u_b - \mathbb{p}_1 u_g - \mathbb{p}_3 u_w - \varphi \tag{A.23}$$

$$V_w = (\mathbb{p}_2 + \mathbb{p}_3)u_w - \mathbb{p}_2 u_g - \mathbb{p}_3 u_b - \varphi \tag{A.24}$$

Denote the vote shares of candidates g, b, and w published by the Formosa poll's last wave prior to ten days before the election as $\hat{S}_g$, $\hat{S}_b$, and $\hat{S}_w$, respectively. Assume the following:

$$\mathbb{p}_1 = \hat{S}_g \hat{S}_b \mathbb{p} \tag{A.25}$$

$$\mathbb{p}_2 = \hat{S}_g \hat{S}_w \mathbb{p} \tag{A.26}$$

$$\mathbb{p}_3 = \hat{S}_b \hat{S}_w \mathbb{p} \tag{A.27}$$

where $\mathbb{p}$ is a scalar. Then, we have the following:

$$V_g = \left(\hat{S}_g \hat{S}_b + \hat{S}_g \hat{S}_w\right)\mathbb{p} u_g - \hat{S}_g \hat{S}_b \mathbb{p} u_b - \hat{S}_g \hat{S}_w \mathbb{p} u_w - \varphi \tag{A.28}$$

$$V_b = \left(\hat{S}_g \hat{S}_b + \hat{S}_b \hat{S}_w\right)\mathbb{p} u_b - \hat{S}_g \hat{S}_b \mathbb{p} u_g - \hat{S}_b \hat{S}_w \mathbb{p} u_w - \varphi \tag{A.29}$$

$$V_w = \left(\hat{S}_g \hat{S}_w + \hat{S}_b \hat{S}_w\right)\mathbb{p} u_w - \hat{S}_g \hat{S}_w \mathbb{p} u_g - \hat{S}_b \hat{S}_w \mathbb{p} u_b - \varphi \tag{A.30}$$

Because $\mathbb{p}$ is a scalar and can be captured by the parameters in u_g, u_b, and u_w, we can rewrite equations (A.31), (A.32), and (A.33) as follows:

$$V_g = \left(\hat{S}_g \hat{S}_b + \hat{S}_g \hat{S}_w\right)u_g - \hat{S}_g \hat{S}_b u_b - \hat{S}_g \hat{S}_w u_w - \varphi \tag{A.31}$$

$$V_b = \left(\hat{S}_g \hat{S}_b + \hat{S}_b \hat{S}_w\right)u_b - \hat{S}_g \hat{S}_b u_g - \hat{S}_b \hat{S}_w u_w - \varphi \tag{A.32}$$

$$V_w = \left(\hat{S}_g \hat{S}_w + \hat{S}_b \hat{S}_w\right)u_w - \hat{S}_g \hat{S}_w u_g - \hat{S}_b \hat{S}_w u_b - \varphi \tag{A.33}$$

The results of the structural estimation based on this alternative assumption are similar to those based on the original one and they are available upon request.

Appendix B.

B.1. Derivations from the first line to the last line of equations (8.1) and (8.2)

Based on equations (8.1) and (8.2), we have the following:

$$\begin{aligned} V_{ig} &= \frac{p_1}{p_0}\left(u_{ig} - u_{ib}\right) - \varphi - \varrho_k + \epsilon_{ig} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ig} - \bar{u}_{ib} + \varsigma_{kg} - \varsigma_{kb}\right) - \varrho_k - \varphi + \epsilon_{ig} \end{aligned} \tag{B.1}$$

$$\begin{aligned} V_{ib} &= \frac{p_1}{p_0}\left(u_{ib} - u_{ig}\right) - \varphi - \varrho_k + \epsilon_{ib} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ib} - \bar{u}_{ig} + \varsigma_{kb} - \varsigma_{kg}\right) - \varrho_k - \varphi + \epsilon_{ib} \end{aligned} \tag{B.2}$$

Adding equations (4.11), (4.12), and (4.13) together, we obtain the following:

$$\varrho_k = -\frac{1}{3}\left(\xi_{kg} + \xi_{kb} + \xi_{kw}\right) \tag{B.3}$$

Considering equation (4.11) minus equation (4.12), we have the following:

$$\varsigma_{kg} - \varsigma_{kb} = \frac{1}{3}\left(\xi_{kg} - \xi_{kb}\right) \tag{B.4}$$

Plugging (B.3) and (B.4) into (B.1) and (B.2), we have the following:

$$\begin{aligned} V_{ig} &= \frac{p_1}{p_0}\left(\bar{u}_{ig} - \bar{u}_{ib}\right) + \frac{p_1}{p_0}\frac{1}{3}\left(\xi_{kg} - \xi_{kb}\right) + \frac{1}{3}\left(\xi_{kg} + \xi_{kb} + \xi_{kw}\right) - \varphi + \epsilon_{ig} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ig} - \bar{u}_{ib}\right) + \frac{1}{3}\left[\left(1 + \frac{p_1}{p_0}\right)\xi_{kg} + \left(1 - \frac{p_1}{p_0}\right)\xi_{kb} + \xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{ig} \end{aligned} \tag{B.5}$$

$$\begin{aligned} V_{ib} &= \frac{p_1}{p_0}\left(\bar{u}_{ib} - \bar{u}_{ig}\right) + \frac{p_1}{p_0}\frac{1}{3}\left(\xi_{kb} - \xi_{kg}\right) + \frac{1}{3}\left(\xi_{kg} + \xi_{kb} + \xi_{kw}\right) - \varphi + \epsilon_{ib} \\ &= \frac{p_1}{p_0}\left(\bar{u}_{ib} - \bar{u}_{ig}\right) + \frac{1}{3}\left[\left(1 - \frac{p_1}{p_0}\right)\xi_{kg} + \left(1 + \frac{p_1}{p_0}\right)\xi_{kb} + \xi_{kw}\right] \\ &\quad - \varphi + \epsilon_{ib} \end{aligned} \tag{B.6}$$

B.2. Derivations from the first line to the last line of equations (9.2) and (9.3)

$$\begin{aligned} V_{ig} &= u_{ig} - u_{ibw} - \varphi - \varrho_k + \epsilon_{ig} \\ &= \bar{u}_{ig} - \bar{u}_{ibw} + \varsigma_{kg} - \varpi_{bw3}\varsigma_{kb} - (1 - \varpi_{bw3})\varsigma_{kw} - \varrho_k \\ &\quad - \varphi + \epsilon_{ig} \\ &= \bar{u}_{ig} - \bar{u}_{ibw} + \varsigma_{kg} - \varsigma_{kw} - \varpi_{bw3}(\varsigma_{kb} - \varsigma_{kw}) - \varrho_k - \varphi \\ &\quad + \epsilon_{ig} \end{aligned} \tag{B.7}$$

$$
\begin{aligned}
V_{ibw} &= u_{ibw} - u_{ig} - \varphi - \varrho_k + \epsilon_{ibw} \\
&= \bar{u}_{ibw} - \bar{u}_{ig} + \varpi_{bw3}\varsigma_{kb} + (1 - \varpi_{bw3})\varsigma_{kw} - \varsigma_{kg} - \varrho_k \\
&\quad - \varphi + \epsilon_{ibw} \\
&= \bar{u}_{ibw} - \bar{u}_{ig} + \varpi_{bw3}(\varsigma_{kb} - \varsigma_{kw}) + \varsigma_{kw} - \varsigma_{kg} - \varrho_k - \varphi \\
&\quad + \epsilon_{ibw}
\end{aligned} \tag{B.8}
$$

Considering equation (4.11) minus equation (4.13), we have the following:

$$
\varsigma_{kg} - \varsigma_{kw} = \frac{1}{3}\left(\xi_{kg} - \xi_{kw}\right) \tag{B.9}
$$

Considering equation (4.12) minus equation (4.13), we have the following:

$$
\varsigma_{kb} - \varsigma_{kw} = \frac{1}{3}(\xi_{kb} - \xi_{kw}) \tag{B.10}
$$

Plugging (B.3), (B.9), and (B.10) into (B.7) and (B.8), we have the following:

$$
V_{ig} = \bar{u}_{ig} - \bar{u}_{ibw} + \frac{1}{3}\left[2\xi_{kg} + (1 - \varpi_{bw3})\xi_{kb} + \varpi_{bw3}\xi_{kw}\right] - \varphi + \epsilon_{ig} \tag{B.11}
$$

$$
V_{ibw} = \bar{u}_{ibw} - \bar{u}_{ig} + \frac{1}{3}[(1 + \varpi_{bw3})\xi_{kb} + (2 - \varpi_{bw3})\xi_{kw}] - \varphi + \epsilon_{ibw} \tag{B.12}
$$

B.3. Derivations from the first line to the last line of equations (10.2), (10.3), and (10.4)

$$
\begin{aligned}
V_{ig} &= 2u_{ig} - u_{ib} - u_{iw} - \varphi - \varrho_k + \epsilon_{ig} \\
&= 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} + 2\kappa_{g3}\varsigma_{kg} + 2\left(1 - \kappa_{g3}\right)\varsigma_{kw} - \varsigma_{kb} \\
&\quad - \varsigma_{kw} - \varrho_k - \varphi + \epsilon_{ig} \\
&= 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} + 2\kappa_{g3}\left(\varsigma_{kg} - \varsigma_{kw}\right) + \varsigma_{kw} - \varsigma_{kb} - \varrho_k \\
&\quad - \varphi + \epsilon_{ig}
\end{aligned} \tag{B.13}
$$

$$
\begin{aligned}
V_{ib} &= 2u_{ib} - u_{ig} - u_{iw} - \varphi - \varrho_k + \epsilon_{ib} \\
&= 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{ig} + 2\varsigma_{kb} - \kappa_{g3}\varsigma_{kg} - \left(1 - \kappa_{g3}\right)\varsigma_{kw} - \varrho_k \\
&\quad - \varphi + \epsilon_{ib} \\
&= 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{ig} + 2(\varsigma_{kb} - \varsigma_{kw}) + \kappa_{g3}\left(\varsigma_{kw} - \varsigma_{kg}\right) \\
&\quad - \varrho_k - \varphi + \epsilon_{ib}
\end{aligned} \tag{B.14}
$$

$$
\begin{aligned}
V_{iw} &= 2u_{iw} - u_{ig} - u_{ib} - \varphi - \varrho_k + \epsilon_{iw} \\
&= 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ib} + 2\varsigma_{kw} - \kappa_{g3}\varsigma_{kg} - \left(1 - \kappa_{g3}\right)\varsigma_{kw} \\
&\quad - \varsigma_{kb} - \varrho_k - \varphi + \epsilon_{iw} \\
&= 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ib} + 2(\varsigma_{kw} - \varsigma_{kb}) + \kappa_{g3}\left(\varsigma_{kw} - \varsigma_{kg}\right) \\
&\quad - \varsigma_{kb} - \varrho_k - \varphi + \epsilon_{iw}
\end{aligned} \tag{B.15}
$$

Plugging (B.3), (B.9), and (B.10) into (B.13), (B.14), and (B.15), we have the following:

$$
V_{ig} = 2\bar{u}_{ig} - \bar{u}_{ib} - \bar{u}_{iw} + \frac{1}{3}\left[\left(1 + 2\kappa_{g3}\right)\xi_{kg} + \left(2 - 2\kappa_{g3}\right)\xi_{kw}\right] - \varphi + \epsilon_{ig} \tag{B.16}
$$

$$
\begin{aligned}
V_{ib} &= 2\bar{u}_{ib} - \bar{u}_{ig} - \bar{u}_{ig} + \frac{1}{3}\left[\left(1 - \kappa_{g3}\right)\xi_{kg} + 3\xi_{kb} + \left(\kappa_{g3} - 1\right)\xi_{kw}\right] - \varphi \\
&\quad + \epsilon_{ib}
\end{aligned} \tag{B.17}
$$

$$
V_{iw} = 2\bar{u}_{iw} - \bar{u}_{ig} - \bar{u}_{ib} + \frac{1}{3}\left[\left(1 - \kappa_{g3}\right)\xi_{kg} + \left(2 + \kappa_{g3}\right)\xi_{kw}\right] - \varphi + \epsilon_{iw} \tag{B.18}
$$