Electoral Reform and Pork Barrel in Parliamentary Questions

David, Yen-Chieh Liao[*]

University of Essex, UK

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Abstract

Measuring legislator behaviours and tendencies towards constituencies under different electoral systems is important. This paper quantitatively investigates this topic using the case of Taiwan Legislative Yuan and data on written parliamentary questions through an electoral reform from multi-member districts (MMD) to single-member districts (SMD). With existing labelled pork legislation, I train deep learning models using convolutional neural networks with an embedding layer extracted from Transformer BERT to detect pork-barrel features in parliamentary questions over time. Evidence exists to show that legislators under MMD are more likely to express political intention about pork-barrel projects in written parliamentary questions. The institutional change subsequently demonstrates heterogeneous effects on major parties vis-à-vis minority parties, respectively.

1 Introduction

How does the electoral reform change legislators' preference and their intentions to bring home the bacon? Scholars have clearly explained why intraparty competition by different rules of electoral systems increases legislators' incentives to run on a personal reputation (Cox 1990; Downs 1990; Carey and Shugart 1995). For example, candidates under multi-member districts (MMD) are more likely to reward small groups of supporters with particularised benefits and deviate from their party line, whereas candidates under single-member districts (SMD) prefer to adopt electoral strategies that target median voters (Cox 1990). With abundant literature on an empirical examination of the relationship between electoral systems and political behaviours (e.g. Cox 1990; Catalinac 2016, 2017; Goplerud and Smith 2021), we however know little about whether actual impacts introduced by the electoral reform through MMD to SMD reduce legislators' motives to purse pork barrel project in the legislature. Understanding such legislative motions is very important for the process of policy making and decision.

Parliamentary activities such as debates and written parliamentary questions, play a significant role in most parliamentary democracies. For example, the floor debate functions as a major platform for Members of Parliament (MPs) to uncover information and discussion regarding government policy, proposed new laws and topical issues of the day. With different regulations limiting MPs to access to the floor, the distribution of time and topics tends to be restricted to displace salient issues (e.g., Bäck, Baumann, and Debus 2019; Martin 2011), which increase difficulties in discovering MPs' genuine interests in preferences (Martin 2011; Saalfeld 2011; Russo 2021) and their nature of substantive representation (Kolpinskaya 2017). On the contrary, the parliamentary questions, known as "non-legislation activities" (Martin and Rozenberg 1957), is one of the primary tools that MPs can freely use to press for action in the government and express their concerns with regards to constituency (Russo 2021; Saalfeld 2011; Martin 2011).

Measuring legislator behaviours and tendencies towards constituencies under the different systems is important. This study consider the relationships between the electoral system and the pork-barrel phenomenon, focusing in particular on legisla-

tors electoral strategies and communication style in parliamentary questions. From theoretical perspective, candidates in single non-transferable vote in multi-member districts (SNTV-MMD) were not only competing with competitors from rivalry parties but also co-partisan candidate from their party (Carey and Shugart 1995). Hence, candidates have more incentives to run on personal votes (Cain, Ferejohn, and Fiorina 1987; Carey and Shugart 1995). For example, Japanese candidates elected via SMD are more likely to pursue national-wised issues (such as defence and fiscal policy) in election manifesto than in SNTV-MMD (Catalinac 2016). However, it is hard to distinguish whether the changes in electoral strategies was caused by the reform or possibly other factors such as recession and military threats (Ishima 2020). While useful for many purposes for understating the implication of the reform, election manifesto are only distributed during election periods and is not able to instantly reflect actual preferences across times (Martin 2011).

MPs ask questions for several reasons. Generally speaking, when MPs ask written questions to the executives (ministerial officials), it may be because of their expertise or domain responsibility of delegation for question topics. Nevertheless, MPs under electoral incentives may be eager to display their attentions to constituency interests in parliamentary questions. In Martin's view (Martin 2011), for MPs to employ parliamentary questions are primarily about involving themselves in the policymaking process, and important factors to consider are their motivations to run on personal vote and differences in the electoral rules (Martin 2011, p.260). In particular, party leaders under SNTV-MMD have a strong incentive to nominate more than one candidate to run in each district in multi-member districts (Cain, Ferejohn, and Fiorina 1987; Carey and Shugart 1995; Reed 1995; Catalinac 2017). Therefore, candidates cannot rely exclusively on their party reputation and have to find an alternative means of attracting votes by running on a personal reputation, which therefore motivate candidates to deviate their party line (Cain, Ferejohn, and Fiorina 1987; Carey and Shugart 1995). Consequently, question types may coherently reflect the orientation that MPs attempt to pursue.

In this paper, I introduce the case of Taiwan Legislative Yuan, where the electoral system reformed through SNTV-MMD to SMD, to evaluate how electoral motives shape legislators' tendency to pork-barrel projects under different electoral systems. In par-

ticular, parliamentary questions are the primary channel for legislators to scrutinize the government and express political intentions. Most importantly, the number of written questions in Taiwan tables to approximately one hundred and fifty thousand since 1993. These parliamentary questions allow identification of different question topics, categories and further information regarding legislators' opinions of policy interests and agenda at the individual level, which enables us to conduct a more nuanced test of theoretical expectations than previously attempted.

Concretely, the paper described here focuses on the following two research questions: are the legislators in the SNTV-MMD more likely to bring home the bacon by asking more about the provision of particularistic goods in the parliamentary questions? 2) Dose the reform change legislators' electoral strategies and increase their attention to other public policies such as regulatory issues?

To answer the research questions, I train deep learning models on multi-convolutional neural networks with an embedding layer extracted from Transformer BERT to detect pork-barrel features in parliamentary questions over time. With Transformers' attention mechanisms, this combination approach enables the machine to learn the condensed features of embedding representation and better handle polysemous words than traditional embedding approaches like Word2Vec. Last, I employ regression analysis to test the impact of the reform occurrence and control for differences between districts and legislators through the transition. Evidence exists to show that the transition of electoral reform incurs essential changes in legislators' behaviour. Legislators under multi-member districts are more likely to express political intention about pork-barrel projects in written parliamentary questions. The reform subsequently demonstrates heterogeneous effects on major parties vis-à-vis minority parties.

2   Personal Vote and Electoral Reform in Taiwan

Since the legislative election became direct in 1992, Taiwan Legislative Yuan used the Single Non-transferable Vote in multi-member districts (SNTV-MMD) to elect 161 members with 31 districts, including party lists and seats for aboriginals and overseas Chinese.[1] Under SNTV-MMD, voters can only cast a single vote for one of the

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[1]All provincial governmental bodies were formally abolished in 1997, with budget and personnel removed. The number of seats increased from 174 to 225 in 1999 to avoid potential political chaos (Wang 2018).

candidates whose number of seats in a district range from the least number, 1 seat, to 17 seats, and the candidates who get the most votes win the seats. In the literature, scholars have explained why candidates in proportional systems have incentives to adopt electoral strategies to target a small group of voters (Cox 1990; Downs 1990; Myerson 1993). For example, SNTV-MMD was believed that intensify majority-seeking parties to run more than one candidate in a district. Party leaders need to not only consider the process of nomination but also vote management carefully. If party leaders over-nominate candidates in a district, it would generate excessive uncertainties for co-partisan candidates to run personal reputations against each others. It consequently creates more additional difficulty for party leaders to discipline voters to spread their votes equally across all a party's candidates.

In addition, district magnitude affect the structure of the party system and inter-party relation (Duverger 1954; Lancaster 1986). In the 2000s, Taiwan's SNTV-MMD has been criticized for not only creating intra-party competition (e.g., Hirano 2006) but also encouraging factional politics and money politics (Cox 1996; Cox and Niou 1994; Batto and Huang 2016; Wu 2003; Richardson 1988). More candidates in a district under SNTV-MMD require lower votes, which increases candidates' motivation to target small groups of voters (Downs 1990; Myerson 1993). Under the circumstances, the candidate not only competes with candidates from opposite parties but avoids co-partisans carving out shared voters. In practice, candidates cannot rely exclusively on their party labels and must find an alternative means of separating themselves from different co-partisans. The most conventional approach is to attract more targeted voters by cultivating a personal reputation (Cain, Ferejohn, and Fiorina 1987; Reed 1994).

In Taiwan, legislators use sponsoring legislation to signal a message to the ministries regarding particularistic goods for their constituents (Luor and Hsieh 2008), whereas the ministers in the central government particularly rely on those records related to any legislative motions to understand their preferences. For example, Luor and Liao (2009) finds that the more particularistic legislation legislators propose, the higher grant allocation the municipalities (districts) receive. Taiwan's legislators usually leave comments on the purpose of the statute or recommendation section at the end of the legislation. How do they promise to secure particularistic goods on behold

of their constituents? In general, legislators insert items or projects such as roads, bridges, tax breaks, and subsidies in the legislation. Those particularistic goods are narrowly distributed to selected groups of voters and areas corresponding to their constituencies.

In many countries, the nature of parliamentary questions is a mechanism used to impose ministers and related ministerial officials' accountability in the public domain. For example, the parliamentary questions in Taiwan's Legislative Yuan are important for the legislators to carry messages to the ministers for the constituency's needs. In particular, each legislator has an equal chance to ask for information about policy and activities of ministries related to any topic of public affairs. Unlike floor debates, the word usage and strategies for delivering debates are deliberately considered, as pointed out by (Slapin and Proksch 2014; Martin 2011). Legislators only have 15 minutes to question invited ministers on the work and policy in the affiliated committee. Thus, legislators only focus on salient topical issues and carefully use their time to question ministers in a minimal period.

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Hypothesis 1 *Under SNTV-MMD, legislators are more likely to propose parliamentary questions regarding the provision of particularistic goods.*

3 Parliamentary Questions and Particularistic Benefits

Parliamentary questions provide a variety of purposes. For example, MPs scrutinize the governments by asking questions without strict party discipline. As a result, the content of the question should be evident if MPs developed a tendency to run on personal reputation. While parliamentary questions as the unit of analysis provide a valuable proxy for understanding MP's representation and electoral purpose, few systematic studies have explained to what extent the reform diminishes legislators' incentive to ask questions devoted to particularistic goods.

To date, most researchers observing the effects of the electoral system on political representation in parliamentary democracies have neither focused on the party-level unit such as floor debates and manifestos nor legislator-level analysis on social media (Høyland and Søyland 2019; Catalinac 2016, 2017; Guinaudeau and Costa 2021; Schürmann and Stier 2022). For example, elected legislators from districts mention more territorial references on Facebook and Twitter than those from party lists (Schürmann and Stier 2022), whereas the reform through SNTV to SMD in Japan decreased LDP candidates' intention to mention particularistic goods in election manifesto (Catalinac 2017). In similar, Taiwan's reform through SNTV-MMD to SMD lessens the legislators' incentive to sponsor pork-barrel legislation with regard to secure particularistic goods geographically (Luor and Hsieh 2008; Luor and Liao 2009).

However, while these approaches in the literature provide valuable implications for studying the impact of the different electoral systems on political representation, there are fundamental limitations. First, analyses of parliamentary speeches have become popular due to the advent of hands-on computational tools. However, access to the floor for speeches tends to be generally restricted and capped (Proksch and Slapin 2009; Martin 2011). Similarly, the process of passing new legislation is hugely greater than most legislators can afford. In particular, members of congressional committees are more likely to grandstand in hearings when being in disadvantaged status (Park

2021). These publicities in the context of the US and UK are more efficient for representatives to distinguish themselves from co-partisans to attract more additional voters (Slapin et al. 2018). While parliamentary questions are not subject to these limitations, analyses of question content allow us to test the theoretical perspective. As theoretically expected, legislators under SNTV-MMD are expected to target smaller groups of voters by asking questions devoted to mentioning particularistic quantities when facing their won co-partisan threat. Therefore, legislators tend to oversee the government in the new SMD system by asking general questions related to programmatic and regulatory policies. Thus, it gives rise to a second hypothesis is:

Hypothesis 2 *Under SMD-MMM, legislators are more like to ask questions related to programmatic and regulatory policies.*

4   Data: Parliamentary Questions

Parliamentary questions recorded in Taiwan Legislative Yuan cover a wide range of topics, with nearly 230 unique subjects. In order to analyze parliamentary questions, I have webscraped the parliamentary questions from the official website of Taiwan Legislative Yuan from 1993 to 2020, including the relevant information about the classified topics, selected keywords and the corresponding question categories.[2]
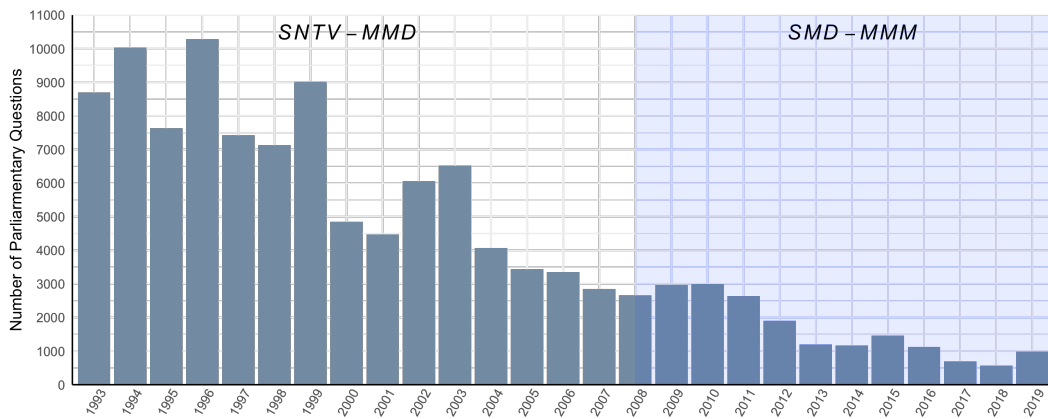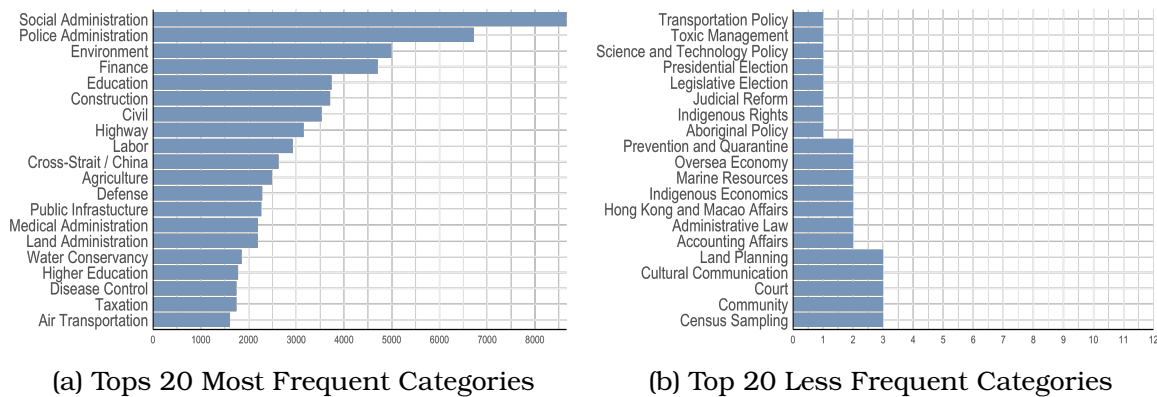

Figure 1: The Number of Parliamentary Questions from 1993 to 2019

To display the distribution of the questions across years, Figure 2 demonstrates the total number of parliamentary questions documented from 1993 to 2019. During

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[2]The designed scraper programme for retrieving parliamentary question from Taiwan Legislative Yuan can be found at https://github.com/davidycliao/legisCrawler.

this period, the Taiwan legislature went through the movement of reducing legislative seats, which started in 2000, and the reform occurred in 2008. In the pre-2000 period, the number of questions asked remained roughly stable with multiple fluctuations. Nevertheless, there was a noticeable drop in the number of questions since 2000, right after the start of the movement. This trend persisted, and the total number of questions plummeted.

The Figure 2a shows the top 20 categories of topics that were frequently asked during the period. Topic categories related to social administration and police administration were the top two topics that appeared in the discussions in the legislature. Coming next are categories about environment and finance.

(a) Tops 20 Most Frequent Categories   (b) Top 20 Less Frequent Categories

Figure 2: The Distribution of Parliamentary Questions Categories Asked by Legislators

5   Training Deep Learning Model with Pork Barrel Legislation

This paper takes advantage of using the Pork-barrel Legislation Dataset assembled by Prof. Dr Ching Jyuhn Luor (Luor and Hsieh 2008; Luor and Liao 2009; Luor and Chan 2012) to train the deep learning model proposed by this paper. The collection of the dataset consists of 7243 pieces of legislation which were manually annotated as *Pork (with label 1)* or *Non-Pork (with label 0)* from 2004 to 2008. In addition, this dataset was cross-coded by three social scone researchers to perform its validity, which achieves 98% in terms of consistency and preciseness among coders (Luor and Hsieh 2008; Luor and Liao 2009).

The gold standard for identifying the pork-barrel legislation is based on the target beneficiaries of the policy (distributed vs concentrated) and attributes of policy

立法院議案關係文書 （中華民國41年9月起編號）
中華民國96年3月28日印發

院總第 1687 號　委員提案第 7375 號

the purpose of statute

案由：本院委員林重謨、蔡啟芳、侯水盛、潘孟安、盧天麟、高建智、余政道、唐碧娥等 40 人，有鑒於最低基本工資可視為人民維持基本生活水準之意涵，現行每月僅有五千元的老年農民福利津貼相較於一萬五千八百四十元之法定基本工資，實

increase farmer's allowance from NTD 5000

已偏低，不但無法維持老年農民基本生活需求，亦與老年農民長期對國家的貢獻不成正比，更有違政府落實照顧農民的承諾，再加上近年來物價年年高漲，使老年農民生活的艱苦更加雪上加霜。職是之故，基於保障老年農民基本生活水準

improving living standards

，肯定老年農民之貢獻並提昇其生活品質，特擬具「老年農

in light of the contribution made by the farmers

民福利津貼暫行條例第四條修正案」，比照國內法定基本工資之標準，將現行老年農民福利津貼發放金額由每月五千元提高至每月一萬五千元。是否有當，敬請公決。

to NTD 15000

Figure 3: Pork Bill Legislation Regarding Improving the Quality of Retired Farmers' Life

cost (distributed vs concentrated), as is illustrated in Figure 4 (Wilson and DiIulio 2001). In particular, typical pork-barrel policies (or legislation) mainly incur distributed costs while generating parochial benefits for specific regions or designated population groups. For instance, the decision to execute an areotropolis project, which involves constructing an airport within a particular area, e.g. Taoyuan City, incurs collective costs for all Taiwanese taxpayers, while the benefit of such a particularistic project is narrowly concentrated within a parochial group of Taoyuan residents (in terms of employment opportunities, economic development, and convenience of the airport) as well as local politicians such as legislators themselves. Moreover, the other evident example is the subsidy for the targeted populations. As illustrated in Figure 3, the purpose of legislation was proposed and sponsored to raise farmers' monthly allowance from NTD 5000 to NTD 15000. In general, the majority of retired farmers are concentrated in agricultural municipalities. From Lour's publications, he oper-

ationalizes major concepts commonly found in Taiwan's political context (Luor and Hsieh 2008; Luor and Liao 2009). These legislation bills are manually classified and validated by Luor and Hsieh (2008) and Luor and Liao (2009).
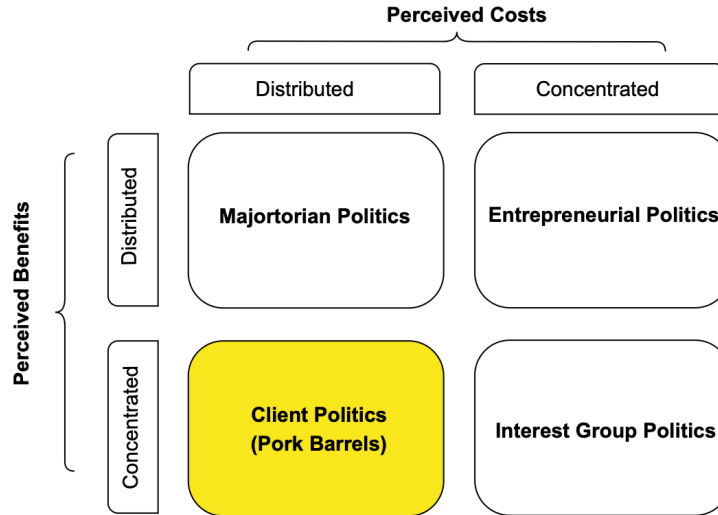

Figure 4: Classifying and Explaining the Politics of Different Policy Issues.
Source: Wilson and DiIulio (2001)

5.1 Using BERT Model as Embedding Layers

With increasingly available quantities of political data, the application of the classification task using deep learning methods has received great attention in political science (Chatsiou and Mikhaylov 2020). In natural language processing, text classification assigns a set of predefined categories to open-ended documents. The major approach for this paper used is to combine one of famous Transformer architecture, BERT developed by Google with convolutional neural networks.

CNN is one of the neural network architectures commonly applied in natural language processing (Zhang, Zhao, and Lecun 2016; Zhang et al. 2017; Kim 2014; Kim et al. 2016). CNN architecture can be constructed by a series of convolutions and pooling layers, filtering input vectors and creating a feature map that summarizes the input texts. Then, the feature map can be stacked one over another to form a matrix by single-dimensional convolutional filters to extract high-level features. In the context of text classification task, convolution layer essentially learns the condensed features as learning image data.

In practice, the convolutional layers (or recurrent neural net) are commonly intro-
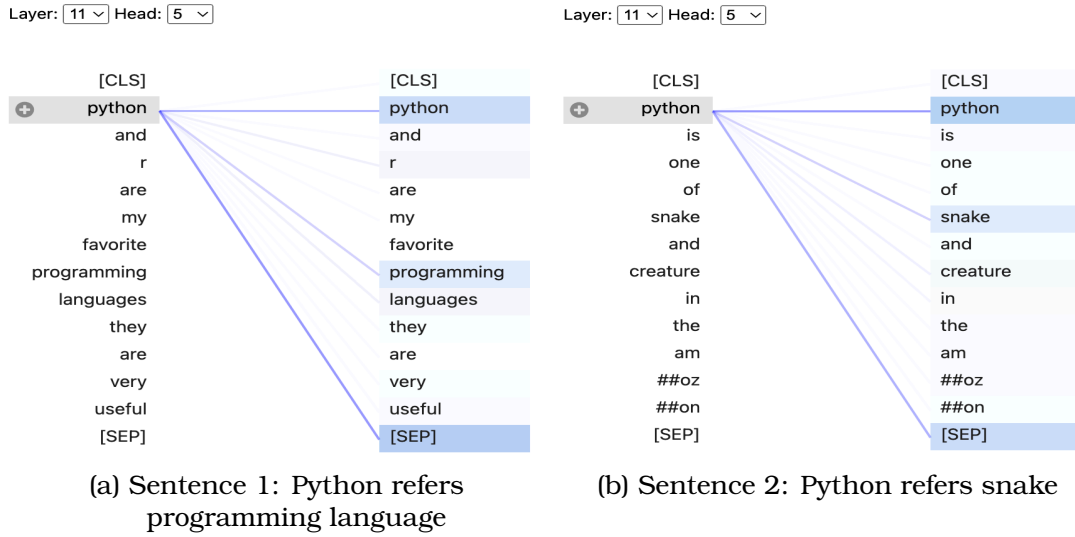
Layer: [11 ˅] Head: [5 ˅]   Layer: [11 ˅] Head: [5 ˅]

(a) Sentence 1: Python refers
programming language

(b) Sentence 2: Python refers snake

Figure 5: An Example of Self-attention Mechanism in BERT Transformer[3]

duced as encoders or decoders to deal with semantics problems in modern application of natural language processing. Generally, we can transform input texts with embedding models such as Word2Vec, Glove or one-hot vector. However, the major challenge of these approaches lies in the fundamental assumption that each input word has fixed representation in different contexts, introducing a potentially severe problem of misrepresentations by referring to inaccurate meaning across sentences. For example, the embedding word "python" as shown in Figure 5 can have different meanings depending on the language context in which it appears. Regardless of polysemous mean in different sentences, the word "python" only renders the same vector. This is because traditional embedding models are context-free, which gives static embedding vectors for the word "python".

Contrary to earlier approaches, BERT is one of the most powerful Transformer architectures that can detect input tokens in bidirectional semantic context with its prominent feature called self-attention (Devlin et al. 2019; Vaswani et al. 2017).[4] Theoretically, BERT consists of 12 encoder layers, stacked over one another as shown in Figure 6, respectively. For instance, giving the single word "python" across two different context in Figure 5, "python" in Figure 5a refers to one of the programming languages because the contextual embedding is highly associated with "programming", "languages", and "r (statistical computing language)". On the other hand, "python" in

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[4]BERT is the first contextual-based model based on the transformer architecture released by Google. Transformers models also include ALBERT, RoBERTa, DistilBERT, GPT2 and others.

Figure 5b refers to an animal in the sentence context as its representation embedding is correlated with snake and creature.

As discussed above, self-attention is a mechanism that allows neural networks to assign a different amount of attention weight to each element to compute representation embedding in a sequence. This is powerful to perform NLP tasks when dealing with unseen words or tokens not included in the static embedding model like Word2Vec.
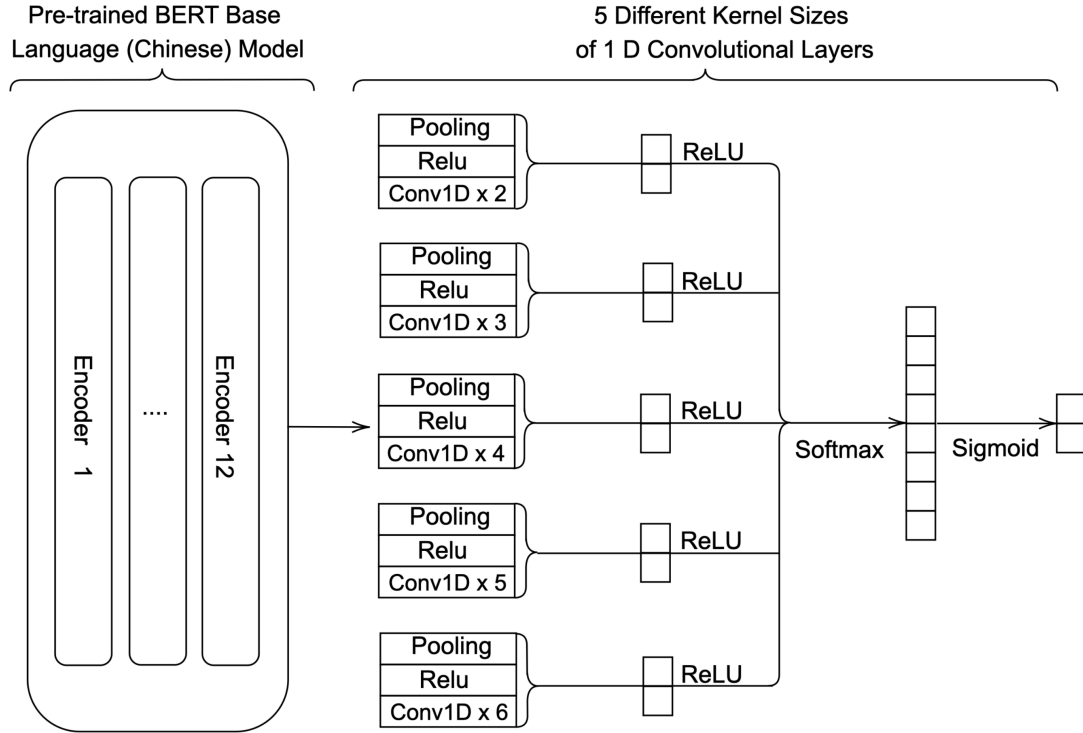

Figure 6: The Designed Architecture for Pork Barrel Classification Task

5.2 Combining Convolutional Neural Net with BERT Embedding Layer

Combining CNN with BERT for classification tasks is getting popular in natural language processing in recent years (Safaya, Abdullatif, and Yuret 2020; Lu and Ni 2019; Lopez and Kalita 2017). For example, Safaya, Abdullatif, and Yuret (2020) use convolutional layers followed by BERT embedding to create a machine learning model that deals with offensive speech identification, while Lu and Ni (2019) deploying the similar approach to patent document classification. Those performance of combination approach is drastically improved from the character-based CNN and the generic BERT

model, respectively. This paper creates the architecture for detecting pork-barrel features in parliamentary questions, as shown in Figure 6. The traditional Chinese BERT model used in the paper is bert-base-Chinese which is maintained by CKIP (Chinese Knowledge and Information Processing) at the Institute of Information Science and the Institute of Linguistics, Academia Sinica. All the encoders use 12 attention heads and 12 layers. Theoretically, each token can be represented as 768 hidden units (see, Wolf et al. 2020).

First, I transform each word in the sentence with its word vector using the Chinese BERT pre-trained model.[5] In order to fit embedding vector into CNN layers, I create five kernels of different lengths, aiming to capture different patterns of the n-gram in the original sentence. After the output is passed through ReLU activation, Global Max Pooling is introduced to flatten high-dimensions feature maps into two-dimensional vectors. At the last set of layers, I use the Sigmoid function commonly adapted for binary class with dense layers to get the final outcome, which is the probability of being classified as pork-barrel project.[6]

Table 1: Sampled Parliamentary Questions Being Most Likely to Mention Particularistic Goods

Legislators	Probability of Being Pork	Topics	Keywords	Questions
林正峰	0.995515823364258	Health Insurance	Health Insurance Deductions	特𝔽扣除額教育支出…
彭添富	0.992780447006226	Aboriginal Affair	Housing Subsidies	而非𝔽用扣除免𝔽額…
李復興	0.992780089378357	Old-age Benefits	Elderly Allowance	原住民家庭租屋補助…
盧秀燕	0.992639720439911	Veterans Welfare	Grants for Retired Veterans	補助金發放金額過低…
李顯榮	0.990033149719238	Farmer Welfare	Subsidies; Allowance	政府前後援賽金額高…
丁守中	0.988385319709778	The Handicapped	Living Allowance	身心障礙者生活津貼…
馮定國	0.985531985759735	Elderly Welfare	Unemployment Fund	高齡失業問題嚴重目…
彭添富	0.983698368072510	Agriculture	Crops Subsidies	農作物損失補償問題…
曾華德	0.979519009590149	Military Affair	Increased Pay	救國軍補發薪𝔽問題…
林鴻池	0.978044390678406	Education	University Subsidy	針對諸多已獲得五年…

To validate the classification quality, I sampled 20 pork and non-pork questions respectively in Table 1 and Table 2, classified by the machine classifier.I merge these questions with corresponding keywords and categories (translated to English) scraped from the website of Taiwan Legislative Yuan. As shown in Table 1, most pork-barrel questions are associated with central government spending for targeted groups and localized infrastructure projects mainly allocated to specific regions. Some legislators raise the question of asking the central government to increase rent subsidies for the

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[5]This model can be downloaded from https://ckip-transformers.readthedocs.io/en/stable/ and *HuggingFace* at https://huggingface.co/bert-base-chinese.

[6]Regarding model performance metrics, see Table 5 in Supplementary Appendix B

aboriginal population from the eastern region of Taiwan, while others target policies related to relief and support programmes such as crop subsidy and elderly allowances for specific groups in some municipalities located in western Taiwan. In addition to Table 2 demonstrate many examples of non-particularistic questions. For instance, the questions of keywords and topics are very closely related to regulatory and national policies such as railway management, drug control and criminal investigation.

Table 2: Sampled Parliamentary Questions Being Less Likely to Mention Particularistic Goods

Legislators	Probability of Being Pork	Topics	Keywords	Questions
李復甸	0.000021549063604	Litigation Procedure	Criminal Investigation	国於刑事偵察實務上…
林建榮	0.000020212990421	Financial Management	Revolving Interest Rate	明定信用卡、現金卡…
林正峰	0.000019731034627	Energy Policy	Energy Saving	要求各級機關和學校…
林正峰	0.000019187420548	Tobacco Restriction	Departmental Hospital	毒品国濫，吸毒人數…
王幸男	0.000017634354663	Public Safety	Road Quality	針對道路人孔蓋或管…
管碧玲	0.000013002485503	Railway Management	Taiwan Railway	台灣鐵路管理局發生…
郭榮宗	0.000004869816621	District Court	Drug Abuse	知名提神飲料遭下毒…
陳朝龍	0.000011277100384	Infectious Disease	Avian Influenza	英國政府宣稱台灣出…
林進興	0.000007685628589	Banking Management	Credit Card	行政院金融監督管理…
潘孟安	0.000002590457370	Election	Legislative Elections	單一選區兩票制即將…

6 Heterogeneous Effects on Different Sizes of Parties

I next examine the distribution of pork-barrel questions aggregated by party level from 1993 to 2019. Figure 7 displays the distribution of the total number of pork-barrel questions that were requested by legislators from two major parties and the minority parties, respectively, as is classified by the deep learning architecture. The left subplot for the two majority parties, KMT (Chinese Nationalist Party) and DPP (Democratic Progress Party), roughly shares a similar pattern as in Figure 1, with a decreasing trend of the numbers overtime after the initiation of the movement that started around 2000. The right subplot 7b shows the multiple plummets and rises in the total number of questions raised by minority parties such as NP (New Party 新黨), PFP (People First Party 親民黨), NPSU (Non-Partisan Solidarity Union, 無黨團結聯盟), TIP (Taiwan Independence Party 台灣獨立黨), TSU (Taiwan Solidarity Union 台灣團結聯盟) and newly established MKT (the Republican Party as known as Minkuotang).

For Figure 7, the changes in the total numbers across times show that parliamentary questions are dwindling steadily, implying that legislators may alternatively use other tools to influence policy for their constituents, such as social media. For ex-
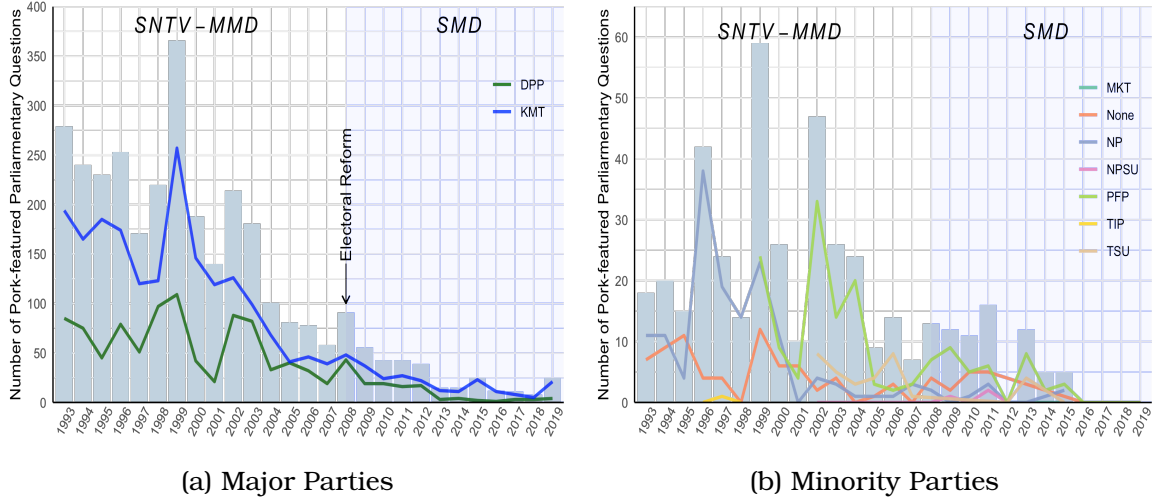
(a) Major Parties   (b) Minority Parties

Figure 7: The Number of Pork Barrel Question by Years

ample, empirical evidence shows that district members mention more geographical terms on their Facebook and Twitter, whereas party-list members have less tendency to secure pork-barrel projects. In particular, the total number of seats was reduced from 225 to 113 after the reform. In the new system, only 73 seats are elected by district, explaining a fall-off in the number of pork-question since the reform occurred in 2008.

To exclude the effect of volatility in the number of seats across years, I illustrate the average number of pork-barrel questions per seat in the legislature. Figure 8 plots the average number of questions per seat devoted to pork-barrel project for majority parties (Figure 8a) and minority parties (Figure 8b), respectively. The actual impacts of the reform seem heterogeneous on major and minority parties. From Figure 8a, for the major parties, the average number persistent declined from around 2001 to 2015, yet there was a significant bounce back since 2017. Generally speaking, there are variations in the number of pork questions asked by minority legislators, compared with majority legislators. From 2003 to 2012, the number of pork questions asked by each legislator from the minority was twice size of majority legislators. However, the reform differed from what I expected regarding the minority legislators: their average number increased from 2001 to 2009, yet this trend stopped in 2007. Afterwards, the trend became downward sloping, and the average number kept declining.
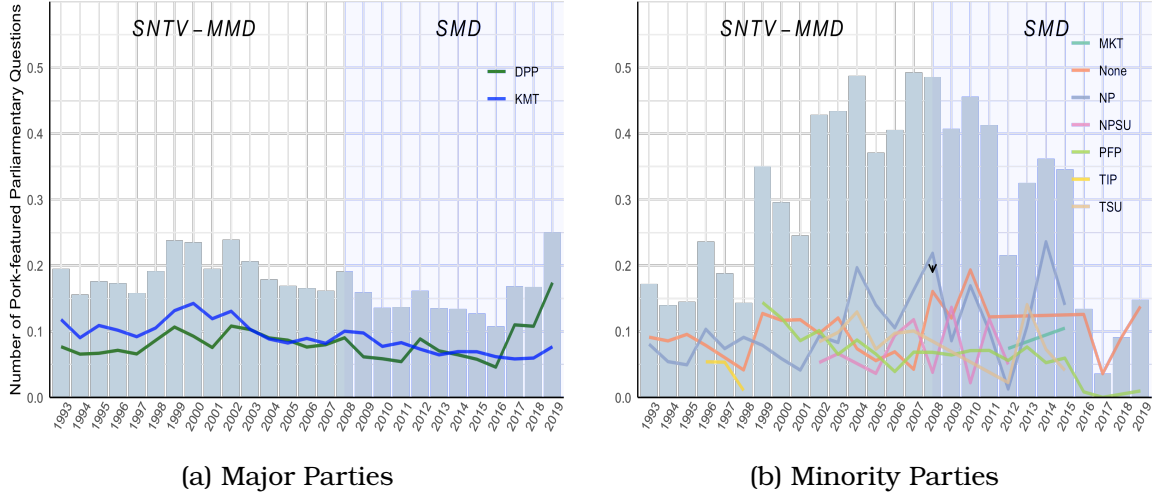
(a) Major Parties   (b) Minority Parties

Figure 8: The Mean Number of Pork Barrel Question by Years

7   The Presence of the Electoral Reform

How does the reform from SNTV-MMD to SMD-MMM change legislators' representation? To answer the question, I investigate to what extent the reform reduces legislators' incentive to ask pork-barrel questions. In total, legislators ask 116248 questions throughout the reform transition covering 1993 to 2020. While multiple plunges and surges between 2000 and 2015 reveal that the passage of years possibly affects the legislators' intention to propose the questions. To distinguish any irrelevant event to influence our analysis, I first calculated the mean of the pork features by an individual legislator at a quarterly unit and ran the following regression in Equation 1,

$$
\begin{aligned}
Pork_{i,t} = & \alpha_0 + \alpha_1 ElectoralReform_t + \alpha_{2t} + \\
& \alpha_3(ElectoralReform_t \times t) + \\
& \theta C_{i,t} + \epsilon_{it},
\end{aligned}
\tag{1}
$$

where the dependent variable, $Pork_{i,t}$, is mean of pork-barrel questions aggregated at quarterly individual level, $ElectoralReformt_t$ is a dummy variable indicating whether the observation is from the period of the post reform, $C_{i,t}$ includes fixed effects for municipality i in election t, and ϵ_{it} is the error term. Table 3 shows a negative and significant effect on legislators' motivation to ask pork-barrel questions after reform, both for *Full Model* and *Majority Parties*, suggesting that changing to SMD decreases legislators' incentives to pay attention to parochial interests. Thus, I find generally consistent empirical evidence in favour of Hypothesis 1.

18

Yet, the heterogeneity issues resulting from natural disasters and political incidents occurred in years that could potentially influence legislators' incentive to ask specific questions or ask more (less) questions. For example, in 2006, a mass movement (Million Voices against Corruption, President Chen Must Go) in Taipei Liberty Square led by former DPP Chairman Shih Ming-teh pressured President Chen Shui-bian to resign. This incident was in the media for over a year, from 2007 to 2008, when the reform was just in practice. To diminish the problem concerning the heterogeneity, I control for the fixed effects from municipalities and legislators across the years. The reform is statistically significant negative, and robust in models (2) and (4).

As such, the empirical evidence shows that increases in time were associated with higher motivation levels to ask pork questions under the old system, SNTV-MMD, and lower levels under SMD. This suggests the institutional change reduces legislators' tendency to ask for the pork-barrel project between KMT and DPP, even if I introduce municipality dummies, legislator dummies, control for the passage of time and other demographics.

Table 3: Regression Analysis for District-level Pork-barrel Parliamentary Questions by Quarter-yearly

	Full Observation		Major Parties		Minority Parties	
	Model (1) Interaction	Model (2) + Controls	Model (3) Interaction	Model (4) (+ Controls)	Model (5) Interaction	Model (6) (+ Controls)
Reform	-14.052***	-13.125***	-14.959***	-16.346***	-11.180	4.954
	(3.946)	(5.085)	(4.173)	(5.569)	(8.365)	(19.928)
Year	-.006***	-.006***	-.006***	-.008***	-.002	-.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Reform x Year	.006***	.006***	.007***	.008***	.005	-.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.004)	(0.009)
Constant	12.610***	12.713***	13.732***	16.206***	5.091	2.712
	(2.129)	(2.735)	(2.408)	(3.672)	(5.614)	(6.546)
District Fixed Effects		✓		✓		✓
Legislator Fixed Effects		✓		✓		✓
The Reform Year	✓	✓	✓	✓	✓	✓
Observations	4,252	4,252	3,539	3,539	713	713
Adjusted R^2	0.016	0.218	0.020	0.233	0.003	0.179

Note: * $p < 0.10$,** $p < 0.05$, *** $p < 0.01$.
Robust standard errors in parentheses. The district-level pork-barrel parliamentary question at quarter-yearly is regressed on year, electoral reform, and interaction between year and electoral reform, with and without fixed effect controls. The controls include fixed effects for electoral districts, municipalities, and individual legislators and the occurrence of the reform.

To distinguish any possible effects from the passage of time and control for differences between municipality and legislators, I ran the same regression as above by using a sub-sample only including major parties (KMT and DPP) and minority parties.

However, the presence of the reform has an insignificant impact on minority legislators *Minority Parties*, revealing that the effects of institutional change do not substantively discourage most minority members from asking pork questions. Under SMD, the minority were squeezed for living space in the legislature, which subsequently motivated them to make more efforts to plea to smaller groups of voters and then ask more pork-barrel questions to the government.

8 Discussion

This paper investigates how institutional change affects legislators' electoral strategies and representation. Combining a dedicated deep learning method with robust regression analysis, I estimate the impacts of the electoral reform through SNTV-MMD to SMD on legislative behaviour. The results show that Taiwan's SMD diminishes legislators' motivation to mention pork-barrel features and increases their awareness of regulatory policies in written parliamentary questions. This finding is in line with a recent study by Catalina showing that the single-member district system eliminating Japan's intraparty competition increases LDP candidates' attention to national policies (Catalinac 2016). Nevertheless, the institutional change has limited impact on legislators from smaller parties. This is due to that the new system introduced in Taiwan is particularly disadvantageous to small parties (Duverger 1954; Reed 2001; Huang 2017; Bawn and Thies 2003), which increases their incentive to plea smaller groups of voters.

This paper thus comes with some limitations. The fact that there has been a steady decrease in the total number of questions since 2003 despite the reform substantially impacting legislative representation is still noteworthy. In particular, social media has become an important platform for legislators to influence agenda setting and take their policy positions (Barberá 2015; Barberá et al. 2019; Schürmann and Stier 2022). Additional limitations arise from language transformation and variation in training data used in this paper. As noted earlier in the data section, the pork barrel legislation was annotated during a given context nearly ten years ago. The deep learning classifier trained in this paper might fail to capture the unknown concepts generated in the post-reform period.

Measuring legislator behaviours and tendencies towards constituencies under the different systems is important. This paper looks at a long-lasting myth about the impact of the 2008 electoral reforms in Taiwan. Although the reform, as scholars argue, some evidence indicates that SMDs may not be as effective as initially presumed in solving drawbacks of the SNTV, such as factional politics and intra-party competition (e.g., Wu 2003; Batto et al. 2018). The empirical evidence shows that increases in time were associated with lower motivation levels to run on personal reputation despite the fact that intense conflicts between parties in recent years.

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A The Description of Training Data for TextCNN, BERT and CNN-BERT

Table 4: The Description of Training Data for TextCNN, BERT and CNN-BERT

| | Text CNN | | | BERT | | | CNN-BERT | | |
	Train	Test	Dev	Train	Test	Dev	Train	Test	Dev
Pork	4259	237	237	4259	237	237	4259	237	237
Non Pork	2259	125	126	2259	125	126	2259	125	126
	7243			7243			7243		

Source: Taiwan Pork Barrel Legislation Data (Luor and Hsieh 2008; Luor and Liao 2009; Luor and Chan 2012)

B   Experiments and Results

In this section, BERT-CNN will be compared with other models such as TextCNN and generic BERT on their abilities to identify pork-barrel features on the holdout set from 15 % of all pork-barrel legislation. First, **TextCNN** is the generic model without having a BERT embedding layer. TextCNN here uses initialized spaCy's pretrained vectors and the Chinese model used in Table 5 can be found at https://spacy.io/models/zh.

As to the **BERT** model in the second column in Table 5, I transformed the corpus into word vector representation extracted from BERT with max words 512. Last, **CNN-BERT** maximizes the utilization of knowledge embedded in pre-trained BERT language models by feeding the outputted contextualized embeddings into several filters and convolution layers of the CNN architecture.

A intuitive approach to evaluate the performance of classifiers is to compare each model's performance on *accuracy* and *recall*, respectively. Precision is constructed by the accuracy of the positive predictions, whereas the ratio of positive instances correctly detected by the classifiers is recall. However, it is much more useful to consider measurement together, like the F1 score. As in Equation 3, the harmonic mean gives much more weight to low values, whereas the regular mean treats all values equally. As a result, the classifier gets a high *F1 score* the performance of the classifier works better in both recall and precision.

$$recall = \frac{TruePositive}{TruePositive + FalseNegative} \tag{2}$$

$$precision = \frac{TruePositive}{TruePositive + FalsePositive} \tag{3}$$

$$F_1 = \frac{2}{\frac{1}{precision} + \frac{1}{recall}} = 2 \times \frac{precision \times recall}{precision \times recall} = \frac{TruePositive}{TruePositive + \frac{FalseNegative \times FalsePositive}{2}} \tag{4}$$

CNN-BERT is still computing on the University of Essex's HPC (CERES) with 2000 epochs to find the best performance in a given epoch and is temporarily not available. I used the generic BERT version to conduct the pork-barrel classification task for the

Table 5: The Performance of CNN, BERT and CNN-BERT

	TextCNN			BERT			CNN-BERT		
	Precision	Recall	F1-score	Precision	Recall	F1-score	Precision	Recall	F1-score
Non Pork	0.95	0.97	0.96	0.96	0.97	0.97	–	–	–
Pork	0.94	0.91	0.92	0.95	0.93	0.94	–	–	–
Accuracy			0.95	0.96		0.96	–	–	–
Macro Avg	0.95	0.94	0.94	0.96	0.95	0.95	–	–	–
Weighted avg.	0.95	0.95	0.95	0.96	0.96	0.96	–	–	–

Note: EarlyStop function with patience = 5 from Tensorflow is used to monitor the performance of the training process, which the model stops when there is no improvement within five epochs. Text CNN model was trained until 13 epochs while generic BERT model finished at 12 epochs with learning rate 1e-08.

rest of the analysis. After the fine-tuning process, I will need to re-train the model until the optimal number of epochs to avoid over-fitting. So far, BERT's performance achieves both 96% in F1-Score in the weighted average, slightly better than TextCNN. I temporally use the BERT model to classify parliamentary questions. The pre-trained model for the pork-barrel classification task is available on my GitHub repository at PorkCNN-BERT. TensorBoard tracking different epochs of experiment can be found at here
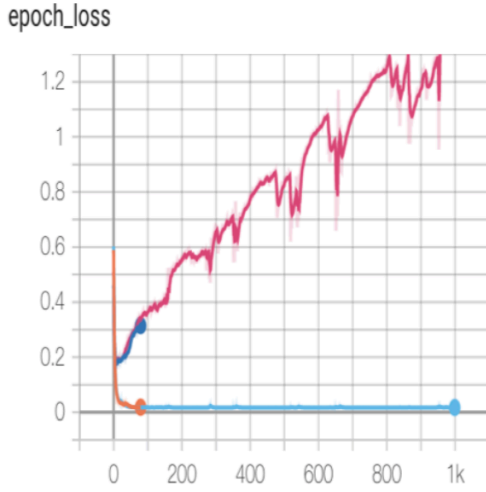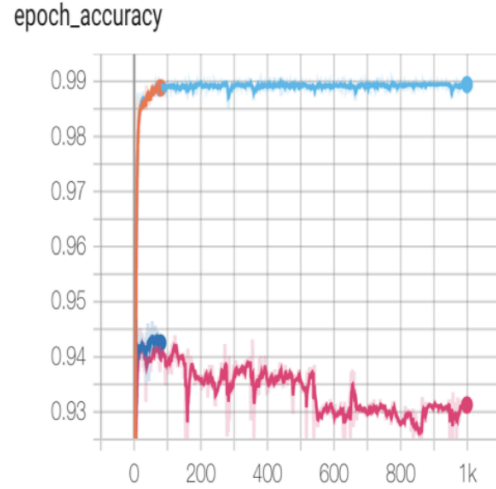

Figure 1. The Loss and Validation Loss   Figure 2. The Accuracy and Validation Accuracy

Figure 9: 1000 Experiments of Loss and Accuracy for TextCNN.