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Abstract

Hong Kong's electricity service is superbly reliable and price-reasonable when compared to those of the major cities in the OECD countries. Based on the rate of return regulation in the U.S., the current scheme of control agreement (SCA) regulating the two local integrated investor-owned utilities (IOUs) will expire in 2018 (or in 2023 after an optional 5-year extension), thus offering an opportune time to consider proposals with long lead time to modify or replace the SCA. The proposals made to date range from modifications of the SCA to electricity market restructure. These proposals, however, overlook two important aspects of regulatory governance: transparency and public involvement. This paper estimates consumer support for the proposal to establish a Hong Kong public utilities commission (HKPUC) to improve the current regulatory process. Based on the responses collected in mid-2014 via a face-to-face survey of 1,100 Hong Kong residents, we find that at the 1.5% bill surcharge, about 70% the respondents are estimated to support an HKPUC. Thus, there is sufficient consumer support for a financially viable HKPUC. The policy implication is that Hong Kong should consider the possibility of establishing an HKPUC in its overall effort of shaping its electricity future; this is notwithstanding the substantial challenges to be overcome prior to the HKPUC's eventual implementation.

Keywords: **public utilities commission; consumer support; scheme of control agreement; Hong Kong**

1. Introduction

On 1 July 1997, Hong Kong became the Hong Kong Special Administrative Region (HKSAR) of China under the framework of "one country, two systems." Over the past 17 years, it has achieved a remarkable economic performance that rivals that of the OECD countries. In 2013, per capita GDP of the 7.2 million residents was US$37,860, and the unemployment rate was 3.3%. It remains a bastion of capitalism and an exemplar of *laissez-faire* economics at its dynamic best, unfettered by government-imposed economic regulations. Indeed, "Hong Kong's economic freedom score of 89.3 [in 2014] keeps it atop the Index rankings for the 19th consecutive year."[1] Nevertheless, since 1978 its electricity industry has been subject to a particular form of rate of return (ROR) regulation (Lam, 1996; Wu and Cheng, 2000).[2]

Hong Kong's average electricity rate in 2012 was HK$1.025/kWh (= US$0.131/kWh at the US$1 = HK$7.8 pegged exchange rate), which is relatively low when compared to the rates of the major cities of the OECD countries.[3] Hong Kong's electricity service is superbly reliable, thanks to the vast capital expenditures made under the Scheme of Control Agreement (SCA) (Woo et al., 2014).

The current 58-page SCA is a bilaterally negotiated 10-year contract signed in 2008 between the HKSAR Government and each of the two local integrated investor-owned utilities (IOUs): China Light and Power (CLP) and Hong Kong Electric (HEC).[4] It stipulates the two utilities' obligation to supply adequate and reliable electricity at affordable rates and the

[1] http://www.heritage.org/index/country/hongkong

[2] Hong Kong's ROR regulation of electricity service was first introduced in 1964 but it only applied to China Light and Power, one of the two local electric utilities.

[3] https://www.clpgroup.com/ourcompany/aboutus/resourcecorner/investmentresources/Documents/2012/CLP_2012AR_English_Full.pdf, p.43.

[4] Scheme of Control Agreement (SCA) with CLP Power Hong Kong Ltd., ExxonMobil Energy Ltd. and Castle Peak Power Co. Ltd., (http://www.EB.gov.hk/en/resources_publications/agreement/files/SCA_of_CLP_Eng.pdf); Scheme of Control Agreement (SCA) with Hong Kong Electric Co. Ltd. and Hong Kong Electric Holdings Ltd., (http://www.EB.gov.hk/en/resources_publications/agreement/files/SCA_of_HEC_Eng.pdf);

government's role in monitoring the financial affairs and operating performance of the utilities. In return, the utilities are allowed to charge tariffs that enable them to recover operating costs, make long-term investments, thereby fulfilling their obligation to serve.[5]

The SCA's contractual relationship is intended to last,[6] as stated in Clause D of the prevailing SCA: "[t]he Government may introduce changes to the electricity supply regulatory framework after 30 September 2018, after consideration of market readiness and other relevant factors. The Government recognizes that the Companies [i.e., CLP and HEC] have made and may make during the scheme of control long-term investments and contractual commitments to meet the demand for electricity." Both the HKSAR Government and the utilities decided not to make major changes to the SCA after the final interim review conducted in 2013. For this reason, any substantial changes to the electricity supply regulatory framework cannot occur prior to the 2018 expiration of the current SCA. Should the HKSAR Government and the utilities decide to exercise the option of a 5-year extension, such changes can only occur after 2023.

While the SCA does not have a franchise area provision, each utility has a *de facto* exclusive service area defined by its ownership of a non-duplicative transmission and distribution (T&D) network.[7] The current SCA is due to expire in 2018 (or in 2023 after an optional 5-year extension), thus presenting an opportune time to consider possible changes which can have a long lead time to improve the electricity industry's economic performance. These changes range from modifications of the SCA to a complete market restructuring.

[5] We thank a very helpful reviewer for his/her excellent clarification of the current SCA.
[6] This paragraph is based on the insightful comment of the same reviewer noted in *supra note* 5.
[7] With about 0.57 million customers, HKE serves Hong Kong Island, Ap Lei Chau and Lamma Island. With about 2.4 million customers, CLP serves the rest of Hong Kong, comprising Kowloon, the New Territories and Lantau Island.

The SCA embodies several salient aspects of electricity regulation. First, the initial 15-year SCA was created in 1964 at the behest of CLP and its business partner Exxon (Lam, 1996; Wu and Cheng, 2000), thus echoing the theory of demand for regulation (Jarrell, 1978).

Second, the SCA requires each IOU to provide safe, reliable, and environmentally friendly service at cost-based rates that reflect least-cost investment and operation, following the regulatory mandate described in Bonbright et al. (1988) and Swartwout (1992).

Third, the SCA is a formal contract, with long-term credible commitment to (a) the utilities that invest in capital-intensive and industry-specific assets, and (b) their customers who ultimately pay for such investments at regulated rates (Goldberg, 1976). These rates are based on the U.S. ROR regulation described in Morin (2006).

Fourth, the SCA's permitted return on assets (ROA) is fixed for the entire contract period. Since an IOU's earned ROA is a weighted average of the IOU's return on equity (ROE) and cost of debt, the SCA encourages asset expansion and debt financing in a low-interest environment (Peles and Whittred, 1996; Lam, 1997; Morin, 2006).[8] The current SCA's permitted ROA is 9.99%, slightly above CLP's earned ROA of 9.94% and HEC's earned ROA of 9.35% in 2012. Thanks to increased debt financing at the historically low interest rate since the 2008-2009 financial crisis, CLP's actual return on equity (ROE) was 19.73% and HKE's ROE was 31.91% (Woo et al., 2014, Table 1), far above the 10-12% allowed ROEs in the U.S. (PUF, 2012; Hyman, 2013).

Finally, Hong Kong does ***not*** have a public utilities commission (PUC) (Lam, 1997). A state PUC in the U.S. is an independent regulatory agency that develops and enforces relevant

[8] To discourage over-investment, the current SCA (Schedule 7) reduces the local utility's revenue requirement, if the utility is determined to have excess generation capacity after a major capacity expansion.

rules and regulations (Spulber, 1989, Chapter 2; Swartwout, 1992).[9] The state PUC administers the public-hearing process (Brown, 1938; Lakusta, 1956; Moore, 2002), which may result in reductions in the regulated IOU's earnings (e.g., Lyon and Mayo, 2005).[10]

A series of papers published in this journal before the 2008 signing of the current SCA make three proposals to improve the economic performance of Hong Kong's electricity industry. The first proposal is to restructure the electricity industry (Lam, 2004; Chan, 2006), so as to lead to competitive markets for generation and customer service under open T&D access, as already been done in parts of North America, South America, Europe, and Australia (Sioshansi and Pfaffenberger, 2006; Sioshansi, 2013). The second proposal is to institute periodic reviews of the SCA's permitted ROA, akin to the general rate-case cycles in the U.S. (Luk, 2005, 2007). The third proposal is to implement performance-based regulation (PBR) (Ngan et al., 2006; Wang et al., 2007), so as to address the potential inefficiency of ROR regulation (Laffont and Tirole, 1993; Liston, 1993; Schmidt, 2000; Vogelsang, 2002). Implementing the first two proposals will require legislative support and action, as these proposals represent significant departures from the current SCA. The last third proposal may require the same, if the PBR replacement significantly deviates from the current SCA (e.g., no automatic 100% pass-through of the fuel cost).

[9] There is empirical evidence challenging a PUC's presumed independence. To wit, the PUC's commissioners may be appointed or elected, with the latter being more pro-consumer (Costello, 1984; Besley and Coate, 2003). Moreover, the regulatory process can be pro-business or pro-consumer (Gormley, 1982; Gormley et al., 1983). Finally, the creation of consumer-advocate groups may lead to consumer capture of the PUC (Holbrun and Spiller, 2002; Holbrun and Vanden Berth, 2006).

[10] Examples of public participation in a PUC hearing can be found at: (a) "Having your say at an AUC hearing", Alberta Utilities Commission (http://www.auc.ab.ca/about-the-auc/auc-information/Documents/AUC_Information/AUC_information_havingYourSay_01.pdf); (b) "Informal Guide to Commission Proceedings", New Hampshire Public Utilities Commission (http://www.puc.state.nh.us/regulatory/practiceguide.htm); and (c) "We want to hear from you", "How your comments are processed", "Participation at CPUC Public Events", Public Advisor's Office, California Public Utilities Commission (http://www.cpuc.ca.gov/PUC/aboutus/Divisions/CSID/Public+Advisor/index.htm).

While all three proposals deserve consideration in anticipation of the current SCA's 2018 (or 2023) expiration, they overlook the possibility of establishing a Hong Kong Public Utilities Commission (HKPUC) to remedy the lack of transparency and public involvement in Hong Kong's regulatory process. While the implementation of an HKPUC will require further study of its governance and design (Laffont and Martimort, 1998; Stern and Holder, 1999), a fundamental question immediately arises: Is there sufficient consumer support for an HKPUC? If the answer is "yes", then a proposal to establish an HKPUC merits further attention and consideration in the policy debate of Hong Kong's electricity future in the next few years.

The goal of this paper is to estimate the consumers support for a proposal to establish an HKPUC. As the proposed HKPUC has yet to occur, we adopt the contingent valuation method (CVM) for survey data collection related to its public acceptance (Mitchell and Carson, 1989; Bates and Willis, 1991; Hoyos, 2010).[11] Based on the responses to a face-to-face survey of 1,100 Hong Kong residents conducted in mid-2014, our key finding is that public support for an HKPUC is about 70% when end-users are asked to pay a surcharge equal to 1.5% of their electricity bills.

The electricity industry in Hong Kong has an annual revenue of about US$5.6B (= HK$44B at US$1 = HK$7.8). At a 1.5% surcharge applicable to all electricity sales, the budget estimate for the HKPUC could be as high as US$84M per year, which is sufficient to fund an HKPUC with up to 200 employees, based on the data for the state PUCs in the U.S.[12] This gives impetus to the consideration of a proposed HKPUC.

[11] For discussions on the validity of CVM, see Hausman (1993) and Carson and Hanemann (2006).
[12] According to the data that we obtained in October 2013from SNL Financial (www.snl.com), 96% of the 50 PUCs in U.S. have an annual budget below US$100M, 75% a staff size less than 200 employees, and 88% a per kWh budget less than 2% of the average retail electricity rate. To be sure, most PUCs in the U.S. regulate multiple industries. For example, the Texas PUC regulates telecommunications and water, as well as electricity. Many regulatory commissions regulate trucking and natural gas. Thus, the proposed HKPUC's size could be less than 200 employees.

To be sure, implementing an HKPUC proposal will definitely require legislative support and action because the proposal is a clear and significant departure from the current SCA. Moreover, the implementation will unlikely occur any time soon because of its substantial challenges, which may include: (a) the contractual nature of the SCA whose modifications require the *mutual* consent of the two local utilities and the HKSAR government; (b) the legislative action required to establish an HKPUC; (c) the thorny issue of stranded cost that will inevitably arise from replacing the SCA with an alternative arrangement (Sidak and Spulber, 1998; Woo, et al., 2003); (d) the design and staffing of an HKPUC; and (e) the likely long transition from the current regulatory process to a new one under an HKPUC. That said, these challenges do not necessarily mean that an HKPUC proposal should now be foreclosed in the upcoming policy debate over Hong Kong's electricity future.

The paper makes the following contributions. First, to the best of our knowledge, this is the first documented evidence of consumer support for a proposed PUC, thus enriching the literature on public utility regulation. Despite the analysis of the election of PUC commissioners and the creation of consumer advocates (e.g., Gormley et al., 1983; Besley and Coate, 2003; Holburn and Vanden Bergh, 2006), there is little empirical evidence that directly points to consumer support for a PUC. Second, it is shown that an estimated 70% of consumers would be willing to incur a 1.5% surcharge on their electricity bills to pay for a PUC, thus indicating a proposed HKPUC's public acceptance and financial viability. Finally, the paper informs the possible development of provincial PUCs in China, the world's second-largest economy, where regulatory governance remains weak for its electricity industry (Xu and Chen, 2006; Ma and He, 2008; Ngan, 2010).

The paper proceeds as follows. To provide a contextual background, Section 2 describes the regulatory process for the electricity industry in Hong Kong and in the U.S. It also describes the data and regression model for estimating consumer support for an HKPUC. Section 3 presents the regression results. Section 4 discusses the estimated support for an HKPUC. Section 5 concludes and states the policy implication of our results.

2. Materials and methods

2.1 Regulatory process for the electricity industry

2.1.1 Hong Kong

In 2012, CLP and HEC sold 43,031 GWH at the SCA-regulated rates that allow each IOU to fully collect its fuel costs via the fuel charge. An increase in the non-fuel charge for the returns on and of a major capital expenditure (e.g., a new generation unit), however, is subject to approval by the government's Executive Council (ExCo). The ExCo comprises (a) the Chief Executive of the HKSAR, (b) 15 Principal Officials (e.g., the Chief Secretary for Administration, the Financial Secretary, and the Secretary for Justice), and (c) 14 non-officials. "Members' appointment or removal is decided by the Chief Executive."[13] The ExCo meeting's content and minutes are classified as government confidential matters.[14]

When faced with an application for a non-fuel rate increase, the Environment Bureau (EB) negotiates bilaterally with the IOU applicant, leading to three possible scenarios:

- Scenario 1: The increase is within 5% of a preset threshold based on the IOU's most recently approved tariff. Such an increase is routinely adopted without being subject to the ExCo's approval.

[13] http://www.ceo.gov.hk/exco/eng/
[14] http://www.legco.gov.hk/yr11-12/english/panels/ps/papers/ps0416cb1-1570-1-e.pdf

- Scenario 2: The increase is 5% to 10% of the threshold. This larger increase *is* subject to the ExCo's approval.
- Scenario 3: The increase is above 10% of the threshold, which triggers a Development Plan Review by the EB, whose recommendation is subject to the ExCo's approval.

Two observations emerge from the preceding discussion. First, there is little transparency and public involvement in the regulatory process. To be sure, the government may occasionally conduct public consultations on such major issues as electricity market reform and power imports from China (Woo et al., 2006; HKSAR, 2014). However, the details of the consultation results and how they are used in the final decision making are unknown to the public. Second, the EB and ExCo are part of the administration and their actions can be seen as non-transparent and politically driven.

Accentuating these two observations is the on-going debate on Hong Kong's future fuel-mix options for reducing carbon emissions from local coal-fired generation (HKSAR, 2014). This debate is encapsulated by a series of newspaper articles regarding:

- Reliability concerns related to the two options proposed in HKSAR (2014): (a) increase power imports from China; and (b) increase local natural-gas-fired generation.[15] Such concerns arise because adopting option (a) may harm Hong Kong's service reliability due to the difference in reliability performance between the Hong Kong and China electrical system. "[T]he supply reliability for Shenzhen and Guangzhou in 2012 was 99.98 per cent and 99.97 per cent respectively, but might have overlooked the meaning behind these figures. At 99.98 per cent, Shenzhen's power interruption is 1.1 hours and Guangzhou 1.8 hours. … In Hong Kong, our reliability is much higher at over 99.999 per cent. Power interruption on Hong

[15] http://www.scmp.com/news/hong-kong/article/1450086/hong-kong-consider-increasing-electricity-imports-energy-mix; http://www.scmp.com/news/hong-kong/article/1498500/experts-split-over-trust-issue-citys-fuel-mix-debate

Kong Island is less than one minute and in Kowloon and the New Territories less than two minutes. Such a minute-vs-hour comparison cannot be considered "a small difference"".[16]

- Lack of informational details in HKSAR (2014). "It is difficult for anyone, even the experts, to judge which option would be environmentally and economically better, as well as in terms of reliability, as a lot of pertinent information is missing from the current consultation document. More work is needed by all stakeholders before any decision can be made."[17]
- The HKSAR Government's alleged favoring of the China power-imports option. "Environmental chief Wong Kam-sing defended the government's proposal to buy electricity from Guangdong over the long term. … Wong was responding to opposition from CLP Holdings and Hongkong Electric on the proposal. … Wong said under the first fuel mix option, which is "grid purchase," importing electricity by purchasing it from the mainland power grid is a new concept for Hong Kong and makes the territory less dependent on a single resource like natural gas."[18]

Had a similar multi-billion resource planning problem been considered in the U.S., there would have been extensive hearings to gather detailed evidence and expert opinions to aid the decision making. Such hearings, however, cannot occur under Hong Kong's regulatory process.

2.1.2 The United States

To contrast the regulatory process in Hong Kong, here we consider the process used in the U.S., due in part to the SCA's origin of the ROR regulation in the U.S. A public hearing is

[16] http://www.scmp.com/comment/letters/article/1510121/china-southern-grid-electricity-imports-could-adversely-affect-cost
[17] http://www.scmp.com/comment/article/1467014/supply-more-details-better-debate-hong-kongs-future-energy-mix; http://energy.cleartheair.org.hk/?p=2277
[18] http://www.thestandard.com.hk/news_detail.asp?we_cat=4&art_id=145741&sid=42333728&con_type=1&d_str=20140526&fc=10

an important tool for the PUC to demonstrate transparent decision making in a public forum on such matters as rates, investments, service quality, and operation and reliability standards.[19]

The quasi-judicial public-hearing process begins with a utility's application for approval of, for example, a rate increase or a major capital expenditure for a power plant or transmission line. The PUC usually issues a hearing notice through newspaper, websites and emails. Any entity may register as an interested party or an intervener to the hearing, as an individual (as in the case of a ratepayer), or as a group (as in the case of a trade association). Then the IOU is required to provide all interested parties with the applicant's submission. All interested parties can ask for details of the application through information requests (IR) to the applicant.

During the hearing chaired by an administrative law judge (ALJ) and open to the public, the applicant presents its case and witnesses. The PUC and interveners may also have their own witnesses. All witnesses are required to submit direct testimony and testify under oath. The applicant, interveners, and PUC staff and Commissioners may examine and cross-examine those witnesses. All parties can then present rebuttal testimony and if necessary, additional witnesses, leading to a new round of cross-examinations. Based on the body of submissions and hearing records, all parties file their reply briefs. At the end of the hearing, each party presents its closing remarks, summarizing its own position and evidence, and commenting on other parties' positions and their relative credibility and merits.

All matters in the hearing are lodged in a docket, including IR and responses, working papers, direct and rebuttal testimony, transcripts of depositions and cross-examinations, and

[19] Canada also has regulatory hearings. A case in point is Alberta. "Hearings are likely for utility rate application, facility projects and consumers' concerns. … [A hearing] provides all parties involved with the opportunity to publicly express their views before a [Commission] panel in a fair and orderly forum, similar to a court of law. This allows the Commission to make a fully informed decision." "Having your say at an AUC Hearing" (http://www.auc.ab.ca/about-the-auc/auc-information/Documents/AUC_Information/AUC_information_havingYourSay_01.pdf).

motions filed and decisions rendered. The hearing rules typically disallow *ex parte* communication that is neither on the record nor on reasonable prior notice to all parties.

At the end of the hearing, the commissioners may vote on (a) the draft decision prepared by the ALJ; or (b) alternative decisions prepared by one or more of the commissioners. After a final decision is reached, the PUC issues its order, supported by the findings of fact and conclusions of law based on the evidences and facts gathered during the public-hearing process.

Participation in a hearing process entails expert witnesses and legal representation. While the applicant, the PUC and some interveners (e.g., large electricity users like oil companies and manufacturers) have the requisite financial resources, some interested parties (e.g., consumer advocates and environmentalists) do not. As a result, the PUC may aid the latter by authorizing their funding requests after its issuance of the order.[20] To prevent frivolous or vexatious claims, each requesting party, however, must demonstrate that its hearing participation has contributed to the formulation of the PUC's decision and order.

2.2 Data description

2.2.1 Questionnaire

To gauge the support of consumers for an HKPUC, we develop a survey questionnaire for use in a face-to-face interview designed to last about 10 minutes. We adopt the face-to-face approach, because the questionnaire seeks a respondent's views on such potentially unfamiliar issues such as the SCA and an HKPUC. Since the HKPUC is yet to occur, the survey design follows the CVM (Mitchell and Carson, 1989; Bateman, and Willis, 1999; Hoyos, 2010). The

[20] The PUC may also have an office of ratepayer advocates to represent consumer interests (Holburn and Spiller, 2002; Holburn and Vanden Bergh, 2006; CPUC, 2013).

survey design and implementation was completed by mid-2014 by the Centre for the Advancement of Social Sciences Research (CASR) of Hong Kong Baptist University.

Two pilot tests, each of which involved 30 Hong Kong residents, of the questionnaire's wording, flow and content, led to the final Cantonese (i.e., Hong Kong's local dialect) version used in the field. In response to the request of a very helpful reviewer, Appendix 1 is the English version of the Cantonese questionnaire, so as to aid a reader's appreciation and understanding of what information was collected in the face-to-face interviews.

The questionnaire has four parts. Part I is a self-introduction by the interviewer to explain the survey's purpose and assure confidentiality of the information provided by a respondent. Part II seeks to identify the appropriate respondent: that is, a Hong Kong resident who is at least 18 years old. Part III is the core of the survey and has three sections to collect information about the respondent's preferences towards an HKPUC. Part IV collects the respondent's demographic data.

Section A of Part III asks questions to help respondents recall their experience with electricity rates and the rate increase mechanism, thus mitigating the potential hypothetical bias that may arise in a consumer preference survey (Bateman and Willis, 1999; p. 200).

Section B collects the respondent's knowledge and view of the existing regulatory system. The goal here is not to educate the respondent about all the details of the SCA or Hong Kong's regulatory process. It is to determine what the respondent knows and wants to know. Thus, the first set of questions is related to the SCA, including the respondent's opinion on the SCA's permitted ROA of 9.99%.

Section B also asks the respondent to assess the HKSAR government's ability to effectively control the local utilities' capital spending. As such, the second set of questions

allows the respondent to vent his/her dissatisfaction, thereby helping identify protest responses in the respondent's preference data to be collected in Section C.

Section C begins with a brief explanation of a PUC, whose creation may only improve regulatory transparency and public involvement but not reduce bills. The goal here is not to educate the respondent about all the details of a PUC's mission, organization, staffing, operation, and annual budget.[21] It is to elicit the respondents' opinions on the important aspects (e.g., independence, transparency and accountability) and functions (e.g., electricity ratemaking, regulatory enforcement and consumer representation) of a PUC, including their willingness to pay for it. To avoid the potential response bias in a lengthy survey (McNair et al., 2011), it uses short questions that can be answered quickly and easily.

Section C's first question is: Should the current regulatory process be changed? The question is intended to detect a respondent's sentiment against the *status quo*.[22] The answer to this question yields the information necessary for controlling the potential effect of a protest response in estimating the support for an HKPUC.

The next two questions ask the respondents to state their preferred characteristics and functions of an HKPUC, from a list of possible answers. The fourth question relates to the respondent's preferred staff size: small ($\leq$ 50 employees), medium (51-200 employees) and large (> 200 employees).[23] The fifth question elicits the respondent's willingness to pay for an

[21] As pointed out by one of the reviewers, the short survey cannot possibly inform the respondents about all the ins and outs of electricity regulation, the SCA and the PUC. We fully concur with this reviewer's assessment. However, the usefulness of the survey should be judged on the reasonableness of the results based on the data thus collected. As will be seen below, our results are reasonable in that they suggest a majority consumer support at a modest bill increase of 1.5%, which is comparable to the surcharges observed in the U.S.

[22] Consumers are typically found to favor the *status quo* (e.g., Samuelson and Zeckhauser, 1988; Hartman et al., 1991; Kahneman et al., 1991). What we try to detect here, however, is whether consumers tend to reject the *status quo*.

[23] These size categories are chosen based on the U.S. PUC data from SNL Financial, *supra* note 12.

HKPUC: Are you willing to pay a monthly bill increase to support an HKPUC? If the answer is "yes", the respondent is asked to give the percentage of bill increase for this purpose.

Section C ends with a choice experiment (CE) comprising three questions. The first CE question is: Would you support an *m*-sized HKPUC if your monthly electricity bill would increase by *n*%? Here, *m* = small, medium, large, and *n* = 0.5, 1, 3. This question clearly conveys that the proposed HKPUC will increase the respondent's bill, thus mitigating the response bias that may arise from a rate reduction perceived to occur due to the adoption of the HKPUC.

Since there are three staff sizes and three bill increases, a (3×3) factorial design yields nine versions of this question. In response to the question, the respondent may answer "yes", "not sure" or "no". By providing the option of answering "not sure", the survey does not force a "yes" or "no" answer when the respondent is incapable of such a response. Our regression analysis in Section 4 focuses on the probability of a "yes" response, conservatively treating a "not sure" response as a "no" response.

To test if public funding is necessary to garner sufficient consumer support, the second CE question asks whether the respondent would support the HKPUC proposal if the government would pay half of the rate increase required to fund the HKPUC. The last CE question checks the respondent's support when the government would pay all of the rate increase necessary to establish the HKPUC.

2.2.2 Data collection

As is true of the other major cities in the world, household demographics vary greatly across the 18 districts in Hong Kong. Each district, however, tends to have residents of similar characteristics (e.g., age, income and education). To obtain a representative sample, the CASR

conducted face-to-face interviews in all 18 districts, between 03/21/2014 and 06/25/2014, resulting in a successful sample of 1,100 respondents. The sample is proportional to the population size of each district, based on the latest Hong Kong census data.[24] Each respondent in a district answered one of the nine versions of the survey questionnaire that correspond to the variations of the first CE question.

As will be shown below, our regression analysis focuses on the proportion of respondents supporting a PUC in Hong Kong. Thus, our sample size of 1,100 respondents meets the requirement of 1,061 observations to achieve a ± 3% error margin at the 0.95 confidence level (Cochran, 1977). More importantly, Table 3 below reports that our estimation sample has 3,291 observations, yielding regression results that are economically meaningful, sharp and statistically significant (p-value ≤ 0.05). This mitigates concerns of estimation bias and imprecision that may be caused by a small sample size.

After being trained in the use of the questionnaire, experienced interviewers went to different districts and selected one out of three people for an interview, so as to ensure inclusion in the survey of people of different age and gender. They contacted a total of 3,967 residents, resulting in a sample of 1,100 respondents. We consider the response rate of 28% reasonable for an unpaid street interview in Hong Kong, a metropolis marked by a fast pace of living.[25]

The interviewers' reports on the non-respondents' gender and age do not suggest a systematic non-response bias. Corroborating this point is Table 1, which presents the descriptive statistics of the respondents' demographics. About 47% of the respondents are male and 50% renters. The respondents have an average age of 43 years, education of 12.7 years, and monthly income of $12,729. These statistics suggests that our sample is representative of the Hong Kong

[24] http://www.statistics.gov.hk/pub/B10100032013AN13B0100.pdf
[25] "Sorry, I am busy!" and fast walking away were the common reactions when approached by an interviewer.

population based on information available from the 2013 Hong Kong Annual Digest of Statistics (http://www.statistics.gov.hk/pub/B10100032013AN13B0100.pdf): (a) median age = 42 years (p.4); (b) male share of the population = 0.465 (p.4); (c) average education = 12.4 years (p.335); (d) median family size = 2.9 (p.12) ; (e) renter share: 0.48 (p.214); and (f) median income: $12,000 (p.50).

2.3 Average views

Table 2 summarizes the average views of the respondents. With an average bill of HK$561 per month, the respondents' average satisfaction score for electricity service is 3.71 on a five-point Likert scale that runs from 5 = "very satisfied" to 1 = "very dissatisfied". This average suggests a moderately positive view of the two local IOUs. About half of the respondents inspect their bills and consider them to be price-reasonable. While 60.1% of the respondents know that their electricity rates are regulated, only 14.2% know how the rates are determined. An apparent consequence of this lack of information is that, having had these issues brought to their attention, 72.8% of the respondents expressed a desire to know more about their rates, and 78.1% expressed an interest in having a say in proposed changes in those rates.

Only 45.1% of the respondents know the SCA, but 58.8% consider the SCA's 9.99% permitted ROA to be excessive. Moreover, 56.1% believe that the utilities tend to over-invest to increase earnings. Only 21.9% view the government as being effective in regulating the utilities' costs, and 2.47 is the respondents' average satisfaction score on a five-point Likert scale that runs from 5 = "very satisfied" to 1 = "very dissatisfied", for the government's effectiveness. In light of these views, almost 75% of the respondents responded that the *status quo* should be changed.

When asked about the important aspects of an HKPUC, 74.2% of the respondents mentioned transparency and 58.1% mentioned public involvement. When asked about the important functions of an HKPUC, 63.0% mentioned regulation of electricity tariffs, 48.7% mentioned monitoring and enforcement of the utility's conduct, and about 40% cited promotion of environmental protection, conservation and energy efficiency, electricity reliability, and communication with the public about electricity service and rates. Finally, only 15.7% of the respondents prefer a small HKPUC, while 44.5% (39.8%) prefer a medium (large) HKPUC.

Taken as a whole, the summary data of Table 2 convey the respondents' desire for transparency and public involvement, as well as their dissatisfaction with the government's regulatory ineffectiveness. The data also convey the respondents' negative sentiment against the *status quo*. Finally, data convey the respondents' view of an HKPUC's role and functions. Hence, Table 2 hints that the respondents may be willing to pay, through a small bill surcharge, for establishing and operating an HKPUC.

2.4 Consumer support for an HKPUC

2.4.1 Willingness to pay

To preview the consumer support for an HKPUC, Fig. 1 explores the respondents' willingness-to pay (WTP) for an HKPUC. Each downward sloping curve in in this figure shows the percentage of respondents with WTP values above a given surcharge level. The figure yields the following observations: (a) the WTP values are similar across three staff-size categories; (b) about 20% of the respondents are willing to incur a surcharge of at least 1% of their electricity bills to fund an HKPUC; and (c) about 40% of the respondents report a strictly positive WTP.

Observations (b) and (c) seem to suggest a weak consumer support for an HKPUC. The CE data presented below, however, indicate that these observations are the likely result of strategic behavior of underbidding in a WTP survey (Mitchell and Carson, 1989, Chapters 6-7).

2.4.2 Consumer preferences

We use the CE data to measure consumer preferences for two reasons. First, the experiment only requires respondents to make their *qualitative* choice ("yes", "not sure" or "no"), which is a relatively easy task when compared to the quantitative assessment of their WTP for an HKPUC. Second, the respondent's choice decision is consistent with the consumer theory of utility maximization (Boxall et al., 1996; Hanley et al., 2001; Hoyos, 2010).

We measure consumer support for an HKPUC by the percent of respondents saying "yes" to an HKPUC proposal. Drawn for the case of 0% government subsidy, Fig. 2 shows that at the 0.5% surcharge, the support is above 50% and does not seem to vary by staff size. Raising the surcharge to 1% increases the support, reflecting the respondents' dislike of a small HKPUC reported in Table 2. When the surcharge is 3%, the support falls below 0.4%. Fig. 3 shows that at the 50% government subsidy, the support is above 70%, at the 0.5% surcharge. Raising the surcharge to 1% does not reduce the support. When the surcharge is 3%, the support remains above 60%. Finally, Fig. 4 shows that at the100% government subsidy, the support is mostly above 80%.

2.4.3 Binary logit regression

The data portrayed by Fig. 2-4 enable a binary logit analysis of consumer preferences (Greene and Hensher, 2010). Specifically, the probability of a respondent saying "yes" to an HKPUC proposal is:

$$\text{Prob(response = "yes")} = \text{Prob}(V = U + \varepsilon > 0) = e^U / (1 + e^U), \quad (1)$$

where U is the systematic portion of a random utility function, $V = U + \varepsilon$, and ε is a logistically-distributed random error term. Thus, equation (1) treats a "not sure" response like a "no" response, thus mitigating the potential of over-stating the support of an HKPUC.

To estimate equation (1), we assume that U depends on the respondent's sentiment and demographics. Thus, we consider the following data available from the survey: (1) X_1 = Sentiment = 1 if the respondent responds that the *status quo* should be changed, and is 0 otherwise; (2) X_2 = Gender = 1 if the respondent is male, and is 0 if the respondent is female; (3) X_3 = Age (years); (4) X_4 = Education (years); (5) X_5 = Family size (number of people); (6) X_6 = Renter = 1 if renting, and is 0 otherwise; and (7) X_7 = Monthly income (HK$/month).[26]

We further assume that U depends on the HKPUC's attributes defined by: (1) Z_1 = 1 if the HKPUC's staff size is small (≤ 50 employees) and is 0 otherwise; (2) Z_2 = 1 if the HKPUC's staff size is medium (51-200 employees), and is 0; (3) Z_3 = Surcharge as a percent of monthly bill (= 0.5, 1.0, or 3.0); and (4) Z_4 = Government subsidy as a share of the surcharge (= 0.0, 0.5, or 1.0).

Finally, we assume a second-order approximation of U, an unknown function of $\{X_i\}$ and $\{Z_j\}$:

$$U = \alpha_0 + \Sigma_i\, \alpha_i X_i + \Sigma_j\, \beta_j Z_j + \Sigma_h \Sigma_i\, \alpha_{hi} X_h X_i + \Sigma_j \Sigma_k\, \beta_{ik} Z_j Z_k + \Sigma_j \Sigma_k\, \theta_{ij} X_i Z_j, \quad (2)$$

whose coefficients are α_0, $\{\alpha_i\}$, $\{\beta_j\}$, $\{\alpha_{hi}\}$, $\{\beta_{ik}\}$ and $\{\theta_{ij}\}$. Since U has a large number of explanatory variables that are correlated, it is likely over-specified. Hence, we use the maximum likelihood method (PROC LOGISTIC in SAS (2004)) to implement a step-wise procedure to identify the statistically-significant (p-value ≤ 0.05) variables in equation (2).

[26] About 23 % of the respondents have missing monthly bill data. Hence, monthly bill is not included as one of the demographic variables.

3. Results

Table 3 reports the regression results based on the data file of over 3,200 observations with non-missing data (≈ 3 CE responses per respondent × 1,100 respondents). The large size of our estimation sample diminishes concerns of (a) small sample bias and imprecision, and (b) our regression results being an artifact of random factors. The resulting set of estimates reflects that the demographic variables of gender, renter, and income, as well as the staff-size indicators, did not survive the 0.05 significance criterion used in the step-wise procedure.

The share of observations with the "yes" response is 70%, matching the preference data shown in Fig. 2-4. The regression's fit to the data is empirically reasonable, as reflected by the McFadden's pseudo R^2 of 0.12 for a large cross-sectional data file. With the exception of the intercept, all coefficient estimates are statistically significant (p-value ≤ 0.05).

The interpretation of the coefficient estimates is as follows:

- The coefficient estimate for X_1 is 0.4971, suggesting that a respondent's negative sentiment towards the *status quo* tends to increase that respondent's support for an HKPUC. Specifically, if the respondent believes that the *status quo* should be changed, this raises the odds that the respondent will support an HKPUC by a factor of $e^{0.4971} = 1.64$, or 64%. It also suggests that once this *status quo* bias vanishes after the HKPUC is established, the support tends to decline. This finding does not contradict the resistance to reform found by Fernandez and Rodrik (1991) because (a) adopting the HKPUC proposal imposes minimal costs on Hong Kong consumers; and (b) it allows Hong Kong consumers to enjoy regulatory transparency and public involvement, which are positive benefits perceived to likely exceed those costs.

- The estimated marginal effect of age on U is given by $\partial U/\partial X_3 = -0.0770 + 0.0014X_3$. Since $\partial^2 U/\partial X_3^2 = 0.0014 > 0$, U is minimized where $\partial U/\partial X_3 = 0$; or, the odds that a respondent will support the proposed HKPUC, decrease as respondents increase in age, reaching their minimum at an age of $X_3 = 55$, and increase as the age of the respondent surpasses 55.
- The estimate for $\partial U/\partial X_4$, the marginal effect of education, is 0.0523. That estimate suggests that the more educated is a respondent, the more likely is that respondent to support the proposed HKPUC.
- The estimate for $\partial U/\partial X_5$, the marginal effect of family size, is 0.1497, implying that a respondent with a large family is more supportive of the HKPUC than is one with a small family.
- The surcharge's marginal effect is $\partial U/\partial Z_3$, which depends on the surcharge Z_3 and government subsidy Z_4. Its estimate is $(0.7735 - 2 * 0.3272 * Z_3 + 0.4405 * Z_4)$. At zero government subsidy ($Z_4 = 0$), the estimated marginal effect is negative (positive) for a surcharge above (below) 0.7735 / (2 * 0.3272) = 1.18%.
- The government subsidy's marginal effect is $\partial U/\partial Z_4$, which depends on the surcharge Z_3 and government subsidy Z_4. Its estimate is $(2.1748 + 0.4405 * Z_3 - 2 * 1.2805 * Z_4)$, which is positive for eight of the nine cases formed by $Z_3 = 0.5, 1.0, 3.0$ and $Z_4 = 0.0, 0.5, 1.0$. The only exception is the case of low surcharge of $Z_3 = 0.5$ and high subsidy of $Z_3 = 1.0$ that results in an estimate of $(2.1748 + 0.4405 * 0.5 - 2 * 1.2805 * 1) = -0.166$. Thus, government subsidy tends to increase the support for a HKPUC.

In summary then, these coefficient estimates imply that a respondent's support for an HKPUC depends on the respondent's demographics and sentiment towards the *status quo*, as well as the bill surcharge and the government subsidy for that surcharge. However, they do not

paint a clear picture of the overall support of heterogeneous consumers under alternative assumptions of the surcharge and government subsidy level.

4. Discussion

The regression results in Section 3 enable our development of a support curve to indicate the overall consumer support at alternative surcharge levels. We measure support based on the probability of a respondent saying "yes" to a HKPUC proposal *sans* government subsidy. We focus on this case because if the HKPUC is financially viable at a relatively low surcharge, it does not need government funding, thus preempting the potential criticism that the government funding for the HKPUC could be used to meet more pressing needs (e.g., education, public housing, and social welfare).

Given the nonlinear nature of equation (2), we use sample enumeration to develop Fig. 5 that portrays the support curve with consumer sentiment against the *status quo*. Assuming no government subsidy ($Z_4 = 0$), this entails the following steps:

- Step 1: Set the surcharge Z_3 as a percent of bill, which can alternatively be 0.5, 1.0, 1.5, 2.0, 2.5, or 3.0.
- Step 2: Use the estimated binary logit model in Table 3 to compute P_r, the estimated probability of respondent r (= 1, …, 1,100) saying "yes" to a HKPUC proposal defined by the surcharge set in Step 1 and zero government subsidy.
- Step 3: Compute UB_r and LB_r, the upper and lower bounds of the 95% confidence interval of P_r at a given surcharge value.
- Step 4: Find $S = \Sigma_r P_r /1100$, an estimate for the share of respondents supporting the HKPUC proposal.

- Step 5: Find $UB = \Sigma_r \, UB_r / 1100$, and $LB = \Sigma_r \, LB_r / 1100$, the estimated upper and lower bounds of *S*.
- Step 6: Plot the results from Steps 4 and 5, with the surcharge on the horizontal axis and the resulting consumer support on the vertical axis.

Based on Step 6 above, Fig. 5 suggests that at the 1.5% surcharge, the estimated support is about 75%, with a lower bound of about 70%. Thus, this figure empirically documents the majority support for a HKPUC.

To determine if the support shown in Fig. 5 can sustain without the consumer sentiment against the *status quo*, we repeat the sample enumeration process after setting $X_1 = 0$ for all respondents in the sample. Fig. 6 shows that at the 1.5% surcharge, the estimated support is around 70% with a low bound above 60%. Hence, the majority support remains after the negative *status quo* bias vanishes.

Taken together, Figs. 5 and 6 suggest that there is initial majority support for an HKPUC and that majority support is likely to sustain after the HKPUC's establishment.

5. Conclusions and policy implications

Hong Kong's electricity service is superbly reliable and price-reasonable under the SCA when compared to those of the major cities in the OECD countries. Despite the industry's reliability-price performance, there are criticisms on the SCA, including: (a) the allegation of economic inefficiency caused by excess capacity; (b) the high ROEs made possible by the SCA's permitted ROA in a low interest rate environment; and (c) the lack of transparency and public involvement in Hong Kong's regulatory process.

The current 10-year SCA will expire in 2018 (or 2023 after an optional 5-year extension), offering a window of opportunity to consider proposals with long lead time to modify or replace the current regulatory arrangement. The proposals made in a series of papers published in this journal range from minor modifications of the SCA (e.g., periodic reviews of the permitted ROA and adoption of PBR) to electricity market restructure to introduce wholesale market competition and retail access to multiple suppliers. These proposals, however, overlook two important aspects of regulatory governance: transparency and public involvement. As a result, we have undertaken a CVM survey to collect the data necessary for estimating consumer support for an HKPUC.

The results thus obtained are sharp and statistically significant. In particular, at the 1.5% incremental bill charge, about 70% the respondents are estimated to support an HKPUC *sans* any government subsidy. In short, the answer is "yes" to the question: is there sufficient consumer support for an HKPUC? The policy implication is that Hong Kong should explore the possibility of establishing an HKPUC as part of the public policy debate on Hong Kong's electricity future.

To be sure, the exploration may not lead to the HKPUC's eventual adoption. One may argue that electricity market restructuring would obviate the need for an HKPUC because market forces could greatly limit its usefulness. This argument, however, is not supported by (a) the omnipresence of a PUC in every state in the U.S., including those states with restructured electricity markets; and (b) the Canadian province of Alberta that established its PUC in 2008, *seven* years after its electricity market restructuring that took place in 2001.[27]

We would be remiss if we failed to acknowledge that the establishment of an HKPUC could cause unnecessary and costly delays in resource decision-making (e.g., major transmission upgrade), as sometimes seen in states like California and New York. Hence, an HKPUC

[27] http://www.auc.ab.ca/about-the-auc/who-we-are/Pages/History.aspx

proposal should not have an excessively complicated structure or an overly burdensome hearing process.

We would also be remiss if we understated the substantial challenges in establishing an HKPUC noted in the introduction of this paper. How to overcome these and possibly other challenges is well beyond the scope of this paper. Nonetheless, a possible starting point may consider the process used by Alberta to establish its PUC.

Finally, there is the question as to whether an HKPUC can exist under the framework of "one country, two systems." As an HKPUC only deals with the *domestic* performance of the two *local* utilities, we believe it can exist like the Hong Kong Competition Commission, which was established under the Competition Ordinance passed on 14 June 2012 by the Legislative Council.[28] Indeed, a separately established HKPUC may not even be necessary if its functions can become part of the Competition Commission's responsibility.[29]

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[28] http://www.compcomm.hk/en/index2.html
[29] This will entail assigning the EB's and ExCo's current regulatory oversight to the Competition Commission.

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