

## Summary

Public procurement (PP) is increasingly applied by the public sectors to achieve horizontal goals including environmental protection and innovation development, with the substantial power of public demand. Green public procurement (GPP) is an environmental instrument designed to utilize this vast spending power to promote environmental protection and advance more environmentally sustainable economies. The European Union (EU) *Eco-innovation Action Plan* in 2011 confirmed that well-targeted policies, such as PP, could accelerate eco-innovation by creating stronger and more stable demand. EU has been the front runner of integrating secondary goals into PP policy. This thesis focuses on the PP or GPP policy and its effect on eco-innovation in European countries and companies.

According to Porter Hypothesis, well-designed environmental policies are able to stimulate eco-innovation that can offset the cost of industries to install or internalize environmental technologies and systems. That emphasizes the important intermediate role of eco-innovation for effectiveness of environmental regulations. What is more, eco-innovation has “double-externalities” of knowledge spillover, as well as the reduced environmental impact. There are synergies and complementarities in promoting environmental innovation. Moreover, this thesis proposes “dual-rationales” of demand-pull and regulatory effect to explain the potential effects of PP on eco-innovation, based on environmental innovation theory, stakeholder theory and neo-institutional theory. The distinct and additional “customer” role of public authorities in PP endows them more power than other instruments to make a difference, theoretically. These interpret the significance of environmental protection, innovation and PP policy and their close nexuses. This thesis embraces the triple themes.

The research questions are as follows:

1. *What factors can influence the GPP uptake? (Chapter 2)*
2. *Whether GPP or PP can promote eco-innovation development, and in what pattern? (Chapter 3 & 4)*

For the first question, the peer reviewed research on factors affecting the uptake of GPP from empirical economic standpoint is rather limited. This thesis provides new evidence based on contract award notice information, which is an original angle. For the second question, only several empirical studies are found. The existing relevant studies either explore the driver of eco-innovation hardly discussing PP, or investigate the innovation public procurement without a green perspective. To my knowledge, this is the first empirical study the effectiveness of PP or GPP on eco-innovation, synthetically tested with macro and micro level data.

The following are the summaries for the three analytical chapter separately.

Chapter 2 aims to find out what factors can have effects on the adaptation of green award criteria in the contracts via probit regression with fixed terms, using the contract award notice data in 33 European countries in 2018. The dataset covers various business sectors and procurement procedures. The findings show that framework agreements, sector of medical equipment, sector of health and social services, and sector of business services negatively relate with whether a contract

is green ( $p < 0.01$ ). On the other hand, contract value, joint procurement, GPA coverage, competitive dialogue, negotiation with a call for competition, restricted procedure, and sector of transport equipment, and sector of food positively correlate with green contract, or these factors increase the possibility of a contract being green ( $p < 0.01$ ). This chapter identifies factors influencing the adoption of green award criteria in public contracts, which implicates the efficient resources allocation in terms of increasing GPP performance for policy makers.

Chapter 3 evaluates the effect of green contract ratio on Eco-innovation Index with country-year data from 28 European nations, applying static and dynamic panel analysis. The findings indicate that eco-innovation correlates with the green contract ratio, and this effect changes along with the ratio. When green contract increases, the additional estimated effect decreases. From static analysis, if increasing the green contracts by one percent from zero and ten, Eco-innovation Index will rise by 0.79 points and 0.67 points, respectively, keeping the control variables constant. The increments are approximately 0.9% and 0.8% of the eco-innovation index average (89.4). The dynamic analysis also implies that the green contract ratio positively influences eco-innovation with a diminishing marginal change, although not all coefficients have a persuasive statistical significance level. It is also proved that eco-innovation is auto-correlated, which means that past decisions on eco-innovation are decisive in its current values.

The theories can explain the positive impact, but not the non-linear pattern, so that semi-structured interviews were conducted in Europe the end of 2019. The interviewees, professionals on GPP issues, support that GPP can promote eco-innovation, at least to some extent, or from aspects such as the diffusion of innovative products or services. Three reasons can be generalized to give hints for the reverse U shape relation of GPP and eco-innovation. Firstly, public authorities need to be responsible for tax payers' money and avoid purchase failure. In general procurements, "proven concepts" are preferred because they have been tested in the market and are less risky. Secondly, the human nature and behavior of executors also matter. Their priority is completion of purchasing project within certain time with certain budget. Following the previous routine or referring to former contracts is rational for officers. Thirdly, the time, budget and knowledge constrain hinders the officers to consider all possible innovative solutions. These reasons lead procurement executors to "copy and paste" what they have done previously. However, if this phenomenon continues, the subjects purchased would be less and less innovative over time, and the green contract would be less and less incentive for companies to innovate.

Chapter 4 applies probit and propensity score matching (PSM) methods to estimate the impacts of public procurement on companies' decisions to introduce innovations with environmental benefits. Only estimations supported by both methods are deemed as credible in this analysis. The data is derived from Community Innovation Survey (CIS) in 2014 collected from enterprises in various industrial sectors from 15 European countries. The findings suggest that the companies with a public contract are 5.7% more likely to introduce innovations with environmental benefits. It is easier for PP to stimulate firms' eco-innovations during consumption and use of goods or services by the end user, than within the enterprises. What is more, environmental innovations on recycling within the companies and by end users are evaluated to be promoted by public contract.

In detail, PP are tested to be effective on innovations of five environmental benefits: recycled waste, water and material for own use or sale; reduced energy use and CO2 footprint by end users; reduced air, water, noise and soil pollution by end users; facilitated recycle of product after use; and extended life length of product. The results demonstrate that PP impels companies, of all size, to make eco-innovation decisions, but especially the small and large companies, rather than the medium-sized ones.