Assessing the Impact of Weberian Bureaucracy and New Public Management on Innovation

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Abstract

This study examines how bureaucratic structures affect innovation at the country level. Although there have been growing scholarly attention to innovation within the public sector, we still have limited understating about what determines cross-national variations in innovation at the country level. Especially, literature on administrative structures of public bureaucracies and their impact on a country level of innovation is scarce. This paper hypothesizes that bureaucratic structures matter for bureaucratic incentives for promoting and supporting innovation. Utilizing cross-national data from the Quality of Government (QoG) Institute Expert Survey and Global Innovation Index (GII), we find that, on average, professional and impartial bureaucracies and those adopting NPM reforms are more likely to achieve higher levels of innovation outputs. The results suggest the importance of administrative structures and designs to promote innovative activities.

Key Words

Innovation; Weberian bureaucracy; Bureaucratic structure, New Public Management (NPM); Comparative public administration,

Introduction

There has recently been growing scholarly attention to innovation in public organizations (Bloch and Bugge 2013, Bugge and Bloch 2016, Demircioglu 2017a, b, Torugsa and Arundel 2015, 2016). Some studies analyze the outcomes of innovation such as efficiency, performance, and legitimacy in public organizations (Damanpour, Walker, and Avellaneda 2009, Verhoest, Verschuere, and Bouckaert 2007), and other studies examine factors affecting adoption of innovations in organizations (Bugge and Bloch 2016, Damanpour 1991, Greenhalgh et al. 2004). In spite of such increasing number of studies on innovation in the discipline of political science and public administration, there have been few studies examining what explains the variations in innovation across countries.[i] Especially, scant attention has been paid to how structures and administrative design of public bureaucracy accelerate or hamper innovative activities within a country.[ii]

This article examines how public bureaucracy affects innovation by conducting a cross-national study of 109 countries. Bureaucratic control and bureaucratic characteristics have been considered to have negative effects on innovation within public and private sectors by scholars and popular writers (Damanpor 1996, Dougherty and Corse 1995). On the other hand, the Weber's model for public bureaucracy has been considered for having positive impacts on socio-economic development of a country (Dahlström, Lapuente, and Teorell 2010, Evans and Rauch 1999, Rauch and Evans 2000). However, we still have limited understanding about what types of bureaucracy and administrative characteristics promote or discourage innovation in society. Systematic cross-national studies that incorporate bureaucratic structures are very few (Dahlström, Lapuente, and Teorell 2010, Egeberg 2012). Such paucity of studies is partly due to the lack of comparable cross-national data for public bureaucracy. However, the recent development of a unique cross-national data sets of bureaucratic structures enables researchers to start to empirically test the relationship between the variation in bureaucratic structures and various socio-economic outcomes (Teorell,

Dahlström, and Dahlberg 2011, Dahlström et al. 2015a). Taking advantage of such unique data sets, we seek to contribute to the emerging literature on the effects of bureaucratic structure on social outcomes in a cross-national setting (Cho et al. 2013, Cornell and Grimes 2015, Dahlström, Lapuente, and Teorell 2012a, Dahlström and Lapuente 2012, Fernández-Carro and Lapuente-Giné 2016, Nistotskaya and Cingolani 2015).

In this study, we argue that administrative structure and design of public bureaucracy matter for innovation level in a country. We assume that bureaucratic structures affect incentives and motivation for promoting innovation, which subsequently influences national level of innovation. We hypothesize that employment and career system of public bureaucracy are associated with innovation. In particular, this article test the proposition that professional bureaucracies characterized by merit-based recruitment and internal promotion rather than political appointees promote innovation. Likewise, those with impartial decision-making and adopting New Public Management (NPM) reforms also accelerate innovation. On the contrary, closed bureaucracies characterized by exam-based recruitment, lifetime employment, and limited personnel exchanges between the public and private sector tend to hinder innovation. We test the above propositions using a cross-national data set of bureaucratic structures from the Quality of Government Institute (QoG) Expert Survey (Dahlström et al. 2015a) and Global Innovation Index (GII) (Cornell University, INSEAD, and WIPO 2016). Findings suggest that bureaucratic structures matter for innovation controlling for economic development, levels of democracy, and infrastructure for innovation. Professional and impartial bureaucracies as well as those adopting NPM reforms have positive impacts on national levels of innovation outputs.

This study seeks to contribute to the existing literature in three ways. First, this study contributes to the literature that explains how administrative designs and structures have impacts on societal outcomes in a cross-national setting by examining the relationship

between bureaucracy and innovation. Second, we incorporate administrative variables in the cross-national study of national level innovation and test their impacts. Third, this study contributes to the recent increased interests in contextual factors in public management and performance in a cross-national setting (Meier, Rutherford, and Avellaneda 2017, O'Toole and Meier 2014). This paper first explains theoretical frameworks of this study. Then, the following section offers hypotheses tested in this study while highlighting how the bureaucratic structure affects innovation of a country. The third section explains the data and methods of this study, followed by a fourth section containing results and analysis. Finally, this paper ends with discussion, conclusions, and limitations.

Theory and hypotheses

Analyzing public sector innovations throughout the world, Albury (2011, 227) asks, "[b]ut why now, as opposed to ten years ago, are governments across the world talking about public service innovation?" He explains that innovation is essential in the 21st century because "we are in the middle of a 'perfect storm' around public service" which innovation provides us solutions. Today, public organizations have ongoing and new challenges such as ageing, retirement, health, terrorism, and security which require innovative solutions. Additionally, fiscal and financial constraints and citizen expectations make public services be more innovative (Albury 2011). Despite such growing scholarly attentions to innovation within the public sector, we still have limited understanding about how bureaucracies affect national level of innovation. Although it has not taken wider scholarly attention, bureaucratic structures and contextual factors shape the outputs of public services and affects social outcomes (Egeberg 2012). Thus, it is worth asking how bureaucratic structures can lead innovations within a country.

In examining this question, we rely on a concept of bureaucratic incentive and motivation for promoting innovation borrowing from policy entrepreneurship and diffusion

literature (Berry, Berry, and Sabatier 2014, Teodoro 2009). Policy diffusion theories state that public sector employees and managers adopt and learn innovative ideas in order either to increase their agencies' efficiency and effectiveness or serve the citizens' well (Berry, Berry, and Sabatier 2014). Berry, Berry, and Sabatier (2014) also finds that internal determinants and diffusion are two major explanations for why some public organizations are more innovative. Such internal determinants of innovation include the motivation for innovation (Mohr 1969). Overall, increasing employees' motivation for innovation and availability of relevant resources as well as reducing the obstacles for innovation are important (Mohr 1969). Other studies on policy entrepreneurship and public sector innovation also emphasize importance of public sector employees' motivation for innovation. Christensen, Anthony, and Roth (2004) states that motivation to innovate is a crucial factor for innovativeness. They argue that "[a]ctions that increase ability or motivation tend to increase innovation; actions that put up barriers to ability or motivation tend to decrease innovation"(Christensen, Anthony, and Roth 2004, p.92). Similarly, McLean (2005) explains that innovation occurs when enabling conditions such as motivating condition is present. Furthermore, by reviewing 181 articles and books on public sector innovation, De Vries, Bekkers, and Tummers (2015) explain that incentives and rewards and degree of risk aversion are one of the important organizational antecedents for organizational innovation. Teodoro (2009) and Hopkins (2015) suggest that institutional incentives and institutional encouragement matter for organizational innovation and policy entrepreneurship.

Previous studies suggest the importance of motivational factors for innovation within bureaucratic organizations. However, it is not certain whether or not such incentive structures of motivation also affects national level of innovation. Most previous studies on public sector innovation and policy diffusion mainly look at innovation within public organizations. Furthermore, previous studies tend to focus on a single country, not a large-N cross-national

study. Additionally, there is very few comparative studies of the effects of bureaucratic structure on social outcomes, including innovation. Our cross-national research contributes to this gap. This paper hypothesizes that bureaucratic structures affect bureaucracies' motivation to support and promote innovation, which leads to innovation in a country. We especially look at three types of bureaucratic structures (professional, impartial, and closed bureaucracies, which represent the Weberian models of bureaucracy) and bureaucracies adopting NPM reforms. The following section explains each proposition.

a. Professional Public Administration

The first dimension of bureaucratic structures we examine is bureaucratic professionalism (Dahlström, Lapuente, and Teorell 2012a, Silberman 1993). Bureaucratic professionalism refers to the degree of meritocracy and politicization in bureaucracies. Professional bureaucracy is characterized by merit-based recruitment and internally recruited senior officials rather than political appointee or political network-based recruitment (Dahlström, Lapuente, and Teorell 2010, 2012b). Higher levels of professionalism indicate more professionally-oriented bureaucracies rather than politicized bureaucracies. Modern bureaucratic structures brings more professionalism which may affect social outcomes (Egeberg 2012). However, the level of professionalism in each country is different. Such professionalism can enhance employee motivation to innovate (Demircioglu 2017b).

How does bureaucratic professionalism influence motivation for supporting and promoting innovation? Public sector organizations can select more competent and skillful bureaucrats in meritocratic recruitment system than they can do in politicized one. Such expertise and skills of bureaucrats contribute to accelerate innovation in society. In a professional public administration, bureaucracy can "recruit the best possible personnel, and merit recruitment is the logical means of filling positions with the best qualified personnel"(Peters 2010, p.83). On the contrary, lack of professional public administration

prevents employees from being knowledgeable and expert in own policy areas, further reducing their motivation to commit their jobs and work effectively. In addition, politicized bureaucracies tend to be unstable (e.g. high turnover particularly for talented employees), which reduces bureaucrats' motivation to engage in projects and perform well (Cornell 2014).[iii] In sum, professional bureaucracy based on meritocratic recruitment has more expertise, long-term perspective, and are less influenced from patronage and political interests than those who are hired mainly by political and personal connection. They are also less willing to act on behalf of short-term political interests. Therefore, they are likely to bring positive impacts on innovation in society. Accordingly,

H1: Professional public administration as a bureaucratic structure is positively associated with innovation.

b. Closed bureaucracy

Closed bureaucracy refers to whether public service is a distinctive career and whether employees are from private sector to public sector, or vice versa (Peters 2010). In a closed bureaucracy, promotion is typically made within the organization rather than hiring a manager from other agency or other sector (Teodoro 2009). The closedness and the rigidity of the bureaucracy is usually an obstacle for innovation. In addition, citizens may consider the closed bureaucracy as not legitimate or acceptable (Peters 2010, p.93). Professional reputation is also not important in a closed bureaucracy because selection of executives are mainly based on familiarity and conformity to organizational norms and rules rather than professional expertise (Teodoro 2009). Thus, such internal hiring practices in closed bureaucracy lowers employee motivation to gain more expertise and learn new skills and knowledge, which negatively affects innovation.

Furthermore, bureaucrats who are experienced and promoted within their agency are less willing to learn new tools and practices (Arnold 2014). Therefore, public managers who

are transferred from other organizations tend to be more innovative than public managers who are promoted within the agency (Teodoro 2009). Experienced bureaucrats have been exposed for a longer time to models of professional practice that are not updated. Therefore, they may be less open to learning new tools. Thus, openness of the bureaucracy tends to motivate bureaucrats to perform well and to be innovative, which can positively affect innovation in society(Goldsmith and Eggers 2005, Linden 2010).

While politicians in closed bureaucracy (e.g. France and Spain) have limited discretion and less motivation to lead bureaucrats and projects, bureaucrats in the open bureaucracy (e.g. the United Kingdom) do not have special treatments and they resemble to private sector managers. Open bureaucracy also increases flexibility in the bureaucracy (Dahlström and Lapuente 2012). All of these factors motivate bureaucrats' motivation to innovate in an open bureaucracy whereas the lack of such factors in closed bureaucracies reduce bureaucrats' motivation to innovate. Overall, the open bureaucracy provides more opportunities and incentives to be innovative. But, in closed bureaucracies, there is limited opportunities for transfer among different sectors, less personnel interaction between public sector and private sector employees, and less public-private partnership. Thus, there is less opportunities and incentives for being innovative. Therefore,

H2: Closed bureaucracy is negatively associated with innovation.

c. Impartial bureaucracy

Weber states that bureaucracy needs to be impartial and bureaucrats should be appointed and be function based on "personally free and subject to authority only with respect to their impersonal official obligations" (Weber, 1968, 333). The impartial bureaucracy provide consistency and generalizability of the rules and applications, therefore it increases fairness and justice (Peters 2010). Nistotskaya and Cingolani (2015) argues that meritocratic recruitment and tenure protection of public bureaucracies assure impartiality and stability in

implementation of rules for entrepreneurs. Their work empirically demonstrates a close link between meritocratic recruitment and entrepreneurship and individual choices to enter new business. In fact, because of impartiality, business actors can make investment for innovation. On average, impartial bureaucracy such as when rules and expectations are known and applicable to everyone (e.g. coercion and monetary reward) affects bureaucrats' motivation to work and perform better (Peters 2010). To give an another example, the 2011 State of the Service Report by Australian Public Service (APS) Commission states that the impartial bureaucracy and the impartial policy advice can brings more innovative culture and provide high quality service to citizens and the society (Australian Public Service Commission (APSC) 2011).[iv] Impartiality can also increase trust and trust can lead more innovative bureaucracy. Taken together, these insights and findings from the existing literature lead us to hypothesize:

H3: Impartial public administration as a bureaucratic structure is positively associated with innovation.

d. New Public Management

Since the 1980s, the NPM reforms in the world and National Performance Review (NPR) in the United States encourage public sector employees to be innovative while establishing innovative practices for public sector (Breul and Kamensky 2008, Kamensky 1996, Kettl 2006).[v] NPM emerged as a response to and a solution for economic, fiscal, political, and institutional problems that became apparent occurred in the 1970s (Box et al. 2001, Green‐pedersen 2002, Wise 2002). As Aucoin (1990) states, public management reforms in the 1980s are driven by both responding governments' concern on fiscal policies and citizens' increasing demands on government services, so these two factors increase bureaucrats' and politicians motivation to innovate and implement innovations.

NPM reforms focus on outputs, competition in public sector, private sector management styles, managerial autonomy, and professionalism (Hood 1991). Such goals of NPM reforms can increase employee motivation to be innovative. The United Kingdom, Australia, and New Zealand are the most important countries adopting NPM reforms, and they are also active for developing innovative culture (Demircioglu 2017a). In the early 1980s, Australia's ruling party's (Labor Party which is the center-left) main concern was efficiency and fiscal austerity and thus budget cuts (Barzelay 2001, Jreisat 2002). Therefore, innovation and reforms were considered to achieve these goals.

Incentive systems in public bureaucracies matter for organizational and social outcomes (Egeberg 2012). In fact, one of the main NPM theme is incentivization. It means, "[s]hifting away from involving managers and staffs and rewarding performance in terms of a diffuse public service or professional ethos, and moving instead toward a greater emphasis on pecuniary-based, specific performance incentives" (Dunleavy et al. 2006, p.470). In this regard, while closed bureaucracies discourage incentives and motivation for innovation, NPM reforms are expected to increase incentives to innovate. Furthermore, NPM also aims at using incentives and motivational tools such as material incentives to increase efficiency and innovativeness in the bureaucracy (Peters 2010). Therefore, we expect that it also affects bureaucratic motivation to promote innovation in society.

According to Mohr (1969), beliefs and ideologies of the public bureaucracy and bureaucrats are the best predictor for adaptation of innovative ideas. For instance, if the bureaucrats' ideology emphasize competition and focus on outcomes instead of the process, bureaucrats will have higher motivation to be more innovative (Mohr, 1969). Similarly, Berry, Berry, and Sabatier (2014) finds that many innovations reflect conservative vs. liberal separation, so ideology affect bureaucrats' motivation to innovate. NPM reforms aims at changing the government structure from risk-averse to risk-taking and exploration, which is

related to innovativeness (De Vries, Bekkers, and Tummers 2015). NPM is also ideologically grounded with a neo-liberal/conservative agenda aiming competition, we expect that NPM is positively associated with innovativeness. Overall, NPM can increase bureaucrats' motivation to innovate and promote innovation through increasing managerial authority which lead to more innovative organizational culture (Verhoest, Verschuere, and Bouckaert 2007, Wynen et al. 2014). Accordingly,

H4: NPM reforms are positively associated with innovation.

Research Design

-Data Collection

Cross-national comparison is very common as a research method in the field of political science. However, unfortunately, despite the growing scholarly attention to various contextual factors in public management and performance (Meier, Rutherford, and Avellaneda 2017, O'Toole and Meier 2014), comparative research has been still few in the study of public administration and bureaucracy (Dahlström, Lapuente, and Teorell 2012b, Eglene and Dawes 2006, Fitzpatrick et al. 2011, Sundell 2014). One such reason is the lack of cross-national data on public bureaucracy and bureaucratic structures and behavior (Dahlström, Lapuente, and Teorell 2012b, Dahlström et al. 2015b). In this study, we utilize data from the Quality of Government (QoG) Institute Expert Survey II (Dahlström et al. 2015a), which is a novel cross-national data set of bureaucratic structures collected from country expert surveys. The QoG Expert Survey was primarily designed based on the pioneering work on mapping of the bureaucratic structure in 35 less developed countries by Peter Evans and James Rauch (Evans and Rauch 1999, Rauch and Evans 2000). The first version of the survey was conducted by a group of researchers at the QoG Institute in 2008-2012, which led to the first Expert Survey data set (Teorell, Dahlström, and Dahlberg 2011). The Expert Survey II was carried out in 2014. The Expert Survey II data was collected from

survey responses from 1,294 country experts covering 159 countries. The survey mainly asks expert perceptions of the current status and characteristics of a country's public bureaucracy. The survey questions are mainly centered on bureaucratic structures such as recruitment and career system, replacement, compensation, policy making and implementation, gender representation, and transparency. In light of a focus of our research, the data set contains variables regarding administrative characteristics and reform. The QoG Expert Survey data has been used in many academic publications, including top public administration journals (Boräng, Nistotskaya, and Xezonakis 2017, Cho et al. 2013, Cornell 2014, Cornell and Grimes 2015, Gustavson and Sundström 2016, Kopecký et al. 2016, Nistotskaya and Cingolani 2015, Sundell 2014).

Our main dependent variable is the country level of innovation outputs. The data is obtained from the database, the Global Innovation Index (GII) (Cornell University, INSEAD, and WIPO 2014). The GII has been established as a leading reference on innovation at the country level since the late 2000s. It ranks the innovation performance of countries and economies around the world. The GII project was launched by INSEAD (Institut Européen d'Administration des Affaires) in 2007. The 2014 report covers 143 economies around the world. Data contained in the report were gathered from various existing statistical data. The GII report is published annually and the latest version was released in 2016. The dependent variables are obtained from the online database of the GII (Cornell University, INSEAD, and WIPO 2016). We utilized data in the 2014 report for the dependent variables and the 2013 report for control variables. The data set contains two aspects of innovation: innovation input and innovation output. The innovation input index captures various national factors that enable innovative activities, including institutions, human capital and research, infrastructure, market sophistication, and business sophistication. The innovation output index look at the results of innovative activities in a country, focusing on knowledge and technology outputs

and creative outputs. Given the purpose of our research, which assess the impact of bureaucratic structure on a country level of innovation, we focus on the output aspect of innovation. Several academic research on innovation has utilized the GII data (Crespo and Crespo 2016, Meissner 2015, Sohn, Kim, and Jeon 2016, Zhan, Bendapudi, and Hong 2015). We also utilize the QoG Basic Dataset 2017 for control variables (Dahlberg et al. 2017a).

-Dependent Variables

The dependent variable in this study is the overall level of innovation output in each country. In order to measure the degree of innovation output, we use innovation output scores from the GII. Specifically, we look at two aspects of innovation output: 1) knowledge and technology output and 2) creative output. In each area of innovation, output score is calculated. In GII, each innovation output score is divided into three sub-components. Knowledge and technology output score consists of three sub-components: 1) knowledge creation, 2) knowledge impact, and 3) knowledge diffusion. Each sub-component is made from four to five individual indicators. List of indicators included in each category is listed in table A1 in appendix. Each sub-component score is calculated as the weighted average of its individual indicators. Then, the knowledge and technology output score is calculated as the weighted average of its sub-component score. The resulting score ranges from 11.2 to 60.9 in samples of 108 countries in our sample. [vi] The creative output category consists of three sub-components: 1) intangible assets, 2) creative goods and services, and 3) online creativity. The creative output score is calculated in the similar way. The creative output score in our sample ranges from 0.6 to 66.1.[vii] Distribution of each score is reported in appendix.

-Independent Variables

The independent variable is structure of public bureaucracy. We use original data from the QoG Expert Survey Dataset II to capture bureaucratic structure (Dahlström et al.

2015a). In particular, we focus on the following bureaucratic characteristics: 1) bureaucratic professionalism, 2) bureaucratic closedness, 3) bureaucratic impartiality, and 4) NPM reform. In this research, we particularly pay attention to bureaucratic incentives and motivation for innovation (Teodoro 2009). To measure bureaucratic structure, the independent variables from the QoG Expert Survey especially look at the employment system in the public sector, which is a core concept of Weberian bureaucracy (Weber 2009). One of the novel contributions of the QoG Expert Survey to the study of comparative public administration is that it provides quantitative assessment of Weberian bureaucracy, which has been empirically overlooked (Dahlström, Lapuente, and Teorell 2010). We test which characteristics of Weberian bureaucratic structures are associated with the country level of innovation.

The first independent variable is professionalism of bureaucracy. The QoG Expert Survey data set contains an index of bureaucratic professionalism, which is constructed from the following four questions: 1) "When recruiting public sector employees, the skills and merits of the applicants decide who gets the job", 2) "When recruiting public sector employees, the political connections of the applicants decide who gets the job", 3) "The top political leadership hires and fires senior public officials", 4) "Senior public officials are recruited from within the ranks of the public sector". Respondents are asked to select a scale from 1 (hardly ever) to 7 (almost always). The data set reverses the scale of the second and third questions, therefore higher values mean more professionalism. The professional bureaucracy index is constructed by using the mean value for each responding expert of the four questions. [viii] Higher values of bureaucratic professionalism index indicate more professional-oriented bureaucrats rather than politicized.

The second independent variable is bureaucratic closedness. We constructed an original indicator of closedness/openness based on the following three questions: 1) "Public sector employees are hired via a formal examination system", 2) "Senior public officials are

recruited from within the ranks of the public sector", 3) "Once one is recruited as a public sector employee, one remains a public sector employee for the rest of one's career". Here, we focus on recruitment and promotion system which determines levels of diversity in human resources in public bureaucracies. Open system indicates more diverse human resources in terms of experience, career, and expertize, whereas closed system means less diverse human resources. Survey respondents were asked to select from 1 (hardly ever) to 7 (almost always). Thus, higher values indicate more closed bureaucracy in terms of recruitment and promotion of the public sector employees. In the closed bureaucratic system as opposed to the open one, recruitment tool for the public sector is mainly restricted to formal meritocratic examination system. Promotion is done mainly internally and bureaucrats enjoy life time tenure protection. We created an additive index for bureaucratic closedness based on the above three questions by running principal component analysis. Cronbach's alpha is 0.7, which passes acceptable criteria.

The third independent variable is bureaucratic impartiality. We rely on the index of impartiality contained in the QoG Expert Survey. This index measures the degree of impartiality of bureaucracies in decision-making. Higher values mean higher impartial exercise of power.[ix] The index is constructed by based on the mean values of the following five survey items. 1) "Firms that provide the most favorable kickbacks to senior officials are awarded public procurement contracts in favor of firms making the lowest bid", 2) "When deciding how to implement policies in individual cases, public sector employees treat some groups in society unfairly", 3) "When granting licenses to start up private firms, public sector employees favor applicants with whom they have strong personal contacts", 4) "Generally speaking, how often would you say that public sector employees today, in your chosen country, act impartially when deciding how to implement a policy in an individual case?", and 5) "Hypothetically, let's say that a typical public sector employee was given the task to dis-

tribute an amount equivalent to 1000 USD per capita to the needy poor in your country. According to your judgement, please state the percentage that would reach: The needy poor."[x] Finally, the fourth independent variable is the degree of NPM reform. We use the following NPM-related questions in the Expert Survey: 1) "The salaries of public sector employees are linked to appraisals of their performance" and 2) "Public sector employees strive to be efficient". We created an additive index for NPM reform based on these survey items. Cronbach's alpha is 0.87, which indicates high internal consistency between two items. The cross-country variations in the above four measurements are presented in Figure A3, A4, A5, and A6 in appendix.

-Control Variables

This study controls for other factors that are expected to influence country level of innovation. Relatively small number of samples does not allow us to include a large number of controls. Therefore, we limit a number of controls to five important factors. We control for 1) GDP per capita (Current Prices) (ln), 2) GDP growth (%), 3) country level of democracy, 4) government fractionalization, and 5) number of researchers per million population. First four variables are obtained from the QoG Basic Dataset (Dahlberg et al. 2017a) and the last variable is from the GII report 2013(Cornell University, INSEAD, and WIPO 2016).

We control GDP per capita and GDP growth because previous research shows that these variables affect innovations at the national level (Fagerberg and Srholec 2008, Lee et al. 2016, Wong, Ho, and Autio 2005). Country level of democracy and government fractionalization may affect country level of innovation. As Acemoglu and Robinson (2006) argue, national elites may hamper innovations because of their fear of replacement. Innovations may erode the advantage of the incumbent political elites and increase a chance for replacement. When political competition is limited, elites may not be willing to initiate changes in economy and institution. We use a simple dichotomous democracy measurement

as well as fractionalization in government.[xi] The government fractionalization measures "[t]he probability that two deputies picked at random from among the government parties will be of different parties"(Dahlberg et al. 2017b, p.52). Because of the high correlations to our independent variables and other control variables such as GDP per capita, we do not include control variables that are related to input aspects of innovation such as government expenditure on R&D, quality of scientific research institutions, and university-industry collaboration in R&D. We do not include the government expenditures on R&D because this input measure is highly correlated with output measures such as our dependent variables. For instance, Wong, Ho, and Autio (2005) states that some scholars have used either input measures (e.g. R& D expenditures) or output measures (e.g. number of innovations), not both of them in the same model. Likewise, Lee et al. (2016) finds that innovation input (R&D) and outputs are highly correlated as seen in a case of Japan, which is ranked one of top for both measures. Therefore, we do not include government expenditures on R&D as a control variable because of its high correlation to innovation inputs. In addition, professional bureaucracy, impartial bureaucracy, and NPM reforms are highly associated with these variables of resources and infrastructure for innovation, which may cause multicollinearity. The summary statistics of the variables used in our study is reported in Table 1. Correlation matrix is reported in Table 2. We conducted collinearity diagnostics using VIF (Variance Inflation Factors) based on our main models with two samples (all countries and OECD). The highest VIF score for the independent and control variables in all of the models is 3.41 (GDP per capita). This means that the models do not have problems in terms of multicollinearity. For the purpose of further robustness check, we run analysis for the same model without the variable which causes high correlation.

[Table 1 about here]

[Table 2 about here]

Empirical Strategy

We investigate the impact of bureaucratic structures and NPM reforms on country levels of innovation by using our cross-sectional data set. Recall that the dependent variables are interval variables, which are innovation output scores. Given the nature of the dependent variable, we employ ordinary-least-squares (OLS) regression analysis. The independent variables are bureaucratic structures and NPM reforms. Since correlations among the independent variables are high, we are not able to include all four independent variables in a single model.[xii] Thus, we test the following three models for each of our four independent variable. In the first model (Model 1, 4, 7, and 10), we investigate the bivariate relationship between bureaucratic structure and innovation outputs. In the second model (Models 2, 5, 8, and 11), we include control variables that may affect the dependent variables. This is to test alternative explanations for the effects on innovation. Control variables, including GDP per capita, GDP growth, and democracy measure, are included. In the third model (Models 3, 6, 9, and 12), further control variables, government fractionalization index and researcher headcounts per population (in million), are included to show robustness of our analysis. The fractionalization index is included as an additional control for political competitiveness. We use the researcher headcount variable as one of the infrastructure variable for innovation. We run a same set of models for two dependent variables.

We test our hypotheses in two samples. One is using all country samples over the world. The other is only OECD member countries. We conduct two separate analysis because of the following reasons. First, the effects of bureaucratic structure on country levels of innovation may differ depending on levels of economic development and other unobservable factors pertaining to them. Second, bureaucratic professionalism, impartiality, and NPM reform are highly correlated to levels of economic development measured by GDP per capita (correlation coefficients range from 0.67 to 0.78).[xiii] Therefore, in order to test robustness of

our assessment of the impact of bureaucratic characteristics on innovation, we conduct analysis with only samples from developed economies (OECD member countries).

To demonstrate robustness of our results, we conduct the following robustness strategy. First, we estimate Huber-White sandwich estimators in all main models, responding to issues of heterogeneity and lack of normality. Secondly, we rerun all models for each independent variable with a jackknife estimator in order to address a concern for influential observations. Thirdly, we rerun the same models without GDP per capita variable, which is highly correlated to most of our independent variables. Collinearity diagnostics show no serious problem regarding multicollinearity. However, as a further robustness check, we estimates the same models without GDP per capita. Results of robustness check are reported in appendix.

Analysis and Results

Figure 1 and 2 show a relationship between bureaucratic characteristics and country levels of innovation. We present these figures mainly to visually show how these two factors are associated. As shown from these figures, bureaucratic professionalism, impartiality, and NPM reforms are highly correlated to country level innovation. Countries with higher level of professionalism, impartiality, and NPM reform tend to record higher levels of innovation measured by knowledge and technology outputs as well as creative outputs. Closedness seems to be moderately associated with knowledge and technology outputs and seems to have no association with creative outputs.

[Figure 1 about here]

[Figure 2 about here]

-Knowledge and technology outputs

Having presented scatterplots of the correlation between independent and dependent variables, now we present results of regression analysis for all country samples in table 3. As seen from the table, all of the bureaucratic structure and NPM reform variables, except the bureaucratic closedness in Model 9, consistently have strong association with the knowledge and technology outputs score at more than 95% level of confidence. In the bureaucratic professionalism model (Models 1-3), Model 1, which only has professionalism variable, explains 35 % of the variation in the model. The professionalism variable is positive and statistically significant at the 99 % level. Country levels of innovation should be influenced by levels of economic development and democracy. Higher level of developed economies tend to have larger and high-quality resources and infrastructure for innovation such as financial resources, good research institutions, and qualified researchers both in private and public sectors. Therefore, controlling GDP captures these factors as well. When we add GDP per capita, GDP growth, and democracy measure variables, R-Squared increases to 65%. Coefficient of the professional bureaucracy variable drops from 7.54 to 3.96, however it is still significant at the 99% level of confidence after controlling these factors. In Model 3, we add further two control variables, government fractionalization and number of researchers per population in million. Bureaucratic professionalism is still positive and significant at the 99% level even after controlling these additional factors that may potentially affect the dependent variable. In Models 4-6, we test the impact of bureaucratic impartiality on knowledge and technology outputs. Here, results show strong association between these two variables. Bureaucratic impartiality alone explains 45 of the variation in Model 4. Impartiality is positive and statistically significant at the 99% level. Coefficient drops from 6.75 to 2.76 in Model 5 after we add three control variables. In Model 6 which includes additional control variables, impartiality is still positive and significant at the 95 % level. Therefore, bureaucratic impartiality positively influences knowledge and technology outputs. Models 7-9

test the effects of bureaucratic closedness on innovation. We hypothesized that bureaucratic closedness negatively influences innovation because of more discretion in decision-making and less interaction and knowledge transfer among different sectors. Surprisingly, results of Models 7 and 8 show that bureaucratic closedness is positively associated with innovation at the 95 % level of confidence. However, when we add further control variables, coefficient of the closedness variable is no longer significant. In Models 10-12, we investigate how NPM reforms are associated with innovation. We assume that NPM reforms aim at increasing incentives of bureaucrats for better performance. Increased incentives and motivation of bureaucrats positively affect innovativeness. Results confirm our hypothesis. NPM reforms are positively associated with innovation at the 99 % level of confidence across three models.

[Table 3 about here]

Table A2 and A3 in appendix report results of the same model estimations with jackknifed estimates as well as those without GDP per capita. We reran the same models with jackknifed estimator responding to the concern for influential observation. We also reran the models without GDP per capita to address the concern for high correlation between the variable and independent variables. Results with jackknifed estimations are almost identical to those in our regular models in terms of direction of coefficients and statistical significance (see Table A2). Coefficients of bureaucratic variables increase in our models without GDP per capita as we expect. Statistical significances do not change from the main models. Significance of impartiality variable even increases in Model 6. To summarize results of the models using all country samples, results of OLS regression analysis show that bureaucratic professionalism, impartiality, and NPM reforms are positively associated with innovation measured by technology and knowledge outputs. Bureaucracies with either of these characteristics tend to have higher levels of innovation as a nation, controlling for other factors. Bureaucratic closedness has positive impact on innovation contrary to our hypothesis. However, the effect of closedness loses statistical significance when we include more control

variables. Therefore, we conclude that it is not certain whether bureaucratic closedness has negative impacts on innovation.

Table 4 reports estimation results of models with only OECD member countries. Recall that we conduct separate analysis using OECD country samples to see if results change in more developed setting. Bureaucratic professionalism and impartiality are positive and significant at the 99 % level of confidence in our first model (Models 1 and 4). That is same with the result of the same models with all country samples. However, these variables lost statistical significance in Models 2-3 and 5-6, which are more restricted. Regarding bureaucratic closedness, results of Model 7 and Model 8 show no statistical significant results. In Model 9, bureaucratic closedness is negatively associated with innovation as we hypothesized. However, it is significant only at the 90 % level. We test the impacts of NPM reforms on innovation in Models 10-12. NPM reform is positive and statistically significant at the 99 % level in Model 10. It is no longer significant in Model 11 with three control variables. However, it is positive and significant at the 95 % confidence level in Model 12, which has more control variables. Controlling for GDP per capita, GDP growth, democratic level, government fractionalization, and number of researchers, bureaucracies with higher degree of NPM reforms tend to achieve higher levels of innovation even when we restrict our sample to OECD member countries. To give specific examples, countries such as Sweden, Switzerland, Finland, and United Kingdom relatively have higher levels of NPM reform and achieve higher scores in technology and knowledge outputs score.

We conducted a same set of robustness check, namely models with jackknifed estimators and models without GDP per capita variable. Models with jackknifed estimates show almost identical results with our main models in terms of direction and statistical significance of coefficients of the independent variables (Table A4 in appendix). This confirms robustness of our results. In models without GDP per capita (Table A5 in appendix),

bureaucratic professionalism is positive and statistically significant at the 99 level in all models (Models-1-3). The same goes for bureaucratic impartiality (Models 4-6). Bureaucratic professionalism and impartiality are positively associated with innovation. However, the same result is confirmed in our main models using OECD samples (Table 4). NPM reform shows positive and significant result consistently across three models (Models 10-12). Therefore, this confirms robustness of the result from the most restricted main model (Table 4, Model 12). Thus, it is safe to conclude that NPM reforms are positively correlated to innovation in our analysis of OECD samples.

[Table 4 about here]

-Creative outputs

Now, we look at the impacts of bureaucratic structures on innovation measured by creative outputs with our global sample. Recall that the dependent variable is creative outputs score, which assess country levels of intangible assets, creative goods and services, and online creativity (See Table A1 in appendix). Bureaucratic professionalism is positive and statistically significant in Models 1-2. When we add further control variables in model, its coefficient is still positive but its significance drops to the 90% level. Therefore, it is safe to say that it is not certain whether professionalism positively affects innovation measured by creative outputs. In Models 4-6, we test how bureaucratic impartiality is associated with innovation. Impartial implementation of public policies increases fairness and justice, which subsequently leads to business investment for innovative activities. Although coefficients of impartiality are reduced as we add more control variables, they are positive and significant consistently across three models. This means that bureaucracies which have more impartial decision-making tend to have higher levels of innovation. This confirms our hypothesis. Regarding bureaucratic closedness, it is not significant in any model (Models 7-9). Models 10-12 show how bureaucracy with NPM reforms are associated with innovation. We hypothesize that NPM reforms emphasis on efficiency and effectiveness in outputs and

motivate public employees to produce such results. Such motivation and business-oriented bureaucracy subsequently gives positive impacts on innovation. As we hypothesize, NPM reforms show positive impacts on innovation. In Model 10, NPM reforms explain 37 % of the variation in model. Its coefficient is 3.83 and statistically significant at the 99 & confidence level. When we include control variables, coefficient of the NPM reform variable drops to 1.88, but it is still significant at the same confidence level (Model 11). Coefficient drops to 1.16 when we add further controls, however it is still significant at the 95% level. Even after we control for other additional factors, result shows positive relationship between NPM reform and innovation.

As a robustness check, we repeated the same procedure as we did for the first dependent variable. Models with Jackknifed estimates show almost identical results with respect to the independent variables. However, statistical significance of NPM variable drops to the 90% level of confidence in Model 12 (See Table A6 in appendix). Results of models without GDP per capita also show similar results with our main models (Table A7). Bureaucratic impartiality is positive and statistically significant at the 99 % level. Its coefficient increases to 7.5 (Model 5) and 4.66 (Model 6). This confirms robustness of our results. NPM reforms are also positive and significant across three models, confirming robustness of results from main models. To summarize our analysis of all samples, results suggest that bureaucratic impartiality as well as NPM reforms tend to have positive influence on innovation operationalized by creative outputs.

[Table 5 about here]

Finally, we look at results of the same models only with OECD member countries. Table 6 reports results of OLS regression analysis on creative outputs. Unlike the result from the global sample analysis, bureaucratic impartiality is no longer significant in the most restricted model (Model 6), even though it is significant at the 90% level in Model 5. On the other hand, interestingly, bureaucratic closedness is negatively associated with innovation as

we hypothesized (Models 8-9). After we include control variables, negative coefficients of closedness becomes statistically significant. Bureaucratic closedness seems to discourage innovation. Regarding the NPM reform variable, result from the most restricted model (Model 12) shows that its impact on innovation is not statistically significant. Thus, we do not argue that there is a positive relationship between NPM and innovation. We go through a same set of robustness check. Bureaucratic closedness is still negative and significant in models with jackknifed estimators (Models 8-9 in Table A8, appendix). However, when we run the same models without GDP per capita, results show no significant coefficients. In conclusion, results of OECD country analysis report negative impacts of closed bureaucracy on innovation. However, the result does not survive robustness check. Therefore, it is not certain whether bureaucratic closedness is negatively related to innovation measured by creative outputs.

[Table 6 about here]

Discussion and Preliminary Conclusions

Although there are increasing number of studies on innovation in the field of public administration and political science, the level of analysis for most of the studies are organizational level. There has been only few cross-national studies that examine factors affect innovation across countries. In particular, although the ideas of bureaucratic structure go back to Max Weber in the last century, we still have very limited understanding about how bureaucratic and administrative structures affect innovative activities at the national level. By relying on a concept of bureaucratic motivation for innovation, this paper aimed at contribute to this research gap by testing how administrative designs of bureaucracy-professionalism, impartiality, closedness, and NPM reform-affect innovation.

Relying on the literature on public sector innovation and policy diffusion, we argued that administrative structures of public bureaucracy determines bureaucratic motivation for promoting and supporting innovation in society. In particular, we discussed that employment

and promotion rules affect work-related behavior of public sector employees, which subsequently affects levels of innovation outputs within a country. In professional bureaucracy, bureaucrats are recruited and promoted based on merit and expertise rather than political connections. In such administrative structure, bureaucrats entering the public sector are likely to have higher expertise and skills than those who are hired through political connections. Therefore, such individuals with higher skills are likely to be motivated for being innovative than those who are in politicized administrative structures. They might be more likely to be willing to learn new tools and ideas with long-term perspectives, which are necessary for innovation. In addition, bureaucracies in more professional oriented bureaucracies tend to be insulated from patronage and political interests (Dahlström, Lapuente, and Teorell 2012a). Therefore, bureaucrats in professional system tend to be free from political discretion and implement programs to promote innovation. In closed bureaucracies which are characterized with less interaction of personnel between public and private sectors, human resources are less diverse than those in open system. There is a limited opportunity for expanding connections outside government organizations and less chance for public-private partnership. Such characteristics hamper employee motivation for being innovative and promoting innovation. In impartial bureaucracies, bureaucrats are expected to implement policies with fairness. Such impartial decision making and policy implementation assures trust among private actors, which positively affects innovation outputs. In addition, such high level of neutrality in administrative decision-making deters bureaucrats from being involved in corruption. Therefore, bureaucrats are likely to be more motivated for promoting innovation. Finally, NPM reforms motivate employees to be innovative because they focus on managerial capacity, effectiveness and efficiency of public service, reward and incentive system, public-private partnership, and risk-taking organizational culture.

The analyses demonstrate that administrative structures matter for the variation in levels of innovation outputs across countries. When using all country samples, results show that bureaucratic professionalism, impartiality, and NPM reforms positively influence knowledge and technology outputs controlling for GDP per capita, GDP growth, democracy, government fractionalization, and number of researchers. Thus, our hypotheses (H1, H3, and H4) are supported. Bureaucracies with higher levels of professionalism, impartial decision-making, and NPM reforms are likely to positively influence innovation within a country measured by knowledge and technology outputs. When we restrict our samples only to OECD member countries, we find that only NPM reform variable is significantly and positively associated with the innovation outputs (H4). With respect to the creative outputs as a dependent variable, we demonstrate that impartiality and NPM reforms accelerate innovation in our analysis of global samples. This confirms H3 and H4. When we use OECD samples, we do not find statistically significant relationships between any of the administrative variables and creative outputs.

The above results are consistent with findings from previous empirical studies. Professional bureaucracy as opposed to politicized one and impartial bureaucracy have positive impacts on social outcomes. This study contributes to previous studies by testing the relationship between bureaucratic structures and national level of innovation outputs. Our empirical findings show that certain characteristics of public bureaucracies have positive impacts on innovation. It is important to recognize the limitations of this research. First, we did our best to incorporate various control factors into our analysis with limited sample size of countries. However, we cannot rule out the possibility that other unobservable country-level factors affect the bureaucratic structure-innovation relationship. Secondly, we rely on a cross-national data set. Even though it is unlikely that bureaucratic structures change within a short period of time, our analyses show results of snapshot of bureaucratic structures and

innovation outputs at a given time period, not considering factors that change across time (Evans 2002). These weaknesses should be further compensated for by testing the external validity of the results through conducting subnational studies where researchers can collect more variables as well as collecting and analyzing panel data of bureaucratic structures and innovation.

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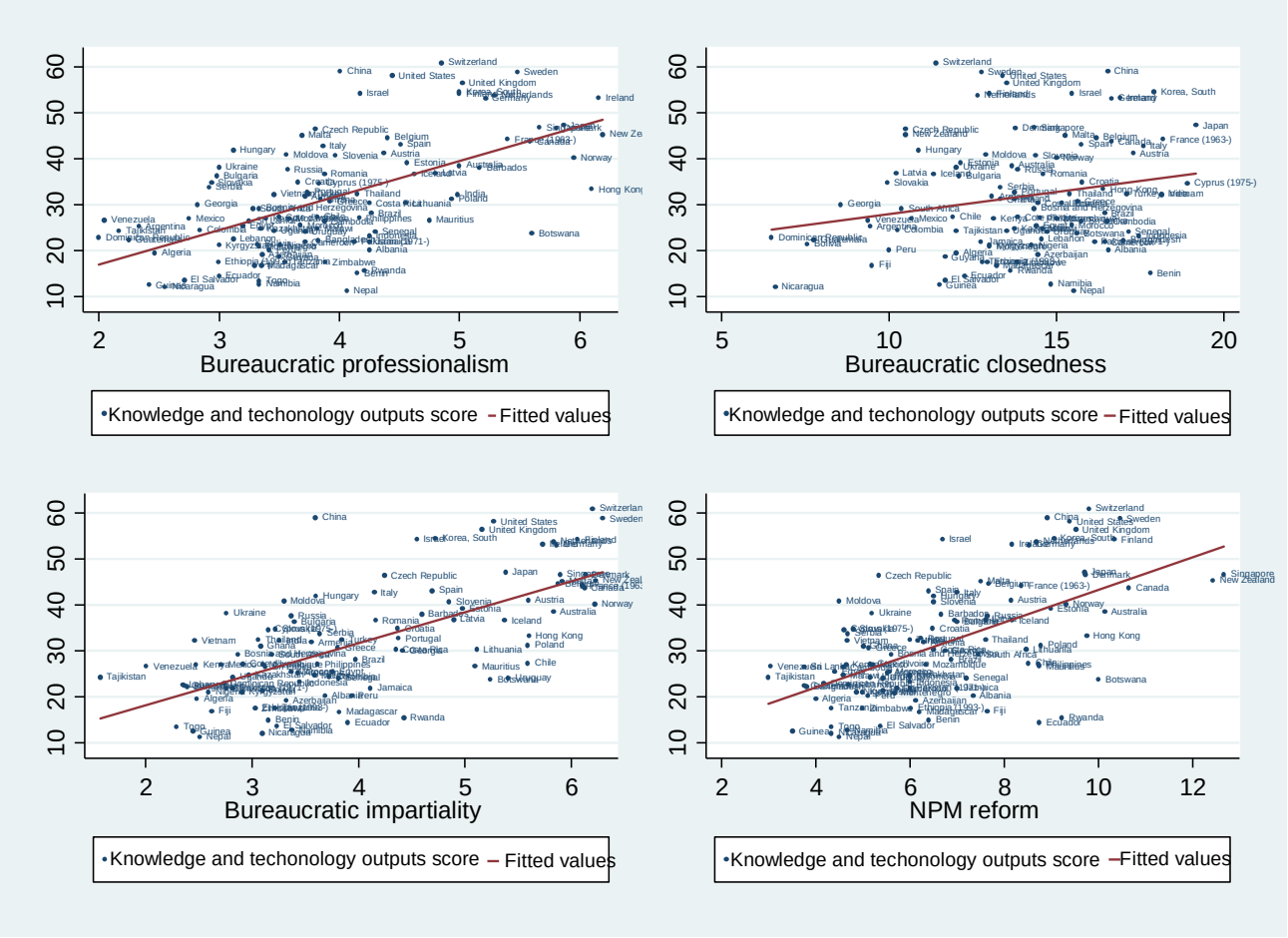
Table 1 Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Dependent variables				
Knowledge and technology outputs	31.43	12.29	11.2	60.9
Creative outputs	34.27	12.84	0.6	66.1
Independent variables				
Bureaucratic professionalism (H1)	3.93	0.96	2.0	6.19
Bureaucratic impartiality (H2)	3.99	1.22	1.6	6.29
Bureaucratic closedness (H3)	13.80	2.72	6.5	19.2
NPM reform (H4)	6.68	2.06	3.0	12.7
Control variables				
GDP per Capita (Current Prices)	15489.90	14321.64	332.27	57,634.77
GDP Growth (%)	3.37	3.13	-6.979	11.91
Dichotomous democracy measure	0.71	0.46	0	1
Government Fractionalization Index	0.23	0.28	0	0.82
Researchers, headcounts/mn pop	18.46	22.27	0.10	100.00

Table 2 Correlation Matrix

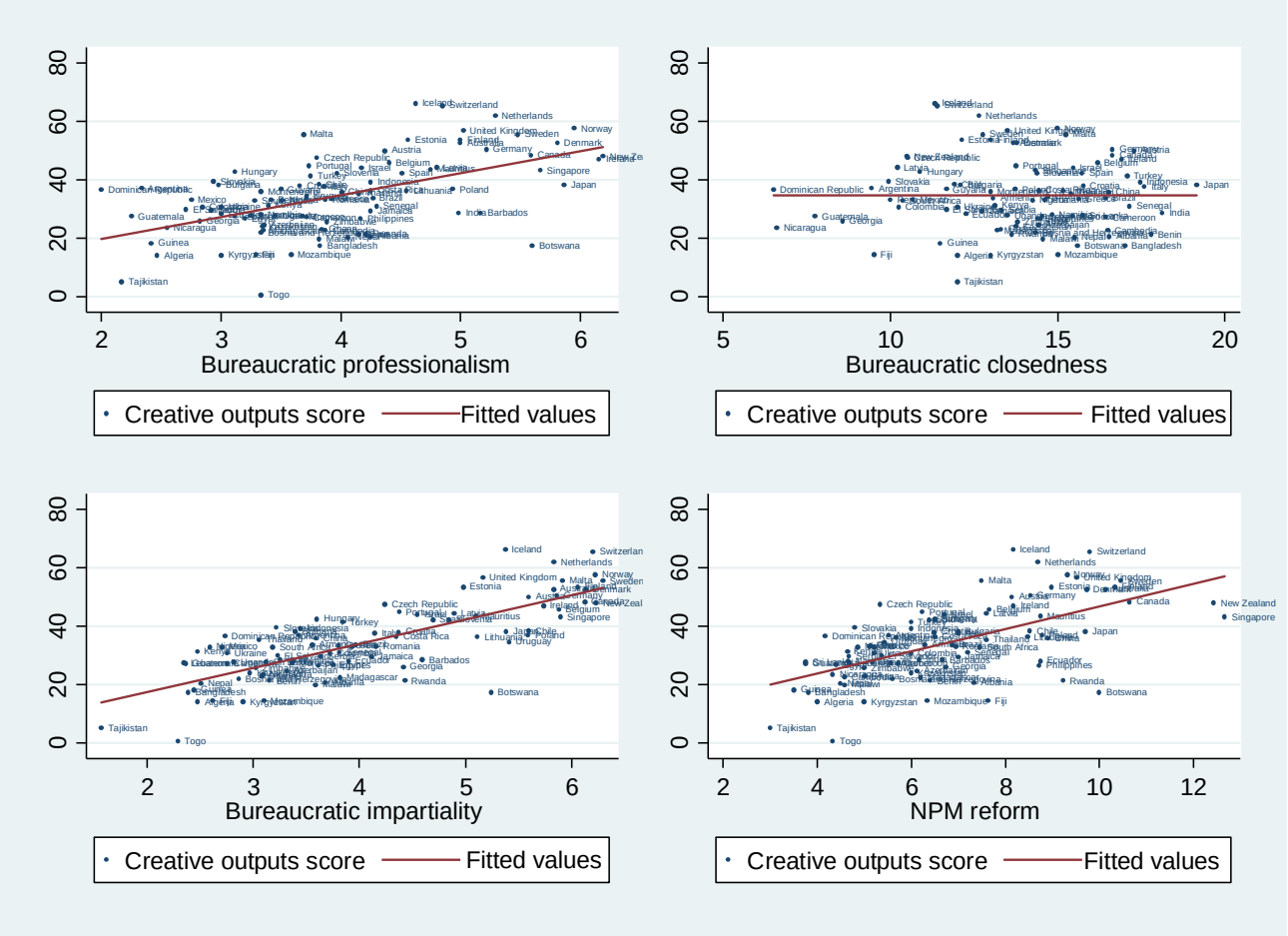
		1	2	3	4	5	6	7	8	9	10	11
1	Knowledge and technology outputs	1										
2	Creative outputs	0.77	1									
3	Bureaucratic professionalism (H1)	0.59	0.56	1								
4	Bureaucratic impartiality (H2)	0.68	0.78	0.79	1							
5	Bureaucratic closedness (H3)	0.21	0.00	0.50	0.20	1						
6	NPM reform (H4)	0.60	0.61	0.79	0.83	0.18	1					
7	GDP per Capita (Current Prices)	0.81	0.80	0.67	0.80	0.18	0.67	1				
8	GDP Growth (%)	-0.42	-0.38	-0.31	-0.39	-0.12	-0.22	-0.46	1			
9	Dichotomous democracy measure	0.35	0.50	0.33	0.47	-0.04	0.31	0.38	-0.38	1		
10	Government Fractionalization Index	0.34	0.38	0.20	0.22	0.03	0.11	0.25	-0.36	0.31	1	
11	Researchers, headcounts/mn pop	0.71	0.78	0.63	0.74	0.09	0.62	0.84	-0.50	0.34	0.40	1

Figure 1 Bureaucratic structures and knowledge and technology outputs



Note: Samples are based on model 1.

Figure 2 Bureaucratic structures and creative outputs



Note: Samples are based on model 1.

Table 3 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (all country samples)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.54***	3.96***	3.32***									
	(0.90)	(0.75)	(0.97)									
Bureaucratic impartiality (H2)				6.75***	2.76***	2.04**						
				(0.66)	(0.78)	(0.98)						
Bureaucratic closedness (H3)							0.97**	0.61**	0.34			
							(0.38)	(0.25)	(0.30)			
NPM reform (H4)										3.54***	1.66***	1.46***
										(0.46)	(0.47)	(0.53)
Controls												
GDP per Capita (ln)		5.92***	5.23***		5.68***	5.10***		7.13***	5.34***		5.73***	5.08***
		(0.81)	(0.98)		(0.84)	(0.95)		(0.83)	(1.07)		(0.77)	(0.86)
GDP Growth (%)		-0.44	-0.21		-0.46	-0.22		-0.50	-0.13		-0.57*	-0.37
		(0.34)	(0.34)		(0.35)	(0.36)		(0.38)	(0.39)		(0.32)	(0.32)
Dichotomous democracy measure		-1.33	-2.31		-1.54	-3.07		-0.25	-1.95		-0.86	-2.33
		(1.88)	(2.12)		(1.89)	(2.09)		(1.99)	(2.15)		(1.91)	(2.03)
Government Fractionalization			5.13*			5.84**			5.22*			6.02**
			(2.72)			(2.80)			(2.94)			(2.69)
Researchers, headcounts/mn pop			0.05			0.07			0.14*			0.06
			(0.07)			(0.07)			(0.07)			(0.07)
Constant	1.80	-35.19***	-28.44***	4.70*	-28.12***	-22.50***	18.23***	-39.44***	-23.33**	7.83***	-28.91***	-23.80***
	(3.46)	(7.37)	(8.65)	(2.64)	(6.78)	(8.06)	(5.25)	(8.38)	(9.76)	(2.90)	(6.62)	(7.94)
Observations	108	100	81	107	99	83	105	97	80	109	101	83
R-squared	0.35	0.65	0.69	0.45	0.63	0.67	0.05	0.60	0.65	0.36	0.64	0.69

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (OECD country samples)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	5.32***	0.03	2.26									
	(1.30)	(1.30)	(1.92)									
Bureaucratic impartiality (H2)				4.66***	-0.41	1.20						
				(1.20)	(1.33)	(1.67)						
Bureaucratic closedness (H3)							0.48	-0.50	-0.84*			
							(0.57)	(0.41)	(0.48)			
NPM reform (H4)										2.49***	0.61	1.80**
										(0.75)	(0.71)	(0.73)
Controls												
GDP per Capita (ln)		19.50***	14.45*		20.36***	17.01**		20.86***	23.49***		17.57***	14.61**
		(5.18)	(6.99)		(5.30)	(6.44)		(4.66)	(6.39)		(5.31)	(5.23)
GDP Growth (%)		0.35	0.03		0.38	0.09		0.38	0.18		0.22	-0.25
		(0.49)	(0.51)		(0.50)	(0.49)		(0.46)	(0.50)		(0.52)	(0.50)
Dichotomous democracy measure		-	-		-	-		-	-		-	-
Government Fractionalization			9.63			7.45			3.94			9.25*
			(5.72)			(5.01)			(6.02)			(4.65)
Researchers, headcounts/mn pop			-0.08			-0.07			-0.08			-0.11**
			(0.06)			(0.06)			(0.06)			(0.05)
		-			-			-	-		-	
Constant	19.32***	157.63***	-116.34*	20.04***	164.31***	-138.02**	37.22***	164.54***	185.13***	23.69***	142.39***	-120.30**
	(6.19)	(50.23)	(65.06)	(6.07)	(50.83)	(60.50)	(8.81)	(45.67)	(60.27)	(6.05)	(51.33)	(50.39)
Observations	33	33	28	33	33	28	33	33	28	33	33	28
R-squared	0.26	0.51	0.63	0.23	0.51	0.61	0.02	0.53	0.64	0.24	0.52	0.68

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 Bureaucratic structures and creativity outputs score, results of OLS regression analysis (all country samples)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.48***	3.33***	2.24*									
	(1.21)	(0.81)	(1.12)									
Bureaucratic impartiality (H2)				8.30***	5.06***	3.87***						
				(0.72)	(0.73)	(1.07)						
Bureaucratic closedness (H3)							0.01	-0.06	-0.01			
							(0.43)	(0.28)	(0.32)			
NPM reform (H4)										3.83***	1.88***	1.16**
										(0.57)	(0.40)	(0.54)
Controls												
GDP per Capita (ln)		5.83***	3.50***		4.03***	2.52**		6.92***	3.31***		5.51***	3.37***
		(1.00)	(1.31)		(0.89)	(1.09)		(0.96)	(1.18)		(0.95)	(1.21)
GDP Growth (%)		-0.09	0.31		-0.03	0.24		-0.27	0.32		-0.22	0.17
		(0.25)	(0.25)		(0.22)	(0.24)		(0.30)	(0.26)		(0.24)	(0.27)
Dichotomous democracy measure		6.99***	6.37***		4.82***	4.57**		6.77***	5.68**		6.31***	5.69***
		(1.92)	(2.13)		(1.69)	(1.88)		(2.20)	(2.36)		(1.99)	(2.11)
Government Fractionalization			3.60			4.65			3.51			4.07
			(3.23)			(3.01)			(3.43)			(3.25)
Researchers, headcounts/mn pop			0.21***			0.16**			0.27***			0.21***
			(0.06)			(0.07)			(0.05)			(0.06)
Constant	4.87	-36.59***	-16.44	0.70	-26.18***	-12.34	34.43***	-31.57***	-6.39	8.41**	-32.37***	-13.48
	(4.72)	(9.21)	(11.95)	(2.96)	(7.25)	(9.75)	(6.25)	(10.04)	(10.42)	(3.66)	(8.28)	(10.92)
Observations	94	88	72	92	86	73	91	85	71	94	88	73
R-squared	0.31	0.68	0.75	0.61	0.75	0.78	0.00	0.63	0.73	0.37	0.70	0.75

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 Bureaucratic structures and creativity outputs score, results of OLS regression analysis (OECD country samples)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	4.67***	-0.15	-0.08									
	(1.27)	(1.98)	(1.81)									
Bureaucratic impartiality (H2)				5.54***	2.57*	1.32						
				(0.87)	(1.43)	(1.33)						
Bureaucratic closedness (H3)							-0.83	-1.96***	-1.59***			
							(0.65)	(0.44)	(0.46)			
NPM reform (H4)										2.50***	1.07*	0.78
										(0.66)	(0.58)	(0.62)
Controls												
GDP per Capita (ln)		17.42***	9.07		11.64**	6.59		22.34***	16.61***		13.55***	6.91*
		(5.26)	(5.35)		(5.01)	(4.65)		(2.55)	(4.65)		(3.70)	(3.93)
GDP Growth (%)		0.63*	0.84***		0.43	0.72**		0.73**	0.84***		0.38	0.65**
		(0.35)	(0.26)		(0.30)	(0.26)		(0.27)	(0.29)		(0.31)	(0.29)
Dichotomous democracy measure		-	-		-	-		-	-		-	-
Government Fractionalization			8.97			8.75			3.02			9.79
			(5.91)			(5.80)			(4.85)			(5.80)
Researchers, headcounts/mn pop			0.16			0.14			0.11*			0.13
			(0.09)			(0.09)			(0.07)			(0.10)
Constant	25.85***	-131.96***	-56.47	18.99***	-86.13*	-37.43	59.00***	-155.94***	-108.30**	27.13***	-101.12***	-40.04
	(5.49)	(46.85)	(49.04)	(4.01)	(45.53)	(43.70)	(10.02)	(24.96)	(41.82)	(4.99)	(35.13)	(38.53)
Observations	30	30	27	30	30	27	30	30	27	30	30	27
R-squared	0.25	0.45	0.65	0.40	0.49	0.66	0.06	0.72	0.78	0.30	0.49	0.66

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[i] Most of previous studies on innovation and public organizations focus on innovation either at the employee or their work group level (Demircioglu 2017a, b, Torugsa and Arundel 2016, 2015) or at organizational level (Bloch and Bugge 2013, Bugge and Bloch 2016, Damanpour, Walker, and Avellaneda 2009), not national level.
[ii] Innovation brings various positive impacts on society such as country's competitiveness (Cantwell 2005), economic development and growth (Carlino 2001, Verspagen 2005), productivity (Fagerberg and Godinho 2005, Mortensen and Bloch 2005), and even unemployment rate (Pianta 2006). Furthermore, economic performance of countries tends to depend on generating knowledge and innovations (Richardson et al. 2016). Thus, it is significant to investigate what factors lead to higher levels of innovation.
[iii] Several empirical studies support the positive impact of bureaucratic professionalism on organizational performance and societal outcomes. Assessing the impacts of merit-based recruitment of public bureaucracies on corruption across countries, Dahlström, Lapuente, and Teorell (2012a) find that meritocratic recruitment reduces corruption level. Nistotskaya and Cingolani (2015)'s study on bureaucratic structure and entrepreneurship shows that bureaucracies who are merit-based recruited and more insulated from political oversight tend to record higher business entry rates. Studying the high turnover rates in public organizations of aid-recipient countries and implementation of foreign aid programs, Cornell (2014) finds that high turnover rates mainly due to political appointee negatively affect implementation of aid programs.
[iv] The same report shows that a core value for the APS is impartiality, saying that the government "must achieve results promptly and to a high standard, while remaining impartial and apolitical, and without compromising other principles of good government administration" (Australian Public Service Commission (APSC) 2011, p.58).
[v] NPR is considered under NPM as both focused on private sector management and applying them to public sector with aiming efficiency, high levels of innovation, citizen/customer satisfaction, and better results (Durant 2008, Kelman 2005, Osborne and Gaebler 1992, Osborne and Plastrik 1997)
[vi] Number of sample is based on model 1 with the knowledge and technology outputs as a dependent variable.
[vii] Number of sample is based on model 1 with the creative outputs as a dependent variable.
[viii] Please see the QoG Expert Survey 2015 Codebook (Dahlström et al. 2015a).
[ix] The impartiality is defined as "[w]hen implementing laws and policies, government officials shall not take into consideration anything about the citizen/case that is not beforehand stipulated in the policy or the law" (Rothstein and Teorell 2008, p.170).
[x] Please see the QoG Expert Survey 2015 Codebook (Dahlström et al. 2015a).
[xi] We tested the mean of the Freedom House and Polity scales, which ranges from 0 to 10 contained in the QoG Basic Dataset 2017 (Dahlberg et al. 2017a). However, the variable is highly correlated to bureaucratic impartiality (pairwise correlation coefficient is 0.61). Therefore, we decided to use a dichotomous variable for democracy (the highest correlation coefficient, which is one with impartiality is 0.46).
[xii] Correlation coefficients between independent variables are more than 0.5 except the one between bureaucratic impartiality and closedness (0.21) and NPM reform and bureaucratic closedness (0.23).
[xiii] Bureaucratic closedness has modest correlation with economic development (0.21).

Appendix

Table A1 List of indicators included in the dependent variables

Knowledge and technology outputs	Indicator	Creative outputs	Indicator
Knowledge creation	Domestic resident patent app/bn PPP$ GDPa	Intangible assets	Domestic res trademark app/bn PPP$ GDP
	PCT resident patent app/bn PPP$ GDPa		Madrid trademark applications/bn PPP$ GDP
	Domestic res utility model app/bn PPP$ GDP		ICTs & business model creation
	Scientific & technical articles/bn PPP$ GDP		ICTs & organizational model creation
	Citable documents H index	Creative goods and services	Cultural & creative services exp., % total tradea
Knowledge impact	Growth rate of PPP$ GDP/worker, %		National feature films/mn pop. 15–69
	New businesses/th pop. 15–64		Global ent. & media output/th pop. 15–69
	Computer software spending, % GDP		Printing & publishing manufactures, %
	ISO 9001 quality certificates/bn PPP$ GDP		Creative goods exports, %
	High- & medium-high-tech manufactures, %	Online creativity	Generic TLDs/th pop. 15–69
Knowledge diffusion	Royalty & license fees receipts, % total trade		Country-code TLDs/th pop. 15–69
	High-tech exports less re-exports, % tot. Trade		Wikipedia monthly edits/mn pop. 15–69
	Comm., comp. & info. services exp., % tot. Trade		Video uploads on YouTube/pop. 15–69
	FDI net outflows, % GDP		

Figure A1 Percent summary of the knowledge and technology outputs score

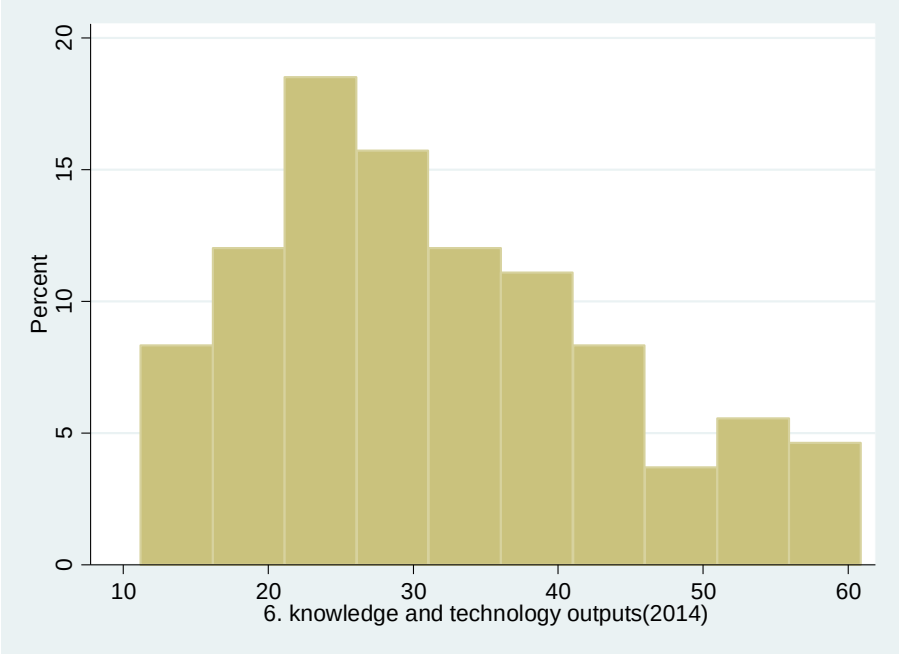


Figure A2 Percent summary of the creative outputs score

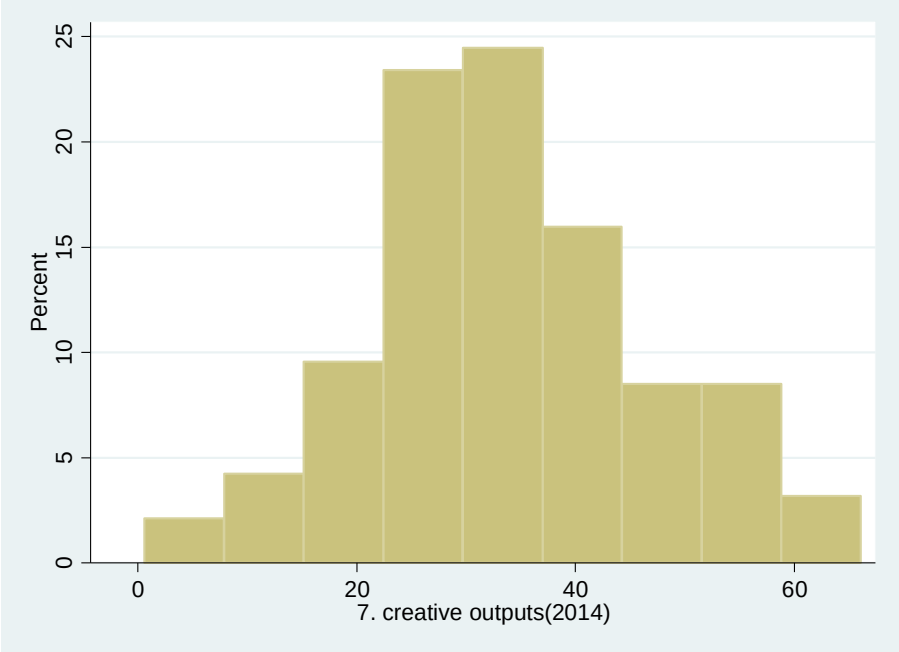
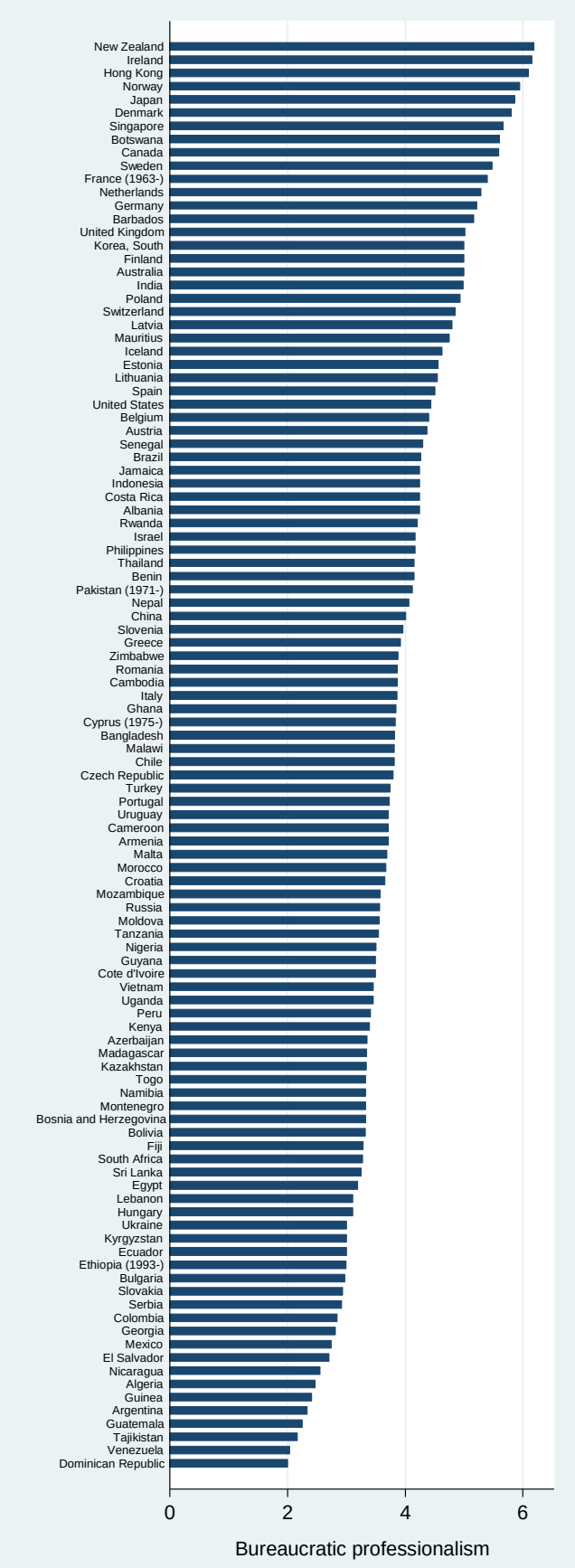
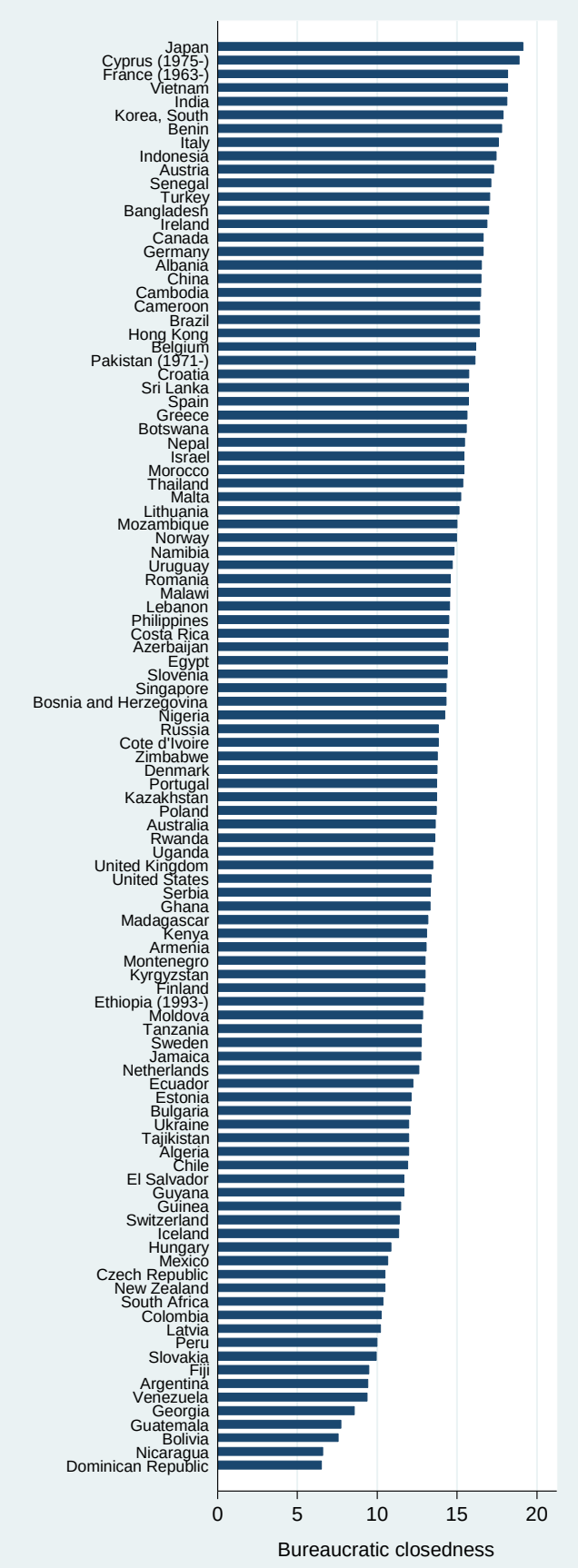


Figure A3 Variations in bureaucratic professionalism



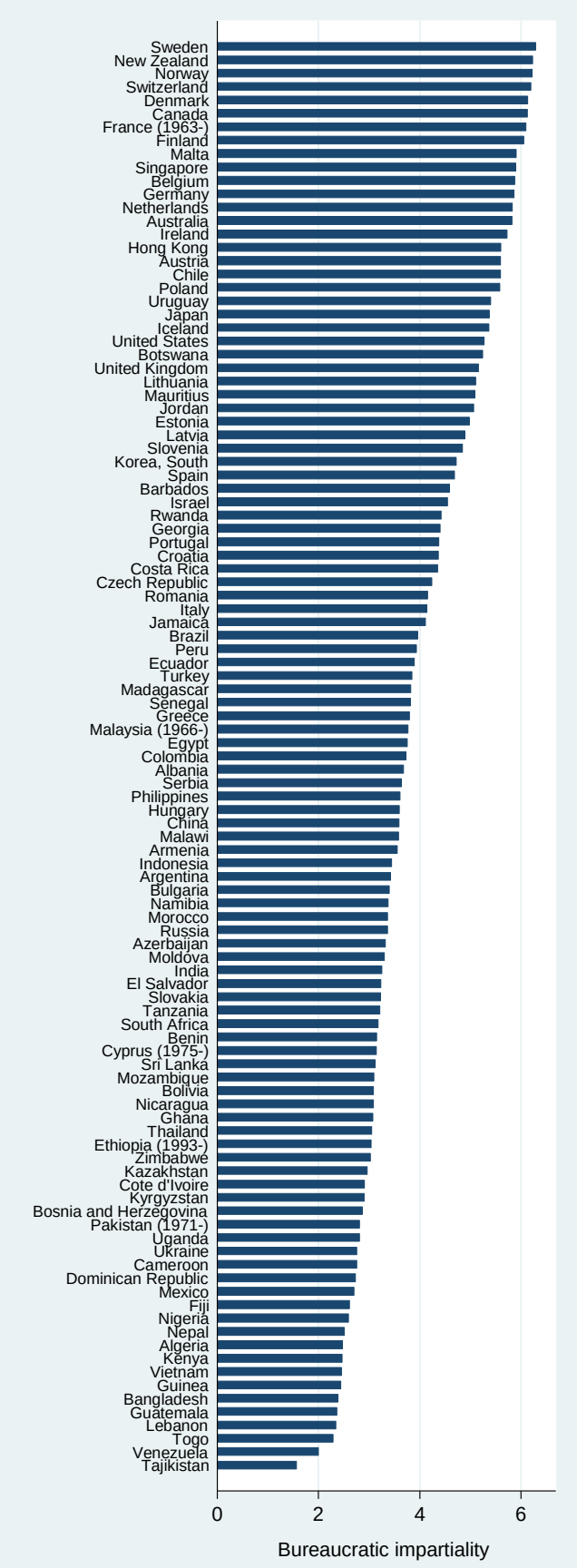
Note: 108 countries in model 1 are included in the above figure.

Figure A4 Variations in bureaucratic closedness



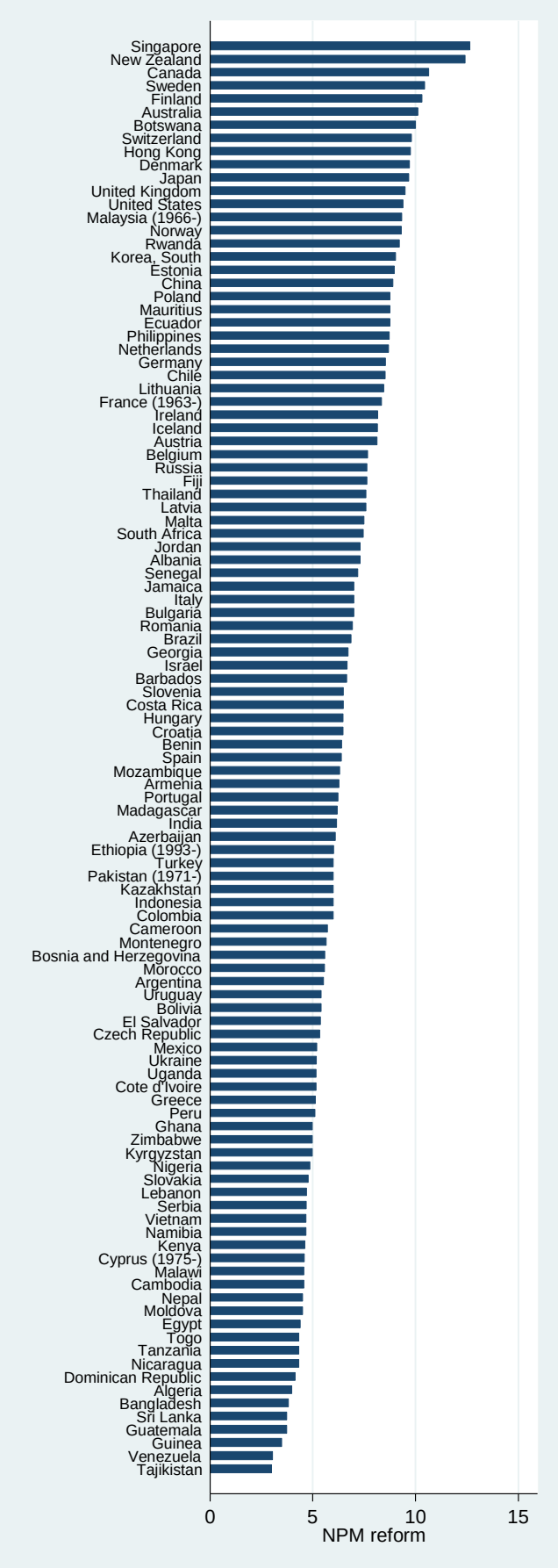
Note: 105 countries in model 4 are included in the above figure.

Figure A5 Variations in bureaucratic impartiality



Note: 107 countries in model 7 are included in the above figure.

Figure A6 Variations in the degree of NPM reform



Note: 107 countries in model 1o are included in the above figure.

Table A2 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (all samples, jackknifed estimates)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.54***	3.96***	3.32***									
	(0.92)	(0.77)	(1.05)									
Bureaucratic impartiality (H2)				6.75***	2.76***	2.04*						
				(0.67)	(0.82)	(1.07)						
Bureaucratic closedness (H3)							0.97**	0.61**	0.34			
							(0.38)	(0.26)	(0.32)			
NPM reform (H4)										3.54***	1.66***	1.46**
										(0.47)	(0.50)	(0.58)
Observations	108	100	81	107	99	83	105	97	80	109	101	83
R-squared	0.35	0.65	0.69	0.45	0.63	0.67	0.05	0.60	0.65	0.36	0.64	0.69

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A3 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (all samples, without GDP per capita)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.54***	6.98***	4.11***									
	(0.90)	(0.92)	(1.36)									
Bureaucratic impartiality (H2)				6.75***	6.19***	3.61***						
				(0.66)	(0.83)	(1.26)						
Bureaucratic closedness (H3)							0.97**	0.91**	0.59			
							(0.38)	(0.40)	(0.38)			
NPM reform (H4)										3.54***	3.22***	2.04***
										(0.46)	(0.51)	(0.70)
Observations	108	101	81	107	100	83	105	98	80	109	102	83
R-squared	0.35	0.45	0.58	0.45	0.49	0.57	0.05	0.24	0.54	0.36	0.46	0.58

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A4 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (OECD samples, jackknifed estimates)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	5.32***	0.03	2.26									
	(1.37)	(1.43)	(2.16)									
Bureaucratic impartiality (H2)				4.66***	-0.41	1.20						
				(1.27)	(1.51)	(2.06)						
Bureaucratic closedness (H3)							0.48	-0.50	-0.84			
							(0.58)	(0.44)	(0.53)			
NPM reform (H4)										2.49***	0.61	1.80**
										(0.81)	(0.76)	(0.85)
Observations	33	33	28	33	33	28	33	33	28	33	33	28
R-squared	0.26	0.51	0.63	0.23	0.51	0.61	0.02	0.53	0.64	0.24	0.52	0.68

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A5 Bureaucratic structures and knowledge and technology outputs score, results of OLS regression analysis (OECD samples, without GDP per capita)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	5.32***	5.31***	5.71***									
	(1.30)	(1.30)	(1.38)									
Bureaucratic impartiality (H2)				4.66***	4.65***	4.58***						
				(1.20)	(1.23)	(1.61)						
Bureaucratic closedness (H3)							0.48	0.48	0.61			
							(0.57)	(0.56)	(0.55)			
NPM reform (H4)										2.49***	2.64***	2.99***
										(0.75)	(0.77)	(0.83)
Observations	33	33	28	33	33	28	33	33	28	33	33	28
R-squared	0.26	0.27	0.53	0.23	0.23	0.45	0.02	0.02	0.30	0.24	0.26	0.53

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A6 Bureaucratic structures and creative outputs score, results of OLS regression analysis (all samples, jackknifed estimates)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.48***	3.33***	2.24*									
	(1.24)	(0.84)	(1.20)									
Bureaucratic impartiality (H2)				8.30***	5.06***	3.87***						
				(0.73)	(0.77)	(1.16)						
Bureaucratic closedness (H3)							0.01	-0.06	-0.01			
							(0.44)	(0.29)	(0.34)			
NPM reform (H4)										3.83***	1.88***	1.16*
										(0.59)	(0.43)	(0.59)
Observations	94	88	72	92	86	73	91	85	71	94	88	73
R-squared	0.31	0.68	0.75	0.61	0.75	0.78	0.00	0.63	0.73	0.37	0.70	0.75

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A7 Bureaucratic structures and creative outputs score, results of OLS regression analysis (all samples, without GDP per capita)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	7.48***	6.29***	2.80**									
	(1.21)	(0.93)	(1.17)									
Bureaucratic impartiality (H2)				8.30***	7.50***	4.66***						
				(0.72)	(0.69)	(1.10)						
Bureaucratic closedness (H3)							0.01	0.12	0.11			
							(0.43)	(0.42)	(0.34)			
NPM reform (H4)										3.83***	3.33***	1.47**
										(0.57)	(0.45)	(0.58)
Observations	94	89	72	92	87	73	91	86	71	94	89	73
R-squared	0.31	0.50	0.71	0.61	0.68	0.76	0.00	0.30	0.69	0.37	0.55	0.71

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A8 Bureaucratic structures and creative outputs score, results of OLS regression analysis (OECD samples, jackknifed estimates)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	4.67***	-0.15	-0.08									
	(1.34)	(2.10)	(2.09)									
Bureaucratic impartiality (H2)				5.54***	2.57	1.32						
				(0.89)	(1.63)	(1.64)						
Bureaucratic closedness (H3)							-0.83	-1.96***	-1.59**			
							(0.68)	(0.51)	(0.58)			
NPM reform (H4)										2.50***	1.07	0.78
										(0.73)	(0.63)	(0.76)
Observations	30	30	27	30	30	27	30	30	27	30	30	27
R-squared	0.25	0.45	0.65	0.40	0.49	0.66	0.06	0.72	0.78	0.30	0.49	0.66

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.

Table A9 Bureaucratic structures and creative outputs score, results of OLS regression analysis (OECD samples, without GDP per capita)

	Professionalism model			Impartiality model			Closedness model			NPM model		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Independent variables												
Bureaucratic professionalism (H1)	4.67***	4.68***	2.07									
	(1.27)	(1.30)	(1.60)									
Bureaucratic impartiality (H2)				5.54***	5.54***	2.64*						
				(0.87)	(0.88)	(1.42)						
Bureaucratic closedness (H3)							-0.83	-0.83	-0.58			
							(0.65)	(0.65)	(0.40)			
NPM reform (H4)										2.50***	2.56***	1.33
										(0.66)	(0.67)	(0.81)
Observations	30	30	27	30	30	27	30	30	27	30	30	27
R-squared	0.25	0.25	0.61	0.40	0.40	0.63	0.06	0.06	0.60	0.30	0.31	0.63

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Control variables are not reported.