



Research paper

Conditions for innovation in public sector organizations

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ARTICLE INFO

Keywords:

Innovation
Public sector innovation
Innovation measurement
Conditions for innovation
Australian public service

ABSTRACT

While a large literature has emerged on the likelihood of innovative activity for firms in the private sector, due to a scarcity of data little is known why innovative activity varies across organizations in the public sector. By utilizing a new source of data, the 2012 Australian Public Service Commission data ($n = 21,093$), this paper is able to overcome these data constraints and provides one of the first studies focusing on the likelihood of innovative activity in the public sector. The empirical evidence suggests that important conditions specific to the public organization influence the likelihood of innovative activity. In particular, experimentation, responding to low-performers, the existence of feedback loops, and motivation to make improvements enhance the likelihood of innovative activity. In contrast, budget constraints do not have a statistically significant effect on single innovation. Thus, the results of this study suggest that intrinsic factors such as experimentation and motivation to improve performance are crucial for achieving innovation in the public sector context.

1. Introduction

In the fifty year span since Kuznets (1962) complained about the paucity of knowledge about innovation, an explosion of research has responded generating what has now become a well-established field of scholarship. Perhaps the most fundamental question emerging in innovation research is why some organizations innovate while others do not (Dosi, 1988; Nelson and Winter, 1982). However, most of the research on innovations at the organizational level has been restricted to the private sector. As Bugge and Bloch (2016, p. 1467) point out, “Innovation has traditionally been studied in the private sector.” Despite an increased awareness of this gap in the literature (Bernier and Hafi, 2007; Brown and Osborne, 2012; Damanpour et al., 2009; Hartley, 2005; Osborne, 2013; Osborne and Brown, 2013; Verhoest et al., 2007), research on why the propensity to innovate varies across organizations remains remarkably focused on the private sector, while generally ignoring the public sector context.

This paucity of research is unfortunate because considerable anecdotal evidence and examples abound suggesting that innovation in the public sector may play an important role (Geels, 2002; Geels and Schot, 2007; Kuhlmann and Rip, 2014; Turnheim and Geels, 2013). In addition, even a small innovation in the public sector may yield large outcomes or effects beyond the limits of the public sector itself (Aschhoff and Sofka, 2009; Edler and Georgiou, 2007; Edler and Yeow, 2016; Edquist and Hommen, 2000; Edquist and Zabala-Iturriagoitia, 2012; Rolfstam 2009; Rolfstam et al., 2011).

The most obvious explanation for this large gap in the literature is not the lack of interest in public sector innovation (Arundel et al., 2015; Audit Commission, 2007; Arundel and Huber, 2013; Bloch and Bugge, 2013; European Commission, 2011; Hughes et al., 2011; Kattel et al., 2013; Torugsa and Arundel, 2016a,b; Bugge and Bloch, 2016; Ferlie et al., 2000; Ferlie et al., 2005), but rather the same thing that held back research on the topic of innovation in the first place—a paucity of measurement (Bloch and Bugge, 2013). The lack of measurement that characterized the entire field has been largely overcome—but only for private firms, not for public organizations.

The purpose of this paper is to fill this gap in the literature by providing one of the first studies addressing what has become the fundamental question in the innovation literature—why the propensity to innovate (Scherer, 1983) varies systematically across organizations—for the public sector context. We are able to analyze why some public agencies innovate while their counterparts do not by relying on a new source of data made available by the Australian Public Service Commission (APSC). A particular feature of the APSC data is that innovation is measured at the level of the workgroup. The workgroup in the Australian Public Service includes both middle managers and front-line employees with different ranks (e.g. Australian Public Service [APS] 1–6 and Executive Level [EL] 1–2). Torugsa and Arundel (2016a, 394) emphasize that an important advantage of APSC is the focus on “innovation at the workgroup level and [the survey] obtains perspectives of individuals at levels within the government bureaucracy... surveying innovation activities at the workgroup level can provide

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high-quality information on a diversity of innovation activities.

Of course, organizational behavior in the public sector does not mirror that of their counterparts in the private sector. As Bloch (2016, p. 1467) point out, ‘Public sector innovation is often seen through the lens of private sector frameworks.’ Thus, in the following section, distinct hypotheses are developed from the extant literature on specific conditions influencing why the propensity to innovate varies across public sector agencies. In the third section the data sources used to measure innovation in the public sector are introduced, along with other main sources of data. The fourth section provides an empirical test of those hypotheses and discusses the results. Finally, in the last section a summary, and conclusion are provided. In particular, this paper finds that not only does the propensity to innovate vary systematically across organizations in the public sector context, but that innovative activity is influenced by the management and organizational strategies of the organization.

2. Innovation in the public sector context

The most prevalent and consistent definitions of innovation apply to the private sector. Research has identified a number of factors, strategies and managerial practices that enhance the likelihood of organizational innovation in the context of the private sector (Roper et al., 2017; Pakes and Griliches, 1980; Freeman, 1974; Mansfield, 1968; Pavitt et al., 1987; Soete, 1979). Some of these, such as organizational size, location, performance, and investments in human capital through training, are clearly applicable in any organizational context, albeit private or public. As Pierce and Delbecq (1997) emphasize, regardless of the context, innovative activity involves creativity and change.

However, the concept of innovation is influenced by the context and the context always matters. As Arundel and Huber (2013, p. 146) point out, “Measurement requires agreement on how to define innovation in the public sector.” There is an agreement that within the public sector context, innovation has been considered to be a novel idea introduced by an organization (e.g. Bloch, 2011; Damanpour, 1991, 2002; Demircioglu, 2016, 2017; Laegreid et al., 2011; Wynen et al., 2014). For instance, Bloch (2011, 14) argues that public sector innovations “comprise new or significant changes to services and goods, operational processes, organizational methods, or the way your organization communicates with users. Innovations must be new to your organization, although they can have been developed by others.” In the survey that employees filled, the APSC (2012, 32) states that public sector innovations “comprise new or significant changes to services and goods, operational processes, organizational methods, or the way your work group communicates with users”, showing that the measurement of the innovation in the Australian survey is consistent with the literature on public sector innovation.

As Sahni, Maxwell, and Christensen, in *Unleashing Breakthrough Innovation in Government* (2013), suggest, innovation in the government may respond to organizational conditions and managerial practices that are specific to the public sector context. In particular, Sahni et al. (2013) introduce an explicit framework identifying those managerial conditions conducive to innovation in public organizations—experimentation, responding to low-performers, the existence of feedback loops, motivation to make improvements, and budget constraints.¹

The Sahni et al. (2013) framework is adopted for this paper for at least two reasons. First, there are not many established theoretical frameworks for testing which factors and managerial practices in the public sector are conducive to innovative activity. Second and more importantly, in developing their framework, Sahni et al. (2013)

examined management theories and practices applied them to the study of public sector innovation. This framework has a bottom-up approach and can be adapted to the individual, group, and organizational level of analysis. Overall, this framework is systematically analyzed, theoretically supported, and empirically grounded for practical research on public sector innovation. Sahni et al. (2013) conclude that their framework is supported by contributions from research groups at the Harvard Kennedy School, the Harvard Business School, many municipalities, and the White House Office of Science and Technology Policy. They have surveyed hundreds of people in government, interviewed public sector innovators, and collaborated with many academics in the United States.

2.1. Experimentation

From the self-determination theory perspective, experimentation within an organization is posited to spur innovative activity because employees prefer to feel that they have control over their actions, such that they want to have a choice of how they do their work (Deci and Ryan, 1985; Ryan and Deci, 2000). Intrinsic motivation, according to Ryan and Deci (2000), is “doing of an activity for its inherent satisfactions rather than for some separable consequence” (Ryan and Deci, 2000, 56). Providing choices and opportunities for experiments enhances intrinsic motivation and satisfaction because they can increase employees’ autonomy, competence, and relatedness (Zuckerman et al., 1978). Borins (2001, 34) concludes that “The process of innovation often proceeds by trial and error. Organizations undertake experiments, put in place a process for evaluating the results, and, depending on those results, expand, modify, or scrap the innovation.” Thus, when employees are given opportunities and are able to experiment, employees can enjoy their work and increase their capability, knowledge, and experience; thus, they are more likely to make innovations.

Similarly, Albury (2011, 233) argues that public organizations are able to innovate thanks to “encouraged experimentation” and conclude that “allowing space for innovation and adaptation, openness and deregulation are all absolutely key to whether innovation happens and whether it spreads.” Space, openness, and deregulation are key components that allow public sector employees to experiment and innovate. Likewise, Sahni et al. (2013, 29) suggest that, “Without the ability to develop experimental infrastructure, fundamentally new and different approaches rarely emerge.” The Australian government encourages trials, so employees are able to make experiments related to their jobs. For instance, the APSC states that the “government can encourage greater experimentation and innovation in program implementation and service delivery where one solution is unlikely to successfully address the whole problem” (APSC, 2003, 162). More experimentation increases the likelihood of innovative activity.

Innovative activity is influenced by individual motivation, organizational culture, and the magnitude of the challenge for employees. The magnitude of the challenge is relevant to employees who take risks, experiment, and innovate (Glor, 2001). According to Marfleet (2008, 153), employees tend to work best in organizations that “encourage creativity and experimentation.” Dawson and Denford (2015) argue that government agency leaders and organizations should encourage experimentation because doing so will increase innovative behavior and innovations. Therefore, when employees are able to experiment, they feel more motivated to work, and they can create innovations. Likewise, when employees are given a choice of how to do their work, they can improve their skills and are able to make more innovations. This leads to the following hypothesis:

H1. Experimentation within a public organization will enhance the likelihood of innovation.

¹ Originally, their second concept is named as the “ability to sunset outdated infrastructure.” Here, this concept is modified to measure “responding to low performers” (i.e. elimination of poor performers), as both concepts refer to similar actions—the elimination/improvement of poor job practices and performances and the elimination/improvement of poor performers.

2.2. Responding to low performance

Although both agencies and supervisors encourage innovation and even provide rewards to employees who are more innovative, there are typically employees who perform poorly and do not innovate. If employees perform poorly but are not dealt with by the agency itself or by supervisors, these underperforming employees may adversely affect other employees who otherwise would be performing well. Low performing employees can generate negative spillovers on the behavior and performance of their colleagues. In this regard, managers can provide incentives or directions for underperformers to improve. Several studies have found that turnover of low performers can be beneficial for organizations and other employees because doing so increases regular or high performing employees' job satisfaction (Futrell and Parasuraman, 1984; Keller, 1984; Spencer and Steers, 1981). LePine and Dyne (2001) explain that if employees have low ability and experience, the organization can help them through training. If, however, employees have low conscientiousness, the organization can deal with those employees via motivating low-experienced employees and via rejecting (e.g. firing) high-experienced employees. Thus, based on the situation, organizations and supervisors can respond to low performance differently, which affects innovative activities.

If all employees are treated the same regardless of their performance, then there will be no motivation and support for those employees whose performances are outstanding, and high performers will not feel that they are being treated justly. If supervisors and agencies can improve underperforming employees (e.g. via incentives or pressure), other employees will feel that they should do their job well. Indeed, Verhoest, et al. (2007) argue, “pressure is needed...Pressure can be created internally in the public sector by means of harsh performance standards...Sanctions and rewards function as drivers for performance and, as a condition for performance, for innovation” (Verhoest et al. 2007, 471). Finally, the Australian Public Service Commission's report argues that “Innovation is generally seen in light of the introduction of new ideas or processes; however, an important corollary is that innovation can also take the form of removing old or redundant processes” (APSC, 2011, 237). Thus, the following hypothesis:

H2. Responding to low performers will enhance the likelihood of innovation.

2.3. Feedback

Because organizations and organizational managers emphasize employee development and managers are accountable to different stakeholders, organizations and managers are expected to provide feedback to employees (Steelman et al., 2004). Feedback tends to positively affect organizational outcomes such as employee performance (Higgins et al. 2002; Kluger and DeNisi, 1996). According to Weibel and Six (2013), if feedback supports an individual's self-development (e.g. learning) and increases an employee's self-esteem, then it will positively affect the individual's motivation and performance. Specifically, constructive feedback enables intrinsic motivation (Deci, 1971; Harackiewicz, 1979; Ryan and Deci, 2000), increases the need for competence (Six, 2013; Weibel, 2007), and thus results in higher performance and innovation. Without clear feedback, public managers cannot make good decisions regarding work such as “when to focus on improving service versus reducing costs” (Sahni et al., 2013, 29).

When constructive feedback does not undermine employees' autonomy, it will enhance internalization of actions and employees' self-determination. A meta-analysis shows that feedback-seeking behavior is positively and strongly related to job satisfaction, proactive relationships, networking, and socialization (Anseel et al., 2015). Ryan and Deci (2000) claim that “offering optimal challenges and effectance-relevant feedback facilitate internalization” (Ryan and Deci, 2000, 64),

which will encourage employee efforts to be more innovative and to improve their learning and development. Receiving feedback on their performance will also increase employee capability and relatedness, which are positively correlated with innovation. Therefore, since feedback mechanisms will enhance employees' competence, autonomy, and relatedness, it will also tend to increase employees' innovativeness. In this regard, employees who receive feedback can create more innovations. This leads to the third hypothesis:

H3. Feedback will be positively related to the likelihood of innovation.

2.4. Motivation to improve performance

For a high-technology firm, producing a large number of innovations and innovative products may increase employee motivation to improve performance, yet selling these products and making profits may motivate shareholders (Makri et al., 2006). Additionally, for any type of organization, trust (i.e. institutional trust, such as trust in the organization's objectives and strategy, and trust among employees and coworkers such as vertical and lateral trust) can enhance employee motivation to achieve organizational objectives and the innovative activity of employees (Ellonen et al., 2008). In this regard, organizational members will be more innovative if organizations motivate employees to improve organizational performance by creating motivation to improve performance and establishing trust, so that employees can create new and innovative ideas that they “developed internally” or “discovered externally” (Makri et al., 2006, 1061). While motivation to improve performance in the private sector comes from the desire to reach more customers and increase profits (Christensen et al., 2004), motivation to improve performance in the public sector comes from other factors. For instance, Wise's (1999) findings on public sector managers who are interested in innovation and reforms found internal, non-monetary, and employee-focused factors.

If a plan for an organization matches with desired outcomes (e.g. innovation in the APS), agencies and organizational leaders motivate employees to help achieve the organization's objectives and inspire employees to be more innovative. Indeed, public managers in the Australian public service are expected to encourage innovation and creativity, and it is expected that organizations motivate employees to make improvements and inspire them to do their best in their job (APSC, 2011). Likewise, to explain how the motivation to improve performance will increase innovation, Denhardt et al. (2009) suggest that “although managers can bring about some changes ‘from the top’; in the long run many more innovations probably occur if those throughout the organization know that change and innovation are valued, that they have been empowered to act, and that calculated risks will be supported by top management” (Denhardt et al., 2009, 364). Likewise, Sahni et al. (2013) argue that employees in public sector organizations can be motivated by how agencies inspire employees to achieve the mission of the work and do their best job. They provide the following example demonstrating how motivation to improve performance can increase innovation:

In Washington, D.C., the motivation to improve performance was twofold. First, municipal leaders saw the mobile payments system as a way to capture savings and increase revenue—thereby decreasing budget burdens on the city. Municipal innovators also had another meaningful motivator: being considered forward-thinking. Adrian Fenty, the mayor of Washington, D.C., at the time of the effort, was known to promote this trait in his managers. Innovators inside the government knew that they would be recognized for their innovative solutions, a public reward that provided a powerful, non-financial incentive (Sahni et al., 2013, 29).

Thus, public sector employees can make innovations when they are motivated to make improvements. This leads to the following hypothesis:

H4. Motivation to improve performance will be positively related to the likelihood of innovation.

2.5. Budget constraints

Resource scarcity is generally considered to impact innovative activity. Prominent public management reforms such as the New Public Management (NPM) have forced countries to do more with less (Farazmand, 1999; Kettl, 2005; Pollitt, 2010) and doing so can increase not only efficiency but also innovation. Likewise, many practitioners argue that public sector employees can be more innovative if they are asked to do the same tasks with reduced budgets (Osborne and Gaebler, 1992; Osborne and Plastrik, 1997). According to Bernier (2001, 18), “More than ever, innovations were becoming necessary” (Bernier, 2001, 18). Glor (2001, 15) claims, “Frequently innovation was driven or affected by central budget cuts,” so higher budget cuts will be related to higher innovation because employees must be more innovative when they are asked to accomplish more or the same with a reduced budget. Sahni et al. (2013) have found that budget constraints in Philadelphia, Boston, Hampton, VA, Indianapolis, and Washington D.C. have led to important innovations (e.g. via Parkmobile and Citizens Connect initiatives) in these cities.

Budget constraints and resource scarcity are also expected to increase innovations in the Australian public service. Since the 1980s, agency managers in Australia have been given extensive autonomy to allocate budget resources, and budget cuts have become common in Australia. “The result,” according to Bartos (2003, 10), “was to encourage a higher degree of innovation and experimentation within the bureaucracy as a whole, with considerable improvements in public sector productivity and effectiveness.” The 2008 global financial crises affected most governments around the world, including Australia. After the crisis, the Australian Minister for Innovation, Industry, and Science Kim Carr wrote, “Tough times demand creative solutions” (Carr, 2009, iii). Thus, as necessity is considered the mother of invention, when public employees are asked to do the same tasks with a reduced budget, they tend to be more innovative. Wynen et al. (2014, 50) conclude, “Linking result-achievement with sanctions and rewards even increase this pressure to innovate in order to achieve high performance, because public organizations and their managers are assumed to be self-interested actors.” Hence, research supports that budget cuts will increase innovations.

However, studies have also found that rather than tight budgets, higher budgets are more likely to produce an innovative workplace culture and thus innovation (Wynen et al., 2014). In fact, higher budgets and resources are seen as a necessity for innovations in the United States federal government (Dawson and Denford, 2015). Likewise, Bernier and Hafsi (2007) conclude, “Public sector organizations perform better when resources can be secured from an organizational and political environment” (Bernier and Hafsi 2007, 500). Additionally, larger organizations are more likely to be innovative due to their larger budgets and greater power. On the other hand, Laegreid et al. (2011) do not find a relationship between budget size and an innovation-oriented culture in agencies in Norway and Flanders. While necessity and budget cuts drive innovation, they may also stifle it (Fernandez and Wise, 2010). Therefore, several researchers suggest that budget constraints do not always positively affect innovation.

H5. Budget constraints will be related to the likelihood of innovation, but the direction of this relationship will be either positive or negative.

3. Methods and data

This section describes the data; dependent, independent, and control variables used in the analysis; model selection; and estimation process.

3.1. Data

As Bloch and Bugge (2013, p. 142) conclude, “There are a number of aspects that argue against an assimilation approach using the same framework of measuring innovation in the public and the private sector.” Thus, the traditional approaches and sources used to measure innovation in the private sector shed light on innovation in the public sector context (Torugsa and Arundel, 2017). Instead, a new source of data which explicitly measures innovation in the public sector, from the Australian Public Service Commission (APSC)’s 2012 State of the Service Employee Census, are used in this paper. The level of analysis is the individual employee in a public agency. The census requires that all public sector employees are invited to respond to questions, so it is not a random sample. A total of 87,214 valid responses from individuals were received, representing a response rate of 55% (APSC, 2012). The census provides data on employee attitudes toward working conditions in the public sector, including leadership, job satisfaction, and innovation. The data are expected to help public sector leaders and managers of Australia “develop targeted and measurable strategies to improve innovative performance” (APSC, 2011, xxxii).

Since this paper aims to correctly and comparatively measure potential conditions for innovation, employees who have worked at their job for at least five years and have experienced changes in budgets are included in the analysis (24,341 out of 87,214 employees). Likewise, since the paper focuses on employees who are sure about changes, non-sure responses are not used for analysis. Finally, because there are no significant differences in observations with and without missing data, missing observations from the dependent, independent, and control variables are not used. As a result, among 24,341 employees who worked for at least five years in their agencies, 21,093 (87%) responses have been used for testing hypotheses.

Because data is self-reported, cross-sectional, and collected from one survey, several authors note the potential for common source bias (e.g. Jakobsen and Jensen, 2015; Meier and O’Toole, 2013; Podsakoff et al., 2003). Harman’s one-factor test reveals that a single factor has not emerged from the factor analysis. More importantly, according to Podsakoff et al. (2003), procedural remedies such as anonymity of respondents, better scale items, and clear questions are very important to reduce this bias. The APSC has taken the survey very seriously and spent a considerable amount of time and money on procedural remedies. Survey items were repeatedly validated by the APSC (APSC, 2012). Finally, Jakobsen and Jensen (2015, 25) conclude that “the best way to evaluate the risk of common method bias when the sources of bias are not measured directly seems to be based on theoretical considerations about the nature of the constructs being measured, through considerations of the survey design.” Thus, the results suggest that common method bias is not eliminated, but it is not a crucial issue in this paper thanks to the theoretical framework of the paper and survey design.

3.2. Dependent variable

The focus of this research is on whether a work group implemented any innovations because innovation is a cooperative work group action (Becker and Whisler, 1967). Whether or not a work group at a public agency innovated is the dependent variable used in this study. The following survey indicator measures the first outcome variable, *innovation*: “In the last 12 months, has your work group implemented any innovations?” There are three options for answering this question: “yes”, “no”, and “not sure.” Since this paper focuses on people who are sure about innovation, “no” (about 35% of responses) and “not sure” (about 15% of responses) responses were combined. Approximately half of responses answered “yes” and the other half answered “no” or “not sure.” Previously, Bowman (1980) used one dichotomous innovation score similar to this study’s variable. This paper’s focus is on actual

Table 1
Descriptive Statistics.

Variable	Mean	Std. Dev.	Min	Max
Implementing innovation	0.52	0.50	0	1
Experimentation	3.22	0.72	1	5
Responding to low performers	2.96	0.85	1	5
Feedback	3.51	0.93	1	5
Motivation to improve performance	3.13	0.92	1	5
Budget constraints	2.84	1.07	1	5
Size of agency	2.85	0.43	1	3
Gender is female	0.52	0.50	0	1
Working in the capital city	0.37	0.48	0	1
Level of job classification	1.42	0.49	1	2
Education Level	2.24	0.84	1	3
Working full-time	0.87	0.34	0	1
Job satisfaction	3.43	0.72	1	5
Agencies' concern for employees' health	3.55	0.86	1	5
Organizational performance	3.01	1.04	1	5
Barriers to Innovation	0.56	0.50	0	1
Access to training and learning	3.42	1.01	1	5
Individual performance feedback	0.81	0.39	0	1
Specialist/professional agency	0.06	0.23	0	1
Regulatory agency	0.03	0.16	0	1
Policy and design agency	0.18	0.38	0	1
Small operations agency	0.04	0.20	0	1
Large operations agency	0.70	0.46	0	1
Accounting and finance job	0.07	0.26	0	1
Administrative job	0.11	0.31	0	1
Communication and marketing job	0.02	0.15	0	1
Regulation job	0.12	0.33	0	1
Engineering and technical job	0.04	0.19	0	1
Information and communication technology job	0.09	0.28	0	1
Information and knowledge management job	0.02	0.14	0	1
Legal and parliamentary job	0.02	0.15	0	1
Monitoring and audit job	0.03	0.16	0	1
Organizational leadership job	0.03	0.16	0	1
People job	0.06	0.23	0	1
Science and health job	0.03	0.17	0	1
Service delivery job	0.14	0.34	0	1
Strategic policy, research, project job	0.12	0.32	0	1
Other jobs	0.11	0.32	0	1

(n = 21,093).

innovations rather than innovative ideas or innovative behavior because most organizations and employees are “good at generating innovative ideas, but are weak at bringing an idea to fruition” (Dawson and Denford, 2015, 13).

3.3. Independent variables

This paper tests the five conditions for innovation identified by Sahni, Maxwell, and Christensen's *Unleashing Breakthrough Innovation in Government Framework* (2013). Survey indicators construct factor scores for experimentation, responding to low performers, feedback, and motivation to make improvements. Budget constraint is not constructed as it is captured with one survey item (Appendix A). Table 1 shows descriptive statistics for the dependent, independent, and control variables. Appendix A shows operational definitions, and Appendix B shows the correlation matrix.

Scale reliability is calculated using Cronbach's alpha tests, which shows low to moderate internal consistency for experimentation (0.60) and responding to low performers (0.63), and moderate to high internal consistency for feedback (0.82) and motivation to make improvements (0.84). For scales with fewer survey items, researchers consider that a lower alpha is also consistent (Damanpour et al., 2009).

3.4. Control variables

Structural and organizational factors (such as organizational size) and cultural factors are correlated with innovation (Wise and Szucs,

1996). Organizational size is positively related with innovation (Wise, 1999), and larger organizations in particular are more innovative as these organizations have more resources, differentiation, and specialization (Pierce and Delbecq, 1977), and they are more likely to have an innovative culture (Wynen et al., 2014). Wynen et al. (2014) have found that higher budgets are likely to increase the innovativeness of an organization's culture and thus innovation. Moreover, organizational location affects innovativeness and change (Fernandez and Wise, 2010; Nasi et al., 2011), as well as the success of the adoption of reforms and changes (Wise and Szucs, 1996). Thus, size of agency, job classification, and organization location are controlled for.

Agency types, job classification (e.g. managers), and task-related factors can affect innovation in public organizations (Fernandez and Wise, 2010; Nas et al., 2011; Wynen et al., 2014). Similarly, innovative activity is influenced by the sector and type of agencies (Wise, 1999). For instance, service delivery agencies focus more on innovation because they interact with people (Borins, 1998; Vigoda-Gadot, 2009; Laegreid et al., 2011; Wynen et al., 2014). Therefore, type of agency and type of job need to be controlled for.

Barriers to innovation are considered to negatively affect adoption of reforms and innovations (Rainey et al., 1995; Wise, 1999). However, other research conducted in the private and public sectors has found that barriers to innovation had a positive effect on innovation because innovative employees are more likely identify barriers to innovation in their organizations (D'Este et al., 2012; Torugsa and Arundel, 2016a). Job satisfaction tends to be positively correlated with innovation and change (Fernandez and Moldogaziev, 2013; Hage and Aiken, 1967). Several researchers have found that work training and learning opportunities can change employees' habits and increase employees' willingness to implement reforms and adopt innovations (Bingham and Wise, 1996; Kaufman, 1981; Wise, 1999). Likewise, access to training and skills positively affects innovation and innovation success (Fernandez and Moldogaziev, 2013; Fernandez and Pitts, 2011). Finally, analyzing the Australian Public Service Commission's 2011 data, Torugsa and Arundel (2016b) found that gender and education have a significant effect on innovation (e.g. males and more educated people have indicated that they had more chances to implement innovations). Therefore, barriers to innovation, whether employees' organizations provide access to training and learning opportunities, gender, and education variables are controlled for.

Organizations' concerns for employees' wellbeing and health can affect employees' perceptions of reforms and innovations. Wise (1999, 154) found that “A variable measuring managers' concern for their employees' well-being was the single most important factor accounting for the presence of innovation in organizations.” Moreover, perceived organizational performance and communication are associated with innovation (Fernandez and Moldogaziev, 2013), so these two variables are also controlled for. Because employees who receive annual reviews or performance feedback in Anglo-Saxon countries tend to be more innovative (Wise, 1999), individual performance feedback is also controlled for. Finally, employment status is also controlled for because it may affect innovation.

3.5. Estimation

The dependent variable *innovation* is a binary variable—whether there was an innovation or not. Using Linear Regression Models such as Ordinary Least Square (OLS) models for categorical variables cause biasedness (e.g. incorrect answer and interpretations), inefficiency (e.g. not using the data well), and inconsistency (e.g. not estimating parameters correctly) due to the nonlinearity and heterogeneity of the categorical variables (Long, 1997; Long and Freese, 2006). Thus, a logit model is preferable for the first dependent variable.

Due to the heteroscedasticity (inappropriate standard errors), robust standard errors are used for all estimations (Verbeek, 2008; Wooldridge, 2015). Finally, to understand whether multicollinearity

exists in the models, the variance inflation factor scores (VIF) scores are calculated. Accordingly, as a rule of thumb, a multicollinearity problem does not threaten the validity of models if VIF scores are less than 10. The VIF scores for all variables in the both of the models are less than 10. Indeed, the highest VIF score is job satisfaction around 3.3 (job satisfaction) for both models; the mean VIF for both models is less than 1.7. Thus, multicollinearity is not an issue in this study.

4. Results

Table 1 reports the descriptive statistics. Many employees report that they receive feedback, and their agencies are large organizations (> 1000 APS employees). 52% of employees are female while 48% of employees are male. Around 63% of employees work in the field, outside of the Australian Capital Territories (ACT). 87% of employees are full-time employees. Over half of the employees report that there are barriers to innovation. 70% of employees work at the large operations agencies (e.g. Department of Defense, Department of Human Services, and Australian Taxation Office). Many employees' jobs involve service delivery.

The results of the unstandardized regressions and odds ratios used to test the five hypotheses are shown in Tables 2 and 3, respectively. These results are based on perceptions from public sector employees working in the Australian public service. There are four models; the first model includes all variables with no dummy variable controls for agency and job type. The second model includes dummy variables controlling for the five agency types, but does not control for job type. The third model includes dummy variables controlling for 15 job types dummies, but does not control for type of agency. Finally, the fourth model includes dummy variables controlling for both agency and job type. We have added these dummy variables in the regression to improve model specification, because as mentioned earlier, type of agencies and jobs may affect innovation.

The coefficients of all variables both four models are very similar to each other. Results of the AIC, BIC, and pseudo R-square show that the fourth model which include both agency and job type dummies are more preferable to other models, suggesting that when agency and job types are included in the regression, the model has a better fit. Model 4 shows that all else being equal, the odds of innovation are 1.51 times greater for experimentation, 1.09 for responding to low performers and feedback, 1.18 for motivation to make improvements, and 1.02 for budget cuts. Although the magnitude of the effects of the second and third measures are not high, they are still statistically significant ($p < 0.001$). The odds ratios of the first and fourth measures are relatively high, suggesting that experimentation and motivation to make improvements can positively affect innovation. On average, for every unit increase of experimentation, an implementation of innovation by a work group increased by 0.41 points, holding other variables constant. As a summary, except for hypothesis 5, all the results are in the expected direction and statistically significant in the first model.

Regarding control variables, the effect of (perceived) barriers to innovation is positive, statistically significant, and its effect size is very high in the models. Accordingly, on average, the odds of innovation are about three times greater when employees report a barrier to innovation, holding other variables constant. Indeed, the coefficients (both standardized and unstandardized) of barriers to innovation are the highest in both of the models. In addition to barriers to innovation, and all else being equal, women report slightly less innovation than men. Organizational performance and access to training and learning have a negative effect on innovation. On the other hand, more education, working full-time, job satisfaction, and receiving individual performance feedback have a positive effect on innovation.

Finally, several robustness checks have been conducted to test the validity, reliability, and stability of the results. Originally, the dependent variable had three categories: yes, no, and not sure. Because "employees who innovated in the previous year" are the focus of the

Table 2

Results of Logit Coefficients for Innovation.

Unstandardized Coefficients	Model 1 No Dummies	Model 2 Agency Dummies	Model 3 Job Type Dummies	Model 4 Both Dummies
Experimentation	0.402*** (0.032)	0.397*** (0.032)	0.418*** (0.032)	0.414*** (0.032)
Responding to low performers	0.098*** (0.023)	0.091*** (0.023)	0.087*** (0.023)	0.083*** (0.023)
Feedback	0.063** (0.022)	0.070** (0.022)	0.068** (0.022)	0.072*** (0.022)
Motivation to improve performance	0.170*** (0.027)	0.169*** (0.027)	0.164*** (0.027)	0.163*** (0.027)
Budget constraints	0.012 (0.014)	0.012 (0.014)	0.015 (0.014)	0.015 (0.014)
Size of agency	−0.046 (0.034)	0.107 (0.055)	−0.057 (0.035)	0.094 (0.056)
Gender is female	−0.103*** (0.031)	−0.084** (0.031)	−0.136*** (0.032)	−0.127*** (0.032)
Working in the capital city	−0.142*** (0.034)	−0.052 (0.036)	−0.103** (0.036)	−0.033 (0.038)
Level of job classification	0.215*** (0.036)	0.249*** (0.036)	0.241*** (0.037)	0.258*** (0.037)
Education Level	0.016 (0.019)	0.024 (0.019)	0.050* (0.020)	0.054** (0.020)
Working full-time	0.181*** (0.045)	0.178*** (0.045)	0.181*** (0.045)	0.183*** (0.046)
Job satisfaction	0.191*** (0.037)	0.182*** (0.038)	0.181*** (0.038)	0.174*** (0.038)
Concern for employees' health	0.073** (0.023)	0.063** (0.023)	0.066** (0.023)	0.060** (0.023)
Organizational performance	−0.02 (0.021)	−0.004 (0.021)	−0.017 (0.021)	−0.006 (0.021)
Barriers to Innovation	1.098*** (0.032)	1.097*** (0.032)	1.081*** (0.033)	1.080*** (0.033)
Access to training and learning	−0.090*** (0.019)	−0.085*** (0.019)	−0.082*** (0.019)	−0.079*** (0.019)
Individual performance feedback	0.182*** (0.038)	0.192*** (0.038)	0.184*** (0.038)	0.191*** (0.038)
Agency dummies	–	(included)	–	(included)
Job type dummies	–	–	(included)	(included)
Constant	−3.841***	−4.337***	−3.987***	−4.464***
Log-likelihood intercept	−14597	−14597	−14597	−14597
Log-likelihood model	−13405	−13363	−13308	−13279
Chi ²	2015.851	2080.259	2151.422	2196.887
AIC	26846.846	26770.223	26680.701	26631.921
BIC	26990.067	26945.271	26935.315	26918.363
Pseudo R ²	0.082	0.085	0.088	0.09
N	21093	21093	21093	21093

(n = 21093) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Standard errors are in parenthesis.

paper, the responses of "no" and "not sure" were combined, as explained in the method section. We have conducted several tests to find out whether the choice of dependent variable is better than other options. First, a logit model is run without using "not sure" responses (so, the number of observations dropped from 21,093 to 17,353). The results are very close to the original model; while none of the statistical significance of the models changed, the coefficients increased very slightly. Second, we recoded the dependent variable (Regarding innovation, 1 = No, 2 = Not Sure, 3 = Yes) and tested the ordinal logit model because the dependent variable becomes ordinal. The results are very similar; and again, except for the fifth hypothesis, all hypotheses are supported in the first statistical model. Third, instead of ordinal logit models, multinomial logit models are tested (with yes, no, or not sure based categories). Again, the results are very similar to our original results. It should also be noted that statistically, the original model (logit model) has a better fit than the other models (ordinal and

Table 3

Odd Ratios.

Odds Ratios	Model 1 No Dummies	Model 2 Agency Dummies	Model 3 Job Type Dummies	Model 4 All Dummies
Experimentation	1.495	1.487	1.518	1.513
Responding to low performers	1.103	1.096	1.091	1.087
Feedback	1.065	1.073	1.07	1.075
Motivation to improve performance	1.185	1.184	1.178	1.177
Budget constraints	1.012	1.012	1.015	1.015
Size of agency	0.955	1.113	0.944	1.098
Gender is female	0.902	0.92	0.873	0.881
Working in the capital city	0.867	0.949	0.902	0.967
Level of job classification	1.24	1.282	1.273	1.295
Education Level	1.016	1.024	1.052	1.055
Working full-time	1.198	1.194	1.199	1.201
Job satisfaction	1.21	1.199	1.199	1.19
Concern for employees' health	1.076	1.065	1.068	1.062
Organizational performance	0.98	0.996	0.983	0.994
Barriers to Innovation	2.999	2.995	2.949	2.944
Access to training and learning	0.914	0.919	0.921	0.924
Individual performance feedback	1.199	1.211	1.202	1.21
Agency dummies		(included)	–	(included)
Job type dummies		–	(included)	(included)

multinomial logit), as the former has higher pseudo R^2 as well as lower AIC and BIC scores.

5. Discussion and conclusion

The conditions conducive to innovation in public organizations is an important and interesting theme, yet there has been little large-scale survey research in this area of public sector innovation. This paper analyses data from a large-scale census of Australian public service employees conducted by the APSC (2012). This empirical study is one of the first studies to systematically analyze innovation at the workgroup level (including front-line employees and middle-level managers). Analyzing innovation at the workgroup level has many advantages, such as “to overcome possible biases in favour of ‘top-down’ innovations when only senior managers or agency heads are surveyed” (Torugsa and Arundel, 2016a, 409).

This study examines the effects of the five conditions for innovation suggested by Sahni et al. (2013) on the likelihood of organizational innovation. The results suggest that experimentation, responding to low performers, feedback, and motivation to make improvements are positively correlated to the likelihood of innovative activity in the public sector context. In addition, budget constraints do not have any statistical effect on public sector employees' innovation.

Although conditions are based on the judgment of individual employees, out of the five measures, the first and fourth concepts—experimentation and motivation to make improvements—focus on the employee; the second and third concepts—responding to low performers and feedback—focus on managers. The fifth concept—budget changes—focuses on the department or government. The results suggest that the conditions of the employee (the first and the fourth conditions) have a higher effect for innovation. Managers (the second and the third conditions) still have a positive and statistically significant effect on innovation, but the effect size is small. Finally, the department or government (the fifth condition) does not have a statistical effect on innovation. Thus, focusing on employees can bring higher returns for innovation than focusing on managers and the government. It is suggested that politicians should give employees control of the innovation process (Torugsa and Arundel, 2016b), as most of the innovations were enacted by employees themselves (Borrins, 2001).

This paper suggests that internal factors such as experimentation and motivation to make improvements in the public sector are strongly associated with innovation. Thus, the findings of the paper are consistent with the self-determination theory (SDT). SDT, which is concerned with the

beneficial effects of valuing intrinsic aspects of work, and suggests that individuals' behaviors should be self-motivated and self-determined (Deci and Ryan, 1985, 1987, 2000; Deci et al., 2001). In this regard, when employees feel that they can control their work such that they can experiment and have motivation to make improvements and innovate, they are more likely to innovate. As a result, public organizations should focus on intrinsic aspects of jobs and increase employee motivation to innovate. Thus, the effects of experimentation and motivation to make improvements in particular are very consistent with early studies of innovation that propose that experimentation and providing motivation to public sector employees are not only key to innovation but also key to motivation and job satisfaction. In this regard, future studies may test how these five conditions affect employee attitudes such as their job satisfaction and organizational commitment.

Finally, results show that budget cuts do not affect the likelihood of innovative activity. Therefore, NPM's “do more with less” theme may not enhance innovative activity in the public sector. More studies in different settings are needed to determine the effects of budget changes on innovation in the public sector.

The distinctive characteristics of public organizations (e.g. goal ambiguity, organizational structures, decision-making processes, and incentive structures) and environmental components for public organizations (e.g. the political economy of public institutions, performance criteria for government organizations, and different actors with political authority and influence over public organizations) (Rainey, 2009) may lead to barriers to innovation in public sector organizations. According to the empirical results of this study, increased barriers to innovation is the highest and statistically most significant predictor of innovative activity. This result may indicate that public sector employees who understand barriers to innovation could use their knowledge and experience to diminish those barriers (D'Este et al., 2012; Torugsa and Arundel, 2016b). Hence, knowledge and experience of innovation, such as learning from innovation activities and the innovation process, can lead to the understanding of how barriers may affect innovative activity. More studies are needed to explore the relationships between different types of barriers to innovation, as well as the effects of barrier breadth on individual and organizational outcomes.

This paper is not without limitations. First, the factors affecting innovation are based on the judgments of individual employees. In other words, these self-reported data are not objective, indicating that results may be subject to a bias. It is particularly true for the survey items capturing the first and fourth innovation conditions (experimentation and motivation to improve performance) that are concerned

with the role and importance of employees, so these items may reflect bias (e.g. employees may overstate the importance of these factors). However, Fernandez and Pitts (2011, 211) argue that “perception is reality in that it is the perception that will guide the respondent's behavior,” indicating that overall the findings of this paper reflect employee behavior and reality. Overall, all survey variables are perceptions from public sector employees, so the results may not be true although they reflect the reality as perceived by employees.

Second, this paper uses data from the Australian public sector, so some of the results may not be generalizable to other countries, particularly non-Anglo-Saxon countries. However, the results of the findings and the insights are important, so they may inform studies in other contexts. Therefore, other researchers may look at the effects of similar conditions on public sector innovation in different contexts. In addition, this study provides a broad perspective on innovation by answering “what” and “how” questions. This type of quantitative study usually lacks answers to “why” questions. In this regard, qualitative studies such as semi-structured interviews and case analyses could explain why particular factors have a stronger impact on innovative activity, while budget changes seemingly have no effect on innovation.

Innovation research is important because public organizations have become more accountable to principals (i.e. citizens) and agents (i.e. managers) due to the forces of globalization and information technology. They need to be efficient (i.e. reducing costs), effective (i.e. improving quality of services), and satisfy citizens. Additionally, there is pressure to save money and reduce budgets since the NPM reforms in the 1980s and particularly since the 2008 economic crises, so creating a workplace encouraging innovation is crucial. Overall, contrary to some early claims, public organizations are innovative, and public sector employees can indeed innovate. Public sector employees can generate innovations when they are able to experiment and when they are motivated to make improvements. Receiving feedback and having managers deal effectively with low performers is similarly conducive to public sector innovation. It is best for public sector managers to focus on motivation to improve performance and other internal factors to encourage innovation. Future studies may find it particularly fruitful to analyze how innovative activity in the public sector context influences both organizational outcomes (e.g. organizational performance) and individual outcomes (e.g. employee job satisfaction, commitment, and turnover intention).

Appendix A. Operational Definitions Variables

Dependent Variable

Innovation: “In the last 12 months, has your work group implemented any innovations?” (1 = Yes, 0 = No)

Independent Variables

1) Experimentation

1: “I have a choice in deciding how I do my work.” (1 = never through 5 = always)

2: “Employees are provided with enough time and resources to try new ideas.” (1 = strongly disagree through 5 = strongly agree)

3: “My workplace provides opportunities to increase knowledge and experience.” (1 = strongly disagree through 5 = strongly agree)

Cronbach's alpha: average interitem covariance = 0.30; Scale reliability coefficient = 0.60

2) Responding to low performers

1: “My supervisor appropriately deals with employees that perform poorly.” (1 = strongly disagree through 5 = strongly agree)

2: “My agency deals with underperformance effectively.” (1 = strongly disagree through 5 = strongly agree)

Cronbach's alpha: average interitem covariance = 0.45; scale reliability coefficient = 0.63

3) Feedback

1: “I receive adequate feedback on my performance to enable me to deliver required results.” (1 = strongly disagree through 5 = strongly agree)

2: “My supervisor provides me with regular and constructive feedback.” (1 = strongly disagree through 5 = strongly agree)

Cronbach's alpha: average interitem covariance = 0.71; scale reliability coefficient = 0.81

4) Motivation to Improve Performance

1: “My agency motivates me to help it achieve its objectives.” (1 = strongly disagree through 5 = strongly agree)

2: “My agency inspires me to do the best in my job.” (1 = strongly disagree through 5 = strongly agree)

Cronbach's alpha: average interitem covariance = 0.77; scale reliability coefficient = 0.84

5) Budget Constraints

1: “Overall, over the last five years or more, how has the work at your current classification level changed in relation to your size of budget?” (1 = decreased greatly through 5 = increased greatly)

Control Variables

Agency size

Number of people working in the agency. (1 = Small (< 251), 2 = Medium (251–1000), 3 = Large (1000 +))

Female/Gender

Respondent's gender. (1 = female, 0 = male)

Work Location

Respondent's workplace (1 = Australian Capital Territory, 0 = Field Office)

Job Level/Classification

Respondent's substantive classification level (1 = Australian Public Service 1–6, 2 = Executive)

Education

Respondent's highest completed qualification (1 = Completed year 12 or below, 2 = Completed vocational qualification, 3 = Completed tertiary qualifications)

Employment Status

Respondent's basis of employment status (1 = Full-time basis, 0 = part-time basis)

Job Satisfaction (10 survey indicators, from 1 = strongly disagree through 5 = strongly agree)

“Overall, I am satisfied with my job.”

“I enjoy the work in my current job.”

“My job gives me a feeling of personal accomplishment.”

“I am satisfied with the recognition I receive for doing a good job.”

“I am fairly remunerated for the work, such as salary”

“I am satisfied with my non-monetary employment conditions”

“Overall, I am satisfied with my agency.”

“I am proud to work in my agency.”

“I am satisfied with the opportunities for career progression in my agency.”

“I would recommend my agency as a good place to work”

Cronbach’s alpha: average interitem covariance = 0.47; scale reliability coefficient = 0.89

Agencies’ concern for employees’ health and wellbeing (2 survey indicators, all from 1 = strongly disagree through 5 = strongly agree)

“My agency genuinely cares about employees being healthy and safe at work.”

“My agency supports employees who are injured or become ill due to work.”

Cronbach’s alpha: average interitem covariance = 0.61; scale reliability coefficient = 0.83

Organizational Performance

My agency is well managed (1 = strongly disagree through 5 = strongly agree)

Barriers to Innovation

“Do you believe there are barriers to implementing innovations in your work place?” (1 = Yes, 0 = No)

Access to training and learning

“My workplace provides access to effective learning and development, e.g. formal training, learning on the job, e-learning, secondment.”

(1 = strongly disagree through 5 = strongly agree)

Receiving individual performance feedback

“Have you received formal individual performance feedback in your current agency in the last 12 months?” (1 = Yes, 0 = No)

Type of Agencies

Type of agencies respondent's working. (1 = Specialist/Professional, 2 = Regulatory, 3 = Public policy and program design, 4 = Small Operations, 5 = Large Operations)

Job Types

Respondent's current type of work (1 = Accounting and finance, 2 = Administration, 3 = Communications and marketing, 4 = Compliance and regulation 5 = Engineering and technical, 6 = Information and communications technology, 7 = Information and knowledge management, 8 = Legal and parliamentary, 9 = Monitoring and audit, 10 = Organizational leadership, 11 = People, 12 = Science and health, 13 = Service delivery, 14 = Strategic policy, research, project and program, 15 = Other).

Appendix B. Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 Innovation	1																	
2 Experimentation	0.17	1																
3 Responding to low performers	0.12	0.42	1															
4 Feedback	0.14	0.46	0.58	1														
5 Motivation to improve performance	0.16	0.62	0.48	0.49	1													
6 Budget constraints	0.03	0.14	0.09	0.09	0.14	1												
7 Size of agency	−0.03	−0.06	−0.02	−0.01	−0.06	−0.01	1											
8 Gender is female	−0.05	−0.03	−0.04	0.03	0.06	−0.01	−0.02	1										
9 Working in the capital city	0.02	0.10	0.03	0.04	0.07	0.05	−0.16	0.01	1									
10 Level of job classification	0.11	0.12	0.00	0.02	0.08	0.03	−0.12	−0.13	0.42	1								
11 Education Level	0.06	0.04	−0.02	−0.03	0.00	0.01	−0.10	−0.08	0.20	0.40	1							
12 Working full-time	0.04	0.04	−0.01	−0.04	−0.01	0.02	0.01	−0.26	0.00	0.06	−0.01	1						
13 Job satisfaction	0.18	0.66	0.48	0.58	0.75	0.15	−0.06	0.05	0.10	0.14	0.01	−0.02	1					
14 Concern for employees' health	0.14	0.51	0.39	0.36	0.56	0.09	−0.07	−0.04	0.05	0.12	0.05	0.02	0.58	1				
15 Organizational performance	0.11	0.51	0.47	0.40	0.66	0.11	−0.05	0.06	0.08	0.07	0.01	−0.02	0.66	0.54	1			
16 Barriers to Innovation	0.19	−0.25	−0.21	−0.16	−0.22	−0.08	0.01	−0.06	0.02	0.13	0.13	0.02	−0.20	−0.15	−0.24	1		
17 Access to training and learning	0.10	0.61	0.32	0.33	0.52	0.12	−0.02	0.01	0.10	0.09	0.02	0.01	0.49	0.42	0.42	−0.18	1	
18 Individual performance feedback	0.07	0.10	0.11	0.19	0.10	0.02	−0.01	−0.04	0.05	0.06	0.05	0.03	0.11	0.08	0.09	−0.01	0.09	1

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