

# Public Sector Innovation: The Effect of Universities

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## **Abstract**

A growing literature in public management has identified the key role that innovation can play in enhancing agency efficiency, effectiveness, performance and legitimacy. However, considerably less is known about the actual sources of knowledge generating innovative activity in the public sector. This paper fills this crucial gap in the literature by explicitly analyzing the link between a key source of knowledge and ideas, universities, and the innovative activities of public organizations. By utilizing a new source of data, this paper is able to show that not only do universities play a key role in generating innovative activity in public organizations, but the nature of innovations and their impact on public sector performance are related to the role played by universities. The findings suggest that universities play a key role in generating innovative activity in public organizations as doing so can increase the quality of public services, employee job satisfaction, and interagency collaboration.

**Key words:** innovation; sources of innovation; university; benefits of innovation; public sector.

## **1. Introduction**

Innovation in the public sector can increase the efficiency, effectiveness, performance, and legitimacy of public organizations (Damanpour et al., 2009; Demircioglu, 2016, 2017a, 2017b; Torugsa & Arundel, 2016a, 2016b; Verhoest et al., 2008), as evidenced by the rising number of studies on innovation in the public sector. Additionally, because employees in the innovative workplace exhibit higher job satisfaction, higher organizational commitment, and lower turnover intention (Demircioglu, 2017b), many public organizations are looking for ways to establish a culture of innovation. Scholars have responded to the increased recognition of the central importance of innovation in the public sector context with an emerging literature identifying how sources of innovation affect organizational outcomes and organizational innovation (Demircioglu et al., 2017b; Thompson & Sanders, 1997; Torugsa & Arundel, 2016b).

However, there remains a paucity of understanding about the role of a particular key source of innovation, at least in the private sector, in generating innovative activity in the public sector—universities. Because collaborative engagement with different innovation sources can bring about “spectacular innovation” in public organizations (Wettenhall, 1988, 364), analyzing sources of innovation is important and poses a gaping gap in public sector research. In particular, a focus on universities as a key source fueling innovative activity is crucial because, “Universities are now widely recognized by public policies throughout the leading developed countries as being crucial for contributing to economic growth, sustainable employment creation, and competitiveness in international markets” (Audretsch, 2014, 7). Additionally, Guerzonie et al. (2014) state that university and research centers can foster innovative activity, particularly with product and process innovations, resulting in an increased productivity for the private

sector, which is also crucial for economic development and performance at the national level (Guerzoni et al., 2014).

However, while the importance of universities in driving innovative activity has been widely recognized and analyzed, these studies have been limited to the domain of the private sector. Despite the burgeoning literature analyzing the impact of universities on private sector innovation, by contrast very little is known about the ways in which universities impact innovative activity in the context of the public sector.

The purpose of this paper is to fill this gap in the literature by identifying the effects of universities and research groups on the benefits accruing from innovation in the public sector. More specifically, this paper analyzes the importance of universities as a source of information or ideas for the most important innovation affecting cost and quality of public services, employee job satisfaction, and cross-agency collaboration. Both academics and the policy makers expect that innovations can reduce costs, increase quality, and increase inter-agency collaboration, which is consistent with the aim of the New Public Management (NPM) reforms and innovation theories (Bloch & Bugge, 2013; Demircioglu, 2017b; Walsh et al., 2016). If an innovation does not generate any benefits by failing to reduce costs, increase the quality of government products and services, increase employees' job satisfaction, and/or increase collaboration, then the innovation may be considered not to have any significant public sector impact. In this regard, analyzing the benefits of innovation is crucial. Thus, this study investigates the effects of universities on the benefits accruing from innovation, with regard to costs, quality, employee job satisfaction, and inter-agency collaboration.

Analyzing public sector innovative activity emanating from universities is important because ideas from external sources are a crucial source for generating innovations

(Demircioglu, 2017b; Demircioglu et al., 2017; Walsh et al., 2016), and universities can function as one of these key external sources for those ideas driving innovation. The literature examining the contribution of universities to innovative activity has generally focused on measures of innovative activity appropriate for the private sector, such as patent applications, or on R&D (research and development) (Acs & Audretsch, 1988; Lee & Walsh, 2016; Walsh et al., 2016). However, the traditional measures of innovation in the private sector may be less applicable in the public sector context. Innovation in the public sector, by contrast, does not typically lead to patent applications or radical innovations (Bloch & Bugge, 2013; Bugge & Bloch, 2016) but can still bring about many benefits. As a result, it is crucial to evaluate the ways that universities can benefit the public sector through innovative activity, and not just restrict the focus to companies in the private sector.

Although it is hard to measure innovative activities in the public sector due to the nature and complexity of the public sector, it is still possible to measure innovation in public sector organizations (Bloch & Bugge, 2013; Bugge & Bloch, 2016; Demircioglu & Audretsch, 2017; Torugsa & Arundel, 2016a). Fortunately, by using data from the Australian Public Service Commission (APSC), we are able to measure innovative activities in the public sector; in particular the university as an innovation source and the perceived benefits to innovation. The university as a source of innovation will be explained in the following section. The third section of the paper develops the hypotheses tested in this study while highlighting the perceived benefits of innovations. The fourth section of this paper explains the data and methods of this study, followed by the results. Finally, this paper ends with discussion, conclusions, limitations, and future research opportunities.

## **2. Universities as a Source of Innovation**

Because sources of innovation is a relatively new topic in the field of generic management (Smith, 2006) and public management (Demircioglu, 2017b), there is a paucity of studies actually analyzing where the knowledge spurring innovative activity in the public sector comes from. Still, there are at least a handful of studies identifying either key actors or sources of knowledge driving innovation in the public sector context (Birkland, 2011; Bloch & Bugge, 2013; Borins, 2001; Bugge & Bloch, 2016; Dolowitz & Marsh, 2000; Nasi et al., 2015). For instance, Dolowitz and Marsh (2000) have identified key actors generating the knowledge and ideas conducive to public sector innovation, such as elected officials, bureaucrats, consultants, policy entrepreneurs, lobby groups, think tanks, and private sector corporations.

In addition, organizational managers, staff, politicians, businesses, citizens, and governments have also been found to serve as important sources of innovation for public organizations, at least in the context of Nordic countries (e.g. Bloch & Bugge, 2013; Bugge & Bloch, 2016). Likewise, analyzing government innovators around the world who have received awards for their innovations, Borins (2001) has found that front-line employees, organizational leaders, members of the public, politicians, and interest groups are important actors for innovation in the context of both United States as well as other major countries. Furthermore, citizens and industries have been identified as a key source of knowledge and ideas spurring innovative activity in the public sector (Birkland, 2011; Borins, 2001; Nasi et al. 2015).

However, none of the above mentioned studies probe the role of universities as a source of public sector innovation. This omission is curious in light of the observation by Guerzoni et al. (2014, 1677) that, “The University has long been recognized as an important factor in driving innovation.” Even more striking, an extensive literature analyzing innovation in the private

sector context has blossomed. While these studies analyzing the impact of universities on firm innovations have blossomed for the private sector (e.g. Arundel & Geuna, 2004; Demircioglu et al., 2017), only a few studies acknowledge universities as sources for public sector innovations. For example, in the 1990s, PACE (policies, appropriation, and competitiveness in Europe) research asked questions about how universities were important to the innovative activities of firms (e.g. Arundel and Geuna, 2004). Similarly, Audretsch and Stephan (1996) have found that via participating in workshops, seminars, and social interactions, employees and firms can learn from universities, and these interactions can increase employees' creativity and firms' innovations. Moreover, a new research on the innovative activities of American firms, the National Survey of Business Competitiveness (NSBC), has found that important sources of new information include universities (Demircioglu et al., 2017). However, these studies are limited to the private sector, and we still have a limited understanding of the contributions that universities and research institutions make in terms of public sector innovation.

In fact, there are compelling theoretical reasons as well as empirical evidence why the universities have emerged as a key source of knowledge for innovation. Within the span of a generation, innovation has shifted from being tangential to central to economic performance. As innovation has become more important in the economy, so too have key sources of knowledge, including universities (Audretsch, 2014). A rich literature has identified industrial research laboratories, R&D, universities, and government institutions as providing crucial sources for innovations (Mowery & Rosenberg, 1993; Nelson & Rosenberg, 1993; Walsh et al., 2016). Throughout the world, "universities play an extremely important role in technical advance, not only as places where industrial scientists and engineers are trained, but as the source of research

findings and techniques of considerable relevance to technical advance in industry” (Nelson & Rosenberg, 1993, 11).

Thus, universities and research institutions have emerged as important innovation sources for the OECD countries in the public as well as the private sector (OECD, 2005). Windrum (2008, 3) concludes that “On a daily basis, novel ideas and technologies are developed in public health and medicine, in universities and general education, and in social services.” There is at least some evidence that university research can generate innovations in the public sector (Richardson et al., 2016). Analyzing public sector innovations in Nordic countries, Bloch (2011) and Bugge et al. (2011) found that public organizations collaborate with universities and government research institutions to generate innovations, particularly in Iceland, Norway, and Sweden. For example, public sector managers in Iceland reported in 2010 that almost half of the innovations came from universities. Additionally, Digital Zoo, a product innovation in Sweden, was created with ideas and assistance from Swedish universities for the public sector (Bugge et al., 2011). Therefore, an important question is not just whether universities can contribute to government innovative activities, but in addition, how universities affect individual and organizational outcomes such as the perceived benefits of innovations in the public sector. The following section will explain how universities and research groups can affect the benefits of innovations in the public sector.

### **3. Universities and Benefits of Innovation**

A rich literature has been generated analyzing the impact of universities on various measures of innovative output in the private sector, such as patent applications and new product introductions (Meyer-Krahmer, 1997; Walsh et al., 2016). However, based on our knowledge, no

empirical study exists analyzing the effects of universities on innovation in the public sector. This is unfortunate because as previously mentioned, universities are a crucial source of knowledge that spurs innovation (APSC, 2011a; Audretsch & Stephan, 1996; OECD, 2005; Walsh et al., 2016) and leading governments such as Germany, Japan, and United States have been increasingly engaging collaboration with universities for innovative activities (Meyer-Krahmer, 1997).

A government document published by the Australian government states that “Pursuing an innovation agenda ... [should] accrue a benefit to the client (government or citizen) ... in terms of improved performance or reduced costs” (APSC, 2011a, 235). Therefore, reducing the cost of and increasing the quality of the services, which benefits to the government, are important aims for public sector innovation. However, innovation systems theory suggests that innovation and benefits of innovation do not happen in isolation, but rather interact with different actors and sources (Bloch & Bugge, 2013), and universities are one of the important sources of knowledge for innovation. For instance, a recent study shows that ideas emanating from universities have positive and very high effects for types of innovation and overall innovation in the United States context (Demircioglu et al., 2017). In fact, “firms’ collaborations with universities will be important to obtain radical or novel knowledge and create high-value invention” (Walsh et al., 2016, 1660). More specifically, analyzing wide range of literature, Walsh et al. (2016) state that collaborating with different sources such as universities has many advantages such as doing this will increase efficiency and quality of firms’ product and services.

Analyzing public sector innovations in Sweden, Norway, Finland, Iceland, and Denmark, Bugge et al. (2011) have found that the most two important goals for innovative activity for the public sectors were increasing the efficiency of public services and improving the quality of

public goods and services; ideas and information emanating from different sources such as from universities help public organizations to achieve these objectives. In particular, universities and research centers collaborate with other sectors to introduce or implement innovations that can reduce costs and increase the quality of an organization's services and products (Guerzoni et al., 2014). In another setting, Baldwin and Lin (2002) have found that a significant innovation—such as the adoption of an advanced technology—can increase the efficiency (e.g. reduce the costs) and quality of products and services.

The economic performance of countries in terms of economic growth, competitiveness, quality of cities, and efficiency depends on generating knowledge spillovers from academic institutions (Richardson et al., 2016). Analyzing university-based scientists and companies, Audretsch and Stephan (1996) have found that the scientists facilitated knowledge transfers from universities to organizations that could increase the quality of organizations' outputs. Guerzoni et al. (2014) found that while university-funded researchers generate more original patents, non-university funded research (e.g. industry-funded) results in fewer original patents, suggesting that universities can also contribute to creativity which spurs more significant innovative activity. Greater creativity and more significant innovative activity can, in turn, reduce costs and increase the quality of products and services for government agencies. Taken together, these insights and findings from the extant literature lead us to hypothesize:

H1: Ideas emanating from universities will reduce the costs of doing work in the public sector.

H2: Ideas emanating from universities will increase the quality of public services.

Innovative activities can affect employee attitudes and behavior such as to their job satisfaction (Demircioglu, 2017a). Self-determination theory (SDT) suggests that individuals are motivated when their needs for autonomy (e.g. having choices about how they do their tasks), competence (e.g. achieving tasks and learning), and relatedness (connecting to supportive and satisfying groups) are met (Deci & Ryan, 1985, 2008; Ryan & Deci, 2000; Stone, Deci, and Ryan, 2009). Innovative ideas emanating from universities and research groups will not reduce the autonomy of public sector employees because universities do not have any formal authority over or command system for public sector employees. Additionally, ideas emanating from universities and research groups may enhance the competence and relatedness of employees because they become linked to universities (relatedness) and can learn from universities (competence). In sum, based on SDT, when employees interact with universities, their autonomy will not be hindered, yet this interaction can increase their competence and relatedness.

In addition, researchers collaborating with other researchers are more satisfied with their job compared to the researchers who do not collaborate (Jung et al., 2017). Additionally, the “curiosity-driven research” central to the mission of universities and related research centers (Guerzoni et al., 2014) may spill over to influence the behavior and knowledge accessed by public sector employees, resulting in enhanced employee job satisfaction. Additionally, Audretsch and Stephan (1996) have found that organizations can learn from university’ research and best practices via interaction and social contacts with university staff while participating in seminars and workshops. These practices can satisfy the needs of employees for competence and relatedness, and thus increase their job satisfaction. Taken together, these insights and findings from the extant literature lead us to hypothesize:

H3: Ideas emanating from universities will enhance employee job satisfaction in the public sector.

Collm and Kuno (2014, 141) argue that “innovations can be created internally, enforced by external pressure, or generated collectively in collaboration with stakeholders. It is especially the third kind of innovation process which is both promising and demanding due to a higher level of uncertainty and complexity.” Collaboration across sectors such as between universities and public organizations become very prevalent (Jung et al., 2017). While developing major innovations, universities collaborate with other organizations, such as government and industry (Guerzoni et al., 2014) and collaboration breeds an openness to collaboration (Jung et al., 2017). Thus, organizations and individual researchers engaged in collaboration are also likely to extend their collaboration to include the the university as a source of innovation which in turn can increase inter-agency collaboration.

Documents published by the Australian Public Service such as the APSC stress that there is a “growing need for collaboration between agencies... [because] governments are confronting complex or multi-dimensional issues that require ... collaborative approaches” (APSC, 2011a, xvii). The same report finds that collaboration across the government and beyond is necessary for successful innovation because increasingly complex policy problems require innovative solutions, and different sources for innovations can foster the requisite innovative activity. Similarly, practitioners have found that ideas emanating from other groups, such as universities, can increase innovative activity, which in turn can increase cross-agency collaboration in governments (e.g. Goldsmith & Eggers, 2004; Linden, 2010). Taken together, these findings and insights from the extant literature lead us to hypothesize:

H4: Ideas emanating from universities will increase cross-agency collaboration.

## **4. Data and Methods**

### **4.1 Data and sample**

The data come from the Australian Public Service Commission's (APSC) 2011 annual survey of Australian Public Service (APS) employees. This survey aims to understand and measure employee attitudes and behavior such as innovative activities, job satisfaction, motivation, and turnover intention. Although APSC has collected data from employees for decades, the 2011 APSC data are unique in that it asks many questions about innovation to understand and measure innovative activities, such as sources and benefits of innovation. The recent APSC data (e.g. 2013, 2014, and 2015), however, have very limited information on or questions about innovative activities.

Since 2003, the APSC has undertaken surveys and analyzed responses from the APS employees. The 2011 survey was conducted by ORIMA Research on behalf of the APSC. A stratified random sample (by agency, size of agency, job classification level, and location of work) of 17,326 APS employees was invited to take the survey, and approximately 10,200 valid responses were received (close to 60% response rate). In order to eliminate the possibility of identifying responses, employees in organizations that employed fewer than 100 employees were excluded from the sample (APSC, 2011b). Because this research focuses on employees whose work group implemented any innovations in the previous year, the sample size is reduced to innovative employees.

Torugsa and Arundel (2016b, 2016) emphasize that 2011 APSC data have many methodological advantages, including that

it collects data from employees at all job levels within government agencies and uses the workgroup as the unit of analysis. As a consequence, it can capture both ‘top-down’ and ‘bottom-up’ innovations of varying significance. In contrast, surveys directed to agency heads and/or supervisory-level managers and using the organization as the unit of analysis could be skewed towards top-down innovations.

Australia is intentionally chosen for this study. In addition to the data availability and the unique dataset, we know from the literature that the Australian government is very active in innovation, and particularly in engaging with various sources for innovation (e.g. Bankins et al., 2016; Demircioglu, 2017b; Torugsa & Arundel, 2016a, 2016b). Australia is one of a few countries focusing on “open innovation strategies,” such as seeking out external sources (e.g. universities) to develop and implement innovations in the Australian public service (Lee, Hwang, & Choi, 2012). In fact, many ideas for innovations emanate from the universities and government research centers in Australia (Yencken & Hindle, 2005). Likewise, innovative policies in Australia are mainly government-led (instead of community-led), suggesting that the Australian government encourages external sources to become involved in the government’s innovative activities (Lee, Hwang, & Choi, 2012).

The Australian Federal government has also realized that interactions and direct collaborations among different sectors (e.g. the university and the public sector) can lead to

innovations in the Australian government, and that universities and research groups are crucial actors for spurring innovative activity in the Australian government (Haukka, 2005). In 2003, approximately 40 universities and 30 medical research institutes and several government research institutions were involved in innovation activity in Australia; more specifically, over 60 government research institutions have collaborated with universities in innovative activity in the Australian government (Nelson, 2003). Similarly, the Australian Public Service Commission (APSC) has identified universities and research groups as important sources of innovation (APSC, 2011a). Other documents in Australia, such as the “Guide to Support Innovation in Small and Medium Enterprises,” confirm that universities and research institutions are important actors for innovations in governments (InnoSupport, 2009). The Management Advisory Committee (2010) suggests that the public sector and public organizations collaborate with academics, universities, and research groups to generate innovations in the Australian government. Hence, the APS represents a very relevant case for collecting data to test the effects of universities as source of innovation on the perceived benefits of innovation.

Because this study uses self-reported data from one source (2011 APSC), common-method bias may be a concern. The survey quality (e.g. data collection process and lack of overlapping variables) and anonymity of individual responses are very critical ways to reduce common-method variances (George & Pandey, 2017; Jakobsen & Jensen, 2015; Podsakoff et al., 2003). These data do not have any procedural problems with the survey design (APSC, 2011; Demircioglu, 2017b; Torugsa & Arundel, 2016a, 2016b). Additionally, regarding the statistical remedy, Harman’s single factor test shows that this bias exists “when a single factor emerges from the analysis or when a general factor accounts for the majority of covariance in the dependent and independent variables” (Torugsa & Arundel, 2016a, 400). The results show that a

single factor does not emerge, suggesting that common method bias is not a serious concern and not likely to generate misleading results.

## **4.2 Variables**

Appendix 1 shows the operationalization of all the variables used in this study. The dependent variable is the perceived benefits accruing from innovations, which consist of four outcomes: Innovation affecting cost, quality, employee job satisfaction, and cross-agency collaboration. According to the APSC (2011a, 237), this measure “has been a first attempt to assess employee perceptions of the effect of innovation... this is an often overlooked area for those involved in measuring innovation.” The exact question posed in the survey is: “Thinking of the most significant innovation that was implemented by your work group in the last 12 months; has it had an effect on any of the following?” Each benefit of innovation ranges from 1=large negative effect to 5=large positive effect, so the scales are ordinal.

Because innovation is a group action (Becker & Whisler, 1967), this dependent variable captures whether an employee’s workgroup has implemented any innovations in the previous 12 months and forced employees’ to think about the most significant innovation, so each group members may have the same opinion about the most significant innovation. A key advantage of this operationalization of the dependent variable is that “the responses to effects are directly linked to the MSI [most significant innovation]” (Torugsa & Arundel, 2016b, 207).

The independent variable captures how important tertiary education (universities) and/or research groups were for the most significant innovation implemented by employee work groups. Response categories include 1=not important, 2=somewhat important, and 3=very important. Tertiary education in the Australian education system typically refers to universities that offer

doctoral degrees, master's degrees, graduate diplomas, or graduate certificates (Haukka, 2005), suggesting that tertiary education or research groups involved in research activities collaborate with the government, and contribute innovative ideas to the government.

Organizational size, type of organizations, organizational location, level of job classification, experience, education level, overall job satisfaction, full-time status, barriers to innovation, and innovation climate have all been identified in the literature on innovation as influencing innovative activity and outcomes, so these variables are included as control variables. For instance, larger organizations are more likely to have innovation strategies in general (Wise, 1999), and in the Australian public service in particular (APSII, 2011; Demircioglu, 2017b). Furthermore, Bankins et al. (2016)'s qualitative study of the APS found that the size of the organization affects innovation and the benefits accruing from innovation (see also Walsh et al., 2016). Audretsch and Stephan (1996) found that location is very important for innovations. Because of the data limitations and privacy concerns, we are not able to measure location in terms of the proximity between universities and public organizations. However, we can control agencies whether they are located within the capital or not within capital. Furthermore, level of job classification, experience, and highest degree of education can affect the significance, the quality, and benefits of innovation (Lee & Walsh, 2016; Torugsa & Arundel, 2016a; Walsh et al., 2016). Therefore these variables are controlled for.

In addition, higher job satisfaction and full-time status are associated with innovative activities in the APS (Demircioglu, 2017b) and are also included as control variables. Several studies suggest that barriers to innovation are associated with innovation and benefits of innovations in the Australian public service and in Nordic countries (Arundel & Huber, 2013; Bloch & Bugge, 2013; Demircioglu & Audretsch, 2017; Torugsa & Arundel, 2016a). Finally, the

innovation climate positively affects innovative activities (Demircioglu, 2017b). Thus, job satisfaction, full-time status, barriers to innovation, and innovation climate are also controlled to reduce potential omitted variables bias.

#### **4.5 Modeling and Estimation**

The seemingly unrelated regression models (SUR) are used for other dependent variables (innovation affecting cost, quality, employee job satisfaction, and cross-agency collaboration), because the errors are correlated with one another. SUR models analyze complex data in a rigorous and coherent way and suitable when dependent variables are linked and their error terms are correlated because this model reduce bias and increase efficiency (Fiebig, 2001; Moon & Perron, 2006; Zellner, 1962).

Because correlations among variables are below 0.7 and variance inflation factor scores (VIF) are less than 10 (the highest VIF is job level, which is below 2 for all models and the mean VIF is below 1.25), multicollinearity is not a problem in this study. Because of the privacy and other concerns, the APSC do not share information about which employees are working at which agencies. In this regard, we cannot use hierarchical modelling such as hierarchical linear models. Nevertheless, agency dummies are included (without identifying agencies) in the regression, so it may help to reduce bias.

### **5. Results**

Table 1 presents the descriptive statistics, and Appendix 2 shows the correlations. Regarding the benefits of innovations, on average, most employees indicate that innovations increased quality, followed by employee job satisfaction, collaboration, and cost. Most agencies

are large (at least 1000 employees) in the sample. Approximately half of the employee' work location is the Australian Capital Territory (ACT). Most employees are full-time with different levels of experience. The mean value of the barriers to innovation is 0.65, indicating that most of the employees are reported barriers to innovation in their workplace.

Table 1 is around here

Table 2 reports the statistical results based on the standardized coefficients. The first model tests the effects of universities on costs directly linked to the MSI. Results of the SUR show that ideas and information emanating from universities do not have a statistically significant effect on costs at the 0.05 level. In addition, while a positive and supportive innovation climate can reduce the costs linked to the MSI, barriers to innovation does not have any statistical effect. Additionally, employees in managerial positions are more likely to report that the most significant innovation reduces costs linked to the MSI. Moreover, on average, more satisfied employees tend to report decreased costs linked to the MSI, which is moderately significant. The other control variables do not have a statistical effect on the dependent variable.

Table 2 is around here.

The second model tests for the effects of universities on the quality of employee work directly linked with the MSI. Overall, the ideas emanating from universities can increase the quality of employees' work (Beta=0.069,  $p<0.01$ ). Employee overall job satisfaction, full-time status, innovation climate, and level of job classification are positively related to the quality of employees' services linked with the MSI. On the other hand, job experience is negatively related to increasing the quality of the most significant innovation. Other variables (size and location of the agency, education level, and barriers to innovation) are not statistically significant.

The third model tests for the effects of universities on employee job satisfaction directly linked with the MSI. As expected, the effects of the university on employee job satisfaction effected by the MSI is statistically significant (Beta=0.07,  $p<0.001$ ), indicating that ideas emanating from universities can enhance employee job satisfaction directly linked to the MSI. In addition, innovation climate, overall job satisfaction, job location, level of job classification, and full-time status are positively related to the dependent variable, while barriers to innovation is negatively related. However, the size and location of the agency, experience, and education level are not statistically significant at the 0.05 level.

The fourth model tests for the effects of universities on the cross-agency collaboration directly linked with the MSI. The effects of the university on the cross-agency collaboration are very high (Beta=0.188,  $p<0.001$ ), and is the second highest in the model after the innovation climate, suggesting that ideas and information emanating universities are crucial sources to increase cross-agency collaboration linked with the MSI. Additionally, level of job classification, overall job satisfaction, and full-time status are positively correlated with inter-agency collaboration linked with the MSI. The size and location of the agency, level of job

classification, experience, education level, and barriers to innovation do not have any effect on the dependent variable.

Although SUR models are more unbiased, the ordinal logit models (OLM) are also used for sensitivity analysis. Accordingly, the results are very similar to the original models that reported at the Table 2; none of major variables' statistically significant levels are changed. For instance, while the p value for the first model was 0.07, the p value of the OLM results for the same model is 0.071. P and t values of the other findings are very close to the original. The findings of these sensitivity analyses strengthen the results of our hypotheses testing.

## **6. Discussion**

While the role of universities in innovative activity has attracted considerable attention across a broad spectrum of academic disciplines and fields, the bulk of this research has remained fixated on the private sector. By contrast, this is one of first studies focusing on how universities and research groups affect the benefits accruing from innovative activity in the public sector context. By utilizing a new source of data, this paper is able to show that not do universities play a key role in generating innovative activity in public organizations, but the nature of innovations and their impact on public sector performance are related to the role played by universities. The results suggest that, on average, ideas and information emanating from universities are associated with larger organizational benefits, in particular increasing the quality of government products and services, employee job satisfaction, and collaboration in the public sector.

The results show that, in particular, the effects of universities and research groups for the MSI affecting collaboration in the public sector is very high and meaningful, suggesting that

policy makers should consider interacting and receive ideas from universities to increase interagency collaboration with other agencies. In addition, the effects of universities and research groups for the MSI affecting employee job satisfaction and the quality of government services are also very high, suggesting for policy makers and public managers that the public organizations should interact with the universities for their innovative ideas as doing so has large benefits.

Walsh et al (2016) have summarized many studies, which argue the necessity and the benefits of collaboration for innovation. Their empirical findings also show that ideas emanating from universities generate high quality innovations for private organizations. Like in the business and the industry, innovation in the public sector should be also beneficial (e.g. to reduce costs and to increase the quality of public services). Thus, it is crucial to analyze which factors or actors can contribute to positive outcomes of innovations. In this regard, universities and research groups can be important and meaningful sources of innovation and increase innovations in the public sector, as well as leading to more benefits associated with those innovations.

Governments and public organizations throughout the world can benefit from the innovative activities of universities as recipients of knowledge spillovers generated by universities (Audretsch, 2007, 2014). “Such knowledge spillovers” argues Audretsch (2014, 12), “are essential for generating economic growth, the creation of jobs and competitiveness in global markets.” This paper illustrates that universities can help public organizations to adopt innovations that increase quality, increase employee job satisfaction, and increase inter-agency collaboration. Future research may continue analyzing (1) the effect of universities on other outcomes such as entrepreneurship in the public sector and (2) which other external sources of

innovation (e.g. industry stakeholders) affect innovation, types of innovations, innovation complexity, and the benefits of innovations.

This study has used a unique dataset that assesses both employee perceptions and innovations conducted in the APSC, so it has a high value. As APSC (2011a, 237) states, “This has been a first attempt to assess employee perceptions of the effect of innovation. As mentioned earlier, this is an often overlooked area for those involved in measuring innovation, and more work is required to refine the measurement approach. However, over time, an interesting direction might be to match employee perceptions to the views of those actually benefiting from the implementation of the innovation.” Future research might consider using alternative methodologies, such as in-depth interviews to analyze and obtain more information about the benefits accruing from innovations, particularly due to the complexity of innovative activity.

## **6.1 Limitations**

Like most other survey-based research using cross-sectional data, this study has several limitations. First, although this is one of the first studies examining the university as a source of innovation and benefits in the public sector context, only one question provides measurement of the university as an innovation source and a single questions captures the benefits of innovation. Thus, a key limitation of this research is the inability to measure the density of innovation activities. Still, as recent studies have emphasized, measuring innovative activities has remained elusive, particularly in the public sector, so being able to include one survey item measuring innovative activities represents considerable progress and an important contribution to the literature (Demircioglu & Audretsch, 2017; Bloch & Bugge, 2013; Bugge & Bloch, 2016; Fernandez & Moldogaziev, 2013; Torugsa & Arundel, 2016a). Future studies can make

additional contributions to the literature by extending this study using surveys asking more detailed and targeted questions on innovation and the importance of universities for innovations. Future research could also conduct qualitative studies on how and why universities affect innovation in the public sector context.

Second, these results are based on employee perceptions, which are not objective measures. Such subjective measures are still valid and important, however, because studies on public sector organizations have found that objective measures are highly correlated with subjective measures (Fernandez, 2008; Pitts et al., 2011; Walker & Boyne, 2006). For instance, Fernandez and Pitts (2011, 211) state that “perception is reality in that it is the perception that will guide the respondent's behavior,” suggesting that the results reflect the reality of innovative activities. Nevertheless, an important challenge for future research may be to develop more objective measures of innovative activity to generate more rigorous analyses.

Third, due to the APSC protection act, the APSC does not provide information about the level of each agency. Instead, only five categories for agency level information are provided. This acts as a limitation because some agencies may have higher levels of interaction with universities (e.g. the Department of Education), while others may have lower levels of interaction. Thus, subsequent research could make a valuable contribution by collecting data from different agencies about innovative activities and comparing how universities may affect the benefits accruing from innovation in these different agencies. Finally, because the data are collected from the APSC, the results may not be generalizable to other national and institutional contexts, such as non-Anglo-Saxon countries, although the findings may hold for other countries, particularly for more economically advanced, developed, and democratic countries.

## **7. Conclusion**

Despite the increasing importance of external actors particularly universities and research centers for innovation in the public sector, the effects of universities on public sector innovation is still unknown. This is one of the first studies analyzing how universities and research groups as sources of innovation affect perceived benefits of innovation in public organizations. Using the 2011 APSC data, this paper has found that universities and research groups can help public agencies to adopt innovations which has many benefits (e.g. to reduce costs, increase quality, increase employee job satisfaction, and increase inter-agency collaboration). In particular, the effects of universities on inter-agency collaboration and job satisfaction is very high, suggesting that public managers and decision-makers should interact with universities as doing so can have many benefits in terms of innovation in the public sector.

Future research may treat universities as an independent variable and explore how universities affect for other outcomes such as performance, complex innovations, and public sector entrepreneurship in the public sector context. Additionally, future researchers may also develop extensive and targeted questions on innovation activities or conduct qualitative data to measure the density of innovations and how sources involved in the innovations. Still, while we anticipate a rich stream of literature in subsequent research, this paper has provided compelling empirical evidence suggesting that not only are universities of key source for innovative activity in the public sector, but they also influence the type and nature of that innovative activity.

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**Table 1: Descriptive Statistics**

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Benefit: Cost	2610	3.57	0.90	1	5
Benefit: Quality	2777	4.02	0.91	1	5
Benefit: Job Satisfaction	2776	3.80	0.96	1	5
Benefit: Collaboration	2360	3.61	0.80	1	5
University as a source of innovation	2841	1.41	0.65	1	3
Size of agency	2841	2.62	0.58	1	3
Location: ACT (capital city)	2841	0.51	0.50	0	1
Level of job classification	2841	1.56	0.63	1	3
Experience	2841	2.82	1.53	1	5
Education level	2841	1.61	0.49	1	2
Overall job satisfaction	2841	3.79	0.90	1	5
Full-time status	2841	0.89	0.31	0	1
Barriers to innovation	2841	0.65	0.48	0	1
Innovation climate	2841	2.58	0.59	0.42	4

**Table 2: Regression Results: Standardized Coefficients**

	Model 1	Model 2	Model 3	Model 4
	Cost	Quality	Job Satisfaction	Collaboration
Source: University	0.035 (-0.027)	0.069*** (-0.025)	0.070*** (-0.026)	0.188*** (-0.024)
Size of agency	-0.002 (-0.034)	-0.027 (-0.032)	-0.009 (-0.033)	0.003 (-0.031)
Location: ACT (capital city)	-0.008 (-0.035)	0.028 (-0.033)	0.044* (-0.034)	0.030 (-0.032)
Level of job classification	0.104*** (-0.032)	0.085*** (-0.030)	0.073*** (-0.031)	0.069** (-0.030)
Experience	-0.022 (-0.012)	-0.045* (-0.011)	-0.019 (-0.011)	-0.028 (-0.011)
Education level	-0.040 (-0.039)	0.009 (-0.036)	0.012 (-0.037)	0.016 (-0.035)
Overall job satisfaction	0.043* (-0.022)	0.114*** (-0.020)	0.223*** (-0.020)	0.044* (-0.020)
Full-time status	0.024 (-0.056)	0.048** (-0.052)	0.040* (-0.053)	0.050* (-0.052)
Barriers to innovation	-0.025 (-0.031)	-0.031 (-0.029)	-0.046** (-0.029)	-0.020 (-0.028)
Innovation climate	0.204*** (-0.034)	0.274*** (-0.032)	0.280*** (-0.032)	0.200*** (-0.031)
Agency dummies	(included)	(included)	(included)	(included)
log-likelihood model	-3351.7	-3462.3	-3507	-2692.3
Chi2	184.4	463.3	745	304.6
AIC	6727.4	6948.5	7037.9	5408.6
BIC	6797.8	7019.7	7109.1	5477.8
R <sup>2</sup>	0.066	0.143	0.212	0.114
N	2610	2777	2776	2360

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001. Standard errors are in parentheses

## Appendix 1: Operationalization of Variables

<b><i>Dependent Variables</i></b>	
Benefit: The cost	The most significant innovation affected the cost of doing work implemented in the last 12 months (From 1=large negative effect to 5=large positive effect).
Benefit: The quality	The most significant innovation affected the quality of employees' work implemented in the last 12 months (From 1=large negative effect to 5=large positive effect).
Benefit: Employee job satisfaction	The most significant innovation affected employees' job satisfaction implemented in the last 12 months (From 1=large negative effect to 5=large positive effect).
Benefit: Cross-agency collaboration	The most significant innovation affected cross-agency collaboration implemented in the last 12 months (From 1=large negative effect to 5=large positive effect).
<b><i>Independent Variable</i></b>	
University as a source of innovation	The importance of the tertiary education and/or research groups as an idea or information for the most significant innovation implemented in the last 12 months (1=Not important, 2=somewhat important, 3=very important).
<b><i>Control Variables</i></b>	
Size of agency	Number of people working in the agency. (1=Small (<251), 2=Medium (251-1000), 3=Large (1000+)).
Location	Respondent's workplace (1=Australian Capital Territory, 0=Field Office).
Level of job classification	Respondent's substantive classification level (1=Australian Public Service 1-6, 2=Executive Level (1-2), 3=Senior Executive Service).
Experience	Total length of service in the Australian Public Service (APS) (1=less than 5 years, 2=5 to 10 years, 3= 10-15 years, 4=15-20 years, 5=20 years or more).
Education level	Respondent's highest completed qualification (1=Completed year 12 or below, 2=Completed vocational qualification, 3= Completed tertiary qualifications).

Overall job satisfaction	Overall, I am satisfied with my job." from 1 = strongly disagree through 5 = strongly agree.
Full-time status	Respondent's basis of employment status (1=Full-time basis, 0=part-time basis).
Awareness of innovation barriers	"Do you believe there are barriers to implementing innovations in your work place?" (1=Yes, 0=No).
Innovation climate	<p>12 survey indicators, from 1 = strongly disagree through 5 = strongly agree. (Alpha=0.89)</p> <ul style="list-style-type: none"> <li>a. I am always looking for better ways to do things.</li> <li>b. I am prepared to challenge others' thinking and points of view in order to solve problems in my workplace.</li> <li>c. I receive support from my manager when I suggest new ideas.</li> <li>d. I know exactly who needs to hear about my ideas so that they can be evaluated.</li> <li>e. There are established processes for evaluating my ideas.</li> <li>f. Employees in my workplace have autonomy and freedom in carrying out their job roles.</li> <li>g. Employees in my workplace are provided with enough time and resources to try out new ideas.</li> <li>h. My workplace encourages innovation and the development of new ideas.</li> <li>i. My workplace is prepared to pilot and trial new ideas.</li> <li>j. My workplace celebrates its successes in innovation and learns from everything it does.</li> <li>k. My workplace shares its ideas and encourages their wider use.</li> <li>l. My workplace has reward or incentive programs that encourage innovation.</li> </ul>

## Appendix 2: Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Benefit: Cost	1													
2 Benefit: Quality	0.39	1												
3 Benefit: Job Satisfaction	0.37	0.63	1											
4 Benefit: Collaboration	0.21	0.34	0.42	1										
5 University	0.08	0.12	0.14	0.22	1									
6 Size of agency	0	-0.03	-0.04	-0.03	-0.04	1								
7 Location: ACT (capital city)	-0.01	0.03	0.05	0.05	0.06	-0.11	1							
8 Level of job classification	0.11	0.11	0.13	0.1	-0.01	-0.15	0.22	1						
9 Experience	0.02	-0.03	0.01	-0.02	-0.08	0.05	-0.03	0.28	1					
10 Education level	-0.02	0.04	0.03	0.03	0.04	-0.12	0.12	0.38	-0.05	1				
11 Overall job satisfaction	0.15	0.25	0.37	0.15	0.09	-0.01	0.02	0.1	0.01	0.02	1			
12 Full-time status	0.04	0.07	0.07	0.06	0.01	-0.02	0	0.07	0.04	0.02	0.03	1		
13 Barriers to innovation	-0.06	-0.08	-0.09	-0.03	0.04	0.03	0.03	0.09	-0	0.1	-0.17	0.01	1	
14 Innovation climate	0.24	0.32	0.38	0.24	0.16	0.04	0	0.05	-0.01	-0.07	0.44	0.03	-0.33	1