

Understanding the Innovation Impacts of Public Procurement

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ABSTRACT *Public procurement accounts for a significant proportion of overall demand for goods and services and is increasingly seen as an attractive and feasible instrument for furthering the goals of innovation policy. However, public procurement is already expected to address a wide range of social goals. Much of the current debate about harnessing procurement to promote innovation draws upon a limited set of examples which are not representative of the bulk of public purchasing and tend to downplay diversity in procurement practices and in the types of goods and services procured. They also downplay diversity in the nature of innovations and in the range of ways that procurement can impact upon innovation. A one-size-fits-all model is unlikely to work across all procurement contexts yet all types of public procurement are likely to have impacts upon innovation by shaping the demand environment in which suppliers innovate and compete. We propose a framework and typology based on the nature of the goods and services procured in order to explore the potential impacts upon markets and innovation of each. We conclude that public purchasing should first and foremost remain concerned with proximate public policy goals and that, rather than trying to co-opt public procurement into the innovation policy toolbox, policy-makers should focus on promoting innovation-friendly practices across all types of procurement at all levels of governance.*

1. Introduction

The notion that public procurement can be actively used to promote innovation is high on the agenda of European policy-makers at all levels. Public procurement accounts for a significant proportion of overall demand for goods and services, which in the EU represents around 16% of the combined EU-15 GDP (European Commission, 2005). While debates about the influence of “demand” on innovation are not new, this interest in the use of public demand as a driver of innovation has become mainstream in innovation policy debates, a process encouraged by the recommendations of a number of inquiries, reports and policy documents (e.g. Edler *et al.*, 2005; European Commission, 2005).

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Procurement for innovation is an element of the European Commission's Action Plan to raise R&D expenditure to the 3% Barcelona target. Both the Kok Report, reviewing progress on the Lisbon strategy, and the Aho Group Report *Creating an Innovative Europe* (Aho *et al.*, 2006) emphasized a need to promote policies driving demand for innovation, including public procurement. The recent Lead Market Initiative (European Commission, 2007) focuses largely on sectors in which the State is an important purchaser and considers public procurement to be one of the key policy instruments relevant to the creation of "lead markets" in Europe. At the national level, and taking the example of the UK, a number of policy statements have highlighted the importance of public procurement not only for achieving greater efficiency in public sector spending (HM Treasury, 2004) but also as a vehicle for innovation and local economic development. This aspiration to harness public procurement in support of innovation has featured strongly in a number of recent statements of UK innovation policy (HM Treasury, 2007; DIUS, 2008).

However, despite this upsurge of interest, we believe that the debate remains too restricted to meaningfully inform public procurement strategies. The current debate is limited in several ways: first, it downplays the varied nature of public procurement in terms of the wide range of types of goods and services procured by the public sector; second, it downplays the varied nature of innovation; and third, it downplays the multiple potential innovation effects of public procurement. Much debate is focused on a limited number of examples used to demonstrate the innovation effect of public procurement, examples generally at the high end of technology and supported by procurement at the early stages of development. While celebrated examples such as the Internet and semiconductors may indeed be examples of successful procurement-induced innovations, these are not representative examples of everyday public procurement of goods and services by national and regional bodies, and it is unclear what lessons can be learned from such cases for "bread and butter" procurement. There is also a definitional problem at the heart of the current debate. Widely used definitions of "innovative procurement" as "the purchase of goods or services that do not yet exist" exclude many categories of innovation and may be of doubtful relevance to many public procurers, who could find this agenda difficult to respond to. The prevailing definitions do not account for innovation through the recombination of existing goods or services, innovation in the delivery of existing services, and exclude most process innovations. In addition, emphasis is placed on the direct effects of procurement on innovation while the possibility of indirect impacts and wider spillover effects are downplayed. Both the academic and policy debates take an aspatial approach to impacts and tend to be biased towards procurement done at the national level (and by powerful departments such as defence). However, public procurement is subject to multi-level governance, and variations in expenditure across different levels, and from territory to territory, mean that the geography of public procurement is complex. Finally, the scope for public procurement to stimulate innovation has to be considered in a context in which public procurement is increasingly expected to pursue a variety of often conflicting policy objectives. Procurement practitioners are thus faced with a wide range of demands placed upon them to simultaneously achieve multiple goals beyond the proximate goals behind the procurement itself.

In this paper, we construct a framework for understanding the different ways in which procurement could influence innovation. We do so by focusing on the nature of the goods and services procured and on purchasing strategies, which influence the type of innovation opportunities firms are confronted with. We explore some implications of this analysis in

terms of dominant buyer–supplier relations and geographical organization. The paper proceeds as follows. Section 2 summarizes some key debates around the influence of demand in shaping innovation. Section 3 deals with definitional issues before examining the avenues through which procurement may, directly or indirectly, influence innovation. Section 4 discusses the influence of product-based procurement types and strategies on firms and elaborates on the implications of this typology as regards categories of innovation, user–supplier relations, modalities of procurement and geography. The paper ends with a short summary.

2. The Influence of Demand on Innovation

There is an increasing consensus in innovation policy discussions that the demand side of innovation has been neglected. Despite an emphasis on user–supplier interaction and a recognition that demand for innovations must be important, policy prescriptions emerging from “systems” approaches have tended to focus predominantly on the supply side of economic life (Edler & Georghiou, 2007). Storper (1997, p. 107) also notes how the literature on evolutionary economics has tended to focus attention “whether implicitly or explicitly” on the supply side, and in particular on the “institutions that deliver up resources crucial to learning and interaction”. Malerba (2007) argues that although demand has received attention in the literature, many questions remain, particularly in relation to the influence of demand on innovation during the evolution of an industry, and the nature of customer involvement in the innovation process (e.g. a passive recipient versus an active contributor).

Of course Schmookler (1966) highlighted the importance of the market size in triggering technological developments. Demand on a significant scale “pulls” innovation as it guarantees a significant level of production and a reduction in uncertainty that allows firms to benefit from economies of scale and technological investment and ensures larger profits. Network externalities on the demand side also create advantages for certain industries by allowing dynamic increasing returns (Katz & Shapiro, 1985). The importance of the home market is relative rather than absolute, so small nations can be competitive in segments that account for a significant share of local demand but a small share elsewhere, even though the absolute size of the segment is larger in other countries (Porter, 1990).

Demand is also treated as a key influence by studies focusing on the dynamic relationship between innovation and market structure (Kamien & Schwartz, 1975; Sutton, 1998) and on innovation and industry life-cycle models (Utterback, 1994). A central tenet of studies on the relation between demand, market structure and innovation is the Schumpeterian argument of a positive impact of market power on innovative activity. Klepper and Thompson (2006) and Sutton (1998) centre their attention on the importance of submarkets and their role in explaining growth and concentration of industries. Life-cycle models address the dynamics of innovation in industry evolution (Utterback, 1994; Klepper, 1997). It is argued that the rate of product innovation in an industry or product class is highest during the “fluid” phase, which is characterized by a great deal of experimentation with product design and operational characteristics. In the “transitional” phase, product variety gives way to standard designs, or dominant designs, shaped by user needs, standards, or legal or regulatory constraints. Some industries further experience a “specific” phase, in which they become focused largely on “cost, volume and capacity” (Utterback, 1994). In this phase there is some incidence of small, incremental product and process innovation.

These models have been criticized on a number of counts, including a perceived neglect of the role of demand in post-dominant design developments; the assumption of a clear succession between product and process innovation (Adner & Levinthal, 2001); and the assumption that a clearly dominant design will always emerge (Windrum & Birchenhall, 1998). Windrum and Birchenhall (1998) argue that convergence to a single design would be limited to mass markets with relatively homogeneous consumer tastes. Observing the market for cameras, they conclude that the system need not necessarily stabilize around a unique design. Instead a process of market differentiation may lead to the emergence of distinct niches. Adner and Levinthal's model based on heterogeneous demand, suggests that, contrary to the product life-cycle model, high levels of innovative activity can occur for "mature" product classes (Adner & Levinthal, 2001). Abernathy and Clark (1985) argue that, contrary to the "birth–growth–maturity–decline" pattern of development suggested by life-cycle notions, conditions may occur that trigger the reversal of an older industry (or "de-maturity"), thus embracing radical innovations that can serve as the basis for renewal in industry development. Among these conditions, they point to changes in customer demands and in public policy and regulation.

Some of the literature focuses more specifically on the needs of users and the involvement of users in innovation. Mowery and Rosenberg (1979) critically analysed existing evidence around the "demand pull" effect, identifying a confounding of "needs" with "demand" in much of the literature which limited the comparability of the various studies identifying "demand" as the key determinant of innovation. They distinguished between the importance of "user needs" or "need recognition" (need-pull) as a source of innovation and demand-pull effects mediated by the market. In their view "myriads of deeply felt needs exist in the world, any one of which constitutes a potential market for some product, yet only a small subset of these potential demands are fulfilled" (p. 109).¹

Porter notes that buyers can anticipate market demand by becoming early adopters of a new product or service that eventually comes to be demanded elsewhere. This anticipatory demand, he argues, stimulates the continuous improvement of products and their ability to compete in emerging segments. These early adopters can also be heavily involved in the innovation process, and even in the co-production of the good or service. Lundvall (1993) has emphasized the importance of user–producer interaction in particular industries. Von Hippel (1986) has explored user-driven innovations in sectors such as scientific instruments and coined the term "lead users" to refer to "users whose present strong needs will become general in a marketplace months or years in the future" (Von Hippel, 1986, p. 791). Bresnahan and Greenstein (2001) point to the importance of co-invention in the IT sector, where user co-inventions adapt the general purpose technology to the diverse specific problems and needs of different users. Malerba *et al.* also highlight the importance of experimental users in cases such as the Internet, automobiles and aircraft. In these cases "new firms got their start selling to experimental users, or to users whose needs were inadequately met" by producers relying on older technology (Malerba *et al.*, 2007, p. 373).

3. The Influence of Public Procurement on Innovation

3.1. Definitional Issues

Before further discussion of the potential of public procurement as an innovation policy tool, a clarification of definitional issues is in order. Public procurement refers to the

acquisition of goods and services by government or public sector organizations. A distinction is commonly made between “normal” or “regular” public procurement on the one hand and “public technology procurement” on the other. Public technology procurement occurs when “a public agency acts to purchase, or place and order for, a product—service, good, or system—that *does not yet exist*, but which could probably be developed within a reasonable period of time, based on additional or new development work—e.g. R&D—by the organization(s) undertaking to produce, supply, and sell the product” (Edquist *et al.*, 2000; 5 *emphasis added*). Regular public procurement, on the other hand, is said to occur when public sector organizations buy ready-made products for which no R&D is required and about which purchasing and supplier selection decisions can be made on the basis of readily available information about price, quantity and performance, given the existence of standardized markets (Edquist *et al.*, 2000). A third modality is when the public sector directly procures R&D to support the activities and decisions of government and public authorities. This is a special case which differs from the procurement of other goods and services for public use and is of less interest for the purposes of this paper. Finally, proponents of the use of public procurement to stimulate innovation increasingly refer to “innovative procurement” or “procurement of innovation”, rather than “public technology procurement”, in an attempt to reflect a broader view of innovation beyond R&D (Edler & Georghiou, 2007).²

Within the category of innovative procurement, further differentiations have been made in terms of the end users of the goods and services procured (Edler & Georghiou, 2007; Hommen & Rolfstam, 2009), the strategic nature of the procurement policy (Edler & Georghiou, 2007), the market position of the public sector in relation to suppliers (Rothwell & Zegveld, 1981; Edquist *et al.*, 2000), the type of innovation and the stage of the technology life cycle in which innovation is seen to occur (Edquist *et al.*, 2000; Edler *et al.*, 2005; Hommen & Rolfstam, 2009). Interestingly, there is no typology based on the nature of the actual goods and services procured.

3.2 Procurement as Explicit Innovation Policy

In the tradition of authors such as Geroski (1990) and Rothwell and Zegveld (1981) there has long been interest in the use of procurement as an innovation policy tool or a tool of industrial policy, see also Rothwell (1984). Rothwell and Zegveld (1981) compared R&D subsidies and state procurement contracts and concluded that procurement was more effective in generating innovation than R&D subsidies. Geroski (1990) reviewed key successful innovations emerging from public procurement such as the computer, civilian aircraft and semiconductor industries and concluded that procurement could be effective in stimulating innovation under certain conditions. These include the enforcement of high standards, the definition of a clear set of needs towards which innovative efforts can be directed, the provision of a market for new products and services at early stages of the product life cycle, and encouragement of competition. He cautiously notes that procurement may only be effective in a small minority of cases (notably defence) and points to potential for misuse, particularly in relation to poor targeting, backward-looking protectionism and the support of national champions.

Recent discussions have unfortunately lost sight of this nuanced understanding, and tend to imply, without a careful analysis of preconditions and limits, that public procurement should have as an intentional or explicit objective the promotion of innovation

(see e.g. Aschhoff & Sofka, 2008). We have argued elsewhere that an expansion of the accepted realm of action for innovation policy has seen policy instruments intended to achieve other policy goals (such as procurement, regulation, education, tax measures, etc) being “co-opted” in the service of innovation policy (Flanagan *et al.*, 2008). This brings with it the implicit assumption that innovation policy goals should take precedence over, or at least co-exist as primary objectives, with other policy goals.

Public procurement is, however, already a multi-objective policy, the main goal of which must remain to ensure the quality of government services and the use of the products and services for the public sector. That said, innovation can be an explicit secondary objective in certain instances, e.g. to ensure that vital government functions can be secured against a range of shocks and threats (mission-critical procurement) or to obtain better products for use in carrying out government functions; to appropriately exploit government market power and to ensure that the needs of those consuming public goods (where market forces may not effectively stimulate innovation) are met (Cave & Frinking, 2003).

It is important to appreciate that, regardless of whether public procurement is explicitly oriented towards innovation, there will be innovation impacts. As Dalpé (1994, p. 66) argues, “decisions concerning prices, quantities, and standards affect innovation, positively or negatively, in a group of industries involved in government procurement”. It is important to understand these effects, whether they are actively sought or not (see next section). Indeed many of the most frequently cited examples of procurement-induced innovation have not been the result of an intentional or conscious drive to encourage innovation but rather the by-product of “normal” procurement.

3.3 *Type of Innovation and Innovation Effects*

Conceiving innovative procurement (or public technology procurement) as the procurement of something that does not yet exist is problematic, in that by focusing on innovation *in what is procured*, it implicitly overlooks innovation effects beyond the initial purchase and is biased towards radical (new to the world) innovations, paying less attention to other categories of innovation. The idea of innovation as synonymous with complete novelty is rarely encountered in practice (Abernathy & Clark, 1985). Clearly, as Geroski (1990, p. 192) notes “using procurement policies to encourage firms to develop new capabilities does not imply that one ought to uncritically encourage them to generate something new”.

In fact Edquist *et al.* (2000) admit that some innovations from procurement are actually not “new to the world”. They differentiate between “developmental” and “adaptive” public technology procurement. Developmental procurement occurs where completely new products, processes or systems are created, while adaptive procurement is the procurement of goods and services not new to the world but new to the country of procurement (Edquist *et al.*, 2000, p. 21). In this case, the emphasis is on adaptation of the existing good or service to local circumstances. The literature mentions many examples of “developmental” innovations such as the US semiconductor industry, the development of the digital telephone switch in France and Italy and the cellular networks in the Nordic countries (see e.g. Edquist *et al.*, 2000). Although often highly visible, such cases probably constitute only a small proportion of all procured goods and services. An illustration that these cases are not widespread is provided by the study of Lember *et al.* (2008) of procurement in Baltic cities. The authors noted that most of the procurement-induced innovations found *did not* involve early-stage innovation of emerging technologies but were rather

adaptations or improvements of existing solutions, or even non-technological innovations. They did not detect any requirement for genuine research and development efforts in the examples studied. However, some incremental innovations resulting from sustained purchasing actually had substantial market impacts. A similar finding was reported by Yaslan (2009) in relation to public procurement of IT solutions in Turkey. His analysis of over 30 procurement projects found little evidence of radical innovations but reported instead a significant impact on further commercial applications (new markets) and organizational and process innovations.

Furthermore, the procurement of a new product or service, for instance a one-off product development, will not necessarily give rise to systemic effects. Conceiving innovative procurement in terms of the act of purchasing a new good or service is to take a static view rather than a dynamic one which takes into account the effects in the medium or longer term of introducing that new good or service in the market. In order to ensure a wider social benefit from a specific public procurement, the supplier firm must subsequently find buyers in the wider (public or) private market (Dalpé, 1994, p. 75). Where government is the end user of a procured technology, the innovation may have an impact on improved public services and on the technological capacities of the supplier firm(s) but may not find a market in the commercial sector. Further spillover effects of innovation on the private market would depend on the relationship between public and private demand. Cave and Frinking (2003) note that public sector demand (or needs) may be different than, complementary to, deeper than or anticipatory to private demand. However, there is a danger that firms in industries serving both public and private sectors will tend to specialize in one type of client or the other (Dalpé, 1994). Firms may decide to specialize in public markets to exploit acquired experience in public contracts when learning costs are significant, or they may simply find public sector clients more reliable than private ones. Public sector contracting may be such that firms with previous public contract experience are privileged, or where procurers opt to maintain regular suppliers in order to guarantee a satisfactory service and/or to avoid switching costs. This will reduce incentives to innovate and limit the exploitation of new markets and new applications.

It is clear then that procuring “goods and services that do not exist” is not always a necessary condition and is by no means a sufficient one to generate systemic impacts. For this reason, we should be cautious in dividing up procurement into two mutually exclusive categories of normal *vs.* innovative procurement. We argue in favour of a broader interpretation that recognizes that public procurement serves specific public needs and that innovation should be encouraged, where possible, as a “by-product” of the procurement process. Suggesting that public procurement should have as a primary objective the promotion of innovation is unrealistic. Furthermore, it could be counter-productive by sending signals to policy-makers engaged in normal procurement either that they cannot hope to have innovation impacts or conversely that they must inflexibly adopt an inappropriate and poorly articulated model of pre-commercial or technology procurement. Neither outcome is likely to stimulate innovation. There also remains the risk that the procurement of innovation may slip down the policy agenda as new and more urgent policy goals emerge.

The challenge instead, then, is to encourage practices that could favour innovative solutions, that is, to encourage more “innovation-friendly” procurement. Decisions should be made on a case-by-case basis depending on the good or service being procured,

the uses to which it will be put and other political and financial constraints and objectives. We should not be asking whether procurement influences innovation or not, but attempting to better understand the mechanisms by which impacts of public procurement on innovation may occur, so that they can be encouraged within an appropriate framework (Geroski, 1990).

3.4 Innovation Impacts—Different Routes

A range of possible impacts of public procurement are mentioned in the literature, from greater efficiencies in production, to incentives to innovation and capacity building, to demonstration effects of the utility of innovative goods or services in wider markets, to the creation of “lead markets”. Effects will occur at different points in time, involve specific risks, and be influenced by different circumstances. Sometimes effects may even cancel each other out.

As we have argued, procurement will influence innovation whether or not this is an explicit goal. Cave and Frinking (2003) differentiate between direct demand–pull impacts, where the intention is to procure innovative goods and services directly, and indirect demand–pull impacts, where innovation is a by-product of government procurement. Public procurement can influence innovation directly through the purchasing of innovative goods and services. The public sector may be willing to pay a premium cost or bear some efficiency losses if it wants to encourage certain policy goals and societal needs, such as sustainability, social inclusion, etc. (McCrudden, 2004; Edler & Georghiou, 2007). Government can be highly influential when it is itself the end user of the innovation (Dalpé *et al.*, 1992; Dalpé, 1994). The public sector can act as an “experimental user” in the sense of Malerba *et al.* (2007), where a cheaper, proven option does not meet its requirements, and may be willing to assume the risk inherent in the purchase of a new product, even if it is only at the prototype stage or earlier. A public procurer with the necessary technical competences could force innovation on the part of the supplier or even engage in co-invention, pushing suppliers to innovate in order to keep up with user requirements.

Cabral *et al.* (2006) identify three kinds of indirect influence of public procurement on innovation: by enlarging the market for new goods; by facilitating the adoption of new standards; and by changing the market structure so as to make it more conducive to innovation (dynamic effects). The UK Office of Fair Trading (2004) in turn identifies a series of impacts of procurement on competition and market structure. They divide these into short-term, long-term and knock-on effects on other markets.

Governments, via the purchasing power of the public sector, are in a position to be able to enlarge the market for certain goods, thus providing an incentive to invest in innovation. The public sector can provide a market and critical mass sufficient to encourage private R&D investment. However, the scale of public demand is only relevant if it can be made effective through the exercise of buyer power, for instance through consolidation of demand and co-ordinated action in cases where the public sector accounts for a large proportion of demand in a market (OFT, 2004).³ The scale of demand is particularly important in those industries characterized by heavy R&D requirements, substantial economies of scale in production, large generational leaps in technology, or high levels of uncertainty (Porter, 1990).

Through procurement, the public sector can also help to create standards or promote convergence to a single standard, thus encouraging diffusion. Economies of scale and

network externalities on the demand side create advantages for certain industries by allowing dynamic increasing returns. The presence of sufficient demand can allow economies of scale in production and use (via network externalities) to justify investment, particularly in information and communication technologies (ICT) areas. When purchasing innovative goods and services on a large scale, public administrations can have a significant effect on the outcome of the technology adoption process by their decision to choose a new technology or a particular version-standard of a new technology (Cabral *et al.*, 2006). So for instance, Fridlund (2000) details the development of the AXE switching system by the Swedish national telephone operator, and its importance in sustaining Ericsson's international competitiveness.

Procurement can also influence innovation indirectly by altering the structure of competition in the market in the short and medium term. In the short term, procurement can affect: the level of participation of firms in particular tenders; the homogeneity of those bidding; and the extent to which they are incentivized to engage in tacit collusion (OFT, 2004). Increased competition in the bidding process should arguably result in lower prices and greater quality. However, certain tender conditions may exclude *de facto* certain types of firms (e.g. SMEs), reducing the chances of innovation by excluding potential sources of innovation. Restrictions can thus have a variety reducing effect, limiting the number of competing solutions and reducing the chance of an innovative solution being selected. While increasing the number of bidders would tend to lead to more intense competition, in some cases, the high cost of evaluating bids, heavy asset specificity or long time scales may mean it is sensible to limit participation through the application of criteria such as reputation and proven ability to meet the requirements (OFT, 2004). The relative homogeneity or heterogeneity of bidders is also relevant: cost competition will be more intense the more similar the bidders are (and less intense the more dissimilar they are). Conversely, heterogeneity of bidders may lead to more intense competition on the basis of performance or quality characteristics (but higher risk and cost of procurement process).

Longer term effects of procurement are brought about by changes in market structure and market position and by changing the incentive structure for investment and innovation. Public procurement can ultimately influence the number of suppliers in the market (in some markets not winning public contracts may threaten the commercial viability of the firm); can increase the gap between market leaders and other suppliers; or can create incumbency advantages for public contractors in future tenders (for instance by changing the playing field for public sector contracts). Through bundling its requirements, the public sector can also affect the vertical organization of supply. Buying bundles of services across the value chain can provide advantages to vertically integrated suppliers, and can thus affect decisions of firms to integrate vertically (OFT, 2004).

The OFT (2004) identifies a further type of impact of procurement on competition, the "knock-on" effect or impact on other buyers' markets. Public procurement can have an impact on the market conditions of other buyers (the overall number and capacity of suppliers), the range of products and services available and the technologies used. For example, as a result of procurement, public sector suppliers may be in an advantageous position *vis-à-vis* other suppliers, pushing the latter out of the market. Furthermore, procurement can lead to the creation of products and services that are then widely available for the general public. By buying a new product or service, the public sector may help demonstrate the benefit to potential users (OGC, 2003). Thus, supplying to the public sector may grant firms reputational or learning benefits that can transfer to and create an advantage in other buyers' markets.⁴

The transfer effect (via reputation, learning, cost advantages, etc.) may even leap to outside markets, giving supplier firms a competitive advantage in foreign markets. This is in line with Porter's (1990) recommendation that procurement specifications should reflect international needs. Considerable attention has been given recently to the emergence of so-called "lead markets", understood as "as regional markets with specific attributes that increase the probability that a locally preferred innovation design becomes internationally successful as well" (Beise & Cleff, 2004, p. 455). The term constitutes an extension of the concept of "lead users" (Von Hippel, 1986) as well as a refinement of the concept of "demand advantage" in Porter's "diamond" of national competitive advantage. The advantage of lead markets for firms is that they can leverage local knowledge internationally (Beise & Cleff, 2004). Successful innovations in lead markets are considered to have a higher potential for becoming adopted world-wide than other designs being developed elsewhere.

The above impacts on procurement are largely considered in an aspatial analysis. However, procurement and innovation happen in space and the impacts of procurement will be felt at specific locations. For instance, mission-oriented defence procurement in the USA is considered to have influenced the development of high-tech clusters such as Silicon Valley. The geographical impact of procurement will depend on the spatial patterns of government procurement, on the mix of goods and services procured, on the degree of control over purchasing by local and regional authorities, and on the extent to which benefits can be retained within a particular locality or region through sub-contracting and knowledge spillovers. We will return to these impacts in the final discussion.

4. Towards a Product-based Typology of Public Procurement: Implications for Strategy, Innovation and Geography

The previous section explored the diverse routes through which procurement can influence innovation. However, these influences also depend on the mix of goods and services that are demanded and the strategies the public sector employs to shape the nature and composition of this mix. As Murmann and Frenken (2006, p. 947) point out, "successful innovation is in essence a coupling process focusing superior technological competencies in products and processes to meet the specific needs of users". In this spirit, we propose a new articulation which considers procurement from the point of view of what is actually procured. In the first part of the section, this differentiation is detailed, followed by an analysis of how this may impact innovation decisions in supplier firms.

The importance of focusing on products that reflect different needs stems partly from the recognition of the variety within a "public sector" which typically comprises many independent agents (OFT, 2004). Knight *et al.* (2003) rightly point out that "it is a sweeping statement to talk of one "public sector"; government and the wider public sector comprises a large array of departments, agencies, quasi-autonomous non-governmental organizations, and executive organizations with very variable characteristics and spend portfolios" (quoted in Caldwell *et al.* (2005)).⁵ The nature and complexity of procured products and services will vary greatly within and across public sector organizations, leading to different buying situations and different strategies to ensure the quality of public service provision. These decisions in turn send messages to supplier firms, influencing the demand environment and thus decisions shaping innovation.

Strategic decisions in the public sector as to what and how to procure will be determined by value for money considerations, the criticality of the procured goods and services to the core mission and the level of complexity/sophistication of the products and services. In this sense, public procurement decisions are not dissimilar to the purchasing decisions made by private firms and in fact “purchasing portfolio models” aimed at developing and implementing differentiated purchasing strategies also constitute “good practice” procurement in the public sector.⁶ The idea behind such methods is to minimize supply risk while taking advantage of buying power. The ultimate objective is to derive competitive advantage by better managing supplier relations, thus converting purchasing activities into a strategic business function (Gelderman & Weele, 2005).

The standard purchasing portfolio model developed by Kraljic (1983) classifies products on the basis of two key dimensions, profit impact and supply risk. Accordingly four categories of purchased items emerge: “bottleneck”, “non-critical”, “leverage” and “strategic”. Each of the categories would necessitate a differentiated strategy (Figure 1). The items in the bottleneck and strategic categories would generally be those goods and services which are of strategic importance for the company or the public administration due to their impact on business or policy. They are mission-critical and therefore entail a greater degree of risk. Bottleneck items require volume insurance, vendor control, security of inventories and backup plans to reduce supply risk. In the case of strategic items, further analysis is recommended of the buying strengths against the strengths of the supply market, and three different supplier strategies are identified in relation to the different power positions: “diversify”, “balance” or “exploit”⁷ (Kraljic, 1983). In turn, non-critical items require efficient processing, product standardization, order volume and inventory optimization, while leverage items allow the buying company to exploit its full purchasing power, for instance through tendering, target pricing and product substitution.

Gelderman and Van Weele (2002) suggest that it is important not only to understand which procedure to follow in each category, but also to consider how best to move to a strategically more attractive (that is less risky or more profitable) position in the matrix. For instance, such an analysis should help purchasing practitioners to move commodities and suppliers around specific segments so that dependence on specific suppliers is reduced. Analysing the strategy followed by a particular company, they point to a number of options used to move around the different portfolio segments. These strategies

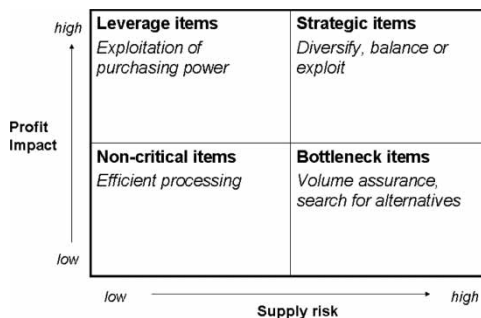


Figure 1. Kraljic’s purchasing portfolio model
 Source: Elaborated from Kraljic (1983).

mainly involve standardization and pooling of resources, reduction of over-specification (“decomplexing”), the use of strategic partnerships with suppliers and supplier development in order to enhance capabilities.

Certainly the challenges faced by procuring firms will differ from those faced by public procurers. Public procurement needs to conform with a particular legal and regulatory framework with its own requirements for transparency and non-discrimination. Public procurement entails political as well as other kinds of risk and incentive structures that clearly differ from the private sector. All this can translate into a greater aversion to risk in procurement. Furthermore, as already noted, public sector procurement frequently seeks to address additional strategic—that is policy—objectives such as regeneration, welfare, sustainability, and now innovation (OFT, 2004; Wang & Bunn, 2004). Nonetheless, strategic decisions are also made in the public sector to reduce risk and allow cost-savings. These entail pooling or aggregating requirements, standardization, specification setting and supplier management. Procurers may decide to pool resources to provide bigger contracts. Alternatively, they may decide to harmonize and standardize requirements. They may aggregate demand to exploit purchasing power. They may open or restrict competition through tendering procedures. They may engage with suppliers and the supplier market through consultation or competitive dialogue.⁸

4.1 Different Opportunities for Innovation on the Firm Side

Different buying strategies in the public sector will in turn influence the demand environment firms are confronted with, particularly those for whom the public sector is a significant customer. According to Storper (1997, p. 108), the demand architecture “defines a collective action problem for innovators, associated with each particular type of product”. The producer needs to assess whether the market will be sufficient to justify the investment and whether the firm can master the capabilities, knowledge and skills to address that demand. Firms are therefore constrained to innovate by internal factors and by the size and quality of the demand.

Following Knight’s (1921) elaboration of the nature of risk and uncertainty, Storper (1997) distinguishes two principal dimensions of products: whether they are specialized or standardized, on the one hand, and whether they are generic or dedicated, on the other. The first dimension refers to whether the supply of inputs, e.g. the technology, information and skills, etc. necessary for production come from a “community of specialists” or whether their supply is relatively easy to expand. The second dimension refers to the degree of uniformity of the client’s needs: whereas generic products correspond to undifferentiated markets, dedicated products are made for more heterogeneous markets, namely “clients whose demands have precision and personality” (Storper, 1997, p. 109).

These different types present different risk and uncertainty situations. Generic products are associated with more predictable markets that enable firms to plan their investments and allocation of resources, and therefore appeal to a larger number of potential buyers. Dedicated products are oriented towards the needs of a particular customer or type of customer, and are thus associated with greater market uncertainty. Standardization, in turn, is associated with higher predictability of outcome, learning and scale economies arising from simplification and routinization. However, economies of scale may be limited by greater demand for variety which is perceived as greater quality, for which customers

may be willing to pay a premium price (Langlois, 2001). These “economies of variety” associated with more specialized products, however, are associated with a greater need for information about customers’ requirements and technologies, and with greater uncertainty of future profits (Guerzoni, 2007).

4.2 Different Types of Procurement

Public procurers can influence the degree to which demand is more dedicated or generic, more or less standardized or specialized. Some goods and services, particularly relatively commoditized items (such as stationery) are amenable to standardization as they satisfy common needs/preferences of a large number of purchasing units/end users with very little need for variety (Dimitri *et al.*, 2006). However, in other circumstances the public sector may demand new or more complex requirements. It can impose greater quality standards and/or allow for greater variety in technical solutions by altering specifications.

Public procurers can also influence the extent to which products and services are generic or dedicated. The latter class includes those goods and services that are provided to suit characteristics or needs that are specific to the local unit. In the case of some public services, dedicated solutions may be driven by the public demanding more personalized services which are tailored to their specific needs. Different authorities, agencies or departments may seek differentiation and hence demand more tailored solutions. Heterogeneity can also be due to specific local technical characteristics (for instance the special problems of maintaining certain public buildings) or geographical variation in the provision of certain proximity-based services (e.g. waste collection). In contrast, in demanding generic solutions, different public sector bodies can choose to pool or aggregate their requirements. Aggregation should allow greater leverage for contracting with suppliers, achieving greater economies of scale.

Building on Kraljic’s model and Storper’s product differentiation, we can formulate a fourfold typology of public procurement (Figure 2): procurement of standardized products serving a generic market (efficient procurement); addressing specific demand niches but employing known production methods and practices (adapted procurement); encouraging new technical solutions to meet a generic need (technological procurement); and adapted technical solutions (experimental procurement). Procurers are also able to move from one segment to another in order to reduce risks for both procurers and suppliers, maximize purchasing power, and minimize cost, through the use of procurement tools as described above. The main challenge is to understand the trade-offs involved in each category and to have a strategy for moving from one segment to another.

Different buying situations will in turn require different types of buyer–supplier relationships. As in the private sector, these will depend on the nature of procured items and associated risks. Wang and Bunn (2004) identify four types of government–business relationships in government contract implementation, depending on the length of contracts, product complexity and uncertainty about results. In collaborative relationships, both parties frequently exchange information, openly and intensely, share cooperative norms and work together to achieve contract objectives. Collaborative relationships could involve co-invention and are particularly important in the case of high product complexity and high results uncertainty, as in “experimental procurement”. Recurrent relationships also involve repeated exchanges between buyers and sellers, although the flow of information shared and frequency of information exchange are low. Recurrent

	Specialised production process	Standardised production process
Dedicated market	Experimental procurement (e.g. specialised technical equipment)	Adapted procurement (e.g. customised software, social services)
Generic market	Technological procurement (e.g. waste management, transport)	Efficient procurement (e.g. office supplies)

Figure 2. A four-fold typology of procurement

relations are important in those cases where low product complexity and low results uncertainty are coupled with lengthy contracts (that mainly characterizes “adapted” procurement). In supervisory relationships, procurers believe that suppliers hold full responsibility for the success of the contract. In these cases, government has a supervisory role and suppliers enjoy more freedom in choosing suitable models and techniques. Finally, in arm’s-length relationships, both government procurers and business sellers view the relationship as a market or transactional interaction. These are the most likely relationships in the case of low levels of product complexity and results uncertainty coupled with short contract lengths. Arm’s-length contracting such as e-procurement would be adequate for “efficient” procurement. In this case, it is important to ensure sufficient transparency of information about contract opportunities to ensure competition and guarantee the best bidders.

4.3 Opportunities for Innovation

Combining these various dimensions (standardized-specialized; generic-dedicated) yields different scenarios for action depending on whether one is a user or a producer, and different opportunities to innovate. Faced with these dimensions, Storper once more turns to Knight (1921), who identified two fundamental methods of dealing with uncertainty, risk reduction by grouping production (*consolidation*) on the one hand and risk reduction “by the selection of men to bear it” (*specialization*) on the other. In the case of dedicated products, consolidation (producing a high variety of dedicated products, generating economies of scale) requires the need to follow markets closely, a situation that Storper dubs the “market world”.⁹ Producers may alternatively opt to specialize to increase the personality or quality of their products to adapt it to the particular demands to which the product is targeted. In this “interpersonal world”, an important role is played by user–producer interactions, and a high degree of sophistication by users willing to pay a premium for the additional quality. For generic products, firms can opt to consolidate provided products are generated at high scale in order to offset large irreversible investments (for Storper, the “industrial world”). Alternatively, firms may seek to specialize, investing in the application of scientific or engineering knowledge (the “intellectual world”).

The types of possible innovations are also different in each combination of market/production system dimensions. These resemble Abernathy and Clark’s (1985) typology of

innovation, based on variation in markets/customer linkages and changes in competences of technology or systems of production. Architectural innovations consist of adapting and applying latent technologies to previously unarticulated user needs and may be a common feature in “technological” procurement.¹⁰ Market niche innovations build on established technical competence but seek to apply it in emerging market segments and would be more characteristic of “adapted” procurement. Successful niche creation innovation would require the matching of customer needs with refinements in technology. Regular innovation implies more cumulative effects on product cost and performance and builds on established technical and production competence applied to existing markets and customers. The effect of these changes is to entrench existing skills and resources. Finally, revolutionary (radical) innovation disrupts and renders established technical and production competence obsolete. Process and radical innovation would be likely scenarios of “efficient” and “experimental” procurement, respectively.

4.4 Geographical Implications

The elaboration so far would suggest that different opportunities for innovation derive from different combinations of market and production conditions associated with different products being procured. Reflecting on this, we note that different government demand conditions can influence innovation in a variety of ways, and that resulting innovations take many forms (radical, incremental, architectural, product, process, etc), at different stages of product technology, and not just at early stages. They can also encourage a shift from one form of innovation to another and even kick-start a process of reversal or renewal of industry development or “dematurity”. Clearly, this influence will also be a product of the above-mentioned purchasing power of the public sector.

Our product-based typology of procurement also has clear spatial implications in terms of the level/scale at which procurement and specification definition take place. Public procurement involves the interaction of multiple and overlapping networks of actors and agencies at different scales and as such is a good example of “multi-level governance” (Bache & Flinders, 2004). This complex and multi-level procurement landscape creates the potential for coordination problems and tensions between policy goals at different spatial scales. The spatial pattern of public spending at different levels of governance will have an effect on where the innovation (and other) impacts of procurement are felt. In the case of regional procurement, the impact would be greater where regional authorities have both significant control over purchasing decisions and the ability to retain benefits within the region. There is a common tendency to privilege local suppliers in the hope that this will create jobs and economic benefit for the local economy. In innovation terms, such favouring of local and regional contractors could be counterproductive in two ways: first, it can exclude innovative solutions that may be available elsewhere. A more innovative solution will bring benefits in terms of value for money, improved public services and indirect value to the region in terms of the technological upgrade of a location. Edler and Georghiou (2007) report the case of the procurement of new, advanced lightning systems for the municipality of Hamburg in Germany, where the decision to purchase these systems overseas caused strong opposition by the public but eventually resulted in significant benefits both to the public service and for the local economy. The second, and related, oversight is

that leakages and spillovers, which can be more significant in terms of innovation impacts than local direct contracting, can be secured through indirect means, such as sub-contracting practices in the region, licensing, and purchasing of complementary products and services such as maintenance services.

Local procurement following local specifications could provide a fragmented market to firms, which would be particularly detrimental to innovation in those instances where new technical solutions are required for a relatively generic type of demand. This is the case of the architectural innovations mentioned above. For standard and generic products, however, even if procurement is done locally but following national specifications, it should appeal to a large number of potential buyers at any given moment as standardization allows producers to estimate fluctuations of the market and thus plan their investments and allocation of resources. But for the procurer, local procurement would imply unnecessary invoicing, bigger transaction costs for both buyer and supplier and diminishing opportunities on the part of the procurer to benefit from larger purchasing power, particularly if suppliers have a dominant position. Local/regional specifications are needed when addressing a particular need. National procurement might be appropriate when dealing with a specialist supplier market to ensure the best suppliers bid for the contracts, although volume insurance may be needed to ensure incentives for innovation. A national strategy may, however, reduce diversity of research paths and increase the distance between technology leaders and followers (Cabral *et al.*, 2006), so it should be combined with decentralized procurement that can allow better adaptation, and the ability to exploit local innovations for which there may not be information at the centre. When a large number of suppliers are available to provide the service, are not easily aggregated or require close interaction with final users, regional or local procurement for local needs would be appropriate.

4.5 *Summary of Potential Scenarios*

Table 1 below summarizes the various implications of our typology in terms of innovation, type of product, dominant user–supplier interaction, procurement practices and barriers, and the spatial organization of procurement. Different types of public procurement respond to different demand-side effects on the part of the government and influence the type of innovation opportunities firms are confronted with. Besides presenting different implications in terms of dominant buyer–supplier relations, geographical organization and innovation in the short term, in dynamic terms each type entails different risks for suppliers and competition in the medium term. For instance, technological procurement may in the medium term have detrimental effects on competition by reducing the number of suppliers and generating incumbent advantages. Experimental procurement may generate innovation in the short term but if the characteristics of the procured product or service are too idiosyncratic, this may hamper commercial opportunities in other markets.¹¹

So far our concern has been on the impact of procurement of innovation. However, public procurement is a multi-objective policy which also aims to further other economic and societal goals such as social inclusion, sustainability, regeneration, employment generation, support for SMEs, etc. (McCrudden, 2004). An implication of our framework is that it is unrealistic to pursue all these goals to the same extent through all procurement types. For instance, the pursuit of innovation may be at odds with employ-

Table 1. Summary table

<i>Procurement type</i>	Adapted procurement	Technological procurement	Experimental procurement	Efficient procurement
<i>Role of the public sector</i>	Niche user	Large/sophisticated costumer	Experimental/lead user	Cost-driven customer
<i>Dominant motivation of procurement/award criteria</i>	Adaptation/customization to specific needs <i>The best/better adapted solution</i>	Fitness for use, value for money <i>The best available/most efficient solution</i>	Functional product performance <i>The most innovative solution</i>	Price, volume <i>The cheapest solution</i>
<i>Product</i>	Diverse designs, customized	At least one product design	Emerging design, prototype, pilot	Mostly undifferentiated, standard products
<i>Innovation type</i>	Market niche	Architectural	Radical	Regular
<i>User–producer interaction</i>	Recurrent	Supervisory	Partnership	Arm’s length
<i>Procurement practices potentially driving innovation</i>	Competition Outcome specifications Aggregation of supply (consortia)	Dialogue with suppliers/capacity planning/aggregation of demand	Outcome specifications Dialogue with suppliers Prestige, transfer effects to other markets	Price/output specifications Aggregation of demand
<i>Innovation-related risks on the supply side</i>	Market uncertainty Fragmented supply	Insufficient/unreliable demand to justify investment	Market uncertainty Poor user–producer communication Insufficient incentives (e.g. IP protection)	Obsolescence Overdependence on public markets
<i>Procurement practices posing barriers to innovation</i>	Emphasis on cost Restricting competition	Dependency on a reduced number of powerful suppliers Incumbents advantage	Narrow specifications	Overdependency of suppliers in stagnant markets/ lack of competition
<i>Geography of procurement</i>	Regional specifications, regional procurement	Centralized specifications, national procurement	Regional specifications, national procurement	Centralized specifications (standard)

ment goals, and support for SMEs may be at odds with sustainability and with innovation objectives if innovation opportunities can only be achieved by large, oligopolistic firms. Efficiency goals may be at odds with allowing SMEs to access procurement contracts (Loader, 2007).

5. Conclusions

Public procurement is increasingly seen as an attractive and feasible instrument for the implementation of innovation policy. However, current debates exhibit a number of weaknesses that limit the extent to which meaningful policy guidance can be drawn. They downplay: the varied nature of public procurement and the wide range of types of goods and services procured by the public sector; the varied nature of innovation; and the multiple potential innovation effects of public procurement. They pay too much attention to a limited set of examples which are not representative of the bulk of public procurement. The innovative procurement (or public technology procurement) model proposed in the literature is unlikely to work in all procurement contexts and for all types of procured good and service yet all public procurement potentially impacts upon innovation by shaping the demand environment in which firms innovate and compete. In this paper, we have proposed a framework within which to better understand the possibilities and limits of government action with regard to the promotion of innovation through public procurement, to better understand procurer-supplier dynamics in a variety of demand contexts, and to better understand the geographical implications.

Based on this framework, we conclude that there are risks in elevating innovation goals above (or even to co-equality with) the proximate goals of public procurement. The framework may be useful for practitioners inasmuch as it gives some indication of how different types of public procurement and different types of public procurer are able to address different combinations of policy goals to different extents. But public purchasing should first and foremost be concerned with ensuring the quality of government services and the use of the products and services for the public sector, recognizing that a focus on the core missions behind public procurement need not reduce the overall potential for positive impacts upon innovation. While some special cases of public procurement can be considered as directly furthering the objectives of innovation policy (for instance through the application of functional or demanding specifications), simply co-opting public procurement into the industrial or innovation policy portfolio could be counterproductive, in that it will send mixed messages to both public procurers and suppliers. Instead we should be encouraging “innovation friendly” public procurement. Policy for public procurement should aim to put in place the necessary incentives but also the necessary skills and capacity to allow public purchasers to make strategic decisions on a case-by-case basis that will also stimulate (or at least not hamper) innovation. Structures and incentives should enable coordination and cooperation within and across government departments and levels of governance, where appropriate. They should also promote active and joined-up thinking about how best to trade-off conflicting policy goals. The governance challenges of moving towards an approach which recognizes the potential importance of indirect innovation impacts are significant. Even more profound are the challenges to policy learning and evaluation stemming from the need to monitor, assess and attribute innovation impacts to public action.

These conclusions signal that in order to understand procurement and innovation, an integrated research framework is needed comprising insights from supply chain management, procurement and project management, innovation dynamics and user–producer interaction. A useful first step would be populating and testing the framework and typology proposed in this paper with detailed case studies.

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Notes

1. Howells (1997) reiterates the idea that the conceptualization around the market-pull vs. technology-push dilemma is flawed and differentiates between the concepts of “use”, “need” and “intended use” to better understand the technology-market matching process.
2. Debates within the public procurement world are often focused on innovation *in* procurement, that is change or innovation in the procurement process itself. Indeed, innovation in procurement processes may be an essential precursor to the active use of public procurement to stimulate innovation in suppliers and the wider economy. However, there exists the potential for terminological confusion between “innovative procurement” and “innovation in procurement” between the innovation policy and the public procurement discourses.
3. A point also noted by Edquist *et al.* (2000) who acknowledge that for effective technology procurement to take place a high concentration of buying power and a comprehensive “articulation of demand” may be necessary.
4. Levinson (2006) argues that the early adoption of containerized shipping by the US military to solve logistics problems associated with the war in Vietnam created both a powerful demonstrator effect and provided an opportunity for entrepreneurs to kick-start the importing of Japanese consumer products into the American market by filling up the empty containers returning across the Pacific to the USA.
5. Insofar as there is a trend here, it is towards increased variety as the various manifestations of decentralization and the “New Public Management” continue to make themselves felt.
6. The purchasing portfolio approach is allegedly widely used by major companies. Despite its popularity, there are few studies providing evidence on their actual use (for a review and critique of purchasing portfolio approaches, see Gelderman and Weele (2005)). There is also little evidence on the use of this technique by public procurers, despite such supply portfolio or positioning matrices being a frequent component of public procurement strategies at national and local authority level in the UK.
7. For items where the company plays a dominant market role vis-a-vis the supplier, the company should “exploit” this advantage. If the supplier’s strength outweighs the company’s, the company should look for material substitutes or new suppliers (“diversify”). For items with neither major visible risks nor benefits, the company should pursue a “balance” intermediary strategy (Kraljic, 1983).
8. Article 29 of the EC 2004 Public Sector Procurement Directive introduced the concept of competitive dialogue, which allows better information flow in designing complex public contracts, and an opportunity for bidders to develop alternative proposals in response to a client’s outline requirements.
9. Storper’s (1997, p. 112) use of the term world of production is meant to “convey the interlinkage of people, organizations, objects, and ideas” associated with each product.
10. Abernathy and Clark provide the example of the Ford model T, which was a creative synthesis of diverse design concepts with the integration of new electrical technology and engine design. The success of the car was assisted by its durable design together with its sufficiently low cost to permit the development of a mass market.
11. This would also be the case if incentives related to intellectual property are mismanaged.

References

- Abernathy, W. J. & Clark, K. B. (1985) Innovation: Mapping the winds of creative destruction, *Research Policy*, 14(1), pp. 3–22.
- Adner, R. & Levinthal, D. (2001) Demand heterogeneity and technology evolution: Implications for product and process innovation, *Management Science*, 47(5), pp. 611–628.
- Aho, E., Cornu, J., Georgioui, L. & Subira, A. (2006) *Creating an Innovative Europe.*, Report of the Independent Expert Group on R&D and Innovation, Luxemburg: Office for Official Publications of the European Communities.

- Aschhoff, B. & Sofka, W. (2008) Innovation on Demand—Can Public Procurement Drive Market Success of Innovations? Working paper, Centre for European Economic Research (ZEW), Mannheim, Germany.
- Bache, I. & Flinders, M. (Eds) (2004) *Multi-Level Governance* (Oxford: Oxford University Press).
- Beise, M. & Cleff, T. (2004) Assessing the lead market potential of countries for innovation projects, *Journal of International Management*, 10(4), pp. 453–477.
- Bresnahan, T. & Greenstein, S. (2001) The economic contribution of information technology: Towards comparative and user studies, *Journal of Evolutionary Economics*, 11(1), pp. 95–118.
- Cabral, L., Cozzi, G., Denicolo, V., Spagnolo, G. & Zanza, M. (2006) Procuring innovations, in: N. Dimitri, G. Piga & G. Spagnolo (Eds) *Handbook of Procurement*, pp. 483–530 (Cambridge, MA: Cambridge University Press).
- Caldwell, N., Walker, H., Harland, C., Knight, L., Zheng, J. & Wakeley, T. (2005) Promoting competitive markets: The role of public procurement, *Journal of Purchasing and Supply Management*, 11(5–6), pp. 242–251.
- Cave, J. & Frinking, E. (2003) Public procurement for R&D. Available at http://www2.warwick.ac.uk/fac/soc/economics/staff/faculty/cave/publications/pp_for_rd.pdf (accessed 19 October 2009).
- Dalpé, R. (1994) Effects of government procurement on industrial innovation, *Technology in Society*, 16(1), pp. 65–83.
- Dalpé, R., Debrsson, C. & Xiaoping, H. (1992) The public sector as first user of innovations, *Research Policy*, 21(3), pp. 251–263.
- Dimitri, N., Dini, F. & Piga, G. (2006) When should procurement be centralized? in: N. Dimitri, G. Piga & G. Spagnolo (Eds) *Handbook of Procurement*, pp. 193–220 (Cambridge, MA: Cambridge University Press).
- DIUS (2008) White paper “Innovation Nation”, March 13 2008.
- Edler, J. & Georghiou, L. (2007) Public procurement and innovation—resurrecting the demand side, *Research Policy*, 36(7), pp. 949–963.
- Edler, J., Ruhland, S., Hafner, S., Rigby, J., Georghiou, L., Hommen, L., Rolfstam, M., Edquist, C., Tsiouri, L. & Papadakou, M. (2005) *Innovation and Public Procurement. Review of Issues at Stake*, Final Report. Available at ftp://ftp.cordis.lu/pub/innovation-policy/studies/full_study.pdf (19 October 2009).
- Edquist, C., Hommen, L. & Tsiouri, L. (2000) *Public Technology Procurement and Innovation* (Norwell, MA: Kluwer Academic Publishers).
- European Commission (2005) *Public Procurement Driving Research and Innovation* (Luxemburg: Office for Official Publications of the European Communities).
- European Commission (2007) *A Lead Market Initiative for Europe*, COM (2007) 860 21.12.2007 (Brussels: European Commission).
- Flanagan, K., Uyarra, E. & Laranja, M. (2008) Opening the Policy Black Box: Understanding the Policy Mix for Innovation in Multi-level, Multi-actor Spaces. Paper presented at PRIME/Globelics Conference, Mexico, September, 2008.
- Fridlund, M. (2000) Switching relations and trajectories: The development procurement of the AXE Swedish switching technology, in: C. Edquist *et al.* (Eds) *Public Technology Procurement and Innovation*, pp. 99–120 (Norwell, MA: Kluwer Academic Publishers).
- Gelderman, C. J. & van Weele, A. J. (2002) Strategic direction through purchasing portfolio management: A case study, *International Journal of Supply Chain Management*, 38(2), pp. 30–37.
- Gelderman, C. J. & Weele, A. J. (2005) Purchasing portfolio models: A critique and update, *The Journal of Supply Chain Management*, 41(3), pp. 19–28.
- Geroski, P. A. (1990) Procurement policy as a tool of industrial policy, *International Review of Applied Economics*, 4(2), pp. 182–198.
- Guerzoni, M. (2007) The Impact of Market Size and Users’ Sophistication on Innovation: The Patterns of Demand, Paper presented at the DRUID Summer Conference, Denmark, June, 2007.
- HM Treasury (2004) *Releasing Resources for the Frontline: Independent Review of Public Sector Efficiency* (Gershon’s review), July 12.
- HM Treasury (2007) *Sainsbury Review of Science and Innovation. The Race to the Top*, October 5.
- Hommen, L. & Rolfstam, M. (2009) Public procurement and innovation: Towards a taxonomy, *Journal of Public Procurement*, 9(1), pp. 17–56.
- Howells, J. (1997) Rethinking the market-technology relationship for innovation, *Research Policy*, 25(8), pp. 1209–1219.

- Kamien, M. I. M. & Schwartz, N. L. N. (1975) Market structure and innovation: A survey, *Journal of Economic Literature*, 13(1), pp. 1–37.
- Katz, M. L. & Shapiro, C. (1985) Network externalities, competition, and compatibility, *The American Economic Review*, 75(3), pp. 424–440.
- Klepper, S. (1997) Industry life cycles, *Industrial and Corporate Change*, 6(1), pp. 145–182.
- Klepper, S. & Thompson, P. (2006) Submarkets and the evolution of market structure, *The RAND Journal of Economics*, 37(4), pp. 861–886.
- Knight, F. (1921) *Risk, Uncertainty and Profit* (New York: Augustus Kelley).
- Kraljic, P. (1983) Purchasing must become supply management, *Harvard Business Review*, 61(5), pp. 109–117.
- Langlois, R. R. (2001) Knowledge, consumption, and endogenous growth, *Journal of Evolutionary Economics*, 11(1), pp. 77–94.
- Lember, V., Kalvet, T. & Kattel, R. (2008) *Urban Competitiveness and Public Procurement for Innovation* (Tallinn: Mimeo, Institute of Humanities and Social Sciences, Tallinn University).
- Levinson, M. (2006) *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* (Princeton: Princeton University Press).
- Loader, K. (2007) The challenge of competitive procurement: Value for money versus small business support, *Public Money & Management*, 27(5), pp. 307–314.
- Lundvall, B. A. (1993) User–producer relationships, national systems of innovation and internationalisation, in: D. Foray & C. Freeman (Eds). *Technology and the Wealth of the Nations—The Dynamics of Constructed Advantage*, pp. 349–369 (London: Pinter Publishers)
- Malerba, F. (2007) Innovation and the dynamics and evolution of industries: Progress and challenges, *International Journal of Industrial Organization*, 25(4), pp. 675–699.
- Malerba, F., Nelson, R., Orsenigo, L. & Winter, S. (2007) Demand, innovation, and the dynamics of market structure: The role of experimental users and diverse preferences, *Journal of Evolutionary Economics*, 17(4), pp. 371–399.
- McCrudden, C. (2004) Using public procurement to achieve social outcomes, *Natural Resources Forum*, 28(4), pp. 257–267.
- Mowery, D. & Rosenberg, N. (1979) The influence of market demand upon innovation: A critical review of some recent empirical studies, *Research Policy*, 8(2), pp. 102–153.
- Murmann, J. P. & Frenken, K. (2006) Toward a systematic framework for research on dominant designs, technological innovations, and industrial change, *Research Policy*, 35(7), pp. 925–952.
- OFT (2004) *Assessing Impact of Public Sector Procurement on Competition* (London: Office of Fair Trading).
- OGC (2003) *Report to the Chancellor of the Exchequer: Increasing Competition and Improving Long-term Capacity Planning in the Government Market Place* (London: Office of Government Commerce).
- Porter, M. E. (1990) *The Competitive Advantage of Nations* (New York: Free Press).
- Rothwell, R. (1984) Creating a regional innovation-oriented infrastructure: The role of public procurement, *Annals of Public and Cooperative Economics*, 55(2), pp. 159–172.
- Rothwell, R. & Zegveld, W. (1981) Government regulations and innovation—industrial innovation and public policy, London, in: R. Rothwell & W. Zegveld (Eds) *Industrial Innovation and Public Policy* (London: Frances Pinter Publishers).
- Schmookler, J. (1966) *Invention and Economic Growth* (Cambridge: Harvard University Press).
- Storper, M. (1997) *The Regional World: Territorial Development in a Global Economy* (New York: Guilford).
- Sutton, J. (1998) *Technology and Market Structure: Theory and History* (Cambridge, MA: The MIT Press).
- Utterback, J. M. (1994) *Mastering the Dynamics of Innovation* (Cambridge, MA: Harvard Business School Press).
- Von Hippel, E. (1986) Lead users: A source of novel product concepts, *Management Science*, 32(7), pp. 791–805.
- Wang, S. & Bunn, M. (2004) Government/business relationships: Insights into contract implementation, *Journal of Public Procurement*, 4(1), pp. 84–114.
- Windrum, P. & Birchenhall, C. (1998) Is product life cycle theory a special case? Dominant designs and the emergence of market niches through coevolutionary-learning, *Structural Change and Economic Dynamics*, 9(1), pp. 109–134.
- Yaslan, B. (2009) Public software procurement and its impacts on the technological capability and the competitive advantage of the software industry, Unpublished PhD thesis Manchester Business School, University of Manchester.

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