Geographical differences in intellectual property strategies and outcomes: establishment-level analysis across the American settlement hierarchy

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ABSTRACT
The wealth of utility patent data has made this form of intellectual property (IP) protection the primary focus of the economics and geography of innovation. However, in addition to utility patents, the IP expressed in a firm’s products or processes may also be protected via design patents, trademarks, copyright, or in non-compete and non-disclosure agreements. Recent research suggests that mixed modes of technological and non-technological innovation are associated with the most rapid firm growth and, thus, mixed-mode IP strategies may provide important insight for understanding the geography of innovation. If non-technological IP is an important complement to technological IP, then analyses focusing solely on the impacts of patents are misspecified. In addition, if the capability for pursuing these various tactics differs across the settlement hierarchy, then our understanding of the geography of IP is similarly distorted by the singular focus on patents. The objectives of this study are to examine how these tactics of protection are combined into IP strategies, how these strategies vary over the settlement hierarchy, how the different strategies are associated with different economic outcomes, and how these different strategic orientations may differentiate entrepreneurial ecosystems across space.

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INTRODUCTION
The wealth of utility patent data has made this form of intellectual property (IP) protection the primary focus of the economics and geography of innovation (Carlino & Kerr, 2014; Carlino, Chatterjee, & Hunt, 2007; Furman, Porter, & Stern, 2002; Jaffe, Trajtenberg, & Henderson, 1993; Thompson & Fox-Kean, 2005; Usai, 2011). However, from a management perspective it is clear that utility patents are essentially just one tactic of more encompassing IP strategies that firms pursue (Howells, Blind, Elder, & Evangelista, 2003). In addition to utility patents, the IP expressed in a firm’s products or processes may also be protected via design patents,
trademarks, copyright, or in non-compete and non-disclosure agreements (NDAs). Unfortunately, the literature on the strategic combination of IP tactics is very thin (Amara, Landry, & Traoré, 2008; Guo-Fitoussi, Bounfour, & Rekik, 2019; Munari & Santoni, 2010). Not surprisingly, differences in IP strategies across the settlement hierarchy have never been examined, as far as we know. The objectives of this study are to examine how these tactics of protection are combined into IP strategies, how these strategies vary over the settlement hierarchy, how the different strategies are associated with different economic outcomes, and how these different strategic orientations may differentiate entrepreneurial ecosystems across space.

The 2014 Rural Establishment Innovation Survey (REIS), a nationally representative data set of establishments in tradable non-farm industries with five or more employees, with roughly 11,000 observations in both rural and urban areas, provides a unique resource for examining IP strategies because the data set contains reliable information on the innovation orientation of respondents (Wojan, 2016; Wojan & Nichols, 2018; Wojan & Parker, 2017; Wojan, Crown, & Rupasingha, 2018). Merely comparing sparse IP strategies with more comprehensive strategies might provide few insights if the capacities for and commitment to applying new knowledge are unknown. For example, more sparse use of IP protections in rural areas might indicate either lower levels of innovation or less vulnerability to misappropriation. Conditioning the IP strategies on innovation orientation reduces this ambiguity.

Examining different IP strategies within a framework that accounts for innovation orientation also allows one to examine the association of various strategies to innovation intensity. If there are substantial differences across strategies, then it may be possible to derive more reliable proxies of innovation from secondary data on IP use. The US Patent and Trademark Office (USPTO) provides comprehensive, establishment-level data on utility patents, design patents and registered trademarks through its PatentView portal. Identifying IP strategies that are strongly associated with innovation will provide an innovation indicator with coverage across space that does not require collection of very large, self-reported innovation surveys.

THE NEED TO EXPAND THE GEOGRAPHY OF INTELLECTUAL PROPERTY AND INNOVATION BEYOND UTILITY PATENTS

The linear model of innovation has guided much innovation policy and innovation research over the past 75 years, which sees innovation as a process of scientific and engineering discovery brought to the market by entrepreneurial skills (Godin, 2006). This model aims the substantive, if not exclusive, IP focus on utility patents (Jasanoff, 2009). Utility patents that protect unique scientific or engineering knowledge from misappropriation are thought of as the principal incentive for, and output of, innovative activities. The linear progression from scientific exploration, to engineering applications, leading to eventual commercialization has been challenged as a caricature of the complex, iterative process characterizing most innovation (Greenhalgh & Rogers, 2010). Noting substantial interaction between research and ‘market finding’, design, testing, production, and distribution, the chain-linked model of innovation provides a more realistic depiction of the innovation process (Kline, 1985). Studies on the feedback from suppliers or customers (Song & Thieme, 2009; Urban & von Hippel, 1988), firm internal linkages between production and R&D (Tecu, 2013), and serendipitous exaptations (Andriani & Cattani, 2016) point to critical inputs to both incremental and radical innovation that fall outside the narrow pathway envisioned in the linear model. And yet, the durability of the linear model owes to its simplicity in establishing science and engineering as the essential inputs to innovation – a role that is not contested by these alternative explanations even if the pathway to a final innovation is (Godin, 2006). With models of innovation based on scientism (Phelps, 2013; Williams, 2015), the functional benefits of an invention are seen as the main contributors to the innovations that consumers value in markets. Non-technological innovation and non-technological IP may play some role
in the innovative process required to bring an invention to market, but the very limited research to date reveals a common belief that these roles are minor.

However, in moving from a conception of economic man as strictly a rational actor to one with dimensions as a social or behavioural actor, the functional attributes of a product may no longer be the main ones that matter. Tim Brown (Brown, 2009), director at the IDEO design consultancy, defines design as a mediation between people and technology. While there is no such thing as an undesigned product, there are products that are designed well and products that are design poorly. The large increases in market capitalization of companies that put design at the centre of their corporate strategy such as Apple or Nike may indicate that protected designs can also be a source of monopoly rents. Tesla, in an effort to accelerate worldwide production of electric vehicles, pledged to open source its utility patents for ‘good faith’ uses that do not imitate the design or appearance of a Tesla product, seemingly turning the tradition technological/non-technological valuation proposition on its head (Rimmer, 2018).

Trademarks provide the incentive to burnish a company’s reputation for quality, reliability, durability and hosts of other unobservable or difficult to observe product attributes. Trademarks have value for consumers in reducing the amount of information needed to make purchasing decisions. In contrast to utility patents, neither design patents nor trademarks have to pass high bars of non-obviousness and uniqueness. They are much less costly to acquire. With a much lower bar it is likely that a large number of design patents and trademarks with little value are granted. However, in combination with other business actions or strategies, such non-technological IP may be critically important for understanding the effect of innovation on business growth.

The limited quantitative research of the association between design and innovation to date is unequivocal: firms with the strongest commitment to design are also much more likely to be innovative (Galindo-Rueda & Millot, 2015; Wojan & Nichols, 2018). The level of commitment to design is critical in making sense of whether design is merely an outgrowth of invention, or if it is an independent source of novelty that directly contributes to innovation. The design ladder concept developed by Statistics Denmark delineates three distinct rungs: (1) firms that have no systematic approach to design; (2) firms that apply design as a last finish before introducing a product to market; and (3) firms that integrate design throughout the development process (Galindo-Rueda & Millot, 2015). The second rung summarizes the assumed role of design in the linear model of innovation – an application of aesthetics to make the functional attributes of a new product more appealing. Wojan and Nichols (2018) confirm that using design as a last finish (31% of establishments) is much more prevalent than integrating design throughout the development process (8% of establishments) in the United States. However, design integrated establishments are more likely to be more far ranging innovators (80%) than design last finish establishments (52% are more far-ranging innovators). Most importantly, design-integrated establishments reported much higher levels of performance than their design last finish peers with respect to expanding market share or entering export markets (Wojan & Nichols, 2018).

Research on the role of trademarks in innovation and performance outcomes is somewhat richer (Schautschick & Greenhalgh, 2016). Descriptive evidence suggests that trademarks have become increasingly important in the transformation from an industrial economy to an innovation economy. Before 1970, trademark applications to the USPTO were one-third or less of the total number of utility patent applications. Trademark applications started to accelerate considerably after 1980, exceeding patent applications for the first time around 1995 (von Graevenitz, Greenhiagh, Helmers, & Schautschick, 2012). And while the increase in both patent and trademark applications has been phenomenal since 1990, preliminary evidence suggests that applying for nearly redundant patents to create patent thickets is a much more serious problem than the strategic use of superfluous trademarks referred to as ‘trademark clutter’ (von Graevenitz et al., 2012). Non-technological IP in the form of trademarks appears to be much more important than it was 30 years ago, suggesting fundamental changes in the economy.
One explanation for the rapid increase in trademark applications is their value as indicators of innovation. The consensus from studies across different developed country contexts is that trademarks are strongly associated with innovation in high-tech manufacturing but less so in low-tech manufacturing and services (Allegrezza & Guard-Rauchs, 1999; Hipp & Grupp, 2005; Jensen & Webster, 2009; Millot, 2012; Schmoch, 2003). However, in terms of stock valuation, productivity or output growth trademarks were found to be more important for low-tech manufacturing and services. Information on intangible investments in trademarks are associated with higher stock valuations in services than in manufacturing (Greenhalgh & Rogers, 2012). And productivity and output growth were associated with trademarks in low-tech industries but less so in high-tech industries (Greenhalgh & Longland, 2005).

The final forms of IP protection considered are non-compete clauses and NDAs. These agreements may protect either technological or non-technological IP limited to trade secrets in the form of an NDA or extending to all the human capital embodied in an employee in the form of a non-compete clause. Because non-compete clauses are much easier to enforce in most states than NDAs, and because they may have a larger impact on labour mobility and new firm formation, they have received the bulk of research attention. Non-compete clauses are very common among chief executive officers (CEOs) (68%), somewhat less prevalent among engineers (41%) and characterize a much smaller but still significant share of the general workforce (18%) (Marx, 2018). The regional impacts of non-compete clauses have been studied the longest, emerging as one of the explanations for why California – which does not enforce non-compete clauses – outpaced Massachusetts in high-tech in the 1970s and 1980s (Saxenian, 1994). Research on the effects of non-compete clauses on individual businesses is much more limited, but the empirical consensus to date is that employee turnover is lower, employee wages are lower, and stock valuations are higher where these clauses are enforceable (Younge & Marx, 2016). A result that is most relevant for the current analysis is that the firm benefits of non-compete clauses are highest ‘when there is more local competition, when employee mobility is a greater concern, and when firms have more growth opportunities’ (Younge & Marx, 2016, p. 653). This suggests that non-compete clauses should be more prevalent in urban areas relative to rural areas; this hypothesis will be examined below. Younge and Marx (2016) also find that the value of non-compete clauses is reduced in the presence of patents, suggesting that other forms of IP protection may serve as substitutes for secrecy imposed through employment restrictions.

The principal interest of this paper is to examine how technological, non-technological and secrecy forms of IP protection are combined, and the outcomes associated with these combinations. Despite the three forms of protection being readily available to nearly all firms trying to put together the most effective IP strategy, the huge bulk of research summarized above has treated these individual tactics in isolation. The simplest explanation for the combination of various IP tactics is that such activities enjoy economies of scope: pursuing one form of IP protection increases know-how and experience possibly making it cheaper for such firms to introduce other types of IP relative to a firm with no IP experience (Somaya & Graham, 2006). Possible strategic motivations for combining IP tactics are examined empirically by estimating whether the tactics are substitutes or complements (Amara et al., 2008; Guo-Fitoussi et al., 2019). If the value of using patents and trademarks jointly is more than the value of using either patents or trademarks in isolation, then patents and trademarks are supermodular complements. Millot and Llerenca found that substitutability or complementarity is dependent on the context that firms operate in: trademarks substitute for patents where the advantages to advertising are highly appropriable but act as complements to patents where technology is highly codified, such as pharmaceuticals. Munari and Santoni (2010) examine the complementarity of IP for small and medium-sized enterprises (SMEs) which may be more applicable to the REIS data given the large share of respondents that qualify as SMEs. They used a propensity score-matching protocol to address concerns about the endogeneity of strategy selection in estimating the
average treatment effect of combined IP strategies versus single or no IP strategies. On measures of economic performance that are self-reported and based on return to sales, a positive treatment effect for combined IP strategies was found relative to no IP use with mixed effects when compared with patent- or trademark-only strategies.

We begin our exploration of how IP tactics are combined in IP strategies by reviewing the most productive approaches for analysing business strategy.

**APPROACHES TO STUDYING BUSINESS STRATEGY AS A COMBINATION OF TACTICS**

The simplest approach to strategy is to assume that all available tactics are additive. Tactics that have demonstrated the highest payoffs (or net payoffs) are expected to be most numerous and tactics demonstrating lower net payoffs are expected to be rare. Examining this strategic assumption also has expositional advantages as a larger number of detailed tactics can be considered without worrying that the combinatorial permutations will become intractable.

The tactics we can track in the 2014 REIS include the following:

- Participating in a utility patent application in the prior three years (i.e., from 2011 to 2013).
- Awarded a utility patent in the prior three years.
- Registered an industrial design (design patent) in the prior three years.
- Registered a trademark in the prior three years.
- Produced materials eligible for copyright in the prior three years.
- Used trade secret protections such as NDAs, non-compete clauses or sought remedies for misappropriation in the prior three years.

To provide some context for the analysis, Table 1 provides a breakdown by industry of the REIS data set. The population was defined as all establishments in tradable sectors with five or more employees, with tradability determined by geographical concentration in an industry (Jensen, Kletzer, Bernstein, & Feenstra, 2005). Statistics are provided for the per cent of establishments in an industry in the study population, the per cent of establishments in an industry in the metropolitan and non-metropolitan subsamples, and per cent of utility patents awarded to an industry in 2014. Comparing the patent per cent with the per cent of establishments in the subsamples provides an indication of the patent intensity of an industry. For example, manufacturing accounted for 67.59% of all patents awarded to tradable industries, but makes up only 17.45% and 25.41% of the metro and non-metro subsamples, respectively. The representation of non-metro establishments in patent intensive industries is a particular concern as comparing IP strategies across the settlement hierarchy may be of little value if rural businesses are largely absent from industries that make up the bulk of patenting. Table 1 confirms this is not the case as the most patent intensive industries such as Computers and electronic equipment (NAICS 334), Information (51), Chemicals (325) and Transportation equipment (336) have similar metro and non-metro shares. Whether patenting and other IP tactics are important in rural businesses would appear to be a compelling empirical question.

The prevalence of the whole set of tactics for urban and rural establishments are provided in Table 2. In addition, the prevalence of these tactics among substantive, or more far ranging, innovators that pursue a combination of continuous improvement with innovation practices that may entail reconfiguration of components or systems, is also provided (Wojan & Parker, 2017).

One of the more interesting regularities in Table 2 is that all IP tactics are a little less than twice as common in metro establishments compared with their rural peers. In addition, the ranking from most common to least common is very similar across metro and non-metro establishments. This also holds true when considering only substantive innovator establishments. In
Table 1. Industry as per cent of target population and as per cent of metro and non-metro samples.

| Industry                                | NAICS code | Metro per cent of study population | Per cent of metro establishments in sample | Non-metro per cent of study population | Per cent of non-metro establishments in sample | Per cent of tradable industry patents | 2014 patents issued to firms conducting R&D |
|-----------------------------------------|------------|------------------------------------|--------------------------------------------|----------------------------------------|-----------------------------------------------|--------------------------------------|-------------------------------------------|
| All tradable industries                 |            | 86.79%                             | 100%                                       | 13.21%                                 | 100%                                          | 100%                                 | 97,119                                    |
| Manufacturing industries                | 31–33      | 15.15%                             | 17.45%                                     | 3.36%                                  | 25.41%                                        | 67.59%                               | 65,645                                    |
| Food                                   | 311        | 1.38%                              | 1.59%                                      | 0.35%                                  | 2.65%                                          | 0.86%                                | 835                                       |
| Beverages and tobacco products          | 312        | 0.25%                              | 0.29%                                      | 0.10%                                  | 0.73%                                          | 0.30%                                | 287                                       |
| Textiles, apparel, and leather products | 313–16     | 0.54%                              | 0.61%                                      | 0.12%                                  | 0.90%                                          | 0.53%                                | 515                                       |
| Wood products                          | 321        | 0.58%                              | 0.67%                                      | 0.38%                                  | 2.87%                                          | 0.05%                                | 51                                        |
| Paper                                  | 322        | 0.38%                              | 0.43%                                      | 0.05%                                  | 0.35%                                          | 0.30%                                | 288                                       |
| Printing and related support activities | 323        | 1.02%                              | 1.17%                                      | 0.13%                                  | 1.01%                                          | 0.10%                                | 97                                        |
| Petroleum and coal products            | 324        | 0.08%                              | 0.09%                                      | 0.01%                                  | 0.11%                                          | 0.07%                                | 69                                        |
| Chemicals                              | 325        | 0.96%                              | 1.10%                                      | 0.14%                                  | 1.04%                                          | 10.51%                               | 10,206                                    |
| Plastics and rubber products           | 326        | 0.61%                              | 0.70%                                      | 0.19%                                  | 1.42%                                          | 1.24%                                | 1200                                      |
| Non-metallic mineral products          | 327        | 0.51%                              | 0.59%                                      | 0.17%                                  | 1.28%                                          | 0.54%                                | 529                                       |
| Primary metals                         | 331        | 0.33%                              | 0.38%                                      | 0.09%                                  | 0.64%                                          | 0.12%                                | 121                                       |
| Fabricated metal products              | 332        | 2.96%                              | 3.41%                                      | 0.59%                                  | 4.45%                                          | 1.01%                                | 979                                       |
| Machinery                              | 333        | 1.60%                              | 1.85%                                      | 0.39%                                  | 2.95%                                          | 4.37%                                | 4245                                      |
| Computer and electronic products        | 334        | 0.78%                              | 0.89%                                      | 0.10%                                  | 0.78%                                          | 27.78%                               | 26,980                                    |

(Continued)
| Industry                                      | NAICS code | Metro per cent of study population | Per cent of metro establishments in sample | Non-metro per cent of study population | Per cent of non-metro establishments in sample | Per cent of tradable industry patents | 2014 patents issued to firms conducting R&D |
|-----------------------------------------------|------------|-----------------------------------|------------------------------------------|----------------------------------------|--------------------------------------------|--------------------------------------|-------------------------------------------|
| Electrical equipment, appliances, and components | 335        | 0.49%                             | 0.56%                                    | 0.07%                                  | 0.51%                                      | 2.42%                                | 2352                                      |
| Transportation equipment                      | 336        | 0.64%                             | 0.74%                                    | 0.21%                                  | 1.56%                                      | 9.11%                                | 8848                                      |
| Furniture and related products                | 337        | 0.57%                             | 0.65%                                    | 0.15%                                  | 1.17%                                      | 0.19%                                | 183                                       |
| Miscellaneous manufacturing                   | 339        | 1.47%                             | 1.70%                                    | 0.13%                                  | 0.99%                                      | 8.09%                                | 7861                                      |
| Mining, extraction, and support activities    | 21         | 0.87%                             | 1.01%                                    | 0.71%                                  | 5.39%                                      | 2.90%                                | 2815                                      |
| Wholesale trade                               | 42         | 17.58%                            | 20.25%                                   | 2.37%                                  | 17.95%                                     | 0.08%                                | 73                                        |
| Transportation and warehousing                | 48–49      | 6.13%                             | 7.06%                                    | 1.41%                                  | 10.65%                                     | 0.06%                                | 62                                        |
| Information                                   | 51         | 5.07%                             | 5.84%                                    | 0.91%                                  | 6.91%                                      | 26.05%                               | 25,299                                    |
| Finance and insurance                         | 52         | 14.96%                            | 17.24%                                   | 2.28%                                  | 17.25%                                     | 0.62%                                | 600                                       |
| Professional, scientific, and technical services | 54        | 24.26%                            | 27.96%                                   | 1.82%                                  | 13.75%                                     | 2.70%                                | 2625                                      |
| Management of businesses (headquarters)       | 55         | 2.14%                             | 2.47%                                    | 0.22%                                  | 1.63%                                      | D                                    | D                                         |
| Arts and museums                              | 71         | 0.64%                             | 0.74%                                    | 0.14%                                  | 1.06%                                      | D                                    | D                                         |

Note: D, data were withheld to avoid disclosing the operations of individual companies.
Sources: 2014 Rural Establishment Innovation Survey (REIS) and Business Research Development and Innovation: 2014, NSF 18–302, table 54.
addition to IP tactics being much more prevalent among substantive innovator establishments compared with the population as a whole, the metro–non-metro differences are also much smaller among substantive innovators. Thus, not only do IP tactics appear to be a good indicator of innovative activity generally, it is arguably a more reliable indicator of innovation for non-metro establishments relative to their urban peers.

An important caveat to this conclusion also concerns the large percentage of substantive innovator establishments using trade secret protections. One assumption used to differentiate substantive innovators from nominal innovators (only engaged in continuous improvement) or non-innovators was that they would be much more likely to produce IP worth protecting (Wojan et al., 2018; Wojan & Parker, 2017). To implement this, whether or not an establishment used trade secret protections was included in the latent class analysis used to identify respondents as non-innovators, incremental innovators, or substantive innovators. By construction, the share of substantive innovator establishments using trade secret protection should be high, as this is one of the principal variables used to differentiate establishments by innovation orientation. And since it is plausible that trade secret protections may be correlated – either positively or negatively – with other IP tactics, the prevalence of IP tactics using the original latent class specification for identifying innovative establishments may distort the relative importance of the tactics to innovation generally. We specify an alternative latent class model that does not include any IP tactics to estimate prevalence rates that are not confounded by class membership dependent on trade secret protections. We replace the trade secret protection response in the latent class analysis with the response to the following question: ‘In the past three years [did the business] plan, engineer, design, or conduct other development work to implement innovations?’ The question is suggestive that some IP warranting protection may be present but is agnostic on its existence or type of protection used.

Table 3 populates the cells in Table 2 with percentages found using the new latent class specification for innovative establishments. Not surprisingly, the share of establishments using trade secret protections is considerably lower when this is no longer used to identify innovative establishments. Lower prevalence of IP across the board for innovative establishments using the new latent class specification may be driven by two factors. First, the use of trade secret protections with other IP tactics is clearly demonstrated in the comparison of Tables 2 and 3. Second, the innovation classification using trade secret protections in Table 2 appears to be tighter or

### Table 2. Per cent of establishments in tradable non-farm industries using various intellectual property (IP) tactics, 2011–13.

| IP tactic                  | Metro          | Non-metro      | Metro substantive innovators with IP | Non-metro substantive innovators with IP |
|----------------------------|----------------|----------------|--------------------------------------|------------------------------------------|
| Participated in patent application | 8.35 (0.80)    | 5.14 (0.29)    | 17.92 (1.91)                         | 15.44 (1.01)                             |
| Awarded patent             | 3.68 (0.43)    | 2.49 (0.18)    | 9.24 (1.19)                          | 8.43 (0.71)                              |
| Industrial design          | 3.81 (0.47)    | 2.26 (0.19)    | 8.52 (1.16)                          | 6.46 (0.62)                              |
| Trademark                  | 15.75 (1.02)   | 8.0 (0.39)     | 31.89 (2.23)                         | 21.26 (1.18)                             |
| Copyright                  | 17.41 (1.05)   | 9.19 (0.40)    | 32.37 (2.25)                         | 21.37 (1.18)                             |
| Trade secret protections   | 30.41 (1.35)   | 15.67 (0.55)   | 61.90 (2.30)                         | 47.79 (1.49)                             |

Note: Standard deviations are shown in parentheses.
Sources: 2014 Rural Establishment Innovation Survey (REIS) and Wojan and Parker (2017).
more stringent than that in Table 3, where the share of innovative establishments went from 33% for the substantive innovators in Table 2 to 39% for the innovators in Table 3, respectively. For analyses not examining IP tactics explicitly the original latent class specification is preferred. Despite the significant change in prevalence, the ranking of most to least common IP tactic for all groupings of establishments remains unchanged between Tables 2 and 3: trade secret protections, copyright, trademark, applying for a patent, awarded a patent, and industrial design (for all but Metro establishments).

To assess the possible contribution of IP tactics as additive to performance outcomes we rely on self-reported indicator measures regarding an increase in metrics of interest. These include whether the business reported an increase in market share or entered export markets in the three years preceding the survey. Given that growth opportunities may differ substantially across industries, two-digit NAICS code dummy variables are included as controls. As an exploratory exercise we maintain the assumption of exogeneity of the IP tactics and specify a parsimonious logistic regression equation that includes only the individual IP tactics and industry controls. The use of dichotomous dependent and independent variables allows a simple interpretation of estimated parameters that are transformed into odds ratios. Odds ratios from the logistic regressions are provided in Table 4.

Values < 1 indicate an event was less likely to occur relative to even odds, while values > 1 indicate an event was more likely to occur. The effect of the individual IP tactics on self-reported performance indicators overall appears to be negative. Of the 48 estimated odd ratios, 33 indicate a lower probability of exporting or increasing market share, 11 indicate a higher probability and four are not statistically different from 0. The award of utility patents is most likely to be positively associated with better performance in increasing market share or entering the export market, seemingly reinforcing the focus on this IP tactic in the literature. The design patent odds ratios are > 1 in two of the equations and copyright and trade secret protections each have an odds ratio > 1, but only marginally so. Modelling IP tactics as an additive, linear contribution to establishment performance does not appear to contribute much more than just focusing on utility patents.

The alternative is to model the contribution as the combination of tactics that define different strategic choices by establishments. The difficulty in implementing this strategy is that six tactics rapidly grow to 720 unique combinations that makes the proposal econometrically and conceptually intractable. The differences across the six tactics that matter most are the technological,
| IP tactic                  | Metro odds increasing market share | Innovative metro odds increasing market share | Metro odds entering export market | Innovative metro odds entering export market | Non-metro odds increasing market share | Innovative non-metro odds entering market share | Non-metro odds entering export market | Innovative non-metro odds entering export market |
|---------------------------|-----------------------------------|---------------------------------------------|--------------------------------|---------------------------------------------|--------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| Participated in patent application | 0.937***                          | 0.744***                                    | 1.604***                      | 1.373***                                   | 0.921**                             | 0.884***                                  | Even odds                                | Even odds                                |
| Awarded patent industrial design | 0.653***                          | 0.648***                                    | 2.231***                      | 1.758***                                   | 1.18*                               | Even odds                                  | 1.745***                                 | 1.456***                                 |
| Trademark                  | 1.842***                          | 1.38***                                     | 0.632***                      | 0.63***                                    | Even odds                            | 0.861**                                   | 0.829***                                 | 0.776***                                 |
| Copyright                  | 0.411***                          | 0.518***                                    | 0.532***                      | 0.607***                                   | 0.433***                            | 0.724***                                   | 0.387***                                 | 0.516***                                 |
| Trade secret protections   | 0.688***                          | 1.059***                                    | 0.518***                      | 0.559***                                   | 0.515***                            | 0.626***                                   | 0.534***                                 | 0.661***                                 |
| Trademark                  | 0.493***                          | 0.621***                                    | 0.69***                       | 1.114***                                   | 0.385***                            | 0.536***                                   | 0.534***                                 | 0.696***                                 |
| N                          | 2213                              | 1037                                        | 2208                          | 1033                                        | 6512                                | 2641                                      | 6507                                     | 2641                                     |

Notes: Two-digit NAICS industry controls are not shown.  
***Significance at < 0.01; **at 0.05; and * at 0.10.  
Source: 2014 Rural Establishment Innovation Survey (REIS).
non-technological or secrecy dimensions of each tactic. Collapsing the tactics along these dimensions results in six combinations, with their prevalence demonstrated in Table 5.

Not surprisingly, strategies that include secrecy tend to be much more prevalent in metro establishments than non-metro establishments. Indeed, the two strategies that do not include secrecy claim nearly an identical share of establishments in metro and non-metro areas, whether for the whole sample or limited to substantive innovators. It is also notable that IP strategies that do not use secrecy make up a minority of all IP strategies. Another way to delineate IP strategy – that is more in line with the availability of secondary data for all but the secrecy tactics – is tech, non-tech, mixed tech/non-tech irrespective of the use of secrecy, and an additional secrecy only category. The prevalence of the four strategic combinations are shown in Table 6.

The largest share of both metro and non-metro establishments, irrespective of their innovation orientation, use non-technological IP strategies. Substantive innovators’ demonstrated preference for this strategy suggests that the primary focus on patents may be missing a critical aspect of the IP story. The mixed tech/non-tech strategy is only the third most prevalent for each category but demonstrates the largest difference between innovators and the sample as a whole. Particularly for non-metro areas, the mixed IP strategy may be a reliable way of identifying substantive innovators from secondary data.

Before moving onto the potential impacts of these IP strategies on establishment performance it is useful to examine the prevalence of these various strategies across the settlement hierarchy in Table 7. To what extent are the most populous metro and non-metro areas driving the metro–non-metro differences? Technological IP strategies appear to be very rare but are present throughout the settlement hierarchy. The prevalence of non-technological IP appears to follow a population gradient from metro to non-metro areas but makes up a consistent share across all non-metro areas. The mixed tech/non-tech strategy displays the strongest population gradient throughout the hierarchy with the largest metro counties having five times the share present in remote, completely rural counties. A similar population gradient might be anticipated for the secrecy only strategy, given the assumed importance of local competitors, but the share of non-metro establishments reporting this strategy does not appear to vary with the size of the urban population. Given the rarity of technological and mixed tech/non-tech strategies in smaller non-metro counties and the relative prevalence of non-technological strategies, the possible returns of these strategies examined in Table 8 comes to the fore.

| IP tactic               | Metro | Non-metro | Metro substantive innovators no IP | Non-metro substantive innovators no IP |
|-------------------------|-------|-----------|-----------------------------------|---------------------------------------|
| Tech only               | 0.51  | 0.68      | 1.07                              | 1.32                                  |
| Non-tech only           | 5.58  | 4.72      | 7.45                              | 7.53                                  |
| Secrecy only            | 10.28 | 5.87      | 12.88                             | 10.25                                 |
| Tech and secrecy        | 0.91  | 0.55      | 1.58                              | 1.32                                  |
| Non-tech and secrecy    | 7.53  | 3.43      | 15.13                             | 7.61                                  |
| Tech, non-tech and secrecy | 4.22 | 2.29      | 9.03                              | 6.16                                  |

Note: Standard deviations are shown in parentheses.
Source: 2014 Rural Establishment Innovation Survey (REIS).
Comparing the odds ratios in Tables 4 and 8 provides strong evidence that the combination of IP tactics into business strategies is much more informative of the effect on performance than simply examining the effect of tactics individually. Comparing the odds ratios in Tables 4 and 8 provides strong evidence that the combination of IP tactics into business strategies is much more informative of the effect on performance than simply examining the effect of tactics individually.1 In contrast to the linear additive assumption implicit in Table 4, the results from the strategy regressions suggest that nearly all IP strategies increased the probability of increasing market share or entering export markets relative to the control strategy of no IP protections. The effects are often quite large. The mixed tech/non-tech strategy had the largest effect across all of the estimated equations (Table 8). A non-metro establishment using this IP strategy was eight times more likely to enter export markets than an establishment with no IP protections. The two pervasive patterns in the results are

Table 6. Per cent of establishments in tradable non-farm industries using technological, non-technological and mixed intellectual property (IP) strategies, 2011–13.

| IP tactic                  | Metro substantive innovators no IP | Non-metro substantive innovators no IP |
|----------------------------|-----------------------------------|----------------------------------------|
| Technological              | 2.65 (0.49)                       | 2.65 (0.34)                            |
| Non-technological          | 22.58 (1.62)                      | 15.14 (0.79)                           |
| Mixed tech/non-tech        | 10.23 (1.32)                      | 7.58 (0.55)                            |
| Secrecy only               | 12.88 (1.32)                      | 10.25 (0.69)                           |

Note: Standard deviations are shown in parentheses.
Source: 2014 Rural Establishment Innovation Survey (REIS).

Table 7. Per cent of establishments in tradable non-farm industries using technological, non-technological and mixed intellectual property (IP) strategies across the settlement hierarchy, 2014.

| Settlement type          | Technological | Non-technological | Mixed tech/non-tech | Secrecy only |
|--------------------------|---------------|-------------------|--------------------|--------------|
| Metro > 1 million        | 1.36 (0.31)   | 14.07 (0.99)      | 5.66 (0.77)        | 9.78 (0.96)  |
| Metro 250,000–1 million  | 1.53 (0.42)   | 11.8 (1.63)       | 3.49 (1.14)        | 10.74 (1.94) |
| Metro < 250,000          | 1.51 (0.63)   | 10.31 (1.89)      | 4.05 (1.12)        | 12.27 (2.69) |
| Non-metro adjusted > 20,000 urban population | 1.74 (0.30)   | 8.59 (0.67)       | 4.14 (0.48)        | 7.01 (0.72)  |
| Non-metro N adjusted > 20,000 urban population | 1.29 (0.47)   | 8.15 (0.94)       | 2.74 (0.59)        | 4.75 (0.80)  |
| Non-metro adjusted 2500–19,900 urban population | 0.97 (0.19)   | 7.98 (0.68)       | 2.97 (0.36)        | 5.76 (0.64)  |
| Non-metro N adjusted 2500–19,900 urban population | 1.08 (0.28)   | 7.65 (0.72)       | 2.3 (0.41)         | 5.27 (0.67)  |
| Non-metro adjusted completely rural | 0.91 (0.54)   | 8.34 (1.46)       | 1.91 (0.65)        | 5.96 (1.59)  |
| Non-metro N adjusted completely rural | 0.92 (0.52)   | 8.77 (1.67)       | 1.11 (0.36)        | 5.79 (1.13)  |

Note: Standard deviations are shown in parentheses.
Source: 2014 Rural Establishment Innovation Survey (REIS).
Table 8. Odds that intellectual property (IP) strategies (secrecy tactics combined and broken out) increased the likelihood of increasing market share or entering export markets between 2011 and 2013.

| IP strategy | Metro odds increasing market share | Innovative metro odds increasing market share | Metro odds entering export market | Innovative metro odds entering export market | Non-metro odds increasing market share | Innovative non-metro odds increasing market share | Non-metro odds entering export market | Innovative non-metro odds entering export market |
|-------------|-----------------------------------|---------------------------------------------|----------------------------------|---------------------------------------------|---------------------------------------|------------------------------------------|------------------------------------------|--------------------------------------------------|
| Technological | 1.733*** | 1.223*** | 1.621*** | 0.834*** | 3.458*** | 1.85*** | 4.858*** | 2.608*** |
| Non-technological | 2.715*** | 1.685*** | 2.436*** | 1.353*** | 3.277*** | 1.922*** | 3.936*** | 2.179*** |
| Mixed tech/non-tech | 3.339*** | 2.522*** | 4.599*** | 2.417*** | 5.433*** | 2.892*** | 8.052*** | 4.504*** |
| Secrecy only | 1.993*** | 1.491*** | 1.421*** | 0.787*** | 2.959*** | 1.98*** | 2.118*** | 1.409*** |
| N | 2294 | 1078 | 2284 | 1072 | 6707 | 2733 | 6701 | 2730 |

**IP strategies that combine secrecy with non-secrecy tactics**

| IP strategy | Metro odds increasing market share | Innovative metro odds increasing market share | Metro odds entering export market | Innovative metro odds entering export market | Non-metro odds increasing market share | Innovative non-metro odds increasing market share | Non-metro odds entering export market | Innovative non-metro odds entering export market |
|-------------|-----------------------------------|---------------------------------------------|----------------------------------|---------------------------------------------|---------------------------------------|------------------------------------------|------------------------------------------|--------------------------------------------------|
| Tech only | 1.803*** | 0.877*** | 1.097* | 0.62*** | 3.496*** | 2.14*** | 4.98*** | 2.357*** |
| Non-tech only | 1.809*** | 1.042*** | 1.941*** | 1.223*** | 2.494*** | 1.38*** | 2.885*** | 1.442*** |
| Secrecy only | 1.996*** | 1.494*** | 1.425*** | 0.789*** | 2.96*** | 1.985*** | 2.12*** | 1.414*** |
| Tech and secrecy | 1.7*** | 1.561*** | 1.977*** | Even odds | 3.433*** | 1.663*** | 4.767*** | 2.869*** |
| Non-tech and secrecy | 3.828*** | 2.214*** | 2.829*** | 1.419*** | 5.11*** | 2.909*** | 5.163*** | 2.876*** |
| Tech and non-tech | 5.06*** | Even odds | 4.185*** | 2.12*** | 2.527*** | 1.825*** | 6.918*** | 4.768*** |
| Tech, non-tech and secrecy | 3.155*** | 2.231*** | 4.69*** | 2.468*** | 7.393*** | 3.374*** | 8.421*** | 4.476*** |
| N | 2294 | 1078 | 2284 | 1072 | 6707 | 2733 | 6701 | 2730 |

Note: Two-digit NAICS industry controls are not shown.

***Significance at < 0.01; * at 0.10.

Source: 2014 Rural Establishment Innovation Survey (REIS).
that (1) the effects of IP strategies on non-metro establishments are larger than for their urban peers and (2) the effects for the sample as a whole are larger than the effects for the subsample of innovative establishments. The latter result is to be expected as the use of IP strategy is strongly associated with innovation orientation which in turn is strongly associated with establishment performance. So in the full sample the IP strategies may be picking up both effects. As regards the large effect of IP strategies on non-metro establishments, the association with innovation is stronger than the metro case which would explain a larger effect in the full sample. The fact that the non-metro effect is also larger for the innovative subsample suggests a larger IP payoff to rural businesses may be real and not merely an artefact of a larger non-metro share of laggard firms.

The larger impacts of IP strategies in non-metro areas relative to metro areas suggested by Table 8 raise additional questions about how these impacts might differ throughout the settlement hierarchy. The one complication this questions raises is an increasing probability of false discovery as the sample size is substantially reduced for each estimation. Estimates for establishments in each of the nine rural/urban continuum categories is provided Appendix Table A2. Sample size for some of the categories is considerably < 500, the threshold below which extreme values in logistic regression are more likely (Nemes, Jonasson, Genell, & Steineck, 2009). To examine the most salient characteristics while maintaining adequate sample size, the nine categories are aggregated in the following ways. To examine potential differences between larger and smaller metro areas, the less numerous observations in the two smaller metro area classifications (with population < 1 million) are combined. The six rural categories are collapsed into two on the basis of adjacency to a metro area.

The results in Table 9 generally support the finding from the metro–non-metro comparison provided in Table 8. In 12 out of 16 of the regressions, the estimated odds ratio for the mixed technological/non-technological IP is at least nominally larger than any other strategy. The exceptions to this include the increasing market share regressions for non-metro/nonadjacent counties where the technological IP strategy is larger and statistically different from the mixed strategy. In two of the metro regressions the mixed IP odds ratio estimate is nominally smaller than non-technological IP strategy. The largest odds ratio occurs in the entering export market equation for non-metro/nonadjacent counties. With an N = 2678 it is unlikely that this is due the estimate being biased toward extreme values. The implications is that establishments in more remote rural areas that use a mixed IP strategy are very likely to be exporters, at least among tradable industries that define the study population.

The findings are instructive for how to use secondary data to identify innovative or high-performing businesses. While patent production in a region may provide some hints regarding the IP landscape, the analysis above suggests that adding information on non-technological IP will paint a much fuller picture. Linking the USPTO PatentView data with the near census of business establishments in the proprietary National Establishment Time Series (NETS) would allow constructing indexes of the prevalence of technological, non-technological and mixed IP strategies across the United States. Whether areas devoid of IP protections have a tougher time entering export markets or increasing market share could be examined empirically and may help explain performance differentials. The share of establishments using mixed IP strategies may be a reliable indicator of the share of highly innovative establishments, particularly in rural areas.

**CONCLUSIONS**

This initial exploration into the combination of IP tactics into IP strategies raises concern about the decision in previous research to focus solely on utility patents. If utility patents comprise a single component of a business’s IP strategy then estimating the impact of utility patents on firm performance may be misspecified (Signorino & Yilmaz, 2003). If the use of non-
technological IP is omitted from studies then it is impossible to tell what share of any putative utility patent contribution is from the patent itself or from some combination with design, trademark or copyright protection. The presumption in the literature, which is also central in the linear model of innovation and technologically oriented linked-chain model variants, assumes that non-technological forms of innovation are largely inconsequential so non-technological forms of IP protection can be disregarded in estimating effects (Bloom & Van Reenen, 2002). The preliminary results from REIS using self-reported performance measures refute this assumption. However, more definitive findings using administrative sources for both performance metrics and IP protections will be needed to confirm whether misspecification error tarnishes the extant IP literature.

On a more positive note, the strong association between mixed IP strategies and substantive innovation opens the possibility of making inferences on the innovative capacity of a region’s businesses using publicly available administrative data on utility patents, design patents, and trademarks. Patent production at the regional level has long been used as a metric of innovative capacity but this analysis demonstrates that technological IP protection in isolation is rare and likely to have less impact than mixed IP strategies. Knowing the share of businesses that combine technological and non-technological IP protection will provide a much richer metric of innovative capacity. The other problem with sole reliance on patents that was not investigated in this paper is the increasing use of patents as a way to strategically thwart competitors by setting up patent thickets. A metric of ‘innovativeness’ that is comprised in part by patents meant to stifle innovation raises serious construct validity questions. The requirement that patents be combined

| Settlement type        | Odds increasing market share | Innovative odds increasing market share | Odds entering export market | Innovative odds entering export market |
|------------------------|------------------------------|----------------------------------------|-----------------------------|---------------------------------------|
| Large metro, N         | 1419                         | 671                                    | 1415                        | 670                                   |
| Technological          | 1.692                        | 1.543                                  | 1.857                       | 0.908                                 |
| Non-technological      | 3.049                        | 1.776                                  | 2.241                       | 1.308                                 |
| Mixed tech/non-tech    | 2.931                        | 2.455                                  | 5.203                       | 2.783                                 |
| Secrecy only           | 2.509                        | 1.682                                  | 1.614                       | 1.053                                 |
| Smaller metro, N       | 875                          | 407                                    | 869                         | 402                                   |
| Technological          | 1.852                        | 0.756                                  | 2.855                       | 0.584                                 |
| Non-technological      | 2.234                        | 1.516                                  | 3.098                       | 1.544                                 |
| Mixed tech/non-tech    | 6.007                        | 3.077                                  | 2.151                       | 1.511                                 |
| Secrecy only           | 1.398                        | 1.186                                  |                             | 0.37                                  |
| No metro adjacent, N   | 4031                         | 1683                                   | 4023                        | 1678                                  |
| Technological          | 2.518                        | 1.303                                  | 4.757                       | 3.265                                 |
| Non-technological      | 3.472                        | 1.99                                   | 3.959                       | 2.312                                 |
| Mixed tech/non-tech    | 6.138                        | 3.651                                  | 6.671                       | 4.005                                 |
| Secrecy only           | 3.66                         | 2.342                                  | 2.097                       | 1.53                                  |
| Non-metro non-adjacent, N | 2676                      | 1050                                   | 2678                        | 128                                   |
| Technological          | 7.374                        | 5.446                                  | 5.006                       | 1.534                                 |
| Non-technological      | 3.046                        | 1.82                                   | 3.916                       | 1.951                                 |
| Mixed tech/non-tech    | 4.293                        | 1.959                                  | 11.433                      | 5.438                                 |
| Secrecy only           | 2.126                        | 1.566                                  | 2.07                        |                                       |

Note: All odds ratios reported are significant at 0.05.
Source: 2014 Rural Establishment Innovation Survey (REIS).
with non-technological IP for an establishment to be counted as innovative may insulate the measure from this non-productive strategic use.

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**NOTE**

1 Table 4 includes more detailed tactics than are feasible to include in strategic combinations. A parallel additive linear analysis using the same aggregate categories used to construct the IP strategies in Table 8 are provided in Appendix Table A1. The results from Table 4 and Table A1 are notably different. Most striking is the association with non-technological IP and self-reported economic outcomes. In Table 4, where the individual tactics of design patents, trademark and copyright are included in the regression, the associations are generally negative. However, in Table A1, non-technological IP when considered together demonstrates a positive association with self-reported outcomes. However, for both technological and non-technological IP, the magnitude of the association is larger when estimated strategically as is done in Table 8. Also notable is that secrecy tactics are negatively associated with self-reported outcomes when modelled as additive (Table A1), but generally have a strong positive association when modelled strategically (Table 8).

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### Table A1. Odds that intellectual property (IP) tactics increased the likelihood of increasing market share or entering export markets between 2011 and 2013.

| IP strategy   | Metro odds increasing market share | Innovative metro odds increasing market share | Metro odds entering export market | Innovative metro odds entering export market | Non-metro odds increasing market share | Innovative non-metro odds increasing market share | Non-metro odds entering export market | Innovative non-metro odds entering export market |
|---------------|------------------------------------|---------------------------------------------|----------------------------------|---------------------------------------------|----------------------------------------|---------------------------------------------|-----------------------------------------|------------------------------------------------|
| Technological | 1.086***                          | 1.260***                                   | 1.818***                        | 1.680***                                   | 1.561***                              | 1.304***                                   | 2.227***                               | 1.956***                              |
| Non-Technological | 1.851***                         | 1.249***                                   | 2.060***                        | 1.662***                                   | 2.310***                              | 1.544***                                   | 2.649***                               | 1.885***                              |
| Secrecy       | 0.494***                          | 0.605***                                   | 0.677***                        | 1.044***                                   | 0.378***                              | 0.525***                                   | 0.523***                               | 0.670***                              |
| $N$           | 2261                              | 1059                                       | 2254                            | 1055                                       | 6626                                   | 2692                                       | 6620                                    | 2690                                  |

Note: ***Significance at < 0.01. Two-digit industry controls are not shown.
Source: 2014 Rural Establishment Innovation Survey (REIS).
Table A2. Odds that intellectual property (IP) strategies increased the likelihood of increasing market share or entering export markets between 2011 and 2014 by settlement type.

| Settlement type | Odds increasing market share | Innovative odds increasing market share | Odds entering export market | Innovative odds entering export market |
|-----------------|------------------------------|----------------------------------------|-----------------------------|----------------------------------------|
| Metro > 1 million, N | 1419                        | 671                                    | 1415                        | 670                                    |
| Technological   | 1.692                       | 1.543                                  | 1.857                       | 0.908                                  |
| Non-technological| 3.049                       | 1.776                                  | 2.241                       | 1.308                                  |
| Mixed tech/non-tech | 2.931                  | 2.455                                  | 5.203                       | 2.783                                  |
| Secrecy only    | 2.509                       | 1.682                                  | 1.614                       | 1.053                                  |
| Metro 250,000–1 million, N | 604                        | 280                                    | 597                         | 274                                    |
| Technological   | 3.031                       | 0.878                                  | 1.264                       | 0.615                                  |
| Non-technological| 2.183                       | 1.413                                  | 3.452                       | 1.649                                  |
| Mixed tech/non-tech | 4.797                   | 2.420                                  | 2.491                       | 1.130                                  |
| Secrecy only    | 0.905                       | 1.131                                  | 0.428                       |                                        |
| Metro < 250,000, N | 271                        | 127                                    | 272                         | 128                                    |
| Technological   | 0.825                       | 0.543                                  | 0.696                       | 0.516                                  |
| Non-technological| 1.949                       | 1.085                                  | 1.775                       | 0.730                                  |
| Mixed tech/non-tech | 7.792                      | 2.820                                  | 2.685                       | 1.581                                  |
| Secrecy only    | 2.930                       | 3.444                                  | 0.731                       | 0.24                                   |
| Non-metro adjusted > 20,000 urban population, N | 1751                        | 781                                    | 1747                        | 778                                    |
| Technological   | 2.781                       | 1.600                                  | 8.887                       | 6.758                                  |
| Non-technological| 3.274                       | 2.312                                  | 3.637                       | 2.346                                  |
| Mixed tech/non-tech | 4.481                   | 3.277                                  | 9.174                       | 5.406                                  |
| Secrecy only    | 3.442                       | 2.379                                  | 2.297                       | 1.577                                  |
| Non-metro N adjusted > 20,000 urban population, N | 806                        | 347                                    | 803                         | 347                                    |
| Technological   | 3.496                       | 3.222                                  | 2.756                       |                                        |
| Non-technological| 2.504                       | 1.327                                  | 3.980                       | 2.597                                  |
| Mixed tech/non-tech | 3.983                   | 1.788                                  | 22.568                      | 14.222                                 |
| Secrecy only    | 2.897                       | 1.710                                  | 3.833                       | 2.789                                  |
| Non-metro adjusted 2500–19,900 urban population, N | 1994                        | 781                                    | 1994                        | 781                                    |
| Technological   | 2.069                       | 1.782                                  |                             |                                        |
| Non-technological| 4.020                       | 2.078                                  | 4.860                       | 2.555                                  |
| Mixed tech/non-tech | 8.989                   | 4.394                                  | 5.001                       | 2.771                                  |
| Secrecy only    | 3.857                       | 2.004                                  | 2.239                       | 1.632                                  |
| Non-metro N adjusted 2500–19,900 urban population, N | 1421                        | 562                                    | 1423                        | 564                                    |
| Technological   | 7.853                       | 4.791                                  | 6.655                       | 1.682                                  |
| Non-technological| 3.796                       | 3.261                                  | 3.318                       | 1.601                                  |
| Mixed tech/non-tech | 4.441                   | 1.921                                  | 6.789                       | 3.071                                  |
| Secrecy only    | 1.914                       | 1.736                                  | 1.844                       |                                        |

(Continued)
Table A2. Continued.

| Settlement type                      | Odds increasing market share | Innovative odds increasing market share | Odds entering export market | Innovative odds entering export market |
|--------------------------------------|-----------------------------|----------------------------------------|----------------------------|----------------------------------------|
| Non-metro adjusted completely rural, N | 286                         | 121                                    | 282                        | 119                                    |
| Technological                        |                             |                                        |                            |                                        |
| Non-technological                    | 1.388                       | 5.621                                  | 0.584                      | 3.317                                  |
| Mixed tech/non-tech                  | 7.024                       | 2.496                                  | 20.02                      |                                        |
| Secrecy only                         | 4.43                        | 0.504                                  |                            |                                        |
| Non-metro N adjusted completely rural, N | 449                         | 141                                    | 452                        | 141                                    |
| Technological                        |                             |                                        |                            |                                        |
| Non-technological                    | 2.869                       | 8.796                                  | 4.655                      |                                        |
| Mixed tech/non-tech                  | 2.794                       | 15.772                                 | 11.110                     |                                        |
| Secrecy only                         | 2.186                       | 1.456                                  | 0.368                      |                                        |
| Metro > 1 million, N                | 1419                        | 671                                    | 1415                       | 670                                    |
| Technological                        | 1.692                       | 1.543                                  | 1.857                      | 0.908                                  |
| Non-technological                    | 3.049                       | 2.241                                  | 2.241                      | 1.308                                  |
| Mixed tech/non-tech                  | 2.931                       | 5.203                                  | 2.783                      |                                        |
| Secrecy only                         | 2.509                       | 1.682                                  | 1.053                      |                                        |
| Metro 250,000–1 million, N          | 604                         | 280                                    | 597                        | 274                                    |
| Technological                        | 3.031                       | 1.264                                  | 0.615                      |                                        |
| Non-technological                    | 2.183                       | 3.452                                  | 1.649                      |                                        |
| Mixed tech/non-tech                  | 4.797                       | 2.491                                  | 1.130                      |                                        |
| Secrecy only                         | 2.590                       | 1.131                                  | 0.428                      |                                        |
| Metro < 250,000, N                  | 271                         | 127                                    | 272                        | 128                                    |
| Technological                        | 0.825                       | 0.696                                  | 0.516                      |                                        |
| Non-technological                    | 1.949                       | 1.775                                  | 0.730                      |                                        |
| Mixed tech/non-tech                  | 7.792                       | 2.685                                  | 1.581                      |                                        |
| Secrecy only                         | 2.930                       | 0.731                                  | 0.240                      |                                        |
| Non-metro adjusted > 20,000 urban population, N | 1751                        | 781                                    | 1747                       | 778                                    |
| Technological                        | 2.781                       | 8.887                                  | 6.758                      |                                        |
| Non-technological                    | 3.274                       | 3.637                                  | 2.346                      |                                        |
| Mixed tech/non-tech                  | 4.481                       | 9.174                                  | 5.406                      |                                        |
| Secrecy only                         | 3.442                       | 2.297                                  | 1.577                      |                                        |
| Non-metro N adjusted > 20,000 urban population, N | 806                         | 347                                    | 803                        | 347                                    |
| Technological                        | 3.496                       | 3.222                                  | 2.756                      |                                        |
| Non-technological                    | 2.504                       | 3.980                                  | 2.597                      |                                        |
| Mixed tech/non-tech                  | 3.983                       | 22.568                                 | 14.222                     |                                        |
| Secrecy only                         | 2.897                       | 3.383                                  | 2.789                      |                                        |
| Non-metro adjusted 2500–19,900 urban population, N | 1994                        | 781                                    | 1994                       | 781                                    |
| Technological                        | 2.069                       | 1.782                                  |                            |                                        |

(Continued)
Table A2. Continued.

| Settlement type                        | Odds increasing market share | Innovative odds increasing market share | Odds entering export market | Innovative odds entering export market |
|----------------------------------------|------------------------------|----------------------------------------|----------------------------|----------------------------------------|
| Non-technological                      | 4.020                        | 2.078                                  | 4.860                      | 2.555                                  |
| Mixed tech/non-tech                    | 8.989                        | 4.394                                  | 5.001                      | 2.771                                  |
| Secrecy only                           | 3.857                        | 2.004                                  | 2.239                      | 1.632                                  |
| Non-metro N adjusted 2500–19,900 urban population, N | 1421                         | 562                                    | 1423                       | 564                                    |
| Technological                          | 7.853                        | 4.791                                  | 6.655                      | 1.682                                  |
| Non-technological                      | 3.796                        | 3.261                                  | 3.318                      | 1.601                                  |
| Mixed tech/non-tech                    | 4.441                        | 1.921                                  | 6.789                      | 3.071                                  |
| Secrecy only                           | 1.914                        | 1.736                                  | 1.844                      |                                        |
| Non-metro adjusted completely rural, N | 286                          | 121                                    | 282                        | 119                                    |
| Technological                          |                              |                                        |                            |                                        |
| Non-technological                      | 1.388                        | 0.584                                  | 0.350                      |                                        |
| Mixed tech/non-tech                    | 7.024                        | 2.496                                  | 2.002                      |                                        |
| Secrecy only                           | 4.430                        | 0.504                                  |                            |                                        |
| Non-metro N adjusted completely rural, N | 449                          | 141                                    | 452                        | 141                                    |
| Technological                          |                              |                                        |                            |                                        |
| Non-technological                      | 2.869                        | 8.796                                  | 4.655                      |                                        |
| Mixed tech/non-tech                    | 2.794                        | 15.772                                 | 11.110                     |                                        |
| Secrecy only                           | 2.186                        | 1.456                                  | 0.368                      |                                        |

Note: Odds ratios reported are significant at the 0.05. Two-digit industry controls are not shown. Source: 2014 Rural Establishment Innovation Survey (REIS).