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**An analysis of Market Channel Alternatives for the
U.S. Ornamental Plants Growers**

by Xuan Wei, Hayk Khachatryan, Ariana Torres, Robin
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An analysis of Market Channel Alternatives for the U.S. Ornamental Plants Growers

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Abstract

The introduction of internet-based process has gradually changed ornamental horticulture industry's marketing paradigm in the past two decades. Combing four waves of the National Nursery Survey from 2004-2019, we explore the relationship between firms' choices of entering wholesale markets, diversification of wholesale market channels, and market shares among major market channels. Over the survey period, traditional wholesale market channels such as landscape services companies, re-wholesalers, and single-location garden centers remained mainstream channels. Surveyed firms also reported 30% of their 2018 sales were generated from direct sales, indicating that direct-to-consumer channel, as a relatively new addition to the conventional channels, has the potential to gain significant market share. While sales are balanced across different market channels, there is a positive correlation between firms' perceived importance in production cost, labor costs and competitions, and the number of wholesale market channels. Plant types are important factors of firms' choices of entering a specific wholesale market channel. The housing price index (as a proxy for housing market trends) is positively associated with the landscape services channel's market share, but negatively associated with the re-wholesalers' market share. This relationship suggests a substitution effect between landscape services and re-wholesaler markets depending on the economic situation.

Keywords: fractional logit, market diversification, market channels, market share

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50 JEL Classifications: C50, M31, L14

51 **1. Introduction**

52 The ornamental horticulture industry provides important economic contributions to the U.S.
53 agricultural sector. Contributions include indirect and induced effects in other sectors estimated
54 at \$348 billion in output and 2.32 million jobs (Hall et al., 2020). In recent years, not counting
55 the surge in demand for houseplant categories due to the COVID-19 pandemic, the ornamental

56 horticulture industry has experienced diminishing revenue and shrinking profit margins
57 (Madigan, 2020). Considerable within-industry consolidation, increased competition, and
58 relatively weak consumer demand were some of the factors that contributed to the downward
59 trend (Hall, 2010; Madigan, 2020).

60 The industry's average annual sales revenue was about \$1.39 million per firm in 2018
61 (Khachatryan et al., 2020) compared to 1.83 million in 2013 (Hodges et al., 2015). The Census
62 of Horticultural Specialties showed a drastic reduction in number of producers (in all
63 horticultural specialty crops) from 23,221 in 2014 to 20,655 in 2019, while sales slightly
64 decreased in that same period from \$13.79 billion to \$13.78 billion (USDA, 2020). The plant and
65 flower growing sector in the U.S. (NAICS 11142) showed a similar pattern in the number of
66 business operations from 2011 to 2020 but gradually catching up in market size (Figure 1).

67 Meanwhile, the markets facing nursery producers have changed dramatically in the past
68 two decades. As a relatively low-cost but highly effective marketing method, digital marketing
69 can expand the boundary of wholesale and retail markets by complementing conventional
70 wholesale and retail channels. The rise in social media usage and online advertising has shifted
71 marketers' attention to new forms of promotion and advertising. Business to business (B2B)
72 online markets (e.g., Amazon.com) and social media platforms (e.g., blogs, Facebook, YouTube,
73 etc.) have been widely adopted for various B2B marketing objectives such as lead segmentation,
74 subscriber/customer engagement, and branding, to name a few (Bruce et al., 2012; Fan et al.,
75 2015; Järvinen et al., 2012; Vieira et al., 2019). The recent growth of consumer-generated
76 media (CGM) on major social media platforms such as Facebook or Instagram, and the creation
77 of digitally enabled communities have also fundamentally changed the interaction format
78 between consumers and firms (Thompson et al., 2007). The use of digital marketing can also be

79 a viable strategy for smaller, resource-constrained firms in the green industry to reach out to
80 customers (Peterson et al., 2018; Yao et al., 2018). Several recent studies have focused on the
81 role of social media marketing and its impact on sales in the ornamental horticulture industry
82 (Barton and Behe, 2017; Li et al., 2019; Palma et al., 2012; Peterson et al., 2018; Yao et al.,
83 2018). However, with the exception of Hinson et al. (2012), no studies exist on market access,
84 market diversification, and shifts among market channels within the ornamental horticulture
85 industry.

86 Understanding market structure by exploring how the number of firms in a market, firms'
87 sizes, potential competitors, and the extent of firms' product lines affect competition and firm
88 profits is the main focus of the field of industrial organization (IO)(Berry and Reiss, 2007).
89 Market diversification has been considered one of the most important strategic management
90 concepts for increasing market share and profitability, while minimizing business risk (Ayal and
91 Zif, 1979; Kotler and Keller, 2012). By increasing the access to markets, businesses in the
92 ornamental horticulture industry can better utilize physical and digital resources and improve
93 financial resilience to changes. In this study, we combine four waves of the National Nursery
94 Survey (2004, 2009, 2014 and 2019) to explore the relationship between firms' choices of
95 entering the wholesale market, diversification of wholesale market channels, and market shares
96 among major market channels. We primarily focus on wholesale market channels (e.g., mass
97 merchandiser retailers, home centers, garden centers, landscapers, and rewholsalers) which have
98 been traditionally used by ornamental horticulture business (Hinson et al., 2012). Observing
99 increasing use of digital marketing strategies in the ornamental horticulture industry along with
100 the changes in agricultural supply chains, the 2019 survey questionnaire included direct-to-
101 consumer (DTC) in addition to these aforementioned conventional market channels. We

102 therefore further investigate the interactions between DTC and other conventional wholesale
103 market channels separately using 2019 data only. With the ongoing consolidation within the
104 industry, uncertainty in demand for horticultural products and services, and an increasingly
105 competitive business landscape, exploring the availability of existing market channels and new
106 sales opportunities is critical for the industry firms to maintain competitiveness.

107 **2. Methods**

108 **2.1 Data**

109 The primary data used in our empirical analysis were the National Nursery Survey conducted by
110 the Green Industry Research Consortium at a five-year interval beginning in 1989. The National
111 Nursery Survey aimed to collect detailed information on the production and marketing practices
112 of ornamental plant growers and allied industries. As the survey's main content remained similar
113 over time, we were able to combine the four most recent surveys conducted in 2005, 2009, 2014,
114 and 2019 to create a larger longitudinal data set. The survey questionnaire consisted of six broad
115 sections, including general firm information (e.g., location, employment), nursery product types,
116 production and management practices, marketing and promotion practices, regional trade
117 patterns, and firm perceptions on factors affecting business. By combining four waves of data,
118 we aimed to provide a dynamic picture of the green industry since the mid 2000s.

119 Accounting for the significant variations in firm size and practices in the green industry, a
120 stratified random sampling procedure was adopted to ensure sample randomness and
121 representativeness. Based on the size of operation (e.g., open field, greenhouse), firms were
122 stratified by four sizes: very small, small, medium, and large firms. large and medium-sized
123 firms were purposely oversampled to reflect their dominant activities in the green industry as
124 well as to maximize response rate. A total of 2,485 firms in 2004, 3,044 firms in 2009, 2,657

125 firms in 2014 and 2,170 firms in 2019 responded and completed the survey. More detailed
126 information regarding the surveys' scope, sampling methodology and descriptive summary about
127 data can be found in Brooker et al. (2005) for the 2004 survey, in Hall et al. (2011) for the 2009
128 survey, in Hodges et al. (2015) for the 2014 survey, in Khachatryan et al. (2020) for the 2019
129 survey. In this study, a cross-sectional data was created by pooling all firms across four survey
130 years together. Table 1 illustrates the wholesale and retail market access reported by survey
131 year. Tables 2 and 3 summarize the wholesale market access proportions in a greater detail.
132 Table 2 presents the number of firms within each wholesale market outlet by survey year, while
133 Table 3 summarizes the number of firms associated with possible numbers of market channels.
134 Table 4 summarized the key variables included in our empirical analysis. We divided these
135 variables into four broad categories: regional indicator variables representing the firms' location,
136 major plant product types, firms' production characteristics and perceptions about factors
137 impacting product price formation and factors impacting business in general. It is worth noting
138 here that even though regional dummy variables were suppressed from our empirical results (i.e.,
139 Tables 5, 6.1 and 6.2), region and fixed effects were included in all regression analysis.

140 We supplemented the National Nursery Survey data with the 5-digit zip-code-level house
141 price index (HPI) in 2004, 2008, 2013, and 2018 to reflect the local housing markets, where the
142 participating ornamental plant growing firms were located.¹ While data on new constructions
143 and building developments can capture the pull mechanism of housing on the green industry, the
144 lack of data availability of such information throughout the analysis period motivates the use of
145 HPI information as an approximate. The HPI at 5-digit zip code level is a weighted, repeat-sales
146 index of single-family house prices, which is an accurate indicator of house price trends in the

¹ HPI data are available from the Federal Housing Finance Agency website (<https://www.fhfa.gov>).

147 local area. We normalized the HPI indices using the year 2000 as a base year to be consistent
148 across survey years.

149 Understanding green industry firms' choices of marketing channels is of our primary
150 interest. We first tabulated the numbers of firms entering wholesale or retail market. As shown in
151 Table 1, about two fifths of the ornamental plant grower firms have marketed their plants
152 through both retail and wholesale channels. Approximately 35% of ornamental plant firms
153 entered only wholesale markets and 25% entered only retail markets. The number of firms
154 engaged in wholesale, retail or both market channels were stable prior to the 2014 survey.
155 Likely due to the financial crisis from 2007 to 2009, a significant number of firms exited the
156 wholesale market (as revealed in the 2014 survey), while the proportion of firms entering the
157 retail market increased. By 2019, the number of firms engaged in wholesale markets bounced
158 back reaching 45% of the participating firms, while the number of firms engaged in retail
159 markets fell back to the pre-2009 level.

160 Given the importance of wholesale markets to the ornamental horticulture businesses, we
161 then consider a subset of firms engaged in the wholesale market (i.e., firms entered the wholesale
162 market only, and firms both wholesale and retail markets). A closer look at the wholesale market
163 outlets distribution in Table 2 reveals that garden centers (including both single location and
164 multiple locations), landscapers, and re-wholesalers used to be the dominant wholesale channels,
165 accounting for more than 80% of firm-level sales of ornamental plants. Even though the demand
166 from big-box stores has been growing, supply to mass merchandisers and home centers remains
167 low. In fact, the share of sales to big-box stores has been gradually decreasing over the past 15
168 years. On the other hand, the direct-to-consumer channel seized a market share of 30% in the
169 2019 survey. With the increasing availability of social media platforms, the direct-to-consumer

170 channel is gradually taking over the leading positions of landscapers and wholesalers and
171 becoming an expanding market segment.

172 In contrast, overall supply to the other six wholesale market outlets has declined with
173 major market channels (e.g., single and multiple location garden centers, landscaper and re-
174 wholesalers) almost down to half of their 2004 levels. Expansion in the direct-to-consumer
175 channel is consistent with the rising trend of digital marketing and online sales strategies in the
176 U.S. ornamental horticulture industry (Peterson et al., 2018; Yao et al., 2018; Torres, Barton, and
177 Behe, 2019). Table 3 demonstrates the diversity of firms' wholesale market channels based on
178 the numbers of wholesale market channels firms participated from 2004 to 2019. Even though
179 the number of firms selling through a single market channel has remained stable, the proportion
180 of those firms has increased from 33% to 53%, indicating firms are becoming more concentrated
181 on a single market segment instead of diversifying market channels. The number of firms selling
182 through more than one channel declined significantly after 2009 and was not yet restored to the
183 same levels by 2019. The size of firms selling through more than three market channels has been
184 shrinking, with only approximately 8% of firms in the 2014 and 2019. This may indicate that
185 changes in the industry and consumer demand for more environmentally friendly plants (e.g.,
186 Wei et al., 2020; Yue et al., 2016) have created bifurcation of the industry, in which larger
187 businesses relying on economies of scale are consolidating and selling larger amounts in fewer
188 wholesale channels. In contrast, smaller businesses rely on the consumer-generated media and
189 are accessing lower volumes but higher value market segments.

190 **2.2 Econometric Models**

191 *Wholesale market channel diversity: tobit model*

192 As shown in Table 1, some firms chose not to enter the wholesale market, so zero responses
 193 were observed. For example, over the period of 2004-2019, a total of 2,202 firms reported
 194 having retail sales only. On the other hand, some firms sold to only one major channel, while
 195 others used omni channel marketing approach (Table 3). Thus, the data on the number of
 196 wholesale market channels followed a pattern of a corner solution, where some responses were
 197 concentrated at zero levels, while others took on strictly positive values. Because of this data
 198 distribution, we employed a Type I tobit.

199 Following Wooldridge (2010), we used a latent variable formulation to exploit the
 200 diversity of wholesale market channels. The number of whole market channels c chosen by a
 201 firm was indicated by a latent variable c^* , which depended on firms' characteristics and other
 202 factors that influenced individual firms' choice. Assuming the error term u has a zero mean and
 203 variance σ^2 , the Type I tobit model could be written as following.

$$204 \quad c = \max[c^*, 0] \quad (1.1)$$

$$205 \quad c^* = \mathbf{x}\boldsymbol{\gamma} + u \quad (1.2)$$

$$206 \quad u|x \sim Normal(0, \sigma^2) \quad (1.3)$$

207 The probability density function for estimation can be presented as follows:

$$208 \quad f(c|\mathbf{x}) = [1 - \Phi(\mathbf{x}\boldsymbol{\gamma}/\sigma)]^{1[c=0]} [\sigma^{-1}\phi[(c - \mathbf{x}\boldsymbol{\gamma})/\sigma]]^{1[c>0]}. \quad (2)$$

209 The expected number of wholesale market channels utilized by firms is given by:

$$210 \quad E(c|\mathbf{x}) = P(c = 0|\mathbf{x}) \cdot 0 + P(c > 0|\mathbf{x}) \cdot E(c|\mathbf{x}, c > 0) \\
 211 \quad = \Phi(\mathbf{x}\boldsymbol{\gamma}/\sigma)\mathbf{x}\boldsymbol{\gamma} + \sigma\phi(\mathbf{x}\boldsymbol{\gamma}/\sigma). \quad (3)$$

212 For a random firm i , the associated log-likelihood function was estimated using the following:

$$213 \quad \ell_i(\boldsymbol{\gamma}, \sigma) = 1[c_i = 0]\log[1 - \Phi(\mathbf{x}_i\boldsymbol{\gamma}/\sigma)] + 1[c_i > 0]\{\log\phi[(c_i - \mathbf{x}_i\boldsymbol{\gamma})/\sigma] - \log(\sigma)\}$$

$$214 \quad (4)$$

215 *Factors influencing shares of major wholesale market channels*

216 To investigate factors influencing the share of the wholesale market channels, we used a
217 fractional logit model following Papke and Wooldridge (1996). As the dependent variable was
218 the proportion of sales through wholesale markets, i.e., with values ranging between zero and
219 one with corners at both zero and one, it was natural to consider two-limit tobit model as an
220 alternative approach.² However, a two-limit tobit model required a full set of distributional
221 assumptions including restrictive assumptions of homoskedasticity and normality of the error
222 term. Both heteroskedasticity and nonnormality will result in the tobit estimators being
223 inconsistent. On the other hand, a fractional logit model had a useful property that produced
224 consistent coefficient estimates and average partial effects (APEs) as long as the conditional
225 mean function was correctly specified. The APEs were of more interest here to understand
226 market share changes among different outlets since we have explored the firms' likelihood of
227 entering a wholesale market as well as choices of market channels in our previous two steps.

228 Letting s to be the share of the sales to a given wholesale market channel, the conditional
229 mean function could be expressed as

230
$$E(s|\mathbf{x}) = \exp(\mathbf{x}\boldsymbol{\delta})/[1 + \exp(\mathbf{x}\boldsymbol{\delta})]. \quad (5)$$

231 Conditional expectations could be obtained similar to the expectations in the standard
232 logit. Nonetheless, conditional expectations in a fractional logit model are on the mean and not
233 the response probability as in a logit model.

234 Following Papke and Wooldridge (1996) , a simple quasi-maximum likelihood estimator
235 (QMLE) method was used to estimate the Bernoulli log likelihood function,

236
$$\ell_i(\boldsymbol{\delta}) = \sum_{i=1}^N \{(1 - s_i)\log[1 - \Lambda(\mathbf{x}_i\boldsymbol{\delta})] + s_i\log[\Lambda(\mathbf{x}_i\boldsymbol{\delta})]\}, \quad (6.1)$$

²Hinson et al. (2012) used a two-limit tobit model emphasizing observations cornered at both zero and one.

237 or equivalently,

$$238 \ell_i(\boldsymbol{\delta}) = \sum_{i=1}^N \left\{ (1 - s_i) \log \left[\frac{1}{1 + \exp(x_i \boldsymbol{\delta})} \right] + s_i \log \left[\frac{\exp(x_i \boldsymbol{\delta})}{1 + \exp(x_i \boldsymbol{\delta})} \right] \right\}. \quad (6.2)$$

239 **3. Results**

240 **3.1 Factors influencing wholesale market channel diversification**

241 As shown in Table 4, 76% of the surveyed firms were from four major regions: Southeast (26%),
242 Northeast (20%), Midwest (18%), and Pacific (12%). This distribution is not surprising, as these
243 four regions are known as major production regions for floriculture and nursery crops and
244 include the 15 states used as primary production states in the USDA's Census of Horticulture.
245 The other 24% of firms in our survey were distributed across the other four regions.

246 Table 5 illustrates the coefficients and marginal effects of the likelihood of entering
247 wholesale markets. Firms located in the Great Plains and Midwest tended to be less diversified
248 than firms in the Southeast region (used as a base group in the regression model).

249 Overall, we found that plant types were important determinants of firms' choices of
250 market channel diversification. Having deciduous shade and flowering trees, broad-leaved
251 evergreen shrubs, narrow-leaved evergreen shrubs, evergreen trees, vines and ground covers, and
252 foliage is likely to increase the number of wholesale market channels. Specifically, having
253 evergreen shrubs and trees, and vines and ground covers extended firms' marketing outlets with
254 an additional wholesale market channel. Conversely, having bedding plants (vegetables, fruits,
255 and herbs) and Christmas trees narrowed firms' marketing channels. These results are consistent
256 with Torres et al. (2017) who reported broad-leaved crops were a primary plant type for larger
257 businesses in the industry, while Christmas trees tend to be sold by firms engaged in retail or
258 landscape installations.

259 In terms of firm characteristics, firms with longer years of operation participated in more
260 market channels than relatively younger firms. Firm size (measured by the numbers of
261 permanent, temporary employees, and firms' total sales value) impacted the choice of market
262 channel diversification. Firms with the largest number of permanent employees tended to have
263 more market channels, but firms with the most temporary employees or highest sales value were
264 not associated with more market channels. As expected, increasing the percentage of contracted
265 sales (Sales_contract) reduced firms' diversification in market channels. Contract grower firms
266 were restricted to their pre-commitment in selling their products to the specific party which could
267 limit their opportunities to explore other possible market channels. This finding aligns with
268 Torres et al. (2020) who found wholesale contracts are an indicative of larger volume customers
269 that are primarily available through wholesale markets. On the other hand, firms were more
270 likely to have more market channels if they contracted to other producers (D_COP), contracted
271 to garden centers (D_CGC), or contracted to mass merchandisers (D_CMM). It is not surprising
272 that contracting to garden centers or mass merchandisers increased market channels as garden
273 centers and mass merchandisers were two major market channels. Being contracted to garden
274 centers or mass merchandisers indicated that firms already secured one additional market
275 channel, all other factors (e.g., firm characteristics) held constant. Meanwhile, contracting to
276 other producers likely increased diversity of market channels as firms could combine with other
277 producers to explore other possible market channel opportunities. Businesses accessing these
278 markets may have implemented a series of sales and advertising procedures resulting an
279 augmented buyer network that allow them to reach more diverse markets.

280 In addition, firms with more negotiated sales or more sales to repeat customers were
281 likely to have more diversified market channels. Repeat customers may have referred businesses

282 to other potential buyers, thus increasing the market reach of businesses. Attending more
283 tradeshows was also likely to increase the number of firms' market channels. It seems that
284 tradeshows were an effective strategy to access more markets due to the face-to-face
285 relationships built at these events. Firms' perceptions toward production cost, labor and
286 competition remained as significant factors influencing firms' market channel selection. Firms
287 who perceived that production costs, labor costs and competition were major factors impacting
288 their product price and business performance, were more likely to use relatively more market
289 channels than other firms. These firms may be focused on developing efforts to reduce costs,
290 increase revenue, and increasing profit margin. The HPI had only a mild impact on the choice of
291 market channels, which could be due to the fact that accessing wholesale markets is farther from
292 end-users. Also, as a broad indicator of the housing market, HPI may be a much noisier than a
293 direct measure of new constructions and developments.

294 **3.2 Factors influencing market shares of major wholesale market channels**

295 Table 6 presents the estimated marginal effects of factors influencing shares of sales to the six
296 major market channels from the fractional logit model (estimated coefficients are reported in
297 Table A1).³ The impact of regional indicator variables on shares of sales varied across market
298 channels.⁴ The regional impact was particularly strong on market shares for single location
299 garden centers, which is not surprising as single location garden centers tend procure from
300 regional suppliers and sell locally. Another pattern was that firms located in Midwest and
301 Mountain regions sold more to landscape firms but less to re-wholesalers (e.g., brokers) than did
302 firms in other regions. Conversely, the opposite holds for firms located in the Pacific region,

³ The DTC market channel was only included in the 2019 Survey. Therefore, there are only six market channels for the combined data. A separate analysis for the 2019 survey only with seven market channels was also conducted and results were reported in Tables A2 and A3.

⁴ The coefficients of regional and year dummies were suppressed from the results tables (Tables 5 and 6), but available from authors upon request.

303 which sold relatively less to landscapers, but more to re-wholesalers than did firms in other
304 regions. This indicates market substitution might occur not only between landscapers and re-
305 wholesalers within the same region, but also across different regions.

306 The role of plant types in determining market channel diversification is more evident
307 when investigating the market share of each market channel. Increasing production in
308 herbaceous perennials, bedding plants, flowering potted plants, tree fruits, foliage and
309 propagated materials categories was likely to increase market shares of mass merchandisers. One
310 explanation may be this type of plant material has been reported as the leading plant category for
311 mass merchandisers as they try to appeal to homeowners (Andrade and Hinson, 2009).

312 For sales to home centers, most plants except narrow-leaved evergreen shrubs, evergreen
313 trees had a significant impact on market shares, which was expected as home centers deal with a
314 wide variety of plant types. Firms selling herbaceous perennials, bedding plants (including
315 flowering annuals, vegetables, fruits, and herbs), and flowering potted plants were more likely to
316 supply to mass merchandisers, home centers and single location garden centers. In contrast, firms
317 producing bedding plants (e.g., vegetables, fruits, and herbs) were less likely to sell to channels
318 such as landscapers and re-wholesalers. Growers who produce roses, herbaceous perennials,
319 bedding plants and flowing potted plants may consider home centers and single location garden
320 centers as two complementary market channels, as increases in producing these plant types were
321 likely to increase market shares in both home centers and single location garden centers. Not
322 surprisingly, having sod production was found to only affect market shares to home centers
323 (positive), landscaping companies (positive) and re-wholesalers (negative). The fact that sod
324 growers are more likely to access landscapers has important implications to the growth of the sod
325 industry. Torres et al. (2017) reported sod as a major plant type purchased by landscaper,

326 especially large operations that primarily focused on the installment of commercial and
327 residential developments.

328 In addition, firms producing shrubs and trees, vines, and ground covers had large market
329 shares with landscaping companies. Interestingly, we found some evidence of shifting sales
330 between landscapers and re-wholesalers, indicating these two marketing channels could be
331 substitute markets for the similar plant types. For example, increasing broad-leaved evergreen
332 shrubs production by 100% increased market share in landscapers by 0.12 percentage point, but
333 reduced market share to re-wholesalers by about 0.16 percentage point. A similar pattern was
334 observed for vines and ground covers and sod. For foliage and propagated materials, market
335 shares shifted away from landscapers to re-wholesalers.

336 In terms of firm characteristics, firms' age had a relatively small impact on increasing
337 sales to multiple location garden center and landscaping companies, but not on sales to other
338 market channels. Firms with the most permanent employees tended to have more market share in
339 the home centers channel but less market share in mass merchandisers compared to other firms.
340 On the other hand, firms with the most temporary employees tended to sell more to mass
341 merchandisers than to landscapers. This could be attributed to the fact that plants sold to mass
342 merchandisers and home centers (such as bedding plants, flowering potted plants, tree fruits,
343 foliage) demanded more labor input, particularly low-skilled temporary workers. In addition,
344 firms selling to home centers tend to have longer contracts and invest in automated processes
345 that require less labor which help cutting production costs (Wheeler et al., 2018).

346 Total sale value and other firms' size were found to only influence market shares to
347 landscapers and re-wholesalers. Firms with large total sales values tended to sell more of their
348 products to landscapers, but less to re-wholesalers. An explanation may be that accessing

349 landscaper markets can help ornamental horticulture businesses to increase revenues, as long as
350 they are able to grow the plant material these buyers demanded. Contracted sales largely reduced
351 firms' sales shares to garden centers but increased sales share to re-wholesalers. Particularly,
352 contracting to other producers were likely to increase sales to re-wholesalers (17 percentage
353 points) by diverting sales from garden centers (-8.4 percentage points) and landscapers (-8.6
354 percentage points). In contrast, contracting to garden centers increased sales to both single-
355 location garden centers (by 18.9 percentage points) and multiple-location garden centers (by 3.8
356 percentage points). This increase in sales shares came from sales cuts primarily in landscapers (-
357 13.8 percentage points), re-wholesalers (-12.3 percentage points), and slightly in mass
358 merchandisers (-1.5 percentage points). It is interesting to note that contracting sales had a higher
359 impact to single-location garden centers than multiple-location ones, which is consistent with the
360 literature reporting that growers used as selling to reduce the transactions costs and number of
361 transactions (Masten, 2000).

362 Similarly, contracting to mass merchandisers significantly increased firms' sales to mass
363 merchandisers and home centers by simultaneously decreasing sales to three market channels,
364 including single-location garden centers, landscapers, and re-wholesalers. Nonetheless, unlike
365 the previous two contracting methods, the impact of contracting to mass merchandisers was
366 asymmetric. Gain in increased market shares from both mass merchandisers and home centers
367 (10.3 percentage points total) was significantly smaller than the decreased market shares from
368 the other three major market shares (-40.7 percentage points). Increasing sales that were
369 negotiated were likely to divert market share from single-location garden centers and
370 landscaping companies to mass merchandisers. On the other hand, increasing sales with repeat

371 customers were likely to shift sales from landscaping companies to multi-location garden centers
372 and wholesalers.

373 Interestingly, while attending trade shows had a significant influence on firms' decisions
374 of entering multiple wholesale market channels, the number of trade shows had little impact on
375 market sales of major market channels. It is likely trade shows allow firms to have face-to-face
376 interactions with potential buyers, which can help them focus on those that are more profitable.
377 On the other hand, firms with more internet expenditures than other firms tended to have slightly
378 more sales to single-location garden centers, but less to landscapers and wholesalers than other
379 firms.

380 As an indicator of potential demand for ornamental plants, increases in the HPI increased
381 firms' sales shares to landscapers who were closely related to the housing market by redirecting
382 sales from re-wholesalers to landscapers. The demand from landscapers went up due to the
383 buoyant housing market in the last two decades (Landvoigt et al., 2015), which has had an
384 impact on the demand of landscape companies and the ornamental horticulture industry. In line
385 with Hinson et al. (2012), the major wholesale market channels were generally substituting to
386 each other. However, this pattern was particularly persistent for sales between landscapers and
387 re-wholesalers. In contrast, sales to multi-location garden centers tended not to sell to other
388 market channels.

389 The fractional logit model was estimated separately for the 2019 survey data only as the
390 2019 survey included DTC sales as a new wholesale market channel. Tables A2-A3 in the
391 Appendix section summarize the results. Producing landscape plants such as evergreen shrubs
392 and trees, vines and ground cover, foliage, and sod decreased market shares in the DTC markets,
393 while producing bedding plants increased the share to DTC. It seems that the DTC channel offers

394 more diverse opportunities for the firms that grow bedding plants. In addition, small-scale firms
395 with relatively more temporary employees (as opposed to permanent employees) tended to have
396 more DTC marketing. Firms with a contract to other producers or sales to repeated customers
397 had fewer market shares in the DTC market. In general, the pattern of substituting among major
398 whole market shares was persistent in 2019.

399 **Conclusions**

400 The ornamental horticulture industry was among the fastest-growing agricultural industries in the
401 1980s and 1990s (Khachatryan et al., 2020). As the industry gradually reached the mature stage
402 of its life cycle (Hall, 2010), digital advertising and the possibility to access to profitable markets
403 became critical to increasing market share, generate profit, and maintain competitiveness among
404 peers. In this study, we explored the relationship between firm's production and business
405 characteristics and choices of entering the wholesale market, diversification of wholesale market
406 channels, and market shares among major market channels. To the best of our knowledge, this is
407 the first study to comprehensively analyze firms' wholesale market channel choices in the U.S.
408 ornamental horticulture industry. We use the number of wholesale market channels (extensive
409 margin) and market share of each channel (intensive margin) to measure market channel
410 diversification. Based on the results from the 2019 survey data, we also find that the DTC
411 channel has overtaken some conventional wholesale market channels such as landscapers and re-
412 wholesalers, becoming a leading marketing channel. This finding is consistent with the rising
413 trend of Internet marketing strategies in the U.S. Ornamental horticulture industry (Peterson et
414 al., 2018; Yao et al., 2018; Torres, Barton, and Behe, 2019).

415 Even though traditional market channels such as garden centers, landscaping companies,
416 and re-wholesalers remained mainstream, the wide use of the Internet along with a wide range of

417 social media and online sales platforms has gradually changed the marketing paradigm. While
418 firms still maintain omni-channel marketing strategies to reduce market uncertainty and balance
419 sales across different market channels, increasing number of firms have become more
420 concentrated in one major wholesale market. We find landscapers and re-wholesalers are
421 apparent substitutes to each other, which suggests a market substitution effect between these two
422 channels.

423 Growers who perceived production cost, labor costs and competitions as more important
424 factors affecting their business, tend to be more diversified and have more wholesale market
425 channels. Plant types are important predictors of firms' choices of entering a specific wholesale
426 market channel. Past research has linked improvements in residential landscapes to increased
427 real property values. In this paper we propose a direct relationship between changes in the
428 housing market and the ornamental horticultural industry's performance. The HPI is a strong
429 predictor of market share. The HPI is positively associated with the market share of landscaping
430 companies, but negatively associated with the market share of re-wholesalers. The sales among
431 major wholesale markets depending on the economic situation and reallocating among major
432 wholesale market channels. With improving economic conditions, we are likely to observe more
433 sales directed from re-wholesalers to landscaping companies.

434 These findings are critical to our understanding of the market structure of the green
435 industry. They provide answers to the question what determines, over time, the set of firms
436 present in the green industry. The results will help to enable participants in the green industry in
437 making strategic decisions regarding competitiveness of entering a specific market channel and
438 market diversification. In addition, policy makers have better information to inform their
439 decisions regarding efficient allocation of resources (e.g., water and labor) among competing

440 industries and interests. Our results could be generalized to assist policy makers, growers, and
441 researchers interested in understanding market competition and diversification across specialty
442 crops industries. Given the types of product offering, growers may consider either concentrating
443 on a single market or diversifying across multiple markets to mitigate potential market risk
444 exposure, and decide which option best suits the short- and long-term goals of their operations.

445

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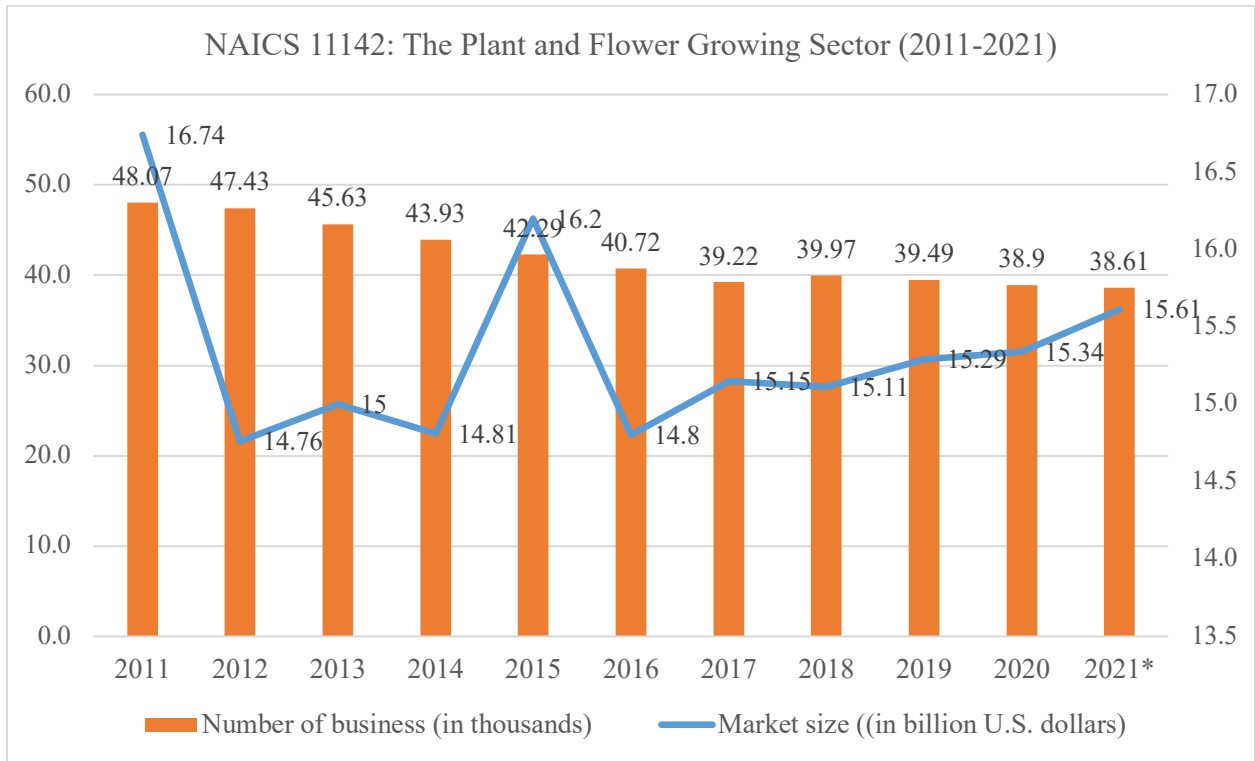
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565 Figure 1. The Plant and Flower Growing Sector (NAICS 11142) in the US from 2011 to 2021



566

567 Source: IBIS World.

568 Note: * Values for 2021 are forecast.

569 Table 1: Market channels (2004-2019)

Survey Year	Market Channels					
	Wholesale only		Retail only		Both	
	Frequency	(%)	Frequency	(%)	Frequency	(%)
2004	903	(37.36)	470	(19.45)	1,044	(43.19)
2009	911	(34.11)	588	(22.01)	1,172	(43.88)
2014	534	(24.42)	804	(36.76)	849	(38.82)
2019	767	(45.49)	340	(20.17)	579	(34.34)
Total	3,115	(34.76)	2,202	(24.57)	3,644	(40.67)

570

571 Table 2: Distribution of wholesale market outlet channels (2004-2019)

Survey Year	Wholesale Market Outlets ^a						
	Mass Merchandiser	Home Center	Single location GC	Multiple location GC	Landscaper	Re-wholesaler	Direct-to-consumer ^b
2004	215 (8.65%)	229 (9.22%)	982 (39.52%)	468 (18.83%)	1,322 (53.20%)	1,138 (45.79%)	-
2009	168 (5.52%)	197 (6.47%)	1018 (33.44%)	305 (10.02%)	1,309 (43.00%)	1,140 (37.45%)	-
2014	88 (3.31%)	105 (3.95%)	650 (24.46%)	151 (5.68%)	801 (30.15%)	685 (25.78%)	-
2019	64 (2.95%)	69 (3.18%)	391 (18.02%)	101 (4.65%)	440 (20.28%)	460 (21.20%)	642 (29.59%)
Total	535 (5.17%)	600 (5.79%)	3041 (29.36%)	1025 (9.90%)	3872 (37.39%)	3423 (33.05%)	642 (6.20%)

572 Notes: ^aThe percentages of all wholesale market outlets do not necessarily sum up to 100% as growers may be engaged in
573 multiple market outlets (see Table 3 for more details). ^b Category “Direct-to-consumer” was only included in the 2019 survey.

574 Table 3: Diversity of wholesale market outlet channels

Survey Year	Number of Wholesale Market Outlets ^a					
	1	2	3	4	5	6 and more ^b
2004	632 (33.42%)	531 (28.08%)	380 (20.10%)	246 (13.01%)	76 (4.02%)	26 (1.37%)
2009	746 (38.16%)	572 (29.26%)	393 (20.10%)	170 (8.70%)	56 (2.86%)	18 (0.92%)
2014	681 (50.26%)	365 (26.94%)	207 (15.28%)	72 (5.31%)	20 (1.48%)	10 (0.74%)
2019	628 (52.55%)	302 (25.27%)	167 (13.97%)	66 (5.52%)	25 (2.09%)	7 (0.58%)

575 Notes: ^a Six wholesale market outlets considered here are: Mass merchandisers, Home centers Single-location
576 garden centers, Multiple location garden centers, Landscape firms, Re-wholesalers. ^b Direct-to-consumer was only
577 included in 2019 Survey and only 3 firms reported participation in all seven wholesale market channels in 2019.

578 Table 4: Summary statistics from the National Nursery Survey for year 2005, 2009 and 2013

Variable	Unit	Mean	SD
Region			
Appalachian	Binary (1, if Yes)	0.11	0.31
Great Plains	Binary (1, if Yes)	0.02	0.15
Midwest	Binary (1, if Yes)	0.18	0.38
Mountain	Binary (1, if Yes)	0.04	0.19
Northeast	Binary (1, if Yes)	0.20	0.40
Pacific	Binary (1, if Yes)	0.12	0.33
Southcentral	Binary (1, if Yes)	0.07	0.26
Southeast	Binary (1, if Yes)	0.26	0.44
Plant types			
PT1: Deciduous shade and flowering trees	Percent (%)	10.36	21.92
PT2: Deciduous shrubs	Percent (%)	4.66	12.07
PT3: Broad-leaved evergreen shrubs	Percent (%)	6.06	15.72
PT4: Narrow-leaved evergreen shrubs	Percent (%)	2.43	8.51
PT5: Evergreen trees	Percent (%)	8.50	21.19
PT6: Vines and ground covers	Percent (%)	1.98	8.33
PT7: Roses	Percent (%)	1.45	7.00
PT8: Herbaceous perennials	Percent (%)	8.18	20.95
PT9: Bedding plants- flowering annuals	Percent (%)	8.80	20.60
PT10: Bedding plants-vegetables, fruits, & herbs	Percent (%)	5.60	16.46
PT11: Flowering potted plants	Percent (%)	5.42	17.07
PT12: Christmas trees	Percent (%)	4.90	19.48
PT13: Tree fruits	Percent (%)	2.42	12.53
PT14: Foliage	Percent (%)	3.54	15.79
PT15: Sod	Percent (%)	1.05	9.12
PT16: Propagated materials	Percent (%)	3.12	14.31
Business and production characteristics			
Age: age of firm	Number	25.11	21.95
Perm: No. of permanent employees	Number	10.79	51.58
Temp: No. of temporary employee	Number	9.15	33.70
Sale: Total sales value of firm	Dollars (in \$100,000)	15.11	62.41
Sale_contract: Sales under contract	Percent (%)	8.78	22.61
Sale_nego: share of negotiated sales	Percent (%)	17.13	29.64
Sale_repeat: share of sales to repeat customers	Percent (%)	72.10	27.26
D_COP: Contract to other producers	Binary (1, if positive)	0.09	0.29
D_CGC: Contract to garden centers	Binary (1, if positive)	0.07	0.26
D_CMM: Contract to mass merchandisers	Binary (1, if positive)	0.03	0.16
Tradeshows: No. of trade shows attended	Number	1.04	3.54
Ad_internet: internet advertisement expenses	Dollars (in \$100,000)	0.07	1.01
Ad_tradeshows: tradeshow expenses	Dollars (in \$100,000)	0.08	2.08
Firm perceptions of factors that impact price and business^a			

Unique: Product uniqueness	Likert (1-4)	2.88	1.07
Other_price: Other growers' prices	Likert (1-4)	2.70	1.01
Cost: Production cost	Likert (1-4)	3.23	1.00
Labor	Likert (1-4)	2.61	1.13
Compete: Competition/Price undercutting	Likert (1-4)	2.53	1.08
Demand: Market demand	Likert (1-4)	3.22	0.96
Housing Price Index			
HPI: House price index at 5-digit zip code level ^b	Number	142.17	27.02
HPI_change: percentage change of HPI	Percent (%)	1.74	7.76

579 Notes: ^a Producers were asked to rate the importance of the factors that impact the prices of their
580 products and business on a 4-point Likert scale with 1 indicating not important and 4 indicating
581 very important. ^b Year 2000 is used as the base year to normalize HPI. For firms located in a 5-
582 digit zip code area where the HPI is missing, the state-level HPI is used.
583

584 Table 5: Likelihood of entering wholesale market outlets: results from Tobit model

Variable	Coefficients	Sta. Err.	Marginal Effects	Sta. Err.
Plant types				
PT1: Deciduous shade and flowering trees	0.008***	(0.001)	0.006***	(0.001)
PT2: Deciduous shrubs	0.003	(0.002)	0.003	(0.002)
PT3: Broad-leaved evergreen shrubs	0.012***	(0.001)	0.009***	(0.001)
PT4: Narrow-leaved evergreen shrubs	0.009***	(0.003)	0.007***	(0.002)
PT5: Evergreen trees	0.006***	(0.001)	0.005***	(0.001)
PT6: Vines and ground covers	0.010***	(0.003)	0.008***	(0.002)
PT7: Roses	-0.002	(0.004)	-0.001	(0.003)
PT8: Herbaceous perennials	0.003*	(0.001)	0.002*	(0.001)
PT9: Bedding plants- flowering annuals	-0.001	(0.001)	-0.001	(0.001)
PT10: Bedding plants-vegetables, fruits, & herbs	-0.007***	(0.002)	-0.005***	(0.001)
PT11: Flowering potted plants	0.004**	(0.002)	0.003**	(0.001)
PT12: Christmas trees	-0.003**	(0.002)	-0.003**	(0.001)
PT13: Tree fruits	0.000	(0.002)	0.000	(0.002)
PT14: Foliage	0.007***	(0.002)	0.005***	(0.001)
PT15: Sod	0.005*	(0.003)	0.004*	(0.002)
PT16: Propagated materials	-0.002	(0.001)	-0.002	(0.001)
Business and production characteristics				
Age	0.004***	(0.002)	0.003***	(0.001)
Perm	0.003***	(0.001)	0.002**	(0.001)
Temp	0.002*	(0.001)	0.001*	(0.001)
Sale	0.000	(0.001)	0.000	(0.001)
Sale contract	-0.005***	(0.001)	-0.004***	(0.001)
D_COP	0.510***	(0.075)	0.407***	(0.060)
D_CGC	0.979***	(0.075)	0.783***	(0.059)
D_CMM	0.882***	(0.132)	0.705***	(0.106)
Sale nego	0.005***	(0.001)	0.004***	(0.001)
Sale repeat	0.015***	(0.001)	0.012***	(0.001)
Tradeshaw	0.046***	(0.012)	0.019***	(0.005)
Ad internet	-0.022	(0.033)	-0.003	(0.008)
Ad tradeshaw	0.001	(0.010)	0.075	(0.137)
Firm perceptions of factors that impact price and business				
Unique	-0.024	(0.024)	-0.003	(0.007)
Other_price	0.029	(0.024)	-0.000	(0.007)
Cost	0.068**	(0.027)	0.026***	(0.007)
Labor	0.091**	(0.024)	0.013**	(0.007)
Compete	0.096***	(0.025)	0.019***	(0.007)
Demand	0.036	(0.029)	0.004	(0.008)
Housing Price Index				
HPI	0.002*	(0.001)	0.001*	(0.000)

Constant	-1.295***	(0.226)	---
No. of Observations	4,131		---
Log likelihood	-6540.02		---
Pseudo R ²	0.102		---

585 Notes: a). Robust standard errors are in parentheses. b). ***, **, and * represent significance
586 level at the 1%, 5% and 10%, respectively. c). Region and year fixed effects are included but
587 suppressed from the table.

Table 6: Impacts on shares of major wholesale market channels: Marginal effects from fractional logit model

Variable	Mass Merchandiser		Home Centers		Single location GC		Multiple location GC		Landscaper		Re-wholesaler	
	Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients	
Plant types												
PT1: Deciduous shade and flowering trees	-0.0007	***	0.0002	*	-0.0008	**	0.0001		0.0013	***	-0.0002	
	(0.0002)		(0.0001)		(0.0003)		(0.0001)		(0.0003)		(0.0002)	
PT2: Deciduous shrubs	-0.0002		0.0003	*	0.0002		-0.0001		0.0010	*	-0.0008	
	(0.0003)		(0.0002)		(0.0005)		(0.0002)		(0.0006)		(0.0005)	
PT3: Broad-leaved evergreen shrubs	-0.0003		0.0006	***	0.0009	***	-0.0002		0.0012	***	-0.0016	***
	(0.0002)		(0.0001)		(0.0003)		(0.0001)		(0.0004)		(0.0004)	
PT4: Narrow-leaved evergreen shrubs	-0.0002		0.0001		0.0005		0.0000		0.0015	**	-0.0006	
	(0.0003)		(0.0002)		(0.0006)		(0.0003)		(0.0008)		(0.0007)	
PT5: Evergreen trees	-0.0004	**	-0.0002		0.0001		0.0002	*	0.0005		-0.0002	
	(0.0002)		(0.0002)		(0.0003)		(0.0001)		(0.0003)		(0.0003)	
PT6: Vines and ground covers	-0.0003		0.0005	***	0.0005		0.0002		0.0016	***	-0.0017	***
	(0.0002)		(0.0002)		(0.0005)		(0.0002)		(0.0006)		(0.0006)	
PT7: Roses	-0.0003		0.0005	***	0.0018	**	0.0002		0.0005		-0.0027	*
	(0.0002)		(0.0002)		(0.0008)		(0.0002)		(0.0008)		(0.0015)	
PT8: Herbaceous perennials	0.0001	**	0.0004	***	0.0009	***	0.0003	***	-0.0005		-0.0012	***
	(0.0001)		(0.0001)		(0.0003)		(0.0001)		(0.0003)		(0.0004)	
PT9: Bedding plants- flowering annuals	0.0003	*	0.0006	***	0.0013	***	0.0001		0.0003		-0.0026	***
	(0.0001)		(0.0001)		(0.0003)		(0.0001)		(0.0004)		(0.0004)	
PT10: Bedding plants-vegetables, fruits, & herbs	0.0002	**	0.0006	***	0.0017	***	-0.0001		-0.0034	***	-0.0018	***
	(0.0002)		(0.0001)		(0.0004)		(0.0003)		(0.0007)		(0.0006)	
PT11: Flowering potted plants	0.0004	***	0.0005	***	0.0015	***	0.0002		-0.0034	***	0.0001	
	(0.0001)		(0.0001)		(0.0003)		(0.0001)		(0.0005)		(0.0004)	
PT12: Christmas trees	0.0003		0.0006	***	0.0008	**	0.0004	***	-0.0012	***	-0.0004	
	(0.0002)		(0.0001)		(0.0004)		(0.0001)		(0.0004)		(0.0004)	

PT13: Tree fruits	0.0002	**	0.0006	***	0.0006		-0.0001		-0.0022	***	0.0005	
	(0.0002)		(0.0001)		(0.0005)		(0.0003)		(0.0006)		(0.0004)	
PT14: Foliage	0.0002	**	0.0005	***	0.0003		0.0003	***	-0.0032	***	0.0016	***
	(0.0001)		(0.0001)		(0.0004)		(0.0001)		(0.0004)		(0.0003)	
PT15: Sod	-0.0002		0.0006	***	-0.0009	*	0.0000		0.0032	***	-0.0029	***
	(0.0003)		(0.0001)		(0.0005)		(0.0002)		(0.0006)		(0.0002)	
PT16: Propagated materials	-0.0004	***	0.0003	*	-0.0004		-0.0001		-0.0040	***	0.0027	***
	(0.0001)		(0.0002)		(0.0004)		(0.0002)		(0.0006)		(0.0002)	
Business and production characteristics												
Age	0.0000		0.0001		-0.0001		0.0001	**	0.0006	**	-0.0002	
	(0.0001)		(0.0001)		(0.0002)		(0.0001)		(0.0003)		(0.0003)	
Perm	-0.0001	**	0.0001	***	0.0000		0.0000		0.0000		-0.0002	
	(0.0000)		(0.0000)		(0.0002)		(0.0000)		(0.0002)		(0.0002)	
Temp	0.0001	***	0.0000		0.0001		0.0000		-0.0013	***	0.0002	
	(0.0000)		(0.0000)		(0.0002)		(0.0000)		(0.0003)		(0.0001)	
Sale	0.0000		0.0000		-0.0001		0.0000		0.0003	**	-0.0003	**
	(0.0000)		(0.0000)		(0.0001)		(0.0000)		(0.0001)		(0.0001)	
Sale contract	0.0000		0.0000		-0.0008	***	-0.0002		-0.0001		0.0008	***
	(0.0001)		(0.0001)		(0.0003)		(0.0001)		(0.0003)		(0.0003)	
D_COP	0.0035		-0.0054		-0.0837	***	-0.0064		-0.0864	***	0.1706	***
	(0.0065)		(0.0050)		(0.0149)		(0.0051)		(0.0188)		(0.0146)	
D_CGC	-0.0146	**	0.0039		0.1891	***	0.0376	***	-0.1382	***	-0.1232	***
	(0.0061)		(0.0045)		(0.0129)		(0.0054)		(0.0190)		(0.0179)	
D_CMM	0.0643	***	0.0393	***	-0.1578	***	0.0052		-0.1746	***	-0.0835	***
	(0.0062)		(0.0053)		(0.0251)		(0.0073)		(0.0375)		(0.0271)	
Sale nego	0.0004	***	0.0001	*	-0.0005	***	0.0000		-0.0004	**	0.0003	*
	(0.0001)		(0.0001)		(0.0002)		(0.0001)		(0.0002)		(0.0002)	
Sale repeat	0.0001		0.0002		0.0005	*	0.0007	***	-0.0017	***	0.0011	***
	(0.0001)		(0.0001)		(0.0003)		(0.0001)		(0.0003)		(0.0003)	
Tradeshaw	0.0002		-0.0001		-0.0005		0.0005	*	-0.0016		0.0026	**
	(0.0003)		(0.0003)		(0.0009)		(0.0003)		(0.0018)		(0.0012)	
Ad internet	-0.0077	*	-0.0003		0.0199	***	0.0002		-0.0224	***	-0.0357	**

	(0.0043)		(0.0013)		(0.0074)		(0.0012)		(0.0086)		(0.0179)	
Ad tradeshow	-0.0010		0.0000		-0.0038	**	0.0004		-0.0035		0.0074	
	(0.0018)		(0.0004)		(0.0018)		(0.0003)		(0.0037)		(0.0046)	
Firm perceptions of factors impacting price and business												
Unique	-0.0014		0.0007		0.0025		-0.0023		0.0034		-0.0079	
	(0.0022)		(0.0019)		(0.0050)		(0.0019)		(0.0062)		(0.0054)	
Other price	0.0010		-0.0012		-0.0087	*	0.0001		0.0003		0.0081	
	(0.0023)		(0.0020)		(0.0051)		(0.0020)		(0.0064)		(0.0057)	
Cost	0.0053	*	-0.0015		0.0019		0.0058	**	-0.0121	*	-0.0001	
	(0.0031)		(0.0021)		(0.0054)		(0.0024)		(0.0068)		(0.0060)	
Labor	0.0059	**	-0.0010		-0.0128	**	0.0008		0.0203	***	0.0091	
	(0.0026)		(0.0023)		(0.0054)		(0.0021)		(0.0063)		(0.0002)	
Compete	0.0049	*	-0.0019		0.0001		-0.0002		0.0076		-0.0055	
	(0.0028)		(0.0025)		(0.0055)		(0.059)		(0.0067)		(0.0061)	
Demand	-0.0058		0.0037		-0.0036		-0.0023		-0.0204	***	0.0160	**
	(0.0036)		(0.0026)		(0.0065)		(0.0024)		(0.0077)		(0.0075)	
HPI	-0.0002		0.0001		-0.0004	*	-0.0001		0.0008	***	-0.0006	**
	(0.0001)		(0.004)		(0.0002)		(0.0001)		(0.0003)		(0.0003)	
No. of Observations	3,154		3,154		3,154		3,154		3,154		3,154	

Notes: a). Robust standard errors are in parentheses. b). ***, **, and * represent significance level at the 1%, 5% and 10%, respectively. c). Region and year fixed effects are included, but suppressed from the table.

Appendix:

Table A1: Impacts on shares of major wholesale market channels: Estimated coefficients from fractional logit model

Variable	Mass Merchandiser		Home Centers		Single location GC		Multiple location GC		Landscape		Re-wholesaler	
	Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients	
Plant types												
PT1: Deciduous shade and flowering trees	-0.024	***	0.010	*	-0.005	**	0.002		0.006	***	-0.002	
	(0.007)		(0.006)		(0.002)		(0.003)		(0.001)		(0.002)	
PT2: Deciduous shrubs	-0.010		0.011	*	0.001		-0.002		0.005	*	-0.005	
	(0.009)		(0.007)		(0.004)		(0.006)		(0.003)		(0.003)	
PT3: Broad-leaved evergreen shrubs	-0.010		0.023	***	0.006	***	-0.005		0.006	***	-0.010	***
	(0.006)		(0.005)		(0.002)		(0.003)		(0.002)		(0.002)	
PT4: Narrow-leaved evergreen shrubs	-0.006		0.005		0.003		0.000		0.008	**	-0.004	
	(0.009)		(0.009)		(0.004)		(0.008)		(0.001)		(0.005)	
PT5: Evergreen trees	-0.014	**	-0.00		0.000		0.006	*	0.003		-0.001	
	(0.007)		(0.008)		(0.002)		(0.004)		(0.004)		(0.002)	
PT6: Vines and ground covers	-0.009		0.019	***	0.004		0.005		0.008	***	-0.011	***
	(0.007)		(0.007)		(0.004)		(0.006)		(0.003)		(0.004)	
PT7: Roses	-0.004		0.021	***	0.012	**	0.007		0.003		-0.017	*
	(0.007)		(0.007)		(0.005)		(0.007)		(0.004)		(0.010)	
PT8: Herbaceous perennials	0.009	**	0.018	***	0.007	***	0.009	***	-0.003		-0.007	***
	(0.004)		(0.005)		(0.002)		(0.004)		(0.002)		(0.002)	
PT9: Bedding plants-flowering annuals	0.007	*	0.024	***	0.009	***	0.003		0.001		-0.016	***
	(0.004)		(0.004)		(0.002)		(0.004)		(0.002)		(0.003)	
PT10: Bedding plants-vegetables, fruits, & herbs	0.012		0.024	***	0.012	***	-0.002		-0.018	***	-0.011	***
	(0.006)		(0.004)		(0.003)		(0.009)		(0.004)		(0.004)	
PT11: Flowering potted plants	0.011	***	0.022	***	0.011	***	0.005		-0.017	***	0.001	
	(0.004)		(0.004)		(0.002)		(0.003)		(0.002)		(0.002)	
PT12: Christmas trees	0.005	**	0.026	***	0.005	**	0.011	***	-0.006	***	-0.003	
	(0.009)		(0.005)		(0.003)		(0.004)		(0.002)		(0.003)	

	(0.145)		(0.053)		(0.052)		(0.035)		(0.044)		(0.113)	
Ad tradeshow	-0.033		0.000		-0.027	**	0.012		-0.018		0.047	
	(0.062)		(0.018)		(0.012)		(0.008)		(0.019)		(0.029)	
Firm perceptions of factors impacting price and business												
Unique	-0.049		0.028		0.018		-0.066		0.018		-0.049	
	(0.076)		(0.075)		(0.035)		(0.054)		(0.032)		(0.034)	
Other price	0.034		-0.051		-0.061	*	0.044		0.002		0.051	
	(0.080)		(0.080)		(0.036)		(0.059)		(0.033)		(0.036)	
Cost	0.182	*	-0.063		0.013		0.167	**	-0.062	*	0.000	
	(0.105)		(0.087)		(0.038)		(0.067)		(0.035)		(0.037)	
Labor	0.201	**	-0.042		-0.089	**	0.022		0.104	***	0.057	
	(0.089)		(0.094)		(0.036)		(0.060)		(0.032)		(0.036)	
Compete	0.166	*	-0.077		0.001		-0.005		0.039		-0.035	
	(0.096)		(0.101)		(0.039)		(0.059)		(0.034)		(0.039)	
Demand	-0.200		0.151		-0.025		-0.066		-0.105	***	0.101	**
	(0.123)		(0.105)		(0.046)		(0.070)		(0.040)		(0.047)	
HPI	-0.006		0.005		0.003	*	-0.003		0.004	***	-0.004	**
	(0.004)		(0.004)		(0.002)		(0.004)		(0.001)		(0.002)	
Constant	-4.593	***	-6.386	**	-1.507	***	-5.620	***	-1.359	***	-1.331	***
	(0.928)		(0.834)		(0.371)		(0.687)		(0.290)		(0.336)	
No. of Observations	3,154		3,154		3,154		3,154		3,154		3,154	
Log pseudo likelihood	-330.293		-293.545		-1220.490		-396.014		-1535.938		-1323.902	
AIC	0.239		0.216		0.804		0.281		1.003		0.869	
BIC	-24540.13		-24631.22		-23459.53		-24566.27		-23049.13		-23331.45	

Notes: a). Robust standard errors are in parentheses. b). ***, **, and * represent significance level at the 1%, 5% and 10%, respectively. c). Region and year fixed effects are included, but suppressed from the table.

Table A2. Impacts on shares of major wholesale market channels: estimated coefficients from fractional logit model (2019)

Variable	Mass Merchandiser		Home Centers		Single location GC		Multiple location GC		Landscaper		Re-wholesaler		Direct-to-Consumer	
	Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients	
PG1	-0.008		-0.006		0.006		-0.006	**	0.004		0.008		-0.010	*
	(0.015)		(0.013)		(0.006)		(0.012)		(0.004)		(0.005)		(0.005)	
PG2	-0.007		0.014		-0.014		0.022		0.023	**	-0.014		-0.007	
	(0.040)		(0.016)		(0.016)		(0.017)		(0.009)		(0.015)		(0.011)	
PG3	-0.014		0.010		0.024	***	0.013		0.008		0.004		-0.028	***
	(0.029)		(0.018)		(0.007)		(0.017)		(0.005)		(0.006)		(0.008)	
PG4	0.011		-0.021		0.003		-0.003		0.023	**	0.007		-0.028	***
	(0.029)		(0.022)		(0.010)		(0.025)		(0.011)		(0.010)		(0.009)	
PG5	-0.290		-0.027		0.008		0.006		0.006		0.002		-0.009	*
	(0.180)		(0.017)		(0.007)		(0.015)		(0.005)		(0.006)		(0.005)	
PG6	-0.039		0.022		0.002		-0.033		0.020	***	-0.014		-0.006	
	(0.062)		(0.018)		(0.010)		(0.039)		(0.006)		(0.012)		(0.007)	
PG7	-0.166	**	0.012		0.006		0.018		-0.006		-0.038		0.000	
	(0.082)		(0.039)		(0.021)		(0.028)		(0.018)		(0.030)		(0.020)	
PG8	-0.041	*	-0.004		0.009		0.010		-0.001		0.002		-0.005	
	(0.023)		(0.009)		(0.006)		(0.016)		(0.005)		(0.005)		(0.004)	
PG9	-0.004		0.020		0.006		0.022		0.002		0.000		-0.005	
	(0.012)		(0.013)		(0.006)		(0.014)		(0.005)		(0.007)		(0.005)	
PG10	0.003		0.011		0.013	**	-0.021		-0.036	***	-0.019		0.013	**
	(0.017)		(0.010)		(0.006)		(0.021)		(0.009)		(0.013)		(0.006)	
PG11	0.019		0.013		0.010	*	-0.006		-0.019	***	0.011		-0.005	
	(0.012)		(0.011)		(0.006)		(0.013)		(0.006)		(0.007)		(0.005)	
PG12	0.018		0.018		0.007		0.017		0.005		-0.016	**	-0.006	
	(0.017)		(0.011)		(0.009)		(0.016)		(0.008)		(0.008)		(0.008)	
PG13	0.033		0.022		-0.018		-0.037	*	0.003		0.008		-0.001	
	(0.024)		(0.009)		(0.012)		(0.022)		(0.008)		(0.010)		(0.009)	
PG14	0.021		0.015		0.008		0.018	*	-0.020		0.022	***	-0.029	***
	(0.016)		(0.013)		(0.007)		(0.011)		(0.008)		(0.006)		(0.007)	

PG15	-0.076		0.020		-0.001		-0.005		0.021	***	-0.025		-0.014	**
	(0.115)		(0.014)		(0.009)		(0.015)		(0.006)		(0.015)		(0.006)	
PG16	-0.003		0.000		0.001		-0.032	*	-0.013	**	0.023	***	-0.012	*
	(0.014)		(0.020)		(0.008)		(0.016)		(0.007)		(0.006)		(0.007)	
Age	0.024	*	0.010		0.001		0.007		0.004		-0.001		-0.007	
	(0.013)		(0.011)		(0.004)		(0.007)		(0.004)		(0.005)		(0.006)	
Perm	-0.050		-0.012		0.000		-0.001		0.007		0.016	***	-0.025	**
	(0.036)		(0.012)		(0.006)		(0.010)		(0.005)		(0.005)		(0.011)	
Temp	-0.076	***	0.019	***	-0.005		0.008		-0.005		-0.009	**	0.019	***
	(0.028)		(0.007)		(0.005)		(0.009)		(0.007)		(0.005)		(0.007)	
Sale	0.059	***	-0.001		0.003		-0.009		-0.002		-0.010	**	-0.002	
	(0.019)		(0.005)		(0.004)		(0.005)		(0.004)		(0.004)		(0.006)	
Sale_contract	0.011		-0.018	**	-0.007		-0.007		0.001		0.001		0.002	
	(0.013)		(0.009)		(0.005)		(0.009)		(0.005)		(0.005)		(0.005)	
D_COP	-0.535		0.799		-0.636	**	0.607		-0.423		1.357	***	-1.005	**
	(0.857)		(0.693)		(0.325)		(0.520)		(0.255)	*	(0.296)		(0.425)	
D_CGC	-0.607		0.792		1.356	***	1.563	***	-0.851		-0.704	**	-0.413	
	(0.839)		(0.631)		(0.334)		(0.587)		(0.366)	**	(0.347)		(0.461)	
D_CMM	0.351		0.351		-1.550	***	1.776	***	-0.153		-0.252		-0.619	
	(0.924)		(0.725)		(0.595)		(0.625)		(0.902)		(0.622)		(0.636)	
Sale nego	0.013		0.010		-0.001		-0.002		-0.002		0.007	**	-0.006	*
	(0.010)		(0.006)		(0.004)		(0.005)		(0.003)		(0.003)		(0.003)	
Sale repeat	0.059	*	-0.008		0.013	**	0.016		0.000		0.009		-0.014	***
	(0.035)		(0.013)		(0.006)		(0.016)		(0.004)		(0.006)		(0.004)	
Tradeshaw	-0.433		-0.009		-0.010		-0.035		-0.039		0.033	***	-0.010	
	(0.283)		(0.017)		(0.017)		(0.548)		(0.029)		(0.014)		(0.016)	
Ad_internet	2.546		-0.718		0.372		0.680		0.318		-0.112		0.111	
	(1.611)		(0.899)		(0.372)		(0.548)		(0.260)		(0.293)		(0.365)	
Ad_tradeshaw	-2.218		-0.528		-0.176		-0.208		-0.060		0.252	**	0.027	
	(2.029)		(0.872)		(0.188)		(0.466)		(0.076)		(0.109)		(0.087)	
Unique	1.281	***	0.164		0.282	*	-0.012		-0.125		-0.051		-0.064	
	(0.458)		(0.392)		(0.155)		(0.237)		(0.125)		(0.134)		(0.142)	

Other_price	-0.388		-0.358		-0.376	**	0.088		0.051		0.037		0.128	
	(0.475)		(0.243)		(0.156)		(0.240)		(0.140)		(0.139)		(0.130)	
Cost	0.490		-0.139		0.087		0.294		-0.128		-0.052		0.034	
	(0.489)		(0.423)		(0.141)		(0.252)		(0.132)		(0.136)		(0.133)	
Labor	1.287	***	0.345		0.023		0.273		0.201	**	0.192		-0.283	***
	(0.474)		(0.282)		(0.125)		(0.182)		(0.102)		(0.120)		(0.102)	
Compete	1.325	***	0.070		0.365	***	0.199		-0.025		-0.084		-0.156	
	(0.412)		(0.262)		(0.132)		(0.214)		(0.106)		(0.111)		(0.111)	
Demand	-0.584		0.019		-0.072		-0.239		-0.018		-0.058		0.070	
	(0.511)		(0.307)		(0.147)		(0.235)		(0.127)		(0.143)		(0.127)	
HPI	-0.004		0.007		-0.006	*	0.002		0.000		-0.001		0.003	
	(0.011)		(0.005)		(0.003)		(0.004)		(0.002)		(0.003)		(0.003)	
Constant	-21.078	***	-7.539	***	-3.802	***	-7.953	***	-1.381		-2.293	**	2.101	
	(4.466)		(2.623)		(1.212)		(2.986)		(0.907)		(0.996)		(0.909)	
No. of Observations	498		498		498		498		498		498		498	
Log pseudo likelihood	-22.199		-28.222		-168.782		-33.863		-183.941		-169.098		-228.368	
AIC	0.266		0.290		0.855		0.313		0.915		0.856		1.094	
BIC	-2790.691		-2784.514		-2578.248		-2783.581		-2583.848		-2592.086		-2455.883	

Notes: a). Robust standard errors are in parentheses. b). ***, **, and * represent significance level at the 1%, 5% and 10%, respectively. c). Region and year fixed effects are included, but suppressed from the table.

Table A3. Impacts on shares of major wholesale market channels: marginal effects from fractional logit model (2019)

Variable	Mass Merchandiser		Home Centers		Single location GC		Multiple location GC		Landscaper		Re-wholesaler		Direct-to-Consumer	
	Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients		Coefficients	
PG1	-0.0001		-0.0001		0.0007		-0.0001	**	0.0006		0.0010		-0.0017	*
	(0.0002)		(0.0002)		(0.0008)		(0.0002)		(0.0006)		(0.0006)		(0.0009)	
PG2	-0.0001		0.0002		-0.0017		0.0004		0.0032	**	-0.0017		-0.0012	
	(0.0006)		(0.0002)		(0.0019)		(0.0003)		(0.0013)		(0.0018)		(0.0018)	
PG3	-0.0002		0.0001		0.0028	***	0.0002		0.0011		0.0005		-0.0047	***
	(0.0004)		(0.0003)		(0.0008)		(0.0003)		(0.0007)		(0.0007)		(0.0012)	
PG4	0.0002		-0.0003		0.0003		-0.0001		0.0032	**	0.0009		-0.0047	***
	(0.0002)		(0.0003)		(0.0012)		(0.0005)		(0.0015)		(0.0012)		(0.0015)	
PG5	-0.0043		-0.0004		0.0010		0.0001		0.0008		0.0002		-0.0015	*
	(0.0027)		(0.0003)		(0.0008)		(0.0003)		(0.0007)		(0.0007)		(0.0009)	
PG6	-0.0006		0.0003		0.0002		-0.0006		0.0027	***	-0.0016		-0.0010	
	(0.0009)		(0.0003)		0.0012)		(0.0008)		(0.0008)		(0.0014)		(0.0011)	
PG7	-0.0024	**	0.0002		0.0007		0.0004		-0.0008		-0.0046		0.0001	
	(0.0012)		(0.0006)		(0.0025)		(0.0005)		(0.0025)		(0.0036)		(0.0034)	
PG8	-0.0006	*	-0.0001		0.0011		0.0002		-0.0001		0.0002		-0.0008	
	(0.0004)		(0.0001)		(0.0007)		(0.0003)		(0.0007)		(0.0006)		(0.0007)	
PG9	-0.0001		0.0003		0.0007		0.0004		0.0003		0.0000		-0.0008	
	(0.0002)		(0.0002)		(0.0007)		(0.0003)		(0.0007)		(0.0008)		(0.0009)	
PG10	0.0000		0.0002		0.0015	**	-0.0004		-0.0050	***	-0.0023		0.0023	**
	(0.0003)		(0.0002)		(0.0008)		(0.0004)		(0.0013)		(0.0016)		(0.0010)	
PG11	0.0003		0.0002		0.0012	*	-0.0001		-0.0026	***	0.0013		-0.0008	
	(0.0002)		(0.0002)		(0.0007)		(0.0003)		(0.0008)		(0.0008)		(0.0009)	
PG12	0.0005		0.0003		0.0009		0.0003		0.0006		-0.0019	**	-0.0009	
	(0.0002)		(0.0002)		(0.0010)		(0.0003)		(0.0011)		(0.0009)		(0.0014)	
PG13	0.0003		0.0003		-0.0021		-0.0007		0.0004		0.0009		-0.0002	
	(0.0002)		(0.0002)		(0.0015)		(0.0005)		(0.0011)		(0.0012)		(0.0014)	
PG14	-0.0011		0.0002		0.0009		0.0004	*	-0.0028		0.0026	***	-0.0049	***
	(0.0002)		(0.0002)		(0.0008)		(0.0001)		(0.0011)		(0.0007)		(0.0012)	

PG15	0.0000		0.0003		-0.0001		-0.0001		0.0029	***	-0.0030		-0.0023	**
	(0.0017)		(0.0002)		(0.0011)		(0.0003)		(0.0008)		(0.0019)		(0.0010)	
PG16	0.0000		0.0000		0.0001		-0.0001	*	-0.0019	**	0.0027	***	-0.0020	*
	(0.0002)		(0.0003)		(0.0010)		(0.0003)		(0.0009)		(0.0007)		(0.0012)	
Age	0.0003	*	0.0001		0.0001		0.0001		0.0005		-0.0002		-0.0012	
	(0.0002)		(0.0002)		(0.0005)		(0.0001)		(0.0006)		(0.0006)		(0.0009)	
Perm	-0.0007		-0.0002		0.0000		0.0000		0.0010		0.0019	***	-0.0042	**
	(0.0005)		(0.0002)		(0.0007)		(0.0002)		(0.0006)		(0.0006)		(0.0018)	
Temp	-0.0011	***	0.0003	**	-0.0006		0.0002		0.0008		-0.0011	***	0.0032	***
	(0.0004)		(0.0001)		(0.0006)		(0.0002)		(0.0010)		(0.0006)		(0.0011)	
Sale	0.0009	***	0.0000		0.0004		-0.0002		-0.0003		-0.0012	**	-0.0003	
	(0.0003)		(0.0001)		(0.0005)		(0.0001)		(0.0006)		(0.0005)		(0.0010)	
Sale_contract	0.0002		-0.0003	*	-0.0009		-0.0001		0.0001		0.0004		0.0004	
	(0.0002)		(0.0001)		(0.0006)		(0.0002)		(0.0007)		(0.0006)		(0.0008)	
D_COP	-0.0079		0.0118		-0.0753	*	0.0118		-0.0590		0.1643	***	-0.1682	**
	(0.0126)		(0.0105)		(0.0385)		(0.0103)		(0.0358)	*	(0.0356)		(0.0709)	
D_CGC	-0.0089		0.0117		0.1606	***	0.0304	***	-0.1186		-0.0853	**	-0.0691	
	(0.0126)		(0.0092)		(0.0387)		(0.0120)		(0.0513)	**	(0.0425)		(0.0769)	
D_CMM	0.0052		0.0052		-0.1836	***	0.0345	***	-0.0213		-0.0305		-0.1036	
	(0.0136)		(0.0108)		(0.0712)		(0.0127)		(0.1256)		(0.0752)		(0.1068)	
Sale nego	0.0002		0.0001		-0.0002		0.0000		-0.0002		0.0009	**	-0.0010	*
	(0.0001)		(0.0001)		(0.0005)		(0.0001)		(0.0004)		(0.0004)		(0.0005)	
Sale repeat	0.0009	*	-0.0001		0.0016	**	0.0003		0.0000		0.0011		-0.0024	***
	(0.0005)		(0.0002)		(0.0007)		(0.0003)		(0.0006)		(0.0007)		(0.0007)	
Tradeshaw	-0.0064		-0.0001		-0.0012		-0.0007		-0.0054		0.0040	***	-0.0017	
	(0.0042)		(0.0003)		(0.0020)		(0.0012)		(0.0040)		(0.0017)		(0.0027)	
Ad_internet	0.0375		-0.0106		0.0441		0.0132		0.0443		-0.0135		0.0186	
	(0.0241)		(0.0133)		(0.0443)		(0.0110)		(0.0362)		(0.0354)		(0.0611)	
Ad_tradeshaw	-0.0326		-0.0078		-0.0208		-0.0041		-0.0083		0.0306	**	0.0045	
	(0.0299)		(0.0130)		(0.0224)		(0.0091)		(0.0107)		(0.10131)		(0.0145)	
Unique	0.0188	***	0.0024		0.0334	*	-0.0002		-0.0174		-0.0062		-0.0107	
	(0.0069)		(0.0060)		(0.0180)		(0.0046)		(0.0173)		(0.0162)		(0.0238)	

Other_price	-0.0057		-0.0053		-0.0445	**	0.0017		0.0071		0.0045		0.0215	
	(0.0070)		(0.0036)		(0.0184)		(0.0047)		(0.0195)		(0.0169)		(0.0218)	
Cost	0.0072		-0.0021		0.0103		0.0057		-0.0178		-0.0063		0.0057	
	(0.0072)		(0.0063)		(0.0167)		(0.0050)		(0.0184)		(0.0165)		(0.0223)	
Labor	0.0189	***	0.0051		0.0028		0.0053		0.0279	**	0.0232		-0.0474	***
	(0.0072)		(0.0043)		(0.0148)		(0.0037)		(0.0140)		(0.0145)		(0.0166)	
Compete	0.0195	***	0.0010		0.0432	***	0.0039		-0.0035		-0.0102		-0.0216	
	(0.0067)		(0.0039)		(0.0156)		(0.0042)		(0.0147)		(0.0135)		(0.0184)	
Demand	-0.0086		0.0003		-0.0085		-0.0047		-0.0025		-0.0070		0.0117	
	(0.0073)		(0.0045)		(0.0174)		(0.0047)		(0.0177)		(0.0173)		(0.0212)	
HPI	-0.0001		0.0001		-0.0007	*	0.0000		0.0000		-0.0002		0.0004	
	(0.0002)		(0.0001)		(0.0004)		(0.0001)		(0.0003)		(0.0004)		(0.0004)	
No. of Observations	498		498		498		498		498		498		498	

Notes: a). Robust standard errors are in parentheses. b). ***, **, and * represent significance level at the 1%, 5% and 10%, respectively. c). Region and year fixed effects are included, but suppressed from the table.