What Drives Herding Behavior in Online Ratings? The Role of Rater Experience, Product Portfolio, and Diverging Opinions

# Web Appendix

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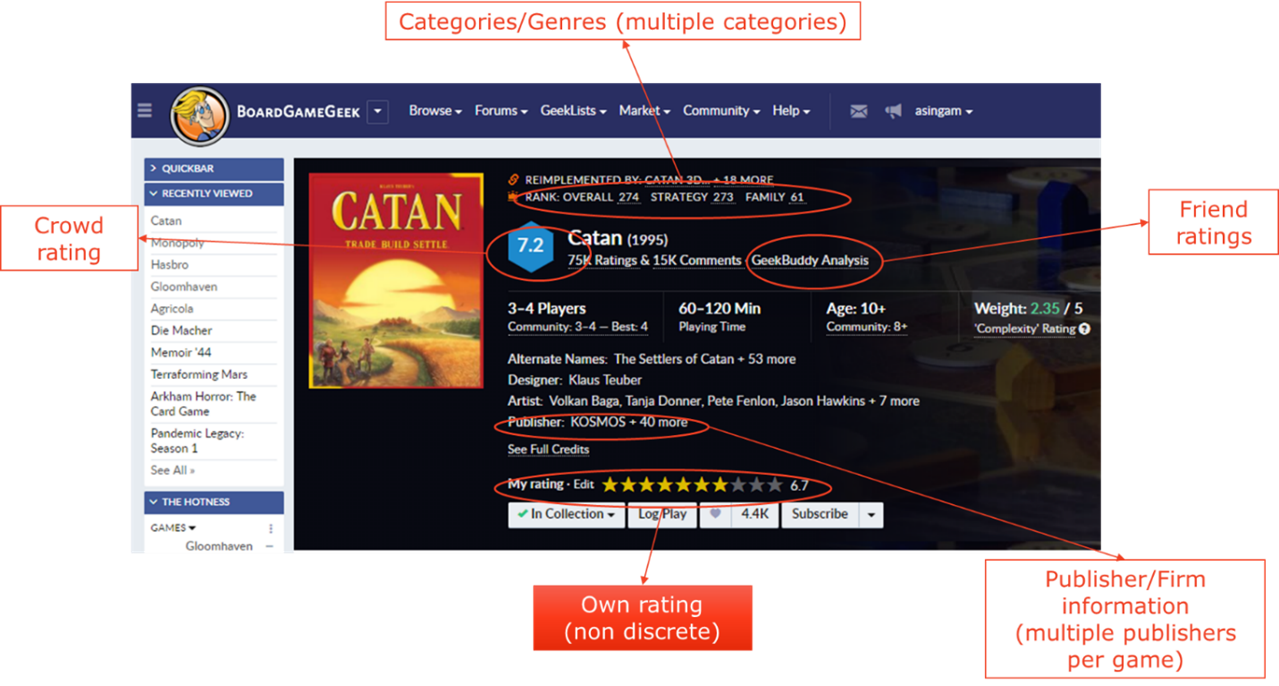
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**Web Appendix A - Empirical Context [Screenshot]**



Notes: A typical screenshot of a product page on boardgamegeek.com. Users are exposed to various pieces of information at the time of rating including crowd ratings (7.2/10 in the example above), the categories and genres that the game is classified under (Strategy, and Family in the example above), the publishing firm information, product level information (such as playing time, number of players etc.), and friend rating information (GeekBuddy Analysis). Users can submit non-discrete ratings of the game. For example, the focal user has rated the game *Catan* as 6.7/10.

**Web Appendix B - Variable considerations (Controls and Alternative measures)**

In this section, we discuss robustness checks to ensure that our main findings are robust even after considering several variables and interactions highlighted form prior work, as well as alternative operationalizations of key variables. Here, we re-estimate the model after considering two-way and three-way interactions highlighted in Lee et al. (2015) and also consider different measures of crowd ratings, rater experience, and product scope. Below, we report the full estimation results.

## Building upon prior literature (including two-way and three-way interactions from prior work)

In this section, we conduct additional analyses to demonstrate robustness even after considering higher order interactions from prior literature (Godes and Silva 2012; Lee et al. 2015; Li and Hitt 2008; Wu and Huberman 2008; Zhang and Godes 2018). First, we interact the volume of ratings with the valence of the rating from each herding source. As shown in the table below, the main findings of this research remain qualitatively consistent. As such, although we did not hypothesize any effects, in line with prior work (Lee et al. 2015), we find that the effect of crowd rating increases as the volume of crowd rating increases as well as the effect of friend rating increases as the volume of friend rating increases. That is, social influence from crowd and friends is strengthened when the game itself is popular. Second, we add the two-way interactions from Lee et al. (2015) and we again find that the main findings of this research remain qualitatively consistent. Third, we add the three-way interactions from Lee et al. (2015) and find consistent results for our main findings of the research. Similar to their paper, we find that the three-way interaction among crowd ratings, volume of friend and crowd ratings is positive and significant.

**Table WA.B.1 – Including Additional Moderators from Previous Research**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *Hypotheses* | *(1)*  *Including interactions between volume and valence of ratings from crowd & friends* | | *(2)*  *Including two-way interactions from Lee et al. (2015)* | | *(3)*  *Including two-way and three-way interactions from Lee et al. (2015)* | |
| *Variable* | *Estimate* | *SE* | *Estimate* | *SE* | *Estimate* | *SE* |
| Crowd rating |  | .465\*\*\* | .013 | .445\*\*\* | .012 | .433\*\*\* | .009 |
| Friends’ rating |  | .210\*\*\* | .004 | .211\*\*\* | .007 | .212\*\*\* | .003 |
| Rater experience |  | -.0005\*\*\* | .00001 | -.0005\*\*\* | .00001 | -.0005\*\*\* | .00001 |
| Divergence between friends and crowd |  | -.007\*\*\* | .002 | -.007\*\*\* | .002 | -.006\*\*\* | .001 |
| Crowd rating Rater experience+ | H1 (–) | -.745\*\*\* | .058 | -.465\*\*\* | .043 | -.465\*\*\* | .036 |
| Friends’ rating Rater experience+ | H2 (+) | .236\*\*\* | .020 | .256\*\*\* | .028 | .261\*\*\* | .023 |
| Crowd rating Divergence b/w friends and crowd | H3a (+) | .015\*\* | .006 | .024\*\*\* | .005 | .019\*\* | .006 |
| Friends’ rating Divergence b/w friends and crowd | H3b (–) | -.013\*\*\* | .004 | -.016\*\*\* | .004 | -.017\*\*\* | .004 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.134\*\* | .047 | -.066\*\* | .024 | -.038\*\* | .013 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .234\*\* | .083 | .248\*\*\* | .025 | .250\*\* | .083 |
| Product Scope | H5 (+) | .078\*\*\* | .001 | .078\*\*\* | .003 | .078\*\*\* | .001 |
| Crowd rating Product Scope | H6 (–) | -.015\*\* | .006 | -.015\*\* | .005 | -.015\*\* | .005 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | .0005 | -.005\*\*\* | .0006 | -.005\*\*\* | .0004 |
| Volume of crowd ratings+ |  | -.006\*\*\* | .0003 | -.007\*\*\* | .0003 | -.007\*\*\* | .0003 |
| Volume of friends’ ratings |  | .003\*\*\* | .0001 | .003\*\*\* | .0001 | .003\*\*\* | .0001 |
| **Crowd rating Volume of crowd ratings+** |  | .007\* | .003 | .011\*\* | .004 | .008\* | .003 |
| **Crowd rating Volume of friends’ ratings** |  |  |  | -.013\* | .006 | -.015 | .009 |
| **Volume of crowd ratings Volume of friends’ ratings+** |  |  |  | .001 | .001 | .0001 | .0001 |
| **Crowd rating Volume of crowd ratings Volume of friends’ ratings+** |  |  |  |  |  | .001\*\* | .0003 |
| **Friends’ rating Volume of crowd ratings+** |  |  |  | -.002 | .001 | -.004 | .002 |
| **Friends’ rating Volume of friends’ ratings** |  | .018\*\* | .007 | .018\*\* | .007 | .019\*\* | .006 |
| **Friends’ rating Volume of crowd ratings Volume of friends’ ratings** |  |  |  |  |  | -.001 | .0004 |
| Time since the first rating+ |  | .037\*\*\* | .002 | .037\*\*\* | .002 | .037\*\*\* | .002 |
| Publisher loyalty |  | .005\*\*\* | .0002 | .005\*\*\* | .0003 | .005\*\*\* | .0003 |
| Number of friends+ |  | .014 | .049 | .001 | .0006 | .0001 | .0007 |
| Endogeneity correction |  | -.023\*\*\* | .001 | -.024\*\*\* | .001 | -.024\*\*\* | .001 |
| Average network size of friends+ |  | .058\*\* | .022 | .032 | .018 | .032 | .020 |
| Number of groups friends are part of |  | .040\* | .016 | .001 | .001 | .001 | .001 |
| Membership length of friends+ |  | .001 | .001 | .002 | .001 | .002 | .002 |
| Intercept |  | -.043\*\* | .013 | -.048\*\*\* | .014 | -.049\*\*\* | .013 |
| Individual-level fixed effect | | Yes | | Yes | | Yes | |
| Game-level fixed effect | | Yes | | Yes | | Yes | |
| Year fixed effect | | Yes | | Yes | | Yes | |

Notes: \*\*\*p<0.001, \*\*p<0.01, \*<0.05. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. All standard errors are bootstrapped and clustered at the individual level.

1. ***Alternative Operationalization of Crowd Ratings***

We check robustness of the results for alternative measurement of the variable. In the main results, the friend rating information was included within the computation. A criticism of this approach is that it might induce double counting of the friend rating information. As a robustness check, we rerun the model after removing the friend information from the variable and report the results in Table WA.B.2. The results remain virtually unchanged and confirm our main findings.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table WA.B.2- Robustness Analyses: Alternative Measure for Valence of Crowd Rating** | | | |
| *Variable* | *Hypotheses* | *Estimate* | *S.E* |
| Crowd ratinga |  | .408\*\*\* | .007 |
| Friends’ rating |  | .191\*\*\* | .003 |
| Rater experience |  | -.0005\*\*\* | .00001 |
| Divergence between friends and crowd |  | -.023\*\*\* | .001 |
| Crowd ratinga Rater experience+ | H1 (–) | -.977\*\*\* | .054 |
| Friends’ rating Rater experience + | H2 (+) | .149\*\*\* | .023 |
| Crowd ratinga Divergence b/w friends & crowd | H3a (+) | .004\*\* | .001 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | -.032\*\*\* | .004 |
| Crowd ratinga Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.055\*\*\* | .005 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .029\*\* | .008 |
| Product Scope | H5 (+) | .078\*\*\* | .002 |
| Crowd ratinga Product Scope | H6 (–) | -.012\*\*\* | .003 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | .0004 |
| Endogeneity correction |  | -.023\*\*\* | .001 |
| Intercept |  | -.064\*\*\* | .013 |
| Control Variables | | Yes | |
| Individual-level fixed effect | | Yes | |
| Game-level fixed effect | | Yes | |
| Year fixed effect | | Yes | |

Notes: \*\*\*p<0.001, \*\*p<0.01. a The crowd rating is computed after excluding the friend rating information. All standard errors are bootstrapped and clustered at the individual level. +The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details.

1. ***Alternative Operationalization of Rater Experience***

We conduct robustness analyses considering two different measures of rater experience: (a) average number of prior ratings and (b) time since joining the website. Table WA.B.3 presents the estimation results. As we can see, the results continue to remain qualitatively consistent. Taken together, we conclude that irrespective of how we conceptualize rater experience, we find that rater experience positively moderates the friend effect but negatively moderates the crowd effect.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table WA.B.3 – Robustness Analyses: Alternative Measures of Rater Experience | | | | | | | | |
| *Variable* | *Hypotheses* | | *(1)*  *Average number of prior ratings* | | | *(2)*  *Time since joining website* | | |
| *Estimate* | *SE* | | *Estimate* | *SE* | |
| Crowd rating |  | | .419\*\*\* | .008 | | .412\*\*\* | .008 | |
| Friends’ rating |  | | .187\*\*\* | .003 | | .196\*\*\* | .003 | |
| Rater experiencea |  | | -.010\*\*\* | .002 | | -.0003\*\*\* | .00005 | |
| Divergence between friends and crowd |  | | -.026\*\*\* | .001 | | -.030\*\*\* | .002 | |
| Crowd rating Rater experiencea+ | H1 (–) | | -47.861\*\* | 19.679 | | -.074\*\*\* | .011 | |
| Friends’ rating Rater experiencea+ | H2 (+) | | 3.438\*\*\* | 5.102 | | .017\*\*\* | .002 | |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | | .060\*\*\* | .013 | | .066\*\*\* | .015 | |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | | -.033\*\*\* | .003 | | -.047\*\*\* | .003 | |
| Crowd rating Rater experiencea  Divergence b/w friends & crowd+ | H4a (–) | | -39.762\*\*\* | 13.931 | | -.081\*\* | .024 | |
| Friends’ rating Rater experiencea Divergence b/w friends & crowd+ | H4b (+) | | 9.520\*\*\* | 2.335 | | .032\*\*\* | .003 | |
| Product Scope | H5 (+) | | .078\*\*\* | .001 | | .078\*\*\* | .001 | |
| Crowd rating Product Scope | H6 (–) | | -.014\*\* | .005 | | -.014\*\* | .005 | |
| Friends’ rating Product Scope | H7 (–) | | -.005\*\*\* | .0004 | | -.005\*\*\* | .0004 | |
| Endogeneity correction |  | | -.024\*\*\* | .001 | | -.025\*\*\* | .001 | |
| Intercept |  | | -.050\*\*\* | .011 | | -.505\*\*\* | .016 | |
| Control Variables | | Yes | | | Yes | | |
| Individual-level fixed effect | | Yes | | | Yes | | |
| Game-level fixed effect | | Yes | | | Yes | | |
| Year fixed effect | | Yes | | | Yes | | |
| Note: \*\*\*p<0.001, \*\*p<0.01, \*p<0.05. a The rater experience variable changes according to the column heading. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. All standard errors are bootstrapped and clustered at the individual level. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details. | | | | | | | | |

1. ***Alternative Operationalization of Product Scope***

Table WA.B.4 presents the results when we use different measures for product scope. Specifically, we test whether the results are substantively the same when using, (a) relevant product scope (i.e. including relevance), (b) product portfolio breadth (i.e. entropy) and (c) product portfolio depth as a composite measure of a firm’s product portfolio (Palepu 1985). In *Web Appendix H*, we motivate and provide an illustration of how relevant product scope is measured. Note that the entropy measure ignores the depth of product portfolio, and only measures breadth. The results in Table WA.B.4 provide further confirmation of the main findings. A firm’s product portfolio provide strong signals of firm experience. Firms with broader product portfolios influence ratings positively *and* attenuate herding influences.

**Table WA.B.4 – Robustness Analyses: Alternative measures of Product Scope**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Hypotheses | (1)  Relevant Product Scope | | (2)  Product Portfolio Breadth (Entropy) | | (3)  Product Portfolio Depth | |
| Estimate | SE | Estimate | SE | Estimate | SE |
| Crowd rating |  | .435\*\*\* | .014 | .415\*\*\* | .016 | .451\*\*\* | .014 |
| Friends’ rating |  | .187\*\*\* | .004 | .185\*\*\* | .004 | .187\*\*\* | .004 |
| Rater experience |  | -.0005\*\*\* | .00001 | -.0005\*\*\* | .00001 | -.0005\*\*\* | .00001 |
| Divergence between friends and crowd |  | -.023\*\*\* | .002 | -.020\*\*\* | .002 | -.023\*\*\* | .002 |
| Crowd rating Rater experience+ | H1 (–) | -1.006\*\*\* | .057 | -1.037\*\*\* | .052 | -1.007\*\*\* | .054 |
| Friends’ rating Rater experience+ | H2 (+) | .162\*\*\* | .021 | .175\*\*\* | .021 | .169\*\*\* | .022 |
| Crowd rating Divergence b/w friends and crowd | H3a (+) | .045\*\* | .014 | .047\*\* | .016 | .045\*\* | .015 |
| Friends’ rating Divergence b/w friends and crowd | H3b (–) | -.031\*\*\* | .004 | -.032\*\*\* | .004 | -.029\*\*\* | .004 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.043\*\* | .017 | -.054\*\* | .021 | -.048\* | .022 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .052\*\*\* | .009 | .051\*\*\* | .008 | .053\*\*\* | .009 |
| Relevant Product Scope | H5 (+) | .130\*\*\* | .002 |  |  |  |  |
| Crowd rating Relevant Product Scope | H6 (–) | -.060\*\*\* | .010 |  |  |  |  |
| Friends’ rating Relevant Product Scope | H7 (–) | -.0001\*\*\* | .00002 |  |  |  |  |
| Product Portfolio Breadth (Entropy) | H5 (+) |  |  | 9.508\*\*\* | .245 |  |  |
| Crowd rating Product Portfolio Breadth | H6 (–) |  |  | -1.898\*\*\* | .275 |  |  |
| Friends’ rating Product Portfolio Breadth | H7 (–) |  |  | -.834\*\*\* | .033 |  |  |
| Product Portfolio Depth | H5 (+) |  |  |  |  | .0004\*\*\* | .00003 |
| Crowd rating Product Portfolio Depth | H6 (–) |  |  |  |  | -.002\*\*\* | .0003 |
| Friends’ rating Product Portfolio Depth | H7 (–) |  |  |  |  | -.0002\*\*\* | .00004 |
| Endogeneity correction |  | -.023\*\*\* | .002 | -.024\*\*\* | .001 | -.023\*\*\* | .002 |
| Intercept |  | -.063\*\*\* | .013 | -.066\*\*\* | .013 | -.068\*\*\* | .013 |
| Control variables | | Yes | | Yes | | Yes | |
| Individual-level fixed effect | | Yes | | Yes | | Yes | |
| Game-level fixed effect | | Yes | | Yes | | Yes | |
| Year fixed effect | | Yes | | Yes | | Yes | |

Note: \*\*\*p<0.001, \*\*p<0.01. a The relevant product scope variable changes according to the column heading. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. All standard errors are bootstrapped and clustered at the individual level. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details.

1. ***Alternative Operationalization for Measure of Divergence of Opinion***

Table WA.B.5 presents the results when we use the absolute value of divergence between crowd and friend ratings, , rather than the categorical variable, . As shown in the table below, the main findings of this research remain qualitatively consistent when the absolute value of divergence between crowd and friend ratings is used as the moderator.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table WA.B.5- Robustness Analyses: Using Absolute Value of Divergence** | | | |
| *Variable* | *Hypotheses* | *Estimate* | *S.E* |
| Crowd rating |  | .447\*\*\* | .013 |
| Friends’ rating |  | .204\*\*\* | .002 |
| Rater experience |  | -.0005\*\*\* | .00001 |
| Absolute Divergence between friends and crowd |  | -.014\*\*\* | .002 |
| Crowd rating Rater experience+ | H1 (–) | -1.038\*\*\* | .059 |
| Friends’ rating Rater experience+ | H2 (+) | .205\*\*\* | .016 |
| Crowd rating Absolute Divergence b/w friends & crowd | H3a (+) | .006\*\*\* | .002 |
| Friends’ rating Absolute Divergence b/w friends & crowd | H3b (–) | -.013\*\*\* | .001 |
| Crowd rating Rater experience Absolute Divergence b/w friends & crowd+ | H4a (–) | -.295\*\*\* | .083 |
| Friends’ rating Rater experienceAbsolute Divergence b/w friends & crowd+ | H4b (+) | .153\*\*\* | .006 |
| Product Scope | H5 (+) | .078\*\*\* | .001 |
| Crowd rating Product Scope | H6 (–) | -.015\*\*\* | .004 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | .0006 |
| Endogeneity correction |  | -.020\*\*\* | .001 |
| Intercept |  | -.068\*\*\* | .013 |
| Control variables | | Yes | |
| Individual-level fixed effect | | Yes | |
| Game-level fixed effect | | Yes | |
| Year fixed effect | | Yes | |

**Web Appendix C – Additional Descriptive Figures**

|  |
| --- |
| **Figure WA.C.1 - Temporal Patterns in Rating Behavior for Select Examples** |
| 1. *Catan* |
|  |
| 1. *Monopoly* |
|  |

|  |
| --- |
| **Figure WA.C.2 –Network Visualization** |
| **C:\Users\ssunder\Box Sync\What will you play - PROJECT\Manuscript\Sarang working docs\Ratings_REV1\pA4_buddy_network_plot.png** |

**Web Appendix D – Auxiliary regression for control function approach**

In this section, we show the first stage regression results for the control function approach. To account for the potential endogeneity related issues that arise for the friends rating, we use four characteristics of friends’ friends as instruments: (1) second degree friends’ volume of ratings, (2) second degree friend’s membership length, (3) second degree friends’ average network size, and (4) second degree friend’s declared groups/guilds.

**Table WA.D.1 – Auxiliary Regression for Control Function Approach**

|  |  |  |
| --- | --- | --- |
| *Variables* | *Estimate* | *S.E* |
| Volume of ratings by friends | .004\*\*\* | .001 |
| Friends’ average length of membership (in days) | -.0001\*\*\* | .00001 |
| Number of friends’ friends | .002\*\*\* | .001 |
| Number of groups friends are part of | -.004\*\* | .002 |
| Intercept | .132\*\*\* | .011 |
| Individual-level fixed effect | Yes | |
| Game-level fixed effect | Yes | |
| Year fixed effect | Yes | |
| Notes: \*\*\*p<.001, \*\*p<.01. | | |

**Web Appendix E - Robustness Analyses: Alternative Model Specifications**

In this section, we conduct a series of robustness checks to ensure that our results are not simply an artefact of the modeling choices that we have made. Specifically, we demonstrate robustness of the results to selection biases, ordinal regressions, and a different treatment of unobserved heterogeneity.

1. ***Controlling for Potential Selection Bias***

The results may be influenced by selection issues caused by rating incidence. As such, an individual’s probability of rating a product may be correlated with the rating level (i.e. users may only select to rate certain games, thus creating a left-censoring problem). To address this concern, we employ a Tobit II style estimation strategy. In the first stage of the estimation, we employ a binary Probit model to estimate the probability that user will rate game as follows

|  |  |  |
| --- | --- | --- |
| WA.E.1 |  |  |
| Where,  = rating incidence with two possible outcomes such that if user rates game at time  = matrix of explanatory variables describing rating incidence  = cumulative distribution function of the standard normal distribution. | | |

Using the estimated parameters from Equation WA.D.1, we construct the inverse mills ratio () and include it in the final model specification outlined in Equation 5. captures the correlation between the error term of the rating incidence model and the rating valence equation.

|  |  |  |
| --- | --- | --- |
| WA.E.2 |  |  |
| Where,  = standard normal density function  All other variables are as defined earlier | | |

The results for the selection model are reported in Table WA.E.1. Following prior literature on online rating behavior, we include rater level, game level, and contextual/environmental variables within the matrix that may influence the probability that a user would rate a game. We ensure that for identification purposes at least one variable in the selection equation is distinct from the main model. We include recency (in days) as a covariate to control for attrition. A common finding in the purchasing literature is that higher recency (i.e. longer time elapsed since last purchase) is related to lower purchase likelihood (Bitran and Mondschein 1996; Neslin et al. 2013; Rhee and McIntyre 2008). We expect a similar pattern to exist when considering rating incidence. As such, a rater who has churned is likely to have high values of recency, thus leading to a lower rating probability. The Tobit II model that we estimate would then at least partially account for attrition in the panel.

|  |  |  |
| --- | --- | --- |
| **Table WA.E.1– Rating Incidence Model** | | |
| Variable | Estimate | S.E |
| Intercept | .591\*\*\* | .011 |
| Recency (in days) | -.004\*\*\* | .00002 |
| Membership length (in days) | .001\*\*\* | .000002 |
| Number of friends | .012\*\*\* | .0001 |
| Number of interest groups enrolled | .015\*\*\* | .003 |
| Rater experience | .001\*\*\* | .00001 |
| Product Scope | .058\*\*\* | .002 |
| Time since game launch (in years) | .024\*\*\* | .0003 |
| Game category 1 (War) | -.219\*\*\* | .005 |
| Game category 2 (Abstract) | .210\*\*\* | .006 |
| Game category 3 (Children) | -.304\*\*\* | .010 |
| Game category 4 (Strategy) | .228\*\*\* | .004 |
| Game category 5 (Family) | .019\*\*\* | .004 |
| Game category 6 (Thematic) | -.050\*\*\* | .004 |
| Game category 7 (Customizable) | -.250\*\*\* | .007 |
| Game category 8 (Party) | .095\*\*\* | .005 |
| Crowd rating (Average) | .129\*\*\* | .002 |
| Crowd rating (Volume) | -.0001\*\*\* | .0000004 |
| Crowd rating (Variance) | .011\*\*\* | .0002 |
| Number of observations | 2,989,412 | |
| Log-likelihood | -1,295,143.1 | |
| Note: \*\*\*p<.001, \*\*p<.01 | | |

We are primarily interested in the rating level (valence) equation with sample selection correction through the inverse mills ratio. The parameter estimates for second stage regression are presented in Table WA.E.2 Column A. The results from the Tobit II model are qualitatively similar to the linear specification presented in Table 4 of the manuscript. We see that the marginal effect of crowd and friend on the focal user’s rating level is positive, indicating that the herding is indeed relevant. Further, the positive main effect of relevant product scope and rater experience on rating behavior is also replicated in the Tobit II model. The moderating effects of product scope and rater experience on the crowd effect is positive and significant as reported in the main results. Lastly, in congruence with the main results, rater (firm) experience positively (negatively) moderates the friend effect. In summary, the results and hypothesis tests presented in Table 4 are robust to additional modeling issues arising from samples selection biases.

Table WA.E.2 – Robustness Analyses: Alternative Model Specifications

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Variable* | *Hypotheses* | *(A) Rating model (Tobit II)* | | *(B) Ordered Probit Model* | |
| *Estimate* | *S.E* | *Estimate* | *S.E* |
| Crowd rating |  | .442\*\*\* | .008 | .320\*\*\* | .009 |
| Friends’ rating |  | .189\*\*\* | .003 | .117\*\*\* | .001 |
| Rater experience |  | -.0005\*\*\* | .00001 | -.0004\*\*\* | .00003 |
| Divergence between friends and crowd |  | -.025\*\*\* | .001 | -.015\*\*\* | .001 |
| Crowd rating Rater experience+ | H1 (–) | -.915\*\*\* | .054 | -.0003\*\*\* | .00004 |
| Friends’ rating Rater experience+ | H2 (+) | .196\*\*\* | .026 | .0002\*\*\* | .00001 |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | .038\*\* | .012 | .011\*\* | .004 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | -.035\*\*\* | .003 | -.014\*\*\* | .003 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.426\*\*\* | .071 | -.227\*\*\* | .044 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .173\*\*\* | .025 | .199\*\* | .067 |
| Product Scope | H5 (+) | .078\*\*\* | .002 | .755\*\*\* | .089 |
| Crowd rating Product Scope | H6 (–) | -.014\*\*\* | .004 | -.216\*\* | .031 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | .0004 | -.034\*\*\* | .010 |
| Inverse Mill’s ratio |  | .236\*\*\* | .009 | .175\*\*\* | .004 |
| Endogeneity correction |  | -.022\*\*\* | .001 | -.027\*\*\* | .001 |
| Intercept |  | -.179\*\*\* | .011 |  |  |
| Control variables | | Yes | | Yes | |
| Individual-level fixed effect | | Yes | | Yes | |
| Game-level fixed effect | | Yes | | Yes | |
| Year fixed effect | | Yes | | Yes | |

Note: \*\*\*p<.001, \*\*p<.01. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details.

1. ***Considering Ordinal Discrete Choice Model***

To examine the robustness of the results to functional form, we replicate the results using an ordinal model specification. Ignoring the continuous nature of the dependent variable in our context, we round the individual ratings to the nearest discrete value and then estimate an ordered Probit model[[1]](#footnote-1). The ordered Probit assumes that there exists an underlying continuous latent variable describing the user’s evaluation of the product that is discretized into levels (i.e. the 10 ordinal ratings in our dependent variable). As such, the underlying latent variable can be specified as a function of deterministic components (i.e. covariates) and stochastic errors. The estimation results, reported in Table WA.E.2 Column B, are similar to those reported in the linear specification and are thus robust to functional form as well.

1. ***Inclusion of Firm-Level Fixed Effects***

To account for the possibility that there could be firm level heterogeneity that may influence the results, we re-estimate the model with firm-level fixed effects. The results, presented in Table WA.E.3 below, continue to be qualitatively similar to the main findings.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table WA.E.3- Robustness Analyses: Including Firm-Level Fixed Effects** | | | | | |
| *Variable* | *Hypotheses* | *Estimate* | | | *S.E* |
| Crowd rating |  | .758\*\*\* | | | .004 |
| Friends’ rating |  | .297\*\*\* | | | .004 |
| Rater experience |  | -.0004\*\*\* | | | .00001 |
| Divergence between friends and crowd |  | -.031\*\*\* | | | .001 |
| Crowd rating Rater experience+ | H1 (–) | -.421\*\*\* | | | .014 |
| Friends’ rating Rater experience+ | H2 (+) | .351\*\*\* | | | .018 |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | .095\*\*\* | | | .004 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | -.088\*\*\* | | | .003 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.203\*\*\* | | | .011 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .225\*\*\* | | | .017 |
| Product Scope | H5 (+) | .001\*\*\* | | | .000 |
| Crowd rating Product Scope | H6 (–) | -.0004\*\*\* | | | .0001 |
| Friends’ rating Product Scope | H7 (–) | -.0004\*\*\* | | | .00002 |
| Endogeneity correction |  | | -.064\*\*\* | | .002 |
| Intercept |  | | -.101\*\*\* | | .007 |
| Control variables |  | | | Yes | |
| Individual-level fixed effect |  | | | Yes | |
| Firm-level fixed effect |  | | | Yes | |
| Year fixed effect |  | | | Yes | |

Notes: \*\*\*p<.001, \*\*p<.01. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details.

# Web Appendix F – Robustness Analyses: Alternative sample COnsiderations

## Relaxing the Sample Restriction

To examine the robustness of our result after relaxing the sample restriction (i.e., raters who have online friends), we re-estimate the model after including raters with no friends in the estimation sample. This results in a sample of 5,930,901 rater-game pairs. Although, this prohibits us from testing the friend effect, it serves as a robustness check for the crowd effect. The results remain qualitatively unchanged (see column (A) of Table WA.F.1 below). This suggests that the crowd effect is robust whether or not the rater has any declared online friends. As an additional insight, we investigate whether having a friend influences the magnitude of the crowd effect. We find that the main effect of crowd remains the same and the crowd effect magnitude does not change due to the absence (or presence) of friend () (see column (B) of Table WA.F.1).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table WA.F.1 – Robustness Check: Replicating the Crowd effect after including Raters with No Declared Friends** | | | | | |
| *Variable* | *Hypotheses* | *(A)* | | *(B)* | |
| *Estimate* | *S.E* | *Estimate* | *S.E* |
| Crowd rating |  | .963\*\*\* | .016 | .964\*\*\* | .016 |
| Has friends (yes=1) |  | -.161\*\*\* | .008 | -.161\*\*\* | .008 |
| Crowd rating Has friends |  |  |  | .008 | .007 |
| Rater experience |  | .0001\*\* | .00003 | .00009\*\*\* | .00003 |
| Crowd rating Rater experience+ | H1 (–) | -.072\*\*\* | .004 | -.072\*\*\* | .004 |
| Product Scope | H5 (+) | .715\*\*\* | .009 | .715\*\*\* | .009 |
| Crowd rating Product Scope | H6 (–) | -.144\*\*\* | .011 | -.144\*\*\* | .011 |
| Rating order/Volume of ratings+ |  | -.009\*\*\* | .0002 | -.009\*\*\* | .0002 |
| Time since the first rating+ |  | .004\*\*\* | .001 | .004\*\*\* | .001 |
| Publisher loyalty |  | .006\*\*\* | .0002 | .006\*\*\* | .0002 |
| Intercept |  | -.304\*\*\* | .016 | -.304\*\*\* | .018 |
| Individual-level fixed effect | | Yes | | Yes | |
| Game-level fixed effect | | Yes | | Yes | |
| Year fixed effect | | Yes | | Yes | |
| Notes: \*\*\*p<.001, \*\*p<.01. All standard errors are bootstrapped and clustered at the individual level. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. | | | | | |

1. ***Concerns about outliers***

Although an average rating of 50 games over a 10-year period is not uncommon in typical rating environments, there is a possibility of ‘fake’ outlier reviewers existing in our dataset. To account for this, we re-estimate the model after removing outliers in the long tail. As shown in the table below, the results remain qualitatively unchanged.

Table WA.F.2 – Removing Top 1% Raters as Outliers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Variable* | *Hypotheses* | | *Estimate* | *SE* |
| Crowd rating |  | | .580\*\*\* | .025 |
| Friends’ rating |  | | .201\*\*\* | .004 |
| Rater experience |  | | .0008\*\*\* | .00002 |
| Divergence between friends and crowd |  | | -.010\*\*\* | .002 |
| Crowd rating Rater experience+ | H1 (–) | | -1.524\*\*\* | .144 |
| Friends’ rating Rater experience+ | H2 (+) | | .324\*\*\* | .044 |
| Crowd rating Divergence b/w friends and crowd | H3a (+) | | .128\*\*\* | .021 |
| Friends’ rating Divergence b/w friends and crowd | H3b (–) | | -.047\*\*\* | .005 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | | -.202\*\*\* | .048 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | | .130\*\*\* | .021 |
| Product Scope | H5 (+) | | .107\*\*\* | .003 |
| Crowd rating Product Scope | H6 (–) | | -.004\*\*\* | .0003 |
| Friends’ rating Product Scope | H7 (–) | | -.0001\*\* | .00003 |
| Endogeneity correction |  | | -.019\*\*\* | .001 |
| Intercept |  | | -.094\*\*\* | .014 |
| Control Variables | | Yes | | |
| Individual-level fixed effect | | Yes | | |
| Game-level fixed effect | | Yes | | |
| Year fixed effect | | Yes | | |

Notes: \*\*\*p<.001, \*\*p<.01. All standard errors are bootstrapped and clustered at the individual level. +The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (*Measures* section) for details.

## Considering only raters with prior experience with the firm

On the website, raters have easy access to a firm’s entire publishing history, categories, etc. However, to ensure that raters are aware of a publisher’s portfolio, we ran an additional analysis. We first note that in the main regression model, *Publisher Loyalty* is positive and significant indicating that raters tend to rate games from their favorite publishers more favorably. This gives us some confidence that raters are at least aware of publishers. Second, as a more conservative test, we rerun the main regression model only considering raters who have rated a publishers’ game prior to the focal game rating. We use raters who have previously rated a game from one of the publishers who developed the current game (33,696 raters’ ratings are used). As shown in the table below, the results remain qualitatively unchanged.

**Table WA.F.3 – Including Only Raters with Prior Experience with the Firm**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Variable* | *Hypotheses* | | *Estimate* | *SE* |
| Crowd rating |  | | .441\*\*\* | .019 |
| Friends’ rating |  | | .191\*\*\* | .005 |
| Rater experience |  | | -.0005\*\*\* | .00002 |
| Divergence between friends and crowd |  | | -.030\*\*\* | .002 |
| Crowd rating Rater experience+ | H1 (–) | | -.942\*\*\* | .071 |
| Friends’ rating Rater experience+ | H2 (+) | | .175\*\*\* | .026 |
| Crowd rating Divergence b/w friends and crowd | H3a (+) | | .041\*\* | .013 |
| Friends’ rating Divergence b/w friends and crowd | H3b (–) | | -.037\*\*\* | .004 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | | -.039\*\* | .013 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | | .044\*\*\* | .012 |
| Product Scope | H5 (+) | | .057\*\*\* | .001 |
| Crowd rating Product Scope | H6 (–) | | -.013\*\*\* | .003 |
| Friends’ rating Product Scope | H7 (–) | | -.001\*\*\* | .0003 |
| Endogeneity correction |  | | -.023\*\*\* | .002 |
| Intercept |  | | -.040 | .022 |
| Control variables | | Yes | | |
| Individual-level fixed effect | | Yes | | |
| Game-level fixed effect | | Yes | | |
| Year fixed effect | | Yes | | |

Notes: \*\*\*p<.001, \*\*p<.01, \*p<.05. All standard errors are bootstrapped and clustered at the individual level. +The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. As with all models presented in the manuscript, the following control variables are used: Time since the first rating, Publisher loyalty, Number of friends, Volume of crowd ratings, Volume of friends’ ratings, Average network size of friends, Number of groups friends are part of, and Membership length of friends. Please refer to the main manuscript (Measures section) for details.

**Web Appendix G - Additional Analyses and Insights**

In this section, we conduct several additional analyses to gain insight into the herding effects that we uncover in the paper. Due to page limits, we include these analyses in the Web Appendix.

1. ***Does Friend’s Experience Influence the Friend Herding Effect?***

We re-estimate the model after controlling for friends’ experience level. That is, we include the average friends’ experience (i.e. the average number of prior ratings provided by friends) as well as the interaction effect between friends’ rating and friends’ experience to check if friends’ experience moderates the friend herding effect. As shown in Table WA.G.1, the results remain qualitatively unchanged. Though not hypothesized, we find that the interaction of friends’ rating with average experience of friends is significant and positive (). That is, the valence of a rating is more likely to be influenced by friends when the friend network is more experienced.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table WA.G.1. Including Friend’s Experience** | | | |
| *Variable* | *Hypotheses* | *Estimate* | *S.E* |
| Crowd rating |  | .433\*\*\* | .008 |
| Friends’ rating |  | .190\*\*\* | .003 |
| Rater experience |  | -.0005\*\*\* | .00001 |
| Average experience of friends |  | -.001\*\*\* | .000 |
| **Friends’ rating Average experience of friends+** |  | .057\*\*\* | .012 |
| Divergence between friends and crowd |  | -.023\*\*\* | .001 |
| Crowd rating Rater experience+ | H1 (–) | -.991\*\*\* | .056 |
| Friends’ rating Rater experience+ | H2 (+) | .172\*\*\* | .025 |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | .046\*\*\* | .012 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | -.031\*\*\* | .003 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.461\*\*\* | .070 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .457\*\* | .165 |
| Product Scope | H5 (+) | .078\*\*\* | .001 |
| Crowd rating Product Scope | H6 (–) | -.015\*\* | .005 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | .0004 |
| Endogeneity correction |  | -.024\*\*\* | .001 |
| Intercept |  | -.076\*\*\* | .012 |
| Control variables | | Yes | |
| Individual-level fixed effect | | Yes | |
| Game-level fixed effect | | Yes | |
| Year fixed effect | | Yes | |
| Notes: \*\*\*p<.001, \*\*p<.01. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. | | | |

1. ***Does the Rater Experience Effect Vary by Volume of Ratings?***

Although not the primary focus of this research, we test whether the rater experience, both main and moderating, is affected by the volume of ratings available at the time of rating. As such, we include two-way interactions between the reference group (crowd and friend) rating and volume to test whether the herding effect varies as more reviews arrive. Further, to test whether experienced raters fall in line with the crowd when there are many reviews, we include three-way interactions of reference group rating, volume of ratings, and rater experience.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table WA.G.2 - Does the Rater Experience Effect Vary by Volume of Ratings?** | | | | |
| *Variable* | *Hypotheses* | | *Estimate* | *S.E* |
| Crowd rating |  | | .438\*\*\* | .008 |
| Friends’ rating |  | | .187\*\*\* | .003 |
| Rater experience |  | | -.0005\*\*\* | .00001 |
| Divergence between friends and crowd |  | | -.023\*\*\* | .001 |
| Crowd rating Rater experience+ | H1 (–) | | -1.071\*\*\* | .052 |
| Friends’ rating Rater experience+ | H2 (+) | | .161\*\*\* | .025 |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | | .045\*\*\* | .012 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | | -.031\*\*\* | .003 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | | -.420\*\*\* | .070 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | | .398\*\* | .144 |
| Crowd rating Volume of crowd ratings**+** |  | | .010\* | .005 |
| Friends’ rating Volume of friend ratings**+** |  | | .014\*\* | .005 |
| **Crowd rating Rater experience Volume of crowd ratings+** |  | | -.0001\* | .0001 |
| **Friends’ rating Rater experienceVolume of friend ratings+** |  | | .0002\* | .0001 |
| Product Scope | H5 (+) | | .079\*\*\* | .001 |
| Crowd rating Product Scope | H6 (–) | | -.015\*\*\* | .005 |
| Friends’ rating Product Scope | H7 (–) | | -.005\*\*\* | .0004 |
| Endogeneity correction |  | | -.022\*\*\* | .001 |
| Intercept |  | | -.051\*\*\* | .011 |
| Control variables | | Yes | | |
| Individual- fixed effect | | Yes | | |
| Game fixed effect | | Yes | | |
| Year fixed effect | | Yes | | |
| Notes: \*\*\*p<.001, \*\*p<.01, \*p<.05. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. | | | | |

The first takeaway from Table WA.G2 is that the main findings presented in-text remain qualitatively consistent. Next, we turn our attention to the interaction effects. The results suggest that there is some dynamics in the rater experience effect. First, looking at the two-way interactions between crowd/friend rating and volume, we find that both crowd and friend herding effects are amplified (positive and significant coefficients) by the presence of a large volume of ratings. That is, the average rater tends to coalesce with both reference groups when a large number of ratings have already been posted for the specific game. This is to be expected according to the theory of herding. The external rating information is more diagnostic when there are more reviews and thus, herding is pronounced. Second, turning to the role or experience (three-way interactions), although the significance is low, we see that even when a large volume of ratings are available, raters with high experience still tend to differentiate from the crowd (negative interaction effect) and coalesce with friends (positive interaction effect). This result is qualitatively similar to our main results; rater experience positively (negatively) moderates herding from the friend (crowd).

1. ***Exploring Synergistic Effects between Friends’ and Crowd Ratings***

We conduct various analyses to test whether the friend-crowd interactions might influence rating behavior. We explore whether there is a synergistic effect of the valence of friends’ *and* crowd ratings on the rating behavior over and above the main effects. That is, we re-estimate the model after including a interaction effect. The effect is non-significant () (see Table WA.G.3 below). We conjecture that this is most likely due to the main effects already explaining the variation in ratings. In the interest of completeness, we also test higher order interactions with rater experience and product scope. We found that the lower order interaction effect )) as well as the higher order three-way interactions (()) and (()) are all non-significant as shown in Table WA.G.3. Notably, in all the regressions, the main results were replicated.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table WA.G.3 – Exploring Synergistic Effects** | | | | | | | |
| *Variable* | *Hypotheses* | *(A) Including Crowd and Friend Interaction* | | | *(B) Including Three-Way Interactions* | | |
| *Estimate* | | *S.E* | *Estimate* | | *S.E* |
| Crowd rating |  | .426\*\*\* | | .008 | .426\*\*\* | | .007 |
| Friends’ rating |  | .188\*\*\* | | .003 | .188\*\*\* | | .003 |
| Rater experience |  | -.0005\*\*\* | | .00001 | -.0005\*\*\* | | .00001 |
| Divergence between friends and crowd |  | -.023\*\*\* | | .001 | -.023\*\*\* | | .001 |
| **Friends’ rating Crowd rating** |  | .013 | | .008 | .013 | | .008 |
| **Friends’ rating Crowd rating Rater experience**+ |  |  | |  | -.002 | | .039 |
| **Friends’ rating Crowd rating Product Scope** |  |  | |  | -.003 | | .004 |
| Crowd rating Rater experience+ | H1 (–) | -1.001\*\*\* | | .056 | -1.001\*\*\* | | .065 |
| Friends’ rating Rater experience+ | H2 (+) | .163\*\*\* | | .025 | .163\*\*\* | | .025 |
| Crowd rating Divergence b/w friends & crowd | H3a (+) | .051\*\*\* | | .010 | .051\*\*\* | | .010 |
| Friends’ rating Divergence b/w friends & crowd | H3b (–) | -.031\*\*\* | | .003 | -.031\*\*\* | | .003 |
| Crowd rating Rater experience Divergence b/w friends & crowd+ | H4a (–) | -.469\*\*\* | | .071 | -.468\*\*\* | | .077 |
| Friends’ rating Rater experienceDivergence b/w friends & crowd+ | H4b (+) | .042\*\* | | .015 | .042\*\*\* | | .013 |
| Product Scope | H5 (+) | .079\*\*\* | | .001 | .079\*\*\* | | .001 |
| Crowd rating Product Scope | H6 (–) | -.014\*\* | | .005 | -.013\*\* | | .004 |
| Friends’ rating Product Scope | H7 (–) | -.005\*\*\* | | .0004 | -.005\*\*\* | | .0005 |
| Volume of crowd ratings+ |  | -.007\*\*\* | | .0004 | -.007\*\*\* | | .0004 |
| Volume of friends’ ratings |  | .002\*\*\* | | .0001 | .002\*\*\* | | .0001 |
| Time since the first rating+ |  | .038\*\*\* | | .002 | .038\*\*\* | | .002 |
| Publisher loyalty |  | .005\*\*\* | | .0003 | .005\*\*\* | | .0003 |
| Number of friends+ |  | .162\*\*\* | | .072 | .162\*\*\* | | .072 |
| Endogeneity correction |  | -.023\*\*\* | | .001 | -.023\*\*\* | | .001 |
| Number of friends’ friends+ |  | .0002 | | .011 | .0002 | | .011 |
| Number of groups friends are part of |  | .001 | | .001 | .001 | | .001 |
| Membership length of friends+ |  | .001 | | .002 | .001 | | .002 |
| Intercept |  | -.065\*\*\* | | .011 | -.065\*\*\* | | .011 |
| Individual- fixed effect | | | Yes | | | Yes | |
| Game fixed effect | | | Yes | | | Yes | |
| Year fixed effect | | | Yes | | | Yes | |
| Notes: \*\*\*p<.001, \*\*p<.01, \*p<.05. All standard errors are bootstrapped and clustered at the individual level. + The coefficients and standard errors are rescaled (i.e., multiplied by 1000) to improve readability. | | | | | | | |

**Web Appendix H – Numerical Illustration of the Relevant Product Scope measure**

In this Web Appendix, we elaborate on how the relevant product scope (*RPS)* measure is operationalized using numerical illustrations.

The idea behind using relevant product scope as an alternate measure is to capture the relevance of a firm’s product scope to the product category being considered. The product scope measure () captures the breadth and overall depth of a firm’s product offerings, but not its relevance to the game being evaluated. To account for this, we define a matching indicator which takes the value of if game is classified in the category and otherwise. Multiplying to the captures the relatedness of the firm’s product scope with the game’s category classification.

Consider an individual who is rating game published by firm at time . Further, let game j be classified under two (out of a total of three[[2]](#footnote-2)) categories/genres; namely Strategy and Family. The relevant product scope is then given by;

|  |  |  |
| --- | --- | --- |
| WA.H (1) |  |  |
| Where  = index for genre (Strategy, Family, War)  = index for firm  = index for game  = index for time  = proportion of products launched by firm in genre up until time  = total number of products launched by firm up until time  = indicator function denoting the classification of game into genre | | |

In order to compute , we need to two pieces of information (1) the firm’s product launch history (to calculate and ) and (2) the game’s genre classifications (to assess ).

In this example, we assume that the firm has launched 20 products (8 in the Strategy genre, 6 in Family genre, and 6 in War genre) [[3]](#footnote-3). Using this information, we can easily compute and at the firm level for each category as follows:

For the Strategy genre, .

For the Family genre, .

For the Family genre, .

Further, the total number of product launches () = 2. Lastly, we assume that the game is classified under Strategy and Family (and not War genre). This allows Now that we have compiled all the required information required for Equation WA.H(1) above, we can plug it into the equation and compute as follows. We first expand the ‘summation part’ of Equation WA.H(1) above as follows,

|  |  |  |
| --- | --- | --- |
| WA.H (2) |  |  |

Next, we substitute the computed and values,

|  |  |  |
| --- | --- | --- |
| WA.H (3) |  |  |

Thus, the relevant product scope for firm , game is 14.55, which is used in the estimation.

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1. We also replicate the analysis using an ordered logit model. The results are available from the authors. [↑](#footnote-ref-1)
2. We assume three genres here (Strategy, War, and Family). [↑](#footnote-ref-2)
3. Games need not belong to only one genre. In such situations, entropy measures of a firm’s product portfolio remain stable and monotonic and the pattern of results holds; the major difference being in those cases that summation of the proportion of games in each genre is greater than one. We have limited each past product for ease of exposition. [↑](#footnote-ref-3)