Internet Appendix for
"Does Stock Liquidity Enhance or Impede Firm Innovation?"*

This Internet Appendix provides supplemental analyses and robustness tests to the main results presented in "Does Stock Liquidity Enhance or Impede Firm Innovation?" Section A discusses robustness checks reported in Tables IA1 – IA3 using alternative measures of stock liquidity. Section B discusses additional results reported in Tables IA4 – IA6. The tables are organized as follows:

Table IA1: Robustness checks using relative quoted spread to measure liquidity

Table IA2: Robustness checks using the Amihud (2002) illiquidity ratio to measure liquidity

Table IA3: Robustness checks using the PIN measure to capture adverse selection component of liquidity

Table IA4: Robustness checks controlling for M&A deal size or removing firms with M&As

Table IA5: Robustness checks partitioning sample into size quartiles

Table IA6: Robustness checks interacting liquidity with time effects

Section A. Robustness Checks Using Alternative Measures of Stock Liquidity

In this section we check to see if the results shown in Table II are robust to the use of alternative measures of stock liquidity. We obtain intraday trades and quotes from the *Trade and*

* Citation format: Fang, Tian, and Tice, 2013, Internet Appendix to "Does Stock Liquidity Enhance or Impede Firm Innovation?" Journal of Finance [DOI:]. Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing material) should be directed to the authors of the article.

Quote (TAQ) database and daily trading information (price and volume) from CRSP daily stock files to construct two alternative measures of liquidity: the natural logarithm of the annual relative quoted spread *RQSPRD* and the natural logarithm of the annual Amihud (2002) illiquidity measure *AMIHUD*. Relative quoted spread is the quoted spread standardized by the mid-point of the prevailing bid-ask quote, based on the same sample we use to calculate relative effective spread. The Amihud measure is calculated as the daily price response associated with one dollar of trading volume and averaged over fiscal year *t* for firm *i*. To build the sample using the Amihud measure, we require a stock to be listed at the end of its fiscal year *t*, to have at least 200 days of return and volume data available in the CRSP daily files during fiscal year *t*, and to have a price of $5 or more at the end of fiscal year *t*. Both liquidity measures are highly correlated with our main measure of liquidity *ILLIQ*: *RQSPRD* has a 0.99 correlation (both Pearson and Spearman) with *ILLIQ*, and *AMIHUD* has a Pearson (Spearman) correlation of 0.90 (0.91) with *ILLIQ*, all significant at the 1% level.

We report the results using the relative quoted spread measure and the Amihud (2002) illiquidity measure in Table IA1 and IA2, respectively. As shown, the coefficient estimates of the relative quoted spread are all positive and significant at the 1% level. For example, the coefficient is 0.130 (p-value < 0.001) in model (1) of Table IA1 Panel A when one-year ahead *INNOV_PAT* is the dependent variable. Increasing relative quoted spread from its median (0.014) to the 90th percentile (0.060) is associated with a 42.7% increase in the number of patents filed in one year and 34.5% increase in the number of citations received by each patent in two years. The coefficient estimates of the Amihud illiquidity measure are also significantly positive.[i] For example, the coefficient is 0.012 (p-value = 0.075) in model (1) of Table IA2 Panel A when one-

year ahead *INNOV_PAT* is the dependent variable. Increasing Amihud illiquidity measure from its median (0.023) to the 90th percentile (0.431) is associated with a 21.3% increase in the number of patents filed in one year and 24.8% increase in the number of citations received by each patent in two years. Thus, our results are robust to using both relative quoted spread and the Amihud illiquidity measure.

Microstructure literature posits that the bid-ask spread can be decomposed into inventory holding, order processing, and adverse selection components (e.g., Huang and Stoll (1997)). Of the three components, the adverse selection component captures information asymmetry between informed and uninformed traders. Since both streams of theories underpinning our hypotheses concern information, i.e., Stein (1988, 1989) on information asymmetry and Maug (1998) as well as Edmans (2009) on collection and/or trading of private information, our baseline results should remain robust to using a proxy for the information-related component of the bid-ask spread (i.e., adverse selection component). We repeat Eq. (1) using the *PIN* (probability of informed trading) measure of Easley, Kiefer, and O'Hara (1997). *PIN* is a widely used measure in prior research to capture the degree of information asymmetry among traders in the secondary market.[ii] We report the results in Table IA3 in the appendix. The coefficient estimates of *PIN* are positive and significant at the 1% level in both panels. Increasing *PIN* from its median (0.205) to the 90th percentile (0.328) is associated with approximately a 2.3% increase in the number of patents filed and a 2% increase in the number of citations received by each patent in one year.

Section B. Additional Insights

In this section we run several tests to examine if the causal effect of liquidity on innovation is being driven by a particular sub-sample of firms. First, we examine if the results are being driven by the sub-sample of firms who have relied on acquisitions to achieve innovation. We begin by identifying firms in our sample that have acquired at least 50% ownership or assets of another firm in a year. We then calculate the aggregate value of all M&As undertaken by these firms normalized by their book value of assets at the end of the year, denoted as *DEALVAL*, and set to zero if no majority acquisition is undertaken. In column (1) of Panels A and B in Table IA4, we augment Eq. (1) by including *DEALVAL*. The coefficient estimates of *ILLIQ* continue to be the same magnitude as they are in Table II and continue to be significant at the 1% level, while the coefficient estimates of *DEALVAL* are positive and statistically insignificant. Increasing the relative effective spread from its median (0.013) to the 90^{th} percentile (0.052) continues to be associated with a 42.3% increase in the number of patents filed in one year and a 31.2% increase in the number of citations received by each patent in one year. Second, instead of controlling for *DEALVAL*, we focus on a subsample of firms that either make no acquisitions or acquire a minor share of target firms (< 50% ownership) in a given year and re-estimate Eq. (1). We report the results in column (2) of Panels A and B in Table IA4. The coefficient estimates of *ILLIQ* continue to be positive and significant at the 1% level, although the magnitudes of coefficient estimates decrease marginally from 0.141 to 0.134 in Panel A and from 0.104 to 0.098 in Panel B. Finally, based on the sample used in column (2), we further exclude firm-year observations for which more than 50% of the firm's ownership or assets are acquired by another firm in a given year and re-estimate Eq. (1). The results are shown in column (3) of Panels A and B in Table IA4. The coefficient estimates of *ILLIQ* continue to be

positive and significant at the 1% level with the magnitudes of the coefficient estimates almost identical to those in column (2). Overall, these tests suggest that while our sample period covers a M&A wave in the 1990s, the findings are not driven by M&As that change the ownership of patenting firms.

Next we partition our sample into size quartiles to see if the results are being driven by small firms that are typically more innovative but usually have low stock liquidity. The results are reported in Panel A and Panel B of Table IA5. The coefficient estimates of *ILLIQ* are positive across all four quartiles in all regressions. The negative relation between liquidity and innovation appears to be strongest for the top two size quartiles. For example, increasing relative spread from the sample median (0.013) to the 90^{th} percentile (0.052) is associated with a 47.1% increase in the number of patents filed in one year (significant at 1%) for firms in the largest size quartile and a .90% increase in the number of patents filed in one year (insignificant) for firms in the smallest size quartile. The results are very similar if we partition our sample based on firm age (not shown for brevity). Overall, the subsample tests suggest that the causal relation between liquidity and innovation is not simply driven by small, young firms.

To rule out the possibility that our results are driven by a large number of firm-year observations with zero patents and citations, we focus on a subsample of firms that have at least one patent in the pooled sample. In untabulated analysis, we continue to observe positive and significant coefficient estimates on *ILLIQ*.

Lastly, we examine if there is a particular year or set of years that are driving the results. To assess this, in addition to controlling for year fixed effects, we add interaction terms between *ILLIQ* and year dummies to Eq. (1) and report the results in Table IA6. The coefficient estimates

of *ILLIQ* are positive and significant, suggesting that the negative relation between liquidity and firm innovation is present in 1994 (the base year). The economic effect of liquidity on innovation is smaller but still economically significant in 1994 (the base year). For example, increasing relative spread from the sample median (0.013) to the 90th percentile (0.052) is associated with a 19.8% increase in the number of patents filed in one year for firms in 1994 and a 19.2% increase in the number of citations received for each patent in one year in 1994. The coefficient estimates of interaction terms are all positive and become significant starting 1998, suggesting that the negative relation between liquidity and innovation is unchanged (compared to 1994) in the period of 1995 to 1997, but become stronger starting in 1998. One possible explanation is that the shift of the minimum tick size in 1997 from the eighth regime to the sixteenth regime enhanced stock liquidity. Also, an interesting observation is that the magnitudes of the interaction terms increase monotonically after 1998, suggesting that the negative relation between liquidity and innovation has strengthened with liquidity increasing in the past decade.

In summary, in this section we show the negative relation between stock liquidity and firm innovation is not being driven by firms acquiring or merging with other firms, is not being driven by small cap firms, is not being driven by firms with zero R&D or patents, and is strengthening over time.

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Table IA1: Robustness Checks Using Relative Quoted Spread to Measure Liquidity
Panel A: Baseline Specifications with Innovation Measured by Patents

This panel reports the pooled regression results of the model $INNOV\_PAT_{i,t+n} = a + bRQSPRD_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_PAT_{i,t+1}$ in column (1) and replaced with $INNOV\_PAT_{i,t+2}$ and $INNOV\_PAT_{i,t+3}$ in columns (2) and (3), respectively. *RQSPRD* is the natural logarithm of relative quoted spread, calculated as quoted spread standardized by the mid-point of the prevailing bid-ask quote and averaged over fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+2}$	$INNOV\_PAT_{t+3}$
$RQSPRD_t$	**0.130*****	**0.181*****	**0.208*****
	(0.021)	(0.023)	(0.027)
LN_MV_t	**0.156*****	**0.101*****	**0.044****
	(0.018)	(0.019)	(0.021)
$RDTA_t$	**0.278*****	**0.259*****	**0.177***
	(0.089)	(0.094)	(0.094)
ROA_t	**-0.038**	**0.238*****	**0.396*****
	(0.068)	(0.068)	(0.081)
$PPETA_t$	**0.290*****	**0.358*****	**0.482*****
	(0.094)	(0.109)	(0.130)
LEV_t	**-0.254*****	**-0.362*****	**-0.472*****
	(0.075)	(0.084)	(0.092)
$CAPEXTA_t$	**0.160**	**0.353*****	**0.189**
	(0.118)	(0.134)	(0.148)
$HINDEX_t$	**0.105**	**0.105**	**0.121**
	(0.086)	(0.099)	(0.108)
$HINDEX^2_t$	**-0.110**	**-0.067**	**-0.181**
	(0.150)	(0.167)	(0.180)
Q_t	**-0.005**	**0.010**	**0.002**
	(0.007)	(0.008)	(0.008)
$KZINDEX_t$	**-0.000***	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.165*****	**0.189*****	**0.221*****
	(0.035)	(0.038)	(0.042)
INTERCEPT	**0.212****	**0.705*****	**1.044*****
	(0.105)	(0.113)	(0.125)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	33,098	27,363
Adjusted R^2	0.839	0.844	0.849

Table IA1: Robustness Checks Using Relative Quoted Spread to Measure Liquidity
Panel B: Baseline Specifications with Innovation Measured by Citations

This panel reports the pooled regression results of the model $INNOV\_CITE_{i,t+n} = a + bRQSPRD_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_CITE_{i,t+1}$ in column (1) and replaced with $INNOV\_CITE_{i,t+2}$ and $INNOV\_CITE_{i,t+3}$ in columns (2) and (3), respectively. *RQSPRD* is the natural logarithm of relative quoted spread, calculated as quoted spread standardized by the mid-point of the prevailing bid-ask quote and averaged over fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+2}$	$INNOV\_CITE_{t+3}$
$RQSPRD_t$	**0.105*****	**0.124*****	**0.134*****
	(0.015)	(0.016)	(0.019)
LN_MV_t	**0.062*****	**0.026***	**-0.001**
	(0.013)	(0.014)	(0.016)
$RDTA_t$	**0.166****	**0.146**	**0.171***
	(0.080)	(0.090)	(0.098)
ROA_t	**0.132****	**0.292*****	**0.244*****
	(0.061)	(0.062)	(0.074)
$PPETA_t$	**0.168****	**0.142**	**0.164***
	(0.077)	(0.087)	(0.095)
LEV_t	**-0.195*****	**-0.264*****	**-0.312*****
	(0.052)	(0.059)	(0.064)
$CAPEXTA_t$	**0.235****	**0.235***	**0.255****
	(0.113)	(0.120)	(0.126)
$HINDEX_t$	**0.127**	**0.102**	**0.084**
	(0.077)	(0.082)	(0.086)
$HINDEX^2_t$	**-0.165**	**-0.032**	**-0.078**
	(0.126)	(0.132)	(0.136)
Q_t	**0.005**	**0.007**	**0.006**
	(0.006)	(0.006)	(0.006)
$KZINDEX_t$	**-0.000**	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.089*****	**0.063****	**0.087*****
	(0.025)	(0.029)	(0.031)
INTERCEPT	**0.626*****	**0.986*****	**1.101*****
	(0.078)	(0.087)	(0.096)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	33,098	27,363
Adjusted R^2	0.652	0.653	0.653

Table IA2: Robustness Checks Using Amihud Illiquidity Ratio to Measure Liquidity
Panel A: Baseline Specifications with Innovation Measured by Patents

This panel reports the pooled regression results of the model $INNOV\_PAT_{i,t+n} = a + bAMIHUD_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_PAT_{i,t+1}$ in column (1) and replaced with $INNOV\_PAT_{i,t+2}$ and $INNOV\_PAT_{i,t+3}$ in columns (2) and (3), respectively. *AMIHUD* is the natural logarithm of Amihud (2002) illiquidity ratio, calculated as the daily price response associated with one dollar of trading volume and averaged over fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+2}$	$INNOV\_PAT_{t+3}$
$AMIHUD_t$	**0.012***	**0.026*****	**0.027*****
	(0.006)	(0.008)	(0.009)
LN_MV_t	**0.093*****	**0.029**	**-0.036***
	(0.018)	(0.019)	(0.022)
$RDTA_t$	**0.265*****	**0.244****	**0.164***
	(0.089)	(0.096)	(0.096)
ROA_t	**-0.021**	**0.255*****	**0.405*****
	(0.070)	(0.070)	(0.084)
$PPETA_t$	**0.294*****	**0.334*****	**0.481*****
	(0.101)	(0.114)	(0.136)
LEV_t	**-0.282*****	**-0.390*****	**-0.492*****
	(0.078)	(0.087)	(0.095)
$CAPEXTA_t$	**0.083**	**0.291****	**0.076**
	(0.123)	(0.139)	(0.152)
$HINDEX_t$	**0.136**	**0.172***	**0.128**
	(0.088)	(0.099)	(0.109)
$HINDEX^2_t$	**-0.181**	**-0.160**	**-0.216**
	(0.148)	(0.165)	(0.178)
Q_t	**0.003**	**0.019****	**0.011**
	(0.007)	(0.008)	(0.009)
$KZINDEX_t$	**-0.000***	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.154*****	**0.175*****	**0.193*****
	(0.036)	(0.039)	(0.043)
INTERCEPT	**0.106**	**0.490*****	**0.805*****
	(0.106)	(0.115)	(0.126)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	37,421	31,410	25,992
Adjusted R^2	0.842	0.847	0.852

Table IA2: Robustness Checks Using Amihud Illiquidity Ratio to Measure Liquidity
Panel B: Baseline Specifications with Innovation Measured by Citations

This panel reports the pooled regression results of the model $INNOV\_CITE_{i,t+n} = a + bAMIHUD_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_CITE_{i,t+1}$ in column (1) and replaced with $INNOV\_CITE_{i,t+2}$ and $INNOV\_CITE_{i,t+3}$ in columns (2) and (3), respectively. *AMIHUD* is the natural logarithm of Amihud (2002) illiquidity ratio, calculated as the daily price response associated with one dollar of trading volume and averaged over fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A.Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+2}$	$INNOV\_CITE_{t+3}$
$AMIHUD_t$	**0.005**	**0.014****	**0.017****
	(0.006)	(0.007)	(0.007)
LN_MV_t	**0.007**	**-0.026***	**-0.049*****
	(0.014)	(0.015)	(0.017)
$RDTA_t$	**0.150***	**0.133**	**0.153**
	(0.080)	(0.091)	(0.100)
ROA_t	**0.152****	**0.308*****	**0.243*****
	(0.063)	(0.064)	(0.076)
$PPETA_t$	**0.175****	**0.124**	**0.170***
	(0.083)	(0.091)	(0.100)
LEV_t	**-0.201*****	**-0.271*****	**-0.322*****
	(0.055)	(0.062)	(0.066)
$CAPEXTA_t$	**0.190**	**0.195**	**0.164**
	(0.119)	(0.125)	(0.130)
$HINDEX_t$	**0.135***	**0.142***	**0.082**
	(0.079)	(0.084)	(0.089)
$HINDEX^2_t$	**-0.173**	**-0.068**	**-0.089**
	(0.128)	(0.135)	(0.139)
Q_t	**0.011***	**0.013****	**0.011***
	(0.006)	(0.006)	(0.007)
$KZINDEX_t$	**-0.000**	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.087*****	**0.054***	**0.071****
	(0.026)	(0.030)	(0.032)
INTERCEPT	**0.538*****	**0.844*****	**0.930*****
	(0.081)	(0.091)	(0.099)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	37,421	31,410	25,992
Adjusted R^2	0.653	0.654	0.654

Table IA3: Robustness Checks using PIN to Capture Adverse Selection Component of Liquidity

Panel A: Baseline Specifications with Innovation Measured by Patents

This panel reports the pooled regression results of the model $INNOV\_PAT_{i,t+n} = a + bPIN_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_PAT_{i,t+1}$ in column (1) and replaced with $INNOV\_PAT_{i,t+2}$ and $INNOV\_PAT_{i,t+3}$ in columns (2) and (3), respectively. *PIN* is the probability of informed trade measure of Easley, Kiefer, and O'Hara (1997), averaged over four quarters of fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A.Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+2}$	$INNOV\_PAT_{t+3}$
PIN_t	**0.296*****	**0.547*****	**0.458*****
	(0.082)	(0.096)	(0.106)
LN_MV_t	**0.087*****	**0.016**	**-0.039****
	(0.015)	(0.015)	(0.017)
$RDTA_t$	**0.257*****	**0.241****	**0.161***
	(0.089)	(0.095)	(0.094)
ROA_t	**-0.022**	**0.239*****	**0.337*****
	(0.070)	(0.070)	(0.082)
$PPETA_t$	**0.359*****	**0.403*****	**0.538*****
	(0.102)	(0.114)	(0.132)
LEV_t	**-0.259*****	**-0.346*****	**-0.467*****
	(0.078)	(0.087)	(0.095)
$CAPEXTA_t$	**-0.002**	**0.195**	**-0.011**
	(0.121)	(0.134)	(0.145)
$HINDEX_t$	**0.158***	**0.142**	**0.141**
	(0.088)	(0.099)	(0.108)
$HINDEX^2_t$	**-0.208**	**-0.142**	**-0.223**
	(0.148)	(0.165)	(0.177)
Q_t	**0.003**	**0.018****	**0.005**
	(0.007)	(0.008)	(0.008)
$KZINDEX_t$	**-0.000****	**-0.000**	**-0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.157*****	**0.176*****	**0.189*****
	(0.036)	(0.038)	(0.042)
INTERCEPT	**0.014**	**0.354*****	**0.653*****
	(0.108)	(0.117)	(0.126)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	37,929	31,811	26,295
Adjusted R^2	0.840	0.845	0.854

Table IA3: Robustness Checks using PIN to Capture Adverse Selection Component of Liquidity

Panel B: Baseline Specifications with Innovation Measured by Citations

This panel reports the pooled regression results of the model $INNOV\_CITE_{i,t+n} = a + bPIN_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_CITE_{i,t+1}$ in column (1) and replaced with $INNOV\_CITE_{i,t+2}$ and $INNOV\_CITE_{i,t+3}$ in columns (2) and (3), respectively. *PIN* is the probability of informed trade measure of Easley, Kiefer, and O'Hara (1997), averaged over four quarters of fiscal year *t* for firm *i*. Definitions of other variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their robust errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+2}$	$INNOV\_CITE_{t+3}$
PIN_t	**0.160****	**0.351*****	**0.247*****
	(0.076)	(0.082)	(0.093)
LN_MV_t	**0.009**	**-0.034*****	**-0.062*****
	(0.012)	(0.012)	(0.014)
$RDTA_t$	**0.143***	**0.117**	**0.140**
	(0.081)	(0.090)	(0.097)
ROA_t	**0.143****	**0.282*****	**0.214*****
	(0.062)	(0.065)	(0.076)
$PPETA_t$	**0.211****	**0.163***	**0.207****
	(0.083)	(0.093)	(0.101)
LEV_t	**-0.198*****	**-0.260*****	**-0.299*****
	(0.055)	(0.062)	(0.067)
$CAPEXTA_t$	**0.098**	**0.151**	**0.111**
	(0.116)	(0.122)	(0.128)
$HINDEX_t$	**0.128**	**0.112**	**0.081**
	(0.078)	(0.084)	(0.089)
$HINDEX^2_t$	**-0.166**	**-0.038**	**-0.070**
	(0.126)	(0.133)	(0.139)
Q_t	**0.010***	**0.013****	**0.012***
	(0.006)	(0.006)	(0.006)
$KZINDEX_t$	**-0.000**	**-0.000**	**-0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.083*****	**0.051***	**0.064****
	(0.026)	(0.029)	(0.032)
INTERCEPT	**0.485*****	**0.770*****	**0.902*****
	(0.083)	(0.090)	(0.102)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	37,929	31,811	26,295
Adjusted R^2	0.652	0.654	0.655

Table IA4: Robustness Checks Controlling for M&A Deal Size or Removing M&A Firms
Panel A: Baseline Specifications with Innovation Measured by Patents

The dependent variable is $INNOV\_PAT_{i,t+1}$ in all three columns. Definitions of variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. In column (1), *DEALVAL* is the deal value (in millions) of the M&A deflated by end of the year book value of assets. *DEALVAL* is included as an additional control variable if there is an acquisition that involves 50% or more in another firm for a firm-year and set to zero otherwise. In column (2), we delete a firm-year if the firm acquires 50% of more in another firm. In column (3), we delete a firm-year if the firm acquires 50% or more in another firm or 50% or more of the firm is acquired by another firm. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+1}$
$ILLIQ_t$	**0.141*****	**0.134*****	**0.133*****
	(0.020)	(0.022)	(0.022)
LN_MV_t	**0.158*****	**0.146*****	**0.146*****
	(0.018)	(0.018)	(0.018)
$RDTA_t$	**0.278*****	**0.237****	**0.236****
	(0.089)	(0.092)	(0.094)
ROA_t	**-0.030**	**-0.037**	**-0.038**
	(0.068)	(0.070)	(0.070)
$PPETA_t$	**0.290*****	**0.300*****	**0.294*****
	(0.094)	(0.098)	(0.099)
LEV_t	**-0.259*****	**-0.294*****	**-0.300*****
	(0.075)	(0.081)	(0.081)
$CAPEXTA_t$	**0.176**	**0.164**	**0.169**
	(0.119)	(0.125)	(0.125)
$HINDEX_t$	**0.107**	**0.117**	**0.112**
	(0.086)	(0.092)	(0.093)
$HINDEX^2_t$	**-0.113**	**-0.108**	**-0.104**
	(0.150)	(0.155)	(0.156)
Q_t	**-0.006**	**-0.014***	**-0.015***
	(0.007)	(0.008)	(0.007)
$KZINDEX_t$	**-0.000***	**-0.000***	**-0.000****
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.168*****	**0.155*****	**0.162*****
	(0.035)	(0.035)	(0.036)
$DEALVAL_t$	**0.044**		
	(0.032)		
INTERCEPT	**0.276*****	**0.315*****	**0.304*****
	(0.106)	(0.109)	(0.110)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	32,466	32,349
Adjusted R^2	0.839	0.833	0.833

Table IA4: Robustness Checks Controlling for M&A Deal Size or Removing M&A Firms
Panel B: Baseline Specifications with Innovation Measured by Citations

The dependent variable is $INNOV\_CITE_{i,t+1}$ in all three columns. Definitions of variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. In column (1), *DEALVAL* is the deal value (in millions) of the M&A deflated by end of the year book value of assets. *DEALVAL* is included as an additional control variable if there is an acquisition that involves 50% or more in another firm for a firm-year and set to zero otherwise. In column (2), we delete a firm-year if the firm acquires 50% of more in another firm. In column (3), we delete a firm-year if the firm acquires 50% or more in another firm or 50% or more of the firm is acquired by another firm. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+1}$
$ILLIQ_t$	**0.104*****	**0.098*****	**0.098*****
	(0.015)	(0.016)	(0.016)
LN_MV_t	**0.060*****	**0.054*****	**0.053*****
	(0.013)	(0.014)	(0.014)
$RDTA_t$	**0.169****	**0.115**	**0.104**
	(0.080)	(0.081)	(0.082)
ROA_t	**0.137****	**0.113***	**0.108***
	(0.061)	(0.065)	(0.065)
$PPETA_t$	**0.168****	**0.100**	**0.093**
	(0.077)	(0.083)	(0.083)
LEV_t	**-0.197*****	**-0.209*****	**-0.214*****
	(0.052)	(0.058)	(0.059)
$CAPEXTA_t$	**0.240****	**0.295****	**0.305****
	(0.113)	(0.118)	(0.119)
$HINDEX_t$	**0.129***	**0.112**	**0.106**
	(0.077)	(0.081)	(0.081)
$HINDEX^2_t$	**-0.167**	**-0.121**	**-0.115**
	(0.126)	(0.124)	(0.124)
Q_t	**0.004**	**-0.001**	**-0.001**
	(0.006)	(0.006)	(0.006)
$KZINDEX_t$	**-0.000**	**-0.000**	**-0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.091*****	**0.078*****	**0.083*****
	(0.025)	(0.027)	(0.027)
$DEALVAL_t$	**0.006**		
	(0.032)		
INTERCEPT	**0.662*****	**0.713*****	**0.707*****
	(0.080)	(0.084)	(0.085)
Year and Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	32,466	32,349
Adjusted R^2	0.652	0.656	0.656

Table IA5: Robustness Checks Partitioning Sample into Size Quartiles
Panel A: Specifications with Innovation Measured by Patents

This panel reports the pooled regression results of the model $INNOV\_PAT_{i,t+n} = a + b\ ILLIQ_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$ for four subsamples. The four subsamples are created by partitioning the pooled sample into size quartiles, with quartile 1 indicating the subsample of the smallest firms. Definitions of variables are listed in Table I Panel A. Control variables, year fixed effects YR_t, and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT			
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_PAT_{t+1}$			
ILLIQ$_t$	**0.003**	**0.069****	**0.128*****	**0.157****
	(0.026)	(0.031)	(0.042)	(0.075)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	10,525	10,097	9,623	9,224
Adjusted R^2	0.672	0.803	0.830	0.891
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_PAT_{t+2}$			
ILLIQ$_t$	**0.044***	**0.089*****	**0.155*****	**0.170***
	(0.024)	(0.033)	(0.047)	(0.087)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	9,023	8,350	7,975	7,750
Adjusted R^2	0.688	0.817	0.843	0.891
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_PAT_{t+3}$			
ILLIQ$_t$	**0.039**	**0.078****	**0.225*****	**0.194***
	(0.026)	(0.034)	(0.059)	(0.101)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	7,612	6,811	6,514	6,426
Adjusted R^2	0.713	0.831	0.858	0.892

Table IA5: Robustness Checks Partitioning Sample into Size Quartiles
Panel B: Specifications with Innovation Measured by Citations

This panel reports the pooled regression results of the model $INNOV\_CITE_{i,t+n} = a + b\ ILLIQ_{i,t} + c'CONTROLS_{i,t} + YR_t + FIRM_i + error_{i,t}$ for four subsamples. The four subsamples are created by partitioning the pooled sample into size quartiles, with quartile 1 indicating the subsample of the smallest firms. Definitions of variables are listed in Table I Panel A. Year fixed effects YR_t and firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE			
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_CITE_{t+1}$			
$ILLIQ_t$	**0.013**	**0.091*** **	**0.102*** **	**0.050***
	(0.028)	(0.030)	(0.028)	(0.030)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	10,525	10,097	9,623	9,224
Adjusted R^2	0.588	0.694	0.721	0.764
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_CITE_{t+2}$			
$ILLIQ_t$	**0.042**	**0.079** **	**0.114*** **	**0.049** **
	(0.030)	(0.031)	(0.033)	(0.019)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	9,023	8,350	7,975	7,750
Adjusted R^2	0.593	0.695	0.727	0.755
	(1)	**(2)**	**(3)**	**(4)**
	Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Dependent Variables	$INNOV\_CITE_{t+3}$			
$ILLIQ_t$	**0.078** **	**0.073** **	**0.093** **	**0.064*** **
	(0.033)	(0.035)	(0.039)	(0.022)
Control Variables	*Included*	*Included*	*Included*	*Included*
Year and Firm Fixed Effects	*Included*	*Included*	*Included*	*Included*
Number of Obs. Used	7,612	6,811	6,514	6,426
Adjusted R^2	0.609	0.691	0.739	0.751

Table IA6: Robustness Checks Interacting Liquidity with Time Effects
Panel A: Specifications with Innovation Measured by Patents

This panel reports the pooled regression results of the model $INNOV\_PAT_{i,t+n} = a + b\ ILLIQ_{i,t} + c'CONTROLS_{i,t} + YR_t + ILLIQ_{i,t} \times YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_PAT_{i,t+1}$ in column (1) and replaced with $INNOV\_PAT_{i,t+2}$ and $INNOV\_PAT_{i,t+3}$ in columns (2) and (3), respectively. Definitions of variables are listed in Table I Panel A. Firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_PAT		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_PAT_{t+1}$	$INNOV\_PAT_{t+2}$	$INNOV\_PAT_{t+3}$
$ILLIQ_t$	**0.066****	**0.066****	**0.078****
	(0.031)	(0.033)	(0.034)
$ILLIQ_t \times YR\_1995$	**0.014**	**-0.010**	**-0.028****
	(0.014)	(0.016)	(0.014)
$ILLIQ_t \times YR\_1996$	**-0.005**	**-0.052*****	**0.004**
	(0.017)	(0.018)	(0.019)
$ILLIQ_t \times YR\_1997$	**-0.058*****	**-0.013**	**0.039**
	(0.019)	(0.023)	(0.024)
$ILLIQ_t \times YR\_1998$	**-0.010**	**0.020**	**0.046***
	(0.023)	(0.027)	(0.026)
$ILLIQ_t \times YR\_1999$	**0.007**	**0.021**	**0.064****
	(0.026)	(0.028)	(0.028)
$ILLIQ_t \times YR\_2000$	**-0.005**	**0.029**	**0.107*****
	(0.027)	(0.030)	(0.030)
$ILLIQ_t \times YR\_2001$	**0.005**	**0.062****	**0.246*****
	(0.029)	(0.031)	(0.034)
$ILLIQ_t \times YR\_2002$	**0.055****	**0.179*****	**0.387*****
	(0.028)	(0.032)	(0.035)
$ILLIQ_t \times YR\_2003$	**0.152*****	**0.312*****	**0.654*****
	(0.029)	(0.033)	(0.070)
$ILLIQ_t \times YR\_2004$	**0.288*****	**0.551*****	
	(0.031)	(0.064)	
$ILLIQ_t \times YR\_2005$	**0.541*****		
	(0.060)		
LN_MV_t	**0.106*****	**0.057*****	**0.025**
	(0.018)	(0.019)	(0.021)
$RDTA_t$	**0.280*****	**0.237****	**0.191****
	(0.090)	(0.096)	(0.095)
ROA_t	**-0.123***	**0.112***	**0.245*****
	(0.068)	(0.068)	(0.078)

$PPETA_t$	**0.277*****	**0.310*****	**0.386*****
	(0.092)	(0.106)	(0.126)
LEV_t	**-0.202*****	**-0.281*****	**-0.372*****
	(0.073)	(0.083)	(0.090)
$CAPEXTA_t$	**-0.014**	**0.170**	**0.018**
	(0.119)	(0.134)	(0.146)
$HINDEX_t$	**0.108**	**0.111**	**0.153**
	(0.086)	(0.098)	(0.106)
$HINDEX^2_t$	**-0.116**	**-0.077**	**-0.202**
	(0.149)	(0.165)	(0.176)
Q_t	**-0.008**	**0.008**	**-0.005**
	(0.007)	(0.008)	(0.008)
$KZINDEX_t$	**-0.000****	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.068****	**0.053**	**0.032**
	(0.031)	(0.034)	(0.037)
YR_1995	**0.127****	**-0.115***	**-0.044**
	(0.056)	(0.066)	(0.061)
YR_1996	**-0.040**	**-0.234*****	**0.012**
	(0.067)	(0.073)	(0.079)
YR_1997	**-0.205*****	**-0.129**	**0.147**
	(0.075)	(0.092)	(0.096)
YR_1998	**-0.062**	**-0.016**	**0.119**
	(0.090)	(0.106)	(0.103)
YR_1999	**-0.001**	**-0.051**	**0.131**
	(0.103)	(0.111)	(0.111)
YR_2000	**-0.115**	**-0.098**	**0.170**
	(0.109)	(0.119)	(0.120)
YR_2001	**-0.105**	**-0.068**	**0.573*****
	(0.114)	(0.123)	(0.133)
YR_2002	**-0.047**	**0.238***	**0.995*****
	(0.112)	(0.127)	(0.140)
YR_2003	**0.201***	**0.639*****	**1.952*****
	(0.117)	(0.133)	(0.277)
YR_2004	**0.590*****	**1.458*****	
	(0.126)	(0.260)	
YR_2005	**1.629*****		
	(0.259)		
INTERCEPT	**-0.081**	**0.269***	**0.439*****
	(0.133)	(0.148)	(0.153)
Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	33,098	27,363
Adjusted R^2	0.843	0.848	0.855

Table IA6: Robustness Checks Interacting Liquidity with Time Effects
Panel B: Specifications with Innovation Measured by Citations

This panel reports the pooled firm fixed effects regression results of the model $INNOV\_CITE_{i,t+n} = a + b\ ILLIQ_{i,t} + c'CONTROLS_{i,t} + YR_t + ILLIQ_{i,t} \times YR_t + FIRM_i + error_{i,t}$. The dependent variable is $INNOV\_CITE_{i,t+1}$ in column (1) and replaced with $INNOV\_CITE_{i,t+2}$ and $INNOV\_CITE_{i,t+3}$ in columns (2) and (3), respectively. Definitions of variables are listed in Table I Panel A. Firm fixed effects $FIRM_i$ are included in all regressions but the coefficients are not reported. Coefficient estimates are shown in bold and their standard errors are clustered by firm and displayed in parentheses below. *** (**) (*) indicates significance at the 1% (5%) (10%) two-tailed level.

	Innovation measured by INNOV_CITE		
	(1)	**(2)**	**(3)**
Dependent Variables	$INNOV\_CITE_{t+1}$	$INNOV\_CITE_{t+2}$	$INNOV\_CITE_{t+3}$
$ILLIQ_t$	**0.064*****	**0.054****	**0.052***
	(0.023)	(0.025)	(0.027)
$ILLIQ_t \times YR\_1995$	**0.018**	**-0.009**	**0.010**
	(0.016)	(0.017)	(0.017)
$ILLIQ_t \times YR\_1996$	**0.006**	**0.001**	**0.022**
	(0.017)	(0.018)	(0.018)
$ILLIQ_t \times YR\_1997$	**0.004**	**0.031**	**0.053*****
	(0.018)	(0.019)	(0.020)
$ILLIQ_t \times YR\_1998$	**0.038****	**0.050****	**0.066*****
	(0.018)	(0.020)	(0.020)
$ILLIQ_t \times YR\_1999$	**0.051*****	**0.059*****	**0.086*****
	(0.020)	(0.020)	(0.022)
$ILLIQ_t \times YR\_2000$	**0.057*****	**0.088*****	**0.133*****
	(0.020)	(0.022)	(0.023)
$ILLIQ_t \times YR\_2001$	**0.097*****	**0.121*****	**0.210*****
	(0.021)	(0.023)	(0.024)
$ILLIQ_t \times YR\_2002$	**0.123*****	**0.167*****	**0.249*****
	(0.021)	(0.023)	(0.024)
$ILLIQ_t \times YR\_2003$	**0.161*****	**0.211*****	**0.298*****
	(0.021)	(0.023)	(0.033)
$ILLIQ_t \times YR\_2004$	**0.212*****	**0.268*****	
	(0.022)	(0.032)	
$ILLIQ_t \times YR\_2005$	**0.287*****		
	(0.031)		
LN_MV_t	**0.036*****	**0.006**	**-0.005**
	(0.013)	(0.014)	(0.016)
$RDTA_t$	**0.169****	**0.139**	**0.182***
	(0.080)	(0.092)	(0.101)
ROA_t	**0.074**	**0.218*****	**0.160****
	(0.061)	(0.063)	(0.073)

$PPETA_t$	**0.136***	**0.093**	**0.091**
	(0.076)	(0.086)	(0.093)
LEV_t	**-0.152*****	**-0.211*****	**-0.252*****
	(0.051)	(0.059)	(0.063)
$CAPEXTA_t$	**0.125**	**0.136**	**0.167**
	(0.112)	(0.120)	(0.126)
$HINDEX_t$	**0.136***	**0.113**	**0.107**
	(0.077)	(0.082)	(0.086)
$HINDEX^2_t$	**-0.179**	**-0.046**	**-0.103**
	(0.124)	(0.130)	(0.135)
Q_t	**0.003**	**0.005**	**0.002**
	(0.006)	(0.006)	(0.006)
$KZINDEX_t$	**-0.000**	**-0.000**	**0.000**
	(0.000)	(0.000)	(0.000)
LN_AGE_t	**0.008**	**-0.034**	**-0.031**
	(0.025)	(0.028)	(0.031)
YR_1995	**0.092**	**-0.088**	**0.065**
	(0.072)	(0.077)	(0.076)
YR_1996	**-0.005**	**-0.016**	**0.058**
	(0.076)	(0.079)	(0.082)
YR_1997	**0.009**	**0.059**	**0.143**
	(0.079)	(0.086)	(0.089)
YR_1998	**0.091**	**0.087**	**0.108**
	(0.083)	(0.093)	(0.092)
YR_1999	**0.096**	**0.035**	**0.074**
	(0.089)	(0.092)	(0.097)
YR_2000	**0.030**	**0.041**	**0.143**
	(0.090)	(0.098)	(0.099)
YR_2001	**0.098**	**0.060**	**0.350*****
	(0.092)	(0.100)	(0.105)
YR_2002	**0.083**	**0.148**	**0.436*****
	(0.092)	(0.103)	(0.108)
YR_2003	**0.134**	**0.251****	**0.545*****
	(0.095)	(0.106)	(0.145)
YR_2004	**0.258****	**0.382*****	
	(0.101)	(0.148)	
YR_2005	**0.525*****		
	(0.145)		
INTERCEPT	**0.273*****	**0.604*****	**0.656*****
	(0.101)	(0.110)	(0.118)
Firm Fixed Effects	*Included*	*Included*	*Included*
Number of Obs. Used	39,469	33,098	27,363
Adjusted R^2	0.656	0.657	0.659

[i] One exception is that when one-year ahead *INNOV_CITE* is the dependent variable, the coefficient estimate of the annual Amihud illiquidity measure is positive but not statistically significant.

[ii] Huang and Stoll (1997) conclude "The spread components differ significantly according to trade size and are also sensitive to assumptions about the relation between orders and trades". Lacking consensus in the methodologies to compute the components of bid-ask spread, we rely on the *PIN* measure to capture information asymmetry rather than decomposing the spread.