Risk Dynamics and Stock Trading Activity around New Product Introductions –

Cost of Capital Implications from the Pharmaceutical Industry

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Abstract

We analyze the relationship between new product introductions, trading activity, and systematic risk changes. The analysis is placed within a real options framework in which new product introductions are associated with the exercise of a real option. Using a unique hand-collected data set on new drug approvals, we find opposing results to previous work. Trading activities change after new product announcements and stock become more liquid. However, we have no evidence on changes in systematic risk. After adjusting for potential biases caused by increased leverage and frictional trading, estimates for systematic risk are indifferent before and after the new product announcement. Our results have implications for the firm's cost of capital and internal investment decisions. Investors' required return remains unchanged and cost of equity for technological-intensive companies is invariant to new product introductions and the exercise of corresponding real options.

Keywords

Product Innovations; Wealth Effects; Trading Activity; Liquidity; Systematic Risk; Real Options

JEL Classification

G32; G14; M21

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I. INTRODUCTION

Product innovation is a necessary requirement for companies in today's research- and knowledge-based economy. Several studies report positive wealth effects for new product introductions (Chaney et al. (1991), Bosch et al. (1994), Sharma and Lacey (2004), Sarkar and De Jong (2006), Dedman et al. (2008)). However, little evidence is provided on risk dynamics associated with new product innovation although systematic risk changes are of great importance to company managers. Outside investors rely on the systematic risk of a company to derive return requirements as outlined in the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Mossin (1965). Corporate managers, in turn, rely on the CAPM implications in capital budgeting decisions. The surveys by Bruner et al. (1998) and Harvey and Graham (2001) reveal that the cost of equity estimate based on the CAPM reflects the predominant method in calculating the firm's cost of capital. The authors also find that most firms use the company's overall risk when assessing new projects. Hence, changes in systematic risk are of vital interest to financial practitioners and affect companies' internal hurdle rates to evaluate new investments. Our goal is to analyze whether new product introductions causes changes in systematic risk and therefore influence the firm's capital budgeting and future investment strategy.

We study systematic risk changes of new product introductions within a real options context in which a product introduction is consistent with the exercise of a growth option. The framework is similar to Bernardo et al. (2007). The firm's assets are split in assets-in-place and growth opportunities. Asset betas are partitioned accordingly. Assuming constant systematic risk of assets in place, a change of the overall asset beta is then attributable to new product introduction and the exercise of the corresponding growth option.

A unique hand-collected data set of new drug approvals serves as empirical testing ground. We analyze the entire spectrum of drugs approved by the European Medicine Agency since its initiation in 1995. A final sample of 150 new drug approvals by 65 pharmaceutical companies serves as data basis. Systematic risk is estimated via a market model approach. We explicitly test for potential biases in estimating systematic risk and employ the procedure introduced by Cohen et al. (1983).

Our results show a significant positive stock price reaction to new product introductions. In addition, we find high abnormal trading activities immediately surrounding the event. The data also provides evidence on long-term, structural changes in trading pattern. Stocks of new product introducing firms become more liquid after the announcement. The absolute and value-weighted daily stock turnover increases significantly after the new product is released. The results on associated risk dynamics are striking. In contrast to the implications modeled by Berk et al. (1999) and Jacquier et al. (2009), we find no evidence on systematic risk changes associated with new product announcements and the exercise of real option. After controlling for potential estimation biases caused by frictional trading and leverage impact (e.g., Hamada (1972), Cohen et al. (1983)), we find no significant changes of systematic risk prior and subsequent to the event.

The findings have important implications for capital budgeting decisions. Evidence suggests that firm risk is invariant to new product introductions. Investors do not adjust their return requirements. Consequently, managers should not mistake a successful new product release with lower cost of capital.

The remainder of this study is organized as follows. In section II, we summarize the literature on new product introductions and associated wealth effects. The risk framework we use is presented as well. Section III introduces the data set employed to test empirically for risk changes of new product introductions. In section IV, we summarize our main empirical results relating to trading activity and systematic risk changes. Section V concludes our paper.

II. THEORETICAL BACKGROUND

REVIEW OF RELATED LITERATURE

Though becoming increasingly important, the field of new product research has been largely unexplored. Historically, empirical studies focused almost exclusively on wealth effects for companies introducing new products (Chaney et al. (1991), Bosch et al. (1994), Sharma and Lacey (2004), Sarkar and De Jong (2006), Dedman et al. (2008)). Employing an event-study context, these studies analyze abnormal stock price reactions to new product introductions. Chaney et al. (1991) analyze new product initiations between 1975 and 1984. The authors report positive announcement effects for launches in the pharmaceutical and chemical industry. Bosch et al. (1994) examine the stock price reaction to 130 FDA drug approval decisions between 1962 and 1989 and find on average a significant positive abnormal return of 1.84 % for the issuing firm. Sharma and Lacey (2004) use an updated data set on 344 FDA drug authorizations. Their analysis reveals a significant positive wealth effect of 1.56%. Sarkar and De Jong (2006) also hark back to the FDA decisions along the drug approval process. The authors report significant abnormal stock returns for each interim decision as well as the final approval. Dedman et al. (2008) study a sample of UK biotechnology and pharmaceutical companies and find positive stock price reactions to marketing authorization decisions, too.

Except for the well documented positive wealth effects, we know little about further dynamics associated with new product introductions. In particular, little evidence has been provided on the impact that product innovations have on corporate risk dynamics and trading behavior. Our study narrows this gap and provides empirical evidence on risk changes and trading patterns surrounding new product initiations

We concentrate explicitly on the changes in systematic risk around the announcement of a new product introduction. From a shareholder's perspective, systematic risk is the only source of concern and determines expected asset returns as outlined in the capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965), and Mossin (1965). Systematic risk, measured as the sensitivity of an asset's return to the market return (denoted as beta), links the corporate viewpoint with the shareholder perspective. The required return for equity investors, in turn, determines the cost of capital for the firm and hence influences corporate investment strategy. Bruner et al. (1998) and Graham and Harvey (2001) report survey results that corporate decision makers use predominantly the CAPM framework to determine the respective cost of capital. The majority of companies also use firm risk rather than project risk in evaluating new investments. Consequently, financial managers should take changes in the firm's systematic risk component into account for capital budgeting decisions. If a product introduction adds marginally to the systematic risk of the firm, then the company's overall cost of capital is to be adjusted.

Several studies analyze different financial variables and their impact on systematic risk (e.g., Beaver et al. 1970), Hamada (1972), Mandelker and Rhee (1984), Ismail and Kim (1989)). However, few empirical studies have addressed the relationship of product innovation and systematic risk so far. Chaney et al. (1991) calculate average equity betas for their sample of 231 firms introducing 1,101 new products between 1975 and 1984. They find an average beta of 1.182 and interpret the results as evidence of greater risk than the average market. Their study is limited by the static view employed. An explicit beta change by comparing systematic risk before and after the product introduction is omitted. Devinney (1992) contrasts explicitly the equity betas around 1,677 new product releases between 1984 and 1988. He reports a small but significant systematic risk decrease from a mean pre-announcement beta of 1.274 to an average post-announcement beta of 1.235. However, the results are possibly biased by not controlling for any confounding effects on the beta estimation such as a change in leverage (e.g., Hamada (1972)) or non-synchronous trading (e.g., Scholes and Williams (1977), Dimson (1979), Cohen et al. (1983)). Denis and Kadlec (1994) show in their study that estimation biases can alter results fundamentally. We take these suggestions on estimation biases into account when assessing the relationship of new product innovation and company systematic risk. Thereby, our study provides new and robust evidence on the relationship of product innovation and systematic risk changes.

RISK FRAMEWORK

To estimate the impact of new product introductions on the firm's systematic risk and its cost of capital, we apply an options-based framework in which the new product release reflects the exercise of a growth option. For our analysis, we distinguish between two sources of company value as reported in equation 1 (e.g., Myers (1977), Miles (1986), Chung and Charoewong (1991), Jägle (1999)): A proportion steaming from assets already in place (e.g. present value of cash flows generated by existing assets) and the value of future growth opportunities (e.g., potential cash flows from new products or projects). This entanglement of sources for company value mirrors adequately the outstanding growth prospects of research- and technology-intensive firms engaged in new product development activities. Shareholder value is created by an existing stock of assets that generates current and future cash flows. In addition, the firm realizes growth opportunities by developing a stock of knowledge and new product candidates. Such intangible investments provide the firm the choice to abandon, delay, or exercise pre-built options in the future. Accordingly, new product development represents an investment in potential growth options for the firm. The future market introduction of the product reflects the exercise of the option associated with an increase in future cash flows. Additional cash flows make the firm more valuable to investors. Hence, positive stock price reactions to new product introductions are to be expected.

$$\text{Market Value} = \text{Futue Value of Existing Assets} + \text{Value of Future Growth Opportunities.} \tag{1}$$

For the risk analysis, we use a framework similar to Bernardo et al. (2007) on the relationship of growth options and asset beta. It allows us to measure the marginal impact of a new product release on the firm's systematic risk and cost of capital. From the above separation of the firm's market value into a present and future component, it follows that a firm's asset beta is split accordingly in a weighted average of assets already in place and the beta of growth opportunities:

(2) $$\beta_{t,i}^{A} = \frac{AP_{t,i}}{A_{t,i}}\beta_{t,i}^{AP} + \frac{GO_{t,i}}{A_{t,i}}\beta_{t,i}^{GO}.$$

Where $\beta_{t,i}^{A}$ denotes the asset beta of firm *i* at time *t*. $\beta_{t,i}^{AP}$ refers to the beta of assets already in place, $\beta_{t,i}^{GO}$ reflects the beta of the firm's growth opportunities, AP and GO indicate the present value of the firm's current assets in place and future growth opportunities with AP and GO adding up to the firm's total assets A.

In a market value balance sheet context, $\beta_{t,i}^{A}$ can also be regarded as the firm's unlevered equity beta. Assuming a beta of zero for the firm's outstanding debt as in Hamada (1972), Denis and Kadlec (1994), Lewis et al. (2002) and desisting from tax issues, we can rewrite $\beta_{t,i}^{A}$ as:

(3) $$\beta_{t,i}^{A} = \left(\frac{E_{t,i}}{D_{t,i} + E_{t,i}}\right)\beta_{t,i}^{E}.$$

Where $\beta_{t,i}^{E}$ refers to the company's equity beta, $E_{t,i}$ represents the market value of equity of firm *i* at time *t* and $D_{t,i}$ denotes the market value of debt accordingly.

It seems reasonable to assume, that the systematic risk component of a firm's assets in place is unaffected by risk changes associated with its existing growth options. That is, we assume that no structural relationship exists between cash flows associated with assets in place and cash flows associated with growth opportunities. If a firm chooses to exercise existing options, the risk of cash flows associated with these growth opportunities $GO_{t,i}$ could change. However, an immediate effect on the risk of cash flows generated by assets already in place $AP_{t,i}$ is unlikely. In summary, we assume throughout our analysis that the beta of the firm’s assets in place $\beta_{t,i}^{A}$ remain constant and invariant to changes in its growth options beta $\beta_{t,i}^{GO}$. We also presume the relative weights of assets in place and growth options to remain constant.[1]

The outlined framework allows us to estimate the firm’s asset beta before and after the new product introduction by unlevering its corresponding equity beta. The latter can be derived via an one-factor market model estimation. A change in the firm’s asset beta would then be attributable to the exercise of a real option and a corresponding change in the risk of the firm’s growth options.

Theory provides no clear prediction about the impact of option exercise on the firm’s systematic risk and its cost of capital. Berk et al. (1999) develop a model in which the exercise of growth options changes a firm’s systematic risk exposure. Jacquier et al. (2009) derive similar conclusions but relate the change to various other company variables. Mc Alister et al. (2007) argue that R&D efforts create intangible assets that, in fact, insulate the firm from stock market changes and therefore lower systematic risk exposure. Our study provides empirical evidence on this large unexplored issue. We examine explicitly the effects of new product introductions on company systematic risk while controlling for confounding effects. The results allow us to draw conclusions on the relationship between new product initiations and changes in the firm’s cost of capital.

[1] This assumption is verified empirically by comparing the relative weights of growth options before and after the new product introduction. We proxy the firm’s growth options by the company's market-to-book ratio of equity capital as in Fama and French (1992) and Chan et al. (2001). We find no significant changes in the level of growth options before and after the new product release.

III. Sample Selection and Description

For our empirical analysis of systematic risk changes around new product introductions we employ a unique data set on new drug approvals by the European Medicines Agency (EMEA). Product innovation in the pharmaceutical industry allow for an unbiased study of introductory effects given the highly regulated and clear-cut drug development procedures. We concentrate on new drug approvals as a form of new product introductions and use both terminologies interchangeably. Since 1995, drug developers can apply for European-wide approval at the EMEA. The centralized approval procedure is a voluntary alternative to multiple approval procedures in each member state and compulsory for all biotechnology products in the European Union (see, e.g., Garattini and Bertele (2004) for more information on the EU centralized drug approval procedure).

We hand-collected all public assessment reports on the entire universe of drugs filled for EMEA approval since 1995.[2] The event of interest is defined as the date when the Committee for Proprietary Medicinal Products (CPMP) which reviews the application documents issued a positive opinion on the drug filled for approval. Although the CPMP decision must officially be approved by the European Commission (EC), the EC decision usually represents a pro-forma step and a positive CPMP vote can typically be regarded as a quasi-approval. Company data for the applying firms is collected via Thomson Datastream and Worldscope.

We examined 447 drug assessment reports for various criteria. Several observations had to be excluded for comparability. First, we eliminate all drug approvals for which the sponsor either was not a listed company or could not doubtlessly identified. Second, companies with missing time-series data in Datastream were deleted. Next, all drug approvals for which the initial product has been given marketing approval elsewhere were eliminated. This ensures that our sample solely consists of true product newcomers. To reduce potential biases of clustered events, we exclude all new drug approvals when the issuing

[2] Public assessment reports are retrieved at http://www.emea.europa.eu/htms/human/epar/a.htm. Missing data was kindly provided by EMEA upon the author's request.

firm had additional drug approvals within a 250 day period. Finally, to prevent our results from being distorted by any illiquidity bias, we employ the procedure developed by Amihud (2002). A 250–trading day period is chosen to estimate the illiquidity measures. We exclude the most extreme 1 % of our events as well as events with missing data on trading volume. The filtering criteria leave us with a final sample of 150 drug approvals by 65 pharmaceutical firms.

Descriptive statistics on our event sample are provided in table 1 – 3. Table 1 reports the event distribution over time. Events are spread evenly across calendar time. We do not observe any clustering of approval events in time. No more than 13.33% of our event universe is attributable to any single year.

Table 1

Event Distribution over Time

This table reports the distribution of events across calendar time. It includes 150 drug approval decisions issued by the EMEA within the observation period between 1995 and 2009. Absolute *Number of Events per Year* as well as *Percentage of Total Events per Year* are included. The Cumulative Percentage of Events per Year are also posted.

Calendar Year	1995	1996	1997	1998	1999	2000	2001	2002
Number of Events per Year	0	5	5	9	5	20	8	14
Percentage of Total Events per Year	0.00%	3.33%	3.33%	6.00%	3.33%	13.33%	5.33%	9.33%
Cumulative Percentage of Events per Year	0.00%	3.33%	6.67%	12.67%	16.00%	29.33%	34.67%	44.00%

Calendar Year	2003	2004	2005	2006	2007	2008	2009	Totals
Number of Events per Year	9	15	9	17	20	14	0	150
Percentage of Total Events per Year	6.00%	10.00%	6.00%	11.33%	13.33%	9.33%	0.00%	100.00%
Cumulative Percentage of Events per Year	50.00%	60.00%	66.00%	77.33%	90.67%	100.00%	100.00%	-

Table 2 assigns the drug approval events to issuing firms. Again, we find no evidence of event clustering for singular firms. In total, our sample comprises of 10 companies with 5 or more events during the observation period from 1995 to 2009. More than 65% of our sample is attributable to firms with 4 or less events for the time of examination. Almost one quarter of the event sample is attributable to firms with one event each. Hence, our sample is not driven by any few firms adding disproportionally many events to our overall data set.

Table 2

Event Distribution across Sample Firms

This table provides information on the event distribution accross sample firms. It includes 150 drug approval decisions by the EMEA from 1995 to 2009. *Event class* refers to the number of events exhibited by any single firm in the entire sample. The second column reports the *number of firms per event class*. The third column is the product of the first and second column and displays the *total number of events in each event class*. The fourth column reports the fraction of events for each event class. The fifth column displays the cumulated frequency of events for each event class.

Event class (events per firm)	Firms per event class	Total events in each class	Events as % of Total	% of Total, cumulated
1	34	34	22.67%	22.67%
2	10	20	13.33%	36.00%
3	8	24	16.00%	52.00%
4	5	20	13.33%	65.33%
5	2	10	6.67%	72.00%
6	3	18	12.00%	84.00%
7	1	7	4.67%	88.67%
8	1	8	5.33%	94.00%
9	1	9	6.00%	100.00%
Totals	-	150	100.00%	-

An overview of key financials for the sample firms is summarized in table 3. Due to missing data, the total number of observations does not add up to 65 for each financial and fiscal year. We find an increasing trend in R&D expenditures over time. Total firm leverage measured as the ratio of long-term debt outstanding to total assets remains rather stable over time.

Table 3

Summary of Key Financials for the Sample Firms

This table provides information on the financials of the sample firms. Data was retrieved from Worldscope. We report figures consistent with the event sample period from 1995 to 2008. Data on year 2009 was not available yet. *Nobs* refers to the number of firms for which data was available in the respective years. *Mean* and *median* numbers are reported. *SD* refers to the standard deviation of the respective figure in the sample. A definition of the variariables reported is included in the appendix.

		R&D Expenses	R&D Expenses to Sales	Net Income	Sales	Total Assets	Intangibles	Return on Assets	Return on Equity	Total Debt in % of Total Assets	LT Debt in % of Total Capital	Yearend Market Cap	Dividend Payout	Cashflow	Free Cashflow
2008	Nobs	51	51	52	52	52	51	52	52	52	52	52	46	52	52
	Mean	1303.79059	31.0520559	1440.55753	9995.52306	16688.6435	6408.49424	5.18092308	63.8226876	26.3831192	35.7938727	24176.1294	24.8718078	2079.68513	1052.6436
	Median	573.992195	16.54454	391.666233	4286.73109	6307.89564	1470.40989	8.25416	16.838582	26.0121	27.146085	12079.4676	27.845995	589.403084	294.888405
	SD	1619.78178	84.2845306	2263.9494	12594.788	21989.7065	11347.5145	16.6962772	263.715496	21.8953861	58.9321647	30480.0978	21.9935004	2998.90606	1597.94357
2007	Nobs	56	56	57	57	57	56	57	57	57	57	57	52	57	57
	Mean	1117.84523	34.0208127	1284.76282	8705.71899	15002.5933	5845.55364	5.35185614	38.5095799	30.0307468	34.5547204	27050.8956	23.4760238	1838.46362	847.200277
	Median	400.830913	17.30441	328.450245	3188	5210.98754	1067.05811	9.5536	18.829623	22.2032	20.82755	13441.5302	17.794695	488.85217	331.9
	SD	1521.08801	57.1996771	2156.51638	12252.028	21590.3242	11765.557	30.2986992	142.915925	47.465452	68.6589927	36151.7251	25.2867934	2904.10148	1248.9699
2006	Nobs	57	57	58	58	58	56	58	58	58	58	58	53	58	58
	Mean	1096.15988	181.256637	1379.11701	8836.79025	14912.4488	5841.11263	1.50590155	17.5195451	25.8194203	32.804021	29140.0253	21.2149764	1920.92586	892.136897
	Median	375.389381	15.6728	273.623475	2370.00292	4369.04273	505.3643	7.847845	14.6510835	17.738525	19.249795	13055.158	22.66941	420.470485	346.76374
	SD	1505.50217	790.289803	2267.25664	12460.0135	22862.5665	12977.5839	24.7382637	92.3226556	30.9422615	58.7201959	40272.4315	19.696404	3037.23036	1485.66815
2005	Nobs	59	58	60	60	60	58	60	60	60	60	59	55	60	60
	Mean	1000.05052	199.976478	1228.82347	8413.424	13386.716	4357.37988	2.7382485	55.3906263	23.3344837	31.7521742	28125.4758	21.2894444	1744.37739	825.973993
	Median	339.207375	15.38013	306.205161	2272.64912	4259.30213	650.9321	8.695775	17.855726	20.367095	20.44339	8573.38916	20.2198	431.070593	128.848039
	SD	1430.10692	1129.32038	2006.89295	12141.3485	20644.4726	10409.3987	21.1670213	292.089059	22.4591245	45.2112237	39754.0463	21.7528733	2743.16288	1491.70023
2004	Nobs	59	58	60	60	60	58	59	60	60	60	58	55	60	58
	Mean	937.277817	70.5362438	936.166901	7302.83281	11945.7184	3844.62963	2.32992729	7.88802343	21.4848593	27.2862485	24377.0908	25.1265773	1386.45182	644.447197
	Median	296.174229	16.422455	258.201828	2507.05043	3379.15218	548.537218	8.43302	12.261076	19.80996	16.958245	7790.94119	19.43106	338.750222	199.198206
	SD	1469.98763	201.181974	1952.99486	10715.7035	18576.477	9533.55836	20.5851825	58.2474362	18.5383722	34.7057451	35745.8837	28.928106	2467.11173	1356.445
2003	Nobs	58	56	59	60	59	54	59	59	59	59	56	54	59	57
	Mean	824.29739	38.4527284	794.30018	7012.7369	10626.0224	3058.72436	2.24352305	3.07116156	21.4420334	23.8842256	25735.7537	21.8011952	1215.9599	626.528727
	Median	284.72281	15.455805	208.3	2338.8367	3325.96289	540.271126	6.70058	10.567242	18.89037	18.19556	7843.95268	18.579755	384.946371	221.034827
	SD	1178.32238	100.358651	1476.6583	10225.2586	16645.2107	7501.4677	16.3920943	32.563143	17.6947039	21.7011278	40331.8041	23.3737642	1880.84079	1167.57073
2002	Nobs	58	57	61	61	61	56	59	61	61	61	55	54	61	59
	Mean	868.100783	67.3161875	721.320878	7397.35559	10659.5244	2557.67146	-0.41079254	1.84520262	20.1825092	20.3931108	26424.7279	20.3385689	1123.87907	460.081388
	Median	326.996898	15.88744	203	2480.19499	3903.19918	624.915172	7.04439	10.084489	19.02808	14.28585	7946.77582	17.641365	351.137349	27.62144
	SD	1173.70961	233.754268	2424.51049	10601.8757	14740.8746	5268.17556	23.3176146	48.02025	16.592547	19.3795266	39269.9547	21.0271577	2589.54352	1380.09255
2001	Nobs	58	56	59	59	59	51	57	58	59	59	54	56	59	57
	Mean	909.08359	61.9226911	1099.58385	8149.60261	12259.8128	2680.64453	2.90047351	-27.8602106	19.4010661	21.2552775	40242.2831	22.5822575	1567.66485	492.670249
	Median	357.63993	14.52105	305.251361	2685.63186	4053.40702	658.363751	7.15244	12.186601	14.24917	12.48206	10250.0955	20.77313	444.438345	141.05452
	SD	1235.44317	159.38935	1852.12788	11702.7675	19659.7675	5887.33857	17.4875189	296.453557	20.5053983	27.3438125	58318.8698	22.9660785	2399.89616	1681.8303
2000	Nobs	53	51	57	57	57	50	54	57	56	56	54	54	57	55
	Mean	904.558169	33.4209814	1109.47851	7686.29677	9878.53307	1916.33327	2.94573426	4.467487	19.1359516	20.4606504	42491.1323	20.9559485	1530.95257	449.880343
	Median	318.302125	13.88351	235.393538	2438.50663	3549.92628	576.737441	7.7508	12.04049	11.75894	10.456485	11887.8561	13.67851	414.97431	79.260907
	SD	1156.5472	55.9492847	1797.58651	10678.3755	12881.5042	3394.10748	18.086859	51.8487111	20.9107636	27.5101497	60942.8864	22.5984276	2302.77046	983.196497
1999	Nobs	50	49	55	56	55	46	54	56	55	55	51	52	56	55
	Mean	780.584196	42.0570471	829.26646	6449.53058	8488.39773	1622.46775	-3.13591759	76.116063	20.6906785	20.7018033	28448.3701	21.805111	1175.48923	293.923851
	Median	329.168145	13.7193	187.734906	2133.54635	3253.85316	325.197387	7.19563	12.440356	15.98705	11.63093	6442.53452	19.365135	256.918166	55.906923
	SD	948.651379	102.398644	1380.45806	8930.82743	11201.5434	2720.70962	28.2833641	479.952907	22.0202684	29.4027208	40155.4048	20.3744443	1790.13207	630.107135
1998	Nobs	46	46	54	54	54	44	53	54	54	54	48	47	54	52
	Mean	594.695106	62.6163511	589.340557	5023.76594	6481.4755	1229.68354	-3.99588925	34.1955992	18.8541174	21.6567235	25742.2995	19.9869253	853.147619	199.553635
	Median	301.36636	13.334095	66.630123	1374.75441	2779.04646	230.725452	6.7672	11.29438	16.18719	14.972585	5666.92177	19.37446	156.360783	6.4304005
	SD	678.721838	162.643495	998.619494	7435.3596	8852.24111	2054.19416	34.6906508	169.791719	15.8897985	29.9845287	38346.662	20.0324621	1331.71931	475.775117
1997	Nobs	46	45	53	53	53	43	51	53	53	53	48	48	52	51
	Mean	560.021598	35.7906951	491.038517	4984.36033	6094.27725	1057.22376	-4.81207059	-7.11282792	16.4843572	15.8025953	20439.9614	19.4361604	747.84869	181.623807
	Median	287.269907	12.49667	93.050501	1500.67303	1621.92891	155.562146	6.11621	9.682573	16.48189	13.9003	4562.21694	18.55203	145.029645	29.390263
	SD	648.946956	82.220167	965.456511	7273.84981	8507.09446	2023.60781	33.2897435	60.2364759	11.2979627	13.828884	30240.2288	19.6243801	1247.1835	479.748482
1996	Nobs	42	42	51	51	51	40	43	51	51	51	46	47	49	45
	Mean	498.731457	113.461309	474.157216	4387.75208	5400.40439	807.425582	0.32736744	-16.1511245	17.5458696	17.2114633	12956.6489	22.3661077	714.709038	194.213291
	Median	284.608398	10.841035	82.179688	1762.07223	2175.72416	176.009147	6.68549	10.399474	16.70032	14.93506	3573.38709	18.8798	131.751049	54.804842
	SD	547.346603	574.026652	716.440538	6456.73996	7549.54701	1330.37855	27.1591886	143.475694	11.5765817	13.2419098	17818.5666	22.3616208	1011.27324	328.23345
1995	Nobs	40	40	43	43	43	34	43	43	43	43	40	40	43	41
	Mean	465.957313	57.7466573	490.691881	4714.26627	5912.84824	750.285217	-0.61996651	-4.13203574	20.1544828	20.6025174	10430.1936	24.6115768	734.813157	196.122969
	Median	295.320728	10.767285	160.643439	2376.20959	3318.55891	128.097777	6.98074	13.090811	19.54808	18.89347	3648.88015	19.68955	318.796112	46.856579
	SD	528.995076	165.95256	698.577468	6361.47641	7557.08119	1350.01679	24.9563044	55.6750915	12.3557302	14.513574	13427.1024	23.235109	987.531994	375.827261

IV. Empirical Results

1. Wealth Effects

We test our sample of drug approvals for wealth effects upon the approval decision. Similar to previous works, we employ event study methodology and estimate a market model over a 150 trading-day period (e.g., Brown and Warner, 1985; MacKinley, 1997; Kothari and Warner, 2007) as well as a mean adjusted model. A 10 day gap is kept between each event window and the beginning of the estimation period to prevent our results from being biased by event-induced effects. The market return is proxied by the corresponding Datastream local market index for each sample company. The significance of the abnormal stock returns around the approval decision is tested via a standard t-test as well as a Boehmer-test (Boehmer et al. (1991)). Several event windows are studied to capture the stock price assessment around the new product introduction.

Table 4

Wealth Effects around New Product Introductions

This table reports the cumulative average abnormal stock returns (CAAR) to new drug approvals at the EMEA between 1995 and 2009. Returns are estimated via a market model as well as a mean adjusted model. Market model paramters are estimated using a 150 trading day estimation period where a 10 day gap is kept between the start of the estimation period and the beginning of the corresponding event window. Panel A reports market model results while panel B summarizes mean adjusted results. Abnormal returns are tested for significance using a t-test and Boehmer test. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Event window	CAAR	Boehmer Test z-score	t-Test t-value	Nobs
Panel A: Market Model				
[-1;+0]	0.79%	2.715***	2.815***	150
[0;+1]	0.84%	1.698*	2.204**	150
[-1;+1]	1.08%	2.432**	2.555**	150
Panel B: Mean Adjusted Model				
[-1;+0]	0.54%	2.162**	2.068**	150
[0;+1]	0.88%	2.035**	2.281**	150
[-1;+1]	0.94%	2.203**	2.221**	150

Table 4 provides the event study results for different event window lengths. The findings reveal significant wealth effects surrounding the approval decision of a new drug candidate. Results are robust to both the market and mean-adjusted model. Similar to previous studies of Bosch et al. (1994), Sharma and Lacey (2004), Sarkar and De Jong (2006), and Dedman et al. (2008), we also find a significant positive cumulative average abnormal stock return (CAAR) of 1.08% for the immediate time of one day prior and subsequent to the approval announcement measured via the market model. The CAAR [-1;+1] measured via the mean-adjusted model is 0.94% and significant as well. The positive announcement effects suggest that the exercise of the real option increases the value of the firm. The company accesses new growth opportunities that will enhance its future business outlook. The positive wealth effects are consistent with the semi-strong form of market efficiency (e.g., Fama (1970) and (1991)). Value-relevant information on the exercise of corporate growth options are promptly translated into stock prices. The market uses this kind of information to update its expectations on the firm's future business outlook.

2. Trading Activity

In a first step, we examine the immediate trading behavior around the announcement. The instantaneous stock price reaction to the product introduction announcement is most likely accompanied by a corresponding increase in trading activity. Once the information on the drug approval reaches the market, investors will trade and rebalance their portfolio to incorporate the value-relevant news. Therefore, we analyze the trading activity surrounding the product innovation announcement. Then, we compare the trading activities prior and subsequent to the new product introduction. The exercise of the real option potentially unlocks future growth prospects. The company becomes increasingly valuable to investors which boost trading activity and liquidity of the firm's stock. To study abnormal trading around the event date we employ the methodology used by Chae (2005).

Table 5

Daily Abnormal Turnover around the Product Introduction

This table provides daily abnormal turnover arround the approval decision of the EMEA. An interval of 5 trading days prior and after the decisison is analyzed. t = 0 denotes the day the approval decision was released. Abnormal turnover is defined according to Chae (2005) as the difference between the log turnover and average log turnover estimated from t = -40 to t = -11 with turnover is trading volume over shares outstanding. Means and medians of abnormal turnover are reported. The p Value of a two-sided t-test as well as the q Value of a two-sided sign test are included. ***,**,* denotes significance at the 1%, 5%, and 10% level respectively. Nobs refers to the number of observations for each day. Panel A includes data on the entire sample. The sample of firms is split according to the average market value of equity for a period of 250 trading days prior to the announcement. Panel B comprises firms with an average market value of equity larger than the median market value. Panel C includes the firms with a lower market value of equity than the median market value.

	Days relative to the approval announcement										
t =	-5	-4	-3	-2	-1	0	1	2	3	4	5
	Panel A: All sample firms										
Mean	0.072	-0.052	0.057	-0.048	0.036	0.044	0.054	0.143	-0.008	0.149	-0.005
Median	0.064	-0.088	0.063	-0.082	-0.025	0.024	-0.008	0.076	-0.012	0.061	-0.012
p Value	0.124	0.362	0.228	0.394	0.429	0.354	0.245	0.006***	0.869	0.004***	0.924
q Value	0.132	0.068*	0.205	0.098*	0.353	0.738	0.801	0.062*	0.932	0.106	0.932
Nobs	143	132	140	132	140	143	142	139	138	138	138
	Panel B: Large sample firms										
Mean	0.040	-0.019	0.071	-0.019	0.033	0.099	0.099	0.086	0.000	0.121	0.000
Median	0.050	-0.070	0.077	-0.070	-0.020	0.042	0.072	0.056	0.027	0.057	0.027
p Value	0.474	0.729	0.231	0.729	0.489	0.059*	0.077*	0.160	0.998	0.035**	0.998
q Value	0.396	0.374	0.268	0.374	0.389	0.182	0.716	0.396	0.708	0.182	0.708
Nobs	68	62	66	62	66	68	68	68	64	68	64
	Panel C: Small sample firms										
Mean	0.101	-0.080	0.046	-0.074	0.039	-0.005	0.013	0.199	-0.015	0.176	-0.009
Median	0.107	-0.139	0.059	-0.139	-0.035	-0.050	-0.103	0.137	-0.028	0.114	-0.028
p Value	0.171	0.399	0.537	0.438	0.606	0.949	0.861	0.019**	0.852	0.038**	0.914
q Value	0.248	0.120	0.561	0.188	0.728	0.489	0.416	0.096*	0.561	0.403	0.561
Nobs	75	70	74	70	74	75	74	71	74	70	74

Turnover and abnormal turnover are measured as described below:

(4) $$\log \text{Turnover}\ (\theta_{i,t}) = \log \frac{\text{Trading Volume}_{i,t}}{\text{Outstanding}_{i,t}}.$$

(5) Abnormal Turnover $(\eta_{i,t}) = \theta_{i,t} - \overline{\theta}_i$, where $\overline{\theta}_i = \frac{\sum_{t=-40}^{t=-11} \theta_{i,t}}{30}$.

Turnover at day *t* for firm *i* is defined as the log of the trading volume (measured in thousands) over the number of outstanding shares. Abnormal turnover is then reported as the difference between the turnover at time *t* and the arithmetic average turnover measure over the preceding 30 trading days. Table 5 reports the results for an 11 trading day period around the new product introduction. We find significant abnormal trading after the new product announcement. Daily turnover increases from 4.4% to 5.4% to 14.3% two days after the product introduction. We split the sample to control for possible size effects. Companies are ranked according to their arithmetic average market value of equity for a 250 trading day period before the event. Large firms are defined as companies with average market value of equity larger than the median market value. Small firms are defined accordingly. Both the small and large firm sample show increased trading activity after the event. However, large firm stocks exhibit abnormal trading activities earlier than small firm stocks. Offsetting trading patterns could be attributable to different coverage intensities for small and large firms. Large firms are exposed to broader media and analyst coverage which can explain the market participants' earlier processing of corporate news.

In addition to immediate trading effects we also examine structural, long-term changes in trading patterns before and after the introduction of new products. To analyze changes in trading activity, we employ various measures similar to Denis and Kadlec (1994). First, we compare the average number of stocks traded before and after the new product announcement for the introducing firms. The raw number of issues traded per day is also adjusted for possible price effects. We weigh the number of stock traded per day by the arithmetic average of the current and previous day's closing prices. Then, we derive the percentage of days when actual trades in that particular stock occurred for a period before and after the event. Finally, the pre- and post announcement percentages of stocks available to investors are compared. We evaluate the free float of company stocks prior and subsequent to the new product introduction. Institutional or strategic investors might alter their holdings in firm when the corresponding company exercised growth options. Estimates of the measures employed are derived over a 250 trading day period prior and subsequent to the event of new product introduction. Throughout the study, we keep a 10 day gap around the event date before the estimation period starts. Table 6 reports the results on changes in structural trading patterns.

Table 6

Changes in Trading Activity for the Sample of New Product Introducing Firms

This table provides alternative measures of trading activity for the sample companies with new drug approvals at the EMEA between 1995 and 2009. The trading activity measures are defined similar to Denis and Kadlec (1994): *Number of Stocks* refers to the average number of stocks traded per day in thousands. *Number of value-weighted Stocks* measures the dollar turnover as the value-weighted number of stocks traded per day in thousands. The number of stocks traded per day is multiplied by the average of the days-end closing price and the previous day's closing price. *Pct of Days with Trades* refers to the number of days during the period prior and subsequent to the annoncement for which the company's stock was traded. *Free Float* measures the percentage of free float in outstanding stocks. The measures are averaged over a 250 trading-day period prior and subsequent to the announcement. A 10 day gap surrounding the event is kept to prevent the estimation periods from being biased. Means and medians are listed below. Changes between post- and pre-announcement values are tested for significance using a standard t-test for means and a non-parametric Wilcoxon signed rank test for medians. ***, **, * indicate significance at the 1%, 5% and 10% level respectively.

		Pre-announcement	Post-announcement	Change	t-Statistic z-Statistic		Nobs
Number of Stocks	Mean	4,326.80	4,743.64	416.84	-2.908	***	150
	Median	2,591.50	2,708.80	117.30	-3.988	***	150
Number of value-weighted Stocks	Mean	144,777.96	160,385.95	15,607.99	-3.532	***	150
	Median	98,575.27	123,995.71	25,420.45	-3.901	***	150
Pct of Days with Trades	Mean	0.95	0.94	-0.01	1.118		150
	Median	0.96	0.96	0.00	-0.041		150
Free Float	Mean	75.98	74.53	-1.45	-0.288		86
	Median	83.49	80.98	-2.51	-1.041		86

New product introductions are associated with an increasing in trading activity. The mean number of stocks traded per day significantly increases from 4,326.8 (median = 2,591.5) before the announcement to 4,743.64 (median = 2,708.8) after the new product is approved. Also, the value-weighted number of stocks traded per day increases significantly after a new product introduction. Comparing the percentage of days for which trades occurred before and after the event, we cannot find significant changes. Prior to the event, stocks were traded on 95% (median = 96%) of the days during the estimation period. Subsequent to the event, trades were reported on 94% (median = 96%) of the days during the estimation period. Our sample exhibits a high trading frequency already prior to the event. Therefore, a further, event-induced increase in the percentage of days with trades seems unlikely. We also find no significant change in the percentage of shares available at free float before and after the event.

In sum, our sample of new product introductions shows significant abnormal trading activities immediately after the product approval. Value relevant information on the exercise of growth options is transmitted into stock prices and reflected in trading activity. We find some evidence for a size effect. Large firms exhibit abnormal trading earlier than smaller companies. Our sample is also associated with structural, long-term changes in trading patterns. After the event, the daily number of stocks traded increases significantly. A possible explanation for the increase in trades is that company stocks become more liquid after new product introductions. Growth options are exercised and provide a positive signal to outside investors. Therefore, stocks are rendered some of their inherent uncertainty and demand for participating in the firms' future prospects emerges.

3. SYSTEMATIC RISK CHANGES

CHANGES IN LEVERAGE

Financial leverage effects systematic risk of common stock (Hamada (1972), Mandelker and Rhee (1984)). We take this potential bias of our systematic risk assessment into account. Table 7 provides summary statistics on corporate leverage ratios before and after the event. Leverage is measured based on both book and market values. Book value of leverage is defined as the ratio of book value of long-term debt to the sum of book value of long-term debt and book value of equity. Pre-announcement book values are derived from balance sheet information of the most recent fiscal year. Post-announcement book values are calculated from balance sheet items of the subsequent fiscal year. Throughout the analysis we assume a 4 month gap until fiscal year end results are publically available as suggested by Chan et al. (2001). To calculate the market value of leverage, we replace the book value of equity by the average market value of equity estimated over a 250 trading day period before and after the new product initiation.

Table 7

Financial Leverage Changes around New Product Introductions

This table reports the changes in financial leverage for firms with new drug approvals at the EMEA between 1995 and 2009. Financial leverage is measured according to book values as well as market values (Levis et al. (2002)). *Book Value of Leverage* is defined as the ratio of the book value of long-term debt to the sum of the book value of long-term debt and book value of equity. *Market Value of Leverage* is defined as the ratio of the book value of long-term debt to the sum of the book-value of debt and the market value of equity. The market value of equity is measured as the average market value of equity over a period of 250 trading-days prior and subsequent to the announcement. Means and medians are reported below. Pre- and post-announcement book values are derived from company disclosures for the fiscal year prior to the event (pre-announcement) and the fiscal year subsequent to the event (post-announcement). Similar to Chan et al. (2001), a gap of 4 month between fiscal year end and disclosure availability is assumed. The changes between pre- and post-announcement values are tested for significance using a t-test and non-parametric Wilcoxon signed rank test. ***, **, * denotes significance at the 1%, 5%, and 10% level.

	Book value of leverage			Market value of leverage	
	Pre-Announcement	Post-Announcement		Pre-Announcement	Post-Announcement
Mean	0.251	0.268		0.070	0.072
Median	0.197	0.198		0.046	0.047
Change in mean		0.017			0.003
t-statistics		0.909			-0.628
Change in median		0.001			0.001
z-statistic		-2.073	**		-0.216
Nobs		150			150

Results on changes in financial leverage are mixed. Weak evidence for an increase in financial leverage is gathered based on book value measures. The median changes from 0.197 to 0.198 around the event. The shift is significant at a 5% level. However, changes in financial leverage are insignificant if compared via a t-test and if measured based on market values of equity.

Table 8

Asset and Equity Betas for New Product Introducing Firms

This table provides estimates of equity and asset betas for firms that recieved a drug approval at the EMEA between 1995 and 2009. Panel A reports equity betas. Equity betas are estimated over a 250 trading-day period prior and subsequent to the announcement day. A 10 day gap is kept around the announcement day to prevent beta estimates from being distorted. Panel B reports asset betas that represent the unlevered equity betas. Betas are unlevered using the market-based debt asset ratio under the assumption that the debt beta is zero. Changes in beta are tested for significance using a t-test and a non-parametric Wilcoxon signed rank test. ***, **, * denotes significance at a 1%, 5%, and 10% level respectively. The entire sample of product approval is split according to size measured as the average market value of equity over a 250 trading day period prior to the event. Large firms include those firms with an average market value in access of the median market value of equity. Small firms include those firms with an average market value less than the median market value of equity.

	Entire Sample		Large Frims			Small Firms	
	Pre-Announcement	Post-Announcement	Pre-Announcement	Post-Announcement		Pre-Announcement	Post-Announcement
Panel A: Estimates of equity betas							
Mean	0.886	0.871	0.847	0.785		0.926	0.957
Median	0.888	0.848	0.887	0.801		0.948	0.950
Change in mean		-0.015		-0.062			0.032
t-statistic		0.537		2.191	**		-0.655
Change in median		-0.040		-0.086			0.002
z-statistic		-1.438		-2.419	**		-0.217
Nobs		150		75			75
Panel B: Estimates of asset betas							
Mean	0.823	0.808	0.801	0.739		0.846	0.877
Median	0.806	0.776	0.814	0.749		0.784	0.880
Change in mean		-0.015		-0.062			0.031
t-statistic		0.610		2.275	**		-0.731
Change in median		-0.030		-0.065			0.097
z-statistic		-1.286		-2.529	**		-0.507
Nobs		150		75			75

Market Model Betas

To analyze systematic risk changes around new product introductions, we employ a standard market model as the ex-post variant of the CAPM. Equity betas are estimated over a 250 trading day period before and after the new product introduction. We account for possible biases to changes in financial leverage by unlevering equity betas based on market values. Potential size effects are analyzed by splitting the event sample based on company size. Results for equity and asset betas are reported in table 8. Taking the entire sample into account, we cannot find significant changes in systematic risk after new product introductions. Equity as well as asset beta estimates for the pre- and post-announcement period do not change significantly. However, a size effect is found after splitting the sample by the introducing firm's market value of equity. Large firms exhibit a significant decrease in systematic risk. Mean equity betas are reduced from a pre-announcement level of 0.847 (median = 0.887) to a post-announcement level of 0.785 (median = 0.801). Asset betas are significantly reduced as well. Prior to the announcement, we calculate an average asset beta of 0.801 (median = 0.814). Subsequent to the new product initiation, we derive an average asset beta of 0.739 (median = 0.749). In contrast, small firms' systematic risk changes are insignificant. For both equity and asset betas we cannot find evidence for significant systematic risk changes.

To sum, we find a significant size effect based on market model beta estimates. Large firm exhibit a significant decrease in systematic risk after exercising their growth options. The systematic risk for small firms, however, is invariant to new product introductions and the exercise of real options.

Adjusted Betas

Changes in the accuracy of return measurement or differences in the speed of price adjustment causes market model beta estimates to be biased. If stocks are subject to liquidity changes, stock return might respond to new information differently for that particular period. Price adjustments take longer for periods of less liquid trading. Consequently, betas measuring the responsiveness of stock returns to market returns represent inadequately the return sensitivity for periods with structural trading pattern changes.

Scholes and Williams (1977), Dimson (1979), and Cohen et al. (1980) show that beta estimates are upwardly biased for stock that are frequently traded in contrast to infrequently traded stock that are downwardly biased. Nonsynchronous trading as well as friction in the trading process can cause price adjustment delays. As a result, stock returns exhibit serial correlation which leads to biased beta estimates (Cohen et al. (1983)). Hence, changes in trading patterns influence return measurement and need to be accounted for when studying systematic risk changes (see Denis and Kadlec (1994) for further discussions).

The above analysis of trading activity reveals significant changes in trading patterns around new product introductions. Given the changes in market micro structure, market model based betas estimates as reported in table 8 are potentially biased. We therefore implement the methodology proposed by Cohen et al. (1983) to check the robustness of our above results. Cohen et al. (1983) develop a procedure that corrects market model beta parameters for frictions in the trading process. They address the intervalling-effect bias and frictions caused by price-adjustment delays. The authors generalize the work seminal work of Scholes and Williams (1977). Their beta estimate includes a generalized lead-lag structure of periodical returns and adjusts for price delays of more than one day.

Table 9 provides the beta estimates based on Cohen et al. (1983) which we further refer to as “Cohen betas”. Cohen betas are estimated over a 250 trading day period before and after the new product introduction. We estimate Cohen betas with up to 5 lead and 5 lags. With that, a period of two trading weeks is covered. Further leads and lags are not included given the inherent loss of efficiency. A symmetric leads and lags structure is used to avoid the impression of data mining (Denis and Kadlec (1994)). We cannot find significant changes in systematic risk for the entire lead-lag structure employed. We also cannot find evidence for a potential size effect as suggested above. After splitting the sample according to market value of equity, we cannot find systematic risk changes for both small and large companies.

This result suggest that the above mentioned reduction in beta based on regular market model estimation is due to changes in trading patterns rather than a structural change in systematic risk. Once corrective estimation techniques are used, systematic risk appears invariant to exercises in growth options and new product introductions.

We explore our results further and take changes in leverage into account. Table 10 reports the unlevered Cohen betas prior and subsequent to the event. We unlever Cohen betas using market values of equity as well as book values of equity. Unlevering Cohen betas reduces the overall level of beta. But again, we cannot find significant changes in systematic risk before and after new product introductions. Panel A reporting market-value based Cohen betas as well as Panel B reporting book-value based Cohen betas show no significant changes in systematic risk prior and subsequent to new product initiations. The sample is also split according to size. However, we find no evidence on potential size effects. Changes in systematic risk are neither important for small firms nor for large firms.

To sum our results, we cannot find evidence on systematic risk changes around new product introductions. Once controlled for potential biases in beta estimation associated with trading frictions and price adjustment delays, beta changes appear statistically insignificant. Results are supported also after controlling for leverage effects. Hence, our findings suggest that new product introductions have no influence on systematic risk of the announcing firm. Consequently, neither outside investor's return expectations should be adjusted nor should the firm alter its cost of capital.

Table 9

Cohen Betas for the Samples of New Product-Introducing Firms

This table provides alternative estimates of pre-announcement and post-announcement systematic risk (beta) for the sample of 150 firms that received a positive opinion by the EMEA for their application of new drug candidates over the period 1994 to 2009. Pre-announcement betas are estimated over a 250 trading-day period preceeding the EMEA decision, while post-announcement betas are derived over the 250 trading-day period subsequent to the announcement. A 10 day gap around the announcement day is kept to prevent the beta estimates from being distorted by any event-induced effects. Beta estimates are derived using the technique detailed in Cohen et al. (1983). The analysis includes lead and lagged coefficients up to 5 trading days. The significance of changes in betas are measured using standard t-tests for means and Wilcoxon signed rank tests for medians. Panel A reports the result for the entire company sample. The sample is further split by the median of equity market value measured over a 250 trading-day period before the event. Panel B includes announcing firms with average market values of equity larger than the median market value while Panel C includes announcing firms with average market values less than the median market value.

		Panel A: All sample firms					*Panel B: Large firms*					*Panel C: Small firms*				
		Pre-Announcement Period	Post-Announcement Period	Change	t-Statistic z-value	Nobs	Pre-Announcement Period	Post-Announcement	Change	t-Statistic z-value	Nobs	Pre-Announcement Period	Post-Announcement	Change	t-Statistic z-value	Nobs
Daily	Mean	0.878	0.874	-0.003	0.088	150	0.833	0.792	-0.041	0.876	75	0.923	0.957	0.034	-0.549	75
(1 lead, 1 lag)	Median	0.873	0.820	-0.053	-0.012	150	0.855	0.772	-0.083	-1.230	75	0.948	0.897	-0.051	-0.919	75
Daily	Mean	0.864	0.865	0.001	-0.031	150	0.804	0.742	-0.062	1.105	75	0.923	0.988	0.065	-0.979	75
(2 leads, 2 lags)	Median	0.864	0.814	-0.050	-0.008	150	0.856	0.769	-0.087	-0.956	75	0.936	0.845	-0.090	-0.861	75
Daily	Mean	0.816	0.840	0.024	-0.534	150	0.727	0.713	-0.014	0.240	75	0.904	0.966	0.062	-0.926	75
(3 leads, 3 lags)	Median	0.788	0.758	-0.029	-1.048	150	0.711	0.687	-0.024	-0.491	75	0.880	0.899	0.019	-1.014	75
Daily	Mean	0.813	0.815	0.002	-0.050	150	0.715	0.723	0.008	-0.142	75	0.911	0.908	-0.003	0.036	75
(4 leads, 4 lags)	Median	0.781	0.750	-0.031	-0.149	150	0.699	0.685	-0.014	-0.412	75	0.882	0.858	-0.024	-0.137	75
Daily	Mean	0.848	0.834	-0.014	-0.413	150	0.746	0.747	0.002	-0.028	75	0.951	0.921	-0.030	0.301	75
(5 leads, 5 lags)	Median	0.795	0.782	-0.014	-0.560	150	0.748	0.745	-0.003	-0.581	75	0.846	0.829	-0.017	-0.259	75

Table 10

Unlevered Cohen Betas for the Samples of New Product-Introducing Firms

Unlevered Cohen Betas for the Samples of New Product-Introducing Firms

This table provides alternative estimates of pre-announcement and post-announcement systematic risk (beta) for the sample of 150 firms that received a positive opinion by the EMEA for their application of new drug candidates over the period 1995 to 2009. Pre-announcement betas are estimated over a 250 trading-day period preceeding the EMEA decision, while post-announcement betas are derived over the 250 trading-day period subsequent to the announcement. A 10 day gap around the announcement day is kept to prevent the beta estimates from being distorted by any event-induced effects. Beta estimates are derived using the technique detailed in Cohen et al. (1983). The analysis includes lead and lagged coefficients up to 5 trading days. Betas are unlevered using the market-based debt asset ratio under the maintained assumption that debt beta is zero as well as book-value based asset ratios. Means and medians are listed below. The significance of changes in betas are measured using standard t-tests for means and Wilcoxon signed rank tests for medians. Panel A reports the unlevered Cohen betas based on market values while Panel B summarized unleverd Cohen betas based on book values. The sample is further split by the median of equity market value measured over a 250 trading-day period before the event. Large firms include announcing companies with average market values of equity larger than the median market value. Small firms include announcing companies with average market values less than the median market value.

		All sample firms					Large firms					Small firms				
		Pre-Announcement Period	Post-Announcement Period	Change	t-Statistic z-value	Nobs	Pre-Announcement Period	Post-Announcement	Change	t-Statistic z-value	Nobs	Pre-Announcement Period	Post-Announcement	Change	t-Statistic z-value	Nobs
Panel A: Unlevered Cohen Betas based on Market Values																
Daily	Mean	0.813	0.811	-0.002	0.059	150	0.787	0.746	-0.041	0.917	75	0.839	0.876	0.036	-0.645	75
(1 lead, 1 lag)	Median	0.801	0.771	-0.030	-0.020	150	0.789	0.741	-0.048	-1.236	75	0.844	0.852	0.008	-0.919	75
Daily	Mean	0.798	0.798	-0.001	0.022	150	0.758	0.701	-0.057	1.084	75	0.839	0.894	0.055	-0.890	75
(2 leads, 2 lags)	Median	0.796	0.751	-0.045	-0.050	150	0.760	0.735	-0.025	-0.914	75	0.863	0.812	-0.051	-0.808	75
Daily	Mean	0.754	0.772	0.019	-0.437	150	0.684	0.669	-0.015	0.256	75	0.823	0.875	0.052	-0.825	75
(3 leads, 3 lags)	Median	0.719	0.694	-0.024	-1.067	150	0.682	0.651	-0.031	-0.533	75	0.826	0.804	-0.021	-1.019	75
Daily	Mean	0.749	0.752	0.003	-0.064	150	0.674	0.679	0.005	-0.094	75	0.824	0.825	0.001	-0.013	75
(4 leads, 4 lags)	Median	0.689	0.701	0.012	-0.245	150	0.660	0.624	-0.036	-0.370	75	0.820	0.789	-0.031	-0.037	75
Daily	Mean	0.783	0.772	-0.011	0.210	150	0.701	0.700	0.000	0.006	75	0.865	0.843	-0.021	0.245	75
(5 leads, 5 lags)	Median	0.711	0.730	0.019	-0.616	150	0.683	0.729	0.046	-0.549	75	0.786	0.730	-0.056	-0.296	75
Panel B: Unlevered Cohen Betas based on Book Values																
Daily	Mean	0.632	0.619	-0.014	0.410	150	0.651	0.626	-0.026	0.671	75	0.614	0.612	-0.002	0.037	75
(1 lead, 1 lag)	Median	0.651	0.602	-0.049	-0.014	150	0.651	0.593	-0.057	-0.813	75	0.650	0.621	-0.030	-0.581	75
Daily	Mean	0.622	0.569	-0.053	1.108	150	0.626	0.589	-0.037	0.830	75	0.617	0.549	-0.068	0.810	75
(2 leads, 2 lags)	Median	0.621	0.591	-0.030	-0.457	150	0.606	0.557	-0.049	-0.502	75	0.671	0.621	-0.051	-0.153	75
Daily	Mean	0.579	0.534	-0.045	0.877	150	0.561	0.556	-0.006	0.116	75	0.597	0.512	-0.085	0.939	75
(3 leads, 3 lags)	Median	0.543	0.522	-0.021	-0.755	150	0.521	0.505	-0.016	-0.840	75	0.622	0.581	-0.041	-0.222	75
Daily	Mean	0.582	0.528	-0.054	1.110	150	0.557	0.565	0.008	-0.166	75	0.608	0.491	-0.116	1.354	75
(4 leads, 4 lags)	Median	0.537	0.526	-0.011	-0.091	150	0.480	0.516	0.036	-0.523	75	0.571	0.568	-0.003	-0.655	75
Daily	Mean	0.604	0.583	-0.021	0.478	150	0.575	0.582	0.007	-0.155	75	0.633	0.583	-0.050	0.664	75
(5 leads, 5 lags)	Median	0.560	0.569	0.009	-0.547	150	0.509	0.563	0.054	-0.771	75	0.589	0.580	-0.009	-0.095	75

V. IMPLICATIONS AND CONCLUSIONS

Systematic risk, as crucial parameter in the CAPM, determines the required return to equity investors and thereby impacts the firm's capital budgeting (e.g., Bruner (1998) and Graham and Harvey (2001)). Changes in the firm's systematic risk influence the overall cost of capital and the company's investment policy and should therefore be of concern to corporate managers. Several variables and their influence on systematic risk have been analyzed (e.g., Beaver et al. 1970), Hamada (1972), Mandelker and Rhee (1984), Ismail and Kim (1989)). However, evidence is scarce on the impact of new product introductions on systematic risk despite the steady shift towards a knowledge- and innovation-based economy (Grossman and Helpman, 1995). Moreover, existing rudimental findings are questionable since previous studies employ a limited focus or do not take potential biases in estimating systematic risk into account.

Our study closes this gap and examines the relationship between new product introductions and associated changes in systematic risk. The marginal effects of new product releases is placed within a real option framework in which we regard the product introduction as exercise of firm's growth options.

To do so, we use a unique hand-collected data set of new product approvals in the pharmaceutical industry. We explicitly test our results for robustness by accounting for leverage-induced risk changes and biases related to frictional trading (Hamada (1972) and Cohen et al. (1983)). Therefore, our analysis provides more thorough empirical evidence on financial consequence of real option exercises and consequences for the firm's systematic risk and cost of capital.

Results show a significant wealth effect associated with new product introductions. We find abnormal stock price reactions of 1.08% around the announcement. Positive wealth effects are associated with abnormal trading activity around the product introductions. Share turnover increases significantly after the announcement. Trading activity for large firms' stocks increases earlier than for small firms' stocks. We explain the size effect by more intensive news coverage and greater investor awareness for large companies. In addition, we find a structural change in trading patterns. Shares of new product introducing companies are traded heavier after the product release. The average daily number of stock traded increases significantly after the event. We interpret this finding as evidence for increased liquidity in the stock for the announcing firm. In analyzing the effects on systematic risk, we first estimate systematic risk with a standard market model for comparison to previous works. We find weak evidence of a decrease in systematic risk after new product introductions. However, once controlled for frictional trading and leverage changes evidence vanishes and we do not confirm a risk reduction. Systematic risk changes as reported previously (e.g., Devinney 1992) are caused by statistical flaw rather than a structural change in the firm risk characteristics.

The results suggest that outside investors do not adjust their return requirements by accounting for different levels of firm risk before and after the new product introduction. We conclude that the exercise of real options – proxied via new product introductions – might influence the likelihood of receiving future cashflows for the firm. However, the sensitivity of such cashflows to overall market movements – as measured by the firm's inherent systematic risk – remains unchanged. Consequently, managers should not mistake a successful new product release with lower cost of capital.

VI. References

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