



Yale SCHOOL of MANAGEMENT

Merck & Co., Inc.



Recommendation: Buy

Target Price	\$ 37.09
Current Price	\$ 26.18
Difference	41.7%↑
Market Cap.	\$ 57.48B
52 Wk High	\$ 36.26
52 Wk Low	\$ 25.50
Shrs. Out.	2,217.6M

As of October 21, 2005

- Market reaction to Vioxx lawsuits too extreme
- Cash flow for company strong enough to absorb potential legal or competitive challenges
- Potential blockbuster drugs in the pipeline
- A stable of existing drugs to continue driving growth
- Aging and growing population
- Medicare Modernization Act of 2003 a boon to drug companies

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Yale School of Management
MGT 948 - Securities Analysis and Valuation

Please see Important Disclaimer at the end of this report

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Investment Thesis

We are initiating our coverage of Merck & Co., Inc. (Merck) with a Buy recommendation, based on an estimated value of \$37.09 per share, which is 41.7% above the current price of \$26.18. We believe the market is currently undervaluing Merck, primarily due to the existing Vioxx litigation. On September 30, 2004, the day of the announced recall of Vioxx, Merck's stock dropped \$11.48, from \$42.84 to \$31.36. With diluted shares outstanding of 2.226bn, that indicated a market assumption of earnings and litigation losses of \$25.6bn. The market cap of the company dropped another \$5.1bn on August 19, 2004, the day a Texas jury awarded a Vioxx plaintiff \$253mm. Although the litigation is undoubtedly a drag on the firm, we believe the overall threat to the company is small and bankruptcy or restructuring is unlikely.

Merck is very strong, with free cash flow of over \$6 billion from its current stable of drugs on the market. The pharmaceutical market is growing steadily in the US and abroad, and populations in most major pharmaceutical markets are aging. In addition, the Medicare Modernization Act of 2003 (MMA) should provide a boon to brand name drug manufacturers.

The company is facing potential risks to its future cash flows. Vioxx is currently on trial, but there is always the possibility of additional litigation relating to other drugs. The company's two largest revenue producing drugs have patents expiring in the next few years. This will require new drugs from the pipeline to replace those revenues lost to generic alternatives. Drugs within the pipeline, however promising, are always risky in that they could be stopped at any time by an unsatisfactory trial or ruling by the FDA. And finally, regulatory reforms, including such measures as price caps, could be instituted by the US government. Although it is unlikely such a measure will come to pass in the near future, this could severely limit Merck profits. While there are risks to Merck, we believe them to be small or overstated by the market.

In the final analysis, we believe Merck is well positioned to continue producing strong free cash flow in the future. These cash flows more than justify a Buy recommendation for the company.

Company Overview

Merck is an international pharmaceutical company with 63,000 employees, about half of them in the United States, that focuses on researching, developing, manufacturing and marketing new drugs, either on its own or through joint ventures. These drugs are created mostly for human use, although a portion of its revenues also come from animal medications. The company primarily markets its drugs to businesses rather than directly to the consumer. These businesses include wholesalers, retailers, hospitals, government agencies, HMO's and other institutions. Merck also markets its drugs to physicians.

Merck competes in markets that are often highly competitive in a number of different ways. Initial competition is in the intense search for technological innovation. Historically, large pharmaceutical companies conducted most of this research themselves, but in recent decades there has been a shift towards partnering with the academic world. In the last few years the pharmaceutical industry's major players have begun allowing smaller bio-tech companies to conduct initial research before partnering with them on drugs that have passed initial hurdles; in other cases, the large firms have simply bought the companies outright. Merck has aggressively purchased and marketed new products through joint ventures and licenses in an effort to enhance its portfolio. In addition to the competitive challenge to find new drugs, there is additional competition from rival firms bringing substitute drugs to the market for the treatment of the same disease. This is a potential price threat to most drugs on the market, whether they are patent-protected or not.

The process through which a drug is brought to market is as follows:

- Scientists discover a new compound with potential medical application. This is usually through a Merck scientist, a university or a bio-tech firm.
- Preclinical testing commences with laboratory testing and animal safety studies. These studies focus on chemistry, pharmacology and toxicology. Those compounds selected for potential human use then undergo further preclinical testing. This stage lasts for an average of six years.
- Clinical testing is then initiated. It has three parts. Phase I focuses entirely on possible adverse affects of the drug, but it does not determine if the drug has the hoped for medical effect. If there are no adverse reactions in humans, Phase II first uses the drug in humans suffering from the disease the drug is hoped to treat. This includes dose and efficacy trials. Phase III launches a more massive trial to confirm the drug's efficacy and safety, including whether or not the drug offers a significant improvement in treatment over a drug currently on the market. These three phases also last six years on average.
- After successful completion of Phase III, the FDA approval process begins, which analyzes the safety, efficacy and value of the drug in question. This process takes an average of two years.

As the process of bringing a drug to market takes an average of fourteen years, the typical large pharmaceutical company must have multiple drugs in the pipeline in all stages of

the process to ensure consistent cash flows in the future. This timeframe also explains why small bio-tech companies are often willing to sell their research outright or enter into a joint partnership with a major pharmaceutical company. In 2004, Merck completed fifty transactions for external research in preclinical and clinical drugs, as well as collaborations with other major pharmaceutical companies for joint research and promotion of potential compounds.¹

Merck operates in a highly regulated industry. In the US, the most important government agency for the pharmaceutical industry is the FDA, which controls the approval process for new drugs and monitors the on-going testing of drugs already on the market for future potential side-effects. The company must also work with individual states, as each state government may legislate differently on the prices, rebates and availability of drugs. Merck also must deal with international agencies, most importantly those in Europe (European Medicines Evaluation Agency – EMEA) and Japan (Ministry of Health Labour and Welfare – MHLW), when trying to market its products abroad. As the foreign market makes up approximately 41% of Merck's revenues, foreign regulations are very important when calculating a drug's potential revenues.²

One of the most crucial issues for the company is patent protection. This is particularly important because of the long, expensive process required to bring a drug to market. Patent protection relates to the introduction of generic drugs into the market, as well as alternative offerings from competitors. Patent protection differs from country to country, depending on the duration of patent protection each country allows and when that protection was granted. The level and scope of protection offered by patents also varies in different countries.

Important Revenue Producing Drugs

Merck, like other major pharmaceutical companies, earns a large amount of its revenues from a few important, blockbuster drugs in its portfolio. Merck's most important existing drugs, associated revenues and potential threats to those revenues are as follows (information comes from the Merck corporate website and 2004 annual report):

- Zocor – This is a drug used to modify cholesterol levels. Zocor saw sales of \$5.2bn worldwide in 2004. This represented a 4% increase from 2003. Estimated sales for 2005 are down to \$4.4bn, a decrease of 15%. Sales are decreasing because of patent expirations outside the US and domestic competition from alternative cholesterol drugs. The patent for Zocor is ending in the US in June of 2006. This event is expected to result in a large decrease in market share and revenue for the drug. Merck is also involved in a licensing agreement with Schering-Plough to produce Vytorin, which contains Zocor and Zetia, a drug co-produced by Schering-Plough and Merck. Worldwide Zetia and Vytorin sales were \$1.2bn in 2004 and are projected to be \$2.4bn in 2005, based on the sales

¹ Merck & Co., Inc. 2004 10-K.

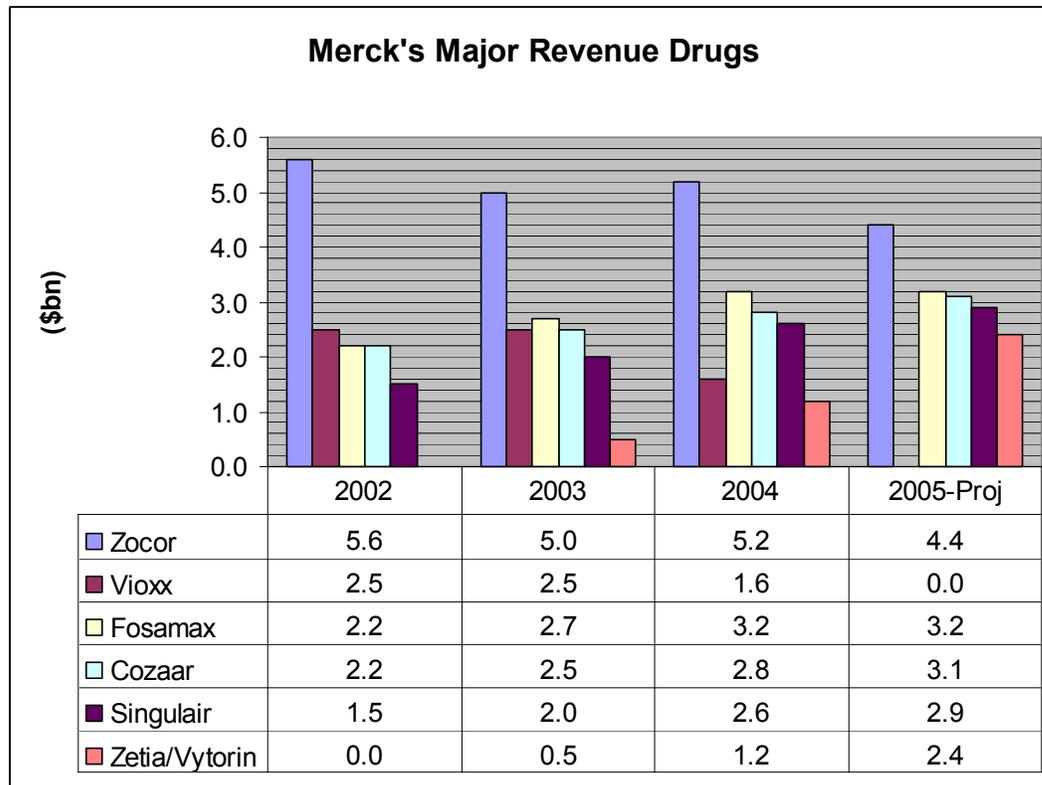
² IBID.

data from the first nine months. This has stolen market share from Zocor and other cholesterol drugs. Analysts expect the expiration of Zocor's patent to have a more muted effect on Vytorin sales. It is predicted that previous users will likely stay with Vytorin even if there are cheaper generic options, because it combines the two drugs into one.³ The decrease in Zocor sales, though, will definitely impact earnings for Merck and will need to be replaced with revenue from drugs in the pipeline.

- Fosamax – Fosamax is the most prescribed medicine worldwide for treatment of postmenopausal osteoporosis. 2004 saw sales grow to \$3.2bn worldwide. This was an increase of 18% over 2003. 2005 sales are up approximately 3% to date, but further large revenue increases for this drug are not expected. Fosamax is patent protected in the US until 2008, at which time the company expects a decline in US sales. Merck recently lost a court case where it sought to reinstate that protection until 2018, but the court refused to review a previous ruling which shortened the protection.
- Cozaar/Hyzaar – These drugs are both used to treat hypertension and are under patent protection in the US until 2010. They saw strong sales of \$2.8bn in 2004, which was an increase of 14% over 2003. Annualizing sales from the first nine months gives revenues in 2005 of \$3.1bn. These two drugs compete in the fastest growing class of hypertension medications, angiotension II antagonists (AIIA). Cozaar is the best selling brand in the category in Europe and the second most popular in the US. Merck recently filed a new formulation with the FDA in an attempt to serve an even broader market. It will file similar requests in other parts of the world throughout 2005 and 2006.
- Singulair – Singulair is Merck's primary asthma and allergy medication. It is the number one asthma controller in the United States. Total sales worldwide reached \$2.6bn in 2004, an increase of 30% over the previous year. In 2005, sales should reach approximately \$2.9bn. Merck plans to file for new applications of Singulair with the FDA for other respiratory maladies in the coming three years.

These four drugs accounted for 60% of Merck's revenues in 2004. This is a large concentration of revenues in a limited number of drugs. As was seen by the market reaction to the recall of Vioxx, concentration of revenue streams into a limited number of drugs can increase risks to a pharmaceutical company.

³ Aaron Smith, "Vytorin Sales Rise During Debut Year", CNN Money, available at <http://money.cnn.com/2005/06/20/news/fortune500/vytorin/>.



If sales from the first nine months of 2005 are annualized, revenues in 2005 will decrease to around \$21.6bn. If sales of Vioxx are excluded from previous years' revenues, the company will have seen revenue growth of 5.8%, 6.5% and 1.4% in 2003-2005, respectively. 2005 has seen a much more limited sales increase because of the decline in Zocor sales. The loss of patent protection has been estimated to decrease market share by the brand name incumbent by 40% to 50%.⁴ Interestingly, prices for brand name drugs increase on average following loss of patent protection. This is due to the elimination of price sensitive consumers from the brand name manufacturer's market.⁵ In coming years, we expect to see continuing declines in Zocor revenues in 2006 and forward, quickly declining to around \$2.0bn after losing patent protection. A similar scenario should play out for Fosamax beginning in 2008. We would expect that revenues for Fosamax will decline to around \$1.5bn by 2009. Eventually, of course, all of the market can be lost when other manufacturers introduce new treatments, but that occurs in an uncertain time frame and can not be accurately estimated. In addition, as the revenues for one drug wane away to nothing, revenues from even non-blockbuster drugs can replace these dwindling sales.

Patents are granted by the patent and trademark office at any time during a drug's development and will last for twenty years. Typically, the patent is granted five years before the drug's FDA approval. The following is a table of major revenue producing

⁴ Chou, Tracy. "An Analysis on Waxman-Hatch Act: The Effect of Generic Entry on Pharmaceutical Prices", 2003. Available at <http://economics.about.com/od/unitedstates/l/aagenericdrugs.htm>

⁵ Chou. *Ibid.*

drugs for Merck and the current dates of patent expiration. In addition, drugs can also receive exclusivity rights lasting for varying amounts of time between six months and seven years. These rights give the company the exclusive ability to market a drug class in an area.

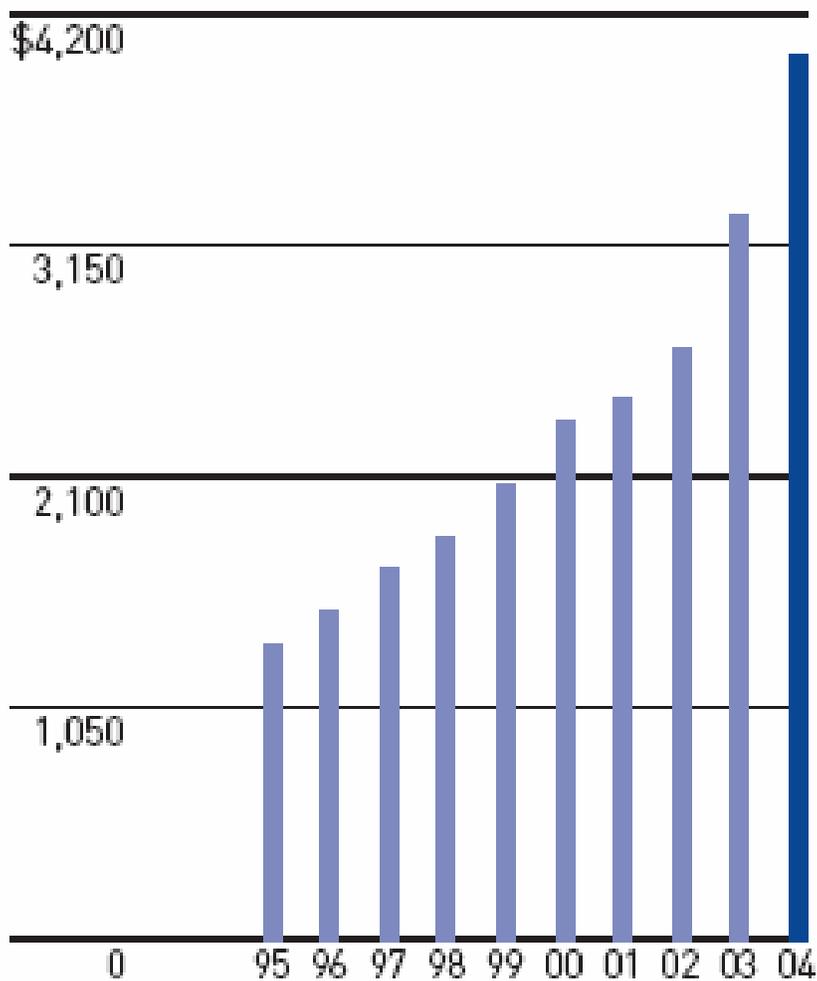
	Est. 2004 Sales (\$bn)	FDA Approval	Patent Expiration
Zocor	\$5.2	1991	6/2006
Fosamax	\$3.2	1995	2/2008
Cozaar/Hyzaar	\$2.8	1995	4/2010
Singulair	\$2.6	1998	2012
Zetia/Vytorin	\$1.2	2002	2013

There will clearly be a strain on revenues between now and 2009, when the full effects of the loss of the Fosamax patent are felt. Yet Merck does have the ability to replace much of the lost revenue with drugs in phase III and those already submitted to the FDA for final approval.

Drugs in the Pipeline

Future revenues for a pharmaceutical company come almost entirely from drugs in the pipeline. All major brand name drug producers earn the vast majority of their revenues from patent-protected drugs. The primary way in which a drug manufacturer can replace revenues lost to generic competition is through the discovery of new drugs. R&D expenses can be used as a barometer to not only determine how committed a company is to investing in the long-term, where the results are often not seen for 10+ years, but it is also a way to gauge when a company has a large portion of its revenues losing patent protection. The following chart shows that Merck has ramped up R&D expenses, especially in the last two years. Much of the expense is being incurred to bring a series of new drugs to market that are in Phase III of the development process or have already been submitted to the FDA for approval. R&D expenses increased 22% in 2004 from 2003. This represented 17.5% of revenues.

Research and Development Expenditures *\$ in millions*



Source: Merck 2004 Annual Report

The following is a list of drugs and the conditions targeted in various stages of development in Merck's system as of February 15, 2005.



Source: Merck 2004 Annual Report

There are a few specific drugs of note among those in the research pipeline. Some of those with the largest potential to be a new blockbuster drug, as estimated by both Merck and other outside analysts, are:

Gardasil – This is a vaccine Merck has submitted to the FDA that was 100% effective in preventing the human papillomavirus (HPV), which is the leading cause of cervical

cancer. HPV causes 288,000 deaths worldwide each year. The vaccine would initially be marketed to women between the ages of 9 and 24. That would include 86 million women in the US and the EU. As this is clearly a life-saving vaccine, it is not unreasonable to assume 50% coverage by the vaccine, which would mean approximately 43 million vaccines. Typical vaccines cost around \$40-50, but life-saving vaccines command a much higher price, often upwards of \$200. This would be a huge initial boost for Merck, assuming the drug receives the proper approval. Since it was so overwhelmingly effective in its treatment of HPV with no safety concerns expressed by the FDA, that assumption seems safe. Vaccines, in general, are not the most profitable medications, because they are generally administered just one time, or perhaps two if boosters are required. But new vaccinations are lucrative initially, and they would supply a steady income for Merck going forward. Tom D'Amore with Morningstar estimates that Gardasil will generate \$1bn/year for Merck by 2009.

RotaTeq – RotaTeq is a vaccine to protect against rotavirus. All children in the world are supposedly infected by rotavirus by the age of five. In the US this results in the hospitalization of 50,000 children under the age of five. It also accounts for the deaths of approximately 500,000 children worldwide each year. The financial windfall from RotaTeq should be less than that of Gardasil. Rotavirus has a much lower morbidity rate than HPV in developed countries. As all children get the virus and very few die from it, there would be less call to vaccinate everyone in the US, Japan and Europe. The non-developed world, where most deaths occur, typically has less ability to pay a premium for the vaccine, limiting revenues and profits for Merck. That being the case, though, it is a vaccine for all children and does have the potential for strong worldwide sales.

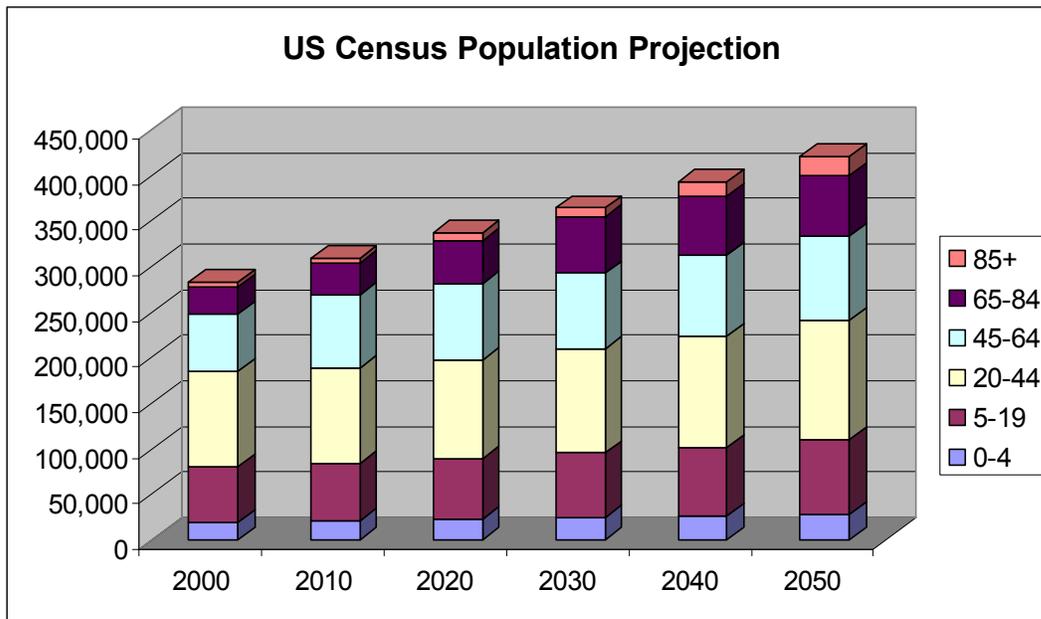
Zostavax – Zostavax is a vaccine that would be used to prevent herpes zoster, a.k.a. shingles, a reactivation of the chickenpox virus. This condition is most commonly found in people over the age of 50 and is said to infect approximately 800,000 people in the United States. The potential market for the vaccine, therefore, can be seen as anyone over 50 years old, of which there are 210 million in the US and the EU. If a person lives to the age of 85, there is a 50% of developing shingles. This would be a one-time vaccine, but it is projected to generate as much as \$150M in revenue by 2009.

Pargluva – Pargluva is a medication to treat type 2 diabetes, which affects around 16 million Americans. This is a joint partnership between Merck and Bristol-Myers Squibb. Analysts predict that the drug could have annual sales ranging from \$500M to \$600M in the coming few years. This was reduced from closer to \$1bn because of another type 2 diabetes drug Merck has in development that has less cardio risk.⁶ This other drug is Sitagliptin, which should be submitted to the FDA in 2006.

⁶ Aaron Smith, "Diabetes Drug Closer to FDA Nod", CNN Money. Available at: <http://money.cnn.com/2005/10/18/news/fortune500/pargluva/>

Demographics

Ultimately revenues for Merck come from individuals buying its drugs. The bigger the population, the more people there are to buy Merck's products. The vast majority of Merck's sales are in the US, Europe and Japan. The US is expected to grow at around 0.9% for the next decade, slowing somewhat after that to 0.7 or 0.8% through 2050.⁷ Japan and Europe are expected to grow even more slowly, if at all.⁸ It would, therefore, be fair to assume very limited total population growth, which would have little to no impact on earnings for Merck. Other areas of the world are growing at a much greater pace, but they represent such a small portion of Merck's sales that the growth is inconsequential.



Source: U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," <http://www.census.gov/ipc/www/usinterimproj/> (population in thousands)

The changing demographics of the population provide a much bigger boost to Merck. From 2000 to 2010 in the US, the population 45 years old and older was forecast to increase by nearly 24 million, from 97 million to 121 million⁹, while the population under 45 was expected to increase by only 3 million. As of 2000, the amount spent on prescription drugs per capita by those 65 and over was more than \$1,100. For those under 65 it was only \$500.¹⁰ The difference could only have increased over the last five years, as life expectancy continues to increase and people need to take a larger number of drugs as they age.

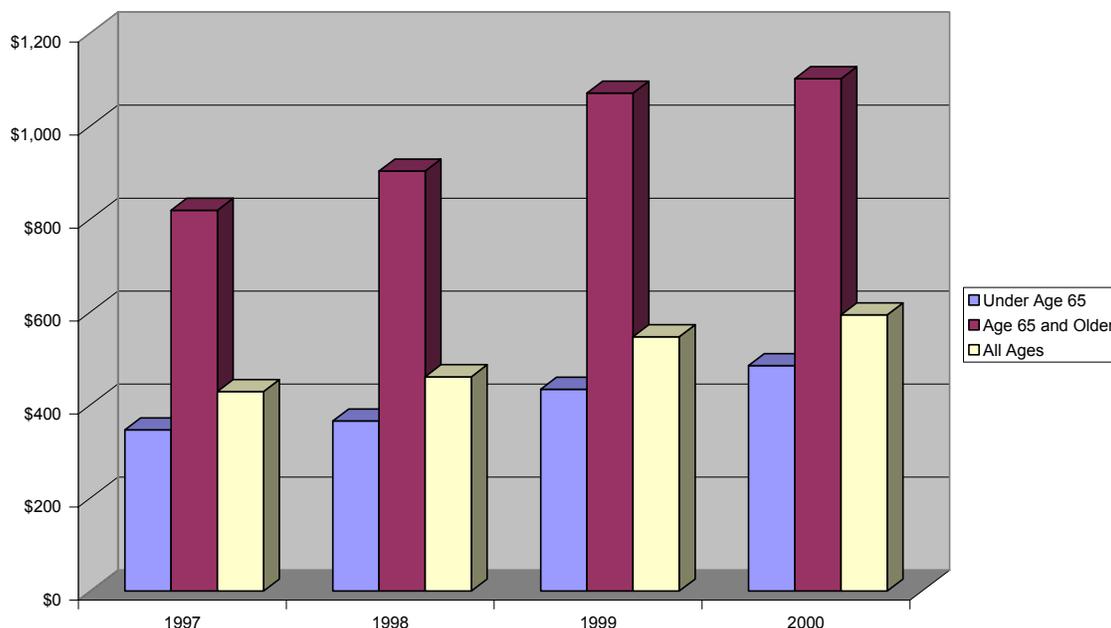
⁷ U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," <http://www.census.gov/ipc/www/usinterimproj/>

⁸ "Economic Intelligence Unit – Country Data", <http://countrydata.bvdep.com/cgi/template.dll?product=101&user=ipaddress>

⁹ U.S. Census Bureau, 2004.

¹⁰ Source: Center for Financing, Access, and Cost Trends, AHRQ, Medical Expenditure Panel Survey - Household Component, 1997-2000 (US Dept. of Health and Human Services)

Average Expenditure for Outpatient Prescription Drugs for Those With a Purchase by Age



Source: Center for Financing, Access, and Cost Trends, AHRQ, Medical Expenditure Panel Survey - Household Component, 1997-2000 (US Dept. of Health and Human Services)

It is the large increase in the older population that is driving prescription drug expenses to grow at nearly 10% a year. Normally Merck would be experiencing the same gains as the industry at an average of around 10%, but the loss of patent protection on key drugs is going to drastically slow revenue growth in the short term, while after five years, when Merck has replenished its drug portfolio, revenue growth should increase in line with industry averages once again.

Medicare Modernization Act of 2003

The Medicare Modernization Act of 2003 (MMA) made significant changes in Medicare, which will have a significant impact going forward. The government will essentially be subsidizing increased drug prices. The law is estimated to bring an additional \$250+bn in revenues to the drug companies.¹¹ Per Yahoo! Finance, the top 24 pharmaceutical companies have a market cap of \$2,406.9bn. Merck has a market cap of \$57.5bn, giving Merck about 2.4% of the industry. Thus, as a rough estimate of the upside to Merck, 2.4% of \$250bn is approximately \$6bn in additional revenues for Merck each year by 2010, due to the MMA. This would represent nearly an 18% increase in sales, which

¹¹ Ganz, Melissa. "The Medicare Prescription Drug, Improvement, & Modernization Act of 2003: Are We Playing the Lottery With Health Care Reform?" Available at <http://www.law.duke.edu/journals/dltr/articles/2004dltr0011.html>

would smooth out the projected revenue growth by increasing revenue steadily through 2010, the time during which Merck is expecting to lose revenue due to patent expiration. After 2010, when many of the new promising drugs have fully entered the market, revenue growth due to the MMA would be minimal.

Partnerships and Joint Ventures

A final boost to Merck's revenues comes in the form of joint ventures and partnerships. Merck brought in over \$1.5bn in partnership revenues in each of the last three years, primarily from its agreement with AstraZeneca regarding the Nexium and Prilosec products. These revenues are protected until 2014 and 2018, respectively, and will be a continuing strong source of income for Merck. Over its full range of partnerships, Merck booked over \$2.5bn in revenues using the equity method of accounting. The company is actively expanding its partnerships with both small firms and major pharmaceutical companies. This is a positive move for the company, because it adds immediate diversification to its revenues. In addition, it makes Merck less reliant on developing drugs exclusively within the company. With the JV and partnership method, the company can buy up a promising product, or enter into a partnership agreement. This has some immediate up front costs, but it is also more likely to produce drugs that will bring in strong sales, based on results demonstrated pre-partnership. These revenues should continue to increase in the future.

Vioxx Litigation

As noted above, Merck product Vioxx has become the subject of significant litigation. For the reasons set forth below, however, we believe that the market has overreacted to the potential financial impact of this litigation. We therefore calculate a reasonable fiscal impact for Vioxx litigation, which we then subtract from our valuation.

A Texas jury recently awarded the surviving spouse of a Vioxx user damages in the amount of \$253 million.¹² Most observers believe that this award will be reduced, due to Texas's statute capping punitive damages, to \$26 million¹³, and our own analysis concurs with this reasoning.¹⁴ We therefore take as a reasonable worst-case scenario the possibility that all 5,000 outstanding lawsuits result in damages of \$26 million, leading to total liability of \$130 billion.¹⁵ This would, of course, force the company into bankruptcy.

¹² Reuters, "Ex-Merck Official Says Doctors Not Shown Vioxx Data," 9/27/05.

¹³ *Id.*

¹⁴ Analyst Peter Lavalley is an attorney and an inactive member of the District of Columbia and New Hampshire Bar Associations, but he is not licensed to practice in Texas or Connecticut.

¹⁵ While other states may not share Texas's punitive damages cap, the actual damages amount was still extraordinary and extremely unlikely to be matched in all suits. We therefore think the \$26mm figure, spread across the gamut of claims, is a reasonable worst-case scenario.

Our analysis, however, points to a number of reasons that this scenario is unlikely to occur. First of all, neither plaintiffs nor their attorneys wish to see the company forced into bankruptcy, where their claims could well be reduced or eliminated. Secondly, a leading Vioxx plaintiffs' attorney's ads suggest that total damages are "expected to reach \$18,000,000,000!"¹⁶ If even plaintiffs' attorneys, who have every incentive to exaggerate potential claims in an effort to recruit plaintiffs, estimate the total damages at \$18 billion, we find it unlikely that damages would exceed that amount by a factor of 10.

A more likely scenario, in our analysis, is analogous to the extensive litigation experienced by Wyeth Labs over the diet drug combination known as phen-fen. Similar to the concerns about Vioxx, phen-fen is believed to cause heart problems and to have led to the death of some users. Moreover, while Merck faces some 5,000 claims over Vioxx, Wyeth has settled a class action and faces some 50,000 additional claims of plaintiffs who have opted out of the settlement.¹⁷ (Many of those claims have been withdrawn in anticipation of settlement.) Since 1999, Wyeth parent American Home Products has paid more than \$16 billion to settle phen-fen claims.¹⁸ The company's audit review has found that approximately 37% of claims will receive some compensation from a \$3.9 billion settlement fund.¹⁹

Vioxx claims, despite the unprecedented publicity surrounding the drug's potential problems and the Texas verdict, number nowhere near the number involving phen-fen. The time to file additional claims is waning, according to the statutes of limitations in various jurisdictions. Therefore, we find it unlikely that Vioxx liability will reach anything like the \$21.1 billion Wyeth expects to spend to settle phen-fen claims.²⁰

There are also, of course, rosier scenarios than the phen-fen analogy that could materialize. In addition, the company has \$630 million in product-liability insurance related to the Vioxx lawsuits, according to its 2004 Annual Report, reducing potential out-of-pocket expenses.

For all of these reasons, we believe a figure of \$20 billion in liability from Vioxx is an extremely conservative estimate.

As illustrated by the sharp drop in the chart below, Merck's share price fell \$11.48 on September 30, 2004, the day the company announced a voluntary withdrawal of Vioxx. With over 2.2 billion shares outstanding, that translates into a market-cap loss of \$25.6 billion. On August 19, 2005, the day a Texas jury found Merck liable for the death of a Vioxx user, the company's market cap fell more than \$5bn. As of the date of this report, the stock has fallen a total of \$16.66 since the Vioxx withdrawal was announced, amounting to a decrease in market capitalization of nearly \$37bn.

¹⁶ Source: online ads for www.vioxx-center.com.

¹⁷ "Mass Layoffs at Porzio Follow Phen-Fen Finale," *New Jersey Law Journal*, July 25, 2005.

¹⁸ "Phen-Fen's Hazards Emerge Anew," *Business Wire*, March 22, 2004.

¹⁹ Source: Wyeth Q3 2003 earnings call.

²⁰ "Weight-Loss Drugs Based on Biased Science Did More Harm Than Good," *Duluth News Tribune*, 7/13/05.



Discounted Cash Flow Analysis

We performed a valuation on the company using a discounted cash-flow analysis. Based on our initial determination that Merck is currently undervalued, we revisited our assumptions and projections to ensure that they were reasonable conservative, to ensure that optimistic assumptions did not color our rating. This analysis confirmed our Buy recommendation.

Assumptions

Vioxx

Merck's 2004 annual report indicates that the company's revenues were impacted by Vioxx in two ways: Sales were negatively impacted \$491.6 million for expected returns; and revenues were negatively impacted by \$700-750 million because the drug was withdrawn for the fourth quarter. To arrive at an adjusted 2004 revenue baseline, we accordingly added back the \$491.6 million and subtracted three times \$725 million to remove Vioxx revenue reflected in Q1-Q3. (We consider this a conservative adjustment, because Vioxx revenues had been growing, so reducing the first three quarters by anticipated fourth quarter revenues errs on the side of caution.)

Cost of Debt

Dividing interest expense by average debt over the last several years resulted in an unreasonably low average cost of debt (2.67%). As an alternative method of pricing debt, therefore, we adjusted the risk free rate by the average spread on AA- debt, Merck's current rating, to arrive at a rate of 4.06%, which we used in calculating the firm's cost of capital. In any event, the company's debt load, like that of many pharmaceutical manufacturers, is so small as to not materially impact the equity valuation.

Beta

Likely due to company-specific fluctuations in Merck's price in recent years – particularly from the Vioxx impact and the spin-off of Medco Health in 2003 – we were unable to get meaningful results from a Beta regression, even attempting to adjust for these events. We therefore used the industry unlevered Beta of 1.21.²¹

Tax Rate

Merck has had an advantageous tax rate for several years. We averaged the firm's tax expense divided by its pre-tax income over the last five years to obtain a rate of 28.3%.

Growth Rate

For our terminal growth rate, we used a common estimate of long-term GDP growth of 3.0%. We initially chose 12% as a conservative short-term growth rate, based on the firm's historic growth rate over recent years. To ensure conservatism and to reflect some of the uncertainty reflecting in valuing a pipeline of future medications, we adjusted that to 7.5%, although the included sensitivity analysis gives a range of possible growth rates.

Market Risk Premium

We used a traditional MRP of 7%, although we also performed a sensitivity analysis to evaluate the effect of adjusting this rate. The 7% is again a conservative choice.

Basis for Recommendation

We took the recent closing price of \$26.18 and added 10%, to determine a reasonable point at which our valuation share price would indicate a buy. This gave us a share price of \$28.80. We then added \$20 billion in market value to the market capitalization, to calculate a price at which our valuation would indicate a buy, assuming \$20 billion in Vioxx liability, resulting in a share price of \$37.82, which was used in our sensitivity analyses. Our DCF valuation of \$46.85, or \$37.09 after the projected Vioxx liabilities, therefore, supports our Buy recommendation.

²¹ Source: Prof. Damodaran, NYU Stern School of Business
(http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html)

Yrend 31 Dec (US\$m)	2004	Adj. 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Revenue	23,430	21,747	23,378	25,131	27,016	29,042	31,220	33,562	36,079	38,785	41,694	44,612	47,289	49,654	51,640	53,189	54,785
% change			7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.0%	6.0%	5.0%	4.0%	3.0%	3.0%
Op. Expenses	13,797	14,570	15,663	16,838	18,101	19,458	20,918	22,486	24,173	25,986	27,935	29,890	31,684	33,268	34,599	35,637	36,706
% change			7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.0%	6.0%	5.0%	4.0%	3.0%	3.0%
% of Sales	58.9%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%	67.0%
Interest Income (Expense)	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Income	1,323	1,323	894	894	894	894	894	894	894	894	894	894	894	894	894	894	894
WC	1,731	1,731	2,321	2,495	2,683	2,884	3,100	3,333	3,583	3,851	4,140	4,430	4,696	4,931	5,128	5,282	5,440
EBIT (operating inc)	9,633	7,176	7,715	8,293	8,915	9,584	10,303	11,075	11,906	12,799	13,759	14,722	15,605	16,386	17,041	17,552	18,079
Taxes	(2,161.10)	(2,405.18)	(2,436.18)	(2,599.91)	(2,775.92)	(2,965.13)	(3,168.53)	(3,387.18)	(3,622.24)	(3,874.92)	(4,146.55)	(4,419.10)	(4,669.05)	(4,889.85)	(5,075.32)	(5,219.99)	(5,368.99)
after-tax EBIT or NOPAT	8,795.40	6,094.46	6,172.99	6,587.86	7,033.85	7,513.28	8,028.68	8,582.73	9,178.33	9,818.60	10,506.89	11,197.48	11,830.84	12,390.32	12,860.28	13,226.84	13,604.41
Adjustments																	
+ Depreciation & amort.	1,643	1,643	1,765.90	1,898.35	2,040.72	2,193.78	2,358.31	2,535.18	2,725.32	2,929.72	3,149.45	3,369.91	3,572.10	3,750.71	3,900.74	4,017.76	4,138.29
- Changes in WC	226.00	226.00	(590.37)	(174.10)	(187.16)	(201.20)	(216.29)	(232.51)	(249.95)	(268.69)	(288.85)	(289.81)	(265.80)	(234.79)	(197.22)	(153.83)	(158.45)
- Capex	(545.00)	(545.00)	(1,344.60)	(1,445.45)	(1,553.86)	(1,670.40)	(1,795.68)	(1,930.35)	(2,075.13)	(2,230.76)	(2,398.07)	(2,565.94)	(2,719.89)	(2,855.89)	(2,970.12)	(3,059.23)	(3,151.00)
FCF			6,003.92	6,866.65	7,333.55	7,835.46	8,375.02	8,955.05	9,578.57	10,248.86	10,969.42	11,711.64	12,417.26	13,050.35	13,593.67	14,031.54	14,433.25
Present value factor			1.11	1.23	1.36	1.51	1.68	1.86	2.07	2.29	2.54	2.82	3.13	3.47	3.85	4.27	4.74
Present value of FCF			5,412.64	5,580.77	5,373.26	5,175.63	4,987.22	4,807.46	4,635.78	4,471.70	4,314.74	4,153.02	3,969.60	3,761.12	3,531.88	3,286.62	3,047.78
																	next year's FCF
																	14,866.25
																	terminal value
																	187,611.07
																	PV of terminal value
																	39,616.61
																	PV of D+E as of beginning of 2003 (=sum of PV of annual FCF + terminal value)
																	100,713.19
																	less debt
																	(4692.00)
																	PV of E
																	96,021.19
																	# of shares
																	2,217,585
																	Price per share as of beginning of 2005
																	43.30
																	Price per share as of 9/30/05
																	46.85

Beta Sensitivity	
	\$46.85
0.9	64.94
1.0	57.90
1.1	52.11
1.2	47.29
1.3	43.20
1.4	39.69
1.5	36.65
1.6	34.00
1.7	31.65
1.8	29.58
1.9	27.72
2.0	26.05

Vioxx Lawsuit Sensitivity	
Total Cost	Price per Share
\$0	\$46.85
\$5bn	44.59
\$10bn	42.34
\$15bn	40.08
\$20bn	37.83
\$25bn	35.57
\$30bn	33.32
\$35bn	31.06
\$40bn	28.81
\$45bn	26.56
\$50bn	24.30
\$55bn	22.05

Growth Rate Sensitivity	
	\$46.85
4.0%	36.85
5.0%	39.47
6.0%	42.27
8.0%	48.48
7.0%	45.27
8.0%	48.48
9.0%	51.91
10.0%	55.59
11.0%	59.51
12.0%	63.70
13.0%	68.18
14.0%	72.95

MRP Sensitivity	
	\$46.85
3.0%	115.70
3.5%	98.82
4.0%	86.00
4.5%	75.94
5.0%	67.84
5.5%	61.19
6.0%	55.62
6.5%	50.90
7.0%	46.85
7.5%	43.33
8.0%	40.26
8.5%	37.54

Growth Rate, Beta Sensitivity											
\$46.85	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%
0.9	\$43.90	47.14	50.62	54.36	58.37	62.68	67.29	72.23	77.52	83.18	89.24
1.0	39.32	42.19	45.27	48.57	52.11	55.90	59.96	64.31	68.97	73.95	79.28
1.1	35.56	38.12	40.87	43.81	46.96	50.34	53.95	57.82	61.96	66.39	71.12
1.2	32.41	34.71	37.18	39.83	42.66	45.69	48.94	52.41	56.12	60.08	64.32
1.3	29.73	31.82	34.06	36.45	39.01	41.76	44.69	47.82	51.17	54.75	58.57
1.4	27.43	29.34	31.37	33.56	35.89	38.38	41.05	43.89	46.93	50.18	53.65
1.5	25.43	27.18	29.05	31.04	33.18	35.46	37.89	40.49	43.27	46.23	49.39
1.6	23.68	25.29	27.00	28.84	30.80	32.90	35.13	37.52	40.07	42.78	45.68
1.7	22.13	23.61	25.20	26.90	28.71	30.64	32.70	34.90	37.25	39.75	42.41
1.8	20.75	22.13	23.60	25.17	26.85	28.64	30.55	32.58	34.75	37.06	39.52
1.9	19.51	20.79	22.16	23.63	25.18	26.85	28.62	30.51	32.52	34.66	36.94
2.0	18.39	19.59	20.87	22.24	23.69	25.24	26.89	28.65	30.52	32.51	34.63

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