Global Asset Allocation

Assignment #1:

Investigating “Innovation Factors” for Growth

February 27, 2006

The Allocators

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1. Objective

After falling out of favor during the post-bubble downturn, articles have surfaced recently in the popular business press describing a shift to “New Economy” drivers of macroeconomic growth. Specifically, BusinessWeek ran a cover story on this topic in its February 13, 2006 issue entitled “Why The Economy Is Stronger than You Think” that began with the following lead-off in boldface type: “In a knowledge-based world, the traditional measures don’t tell the story. Intangibles like R&D are tracked poorly, if at all. Factor them in and everything changes.” Similarly, the February 20, 2006 volume of John Maudlin’s Outside the Box newsletter published an article titled “The Innovation Boom.” Both articles contained similar claims of “innovation factors” driving the new knowledge based economy. Therefore, this study explores whether “innovation factors” can identify excess returns. In particular, we will attempt to quantify the predictive ability of research and development expenditures, investment in intangible assets, and investments in human capital.

1.1. Summary of “Why The Economy Is A Lot Stronger Than You Think”

The BusinessWeek article asserts that globalization, outsourcing, and the emphasis on innovation and creativity are forcing businesses to shift from investment in tangible assets to intangible assets (Appendix 1). It goes on to describe traditional macroeconomic drivers and focuses on capital spending. It describes the metrics used to measure corporate performance in the capital spending paradigm as return on assets, capital expenditures, and property, plant and equipment. The author recognizes the necessity of these metrics to evaluate and industrial-based economy and the companies within it, but then counters with the claim that U.S. businesses are presently investing more in “knowledge spending”. As such, the author claims that it is more appropriate to use metrics that are more applicable to this post-industrial economy, such as return on intangible assets, research and development expenditures, and investments in human capital. According to BusinessWeek, investment in intangibles such as product development and training is critical for long-term profitability, but is not counted in GDP. It argues that unmeasured intangibles would have increased the $1,139 billion average measure of physical capital and software for 2000-2003 by another $977 billion. Our objective is to determine whether these factors have actually been driving significant asset returns.
1.2. Summary of “The Innovation Boom”

Steven Vannelli claims that less capital is being invested today in the expansion of physical capacity and more capital is being invested in the expansion of intellectual capacity (Exhibit 2). He presents comparisons of research and development expenses relative to capital expenditure for a number of companies, including: Pfizer, Johnson and Johnson, Microsoft, Oracle, Boeing, United Technologies, DuPont, Ford, and Proctor and Gamble.

Based upon the comparisons, the author claims that investments in research and development have grown much faster than capital expenditures, and that the rate of increase in R&D spending is still accelerating in some cases. He points to the early 1990s as the beginning of the divergence between spending trends for R&D and CapEx and notes the correlation with the widening US trade deficit. Further, he asserts that in contrast to capital expenditures, spending on R&D was unaffected by recessions, mid-cycle slowdowns or financial crises. Finally, he credits corporate investment in research and development with the strong productivity gains witnessed recently. Therefore, we determined to test the predictive power of research and development expenses on asset returns.

2. Methodology

In order to quantify the “innovation” described in the articles, we first had to identify suitable “innovation factors”. We then generated the stock screens and executed an in-sample alpha test. Based upon our results, we evaluated each factor and developed a scoring system. After applying the scoring system to the in-sample data and reviewing the results, we conducted an out-of-sample alpha test using the scoring system.

2.1. Identified “Innovation Factors”

In order to evaluate the claims made by both articles, we first identified suitable “innovation factors”. We began by comparing return on assets: ROIA versus ROA. We also designed factors to measure investments in information assets and the effectiveness of these investments. Finally, we looked at productivity measures. We also attempted to measure investment in human capital, but were unable to find suitable sources of data for this factor.

Return on Assets

Based upon the discussion of intangible assets in both articles, we decided to compare return on intangible assets (ROIA) as the “innovation factor” with return on assets (ROA). We measured each of these factors as follows:

- Return on Intangible Assets (ROIA)
  - Parameters:
    - Quarterly Net Income Before Extra-ordinary Items, After Dividends
      - CQ_NET_INC_XDIVS(0,R10)
    - Quarterly Intangible Assets

- Return on Assts (ROA)
  - Parameters:
    - Quarterly Net Income Before Extra-ordinary Items, After Dividends
      - CQ_NET_INC_XDIVS(0,R10)
    - Quarterly Average Total Assets
      - CQ_ASSETS_AVG(RF 0 L45D)
  - Calculation:
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- ROA = Quarterly Net Income Before Extra-ordinary Items, After Dividends divided by Quarterly Average Total Assets
- ROA = CQ_NET_INC_XDIVS(0,R10) / CQ_ASSETS_AVG(RF 0 L45D)

Investment in Information Assets
In response to “The Innovation Boom”, we designed a factor to capture the relative investment in research and development versus traditional capital expenditures.

- R&D to CapEx Ratio Lag 1YR
  - Parameters:
    - R&D Expense, Lagged 1 Year
      - CA_RESEARCH_EXP(0 L410D)
    - Capital Expenditure, Lagged 1 Year
      - CA_CAP_EXPEND_CF(0 L410D)
  - Calculation:
    - R&D to CapEx = R&D Expense divided by R&D Expense plus CapEx
    - R&D to CapEx = CA_RESEARCH_EXP(0 L410D) / [CA_RESEARCH_EXP(0 L410D) + CA_CAP_EXPEND_CF(0 L410D)]

Effectiveness of Investments in Information Assets:
We hypothesized that the sheer size of a company’s investment in intangible assets might not predict excess returns. Therefore, we developed a factor that attempted to quantify the effectiveness of the company’s investments by measuring sales versus advertising expense, which is a commonly reported intangible expense.

- Sales/Advertising Ratio
  - Parameters:
    - Annual Sales
      - CA_SALES(0 L45D)
    - Advertising Expense
      - CA_ADVERTISING_EXP(0 L45D)
  - Calculation:
    - Sales to Advertising = Annual Sales divided by Advertising Expense
    - Sales to Advertising = CA_SALES(0 L45D) / CA_ADVERTISING_EXP(0 L45D)

Productivity:
The underlying theme of most “innovation economy” arguments is productivity growth. Therefore, we attempted to determine whether the most productive companies also deliver excess returns. In order to measure productivity, we divided five year sales growth by the current number of employees.

- Sales Growth 5YR per Employee
  - Parameters:
    - Sales Growth Five Years Rolling
      - CA_SALES_5YGR(0 L45D)
    - Employees
      - CA_EMPLOYEES(0 L45D)
  - Calculation:
    - Sales Growth per Employee = Sales Growth Five Years Rolling divided by Employees
    - Sales Growth per Employee = CA_SALES_5YGR(0 L45D) / CA_EMPLOYEES(0 L45D)
Investments in Human Capital:
We also sought to measure investments that companies were making in order to improve productivity. Specifically, based upon our sales per employee paradigm, we were interested in evaluating spending on training employees. Unfortunately, this data is not available, which prevented us from including this factor.

2.2. Screening and Alpha-Test Setup
We set our screening parameters to limit the universe to S&P 500 securities and to rebalance the portfolios monthly. The in-sample period is 1996-2002, which we choose as the beginning of the “new economy”. The out-of-sample period is 2003-2005, which should still reflect the changing macroeconomic drivers, but follows the period of “irrational exuberance” in the market. Finally, we performed quintile analysis for 25 factors, comparing monthly returns against the S&P 500 benchmark.

2.3. Scoring System
We created our scoring system by first determining which factors to include. Factors were accepted or rejected based upon quintile analysis of total returns and evaluating year to year performance. We then determined a score for relevant quintiles and applied the scoring system using Alpha-Tester.

Return on Assets
Based upon the quintile analysis of ROIA and ROA, we selected ROA as the preferred metric. ROIA demonstrated an inconsistent linear relationship, while ROA had a promising linear relationship with a significant spread of 1.53% between quintiles 1 and 5.

ROIA:

![ROIA Chart](image-url)
Further, ROA was ultimately accepted as a factor used in our scoring system because it proved to be a solid indicator of performance in 4 out of 7 years for both quintiles 1 and 5.

<table>
<thead>
<tr>
<th>Annual Returns</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Market</th>
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<tr>
<td>1996</td>
<td>51.24%</td>
<td>29.15%</td>
<td>23.70%</td>
<td>32.31%</td>
<td>17.48%</td>
<td>26.27%</td>
</tr>
<tr>
<td>1997</td>
<td>41.74%</td>
<td>30.47%</td>
<td>32.63%</td>
<td>40.00%</td>
<td>27.19%</td>
<td>26.90%</td>
</tr>
<tr>
<td>1998</td>
<td>55.39%</td>
<td>22.78%</td>
<td>24.41%</td>
<td>18.55%</td>
<td>19.57%</td>
<td>32.49%</td>
</tr>
<tr>
<td>1999</td>
<td>59.98%</td>
<td>8.27%</td>
<td>3.29%</td>
<td>6.76%</td>
<td>9.61%</td>
<td>10.35%</td>
</tr>
<tr>
<td>2000</td>
<td>29.08%</td>
<td>30.97%</td>
<td>34.94%</td>
<td>40.43%</td>
<td>30.10%</td>
<td>-0.90%</td>
</tr>
<tr>
<td>2001</td>
<td>-0.30%</td>
<td>8.04%</td>
<td>3.02%</td>
<td>4.37%</td>
<td>-2.82%</td>
<td>-16.14%</td>
</tr>
<tr>
<td>2002</td>
<td>-11.99%</td>
<td>-6.91%</td>
<td>-12.90%</td>
<td>-13.15%</td>
<td>-30.47%</td>
<td>-23.01%</td>
</tr>
</tbody>
</table>

**Investment in Information Assets**
Sales Growth 5YR per Employee was initially accepted as a factor for the scoring system based upon the preliminary results of our quintile analysis. The factor demonstrates a promising linear relationship between the quintiles (with the exception of Quintile 5, which we believe is skewed by capital intensive companies in traditional industries that invest little or nothing in R&D) and has a 0.93% spread between quintiles 1 and 5. Unfortunately, after further analysis, the factor failed to be a consistent predictor. Quintile 1 had the best return in three of the first four years, but Quintile 5 exhibited the best returns in two of the last three years. Further, during the last three years, Quintile 1 delivered negative returns in two of the three years and was the worst performer the last year. While the factor did appear to explain returns during the dot com bubble period, it appeared that investors retreated from the factor following the market correction. Therefore, we eliminated this factor from our scoring system.
Effectiveness of Investments in Information Assets
Sales to Advertising was rejected as a factor based upon quintile analysis. The quintiles demonstrated no linear relationship, and Quintile 1 only delivered maximum returns in 2 of 7 years.
Productivity

Productivity, as measured by five year sales growth per employee, was accepted as a factor based upon quintile analysis. The factor performs well with a significant linear relationship between its quintiles and a 1.23% spread between Quintiles 1 and 5. In addition, the predictive power of the factor is promising; Quintile 1 delivered the maximum return in five of the seven years. Finally, Quintile 1 outperformed the market in each of the seven years.
Score Weights
Based upon the performance of each quintile across the seven year in-sample period, we determined the following scoring weights:

- Factor 1: ROA(1) = +5
- Factor 2: ROA(5) = -4
- Factor 3: SalesGrwth/Emp(1) = +4
- Factor 4: SalesGrwth/Emp(5) = -2

We modified our initial screen to incorporate a “Total Score” based upon a sorting of securities each month over the in-sample period and reran Alpha Tester to capture monthly returns versus the S&P 500.

3. In-Sample Analysis

The model returns incorporating our “Total Score” were very promising when analyzed in-sample. The quintiles demonstrated a solid linear relationship with a significant spread between Quintiles 1 and 5 of 1.70%.
Further, the model appeared to generate significant alpha for Quintile 1 – 1.74% over the in-sample period. In addition, Quintile 1’s beta was 1.09, which we considered to be moderate additional beta risk.
4. Out-of-Sample Analysis

Unfortunately, our “Total Score” model did not perform nearly as well during the out-of-sample period of 2003-2005. Quintile analysis of the model resulted in a poor linear relationship between the quintiles. While Quintile 1 did outperform the market in each of the three years, it failed to outperform all other quintiles in any of the three years tested. Therefore, we believe the data indicates that the model is not useful for a long-short strategy.
However, after reviewing our results carefully, we noticed that all five quintiles outperformed the market. Therefore, we believe our use of an equal-weight strategy is skewing our results against the value-weighted S&P 500 benchmark.

Further, the model did not return substantial alpha to compensate for the additional beta risk. Quintile 1 returned 0.66 alpha and a beta of 1.12. However, the model as a whole returned an alpha of 0.34 for a beta of 1.25.
5. Closing Thoughts

Based upon our analysis, we concluded that “Innovation” factors are intriguing, but don’t seem to be a compelling driver of above-average returns. We believe that new economic indicators such as “innovation” factors are likely to impact macro economic growth, but have less predictive power at the individual asset level. However, additional data sources are necessary to evaluate innovation factors properly, especially in areas of human capital. Unfortunately, these data sources are not likely to be available in the near future. In order to comprehensively evaluate investments in intangible assets, reporting regulations would need to be updated to require companies to disclose the data more regularly and thoroughly. As *BusinessWeek* suggests, changes to macroeconomic metrics used to measure the broader economy will probably be slow in coming.

We were able to perform some additional analysis of the “innovation factors” by industry, which is not presented in this report. Initial results were promising and deserve further investigation. We hypothesize that the model is more likely to show promise in information-based industries. We also suspect that the inclusion of traditional, capital intensive industries and financials may be clouding results.

Finally, if we were to perform this analysis again, we would analyze the impact of our equal-weight strategy when compared against a value-weighted benchmark. Further, we would explore the value of pursuing a long-only strategy using the “innovation factors” versus a long-short strategy on model performance. Lastly, we would investigate the performance of the model within a broader universe than the S&P 500, in order to include more young, technology-based enterprises.
6. Appendix 1: BusinessWeek: Why The Economy Is A Lot Stronger Than You Think

FEBRUARY 13, 2006

COVER STORY
By Michael Mandel, with Steve Hamm in New York and Christopher J. Farrell in St. Paul, Minn.

Why The Economy Is A Lot Stronger Than You Think
In a knowledge-based world, the traditional measures don’t tell the story. Intangibles like R&D are tracked poorly, if at all. Factor them in and everything changes.

You read this magazine religiously, watch CNBC while dressing for work, scan the Web for economic reports. You’ve heard, over and over, about the underlying problems with the U.S. economy -- the paltry investment rate, the yawning current account deficit, the pathetic amount Americans salt away. And you know what the experts are saying: that the U.S. faces a perilous economic future unless we cut back on spending and change our profligate ways.

But what if we told you that the doomsayers, while not definitively wrong, aren’t seeing the whole picture? What if we told you that businesses are investing about $1 trillion a year more than the official numbers show? Or that the savings rate, far from being negative, is actually positive? Or, for that matter, that our deficit with the rest of the world is much smaller than advertised, and that gross domestic product may be growing faster than the latest gloomy numbers show? You’d be pretty surprised, wouldn’t you?

Well, don’t be. Because the economy you thought you knew -- the one all those government statistics purport to measure and make rational and understandable -- actually may be on a stronger footing than you think. Then again, it could be much more volatile than before, with bigger booms and deeper busts. If true, that has major implications for policymakers -- not least Ben Bernanke, who on Feb. 1 succeeded Alan Greenspan as chairman of the Federal Reserve.

Everyone knows the U.S. is well down the road to becoming a knowledge economy, one driven by ideas and innovation. What you may not realize is that the government’s decades-old system of number collection and crunching captures investments in equipment, buildings, and software, but for the most part misses the growing portion of GDP that is generating the cool, game-changing ideas. "As we’ve become a more knowledge-based economy," says University of Maryland economist Charles R. Hulten, "our statistics have not shifted to capture the effects."

The statistical wizards at the Bureau of Economic Analysis in Washington can whip up a spreadsheet showing how much the railroads spend on furniture ($39 million in 2004, to be exact). But they have no way of tracking the billions of dollars companies spend each year on innovation and product design, brand-building, employee training, or any of the other intangible investments required to compete in today’s global economy. That means that the resources put into creating such world-beating innovations as the anticancer drug Avastin, inhaled insulin, Starbuck’s (SBUX), exchange-traded funds, and yes, even the iPod, don’t show up in the official numbers.

Now, a generation of economists who came of professional age watching the dot-com boom and bust are trying to get a grip on this shadow economy: People like Carol A. Corrado and Daniel E. Sichel of the Federal Reserve Board, who, along with Hulten, figured out that businesses are spending much more on future-oriented investments than widely believed. In a way, these economists are disciples of Greenspan, who understood earlier than most that the conventional numbers don’t capture the emerging knowledge economy.
Greenspan was continually digging into arcane factoids he hoped would give him a better insight into what was going on under the hood of the U.S. economy. And Bernanke seems to understand the importance of doing the same. In a speech last year, he said that intangible investments "appear to be quantitatively important." As a result, Bernanke noted, "aggregate saving and investment may be significantly understated in the U.S. official statistics."

BEYOND WIDGETS
As Greenspan would be the first to tell you, it's a lot easier counting how many widgets the nation produces in a year than quantifying the creation and marketing of knowledge. After all, we're talking about intangibles: brand equity, the development of talent, the export of best practices.

This stuff is hard to measure, but to ignore it is to miss what the economy is telling us. And to miss that is to increase the likelihood of committing policy blunders. Including these intangible investments could provide a better picture of the economy, one that offers more advance warning of recessions, slippage in our ability to innovate, and other nasty surprises.

To understand why the government measures the economy the way it does, it helps to go back in time to the 1930s. The Great Depression had the nation in a death grip, and government planners and politicians lacked the tools to answer the big question of the day: Was the economy getting better or worse? To find out, the Commerce Dept. brought in economist Simon Kuznets, then at the National Bureau of Economic Research, to calculate for the first time the nation's income and output -- the purchasing power and production of the U.S. economy. Setting such a benchmark would allow the government to figure out if the economy was growing or shrinking.

Working with handwritten data, Kuznets and a small group of fellow economists began counting tangible things like machines and buildings as long-term investments. It made sense, since this was still the Industrial Age. And such calculations came in handy during World War II, when the Roosevelt Administration needed a fix on the nation's capacity to grind out tanks, ships, and planes.

A BREAK WITH THE PAST
Kuznets' work set the tone for the rest of the century, not to mention helping win him the Nobel prize in Economics in 1971. Machines and buildings were counted as future-oriented investment, but spending on education, training, and R&D was not. No attempt was made to judge the social utility of expenditures. For example, the $6 million cost of building the Flamingo Hotel, the Las Vegas casino opened by Bugsy Siegel in 1946, was tallied as an investment. But AT&T's funding of Bell Labs, where the transistor was invented around the same time, wasn't even included in GDP. Kuznets himself acknowledged the limitations of his system, yet it stayed basically the same for most of the postwar period.

By the early '90s, Greenspan was becoming increasingly frustrated by the official numbers' inability to explain a rapidly evolving economy. In 1996 and 1997 he refused to accept conventional data telling him that productivity growth was falling in much of the service sector, noting -- correctly, as it turns out -- that "this pattern is highly unlikely." He also pointed out that the official numbers for consumer inflation were too high.

At the Washington offices of the BEA, J. Steven Landefeld, who became director in 1995, felt pressure to include numbers that better reflected the knowledge economy. Landefeld isn't a rash fellow, and the pace of change at the BEA, while quick for a statistical agency, would be called deliberate by most. But in 1999 -- six decades after Kuznets laid the groundwork for calculating GDP -- Landefeld and the BEA decided to break with the past.

The BEA started treating business spending on software as a long-lived investment. The decision was overdue. Companies were spending more than $150 billion annually on software, far more than the $100 billion for computer hardware. And the software often stayed in use longer than the hardware. The fact that economists could go into stores and see software in brightly colored boxes reassured them that it was real. "Prepackaged software is a lot easier" to count, recalls Landefeld.

Silly as it may seem now, it was a revolutionary change at the time. But over the past seven years the economy has continued to evolve while the numbers we use to capture it have remained the same. Globalization,
outsourcing, and the emphasis on innovation and creativity are forcing businesses to shift at a dramatic rate from tangible to intangible investments.

According to *BusinessWeek’s* calculations, the top 10 biggest U.S. corporations that report their R&D outlays -- a list that includes ExxonMobil (*XOM*), Procter & Gamble (*PG*), General Electric (*GE*), Microsoft (*MSFT*), and Intel (*INTC*) -- have boosted R&D spending by 42%, or almost $11 billion, since 2000. Yet over the same period, they have only increased capital spending by a meager 2%, or less than $1 billion. So all together, these giants have actually increased their future-oriented investment by roughly $12 billion -- most of which doesn't show up in the BEA numbers.

This shift to intangibles looks all the more remarkable when we look a bit further back. P&G, for example, has boosted its spending on R&D, which doesn't count as investment in the GDP statistics, by 39% since 1996. By contrast, the company's capital budget, which does factor into GDP, is no bigger today than it was back then. The same is true at spicemaker McCormick & Co. (*MKC*), where capital spending is basically flat compared to 1996 but R&D outlays to create new products have tripled over the same period.

Want to see how this works? Grab your iPod, flip it over, and read the script at the bottom. It says: "Designed by Apple in California. Assembled in China." Where the gizmo is made is immaterial to its popularity. It is great design, technical innovation, and savvy marketing that have helped Apple Computer sell more than 40 million iPods. Yet the folks at the BEA don’t count what Apple spends on R&D and brand development, which totaled at least $800 million in 2005. Rather, they count each iPod twice: when it arrives from China, and when it sells. That, in effect, reduces Apple -- one of the world’s greatest innovators -- to a reseller of imported goods.

That’s why the new research from Corrado, Sichel, and Hulten is so important, and why building and improving upon it could become a key goal of economists in the coming years. Ultimately, we might end up with a "knowledge-adjusted" GDP, which would track the spending so crucial for global competitiveness.

Right now, though, rough calculations of these intangibles are all we have. To help come up with their $1 trillion number for unmeasured business investment, for example, Corrado, Sichel, and Hulten counted the portion of advertising designed to have long-lived effects on perception (that would include the sort of corporate image advertising seen here at *BusinessWeek*). They also estimated the value of new product development in the financial-services industry, which current R&D numbers miss. "We had to hunt around for bits and pieces of data," says Hulten.

Assessing how much bang for the buck companies get from their spending on intangibles is even harder, especially in the fast-changing knowledge economy. Take employee training. In the old days, that required flying people to a teaching facility, which cost companies a lot of time on top of the cost of the instructors and real estate. Now online learning and other innovations are driving down the cost of training. At IBM (*IBM*), the training budget fell by $10 million from 2003 to 2004, a 1.4% decline, while the number of classroom and e-learning hours rose by 29%. Are other companies seeing an equally dramatic decline in the cost of training? No one knows.

**CHANGING PERCEPTIONS**

That’s why the BEA doesn’t want to move too fast. It plans to publish supplementary accounts for R&D in the next few years, which will track R&D spending without adding it into the official GDP numbers. Other intangibles, though, remain below the radar. "No one disagrees with this conceptually," says BEA chief Landefeld. "The problem is in the empirical measurement."

But look at how our perception of the economy changes once you add in things like R&D and brand-building. The published data show that total investment -- business, residential, and government -- has been falling over the past three decades as a share of national spending, while consumption has been rising. Add in the intangible investments provided by our three economists, and the picture changes completely.

Total investment rises, going from 23.8% of national spending in the 1970s to 25.1% in the early 2000s -- much higher than the 18.3% the conventional numbers show. That helps explain why the economy has sustained strong productivity growth, and why foreign investors continue to pour money into the U.S.
Factoring in the knowledge economy also helps us understand why the recession of 2001 seemed worse than the official statistics showed -- and why the recovery was so slow. According to the published numbers, the six-month recession of 2001 was so mild the business sector actually grew at a modest 0.4% pace that year. By 2003, however, more than 3 million private sector jobs had disappeared.

One reason for this disconnect is simple: Corporations hacked back their budgets for R&D, advertising, training, and so forth. Yes, that canceled out a ton of high-paying jobs, but had no direct effect on GDP. Remember that R&D and other intangible business investments are not currently counted as national output. Therefore, when a company laid off an engineer doing long-term product development but kept selling the same number of its old products, GDP stayed the same. Productivity even went up, because fewer workers were producing the same amount of output. And if that laid-off engineer went to work, say, building houses? National output might even have risen.

There’s enough data available through 2003 to estimate how business intangibles would have changed the growth numbers. For our purposes, let’s assume that overall intangible business investment followed the same path as industrial R&D and advertising, for which annual data are available. Crunch the numbers and it looks like the business sector really grew by only 0.1% in 2001, less than a quarter of the size of the official increase. Growth in 2002 now also looks slower than the published data.

By contrast, the conventional numbers may be understating the strength of the economy today. The BEA announced on Jan. 27 that growth in the fourth quarter of 2005 was only 1.1%. In part that was because of a smaller-than-expected increase in business capital spending. However, employment at design and management-consulting firms is up sharply in the quarter, suggesting that businesses may be spending on intangibles instead. Indeed, the consumer confidence number for January zoomed to the highest level since 2002, as Americans became more optimistic about finding jobs.

Then again, the economy may hit bigger bumps in the years ahead. When companies significantly trim their spending on R&D, design, training, and other knowledge-enhancing activities, as they did in 2001, the resulting pain in terms of job losses and reduced innovation could deepen the next downturn.

Perhaps the trickiest and most controversial aspect of the shadow economy is how it alters our assessment of international trade. The same intangible investments not counted in GDP, such as business knowhow and brand equity, are for the most part left out of foreign trade stats, too. Also largely ignored is the mass influx of trained workers into the U.S. They represent an immense contribution of human capital to the economy that the U.S. gets free of charge, which can substantially balance out the trade deficit of goods and services. "I don’t know that the trade deficit really tells you where you are in the global economy," says Gary L. Ellis, chief financial officer of Medtronic Inc., a world leader in medical devices such as implantable defibrillators. "We’re exporting a lot of knowledge."

Time for another real-world example. In December, Intel Corp. (INTC) announced plans to build a new wafer-fabrication plant in Israel. To the statisticians, the value of that foreign investment is the book value of the plant -- that is, the cost of erecting the building and installing the chipmaking machinery.

Not counted is the systematic export of knowhow to Israel that enables that factory to operate profitably. At the core is a program called Copy Exactly!, which requires that a new fab duplicate an existing one that is working well, down to how often the plant’s pumps are serviced. All of this critical information is documented and transferred from the U.S. to the new plant, but it is not picked up by the trade statistics.

The numbers don’t catch Intel’s exhaustive training program either. To get its new plants running quickly, the chipmaker brings 800 or 900 employees from the new fab to spend a minimum of six months in Hillsboro, Ore., where Intel develops new production processes. By the time they return home, these people will have picked up not just the details of the process but also tribal knowledge -- the unwritten lore of how Intel works. With that info in their heads, they’re equipped to get the new factory up and running at high volume within a quarter, rather than taking a year or more. In economics speak, this is a classic transfer of human capital. So why isn’t it called an export?
Ricardo Hausmann, director of Harvard’s Center for International Development, believes it should be. He describes these cross-border flows of knowhow as “dark matter.” Hausmann notes that U.S. multinationals consistently earn higher rates of return than their foreign counterparts -- an average of 6% on foreign operations since 2000, vs. the 1.2% foreign multinationals earn in the U.S., according to the latest BEA figures. From that, he infers that the multinationals are benefiting, in part, from knowledge exported from the U.S., a country with faster productivity growth than the rest of the industrialized world.

Using these arguments, Hausmann finds that the U.S. current account deficit actually disappears, averaged over time. “With globalization, you develop a blueprint and sell it in all countries,” he says. “Countries that are good at creating blueprints get more exports of dark matter.”

Admittedly, most trade experts are hostile to Hausmann’s conclusions. A recent report from Goldman, Sachs & Co. (GS) likened Hausmann’s dark matter to cold fusion. And the economists at the BEA worry that adding knowledge exports to the trade stats would make published data less useful. “I have a problem putting fabricated flows into exports,” says Ralph H. Kozlow, who oversees international accounts at the BEA. “You get into an impossible statistical maze when you try to value all of this at anything that anyone would believe.”

But even if Hausmann is overstating his case, he’s on the right track. There’s no doubt that the statistical problems are formidable, but it’s also certain that the conventional trade statistics are missing a big portion of the knowledge flows that create value these days. Suppose we assume that U.S. multinationals can earn an extra percentage point of return on their foreign investments by being able to use business intangibles exported from the U.S. Then a rough estimate of the value of the unmeasured exports of knowledge is anywhere from $25 billion to $100 billion per year, depending on what assumptions are used.

And let’s not forget about immigrants. The workers who move to the U.S. each year bring with them a mother lode of education and skills -- human capital -- for free. One celebrated example is Jonathan Ive, the man who designed the iPod and iMac. Ive was born in England and educated at Newcastle Polytechnic University of Northumbria before joining Apple Computer Inc. in California in 1992.

Ive is not unique. Most of the workers who immigrate to the U.S. each year have at least a high school diploma, while about a third have a college education or better. Since it costs, on average, roughly $100,000 to provide 12 years of elementary and secondary education, and another $100,000 to pay for a college degree, immigrants are providing a subsidy of at least $50 billion annually to the U.S. economy in free human capital. Alternatively, valuing their contribution to the economy by the total wages they expect to earn during their lifetime would put the value of the human capital of new immigrants closer to $200 billion per year. Either the low or high estimate would make the current account deficit look smaller.

These numbers may also seem squishy. Still, if Fed chief Bernanke, corporate executives, and ordinary investors want to know where we’ve been, and where we’re headed, tracking the creation and flow of knowledge is the only way to go.

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7. Appendix 2: John Mauldin’s “Outside The Box”

John Mauldin's, "Outside The Box"

Volume 2 - Issue 22
February 20, 2006

The Innovation Boom
By Steven Vannelli
February 16, 2006

We are usually loath to quote politicians, especially those on the Far Left, but this paragraph from House Minority Leader Nancy Pelosi's op-ed piece in the Wall Street Journal entitled "R&D Democrats" says it all: "America has always been committed to being number one. Every scientific advance once thought impossible that has been achieved--splitting the atom, landing a man on the moon, mapping the human genome--has been achieved by Americans. We accomplished these extraordinary goals, and then benefited from the jobs, industries and successive innovations they have yielded because our country was willing to make two critical commitments. We invested in the education and ambition of the American people, and we promoted an entrepreneurial culture that supports long term, high risk ideas."

And this is a great point. Where do some of the things we take for granted, the every day items like pyrex cookware, or velcro fasteners, or light emitting diodes come from? All around us, from color laser printers to mass spectrometers, from the computer mouse to or open-sided MRIs, from satellite radio to all aluminum engines (which save weight and improve performance), from Teflon pans to "natural light" bulbs... we stand in awe of the products churned out by research and development efforts of companies around the world. Even the ability of our Captain Crunch cereal to stay crunchy for at least fifteen minutes is a testament to the research and development capabilities of General Mills!

BASF, the German chemical company, has a commercial that states "we don't make the things you buy, we make the things you buy better." Increasingly that is becoming more true of platform companies. In our recent book Our Brave New World, we described the three broad functions of companies: to design a product, to manufacture a product and to distribute a product. And successful companies in the Western world are deciding to focus their resources on the first--designing products.

In the forgone US manufacturing age, growth was achieved by physically producing, with company owned assets, more of the same products. Improvements in quality, whether it be in size or speed or otherwise, was not of primary concern (anyone who owned an American made car in the 1970s or 1980s can attest to that). Increases in volumes, without damaging pricing, were easily achievable with proper planning because there wasn't an abundance of supply relative to demand. With the Cold War, trade restrictions and misguided monetary policies global markets were less efficient and price was easier to realize.

In the 1980s, with the backdrop of a falling rate of inflation and freer trade, vertically integrated companies realized they could enhance profitability by locating productive assets in places like Japan and Korea--they began the process of deverticalization. This relocation of fixed assets drove profitability by allowing companies to shed capital consuming functions
and focus on profit producing ones.

Then, in the early 1990s, the opportunity to outsource the manufacture of an entire product availed itself as global borders opened and capital flowed more freely around the world. Highly efficient producers that could fulfill any order with impressive quality and speed sprang up everywhere, from Southeast Asia to Korea, from Central America to Eastern Europe.

The technology revolution was an accelerant to this trend of outsourcing, as far flung participants in a supply chain could be connected and efforts coordinated. Just in time inventories, supply chain management and business process outsourcing became part of the lexicon of business.

Platform companies realized that in a deflationary boom environment, characterized by plentiful physical fulfillment, to sustain profits and to grow, they had little choice but design new features, improve existing products and create whole new products or product categories. In short, they had to become more productive.

**And this meant a different kind of investment.** Today, less capital is being invested in the expansion of physical capacity and more capital is being invested in the expansion of intellectual capacity. In the following pages, we look at a cross-section of some of America’s largest companies. From technology to auto manufacturers, from drugs to aerospace... And everywhere we care to look, we note the following trends in R&D expenses relative to capital expenditures:

- They have grown much faster
- They were unaffected by recessions, mid-cycle slowdown or financial crises
- The rate of increase, in some cases, is accelerating
- The trends really diverged in the early 1990s (the beginning of the explosion in the trade deficit)
- They have led to strong productivity gains.

Reviewing these trends, we have a tough time getting worried about the outlook for US equities, or for the US economy.

Let us start with an industry in which R&D is crucial: pharmaceuticals. Note the divergence in spending trends at Pfizer. In 1991, R&D, at $1 billion was only 25% bigger than Capex of $800 million. But after growing at a near 15% compound rate, R&D is now almost 3x the size of Capex.
At Johnson and Johnson, the surge in R&D relative to Capex is more pronounced as the two costs began the 1990s at parity. But in the past 15 years, R&D has grown at a 12% compound rate while Capex has grown at a 6% rate. Now annual R&D expenses are 2.5x annual capital expenditures. Neither midcycle slowdown nor recession effected R&D, though it definitely affected Capex.

Moving on to technology, Microsoft has grown its R&D at 25% compound over the last 15 years. The 1997 bulge was likely linked to the efforts to get Windows 98 out the door. Which raises the question of whether Vista will cause a repeat?
We witness a similar trend at Oracle, with R&D growing at 22%, while Capex has been in outright decline since 1996. Annual R&D expenses are almost 10x the size of Capex.

And the same is true of industrial companies. Boeing’s R&D doubled over the last decade and a half while Capex has been halved. The acceleration in R&D from 2000 to present in the face of a recession and a stock market crash is rather impressive. Apparently, Dreamliner’s are very expensive to design...
We witness a similar trend with United Technologies. Despite the fact that durable goods deflation has been highly pernicious in recent years, UTX has still managed to turn in all-time record operating margins last year!

For the first time in its History, Dupont, spent more on R&D last year than it did on Capex. Notice capex is a fifth the level it was in 1991.
Should we be surprised by the fact that Ford spent more on R&D last year than on Capex? Almost $500m more! Capex has been flat for 15 years while R&D has doubled. Unfortunately, Fuel cells, heads-up displays, satellite radios, hybrid engines, airbags, anti-lock brakes, drive-by-wire tech... don't invent themselves.

Another example of stagnant Capex and vibrant research and development can be found at Proctor and Gamble. In the next recession, Capex will likely fall to levels permanently lower than R&D.
As an example of the productivity of the R&D investments, let's review sales per employee at P&G. They were roughly $275,000/employee in 1991. Today, they stand nearer to $525,000/employee— that represents a 4.5% annual growth.

Putting it all together, we find it hard to understand the perma-bears’ mantra that the US economy is on the verge of implosion. Looking at capital spending numbers gives a very incomplete picture of the health, and innovation, prevalent across the US corporate sector. In Our Brave New World, what matters is R&D, not capex. And those who do not keep in mind the R&D trends will continue to miss an important piece of the puzzle.