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Accounting for the Knowledge Economy

Charles Hulten
University of Maryland
The Conference Board
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About the Report: The Conference Board has recently undertaken a project on innovation and competitiveness, with funding from Microsoft Corporation. The goal of the project is to provide an overview of the current state of knowledge on the nature of innovation, and its role in stimulating economic growth and improved living standards in the U.S. The project draws on experts across the academic, corporate, and policy arenas, in addition to The Conference Board's own analysis, surveys, and focus groups of the business community. Such experts met in February 2007 to present and discuss various aspects of the innovation process and measurement thereof. Each presenter wrote a summary piece focusing on his respective area of expertise. These summary documents underpin the content in *Innovation and U.S. Competitiveness*; however the conclusions drawn are those of The Conference Board alone. These papers are retained for reference in The Conference Board Economics Program Working Paper Series.

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Economics Program
845 Third Avenue
New York, NY 10022-6679
Tel. 212-759-0900
www.conference-board.org/economics

ACCOUNTING FOR THE KNOWLEDGE ECONOMY[1]

Charles Hulten
Professor of Economics, University of Maryland
Senior Fellow, The Conference Board
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We live in an era of rapid, almost dizzying, innovation in products and processes. These innovations have increased consumer welfare through the introduction of new goods and services, improvements in the quality and lower costs of existing products, and an increase in the amount of information about available products. They have also revolutionized the organization of production, not just in the 'technology' of production as narrowly conceived, but also in the management and global reach of corporations around the world.

While the impact of the revolution in technology is evident 'on the ground,' it has proved surprisingly hard to develop an overall macroeconomic measure of the magnitude of the impact. How much of the recent growth in GDP is due to this revolution? What is the impact on living standards and worker productivity? Some progress has been made in answering these questions, particularly in the measurement of IT capital, but the answers tend to be piecemeal or incomplete.[2]

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[1] Paper prepared for the Conference Board's Workshop *Perspectives on U.S. Innovation and Competitiveness*, February 8 and 9, 2007. It has been revised to include material from the comment prepared for the *Measuring Innovation in the 21th Century Economy Advisory Committee*, "Toward A National Innovation Account," May, 2007. Many thanks are due to Janet Hao of the Conference Board for helping with the revision to the original draft.

[2] The ability of macroeconomic data to capture innovation is reflected in the following comments by prominent economists. In the earlier stages of the IT revolution, Solow (1987) famously quipped that "You see the computer revolution everywhere except in the productivity data." A decade later, Nordhaus (1997) remarked that official price and output data "miss the most important revolutions in history." Greenspan's 1990 remarks on the bias in the CPI and the unreliability of service sector productivity data were motivated by what he saw as the failure of these statistics to provide accurate metrics for what was then called the 'New Economy.' This view has persisted at the Federal Reserve Board, as witnessed by the analogy by

The treatment of intangible knowledge assets is an area in which improvement is clearly needed. Official statistics in the U.S. and international statistical systems, as well as financial accounting practice, have traditionally outlays for intangibles like R&D as current expenses rather than as investments. This situation is starting to change, and recent estimates indicate that when the conventional concept of capital is expanded to include investments in R&D, marketing, human resource development, and investments in management capability and strategic planning, a more dynamic view of the U.S. economy emerges.[3] The growth of output per worker in the U.S business sector grows at a higher rate when intangibles are counted as investments, and knowledge-related capital becomes the most important driver of growth.

The Current State of the Data

Part of the innovation metric problem results from the way both national statistics and firm financial data are organized. In neither case are they organized to show innovation, because both macro and financial accounting practice tend toward a conservatism that emphasizes accuracy and continuity with the past over approximation and innovation.[4] Thus, accounting practice has traditionally concentrated on market data

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Bernanke that "If making monetary policy is like driving a car, then the car is one that has an unreliable speedometer, a foggy windshield … ," with inadequate innovation metrics identified as a source of the fog.

[3] See, for example, the estimates in Corrado, Hulten, and Sichel (2005, 2006). See, also, Blair and Wallman (2001) and Lev (2001) for a general overview of the accounting issues associated with intangibles. Moreover, the Bureau of Economic Analysis has recently moved to incorporate some types of R&D spending into the U.S. national accounts as a satellite account (Robbins and Moylan (2007)).

[4] The accounting scandals of recent years illustrate the virtue of accounting accuracy. But the obvious need for investor confidence should not obscure the need for accounting metrics that reveal the true dynamism and future prospects of a company. Accounting practice should ideally be able to accomplish both objectives.

generated by arms-length transactions and avoided making imputations where possible. On the other hand, innovation involves new ideas and products whose nature and significance take time to understand, and that often require new non-market mediated measurement strategies, which also take time for the users of the data to understand.

One important consequence of this conservatism is that non-market intangibles internally produced like R&D are treated as a current expense rather than as an investment in the future of the company. This means, for example, that the typical biotechnology company does not add to the GDP in the first years of its existence, nor is its research program deemed to have a long-run impact on the value of the company or the economy. [5]

The treatment of intangibles as a current expense is beginning to change in national accounting practice, with the decision in the late 1990s to capitalize software expenditures and include them as an investment that contributes to GDP. This treatment has recently been extended to scientific R&D in the U.S. national accounts and possibly by the decision by the United Nations to do likewise in its System of National Accounts. Financial accounting practice continues to be stuck in the past. Moreover, the full range of value-building intangible assets are not likely to be accorded the treatment of scientific R&D in the national accounts, even though assets like marketing and employee-training expenditures are important coinvestments with R&D.

The treatment of intangibles is by no means the only problem area. Product innovation is another aspect of the ongoing technological revolution, but, with the

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[5] Corrado, Hulten, and Sichel (2005, 2006) note that standard macroeconomic theory provides a strong rationale for treating expenditures on intangibles as an investment, because it increases future productive capacity and thus future consumption. If a tangible expenditure on IT equipment is considered as part of GDP, then why isn't an equal investment in R&D that is made for the same general reason? Symmetry suggests that it should be.

exception of computer prices, it is poorly represented in official statistics. Improvements in the quality of existing products are picked up for some items (like computers), but this is not done systematically for a full range of products. The treatment of entirely new goods is more problematic. The improvements in consumer well-being due to the introduction of cellular telephones, cholesterol–lowering drugs, and the internet are effectively ignored in the procedures used in constructing the consumer price index (see, for example, Hausman (1999)). This reflects the conservatism of the statistical system noted above, which, in the case of price measurement, tends to treat product innovation as an adjustment to price indexes and not something that is valuable in its own right.[6] These price statistics are used in the national accounts to express income and product in constant prices in order to measure real GDP. The failure to capture innovation in the price statistics thus carries over to errors in the measurement of real output and productivity.

There are other problems as well. NSF data on research and development are one of the most important sources of information about the source of innovation in the economy. However, these data are collected primarily for scientific R&D only and exclude research in important areas like financial services and retail distribution (e.g., the research and development of new financial products at places like Morgan Stanley and Goldman Sachs, the development of retailing models like that of Walmart). The NSF data do not include coinvestments in marketing and training, and more generally, focus more on

[6] Surprisingly, there is still a debate in the U.S. over the question of whether the CPI should be based on a fixed market basket of products. In this view, apparently shared by some members of the recent National Research Council price-statistics panel, the CPI should reflect the change in the prices of the same bundle of items year after year (the "Cost-of Goods Index" discussed in the NRC report). If the logic of this view were to prevail in its pure form, and it is not the dominant view of price-measurement specialists, it would virtually remove product innovation from official price statistics.

scientific laboratory research than on innovation outcomes of the sort that are currently collected in Europe. The NSF supports numerous projects that conduct surveys and interviews, and these provide an important base of information about the micro innovation process, but there is a need to translate these new metrics into the dollar metrics needed to improve current accounting practice.[7]

Better Data Requires Better Theory

The need to improve the underlying economic theory of innovation in the firm is just as pressing as the need for better data if there is to be a successful move to a 'knowledge-based GDP.' Indeed, the two go hand in hand, as the Noble Laureate Tjalling Koopmans reminded fifty years ago with his injunction against measurement without theory. Unfortunately, conventional econometric practice treats the company as little more than a simple transformation of input into output via a production function. This approach emphasizes productivity and the sources of output growth, but innovation is typically treated as a residual (as a time trend in econometric analyses, and the multifactor productivity residual in growth accounting).

This empirical model of the firm emphasizes the production of commodities, and tends to ignore the other functions of a successful company. Companies are complex organizations that aim to persist over time by making firm-specific intangible investments in research on new products and processes, in employee development, and in

[7] Other measurement issues related to innovation include the need to improve existing measures of tangible capital, particularly in the areas of capital-embodied technical change, depreciation, and obsolescence. More emphasis on the role of human capital and 'human-embodied' technical change is also needed, as well as on developing stronger links to data for the household sector.

new markets and market models. This larger concept of a company's organizational capital was described as early as 1959 by Penrose, and repeated in various ways by many others since then, but has still not penetrated deeply into accounting practice.

The consequences of this gap in understanding the true innovative capacity of U.S. companies is noted by Michael Mandel in his recent Business Week article: "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 [national accounts] 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."

A Concrete Example of What's At Stake

The pharmaceutical company Merck operates in one of the most R&D-intensive industries of the U.S. economy. According to Standard and Poors Compustat data, Merck had approximately $23 billion in product sales in 2006. The cost of these sales was just under $4 billion, while R&D and sales and administrative expenses totaled $11.5 billion, or around half of total sales. This pattern is typical of this type of innovative business, but not of the business sector in general. Merck had over $6 billion in net income in 2006, and reported total assets of $45 billion and shareholder equity of $18 billion.

This version of Merck's 2006 finances follows the convention that R&D expenditures are treated as a current expense and subtracted from the top line sales figure. However, much of Merck's R&D outlays were directed toward new drug development, a process that takes from eleven to fourteen years according to statistics reported in Berndt et. al. (2005). These expenditures are clearly intended to increase future income, and there is thus no good economic reason for treating these outlays differently from other capital expenditures. From an economic point of view, they should therefore be treated as an internally-produced output of the company and added to product sales. For the year 2006, the value of R&D as an output would add some $7 billion to the company's top line ($5 billion is direct costs and the rest in imputed capital costs). Under this new convention, Merck's top line increases to $30 billion. When the amortization of the stock of R&D assets is taken into account, this new top line translates into a net income of $10 billion, a $4 billion jump from its conventional value.[8]

The revised treatment of R&D leads to a rough estimate of the implied stock of internally-produced R&D capital of $36 billion. When added to the balance sheet, total assets are increased by from $45 to $81 billion. The increase in shareholder equity is even more dramatic, from $18 to $53 billion.

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[8] R&D should, in principle, be depreciated over the life-cycle of each product separately, but only the aggregate amount is reported on the financial statement. The estimates shown in this paper assume a 10 year write off period. This assumption probably overstates depreciation, given the long gestation lags involved in the drug development process. Moreover, the estimates should be adjusted for the time value of money, which can easily double the investment cost of a successful drug, but that adjustment is not made in the estimates reported above (see Hulten and Hao (2008) for further elaboration of these points).

R&D is not the only type of intangible expenditure associated with the innovation process. Merck has a large advertising budget designed, in part, to launch new products and gain market share. Some part of this expenditure is a necessary coinvestment made in order to recoup the substantial costs of product development, and it should therefore be accorded the same treatment as R&D investment. Unfortunately, Merck's financial statements follow conventional accounting practice and provide little detail on these intangible coinvestments. Therefore, to illustrate the potential effect of expanding the list of intangible capital, we assume that one-third of Merck's SG&A outlays are actually a capital investment (a proportion based on the macroeconomic studies by Corrado, Hulten, and Sichel). With this additional internal investment, the top line increases by $3 billion to $33 billion, but because a shorter depreciation life is used for these expenditures than for R&D, net income increases by less than $1 billion. Total assets, on the other hand, are increased to $95 billion, and shareholder equity to $68 billion.

The significance of this last estimate becomes apparent when it is compared to the Merck's stock market of value of $84 billion in 2006. According to current accounting practice, the book value of Merck's equity was $18 billion. This is the amount that shareholders were deemed to have after liabilities were netted against assets. It is only about 20 percent of the stock value. This is the well-known book versus market value puzzle that affects many companies. This puzzle can be greatly reduced when intangibles are brought into the picture, as economic theory and a large body of empirical analysis suggests they should. The book value of adjusted equity rises to $68 billion, which is now some 80 percent of market capitalization.

This result does not, by itself, prove that intangibles are capital (other studies have advanced this case).[9] What is apparent in this last calculation is the importance of getting the intangibles story right in order to understand corporate valuation. A similar remark applies to the income statement. The adjustments to the top line (46 percent) and to the bottom line (68 percent) when intangibles are brought into the picture suggest that these conventional accounting practice may miss a significant part of the value created by companies when they invest in themselves via intangibles (value that will henceforth be counted in the U.S. national accounts).

Productivity and Intangibles in the Macro Economy

The possibilities and problems illustrated by the Merck example have been generalized to the U.S. Nonfarm Business sector by Corrado, Hulten, and Sichel (2005, 2006). An estimate of a broad range of intangibles is developed for the 1990s in the first of these papers. This list is shown in Table 1 along with an annualized estimate for each category. The first general category is computer software, which has already been capitalized in the U.S. national accounts. Innovative property includes both NSF-style scientific property with what may be called 'non-scientific' R&D, although this is somewhat misleading because much of this category, which includes the development of innovative new financial products and architectural modeling, is conducted by personnel with scientific degrees. It is worth noting here that spending on nonscientific R&D exceeds the amount spent on the conventional NSF science-lab type. The third category,

[9] Corrado, Hulten, and Sichel (2005, 2006) provide an overview of the literature linking investment in intangibles to increased productivity and company valuation, as do Hulten and Hao (2008).

firm-specific human competencies, includes three subcategories: brand equity, worker-training, and management capability. This is by far the most controversial group, and it is also the largest.

The key finding of this research is that intangible investment by U.S. businesses averaged $1.2 trillion per year during the 1998-2000 period. This is also the amount by which U.S. GDP is increased by the capitalization of this broad list of intangibles. In percentage terms, the resulting estimate of GDP is 10 percent larger. The software portion of this is already included in current GDP estimates, but this amounts to only 13 percent of the $1.2 trillion increase. Moreover, even if scientific R&D were added to this percentage, it would only rise to 28 percent. In other words, intangible capital is broader than scientific R&D and software.

The $1.2 trillion of intangible investment equals the total amount spent by businesses for their tangible plant and equipment. When these figures are extended backward in time in order to obtain a broader perspective on economic growth, it also becomes apparent that these intangibles have become more important over the last five decades. Figure 1 from Corrado, Hulten, and Sichel (2006) shows investment as a fraction of business output over this period, and compares the results for tangible and intangible investment combined with those of tangibles alone. For the latter, the share of business output is around 12 percent for the period as a whole, while the combined share grows from 14 percent of output to more than 22 percent. Intangibles not only matter for the level of GDP, they also matter for its rate of growth as well. Figure 2 shows which intangibles have been the most dynamic growers, and surprisingly, scientific R&D has been a rather flat contributor to the overall increase (as has brand equity). Thus, the move by BEA to incorporate scientific R&D in U.S. GDP will not lead to a large boost in the growth rate of GDP, if current trends hold.

As with the example of Merck, the capitalization of intangibles adds to income as well at output, in the form of increased gross operating income accruing to capital. The effect of this increase on the distribution of income between labor and capital is noted in Figure 3. The share of income going to labor has been relatively constant at around 70 percent over the last 50 years. With intangibles, labor's share has fallen considerably.

There are also important productivity effects associated with intangibles. The Corrado, Hulten, and Sichel (2006) estimates indicate that the capitalization of intangibles increases the measured growth rate output per hour in the U.S. non-farm business sector by more than ten percent compared to the conventional BLS estimate, which averages around three percent for the period 1995-2003. This may not seem like a large effect, but annual compounding over a period of years increases its significance. Moreover, the introduction of intangibles restates the relative importance of the various sources of growth. When intangibles are included in the analysis, they explain more than a quarter of the growth rate of output per worker and are the most important *systematic* source of growth.

These findings points to the importance of the "knowledge economy." Knowledge capital comprises intangibles, IT capital, and labor quality (which largely reflects human capital), and together, they explain nearly 60 percent of productivity growth. This knowledge capital also gives rise R&D and human capital spillover externalities that are a component of the residual MFP measure. Conventional plant and equipment, excluding IT capital, accounts for less than ten percent of growth.

Conclusion

Achieving a rising living standard is a central objective of economic policy in nations around the world, rich and poor, and the growth in output per worker hour is a key determinant of the standard of living. If workers can produce more goods and services, they can consume more, both now and in the future. However, sustained growth in output per worker does not happen automatically or autonomously. The standard sources-of-growth model reminds us that it is the result of systematic investments in a broad range of capital assets and improvements in productive efficiency (measured as a residual). This is why it is important to count all the sources of innovation, not just those that are more easily measured.

The extension of the conventional sources-of-growth analysis to include intangible inputs and outputs is still in its infancy, though the literature is expanding. The recent work of Haskell and Marrano (2007) applies the Corrado, Hulten, and Sichel (2005, 2006) framework to the U.K., and reports very similar results to those for the U.S., while Fukao et. al. (2007) find a somewhat different pattern for Japan. As research proceeds, measures of the intangible components will hopefully be refined. Moreover, the estimates described above must be viewed as imprecise, but as John Maynard Keynes once remarked, "it is better to be imprecisely right than precisely wrong." The available theory and evidence strongly suggest that the current practice of treating most intangible expenditures as though they have no long-run impact on economic growth is plainly wrong.

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TABLE 1

Expenditures on a Broad List of Intangible Capital
U.S. Nonfarm Business Sector, 1998-200 (average)
(in billions of dollars)

COMPUTERIZED INFORMATION ($154)

- COMPUTER SOFT WARE ($151)
- COMPUTERIZED DATABASES ($3)

INNOVATIVE PROPERTY ($424)

- SCIENTIFIC R&D ($184)
- MINERAL EXPLORATION ($18)
- COPYRIGHT AND LICENCE COSTS ($75)
- OTHER PRODUCT DEVELOPMENT ($149)

ECONOMIC COMPETENCIES ($642)*

- BRAND EQUITY (ADVERTISING) ($236)
- FIRM-SPECIFIC HUMAN CAPITAL (TRAINING) ($116)
- ORGANIZATIONAL STRUCTURE MANANGEMENT ($291)

Source: Corrado, Hulten, and Sichel (2006).
* $505 of this category is considered investment

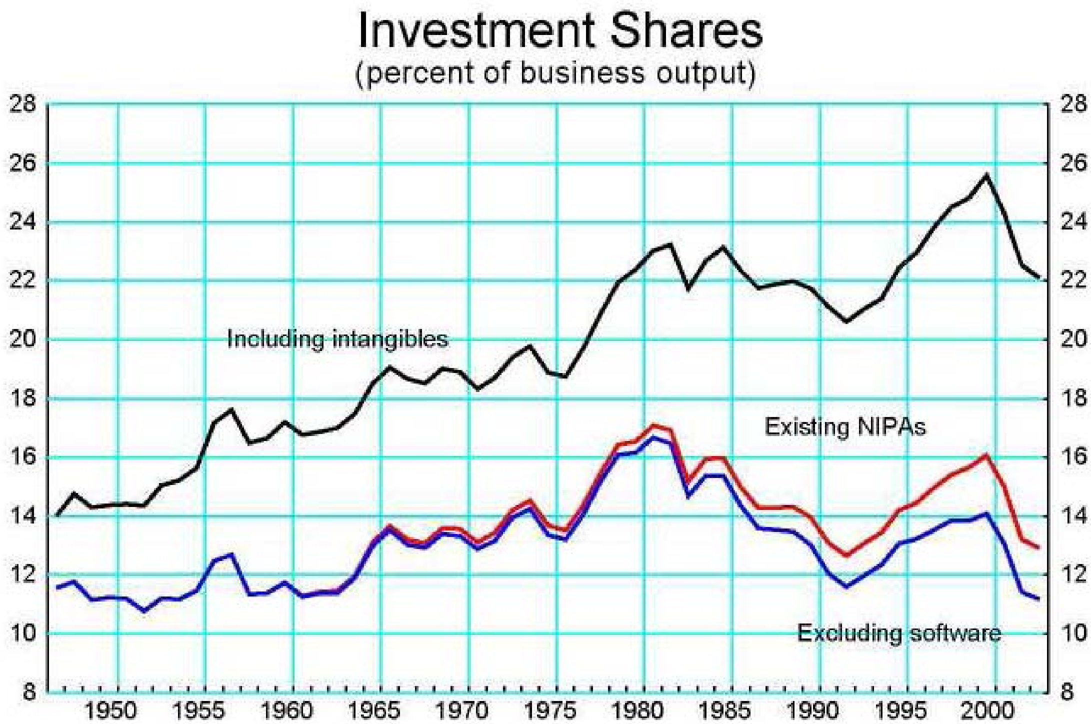


Figure 1
Source: Corrado, Hulten, and Sichel (2006).

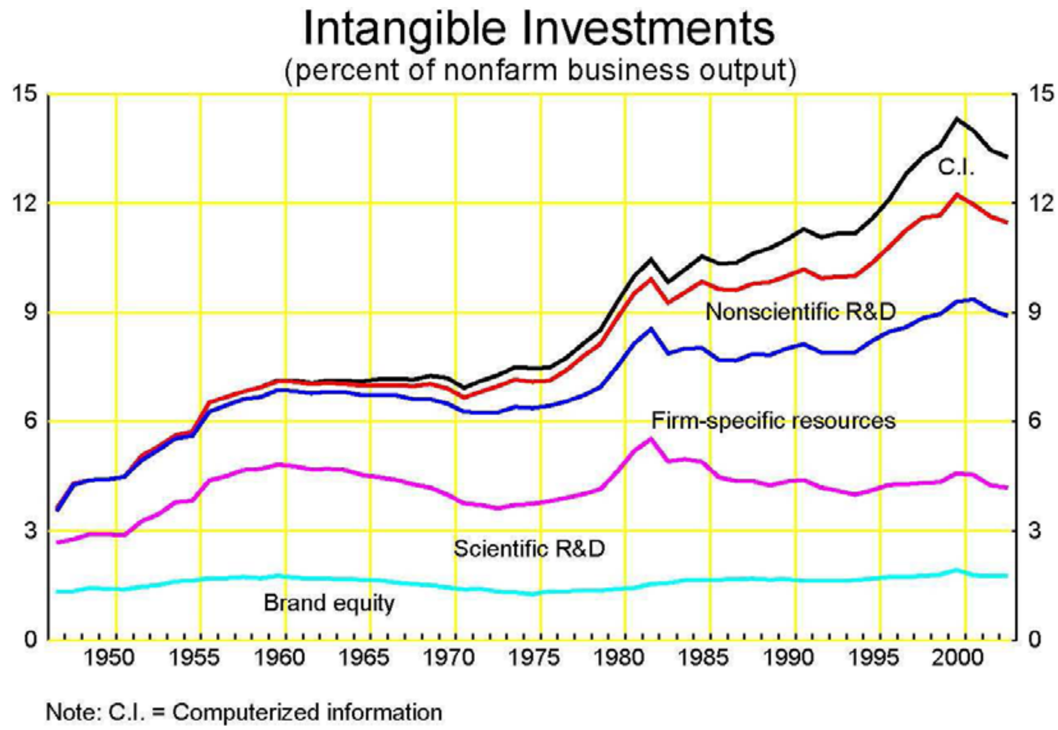
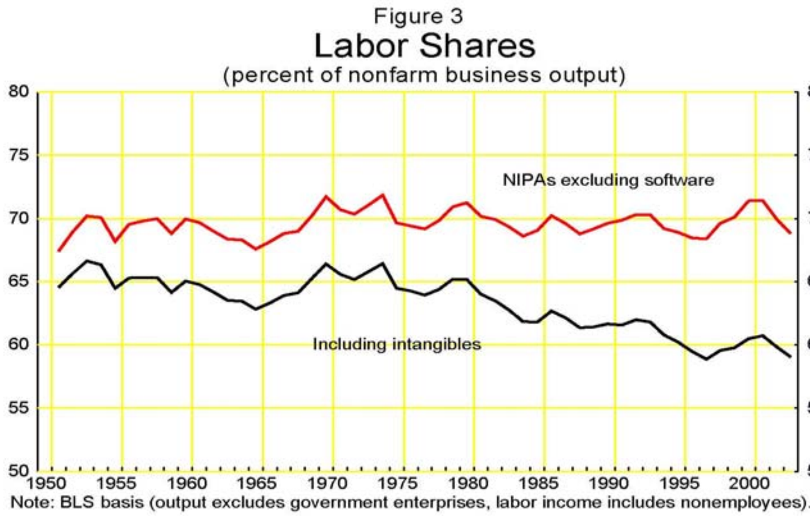


Figure 2

Source: Corrado, Hulten, and Sichel (2006).



Source: Corrado, Hulten, and Sichel (2006).