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Who Captures Value in a Global Innovation Network? The Case of Apple's iPod

INNOVATION IS OFTEN TOUTED AS A KEY DRIVER OF economic growth.[7,11] However, when firms operate within production and innovation networks that span national and firm boundaries, the question arises as to who actually benefits from innovation. Is it the home country of the innovating firm, the country where the innovative product is manufactured, or the countries that supply the key high value components?

This question recalls a debate in the early 1990s between Robert Reich and Laura Tyson. Reich[8,9] argued that the nationality of firms was less important than what activities they carried out in the U.S. or abroad; that is, a foreign company with a large U.S. workforce was more valuable to the U.S. than an American company whose workers were mostly abroad. Tyson[12] responded that this case was actually quite rare, and that most companies retained a large share of high value activities in their home country; therefore ownership still mattered.

The Reich-Tyson debate took place in an era when few had heard of the Internet or outsourcing, when vertically integrated multinational corporations still dominated most high-technology industries, and China and India were just taking their first tentative steps into the global hardware and software industries. Yet, while the world looks much different today, the core question debated then is just as relevant. For instance, an innovative product may be designed in one country, manufactured in another, with software developed in a third, and components sourced from several other countries. In such a case, how are the benefits distributed?

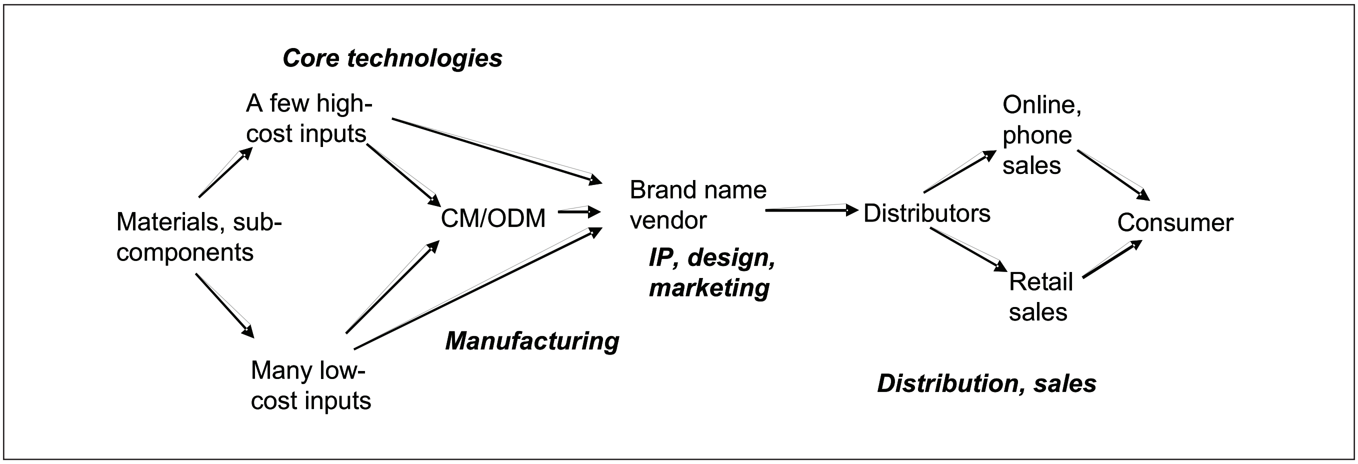
To begin to unravel that question, we have moved away from macroeconomics and down to a micro-level analysis of one well-known innovative product, the Apple iPod. The iPod is designed and marketed by an American company, assembled by Taiwanese manufacturers in China, and includes key parts from Japanese, Korean and U.S. suppliers. So who captures the value generated by this hugely successful innovation? How much would the answer differ if the iPod were sold by Sony or Samsung instead of Apple, or if it were assembled in the U.S.? This paper develops a framework for analysis based on financial measures of value capture, and uses that framework to study one iPod model to provide one perspective on these questions.[a]

Background

In the past, large electronics companies such as IBM, HP, Sony, Toshiba and others designed and manufactured their own products, often using internally

a The concept of "value" could be defined in various ways, including the number of jobs or the wages generated by an activity. Such alternate measures are being studied in our ongoing research.

Figure 1. Generic Electronics Supply Chain



produced components. Such highly integrated companies created and captured a large share of the value of innovation, mostly in their home countries where most of their workers resided.

Since then, supply chains in the global electronics industry have steadily disaggregated across corporate and national boundaries.[2, 11] Companies that formerly manufactured most products in-house, as well as start-ups that never had manufacturing capabilities, have outsourced production and even product development to global networks of contract manufacturers (CMs) and original design manufacturers (ODMs).

Today the creation of a successful product in the global electronics industry spreads wealth far beyond the lead firm, such as the company whose brand appears on the product. While the lead firm and its shareholders are the main intended beneficiaries of the firm's strategic planning, other beneficiaries include partners in the firm's supply chain and firms that offer complementary products or services.

Within a supply chain, each producer purchases inputs and then adds value, which then becomes part of the cost of the next stage of production. The sum of the value added by everyone in the chain equals the final product price. A stylized supply chain for a generic electronic product is shown in Figure 1.

Each product has a large number of low-value components, such as capacitors and resistors, that cost only pennies each. Although the manufacturers of these components earn profits, they account for a small share of the total value added along the supply chain.

Most electronics products also contain a few high-value components, such as a visual display, hard drive or key integrated circuits. These components are the most likely to embody proprietary knowledge that helps to differentiate the final product and to command a commensurately high margin. By virtue of their high cost, these inputs will usually account for a relatively large share of total value added. Innovation is rapid in these components, and accounts for much of the short product cycles for final products such as the iPod.

The assembly of these components into the final product is often outsourced to companies who are themselves large multinationals, such as Flextronics, Solectron, Foxconn, Quanta, and Compal. A lead firm that outsources manufacturing contributes its market knowledge, intellectual property, product design, system integration and cost management skills, and a brand name whose value reflects its reputation for quality, innovation, and customer service. Distributors and retail outlets are the final links in the chain from innovation to the consumer.

Using this map as a guide, we can estimate the value added at each stage of the supply chain. A product-level study, that is the one we are undertaking, allows us to break out the value embedded in an innovative product and clarifies how it is distributed across the many participants in the supply chain. Aggregating this firm-level data, we are able to make an initial estimate of the distribution of value by country as well.

Data sources and Analytical Approach

Product-level data are extremely hard to obtain directly from electronics industry firms, who jealously protect information about the pricing deals they have negotiated, and often require the silence of their suppliers and contractors through non-disclosure agreements. However, for many electronic products, lists of components and their factory prices are available from industry analysts. These "teardown" reports can be used to estimate the distribution of a product's value added by subtracting the input prices from the wholesale price.

Firm-level information about value added isn't readily available because publicly-listed companies do not generally reveal the amount of their wages for "direct labor" (workers who are involved in converting inputs to a salable product). Instead, the wage bill is combined with the cost of purchased inputs as "cost of goods sold" or "cost of sales." Therefore, the number we will use to estimate the value captured by suppliers is "gross profit," also called "gross margin," the difference between "net sales" and "cost of goods sold." Gross profit data are readily available from annual reports in the case of public companies, and we will use these company-wide figures for iPod suppliers to develop our estimate of Apple's iPod-specific gross margin. Figure 2 shows the difference between value added and gross profit. The orange area covers the items that make up value added and the blue area includes only those that make up gross profit, or value captured by the firm.

Figure 2. Components of Value Added and Gross Profit

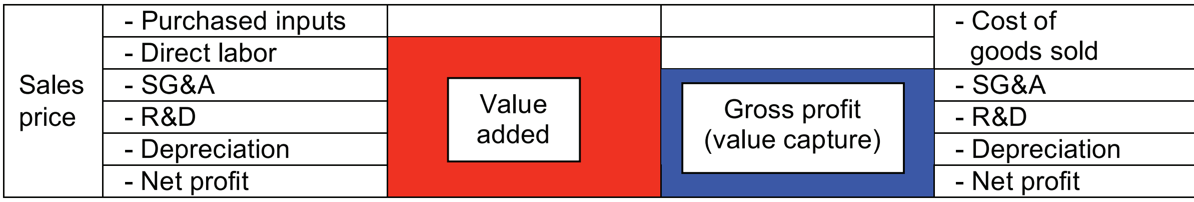


Table 1. The Most Expensive Inputs in the 30GB Video iPod, 2005

Component	Supplier	Company HQ Location	Estimated Factory Price	Price as % of total factory cost	Gross Profit Rate	Est'd Value Capture
Hard Drive	Toshiba	Japan	$73.39	50%	26.5%	$19.45
Display Module	Toshiba-Matsushita	Japan	$23.27	16%	28.7%	$6.68
Video/Multimedia Processor	Broadcom	US	$8.36	6%	52.5%	$4.39
Controller	PortalPlayer	US	$4.94	3%	44.8%	$2.21
Insertion, test, and assembly	Inventec	Taiwan	$3.86	2%	N.A.**	$3.86
Battery Pack	Unknown	Japan*	$2.89	2%	30%*	$0.87
Mobile SDRAM Memory - 32 MB	Samsung	Korea	$2.37	2%	28.2%	$0.67
Back Enclosure	Unknown	Taiwan*	$2.30	2%	30%*	$0.69
Mainboard PCB	Unknown	Taiwan*	$1.90	1%	30%*	$0.57
Mobile RAM - 8 MBytes	Elpida	Japan	$1.85	1%	24.0%	$0.46
Subtotal for 10 most expensive inputs			**$125.13**	**85%**		**$39.85**
All other inputs			$19.28	15%		
Total all iPod inputs			$144.40	100%		

Source: Portelligent, Inc., 2006 and authors' calculations
* Supposition based on other iPod models or Apple products
** See text for explanation of how Inventec's gross margin is calculated

Gross profit does not equal the full value added, but it measures the value that the company (excluding its direct workers) captures from its role in the value chain, which it then can use to reward shareholders (dividends), invest in future growth (R&D), cover the cost of capital depreciation, and pay its overhead expenses (marketing and administration).

The iPod Supply Chain

We obtained "teardown" reports for several iPod models from Portelligent Inc. These reports are based on the dismantling of an actual product, and they list suppliers of components where they can be identified.

One of these Portelligent reports details the components in the 30GB version of Apple's fifth-generation iPod, the Video iPod, which went on sale in October 2005. Table 1 shows the ten most costly inputs in that iPod model based on Portelligent's estimates. The ten inputs in Table 1, including the cost of assembly and test, total $126.00, which is more than four-fifths of the estimated $148.10 total cost of inputs into the iPod and its accessories.

By far the most costly input is the 30GB hard drive from Toshiba, which had an estimated cost of $73. In order to estimate the value captured by Toshiba, we will use its gross profit. This is only an estimate since Toshiba makes a wide range of products. According to Toshiba's income statements, the gross margin for the fiscal year ending March 2006 was 26.5% of net sales.[b] Using this overall gross margin, which is not untypical for margins in the hard drive industry, the value captured by Toshiba and assigned to Japan from a 30GB iPod is about $19.

A similar procedure was performed for all of the inputs in Table 1 except for the cost of assembly, which required a different approach. Inventec purchases some of the components it assembles, so to count those components against Inventec's revenue and again as part of Apple's factory cost would constitute double-counting. Instead, we will treat Apple's cost of assembly services, as estimated by Portelligent, as pure profit for Inventec.

Where a component could not be attributed to a specific company (three of the ten inputs in Table 1 had no supplier markings), we used comparisons from other Apple products to tentatively assign the component to a country. In addition to the ten inputs shown, the Video iPod has more than 400 additional inputs with values from two dollars down to fractions of a penny. Their combined value was $19.28.

The retail price for the 30GB model at the time of Portelligent's analysis was $299. The difference of $154.60 between the retail price and the $144.40 cost of inputs can be decomposed into transportation related costs, retail margin, distributor margin, and Apple's gross profit margin. Based on evidence from interviews and press reports, we estimate a 25% wholesale discount ($75), divided between wholesale and retail. Included in this is the cost of transporting the iPod from China to the final market.

Based on these values, Apple's gross profit on those units sold through non-Apple outlets would be $80, which is 36% of the $224 estimated wholesale price and greater than the value added for any of its partners. For sales made through Apple's own Web or store outlets, it also captures the $45 retail margin.

Table 2 summarizes the preceding analysis of the 30GB fifth-generation iPod.

The uncounted value capture from the many components not included in Table

b Gross profit rate calculated from data at http://www.toshiba.co.jp/about/ir/en/finance/pl.htm.

1 might be as much as $6, which would be distributed across the countries in Table 2 and possibly other countries.

The dominance of Apple's gross margin suggests that, in this particular iPod model, the U.S. captures most of the value, especially when the product is sold in the U.S., where approximately half of iPods still are sold. In the case of retail units sold in other countries, some or all of the distribution and retail value could be captured in those countries, depending on nature of the distribution channel.

Figure 3 provides a reconciliation of the analysis back to the retail price of $299. The item that has been added is the $85 Cost Of Goods (Factory Price minus Value Capture) for the top 10 inputs analyzed in Table 1. This includes the cost of purchased inputs and materials from upstream suppliers into components such as the hard drive or display, and the direct labor cost of their manufacture. Since none of the Top-10 inputs are especially labor-intensive, the upstream direct labor value is probably no more than $4 (5% of $85).

Apple's margins are not that unusual for brand name firms in the electronics industry, and an analysis of the iPod can shed light on some of the ways that lead firms profit from innovation when most core technologies are available to competitors from a global supply base. Apple's success was driven by a combination of marketing, design innovation, and a strategy of building an ecosystem for the iPod while raising barriers to competitors.

In the initial iPod models, there was little technology that was unique to Apple. Apple even paid licensing fees to Singapore's Creative Technology for its method of navigating through song lists.[c] But Apple understood the iPod needed to be at least as appealing aesthetically as functionally, and drew on its strengths in industrial design and software to bring the technology elements together in a unique way.[6]

iPod sales were initially modest while Apple built up the product's ecosystem. The second-generation iPod, introduced in 2002, added support for the Windows platform, greatly expanding the available market. In 2003, Apple introduced the iTunes Music Store (iTMS) with cooperation from the major music labels. The iTMS uses a system of digital rights management called FairPlay which prevents downloaded tracks from playing on portable players other than the iPod, since Apple has chosen not to license the system to its rivals.

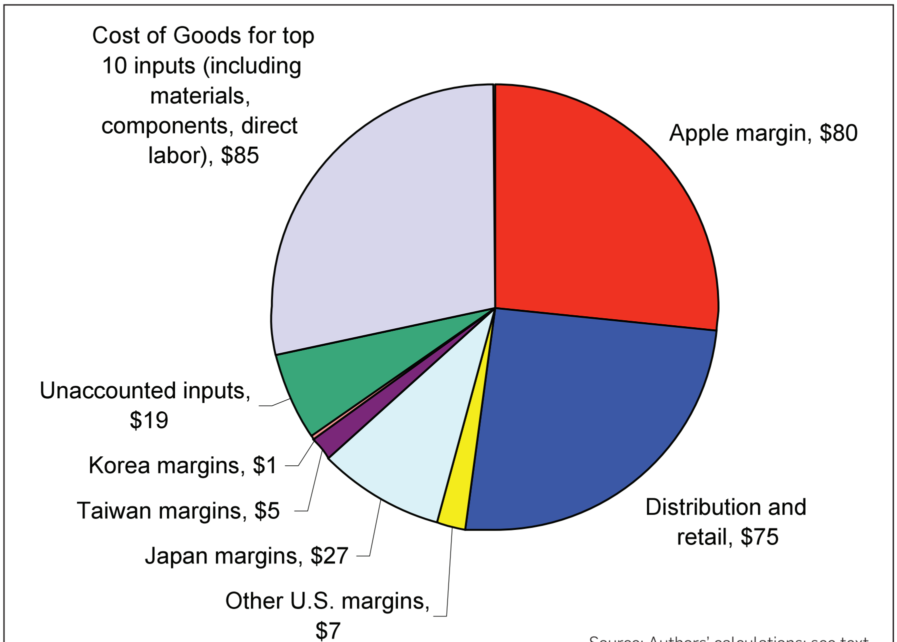
To capitalize on the music ecosystem it created, Apple also reportedly spent $200 million on advertising in the iPod's first four years, which was far more than its music-player rivals at that time.[d] It was in the fourth quarter of 2004 that the elements came together and iPod sales really took off, growing more than 600 percent from a year earlier and giving Apple a dominant market position that it has not relinquished.

Table 2. The Geography of $190 of the Captured Value in a single $299 Video iPod

	Country of final sale	U.S.	Japan	Korea	Taiwan	Total
Distribution and Retail	$75					$75
Apple		$80				$80
Top Ten Inputs from Table 1		$7	$27	$1	$5	$40
TOTAL	**$75**	**$87**	**$27**	**$1**	**$5**	**$195**

Source: Authors' calculations

Figure 3. Breakdown of iPod $299 Retail Price



Source: Authors' calculations; see text.

Conclusion

The analysis in this article points to several conclusions.

First, nationality matters. While the iPod is manufactured offshore and has a global roster of suppliers, the greatest benefits from this innovation go to Apple, an American company, with predominantly American employees and stockholders who reap the benefits. Consistent with Laura Tyson's[12] claim that multinational operations remain firmly anchored in home countries, Apple keeps its product design, software development, product management, marketing and other high value functions in the U.S. This is not necessarily because the U.S. work force has superior capabilities in all of these areas, but because Apple has developed very specialized knowledge and ways of doing things that reside within the company and would be difficult to transfer to external locations.

Clearly, firms do look around the world for low cost talent, and market opportunities, consistent with Reich's[9] view of a global corporation with little

c "Apple to pay $100M to settle 5 lawsuits," Associated Press, August 23, 2006.

d Levy (2006), Chapter: Cool.

loyalty to its home country. Firms are increasingly globalizing innovative activities.[3,4] Yet at the same time, most firms keep a substantial base of operations in their home countries. The leading mobile phone maker, Nokia, for example, has about one-third of its 35,000 employees in its home of tiny Finland. This home-country bias may be due to historical inertia, top management preferences to live in their home countries, or other factors. In the case of the U.S. and other large economies, their importance as a leading market serves as another anchor for firms based there. So in Tyson's terms, we still largely live in a world where "they are not us" and firm nationality does matter in terms of the value capture measure used in this study. It is worth noting, however, that the home-country bias does not necessarily extend to supply relationships. PortalPlayer, for example, lost its coveted place in newer iPod models to Samsung.

Second, innovation matters. The producers of high value, critical components capture a large share of the value of an innovative product. A recent study showed that high R&D-to-sales ratios are correlated with high gross margins, although not with overall firm performance or growth.[5] For the 30GB Video iPod, the highest-value components are the hard drive and the display, both supplied by Japanese companies. Thus Japan captures the next largest share of the value of the iPod, thanks to its companies' strengths in those technologies. U.S. chip makers such as Broadcom and PortalPlayer provide less costly inputs, but earn high margins and thus bring additional value to the U.S. By contrast, Inventec, which was actually responsible for assembly of this iPod (the activity that most people think of as "making" a product), earns a relatively modest share of its value. So in general, the greatest value from providing inputs to an innovative product goes to the countries whose firms provide critical, differentiated technologies.

Third, trade statistics can mislead as much as inform. For every $299 iPod sold in the U.S., the politically volatile U.S. trade deficit with China increased by about $150 (the factory cost) plus the cost of shipping. Yet the value added to the product through assembly in China is at most a few dollars. Even if we included the direct labor involved in making various parts and components in China, it would still add only marginally to China's share of the value.[e]

By this same logic, if the iPod were assembled in the U.S., most of the corresponding $150 bilateral (US-China) trade deficit would disappear, but the overall U.S. trade deficit associated with each unit would only fall by a few dollars. The rest would simply shift to the countries where the components are made, as those would have to be imported to the U.S. for final assembly. This is not to say that the U.S.-China trade imbalance is not a serious concern in a broader sense, but it shows that there is a need for better data to understand what that deficit really means for each country.

To conclude, no single country is the source of all innovation and therefore U.S. companies need to work with international partners to bring new products to market. These companies will capture profits commensurate with the extra value they bring to the table. This is simply the nature of business in the 21st century, and the fact that many U.S. companies are successful in this environment brings significant benefits to the U.S. economy.

As long as the U.S. market remains dynamic, with innovative firms and risk-taking entrepreneurs, global innovation should continue to create value for American investors and well-paid jobs for knowledge workers. But if those companies get complacent or lose focus, there are plenty of foreign competitors ready to take their places. If this happens, the benefits from the global innovation system could shift quickly away from the U.S. C

e According to Branstetter and Lardy (2006), China's "domestic value-added accounts for only 15 percent of the value of exported electronic and information technology products" (p.38). For a product like the hard-drive iPods, in which few parts are manufactured in China, the share will be below the average.

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