

## Taking Account...

### **BEA Participates in Panel on Semiconductors**

At the Allied Social Sciences Association meeting in January, BEA Chief Economist Ana Aizcorbe arranged a panel on semiconductors, chaired by Samuel Kortum (University of Chicago).

### **How Licensing Resolves Holdup: Evidence From a Dynamic Panel Data Model with Unobserved Heterogeneity**

Ralph Siebert (Purdue University) and Georg von Graevenitz (University of Munich). Discussant: Carol Robbins (BEA).

This paper examines whether licensing is an appropriate instrument to cut through a patent thicket. In the semiconductor industry, new technologies might be thwarted by firms holding blocking patents. In the model, high expected blocking leads to ex ante licensing, while ex post licensing arises if expected blocking is low but realized blocking is high. Also, ex ante licensing reduces firms' research and development incentives. The results suggest that licensing helps firms to resolve blocking, but it is not a cure-all: it decreases as fragmentation of property rights increases and arises mainly between large firms with similar market shares.

### **The Microeconomics of Microprocessor Innovation**

Kenneth Flamm (University of Texas, Austin). Discussant: Paul Thomas (Intel Corporation).

This paper develops a technique that can be used to apportion improvements in an index of quality-adjusted price between changes in nominal prices and quality improvements in the high-tech product. Detailed data on prices and physical, electrical, packaging, and architectural features of Intel desktop PC processors is used to estimate hedonic price indexes and to construct a quality-adjusted price index. The index shows that a slowdown in the rate of decline of quality-adjusted prices for Intel microprocessors occurred during and after 2003. Potential contributions of manufacturing technology gains, architectural innovation, and software improvement are also analyzed; implications for R&D investment strategies in computing technology are summarized.

### **Microprocessors: The Economics of New Process Technology**

Unnikrishnan Sadasivan Pillai (University of Minnesota). Discussant: Daniel Sichel (Federal Reserve Board).

Intel's choices about the size of transistors and how many to put on a microprocessor are governed by the timing of the adoption of new manufacturing processes that reduce the size of the smallest feature that can be etched on a microprocessor. Assuming a Poisson process for the arrival of innovations that reduce this feature size, the paper characterizes Intel's optimal adoption policy and its pricing,

engineering, and production decisions. The paper estimates the underlying demand and (1) quantitatively compares Intel's policy with the socially optimal policy and (2) estimates the welfare consequences of changes in Intel's decisions caused by shocks to demand and by an investment subsidy.

### **Durable Goods Oligopoly with Innovation: Theory and Empirics**

Ronald Goettler (Carnegie Mellon) and Brett Gordon (Columbia). Discussant: Ana Aizcorbe.

This paper proposes a model of dynamic oligopoly and applies it to the microprocessor industry. Our findings highlight the "competing-with-itself" aspect of being a monopolist of a durable good: the monopolist must innovate to stimulate demand through upgrades. The benefit is higher for the monopolist because its substantial pricing power enables it to extract much of the innovation-generated surplus. We also show that prices and profits are much higher when firms correctly account for the dynamic nature of demand, compared with an alternative scenario in which they ignore the effect of current prices on demand. Finally, equilibrium prices, profits, innovation, and consumer surplus are all increasing in the consumer's discount factor. Higher discount factors imply higher discounted flow utility from the durable good, which raises the consumer's willingness-to-pay.