

Product Repositioning and Short-Run Responses to Environmental Change

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Background

- Product repositioning: a change in the characteristics of the products marketed by an incumbent firm.
- Empirical analysis of equilibrium responses to environmental changes typically distinguish between the response of
 - "static" controls (prices or quantities)
 - "dynamic" controls effects (entry, exit, and various forms of investment including in new products).
- Product repositioning generally allocated to dynamics.
Dynamics are harder to do formally (especially when there are time constraints, as is often the case when policy decisions must be made) and so often left to informal analysis.

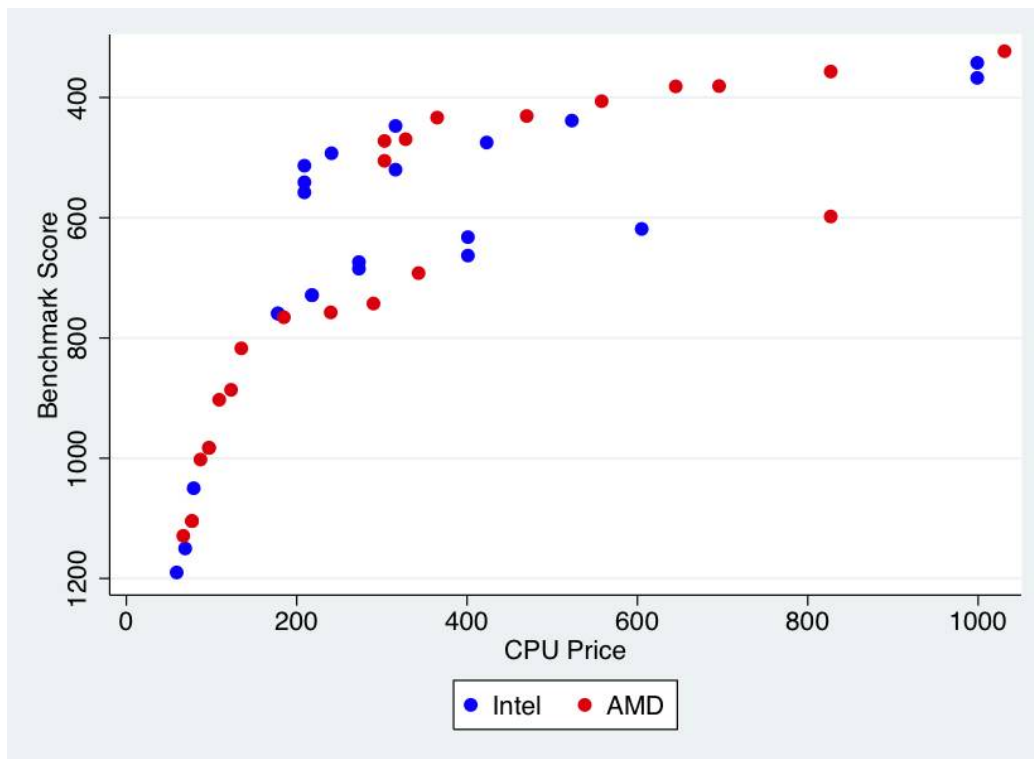
- Recent work:
 - a number of industries in which firms already in the market can change the characteristics of their products as easily as they can change prices, and
 - shows that static analysis that does not take repositioning into account is likely to be misleading, even in the very short run.
- The product repositioning literature
 - employs different empirical tools than the dynamic literature,
 - the tools are easy to use (at least once the static pricing analysis is done),
 - analysis does raise the issue of multiplicity of equilibria (come back to this).

- Nosko (2011): Response of the market for CPU's to innovation: easy to change chip performance to lower values than the best performing chips of the current generation.
- Eizenberg (2014): Introduction of the Pentium 4 chip in PC's and notebooks: decisions to stop the production of products with older chips (and lower prices) is easy to implement. Total welfare does not increase, but poorer consumers do better with the low end kept in.
- Wollman (2015): commercial truck production process is modular (it is possible to connect different cab types to different trailers), so some product repositioning immediate. Considers the bailout of GM and Chrysler, and asks what would have happened had GM and Chrysler been forced to exit the commercial truck market (once allowing for product repositioning and once not), and once with pure exit and once with them being bought out by an existing producer.

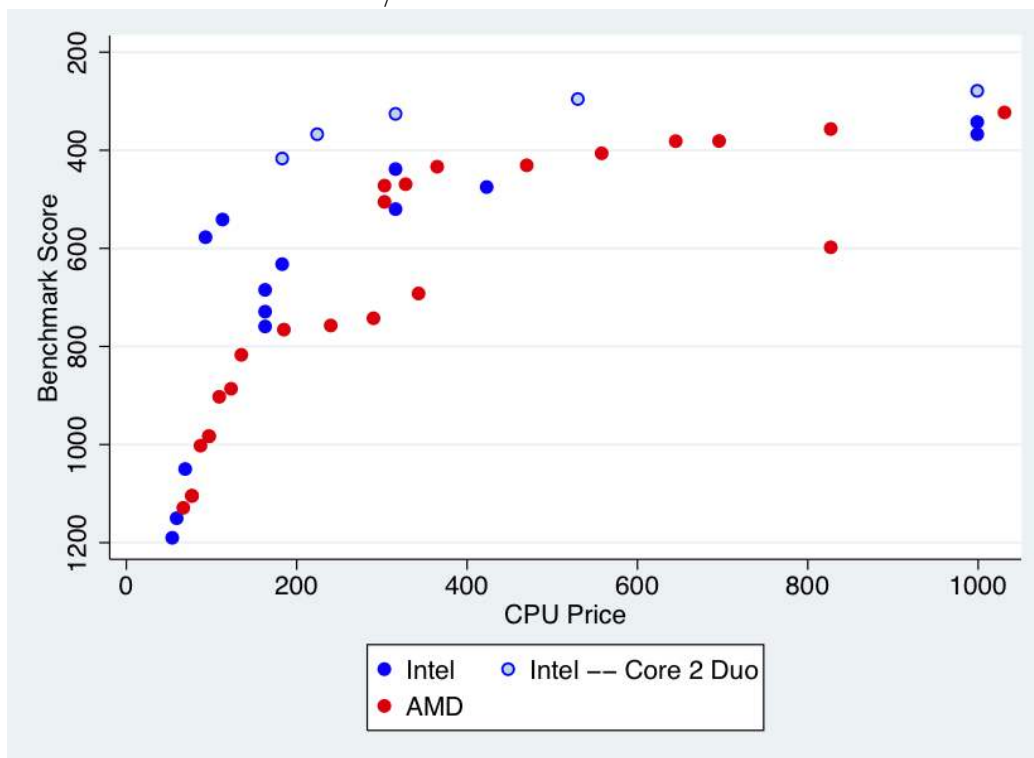
Nosko: Intels' Introduction of The Core 2 Duo Generation in Desktops.

- Chips sold at a given price typically change their characteristics about as often as price changes on a given set of characteristics.
- Figures provide benchmark scores and prices for the products offered at different times.
 - June 2006: just prior to the introduction of the Core 2 Duo. The red and blue dots represent AMD's and Intel's offerings. Intense competition for high performance chips with AMD selling the highest priced product at just over \$1000: seven sold at prices between \$1000 and \$600.
 - Core 2 Duo introduced in July. By October; (i) AMD no longer markets any high priced chips (ii) there are no chips offered between \$1000 and \$600 dollars.

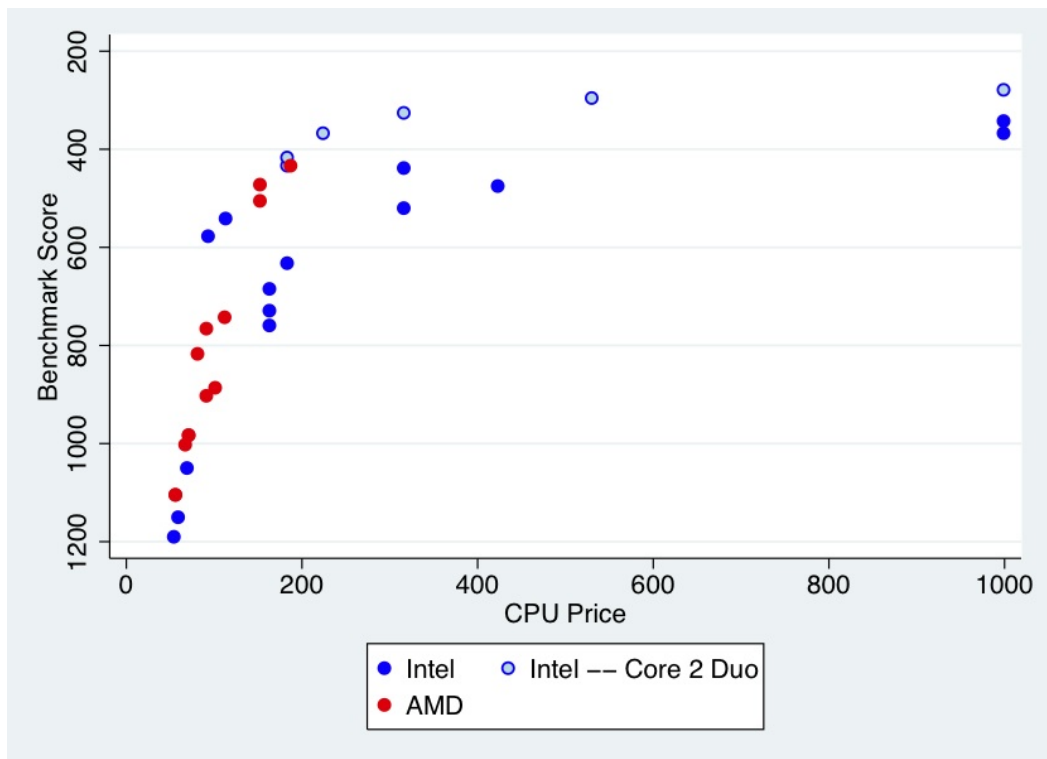
- November 2006: Only Core 2 Duo's at the high end.
- Nosko goes on to explain
 - that the returns from the research that went into the Core 2 Duo came primarily from the markups Intel was able to earn as a result of emptying out the space of middle priced chips and dominating the high priced end of the spectrum.
 - how a similar phenomena would likely occur if AMD were to merge with Intel.



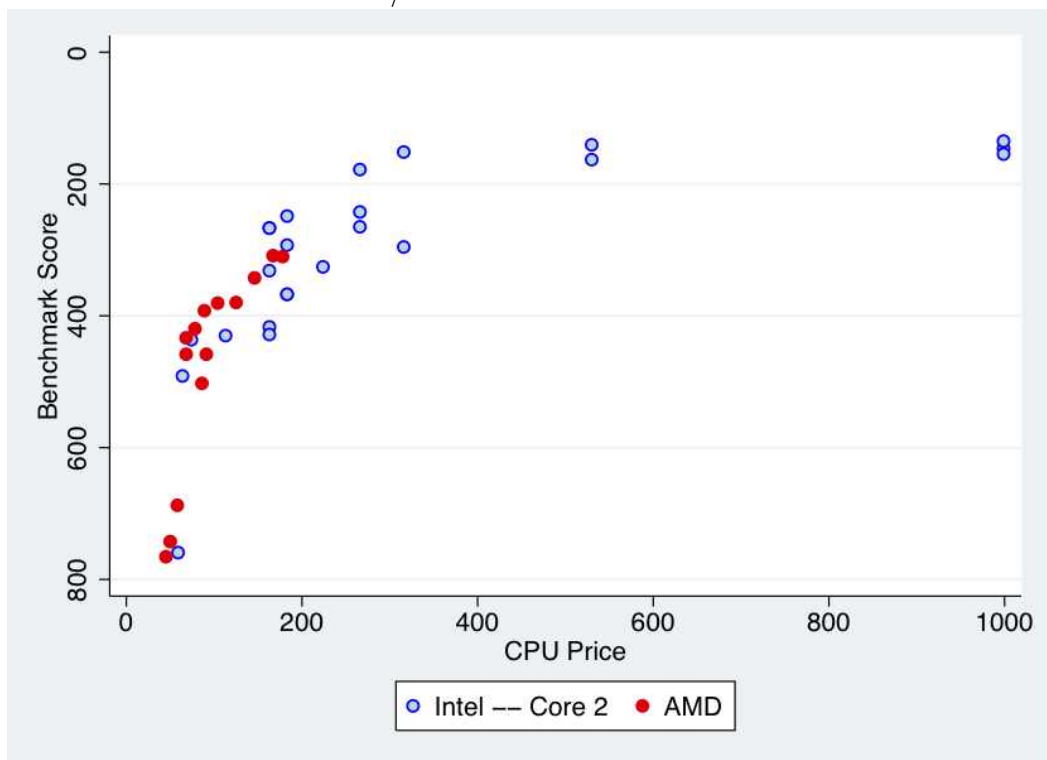
Price/Performance – June 2006



Price/Performance – July 2006



Price/Performance – Oct 2006



Price/Performance – January 2008

Analytic Framework Used in these Papers.

- Two period sub-game perfect model (backward induction)
 - product offerings set in the first stage and
 - prices set in the second.
- Two period model ignores effect on subsequent periods.
Come back to correct this.
- Even for two period model, need
 - Estimates of the fixed costs of adding and of deleting products.
 - A way of dealing with the multiplicity problem if we compute counterfactuals (and all papers do).

Estimates of Fixed Costs (F);

The three examples use

- Estimates of demand and cost as a function of product characteristics (use either BLP or the pure characteristics model in Berry and Pakes, 2007).
- An assumption on the pricing (or quantity setting) in the "but for" world in which; (i) one of the products that was offered was not, and (ii) one that was not offered was offered (use Nash pricing equilibrium).
- The profit inequality approach proposed in Pakes, Porter, Ho and Ishii (2015) and Pakes (2010).

Constant F case.

- x_j be a vector of 1's and 0's; 1 when the product is offered. Say e_z is vector with one in the "z" spot and zero elsewhere.
- Assume z had been added. Compute the the implied profits had the product not been added (unilateral deviation in a simultaneous move game).
- Let $\Delta\pi_j(x_j, x_j - e_z, x_{-j}) \equiv \pi_j(x_j, x_{-j}) - \pi_j(x_j - e_z, x_{-j})$.
- \mathcal{I}_j is the agent's information set. z_j added because

$$E[\Delta\pi_j(x_j, x_j - e_z, x_{-j})|\mathcal{I}_j] \geq F.$$

- Average over all the products introduced and assume agents' expectations are unbiased. \Rightarrow a consistent lower bound for F .
- If z is a feasible addition that was not offered and $\Delta\pi_j(x_j, x_j + e_z, x_{-j}) \equiv \pi_j(x_j, x_{-j}) - \pi_j(x_j + e_z, x_{-j})$, then

$$E[\Delta\pi_j(x_j, x_j + e_z, x_{-j})|\mathcal{I}_j] \leq F.$$

which gives us an upper bound to F .

Complications: Non-constant F .

- If the fixed costs are a function of observed characteristics of the product all we need is more complicated moment inequality estimators (Chernozhukov, Hong, and Tamer. 2007; Andrews and Soares, 2011).
- Allowance for unobservable fixed cost differences that were known to the agents when they made their product choices implies that the products provided may have been partially selected on the basis of having lower than average unobservable fixed costs (and visa versa for those that were not selected). Need a selection correction.
- Alternatives considered in Manski (2003) and PPHI (2015); for an application which combines them see Eizenberg (2014).

Complications: Sunk (in contrast to Fixed) Costs.

- Find a z that was not marketed, and assume that the firm could have marketed it and commit to withdrawing it in the next period *before* competitors next period decisions are taken.
- Then our behavioral assumption imply that the difference in value between, (i) adding this z and then withdrawing it in the next period, and (ii) the value from just marketing the products actually marketed, would be less than zero. I.e.

$$E[\pi_j(x_j + e_z, x_{-j}) - \pi_j(x_j, x_{-j}) | \mathcal{I}_j] \leq F + \beta W,$$

$W \geq 0$ is the cost of withdrawing and β is the discount rate.

- Lower bounds require further assumptions, but the upper bound ought to be enough for examining extremely profitable repositioning moves following environmental changes (like those discussed in Nosko (2011)).

Selection of Equilibria for Counterfactuals.

Possibilities that have been used.

- Enumerate all possible (or at least all relevant) equilibria (used in Eizenberg, 2014).
 - Seems like there may be many, but investment history limits what can be supported. (see Lee and Pakes, 2009, for an example).
- Use a learning model to select among equilibria (used in Wollman, 2015).
 - Eg.s: best response, fictitious play (Fudenberg and Levine, 1998, for a discussion of alternatives.).
 - Will settle down at a Nash equilibrium. Repeat and get a probability distribution of possible equilibria.
 - Probably not suitable for major changes that induce experimentation (Doraszelski, Lewis, and Pakes, 2015).