When Does Procompetitive Entry Imply Excessive Entry?

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**Introduction**

- **Dixit-Stiglitz Monopolistic Competition under CES**

- **Two remarkable (but knife-edge) features:**
  - Markup Rate Invariance, particularly with respect to market size of the sector
  - Optimality of Free-Entry Equilibrium, efficient resource allocation within an MC sector.
    (Intersectoral allocation is generally inefficient even if all sectors are CES.)

- Departure from CES could make equilibrium entry *either*
  - Pro- or Anti-competitive: Market expansion $\rightarrow$ more product varieties $\rightarrow$ markup rate may go down or up
  - Excessive or Insufficient: too many varieties produced too little *or* too few varieties produced too much

- What do we know about
  - The condition for pro- vs. anti-competitive entry?
  - The condition for excessive vs. insufficient entry?
  - The relation between the two conditions?

- Generally, all $2 \times 2 = 4$ combinations are possible.
  - Comparative static questions like “pro- vs. anti-competitive” hinge on the *local* property of the demand system
  - Welfare questions like “excessive vs. insufficient” hinge on the *global* property
But, there are some close connections between the two conditions.

- **Two Sources of Externalities in Entry** (Introduction of a new product variety)
  - **Negative externalities (business stealing)**, entry reduces the profit of other firms → excessive entry
  - **Positive externalities (imperfect appropriability)**, entrants do not fully capture social surplus created → insufficient entry

Under CES, the two sources of externalities exactly offset with each other.

- Starting from the knife-edge CES benchmark, introducing
  - **Procompetitive effect amplifies** negative externalities (business stealing), tips the balance for **excessive entry**
  - **Anticompetitive effect mitigates** negative externalities (business stealing), tips the balance for **insufficient entry**

Only *suggestive*, because positive externalities (imperfect appropriability) may also be affected.

- That is why we ask: *When (i.e., under what additional restrictions)*
  - Is procompetitive entry excessive?
  - Is anticompetitive entry insufficient?
Three Classes of Homothetic Demand Systems: Matsuyama-Ushchev (2017)

- **H.S.A.** (Homotheticity with a Single Aggregator)
- **HDIA** (Homotheticity with Direct Implicit Additivity)
- **HIIA** (Homotheticity with Indirect Implicit Additivity)

which are pairwise disjoint with the sole exception of CES.

Here, we apply these 3 classes to the Dixit Stiglitz environment by imposing

- **Symmetry**
- **Gross Substitutability**

across a *continuum* of product varieties.
The Dixit-Stiglitz Environment: A General Case

A Sector consists of

- **Monopolistic competitive firms:** produce a continuum of differentiated *intermediate inputs varieties*, $\omega \in \Omega$
  - Fixed cost of entry, $F$
  - Constant marginal cost, $\psi$

*We can also allow multi-product MC firms, as long as they do not produce a positive measure of products.*

- **Competitive firms:** produce a single good by assembling intermediate inputs, using **CRS technology**

**CRS Production Function:**

$$X = X(x) \equiv \min_p \left\{ px = \int_{\Omega} p_\omega x_\omega d\omega \mid P(p) \geq 1 \right\}$$

**Unit Cost Function:**

$$P = P(p) \equiv \min_x \left\{ px = \int_{\Omega} p_\omega x_\omega d\omega \mid X(x) \geq 1 \right\}$$

**Duality Principle:** Either $X = X(x)$ or $P = P(p)$ can be used as a primitive of the CRS technology, as long as linear homogeneity, monotonicity and quasi-concavity are satisfied.
Demand Curve for $\omega$

$$x_{\omega} = X(x) \frac{\partial P(p)}{\partial p_{\omega}}$$

Inverse Demand Curve for $\omega$

$$p_{\omega} = P(p) \frac{\partial X(x)}{\partial x_{\omega}}$$

Market Size of the Sector

taken as exogenous

Revenue Share of $\omega$

$$s_{\omega} = \frac{p_{\omega} x_{\omega}}{p x} = \frac{p_{\omega} x_{\omega}}{P(p)X(x)}$$

Price Elasticity of $\omega$:

$$\zeta_{\omega} = -\frac{\partial \ln x_{\omega}}{\partial \ln p_{\omega}}$$

$$\zeta_{\omega}(p_{\omega}, p) = 1 - \frac{\partial \ln \left( \frac{\partial \ln P(p)}{\partial \ln p_{\omega}} \right)}{\partial \ln p_{\omega}}; \quad \zeta_{\omega}(x_{\omega}, x) = \left[ 1 - \frac{\partial \ln \left( \frac{\partial \ln X(x)}{\partial \ln x_{\omega}} \right)}{\partial \ln x_{\omega}} \right]^{-1}$$

Under general CRS, little restrictions on $\zeta_{\omega}$ beyond the homogeneity of degree zero in $(p_{\omega}, p)$ or in $(x_{\omega}, x)$.

Under CES, $\zeta_{\omega}$ is constant, independent of $(p_{\omega}, p)$ and of $(x_{\omega}, x)$. 
### Symmetric H.S.A., HDIA, and HIIA

<table>
<thead>
<tr>
<th></th>
<th>( P(p) ) or ( X(x) )</th>
<th>Revenue Share: ( s_\omega )</th>
<th>Price Elasticity: ( \zeta_\omega )</th>
<th>For CES</th>
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<tr>
<td><strong>H.S.A.</strong></td>
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<td>( P(p) ) / ( cA(p) )</td>
<td>( \exp \left[ - \int_\Omega \left[ \int_{p_\omega / A(p)}^z s(\xi) \frac{d\xi}{\xi} \right] d\omega \right] )</td>
<td>( s \left( \frac{p_\omega}{A(p)} \right) ) with ( \int_\Omega s \left( \frac{p_\omega}{A(p)} \right) d\omega = 1 )</td>
<td>( \zeta \left( \frac{p_\omega}{A(p)} \right) \equiv 1 - \frac{zs(z)}{s(z)} \bigg</td>
<td><em>{z=p</em>\omega / A(p)} &gt; 1 )</td>
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<td>( X(x) / ( cA^*(x) )</td>
<td>( \exp \left[ \int_\Omega \left[ \int_0^{x_\omega / A^<em>(x)} s^</em>(\xi) \frac{d\xi}{\xi} \right] d\omega \right] )</td>
<td>( s^* \left( \frac{x_\omega}{A^<em>(x)} \right) ) with ( \int_\Omega s^</em> \left( \frac{x_\omega}{A^*(x)} \right) d\omega = 1 )</td>
<td>( \zeta^* \left( \frac{x_\omega}{A^<em>(x)} \right) \equiv \left[ 1 - \frac{ys^</em>(y)}{s^*(y)} \bigg</td>
<td><em>{y=x</em>\omega / A^*(x)} \right]^{-1} &gt; 1 )</td>
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<td><strong>HDIA</strong></td>
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<td>Kimball</td>
<td>( \int_\Omega \phi \left( \frac{x_\omega}{X(x)} \right) d\omega = 1 )</td>
<td>( \frac{x_\omega}{C^<em>(x)} \phi' \left( \frac{x_\omega}{X(x)} \right) ) with ( C^</em>(x) \equiv \int_\Omega x_\omega \phi' \left( \frac{x_\omega}{X(x)} \right) d\omega )</td>
<td>( \zeta^{D} \left( \frac{x_\omega}{X(x)} \right) \equiv - \frac{\phi(y)}{y \phi'(y)} \bigg</td>
<td><em>{y=x</em>\omega / X(x)} &gt; 1 )</td>
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<td><strong>HIIA</strong></td>
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<td>( \int_\Omega \theta \left( \frac{p_\omega}{P(p)} \right) d\omega = 1 )</td>
<td>( \frac{p_\omega}{C(p)} \theta' \left( \frac{p_\omega}{P(p)} \right) ) with ( C(p) \equiv \int_\Omega p_\omega \theta' \left( \frac{p_\omega}{P(p)} \right) d\omega )</td>
<td>( \zeta^{I} \left( \frac{p_\omega}{P(p)} \right) \equiv - \frac{z \theta'(z)}{\theta(z)} \bigg</td>
<td><em>{z=p</em>\omega / P(p)} &gt; 1 )</td>
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with some restrictions on \( s(\cdot) \) or \( s^*(\cdot), \phi(\cdot), \theta(\cdot) \) to ensure
- the monotonicity and quasi-concavity of \( P(p) \) or \( X(x) \)
- the gross substitutability, as well as the existence and the uniqueness of the free-entry equilibrium.
Appealing features of these three classes

**Homothetic:**
- To isolate the efficiency effect of the markup rate response to market size, we need to avoid introducing the scale effect of market size due to nonhomotheticity.
- To keep it useful for a building block in a multi-sector setting.
- Without homotheticity, we also need to worry about the composition of market size.

**Nonparametric:** To avoid functional form restrictions.
- But we develop many parametric examples to illustrate our results in the paper.

**Tractable,** because entry and pricing behavior of other firms affect
- Revenue share only through a single aggregator under H.S.A; and two aggregators under HDIA & HIIA.
- Price elasticity only through a single price (or quantity) aggregator under all three classes
  - A single aggregator captures the effect of competition on the markup rate.
  - Comparative statics results dictated by the derivative of the price elasticity function which help to find
- The conditions for the existence and uniqueness of free-entry equilibrium.
- The condition for procompetitive vs anticompetitive.
- The condition for excessive vs insufficient.
- the relation between the last two conditions.
Main Results: In all three classes,

- Procompetitive Entry $\iff$ Strategic complementarity $\iff$ Marshall’s 2nd Law(Incomplete Pass-Through). These equivalences do not hold in general, including many commonly used non-CES demand systems!!

- Entry is excessive if globally procompetitive; insufficient if globally anticompetitive. (sufficient but not necessary)

- Entry is procompetitive & excessive for a sufficiently large market size in the presence of the choke price.

Cautionary Notes on interpreting these results

- We model a MC sector as a building block in a multi-sector model.
- We do not assume that an economy has only one MC sector.
- The MC sector we model may coexist with other sectors, which may not have to be MC.
- We study distortion of intra-sectoral allocation conditional on the size of the sector.
- In a multisector setting, inter-sectoral allocation is generally distorted even if all sectors are MC under CES.
One Frequently Asked Question

What are the relative advantages of the three classes for applications?

We believe that H.S.A. has advantages over HDIA and HIIA, because

- the revenue share functions, $s_\alpha(\cdot)$, are the primitive of H.S.A. and hence it can be readily identified by typical firm level data, which has revenues but not output.

- With free-entry, easier to ensure the existence and uniqueness of equilibrium und characterize the equilibrium and conduct comparative statics under H.S.A., because
  - For H.S.A., one need to pin down the equilibrium value of only one aggregator in each sector.
  - For HDIA and HIIA, one need to pin down the equilibrium values of two aggregators in each sector.
Related Literature
Excessive entry in *homogeneous good oligopoly*: Mankiw-Whinston (1986), Suzumura-Kiyono (1987)

**Macro Misallocation**, starting with Hsieh-Klenow (2009)

**MC under non-CES**: Thisse-Ushchev (2018) for an overview
- Parenti-Thisse-Ushchev (2017) studied the uniqueness, symmetry, and the “pro- vs. anti-competitive” under general symmetric demand but only under the conditions given in reduced form.
- **MC under nonhomothetic non-CES**, *Blue compare the equilibrium and optimum.*
  - DEA: $U = \int_{\Omega} u(x_\omega)d\omega$. Dixit-Stiglitz (1977), Zhelobodko et.al.(2012), Dhinra-Morrow(2019), Behrens et.al.(2020). Under DEA, markup rate unaffected by market expansion through higher spending
    Under LQ, markup rate goes up (down) due to market expansion via higher spending (more consumers).
- **MC under homothetic non-CES** *None compare the equilibrium and the optimum.*
  - Feenstra (2003)’s translog, a special case of H.S.A.
    - Functional form implies procompetitive entry and choke price.
    - Our analysis suggests excessive entry.
    - Under the popular functional form used in calibration study, non-existence of equilibrium under free entry
    - We identify the conditions for the existence & uniqueness of free-entry equil. for each of the 3 classes.
  - Bucci-Ushchev (2021) uses general homothetic.
This is a part of our big project!!

**Matsuyama-Ushchev (2017)**, “Beyond CES: Three Alternative Classes of Flexible Homothetic Demand Systems” Propose the same 3 classes more broadly, which allow us to introduce Asymmetric Demand Across Sectors with
- a mixture of gross complements and gross substitutes
- a mixture of essential and inessential sectors, etc.

**Matsuyama-Ushchev (2020)** “Constant Pass-Through” Propose and characterize parametric families within each of the 3 classes
- with firms heterogenous in many dimensions (market size, quality, substitutability, productivity)
- key restriction that buys us a lot of tractability: constant pass-through rate among MC firms

**Matsuyama-Ushchev (2020)** “Destabilizing Effects of Market Size in the Dynamics of Innovation” Replace CES with H.S.A. in a dynamic MC model of innovation cycles and show, under the procompetitive effect
- Under the procompetitive effect, large market size makes the dynamics of innovation more volatile

**Matsuyama-Ushchev (coming soon!)** “Procompetitive Effect and Selection and Sorting of Heterogenous Firms” Replace CES with H.S.A. to introduce the procompetitive effect in a Melitz-type MC model,
- Large market size leads to more selection of more productive firms in a closed economy
- More productive firms self-select to larger regions in a spatial model.

In the last two, we use H.S.A. not HDIA or HIIA, for the ease for ensuring the existence & the uniqueness of equilibrium.
Summing Up:

**Dixit-Stiglitz under 3 classes of homothetic demand systems**

- **H.S.A.** (Homotheticity with a Single Aggregator)
- **HDIA** (Homotheticity with Direct Implicit Additivity)
- **HIIA** (Homotheticity with Indirect Implicit Additivity)

- mutually exclusive except CES.
- entry and behavior of other firms affect
  - revenue and profit of each firm only through one aggregator (for H.S.A.) or two aggregators (for HDIA and HIIA)
  - its price elasticity only through a single aggregator (for all three classes)
- flexibility and tractability allow us to identify the conditions for
  - the existence of the unique symmetric free entry equilibrium
  - the non-existence for an asymmetric free-entry equilibrium
  - procompetitive vs. anticompetitive
  - excessive vs. insufficient entry

as well as the relation between the last two conditions

- Main findings
  - Procompetitive entry ⇔ Strategic complementarity ⇔ Marshall’s 2nd Law (Incomplete pass-through).  
    **Generally not true!!**
  - Entry is excessive (insufficient) if it is *globally* procompetitive (anticompetitive)
  - Entry is procompetitive and excessive for a large market size with the choke price