Reconciling Markup Behavior under Trade and FDI: 
Gravity versus Market Power in a Ricardian World

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This draft: 8 September 2010
PRELIMINARY AND INCOMPLETE

Abstract

While classic trade theory predicts that both trade and FDI reduce markups, empirical studies show that firms’ markups over marginal cost fall under trade liberalization, but increase with FDI. Our model of trade and foreign direct investment builds on firm heterogeneity, strategic pricing behavior, and an endogenous market structure to explain this dichotomy and derive its implications for prices. Either trade or FDI by itself reduces prices, but the result with both can be ambiguous if multinationals engage in strategic takeovers of their competitors.

*The authors thank Andrew Bernard, Jonathan Eaton, Cecilia Fieler, Ann Harrison, James Markusen, Adam Russ, Ina Simonovska, Barbara Spencer, Deborah Swenson, Andreas Waldkirch, and especially Stefania Garetto, Robert Feenstra, and Peter Neary for helpful suggestions, as well as participants at the 2010 American Economics Association Winter Meetings and the 2010 Western Economics Association International meetings.

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1 Introduction

An impressive list of empirical studies\(^1\) demonstrates that trade liberalization is associated with firms charging lower markups over marginal costs when setting prices. A smaller literature demonstrates that foreign direct investment (FDI) also generates higher markups or profit margins in target firms following foreign takeovers and that foreign greenfield investments show a similar pattern compared to domestic firms. Studies in both classic (Krugman 1979) and new (Melitz and Ottaviano 2005, Bergin, Feenstra, and Hanson 2008) trade theory predict that markups should fall with trade liberalization due to increased competitive pressure on surviving firms. Yet neither classic theory nor the modern theory of trade with heterogeneous firms can explain observed increases in markups associated with FDI. We build a unified framework that can capture both phenomena in a general equilibrium setting with homothetic preferences.

Stephen Hymer (1960,1976) states two principal factors that would compel a firm to control an enterprise in a foreign country. The first is that it might be possible to eliminate the competition between them, increasing the acquiror’s market power. The second is to exploit firm-specific competencies or technological advantages. Advances in modern trade theory fomented several models to examine the effects of technological advantages, including Helpman, Melitz, and Yeaple (2003) and Nocke and Yeaple (2005). These models rely on a constant elasticity of substitution across a continuum of goods to limit the market share of any individual firm, even if it is far more efficient than its average rival. The love of variety prevents any firm from absorbing the entire market share no matter how superior its technology or how low its price. They provide a window on the interesting tradeoff between exporting and investing abroad for greenfield foreign direct investment (FDI) and cross-border mergers and acquisitions (M&A), showing that FDI allows the most technologically efficient firms to capitalize upon their superiority, as their tariff-jumping gives them an additional cost advantage over exporters, boosting their market share above what the technological edge by itself would imply. Nonetheless, the preference structure imposes a constant markup in price setting, precluding the type of strategic behavior that constitutes Hymer’s first motivating factor behind cross-border takeovers. We show that

\(^{1}\)See for instance Levinsohn 1993, Harrison 1994, and Feenstra and Weinstein 2010, as well as other papers discussed in Section 3 below.
the same effect is possible with greenfield investment, as well.

Neary (2008) explores this strategic basis for cross-border M&As in an innovative way. He shows that trade liberalization can trigger waves of cross-border M&As, as firms hurry to buy up new rivals in foreign countries and shut them down to eliminate price competitors. The result is an increase in prices and firm profits, extremely plausible in a world characterized by the market concentration that accompanies the existence of enormous multinational firms. At the same time, the annihilation mechanism driving the result precludes any potential benefits of FDI for firm profits (and consumer welfare) stemming from the transfer of technology across countries. Our model addresses the effects of both strategic behavior and technological advantage, providing a unified framework to evaluate the impacts of FDI on prices, profits, and welfare.

The intuition behind the result rests on a form of duopolistic competition modeled in the context of trade by Bernard, Eaton, Jensen and Kortum (2003). They use the CES love of variety to limit the market shares of heterogeneous firms. Only one firm ends up supplying each good, similar to the Dixit-Stiglitz model of monopolistic competition. However, the supply side of the market for each good in the continuum is characterized by a fierce competition among a group of firms competing to be the sole producer. The most efficient firm in this group ultimately becomes the only supplier of that particular good, but only because it beats back its competitors by underselling them: it can not charge a price higher than the marginal cost of its next best rival. The low-cost supplier can not automatically charge the CES markup despite the CES preferences. Rather, if the competition is sufficiently strong, it must charge a price equal to the marginal cost of its next best rival. The CES markup becomes the maximum markup that it might charge over its own marginal cost without jeopardizing profits, not the default markup.

On average, takeovers increase markups and reduce prices in the host country. When a cross-border takeover transfers a superior foreign technology to a local target firm, the target becomes even more efficient than its next best local competitor, increasing the markup. At the same time, the marginal cost of the next best local rival has not changed, so the acquired firm can not increase increase its price and may even end up cutting it, passing on some of its technological efficiency gains to consumers. We show that prices can only increase if a cross-border takeover allows a multinational firm to segment the market for its good so that it can price discriminate beyond the extent possible solely due to frictions in goods markets.

The challenge is to fit this competitive effect in a framework which also captures ob-
served reductions in markups under trade, as the distribution of markups does not change with trade liberalization in the BEJK framework. To do this, we generalize the BEJK framework to allow for an endogenous number of rival competitors in each industry. This entry does not affect the number of goods produced, but rather the number of firms competing to be the low-cost supplier of a particular good. “Competing” in this sense means drawing an efficiency parameter from an identical distribution and being ready to jump into production if a chance arises to undersell an active firm. The most efficient firm will have the lowest cost, the first order statistic for costs in the industry, and become the only active supplier. An increase in the number of firms that compete to be the low-cost supplier of a good changes the shape of the entire distribution of marginal costs and lowers the expected value of the first order statistic. Naturally, higher entry in all industries reduces the aggregate price level. Openness to trade has an effect that is similar to increasing domestic entry, so that higher geographic frictions impede trade as in BEJK, but also increase suppliers’ market power, allowing them to charge higher markups. A new result in the heterogeneous firm literature is that trade can also increase efficiency by encouraging more entry, which in our framework changes the entire shape of the distribution of efficiency levels among active firms, moving the mass toward the upper end of the distribution.

We also show the importance of the pre-existing level of domestic competition when evaluating the impact of FDI and trade on markups and prices. Higher domestic entry results in fewer firms charging the maximum markup, leaving less room for foreign competitors to challenge high profit margins in the domestic market. Thus, trade and FDI have a bigger effect on markups and prices in countries with few entrants, a situation that we call low contestability.

Section 2 presents a simple closed economy model with analytical solutions for the distribution of markups and prices, including contestability. Section 3 considers the transition from autarky to one with trade in goods without FDI. In Section 4, we contrast this case with that of FDI when no goods are traded and use closed-form solutions to illustrate the boost that cross-border takeovers give to markups in the host country. We then combine the two modes of market participation to examine their countervailing effects on markups and prices in the host versus source country given different degrees of contestability, market segmentation, and trade openness. We save discussion of empirical studies of markups under trade and FDI until Sections 3 and 4 to show the plausibility of our theoretical results. Section 5 concludes.
2 Autarky

The heart of the model lies in the production of intermediate goods by heterogeneous firms. For simplicity, we assume that producers of the final good are perfectly competitive and simply assemble the intermediate goods, with no additional capital or labor necessary. The continuum of intermediate goods $j$ spans the fixed interval $[0,1]$. The assembly process uses a technology involving a constant elasticity of substitution across inputs,

$$y = \left[ \int_0^1 Y(j)^{\frac{\sigma-1}{\sigma}} \, dj \right]^{\frac{\sigma}{\sigma-1}},$$

with elasticity of substitution $\sigma$ greater than one. The demand for an individual input is downward sloping in its price,

$$Y(j) = \left( \frac{P(j)}{P} \right)^{-\sigma} Y,$$

and the aggregate price level $P$ is given by

$$p = \left[ \int_0^1 P(j)^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}}.$$

Each producer of an intermediate good draws an efficiency parameter $z$ from a cumulative distribution $F(z)$ with positive support over the interval $(0,\infty]$. Eaton and Kortum (2009, Chapter 4) describe a process whereby over time, $F(z)$ can emerge as a frontier distribution representing the efficiency levels associated with the best surviving ideas available to produce a particular good $j$. Being the distribution of the best surviving ideas, this distribution naturally takes on an extreme value form and under mild assumptions, it can be characterized by a Fréchet distribution.\(^2\) Thus, we assume that a number of firms $n$ each

\(^2\)In particular, EK suppose that each period a group of new ideas emerges with the quality of these ideas distributed as Pareto. Over time, the distribution of the best (lowest cost) idea from each period then becomes Weibull. More generally, BEJK (2003) state that if firms draw from this frontier distribution, the lowest cost (the first order statistic) takes on a Weibull distribution. We note that the first order statistic of a Weibull distribution is also Weibull, so the underlying distribution from which firms are drawing their cost parameters can be reasonably modeled as Weibull, as we do here. Costs and efficiency levels are simply the inverse of one another, so that assumption implies efficiency levels distributed as inverse Weibull. The Fréchet distribution is isomorphic to an inverse Weibull distribution, so we can equivalently describe the
draw an efficiency parameter from a distribution given by

\[ F(z) = 1 - e^{-Tz^{-(\theta)}}. \]

We assume that \( T > 0 \) and also that the shape parameter, \( \theta \), is no less than \( \sigma - 1 \) to ensure the existence of certain moments of interest below. Only the most efficient firm with efficiency level \( Z_1(j) \) in any industry supplies the market. This efficiency parameter increases the level of output a firm produces from one unit of labor:

\[ Y(j) = Z_1(j)L(j). \]

We define a cost parameter as the inverse of the efficiency parameter,

\[ C_1(j) = \frac{wd}{Z_1(j)}. \]

The unit cost is equal to \( C_1(j) \), which accounts for both the cost of an input bundle, \( w = \omega^\alpha p^{1-\alpha} \), and any frictions involved in distribution of intermediate goods to the assemblers of the final good \( d \geq 1 \). As such, the cost parameter drawn by any firm hoping to produce good \( j \) is distributed

\[ G(c) = 1 - e^{-T(wd)^{-(\theta)c^{\theta}}}. \]

Given that \( r \) rivals draw an efficiency parameter hoping to be the low-cost supplier of industry \( j \), the distribution of the lowest cost \( C_1(j) \) is

\[ G_1(c_1) = 1 - e^{-rT(wd)^{-(\theta)c_1^{\theta}}}, \]

distribution from which firms draw their efficiency levels as Fréchet. We do this to match the model with the EK and BEJK terminology.

\(^3\)Here, \( \omega \) is the labor wage rate and \( p \) is the aggregate price level, so the cost of a bundle of intermediate goods.

\(^4\)See Rinne (2009), p.237 for derivation. EK and BEJK simplify their frameworks by using the underlying assumption that the number of firms competing to be the low-cost supplier in any industry is a random variable with a Poisson distribution. It elegantly drops from the analysis, though one could possibly interpret an increase in the technology parameter \( T \) in their model as an increase in the mean number of competitors because \( T \) enters their Fréchet distribution of surviving ideas through the Poisson exponent.
2.1 The distribution of markups

Let $C_2(j)$ represent the unit cost of the second-best competitor in industry $j$, who sits inactive but ready to begin production instantly should the opportunity arise. Given the CES assembly technology for the final good, the lowest-cost firm producing good $j$ would like to set a price that provides the maximum markup possible subject to demand— the CES markup, $\bar{m} \equiv \frac{\sigma}{\sigma - 1} > 1$. However, if charging the CES markup results in a price that exceeds the unit cost of the second-best competitor waiting in the wings, the low-cost supplier may find itself undersold. In short, no firm can charge a price that exceeds the unit cost of its next best rival. The low-cost supplier in each industry $j$ takes the prices of the low-cost supplier in every other industry as given. The markup for industry $j$ is then

$$M(j) = \min \left\{ \frac{C_2(j)}{C_1(j)}, \bar{m} \right\}.$$ 

With this formula for the markup, we compute the expected output-weighted price for any good $j$ in several steps. First, note that the price for good $j$, $P(j)$, is given either by

$$P(j) = \frac{C_2(j)}{C_1(j)} C_1(j) = C_2(j) \quad \text{for} \quad \frac{C_2(j)}{C_1(j)} \leq \bar{m},$$

or by

$$P(j) = \bar{m} C_1(j) \quad \text{for} \quad \frac{C_2(j)}{C_1(j)} \geq \bar{m}.$$ 

Thus, the pricing rule depends not only upon the distribution of the first and second order statistic of the unit costs, but also upon the distribution of the ratio of the two order statistics. Rinne (2009, p.243) provides a formula for the distribution of $\frac{C_1(j)}{C_2(j)}$. We apply a Jacobian transformation to find the distribution of $\frac{C_2(j)}{C_1(j)}$. Assuming that the frontier distribution of efficiency parameters is identical for every industry $j$, for values of the markup less than $\bar{m}$ the probability density of the markup is given by

$$h(m) = \frac{r(r-1)\theta m^{-(\theta+1)}}{[(r-1) + m^{-\theta}]^2}. \quad (1)$$

Like the distribution of markups given in BEJK, this distribution is entirely independent of $C_1(j)$ and $C_2(j)$. However, because we explicitly include the number of rivals $r$— rather than elegantly integrating it out to focus on the role of gravity in a Ricardian setting as they
do—we see that the distribution of markups is directly affected by the number of firms competing to be the low-cost supplier, a measure which we call contestability, drawing on work by Classens and Laeven (2004) and de Blas and Russ (2009). One can conceptualize $r$ as an exogenous policy parameter, as in the numerical analysis by de Blas and Russ (2009), or endogenize it using a free entry condition as in Melitz (2003). The key is that unlike models using a Pareto distribution of firm efficiency parameters, the degree of entry embodied in $r$ changes the shape of the entire distribution of markups, costs, and firm size. In the case of the markup, integrating $h(m)$ over values from $\bar{m}$ to $\infty$ gives the probability that a firm will charge the maximum CES markup,

$$\Pr[M(j) \geq \bar{m}] = \frac{r}{1 + (r - 1)\bar{m}^\theta}. \quad (2)$$

**Proposition 1:** The fraction of firms charging the maximum markup is decreasing in contestability $r$ under autarky.

**Proof:** Assuming that at least two firms compete in each industry and recalling that the maximum markup exceeds one for $\sigma > 1$, the derivative of this probability with respect to $r$ is negative:

$$\frac{\partial}{\partial r} \left[ \frac{r}{1 + (r - 1)\bar{m}^\theta} \right] = \frac{1 - r\bar{m}^\theta}{1 + (r - 1)\bar{m}^\theta} < 0.$$ 

As the number of rivals in an industry $j$ increases, the probability that firms will be able to charge the maximum markup falls—increased contestability squeezes markups.

### 2.2 The distribution of prices

The joint distribution for the first and second order statistic also contains the contestability measure $r$:

$$g_{1,2}(c_1, c_2) = r(r - 1) \left[ \theta T w^{-\theta} \right]^2 c_1^{\theta - 1} c_2^{\theta - 1} e^{-rT w^{-\theta}} e^{-T w^{-\theta} c_2^{\theta}(r-1)}.$$ 

To find the marginal distribution for $C_1(j)$ ($C_2(j)$), one can integrate the joint distribution over values of $c_2$ ($c_1$) from 0 to $\infty$. We find that increasing the number of rivals leads, on average, to lower costs in the industry. We compute a particular moment of interest, $1 - \sigma$, for the first and second order statistics that will be used below to construct the aggregate
price level

\[ E[C_1(j)^{1-\sigma}] = \int_0^\infty c_1^{1-\sigma} g_1(c_1) dc_1 = \left(rTw^{-\theta}\right)^{\frac{\sigma-1}{\theta}} \Gamma\left(1 - \frac{\sigma + \theta}{\theta}\right) \]

\[ E[C_2(j)^{1-\sigma}] = \int_0^\infty c_2^{1-\sigma} g_2(c_2) dc_2 = \left[T(r - 1)w^{-\theta}\right]^{\frac{\sigma-1}{\theta}} \Gamma\left(1 - \frac{\sigma + \theta}{\theta}\right). \]

Taking the derivative of \( E[C_1(j)^{1-\sigma}] \) and \( E[C_2(j)^{1-\sigma}] \) with respect to \( r \), we find that the \((1 - \sigma)\)th moment of the second-lowest cost increases in \( r \) faster than the same moment for the lowest cost.

\[ \frac{\partial E[C_2(j)^{1-\sigma}]}{\partial r} = \left(\frac{r}{r - 1}\right)^{\frac{\theta-(\sigma-1)}{\theta}} > 1, \]

In other words, the second-lowest cost is falling in \( r \) faster than the lowest cost, demonstrating how increases in contestability can reduce markups. Because the distribution of the markup is independent of outcomes for the individual order statistics \( C_1(j) \) and \( C_2(j) \), we can compute the expected price \( P(j)^{1-\sigma} \) as

\[ E[P(j)^{1-\sigma}] = \Pr[M(j) > \bar{m}] \bar{m}^{1-\sigma} E[C_1(j)^{1-\sigma}] + \Pr[M(j) \leq \bar{m}] E[C_2(j)^{1-\sigma}], \]

which is also increasing in \( n \). Since firms in all industries draw from the same underlying distribution, using the law of large numbers one can calculate the aggregate price level as

\[ p^{1-\sigma} = E \left[ \int_0^1 P(j)^{1-\sigma} dj \right] = \int_0^1 E[P(j)^{1-\sigma}] dj = E[P(j)^{1-\sigma}]. \]

**Proposition 2:** The aggregate price level is decreasing in the level of contestability under autarky for \( \theta \geq 1 \) and \( \theta \geq \sigma - 1 \).

*Proof* Intuitively, this is true because increases in \( r \) shift markups away from the maximum at the same time they reduce the first- and second-lowest unit costs on average. More rigorously, taking the derivative of \( p^{1-\sigma} = E[P(j)^{1-\sigma}] \) yields

\[ \frac{\partial p^{1-\sigma}}{\partial r} = \Pr[M(j) \geq \bar{m}] \frac{\partial E[\bar{m}C_1(j)^{1-\sigma}]}{\partial r} + (1 - \Pr[M(j) \geq \bar{m}]) \frac{\partial E[C_2(j)^{1-\sigma}]}{\partial r} 
- \frac{\partial \Pr[M(j) \geq \bar{m}]}{\partial r} \left(E[C_2(j)^{1-\sigma}] - E[(\bar{m}C_1(j))^{1-\sigma}]\right). \]
The first two terms on the right-hand side are positive, while it has been shown that the probability of charging the maximum markup is falling in $r$, making its partial derivative negative. The derivative is positive and $p^{1-\sigma}$ is increasing in $r$ as long as $E[(\bar{m}C_1)^{1-\sigma}] \leq E[C_2^{1-\sigma}]$. Using the expressions for $E[C_2(j)^{1-\sigma}]$ and $E[C_1(j)^{1-\sigma}]$ derived above, we see this is possible whenever $\bar{m}^\theta \geq \left( \frac{r}{r-1} \right)$. Assuming that there are at least two competitors in each industry, a sufficient condition is $\bar{m}^\theta \geq 2$, which one can see from a simple numerical analysis is satisfied by our assumption that $\theta \geq \sigma - 1$ a weak additional assumption, $\theta \geq 1$. The first is akin to the assumption that the Pareto shape parameter be at least as large as $\sigma - 1$ to ensure the existence of the moments used to compute the aggregate price level and plays the same role here. Since Eaton and Kortum (2002) and Simonovska and Waugh (2009) argue that $\theta$ and $\sigma$ play very similar roles in governing the distribution of firm size and bilateral trade patterns and estimate values for $\theta$ above 1, it is also reasonable to bound $\theta$ in the same way that we bound $\sigma$.

Thus, under autarky, the aggregate price level $p$ is decreasing (implying that real income is rising) in the number of rivals $r$ under standard constraints on the parameters $\theta$ and $\sigma$.

2.3 The number of rivals

The BEJK framework is attractive because it combines endogenous markups and firm heterogeneity with homothetic preferences that allow for general equilibrium solutions. In this section, we present the free entry condition that pins down the solution for $r$. The distribution of prices and markups is the same for any $j$ within a particular country, so from this point we drop the index $j$. We follow the existing literature by using $P$ and $Y$ to refer to the price of an individual good and the output of an individual firm. The lowercase letters $p$ and $y$ refer to the aggregate price level and aggregate output.

A free entry condition limits the number of rivals $r$ competing to be the low-cost producer of any good $j$. We assume that there is a uniform probability of death, $0 < \delta < 1$, in every period and that a startup cost must be paid by the active supplier of each good in the first period that the firm begins supplying the market. This startup cost is equal to a fraction of output, $0 < \kappa < 1$, in the first period of active production. In equilibrium, the number of rivals must be such that the expected present discounted value of output for an
active producer equals the startup cost,

$$\sum_{s=0}^{\infty} \delta^{t+s} [PY - C_1Y] \equiv \kappa C_1 Y,$$

yielding the expression

$$\frac{E[M^{1-\sigma}]}{E[M^{-\sigma}]} = (1 + \delta \kappa).$$

In the Appendix, we show that the left hand side is decreasing in \( r \), resulting in a unique equilibrium solution. More intuitively, if an infinite number of entrepreneurs were to compete in the industry, the markup would fall to 1, with zero marginal profit and negative expected net profit because the most efficient producer would still have to pay the startup cost. Thus, in equilibrium, there must be some finite number of rivals such that expected net profit is zero.

Recall that the probability of forced exit is independent of firm efficiency and that the distribution of the markup is independent of the distribution of costs,\(^5\) so the free entry condition reduces to\(^6\)

$$E[\ln M] \geq \ln(1 + \delta \kappa).$$

Noting that \( E[M] \geq \ln E[M] \) and using Jensen’s inequality, we have

$$E[M] \geq \ln E[M] \geq E[\ln M] \geq \ln(1 + \delta \kappa) \quad (3)$$

The mean markup, \( E[M] \), is decreasing in the number of rivals for reasonable parameterizations,\(^7\) meaning that entrepreneurs will keep “entering” the industry (i.e., draw a productivity parameter) to the point that the net markup an entrepreneur expects to charge if it is the low-cost supplier is no lower than the fraction of first-period output that must be set aside as the startup cost, discounted by the probability of a forced exit. Since the mean markup is decreasing in the number of rivals \( r \), it is clear that the maximum number of rivals is decreasing in the fixed cost parameter \( \kappa \) and the exit rate \( \delta \).

The distribution of the markup derived above does not yield a closed-form solution for the expected markup \( E[M] \) or for the expected log markup, \( E[\ln M] \). However, we can express the minimum number of rivals as a function of the expected log markup and

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\(^5\)To see this, note that the cost parameters \( C_k \) do not enter into the expression for \( h(m) \) for \( k \in \mathbb{N} \).

\(^6\)See Appendix A for derivation and proof of existence.

\(^7\)See Appendix B for proof.
derive a closed form solution for the maximum number of rivals. Let \( V = \ln M \) and define \( f(\cdot) = \ln(\cdot) \). Then the probability density for \( V \) is a simple transformation of \( h(m) \),

\[
h_V(v) = e^v h(e^v) I_{\mathbb{R}_+}(v)
\]

\[
= e^v r(r - 1) \theta (e^v)^{-\theta+1} \left[ (r - 1) + (e^v)^{-\theta} \right]^2.
\]

The probability that \( V \geq \bar{m} \) is then

\[
\int_{\ln(\bar{m})}^{\infty} e^v r(r - 1) \theta (e^v)^{-\theta+1} \left[ (r - 1) + (e^v)^{-\theta} \right]^2 dv = \frac{r}{1 + (r - 1)e^{\theta \bar{m}}}.
\]

Using a generalized version of Chebyshev’s inequality\(^8\), we have

\[
\bar{m} \Pr[\ln M \geq \bar{m}] \leq \frac{E[\ln M]}{r \bar{m}} \leq E[\ln M]
\]

\[
r \geq \frac{E[\ln M](e^{\theta \bar{m}} - 1)}{E[\ln M]e^{\theta \bar{m}} - \bar{m}}.
\]

As noted previously, the expected markup and the number of rivals is inversely related, a relationship seen here in the upperbound for \( r \). When \( E[M] \) falls, the lowerbound increases, and vice versa. We know from (2.3) that the expected gross markup \( E[M] \) must be at least as large as the gross per-period cost of production, \( (1 + \delta \kappa) \).

\[
\frac{\ln (1 + \delta \kappa) (e^{\theta \bar{m}} - 1)}{\ln (1 + \delta \kappa) e^{\theta \bar{m}} - \bar{m}} \geq r \geq \frac{E[\ln M](e^{\theta \bar{m}} - 1)}{E[\ln M]e^{\theta \bar{m}} - \bar{m}}.
\]

When either the fixed cost parameter \( \kappa \) or the probability of default \( \delta \) increase, the maximum number of rivals falls. Note also from Eq.(2)) that increasing the number of rivals acts as a positive technology shock, just as increasing \( T \) would.

Normalizing the wage \( \omega \) to equal 1, the model is easily closed by imposing the standard consumer budget constraint.

\(^8\)See Theorem 5 in Mood, Graybill, and Boes (1974, p.71): For a random variable \( X \), a nonnegative function \( g(\cdot) \), and a scalar \( k > 0 \), then \( k P[g(X) \geq k] \leq E[g(X)] \).
3 Trade in goods

Here we demonstrate that trade not only shifts production toward lower-cost producers in the classic Ricardian sense, but also reduces markups in countries with low contestability, lowering the aggregate price level for all trading partners. This squeeze on markups generates a gain from trade that is new to the BEJK framework. Trade also encourages increased entry (higher $r$), which itself also reduces markups, generating a second gain from trade that is new to the BEJK framework, though not to Melitz and Ottaviano (2005). The increase in entry, however, also itself shifts the distribution of efficiency levels among active firms to the right, which is not captured by either BEJK or Melitz and Ottaviano (2005). The increase in entry acts both as a technological advance and an increase in contestability. Thus, trade always reduces the prices of imported goods relative to autarky when there are no multinationals present. We will also show how geography, or trade frictions, interferes with all three of these sources of welfare gains.

Again, we drop the industry index $j$ to simplify notation. This is possible because in both autarky and the open economy, the same distributions apply to each industry within a particular country. We also add the subscript $n$ to the notation $C_k(j)$, $g_k(c)$, etc., from the autarkic case to denote the producer native to country $n$ with the $k^{th}$ lowest cost for good $j$, so that it becomes $C_{kn}$, $g_{kn}(c)$, etc., where $k$ is a positive integer. We assume that Eaton and Kortum’s no arbitrage condition for trade costs holds: $d_{ni} < d_{ui}d_{nu}$.

Let $G_{1n}^T(c)$ be the probability that the low-cost supplier of a good $j$ to the home country $n$ has a unit cost less than or equal to some level $c_1$. The probability is equal to one minus the probability that any potential supplier (including the one in the home country) has a unit cost greater than $c_1$. The cumulative distribution for low-cost suppliers under trade is thus

$$G_{1n}^T(c_1) = \Pr[C_{1n}^T \leq c_1] = 1 - \prod_{i=1}^{N} [1 - G_{1ni}(c_1)]$$

$$= 1 - e^{-\Phi_n^T c_1},$$

where $G_{1ni}(c_1)$ is the distribution of low-cost suppliers to $n$ from country $i$, $\Phi_n^T = \sum_{i=1}^{N} T_i(w_i d_{ni})^{-\theta} r_i$, and $d_{ni} \geq 1$ is an iceberg trade cost involved in shipping goods from country $i$ to country $n$. It is straightforward to show that the probability that a country exports to $n$ is the
same as in Eaton and Kortum (2002) and BEJK, but allowing for contestability:

\[ \pi_{ni} = \Pr[\text{EXPORT}_{ni}] = \frac{T_i(w_i d_{ni})^{-\theta} r_i}{\Phi_n^T}. \]

We can compute the full distribution of markups under costly trade with asymmetric countries. Let \( \psi^T_{ni} \) be the probability that the two best rivals to supply country \( n \) both originate in country \( i \). Then, it must be that the two best rivals in a particular industry in country \( i \) are more efficient (have lower unit costs) than any other potential suppliers of the good to country \( n \). The probability that this occurs is

\[
\psi^T_{ni} = \int_0^\infty g_{2ni}(c_2) \prod_{u \neq i} [1 - G_{1nu}(c_2)] dc_2 = \frac{(r_i - 1)T_i (w_i d_{ni})^{-\theta}}{\Phi_n^T}
\]

and the full distribution of markups in country \( n \) under trade, \( h_n^T(m) \), is given by

\[
h_n^T(m) = \sum_{i=1}^N \psi_{ni} h_i(m) + \sum_{i=1}^N (1 - \psi_{ni}) h_{ni}^{T,D}(m),
\]

where \( h_i(m) \) is simply the distribution of markups in country \( i \) as given under autarky and \( h_{ni}^{T,D}(m) \), derived in the Appendix, is the distribution of markups when the first- and second-best suppliers are from two different countries, \( i \) and \( u \neq i \), respectively.

The distribution \( h_{ni}^{T,D}(m) \) itself is a compound distribution,

\[
h_{ni}^{T,D}(m) = \sum_{i \neq u}^{N-1} \psi_{niu} h_{niu}(m),
\]

where \( \psi_{niu} = \frac{r_u T_u (w_u d_{nu})^{-\theta}}{\Phi_n^T - r_i T_i (w_i d_{ni})^{-\theta}} \) is the probability that the second-best rival to country \( i \) when supplying a particular good to country \( n \) is from country \( u \neq i \), and \( h_{niu}(m) \) is the distribution of markups given that the first- and second-best suppliers come from these
two countries,

\[ h_{niu}(m) = \int_0^\infty c_1 g_{1ni}(c_1) g_{1nu}(mc_1) dc_1. \]

We derive this distribution in the Appendix, but here focus on the resulting probability that the supplier charges the maximum markup when its next-best rival is an exporter in

\[ \text{Pr}[M \geq \bar{m}] = \frac{r_i T_i (w_i d_{ni})^{-\theta} - \theta r_i T_i (w_i d_{ni})^{-\theta} + r_u T_u (w_u d_{nu})^{-\theta} \bar{m} \theta}{r_i T_i (w_i d_{ni})^{-\theta} + r_u T_u (w_u d_{nu})^{-\theta} \bar{m} \theta}. \]

One can see immediately that the supplier to \( n \) exporting from country \( i \) will be more likely to charge the maximum markup when its next-best rival (1) resides in a country far from the destination country \( n \) (high \( d_{nu} \)), or (2) resides in a country with low contestability, low technology, or a high wage relative to country \( i \). The country-\( i \) supplier’s own distance from the destination country lowers the probability that it can charge the maximum markup. If all countries are identical, this probability reduces to \( \frac{1}{1 + \bar{m} \theta} \), which is easily shown to be lower than the probability under autarky in Eq.\((2)\)). Thus, the only way that markups would increase under trade is if the home country \( n \) opened its borders to trade with a world dominated by one country that was much closer than other trading partners (low \( d_{ni} \)) and was far superior to all other countries by having greater contestibility (high \( r_i \)), a much lower input costs (low \( w_i \)), or very advanced technology (high \( T \)).

To illustrate more intuitively how trade affects the full distribution of markups, it is useful to suppose for a moment that countries are identical and trade is costless, so that \( T_i = T, w_i = w \equiv 1 \), and \( d_{ni} = 1 \) for all \( i \). Then we see that the distribution for the lowest unit costs among all potential suppliers to country \( n \) reduces to the Weibull distribution

\[ G_{1n}^T(c_1) = 1 - e^{-rNTc_1^\theta}, \]

which is observationally equivalent to a world with \( R = rN \) rivals all drawing from an underlying distribution takes the same form as the distribution of cost parameters for any individual country, \( G^T(c) = 1 - e^{-Tc^\theta} \). The distribution of markups in this special case

---

9 See Mood, Graybill and Boes (1974, pp.187-88) for a description of the transformation method used to find the distribution of the quotient of two random variables.

10 The distribution of first order statistics for samples drawn from a Weibull distribution is also Weibull.
takes the form

\[ h^T(m) = \frac{R(R - 1)\theta m^{-(\theta + 1)}}{[(R - 1) + m^{-\theta}]^2}. \]

The implication is clear: trade has the same effect on the distribution of markups as increasing contestability and therefore reduces the number of firms charging the maximum markup and, all else equal, the aggregate price level, which takes the same form as under autarky, but replacing \( r \) with \( R > r \). The result can be summarized as follows:

**Proposition 3:** In a world with symmetric countries, free trade reduces the average markup and the aggregate price level by increasing contestability.

This result echoes that of Bergin, Feenstra, and Hanson (2009) and Melitz and Ottaviano (2008), but now within the *homothetic* preference structure of Bernard, Eaton, Jensen, and Kortum (2002). Note that increasing the number of trading partners has a similar effect to increasing the number of rivals in any trading partner, similar to the numerical solutions calculated in Garretto (2010). In numerical simulations using the BEJK framework, de Blas and Russ (2009) demonstrate the effect of increasing contestability on markups under trade. Under costless trade, it does not matter how the rivals are distributed across countries. Markups respond as though all entrants worldwide compete on equal footing to be the low-cost supplier. As in classic studies of trade and endogenous market structure, geographic frictions here increase market power, dampening the effect of foreign industrial structure on domestic markups and prices.

Trade also lowers the aggregate price level, since a country will never import a good with a higher price than it pays under autarky and the second-best competitor will never be less efficient than the second-best competitor under autarky. Crucial to this point is the assumption of constant returns to scale. To quantify the impact on the aggregate price level this, we can compute

\[
(p^T_n)^{1-\sigma} = E[(P^T_n)^{1-\sigma}] = \Pr [M^T_n > \bar{m}] \bar{m}^{1-\sigma} E[(C^T_{1n})^{1-\sigma}] + \Pr [M^T_n \leq \bar{m}] E[(C^T_{2n})^{1-\sigma}],
\]

and note that

\[
E[(C^T_{1n})^{1-\sigma}] = \int_0^\infty c_1^{1-\sigma} g^T_{1n}(c_1) dc_1 = (\Phi^T_n)^{\frac{\alpha-1}{\sigma}} \Gamma \left( \frac{1-\sigma + \theta}{\theta} \right),
\]

which is strictly greater than its counterparts under autarky. It is less straightforward
to show that $E[(C_{2n}^T)^{1-\sigma}] > E[(C_{2n})^{1-\sigma}]$ when countries and trade costs are asymmetric. Assuming that countries are identical and that trade is costless, $E[(C_{2n}^T)^{1-\sigma}]$ takes the exact form of its counterpart under autarky, only substituting $R > r$ for the number of rivals, making $E[(C_{2n}^T)^{1-\sigma}]$ greater than its counterpart under autarky, as well. Intuitively, it is clear that the second-best rival producer of a good $j$ in the entire world (including the home country) by definition could not charge a price any higher than the second-best rival under autarky, even if countries are not identical and trade is costly.

The probability of exporting to a country $n$ can be used to formulate the free entry condition:

$$\frac{1}{\delta} \sum_{i=1}^{N} \pi_{in} E[P_i Y_i - C_{1i} Y_i] = \kappa C_{1n} Y_n.$$ 

To see how free trade affects entry, it is convenient to suppose that there are $N = 3$ identical countries and that $d_{in} = d > 1$ for all $i \neq n$. In this case, we have

$$\frac{E[M^{1-\sigma}]}{E[M^{-\sigma}]} = \ln \left[ 1 + \frac{\delta \kappa}{1 + (N-1)d} \right].$$

Since the left-hand side is decreasing in $r$ and $\ln \left[ 1 + \frac{\delta \kappa}{1 + (N-1)d} \right] < 1 + \delta \kappa$, it is clear that the possibility of exporting strictly increases entry.\(^\text{11}\) And a higher trade cost $d$ reduces entry, but not in a linear fashion. Thus, the effect of incremental reductions in the trade cost on the import penetration ratio is no longer a constant, which Arkolakis, Costinot, and Rodriguez-Clare (2010) report is the case for the BEJK model without entry. As in the variablemarkup frameworks of Melitz and Ottaviano (2005) and Feenstra and Davis (2009), entry changes the effective elasticity of demand (the price-elasticity of marginal revenues), even though the Dixit-Stiglitz elasticity of demand governing the upperbound for the markup is a constant. Trade can create welfare gains not only through productivity-based comparative advantage, but also by reducing firms’ market power.

\(^{11}\)Obviously, trade also increases the upperbound for the number of entrants:

$$\frac{\ln \left( 1 + \frac{\delta \kappa}{1 + (N-1)d} \right) (e^{\theta \bar{m}} - 1)}{\ln \left( 1 + \frac{\delta \kappa}{1 + (N-1)d} \right) e^{\theta \bar{m}} - \bar{m}} \geq r \geq \frac{E[\ln M(j)](e^{\theta \bar{m}} - 1)}{E[\ln M(j)]e^{\theta \bar{m}} - \bar{m}}$$
3.1 Stylized facts regarding trade and markups

[TO BE COMPLETED]

4 Cross-border takeovers without trade

Suppose that a country or industry is open to cross-border takeovers but not to trade. A foreign firm can acquire a domestic one, replacing the domestic technology with its own. An asterisk denotes prices, costs, and markups charged by foreign-owned firms in the host country. To clarify the intuition behind the increase in markups that occurs as a result, we first suppose that no trade in goods occurs, forcing all production to be for local sale. For acquired firms, the markup becomes

\[ M^*_n = \min \left\{ \frac{C_{2n}}{C^*_1}, \bar{m} \right\}, \]

where \( C^*_1 \) is the lowest-cost draw among all foreign firms (originating in any of \( N - 1 \) countries outside of the home country \( n \)) for industry \( j \). \( C^*_1 \) must be lower than \( C_1 \) for an acquisition to be profitable for the parent firm, so the markup charged by a foreign-owned firm in the home country will always be at least as large as the pre-takeover markup. The only case where the markup would not increase after a takeover is when the target was already charging the maximum markup \( \bar{m} \). A takeover can be profitable for a parent firm even in this case because the parent applies its superior technology in the acquired plant, resulting in a lower price (\( \bar{m}C^*_1 < \bar{m}C_1 \)) and greater sales, which allow it to buy out the target firm at a price equal to the profits it would have earned had it not sold out, given the level of the aggregate price index \( P \) that would prevail if all possible takeovers had occurred.

The distribution of the lowest-cost draw among all foreign firms is independent of draws in the home country. In addition, because the distribution of the ratio \( \frac{C_{2n}}{C^*_1} \) is independent of \( C_1 \), the distribution of the ratio is also independent of the probability that \( C_1 \) is greater than \( C^*_1 \). This means that the marginal distribution of \( C_{2n} \), \( g_{2n}(c_2) \), is independent of the distribution of \( C^*_1 \), \( g^*_1(c^*_1) \) — the joint distribution of \( C_{2n} \) and \( C^*_1 \) given that a takeover occurs is simply \( g_{2n}(c_2)g^*_1(c^*_1) \). To calculate the distribution of the lowest cost firm among all foreign firms, we note that the probability that \( C^*_1 \) is less than or equal to some level \( c^*_1 > 0 \) is one minus the probability that any foreign country \( i \) has a firm in industry \( j \) with
unit cost less than or equal to $c_1^*$. Let $G_{1n}^*(c_1^*)$ be the cumulative distribution for the firm with the lowest cost among all foreign firms that could invest in the home country. Then this cumulative distribution takes the form

$$
G_{1n}^*(c_1^*) = \Pr[C_{1n}^* \leq c_1^*] = 1 - \prod_{i \neq n} [1 - G_{1ni}^*(c_1^*)]
$$

where

$$
\Phi_n^* = \sum_{i \neq n} T_i \gamma_{ni}^{-\theta} r_i, \quad \gamma_{ni} \text{ represents frictions that prevent the seamless transfer of technology from country } i \text{ to the home country } n \text{ after a cross-border takeover, and } G_{1ni}^*(c_1^*) \text{ represents the distribution of the lowest-cost draws for a firm from country } i \text{ producing in country } n \text{ via a cross-border takeover, } G_{1ni}^*(c_1^*) = 1 - e^{-T_i \gamma_{ni}^{-\theta} r_i w_n c_1^*}. \text{ We assume that Eaton and Kortum’s no arbitrage condition for trade costs also holds for technological hangups: } \gamma_{ni} < \gamma_{ui} \gamma_{nu}. $$

Using the joint distribution, we exploit the methodology used in the case of trade above by applying a simple transformation to find the distribution of the markup for merged firms, $\frac{C_{2n}}{C_{1n}}$, we have

$$
h_n^*(m) = \int_{c_1^*}^{\infty} c_1^* g_{1n}^*(c_1^*) g_{2n}(mc_1^*) dc_1^*
$$

where

$$
\int_{c_1^*}^{\infty} c_1^* dG_{1n}^*(c_1^*) = \Phi_n^* \Phi_{n}^* + (r_n - 1) T_{n} m \theta
$$

and

$$
g_{2n}(.) \text{ is defined exactly as in autarky, since the second-best competitor is necessarily a domestic firm when there is no goods trade. We can integrate from } \bar{m} \text{ to } \infty \text{ to find the probability that a foreign-owned firm in } n \text{ will charge the maximum markup,}
$$

$$
\Pr[M_n^* \geq \bar{m}] = \int_{\bar{m}}^{\infty} \frac{\theta T_{n} m \theta - 1}{\Phi_n^* + (r_n - 1) T_{n} m \theta^2} dm = \frac{\Phi_n^*}{\Phi_n^* + (r_n - 1) T_{n} \bar{m} \theta}.
$$
Markups are increasing in the level of technology and contestability outside the home country, and decreasing in the degree of technological hangups involved in transferring technology to foreign affiliates. In a two-country world, the proportion of firms charging the maximum markup is greater among merged firms as long as the foreign country \( i \) has sufficiently high contestability and technology: \( r_i T_i > 1 \). For \( r_i \geq 2 \), this requires \( \frac{1}{T_i} > 0.5 \), well within the range presented by Eaton and Kortum (2002) for foreign countries relative to the U.S.

The effect is almost exactly the same for greenfield investment as for mergers and acquisitions. In this case, we integrate over \( g_{1n}(\cdot) \) instead of \( g_{2n}(\cdot) \) when computing \( h_n^*(m) \) and all expressions are the same, except that \( (r_n - 1) \) becomes just \( r_n \), leaving the role of domestic contestability virtually unchanged.

The intuition behind the higher markups among merged firms is very simple: Suppose the second-best firms supplying high-quality mechanical pencils in the home market has unit cost 2, while the first-best has unit cost 1.5, with \( \sigma = 3 \), yielding \( \bar{m} = 1.5 \). Then the markup under autarky is simply \( \frac{2}{1.5} = 1.3 \). If a parent firm with unit costs, including hangups, buys out the active domestic firm and transfers a lower unit cost, say 1.2, then the markup of the merged firm will be \( \min \{2/1.2, \bar{m} \} = \bar{m} \).

In addition, merged firms have lower costs, since the parent must be more efficient than the target to afford the takeover. It is important to note that although the markup may increase after a takeover, the price charged for the good will never exceed \( \min \{C_{2n}, \bar{m}C_{1n}^* \} \). Since \( C_{2n} \) has not changed and \( C_{1n}^* < C_{1n} \), the price charged for good \( j \) in the host country may fall, but will never increase, even if the markup does. To show this explicitly, we can calculate the probability of a cross-border takeover in the home country \( n \) and use it to compute the aggregate price level. The probability of a merger is simply the probability that some foreign country has a low-cost supplier with unit cost \( c_1 \) (including the technological hangup \( \gamma_{ni} \) involved in mergers) given that the home country has a low-cost supplier of good \( j \) with unit cost greater than \( c_1 \). The probability of a takeover in
country \( n \) by a foreign firm is thus
\[
\pi_n^* = \int_0^\infty g_{1n}(c_1)[1 - G_{1n}(c_1)]dc_1
\]
\[
= \int_0^\infty \theta \Phi_n^* w_n^{-\theta} c_1^{\theta-1} e^{-(\Phi_n^* + T_n)w_n^{-\theta}c_1} dc_1
\]
\[
= \frac{\Phi_n^*}{r_n T_n + \Phi_n^*}.
\]
Similarly, the probability that a firm from country \( i \) takes over a firm in country \( n \) is
\[
\pi_{ni}^* = \frac{r_i T_i \gamma_{ni}^{-\theta}}{r_n T_n + \Phi_n^*}
\]

Now it is possible to calculate the aggregate price level as the weighted average of prices charged by merged firms and unmerged firms, noting that the distribution for the second best rival, \( g_{2n}(c_2) \), and thus the expected value \( E[C_{2n}^{1-\sigma}] \) remain the same as under autarky:
\[
(P_{n}^{FDI})^{1-\sigma} = E[(P_n^{FDI})^{1-\sigma}]
\]
\[
= \pi_n^* \left( \frac{\Pr [M_n^* > \bar{m}] \bar{m}^{1-\sigma} E[(C_{1n}^*)^{1-\sigma}]}{\Pr [M_n^* \leq \bar{m}] E[C_{2n}^{1-\sigma}]} \right) + (1 - \pi_n^*) \left( \frac{\Pr [M_n(j) > \bar{m}] \bar{m}^{1-\sigma} E[C_{1n}^{1-\sigma}]}{\Pr [M_n(j) \leq \bar{m}] E[C_{2n}^{1-\sigma}]} \right).
\]

We have shown that the probability of charging the maximum markup is greater among merged firms. It remains only to show that \( E[C_{1n}^{1-\sigma}] > E[C_{1n}^{1-\sigma}] \)\(^{12}\) to prove that the aggregate price level in the host country is strictly smaller after opening its borders to foreign takeovers. We can compute \( E[C_{1n}^{1-\sigma}] \) as
\[
E[C_{1n}(j)^{1-\sigma}] = \int_0^\infty c_1^{1-\sigma} g_{1n}(c_1)dc_1 = \left( \Phi_n^* w_n^{-\theta} \right)^{\frac{\sigma-1}{\theta}} \Gamma \left( \frac{1 - \sigma + 2\theta}{\theta} \right),
\]
\(^{12}\)The direction of the inequality is due to the fact that there is a negative exponent on the aggregate price level \( P \) in the expression above.
which is strictly greater than \( E[C_{1n}^{1-\sigma}] \) as long as \( \Phi_n^* = \sum_{i \neq n} T_i \gamma_{ni}^{-\theta} T_n r_n > T_n r_n \). The expression implies that cross-border takeovers have less of an effect on the aggregate price level in countries with high contestability or a highly superior set of available technologies (high \( r \), high \( T \)).

4.1 Entry

We assume for simplicity that the parent firm pays a fixed fraction \( \varepsilon \) of its first period output to the target firm each period as a condition of the buyout.\(^{13}\) Then, the expected value of profits earned domestically, combined with expected profits earned from overseas operations given that a firm becomes a multinational or the expected takeover fees given that a firm sells in a cross-border takeover, must equal the startup cost:\(^{14}\)

\[
\sum_{s=0}^{\infty} \delta^{t+s} \left[ (1 - \Pr[FDI_n]) (P_n Y_n - C_{1n} Y_n) + (1 - \varepsilon) \sum_{i \neq n}^{N-1} \pi_{in}^* (P_i Y_i - \gamma_{in}^{-\theta} C_{1n} Y_i) + \varepsilon \sum_{i \neq n}^{N-1} \pi_{ni}^* (P_n Y_n^* - \gamma_{ni}^{-\theta} C_{1n} Y_n^*) \right] \equiv \kappa (1 - \Pr[FDI_n]) C_{1n} Y_n.
\]

In the case of symmetry, the expression reduces to

\[
(1 - \Pr[FDI]) \left( \frac{E[M_1^{1-\sigma}]}{-(1 + \delta \kappa) E[M^{-\sigma}]} \right) + \gamma^{1-\sigma} \Pr[FDI] \frac{1}{N-1} (N-1) \left( \frac{E[(M^*)^{1-\sigma}]}{-(1 + \delta \kappa) E[(M^*)^{-\sigma}]} \right) \equiv 0
\]

From the autarkic case, we know that \( E[M_1^{1-\sigma}] - (1 + \delta \kappa) E[M^{-\sigma}] \) is monotonically decreasing in \( r \). But the direction of \( E[(M^*)^{1-\sigma}] - E[(M^*)^{-\sigma}] \) as \( r \) increases depends on several factors. Using an approach similar to that in Appendix B, we find that in the case of symmetry, where all countries are identical \( ex \ ante \), this second value is decreasing in \( r \)

\(^{13}\)de Blas and Russ (2010) fully endogenize the cost of the takeover– making it equal the option value for the target firm if it does not merge– with no substantive change in the behavior of parents or targets. The simpler assumption here allows greater tractibility without loss of generality. The fraction \( \varepsilon \) must be large enough that the takeover price is at least as large as the startup cost.

\(^{14}\)The firm does not pay the startup cost if it sells out to the foreign firm. The parent firm pays only a startup cost in its native country. Thus, there are firm-level economies of scale from multinational production.
only if
\[ \left( \frac{r-1}{2r-1} \right) \left( N - 1 \right) \frac{1}{\theta} < m, \text{ for } 1 \leq m \leq \bar{m}. \]

This means that the expected profit from overseas operations and buyout fees actually increases in \( r \) unless \( \theta \) is sufficiently large relative to the size of the market and the number of entrants. A low shape parameter, \( \theta \), means more dispersion in firm productivity—thus, greater potential for cross-border mergers to occur. Increasing the number of draws augments this comparative advantage dimension of the BEJK Ricardian framework, increasing the possibility of a cross-border takeover and thus the expected gains from a takeover or buyout from the point of view of potential entrants deciding whether to draw a cost parameter. When there is little dispersion between draws to begin with (a high \( \theta \)), having additional entrants (higher \( r \)) increases the probability of an active firm benefitting from a buyout or acquisition less than it reduces the expected markup through the competitive effects seen in the autarkic case.

### 4.2 FDI, Markups and Competition: Stylized facts

The results are consistent with the few existing studies of markups and cross-border mergers and acquisitions. As authors since Caves (1974) have pointed out, it is difficult to disentangle the impacts of technology transfer from changes in market competitiveness when foreign-owned firms enter a market. Authors such as Chung (2001), Arnold and Javorcik (2005), Alfaro, Kalemli-Ozcan, and Sayek (2009) have documented the technological transfer and spillovers that accompany foreign takeovers or inflows of foreign direct investment. Only a few studies have measured the effect of foreign takeovers on industry competitiveness and firm profits. The most extensive set of studies analyzes foreign takeovers and markups in the banking sector. An array of studies, including Barajas, Steiner and Salazar (1999), Claessens, Demirgüç-Kunt, and Huizinga (2001), Goldberg (2007), and Vera, Zambrano-Sequin, and Faust (2007), demonstrates that net interest margins—which de Blas and Russ (2009) show is equivalent to the log of a markup in standard trade models—increase in targeted banks following foreign takeovers, while costs tend to fall.

Sembenelli and Siotis (2008) show that the same pattern applies among Spanish manufacturing industries. In the industries most intensive in research and development (R&D), "FDI has a positive long-run effect on the mark-ups of target firms (p.108)." They argue that the key role of R&D in predicting the behavior of pre- versus post-takeover markups
implies a key role for technology transfer between parents and subsidiaries in augmenting market power. In these sectors, they interpret their findings as support for “the fact that MNCs possess firm-specific advantages that can be transferred” so that after a foreign takeover, targeted firms “enjoy greater levels of efficiency, and therefore mark-ups (p.115).” Chari, Ouimet, and Tesar (2010) find that shareholders expect a bigger return when a firm in an industrialized country takes over a firm in a developing country than when it takes over a firm in its native market— an effect that cannot be attributed to proximity, but rather to the transfer of managerial know-how. Thus, despite the difficulties of splicing technology gains from pricing behavior, evidence for both financial and non-financial firms points to increased markups and efficiency following foreign takeovers that involve technological transfer.

4.3 Cross-border mergers and trade

Given the complete market segmentation described above, a cross-border takeover in industry \( j \) results in a lower or unchanged price in the host country, with no change in the price or markup charged in the source country. Depending on the degree of market segmentation and symmetry between countries, trade in goods can change this result. Market segmentation can take two forms: (1) a pure gravity effect, where distance and other barriers impede the free flow of goods, or (2) a strategic segmentation where a cross-border takeover facilitates price discrimination by two branches of a multinational firm. We study two types of strategic segmentation, a bilateral form where it is simple to characterize the distribution of markups and the aggregate price level and a more aggressive multilateral form, which uses the same underlying mechanism and has a similar effect on markups and prices.

4.3.1 Bilateral segmentation: The Hymer-Neary effect

Suppose there is both trade and FDI. Foreign firms from \( i \) will serve a country \( n \) through trade rather than FDI only when the net profit from exporting is greater than the net profit from a takeover. The condition that profit under trade equals profit from FDI (net of takeover costs) from \( i \) to \( n \) reduces to

\[
(1 - \varepsilon)(M^*_{n}\gamma_{ni}w_{in})^{1-\sigma} = (M^T_{n}d_{ni}w_{i})^{1-\sigma}
\]
Let $\Gamma_{ni} = (1 - \varepsilon)^{\frac{1}{1-\sigma}} \gamma_{ni} \left( \frac{M_{ni}^* w_{i}}{M_{ni}^* w_{i}} \right)$ represent the procedural and technological hangups net of differences in labor costs and markups involved in serving country $n$ through a takeover versus exports. Assuming that the firm focuses only on country $n$ market conditions when deciding on how it will serve country $n$, the necessary condition for country $i$ to prefer trade to FDI reduces to

$$d_{ni} < \Gamma_{ni}.$$ 

We define $I_{d_{ni}<\Gamma_{ni}}$ as an indicator variable that takes the value of 1 when this condition holds.

The ratio of markups the firm can charge as a multinational versus an arms-length exporter reduces to 1 if the firm were able to charge the maximum markup $\bar{m}$ using either mode to access country $n$ or $\frac{d_{ni}}{\gamma_{ni}}$ if there were some rival outside of country $n$ that forced it to charge a lower markup.\(^{16}\) In some fraction of cases, the next-best rival to a firm from country $i$ exporting to country $n$ will be native to country $n$ itself. In these cases, even if there is no cost advantage from buying out the local rival to serve country $n$ as a multinational, a firm from country $i$ might do so if it could increase the markup it charges to country $n$ consumers enough to outweigh any cost disadvantage, producing a Hymer-Neary effect, where a firm takes over a foreign competitor to increase its market power. Further, if relative labor costs are so low in $n$ that the unit cost of production net of the trade cost and technological hangup is lower than in country $i$, then the firm may choose to serve its native country $i$ through its foreign branch in $n$. The firm need not pass on the entire cost savings unless it was already charging the maximum markup on sales in its native country. Call $M_i'$ the markup charged by the multinational exporting back to its native country $i$, which must be at least as large to the markup it could charge if it produced in its native country, $M_i$. If the firm’s next-best rival in serving its native market $i$ were again the best firm in country $n$, then the takeover (FDI from country $i$ to $n$)...

\(^{15}\)Note that a firm native to country $i$ that serves market $n$ necessarily supplies its own market, as well, due to our no-arbitrage conditions for trade costs and technological hangups described above.

\(^{16}\)Note that $M_n^T = \min \left\{ \frac{C_{2n}}{C_{1n}}, \bar{m} \right\}$ and $M_n^* = \min \left\{ \frac{C_{2n}}{C_{1n}}, \bar{m} \right\}$, where $C_{2n} = C_{2n}$ if the second-best competitor originates outside of country $n$. Thus,

$$\frac{M_n^*}{M_n^T} = \min \left\{ \left( \frac{C_{2n}}{C_{2n}}, \frac{C_{1ni}}{C_{1ni}} \right), 1 \right\} = \min \left\{ \left( \frac{C_{2n}}{C_{2n}}, \frac{d_{ni}}{\gamma_{ni}} \right), 1 \right\}.$$
may allow the multinational firm headquartered in country $i$ to increase its markup even further, so that $M_i'$ contains both a cost-advantage factor and a second anti-competitive Hymer-Neary component. Then, the profit condition for arms-length exporting is

$$(1 - \varepsilon) (M_n^* \gamma_n \gamma_n w_n)_{\gamma_n}^{1-\sigma} p_n^\sigma y_n + (M_i' d_{nu} \gamma_i \gamma_i w_i)_{\gamma_i}^{1-\sigma} p_i^\sigma y_i < \frac{(M_n^T d_{nu} w_i)_{\gamma_n}^{1-\sigma} p_n^\sigma y_n + (M_i d_{nu})_{\gamma_i}^{1-\sigma} p_i^\sigma y_i}{w_i (M_n^T d_{ni} p_n^\sigma y_n + M_i p_i^\sigma y_i)^{\frac{1}{1-\sigma}}} \gamma_n w_n \left[ (1 - \varepsilon) (M_n^*)_{\gamma_n}^{1-\sigma} p_n^\sigma y_n + (M_i' d_{nu})_{\gamma_i}^{1-\sigma} p_i^\sigma y_i \right]^{\frac{1}{1-\sigma}}$$

The cost advantage is given by $\frac{\gamma_n w_n}{w_i}$, while the total strategic component is given by

$$\frac{\left[ (1 - \varepsilon) (M_n^*)_{\gamma_n}^{1-\sigma} p_n^\sigma y_n + (M_i d_{nu})_{\gamma_i}^{1-\sigma} p_i^\sigma y_i \right]^{\frac{1}{1-\sigma}}}{(M_n^T d_{nu} p_n^\sigma y_n + M_i p_i^\sigma y_i)^{\frac{1}{1-\sigma}}}.$$

The strategic component of the takeover decision complicates the computation of the distribution of markups and prices, as well as the probability that a country will import from a particular source. Suppose for a moment that the firm completely ignores the markup decision, so that a firm exports whenever there is a cost advantage to doing so,

$$d_{ni} < (1 - \varepsilon)^{\frac{1}{1-\sigma}} \gamma_n \left( \frac{w_n}{w_i} \right) = \Gamma_{ni}^{NS},$$

where the superscript $NS$ is a mnemonic for “no strategy.” Then, it is straightforward to calculate the probability that a country $n$ will be served by a branch of a multinational firm headquartered in country $u$ operating in country $i$ (either horizontal sales if $i = n$ or export platform sales from country $i \neq n$),

$$\pi_{ni}^{NS} = \int g_{1iu}^* \frac{(c_1)}{d_{ni}} \left( 1 - I_{d_{iu} < \Gamma_{ni}^{NS}} \prod_{v \neq u}^{N} I_{d_{nu} < \Gamma_{nv}^{NS}} [1 - G_{1nu}(c_1)] \right) dc_1,$$

where $g_{1iu}^*(d_{nu} c_1) = g_{1nu}(\frac{c_1}{\gamma_{nu}})$. We can also compute the probability that a foreign branch of a multinational located in $i$ and headquartered in any country supplies country $n$,

$$\pi_{ni}^{NS} = \int g_{1i}^* \left( \frac{(c_1)}{d_{ni}} \prod_{u=1}^{N-1} \left[ 1 - G_{1nu}(c_1) I_{d_{nu} < \Gamma_{nu}^{NS} d_{ni}} \right] \right) dc_1,$$

where $g_{1i}^*(\frac{c_1}{\gamma_{ni}}) dc_1 = dG_{1i}^*(\frac{c_1}{\gamma_{ni}})$, and $G_{1i}^*(\frac{c_1}{\gamma_{ni}}) = 1 - e^{-\Phi_{1i}^*(d_{nu} w_n)^{\theta} c_1^{\theta}}$, for $\Phi_{1i}^* = \sum_{u \neq i}^{N-1} T_u \gamma_{ui}^{\theta} \left( 1 - I_{d_{nu} < \Gamma_{nu}^{NS} d_{ni}} \right) r_i$. 

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The distribution $G_{ii}(d_{ni})$ arises in the same manner as the distribution of costs among multinational firms without trade, defined above, adjusting for the additional trade cost involved in export sales and conditional on export platform FDI bearing some cost advantage over direct export from the headquarters country ($d_{nu} < \Gamma_{iu}^{NS}d_{ni}$). The probability that country $n$ imports directly from a domestic producer in country $i$ is then

$$\pi_{ni}^{NS} = \int g_{1ni}(c_1)I_{d_{ni}<\Gamma_{ni}^{NS}} \left[ 1 - G_{ii}(\frac{c_1}{d_{ni}}) \right] \prod_{u \neq i} \left[ 1 - G_{1nu}(c_1)I_{d_{nu}<\Gamma_{iu}^{NS}d_{ni}} \right] dc_1.$$ 

Computing the probability that $n$ is served by multinationals versus direct exporting from domestic producers when firms choose their location in a way that balances cost advantages with increased market power (higher markups) is less straightforward. We can use $\Gamma_{ni}'$ rather than $\Gamma_{ni}^{NS}$ in the above process, but $\Gamma_{ni}'$ contains choice variables (the markups), so the formulas presented above would no longer be reduced-form with respect to firm behavior. [To be completed.]

### 4.4 Multilateral segmentation

The strategic behavior need not stop with one takeover. A firm may consider the impact of various takeovers on the markups in multiple markets. At this point, the problem loses the tractability necessary to compute the probabilities of modes of service, as well as the distribution of markups and costs. Nonetheless, it is possible to compare the amount of multinational branch trade with direct export with the non-strategic example above, as well as to impute the impact of multilateral segmentation on the direction of markups and the aggregate price level with the solutions from the example of free trade.

[To be completed]

### 5 Conclusions

In summary, we present a model which can capture the stylized fact that foreign takeovers result in increased markups and the transfer of improved technology. To do so, we generalize the BEJK framework with endogenous markups and heterogeneous firms to allow a role for domestic entry and foreign takeovers. Entry in our model is distinct from the number of varieties (which we fix, but which could also be endogenized) does not truncate the distribution of individual firm efficiency levels, as in Melitz (2003), rather it changes the
shape of the entire distribution. Entry also influences the entire distribution of markups, with greater “contestability” in each market niche resulting in fewer firms being able to charge the maximum markup. Takeovers by foreign firms increase the technological edge of target firms, allowing them to increase their markup and increasing the average markup in the economy, which we prove analytically for the first time in the context of heterogeneous firms. The increased markup is always outweighed by the efficiency gains arising as parents transfer superior technologies to their new subsidiaries, causing prices to stay the same in the source country and fall in the host country as in Nocke-Yeaple (2007). The exception occurs when a parent takes over its next best rival for the purpose of segmenting the market and increasing, generating a “Hymer-Neary effect” proposed by Hymer in 1960 and first demonstrated in a world with heterogeneous firms by Neary (2007).

References


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Substituting the pricing rule into the free entry condition, we have

\[
\frac{1}{\delta} E \left[ (M(j)^{1-\sigma} C_1(j)^{1-\sigma} P^a Y - M(j)^{-\sigma} C_1(j)^{-\sigma} P^a Y) \right] = \kappa E[M(j)^{-\sigma} C_1(j)^{-\sigma} P^a Y], \\
\frac{1}{\delta} E \left[ M(j)^{1-\sigma} - M(j)^{-\sigma} \right] = \kappa E[M(j)^{-\sigma}], \\
E \left[ M(j)^{1-\sigma} \right] = (1 + \delta \kappa) E[M(j)^{-\sigma}],
\]

where the second equality comes from the fact that the distribution of markups is independent of any other variable, including unit cost, and the assumption that firms take the behavior of all firms outside their own niche \( j \) (and thus aggregate variables) as given.

A.1 A lowerbound for the log markup.

Since the distribution of markups is the same for all goods \( j \), we drop the goods index below for simplicity. Taking (natural) logs, the expression decomposes into

\[
\ln(1 + \delta \kappa) + \ln E[M^{-\sigma}] = \ln E[M^{1-\sigma}].
\]  

(4)

Since the natural log is a concave function, Jensen’s inequality implies \( E[\ln M^{1-\sigma}] \leq \ln E[M^{1-\sigma}] \) and \( E[\ln M^{-\sigma}] \leq \ln E[M^{-\sigma}] \). The function \( M^{-\sigma} \) has a greater degree of convexity than \( M^{1-\sigma} \), so \( E[M^{-\sigma}] - E[\ln M^{-\sigma}] \geq E[M^{1-\sigma}] - E[\ln M^{1-\sigma}] \). \(^{17}\) This last inequality implies that

\[
E[\ln M^{1-\sigma}] \geq \ln(1 + \delta \kappa) + E[\ln M^{-\sigma}],
\]

\(^{17}\)Another way to see this is to note that \( E[\ln M^{1-\sigma}] \), \( E[M^{1-\sigma}] \), \( E[\ln M^{-\sigma}] \), and \( E[M^{-\sigma}] \) are all negative numbers, with \( |\ln E[M^{1-\sigma}]| < |\ln E[M^{-\sigma}]| < |E[\ln M^{-\sigma}]| \) and \( |E[\ln M^{1-\sigma}]| < |E[\ln M^{-\sigma}]| \). Thus, switching the logs from outside to inside the expectation in equation (4) reduces the left hand side more than the right hand side.
as taking the log inside the expectation reduces the right hand side more than the left hand side. We note that for any constant \( k \), \( E[\ln M^k] = kE[\ln M] \), yielding

\[ E[\ln M] \geq \ln (1 + \delta \kappa). \]

### A.2 Uniqueness

Standard properties of expectations tell us that \( E[M(j)^{1-\sigma}] > E[M(j)^{-\sigma}] \) for \( \infty > \sigma > 1 \) and \( M(j) \geq 1 \). In Appendix B below, we show that \( E[M(j)] \) is decreasing in the number of rivals. Thus, \( E[M(j)^{1-\sigma}] \) is increasing in \( r \) and \( E[M(j)^{-\sigma}] \) is increasing even faster. Thus, \( E[M(j)^{1-\sigma}] / E[M(j)^{-\sigma}] \) is greater than 1 and decreasing in \( r \) toward 1, meaning that there can only be one \( r \) for which the ratio equals the constant \((1 + \delta \kappa)\).

### B The expected markup and the number of rivals

The expected markup is given by:

\[
E[M(j)] = \int_1^\infty m \frac{r(r-1)\theta m^{-\theta} + \theta}{(r-1+m^{-\theta}y)^2} dm + \int_1^\infty \frac{r(r-1)\theta m^{-\theta} (r-1+m^{-\theta})^2}{(r-1+m^{-\theta})^2} dm,
\]

so the derivative of expected markup with respect to \( r \) is

\[
\frac{\partial E[M(j)]}{\partial r} = \int_1^\infty \frac{\partial}{\partial r} \left( \frac{r(r-1)\theta m^{-\theta}}{(r-1+m^{-\theta}y)^2} dm \right) + \frac{\partial}{\partial r} \left( \frac{r}{1+(r-1)} \right).
\]

Let’s compute the first derivative

\[
\int_1^\infty \frac{\partial}{\partial r} \left( \frac{r(r-1)\theta m^{-\theta}}{(r-1+m^{-\theta}y)^2} dm \right) = \int_1^{\infty} \frac{(2r-1)\theta m^{-\theta} [(r-1) + m^{-\theta}]^2 - r(r-1)\theta m^{-\theta} 2 [(r-1) + m^{-\theta}]^2}{[(r-1) + m^{-\theta}]^4} dm,
\]

The numerator is positive whenever \((2r-1)m^{-\theta} < r - 1\), which requires

\[ r > \frac{m^\theta - 1}{m^\theta - 2} > 1. \]
Given \( m \geq 1 \) and \( 1 \leq \theta \leq 11 \), this is always satisfied.\(^{18}\)

Regarding the second term of the derivative, we know that
\[
\frac{\partial}{\partial r} \left[ \frac{r}{1 + (r - 1)m^\theta} \right] = \frac{1 - r\bar{m}^\theta}{1 + (r - 1)m^\theta} < 0.
\]

Then, as long as \( r > \frac{m^\theta - 1}{m^\theta - 2} \), we have that the expected markup is decreasing in \( r \).

\section*{C Deriving the lowerbound}

Beginning from the generalization of the Chebyshev inequality in the text, we have
\[
\frac{r\bar{m}}{1 + (r - 1)m^\theta} \leq E[M(j)],
\]
\[
r\bar{m} \leq E[M(j)] \left[ 1 + (r - 1)m^\theta \right],
\]
\[
r \left( \bar{m} - E[M(j)]m^\theta \right) \leq E[M(j)] \left( 1 - m^\theta \right),
\]
\[
r \left( E[M(j)]m^\theta - \bar{m} \right) \geq \frac{E[M(j)](m^\theta - 1)}{E[M(j)]m^\theta - \bar{m}}.
\]

\section*{D Markups under trade}

We begin by calculating the probability that the first- and second-best rivals are from the same country, so that they come from a joint distribution. Let \( G_{kni}(c_k) \) and \( g_{kni}(c_k) \) be, respectively, the cumulative distribution and probability density of unit costs for the \( k^{th} \)-best firm from country \( i \) competing to supply country \( n \).\(^{19}\) Then we calculate the probability that the unit cost for the second-best rival to supply country \( n \) with some good \( j \) (we have omitted the \( j \) index) is less than the unit cost of the best firm that could supply \( j \) to country \( n \) from any country \( u \neq i \) as

\(^{18}\)The condition will also be satisfied by the lowerbound for \( r \) given above as long as the upfront cost of production, \( \kappa \), and the probability of forced exit, \( \delta \), are not too large.

\(^{19}\)Explicitly,
\[
g_{1ni} = \theta r_i T_i (w_i d_{ni})^{-\theta} e^{-r_i T_i (w_i d_{ni})^{-\theta}} c_1 \]
and
\[
g_{2ni} = \theta r_i (r_i - 1) T_i (w_i d_{ni})^{-\theta} e^{-(r_i - 1) T_i (w_i d_{ni})^{-\theta}} c_2 \]