Testing the Melitz Model of Trade:

An Application to U.S. Motion Picture Exports

Gordon H. Hanson
University of California, San Diego and NBER

Chong Xiang
Purdue University

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Abstract. In this paper, we develop a simple empirical method to test two alternative versions of the Melitz (2003) model, one with global fixed export costs and one with bilateral fixed export costs. With global costs, import sales per product variety (relative to domestic sales per variety) are decreasing in variable trade costs, as a result of adjustment occurring along the intensive margin of trade. With bilateral costs, imports per product variety are increasing in fixed trade costs, due to adjustment occurring along the extensive margin. We apply our approach to data on imports of U.S. motion pictures in 44 countries over 1995-2005. Imports per product variety are decreasing in geographic distance, linguistic distance, and other measures of trade costs, consistent with adjustment to these costs occurring along the intensive margin. There is relatively little variation in the number of U.S. movies that countries import but wide variation in the box-office revenues per movie. The data thus appear to reject the bilateral-fixed-export-cost model in favor of the global-fixed-export-cost model.

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I. Introduction

Recent literature suggests fixed trade costs matter for the volume of trade. Data on manufacturing industries in the U.S. and France show that most plants do not export any output and the plants that do export are larger and more productive than those that do not (Bernard and Jensen, 1999 and 2004; Eaton, Kortum and Kramarz, 2004). Melitz (2003), in widely cited work, develops a model with firm heterogeneity and fixed export costs that can account for these phenomena.[1] Because of fixed trade charges, only more productive plants find it profitable to sell goods abroad. When applied to aggregate data, this framework yields a gravity specification that can account for why many country pairs have zero trade (Helpman, Melitz, Rubinstein, 2007; Baldwin and Harrigan, 2007).

The presence of fixed trade costs raises the possibility that adjustment in trade volumes occurs along both the intensive margin (value of trade per product) and extensive margin (number of products traded). In the standard monopolistic model, consumer preference for variety ensures that all products are exported, implying that all variation in trade is at the intensive margin (Helpman and Krugman, 1985). A fall in transport costs would cause exports of all products to increase, consistent with the robust negative coefficient on distance in the gravity model of trade (Anderson and van Wincoop, 2004). Yet, with fixed export costs and firm heterogeneity a fall in transport costs may cause trade volumes to rise both through existing exporters exporting more and new firms entering into exporting. Bernard, Jensen, Redding, and Schott (2007) find that most variation in U.S. exports across destination markets is at the extensive margin, with smaller countries importing fewer U.S. products. They also find that the negative gravity

[1] For other theoretical work on firm heterogeneity and trade see Bernard, Eaton, Jensen and Kortum (2003).

coefficient for distance is due in part to adjustment at the extensive margin, with countries more distant from the U.S. importing fewer U.S. products.[2]

Despite the now abundant indirect evidence that fixed trade costs exist, we know little about their magnitude or structure. While we can measure variable trade barriers in the form of tariffs or transport fees, no similar data exist for expenses that are fixed. If fixed export costs are bilateral, such that firms incur a fee to enter each new foreign market, small countries will be disadvantaged in global trade. However, if fixed export costs are largely global in nature, such that once firms establish a global distribution network they face only variable charges in adding new markets, small countries are not at a disadvantage and it is only unproductive firms that are excluded from trade.

In this paper, we develop a simple empirical method to test two alternative versions of the Melitz (2003) model, one with global fixed export costs and one with bilateral fixed export costs. With global fixed export costs, import sales per product variety (relative to domestic sales per variety) are decreasing in variable trade costs, as a result of adjustment occurring along the intensive margin of trade. With bilateral fixed export costs, however, imports per product variety are increasing in fixed trade costs, due to adjustment occurring along the extensive margin. Both models produce an empirical specification that has sales per foreign variety relative to sales per domestic variety as the dependent variable and trade costs as independent variables. To test one model against the other, one simply examines the sign of the coefficients on trade costs.

An advantage of our approach is that we need not take a stand on which trade barriers represent fixed costs and which represent variable costs. The empirical literature

[2] In related work Chaney (2006) finds that variation in trade cost elasticities across sectors is consistent with adjustment to trade occurring at the extensive margin.

offers little guidance on this issue. In practice, standard gravity variables – distance, language, colonial history – are likely correlated with both fixed and variable trade charges. Instead, we exploit the divergent predictions of the alternative models for whether adjustment to trade costs occurs on the intensive or extensive margin.

We apply our approach to data on imports of U.S. motion pictures. The characteristics of the motion picture industry are consistent with the general assumptions of the Melitz framework. Fixed costs are an important component of movie production and studios clearly differentiate their film product (De Vany, 2004). There is considerable heterogeneity in movie performance, with box-office revenues for U.S. films being asymptotically Pareto-distributed (De Vany and Walls, 1997 and 2004), matching the distributional assumptions in Melitz (2003) and most extensions. Not all U.S. movies are exported, with no country importing more than two-thirds of the movies the U.S. produces in a given year. Data for the analysis cover box-office revenues for domestic and U.S. movies in 55 countries over 1995-2006, as collected by ScreenDigest.com, an entertainment industry consultancy. We also make use of national trade barriers in motion pictures as documented by the U.S. Trade Representative, the Motion Picture Association of America, and other sources.

Our main findings are that imports per product variety are decreasing in geographic distance, linguistic distance, and other measures of trade costs, in a manner consistent with adjustment to these costs occurring along the intensive rather than extensive margin. There is relatively little variation in the *number* of U.S. movies that countries import but wide variation in the box-office *revenues* per movie, with countries that are more distant from the U.S. spending less on the U.S. movies that they import.

Argentina, for instance, imports roughly the same number of U.S. movies each year as Germany, though its box office revenues per film are far lower. The data thus reject the bilateral-fixed-export-cost model in favor of the global-fixed-export-cost model.

Interestingly, the specification the Melitz model preferred by the data is quite similar to that for the standard monopolistic-competition model (e.g., Krugman, 1980; Helpman and Krugman, 1985), which has no firm heterogeneity or fixed export costs. This is because in both the monopolistic competition model and the Melitz model with global fixed export costs adjustment to trade costs occurs along the intensive margin. Where the standard monopolistic competition model obviously fails in our data, is that it does not account for why some U.S. movies are not exported.

In section II, we develop alternative versions of the Melitz model and derive the empirical specifications. In section III, we describe data on the exhibition of domestic and foreign motion pictures and measures of trade barriers in the industry. In section IV, we present the empirical results. And in section V, we conclude.

II. Theory

In this section, we develop two versions of the Melitz model, which we apply to production and trade in motion pictures. In one version, fixed exports costs are bilateral, incurred each time a producer enters a new export market; in the other, they are global, incurred only once when a producer starts exporting. These two models yield quite different predictions for how trade costs affect average box office revenues per movie. We also explore how fixed production costs impact trade patterns, depending on whether

a portion of these costs are incurred after producers learn their type. From these alternative models, we derive four empirical specifications.

II.A Global Fixed Export Costs

There is a continuum of industries indexed by $z \in [0, 1]$. There are many countries, where u indexes the exporting country and k indexes the importing country. Consumers have identical Cobb-Douglas preferences, where $\alpha(z)$ is the consumption share of industry z and $\int_0^1 \alpha(z)\,dz = 1$. To focus on the movie industry, we leave the other industries in the background and drop the index z. Each movie is a Dixit-Stiglitz-type variety in the film industry, where σ is the elasticity of substitution between movies.

Movies are subject to a cultural discount. For a consumer in country k, one unit of a domestic movie brings as much satisfaction as $1/\delta_{uk}$ units of a movie from country u, where $0 < \delta_{uk} < 1$. δ_{uk} is the fraction of a movie's value that is *not* lost in translation in moving from one national context to another. We expect δ_{uk} to be higher the more similar are two countries' culture and language. Movies are also subject to an ad valorem policy trade barrier, $t_{uk} > 1$. A higher value of δ_{uk} or t_{uk} indicates higher trade barriers.

Movies are heterogeneous. The demand for movie j is subject to a random demand shifter θ_j that is drawn from the distribution $G(\theta)$. The sub-utility for movies for the representative consumer in country k is,

$$u_k = \{\sum_j \theta_{kj} c_{kj}^{\frac{\sigma-1}{\sigma}} + \sum_{u \neq k} \sum_j \theta_{uj} [\delta_{uk} c_{uj}]^{\frac{\sigma-1}{\sigma}}\}^{\frac{\sigma}{\sigma-1}}. \qquad (1)$$

In (1), θ_{kj} scales up the level of consumption, c_{kj}. A movie with a high θ_{kj} is popular (e.g., *Titanic*) and one with a low θ_{kj} is unpopular (e.g., *Battlefield Earth*). Net of the effects of the cultural discount, δ_{uk}, and policy trade barrier, t_{uk}, the popularity of a movie does not

depend on the country in which the movie is shown. We introduce heterogeneity in demand rather than in marginal costs, as in Melitz (2003), because this preserves uniform admission prices for movies, which appears consistent with the data.

From (1), box-office revenues (total sales) of a country-u movie in country k are

$$s_{ukj} = \theta_{uj}^{\sigma-1}\delta_{uk}^{\sigma-1}t_{uk}^{1-\sigma}p_{ukj}^{1-\sigma}A_k, \qquad A_k \equiv \frac{\alpha Y_k}{P_k^{1-\sigma}}, \tag{2}$$

where j indexes the movie, Y_k and P_k are income and the CES price index in country k, α is the expenditure share for the movie industry, and p_{ukj} is the price of movie j net of the policy trade barrier. In equation (2), both the cultural discount and the policy trade barrier appear as variable trade costs and have similar effects on the sale of movie j. Box-office sales of domestically produced movie h in country k equal,

$$s_{kkh} = \theta_{kh}^{\sigma-1}p_{kkh}^{1-\sigma}A_k. \tag{3}$$

We assume movie production occurs in five steps. (i) For a producer in country u, f_E units of country-u labor are required to produce an original work (a master film print), which is a sunk labor input. (ii) After sunk costs are incurred, the producer draws θ_{uj} from the distribution $G(\theta)$. (iii) The producer then uses a variable labor input to exhibit the movie to an audience, with input costs incurred in the country where the audience is located. For each unit of the movie shown in country k, the producer hires one unit of country-k labor. (iv) The producer collects profits for one period. (v) At the end of this period, all movies die. In the next period, if there is one, the process repeats itself.

By assumption (ii), all fixed production costs are incurred before the popularity of a movie is revealed, which we refer to as a *pure sunk cost* setting. This assumption differs from Melitz (2003), in which some fixed production costs are incurred after heterogeneity is revealed, which we refer to as a *partial sunk cost* setting. We first derive

results for pure sunk costs and later consider partial sunk costs. Pure sunk costs capture the riskiness and short-lived nature of movies. A strong indicator of a movie's popularity is the box office revenue earned during its first week of release (typically, on the domestic market), by which time all production and domestic distribution costs have been paid for. By the end of three weeks, the average movie has earned 66% of its total box-office revenues (De Vany and Walls, 1999). As in Melitz (2003), the role of the sunk entry cost is to pin down N_k, the number of country-k producers that draw from $G(\theta)$.[3]

By assumption (iii), for a movie *created* in country u its showings are *provided* using labor in the country where consumers watch the movie. Since price is a constant markup over marginal cost, the price of a movie shown in country k is the same for all movies, regardless of where they are produced:

$$p_{kkj} = p_{ukj} = \frac{\sigma}{\sigma - 1} w_k \quad \text{for all } u, k, j, \tag{4}$$

where w_k is the wage in country k. Because the cultural discount is a source of home bias in demand, it does not affect prices (Anderson and van Wincoop, 2004). Similarly, θ_{uj} affects the quantity demanded but not prices. Equation (4) implies that in any market k, the prices of domestic and foreign movies are the same, which is consistent with the fact that admission prices vary little across newly released films (De Vany, 2004).[4]

By the time a producer in country k has drawn its θ, sunk costs have been incurred, implying the movie will be made, with pricing given by (4) and sales by (3). The number of country-k movies produced, n_{kk}, thus equals the number of country-k movies that draw from G(θ), N_k:

[3] In an Appendix we derive N_k assuming m identical countries and each country having one sector, as in Melitz (2003). N_k and its counterparts in other countries are jointly determined.
[4] See Gil and LaFontaine (2007) on distribution contracts and pricing in the Spanish movie industry.

$$n_{kk} = N_k \,. \tag{5}$$

To derive the total sales of domestic movies in country *k*, we assume that the distribution function *G(·)* is Pareto, such that $G(\theta) = 1 - a^{\varsigma}/\theta^{\varsigma}$, with $a, \varsigma > 0$ and $\theta \in [a, +\infty)$. A large ς would mean thin tails for *G(θ)*. Total sales of country-*k* movies in country *k* are $S_{kk} = N_k \int_a^{\infty} s_{kkh} dG(\theta_{kh})$. For the integrand to be finite, the distribution *G(θ)* must have a sufficiently thin tail, which requires that $\varsigma > \sigma\text{-}1$. It follows that,

$$S_{kk} = N_k \int_a^{\infty} s_{kkh} dG(\theta_{kh}) = C_0 n_{kk} w_k^{1-\sigma} A_k, \quad C_0 = [\frac{\sigma}{a(\sigma-1)}]^{1-\sigma} \frac{\varsigma}{\varsigma-(\sigma-1)}. \tag{6}$$

As expenditure for movies by country *k*, A_k, increases, or the wage in country *k*, w_k, decreases, the sale of each country-*k* movie, s_{kkh}, increases, causing the total sale of domestic movies in country-*k* movies to increase.

Consider the producers of country-*u* movies who would like to export to country k. Exporting requires a global fixed cost of f_G units of country-u labor, incurred after the drawing of the demand shifter θ. We allow producers to observe their type before making the export decision, consistent with standard practice in the movie industry where producers release films on the domestic market first, and then, if they are sufficiently successful, in theatres abroad.[5] Paying this fixed cost allows a country-*u* movie to be exported to the rest of the world. By equation (2), a country-*u* producer of movie *j* gets revenue s_{ukj} for serving country *k*. Total sales from exporting movie *j* is then $\sum_{k \neq u} s_{ukj}$ and the profit from exporting movie *j* equals

$$\pi_{uj} = \theta_{uj}^{\sigma-1} B Q_u - f_G w_u \,, \tag{7}$$

[5] Elberse and Eliashberg (2003) find that U.S. movies with stronger domestic market performance tend to have higher opening-week box-office revenues when they are released in the foreign markets.

where

$$Q_u = \sum_{k \neq u} \delta_{uk}^{\sigma-1} t_{uk}^{1-\sigma} A_k w_k^{1-\sigma} \quad \text{and} \quad B = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}.$$

Setting $\pi_{uj} = 0$ yields the cut-off value of θ for a country-*u* movie to be exported:

$$\underline{\theta}_u = \left(\frac{f_G w_u}{B Q_u} \right)^{\frac{1}{\sigma-1}}, \qquad Q_u = \sum_{k \neq u} \delta_{uk}^{\sigma-1} t_{uk}^{1-\sigma} A_k w_k^{1-\sigma} \quad . \tag{8}$$

Equation (8) says that the cut-off value, $\underline{\theta}_u$, does not vary across importing countries due to the global nature of the fixed export cost. Once a movie is shown abroad, it is shown around the globe. Country *u* thus produces two kinds of movies: those below the export cut-off ($\theta_{uj} > \underline{\theta}_u$) are domestic movies, shown only to the domestic audience, while the rest are movies shown to the global audience.

Using the value of $\underline{\theta}_u$, we can derive (a) the number of country-*u* movies exported to country *k*, and (b) total sales of country-*u* movies in country *k*:

$$\text{(a) } n_{uk} = N_u \int_{\underline{\theta}_u}^{\infty} dG(\theta_{uj}) = N_u a^{\varsigma} (\underline{\theta}_u)^{-\varsigma},$$

$$\text{(b) } S_{uk} = N_u \int_{\underline{\theta}_u}^{\infty} s_{ukj} dG(\theta_{uj}) = C_u n_{uk} \delta_{uk}^{\sigma-1} t_{uk}^{1-\sigma} A_k w_k^{1-\sigma}, \qquad C_u = \frac{B\sigma\varsigma\underline{\theta}_u^{\sigma-1}}{\varsigma - (\sigma-1)}. \tag{9}$$

To see the intuition behind (9), consider the total sales of country-*u* movies in country *k*, S_{uk}. Equation (9b) is a gravity-like prediction in which S_{uk} responds to country-*k* characteristics, such as income, and variable trade costs between *u* and *k*. This variation consists of an extensive margin – the number of country-*u* movies exported to *k* – and an intensive margin – the average sale per country-*u* movie. In (9a), the extensive margin is exporting-country specific and does not vary with importing-country characteristics. As

a result, all variation in S_{uk} occurs along the intensive margin. The fixed export cost does not affect the intensive margin because it does not vary across importers.

Together, equations (5), (6) and (9) imply that:

$$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = (1-\sigma)\ln(\frac{t_{uk}}{\delta_{uk}}) + \ln C_u, \qquad C_u = \frac{B\sigma\varsigma\underline{\theta}_u^{\sigma-1}}{\varsigma-(\sigma-1)}. \tag{10}$$

In equation (10), S_{uk}/n_{uk} and S_{kk}/n_{kk} are the average sales in country k of a movie produced in country u and of a movie produced domestically. On the left of (10) are average sales in relative terms, $\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}})$, which we refer to as the average sales ratio. By expressing average sales as a log difference, the CES price index, $P_{k,}$ domestic expenditure on movies, αY_k, and marginal costs, w_k, all drop out. We summarize (10) as:

Proposition 1 With global fixed export costs and pure sunk costs, the average sales ratio, $\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}})$, is negatively correlated with variable trade costs between an importer and an exporter and uncorrelated with other importing-country characteristics.

A result similar to Proposition 1 holds for standard monopolistic competition, which has no firm heterogeneity or fixed export costs. Here, the average sales ratio is,

$$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = \ln(\frac{s_{ukj}}{s_{kkj}}) = (1-\sigma)\ln(\frac{t_{uk}}{\delta_{uk}}). \tag{11}$$

Equation (11) is isomorphic to equation (10), except for the constant C_u in the latter equation. In the monopolistic competition model, the variation of S_{uk} occurs along the

intensive margin, as in (9).[6] Of course, the standard monopolistic competition model also predicts all movies are exported, contrary to Melitz-type models.

II.B Bilateral Fixed Export Costs

Next, we consider a model with bilateral fixed export costs. To exhibit a motion picture abroad, producers are now subject to a fixed cost that is specific to each destination market. Showing a country-u movie in country k involves a fixed input of f_{uk} units of country-k labor, showing the movie in country l involves an additional f_{ul} units of country-l labor, etc. The other elements of the model are the same. The assumption of bilateral fixed export costs is widely used in the literature on firm heterogeneity (e.g., Chaney, 2006; Helpman, Melitz and Rubinstein, 2007), though Melitz (2003) makes no explicit case for fixed export costs being bilateral or global in nature.

For a country-u producer, showing movie j in country k now yields profit

$$\pi_{ukj} = \theta_{uj}^{\sigma-1}\delta_{uk}^{\sigma-1}t_{uk}^{1-\sigma}A_k B w_k^{1-\sigma} - f_{uk}w_k . \tag{12}$$

Setting $\pi_{ukj}=0$, the cut-off value of θ_{uj} for a country-u producer to serve country k is

$$\underline{\theta}_{uk} = \left(\frac{f_{uk}\delta_{uk}^{1-\sigma}t_{uk}^{\sigma-1}w_k^{\sigma}}{BA_k} \right)^{\frac{1}{\sigma-1}} . \tag{13}$$

Analogous to (9), we can use the value of $\underline{\theta}_{uk}$ to derive: (a) the number of country-u movies exported to country k, and (b) the total sales of country-u movies in country k:

[6] To further examine the similarity of the global fixed export cost model and the standard monopolistic competition model, we derive in the Appendix an expression for N_k, the number of movies that have their θ's drawn, assuming that country k is closed and has only one sector. In this case, $N_k = L_k/(\sigma f_E)$, where L_k is the labor force of country k. Here, the sunk entry cost f_E pins down N_k through free entry and exit so that producers earn zero expected profits prior to entry. This expression is analogous to the expression for the number of varieties in the one-sector monopolistic competition model (e.g., Krugman 1980).

(a) $n_{uk} = N_u \int_{\underline{\theta}_{uk}}^{\infty} dG(\theta_{uj}) = N_u a^{\varsigma} (\underline{\theta}_{uk})^{-\varsigma}$.

(b) $S_{uk} = N_u \int_{\underline{\theta}_{uk}}^{\infty} s_{ukj} dG(\theta_{uj}) = \frac{B\sigma\varsigma a^{\varsigma}}{\varsigma - (\sigma - 1)} N_u \delta_{uk}^{\sigma-1} t_{uk}^{1-\sigma} A_k w_k^{1-\sigma} (\underline{\theta}_{uk})^{\sigma-\varsigma-1}$

$$= n_{uk} f_{uk} w_k \frac{\sigma\varsigma}{\varsigma - (\sigma - 1)}. \qquad (14)$$

In contrast to (9), (14) says that variation in S_{uk} across importing countries k occurs primarily along the extensive margin, n_{uk}, and that the intensive margin, S_{uk}/n_{uk}, does not depend on variable trade costs, δ_{uk} and t_{uk}, or expenditure on movies by k.[7] To see the basis for this result, compare importing country l, which has low variable trade costs with exporting country u, to importing country m, which has high variable trade costs with u. Higher variable trade costs in m mean that total sales of country-u movies in m are lower than in l. They also imply a higher cut-off level of θ for country-u movies shown in m, such that m imports a smaller number of movies from u. Given the assumption that the distribution of movie types is Pareto, these two effects exactly offset each other, leaving sales per movie unaffected by variable trade costs.

Equations (5) and (6) continue to hold for the domestic production and sales of country k movies. Together with equation (14) they imply that:

$$\ln\left(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}\right) = \ln(f_{uk}) + \ln\frac{w_k^{\sigma}}{A_k} + C_3, \quad \text{for } C_3 = \text{constant}, \qquad (15)$$

which we summarize as:

[7] An importing country with a large GDP, Y_k, may also have a large number of domestic movies and so a low CES price index, P_k. This tends to reduce the demand for foreign movies and may dampen the effect of Y_k. In a stylized model, Helpman, Melitz and Yeaple (2004) show that the competition effect of P_k may completely offset the country-size effect of Y_k in general equilibrium such that n_{uk} is the same across all importing countries k. This result is derived under factor-price equalization and identical trade costs for every country pair, assumptions we do not maintain. This result also implies that S_{uk} is the same across all importing countries k, contrary to what we observe in the data.

Proposition 2 With bilateral fixed export costs and pure fixed costs, the average sales ratio, $\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}})$, is positively correlated with fixed trade costs and the importing-country wage, and negatively correlated with importing-country movie expenditure.

Propositions 1 and 2 highlight the importance of the nature of fixed export costs for the intensive and extensive margin of trade. Changing fixed export costs from global to bilateral reverses the sign of correlation between the average sales ratio and trade costs and changes the set of correlates for the average sales ratio.

II.C Pure versus Partial Sunk Costs

Our treatment of fixed production costs as being entirely sunk (incurred before a producer discovers its type) departs from what is standard in the literature. We now explore how introducing fixed production costs that are incurred after a producer learns its type affects the results, under either global or bilateral exports costs.

Suppose a producer of movie h in country k incurs fixed production costs of b units of country-k labor, after he draws the demand shifter θ_{kh} from the distribution $G(\theta)$. Of all the N_k movies that *could* be made (i.e., all those that have had their θ's drawn), only $n_{kk} < N_k$ movies will *actually* be made. After the producer observes θ_{kh}, he may decide not to make movie h at all to avoid paying the fixed production cost. Analogous to equations (13) and (14), we can derive (a) the profit of movie h, (b) the cutoff value of θ for movie h to be made, (c) the number of country-k movies actually made, and (d) the total box-office sales of country-k movies:

(a) $\pi_{kkh} = \theta_{kh}^{\sigma-1} A_k B w_k^{1-\sigma} - b w_k, \;\; A_k \equiv \frac{\alpha Y_k}{P_k^{1-\sigma}},$

(b) $\underline{\theta}_{kk} = \left(\frac{bw_k^{\sigma}}{BA_k} \right)^{\frac{1}{\sigma-1}}$,

(c) $n_{kk} = N_k \int_{\underline{\theta}_{kk}}^{\infty} dG(\theta_{kh}) = N_k a^{\varsigma} (\underline{\theta}_{kk})^{-\varsigma}$,

(d) $S_{kk} = N_k \int_{\underline{\theta}_{kk}}^{\infty} s_{kkh} dG(\theta_{kh}) = \frac{B\sigma\varsigma a^{\varsigma}}{\varsigma - (\sigma - 1)} N_k A_k w_k^{1-\sigma} (\underline{\theta}_{kk})^{\sigma-\varsigma-1}$

$= n_{kk} b w_k \frac{\sigma\varsigma}{\varsigma - (\sigma - 1)}$. (16)

The fraction of movies that are made (n_{kk}/N_k) varies with domestic market conditions, such as national expenditure and the expenditure share on movies, adjustment mechanisms that are absent under pure sunk costs.

To see the importance of these mechanisms, consider domestic movie sales in country k, S_{kk}. Suppose the size of country k increases and the number of movies that have their θ's drawn, N_k, remains unchanged.[8] The result will be that S_{kk} rises. From (3), there is a direct effect in that the revenue of each movie is higher. From (16c), there is also an indirect effect in that the variable profit of each movie is higher, meaning that more movies will be made (n_{kk} rises). Does the number of movies made rise by more or less than total movie sales? The indirect effect on $\ln(S_{kk})$ depends on the box office revenues of the infra-marginal movies relative to the rest of country-k movies (the extra-marginal movies) while the effect on $\ln(n_{kk})$ depends on the *number* of infra-marginal movies relative to the number of extra-marginal movies. Because infra-marginal movies are less popular than extra-marginal movies, they carry more weight in movie numbers than in movie sales. As a consequence, the effect of Y_k on $\ln(n_{kk})$ exceeds the indirect

[8] By (10) and (16), a change in N_k has the same effects on n_{kk} and S_{kk}.

effect on ln(S_{kk}). In fact, given the assumption that the distribution of movie types is Pareto, the effect of Y_k on ln(n_{kk}) equals the *total effect* on ln(S_{kk}),. This means that a change in market size has no effect on the intensive margin, S_{kk}/n_{kk}, and all adjustment in S_{kk} occurs along the extensive margin. In contrast, under pure sunk production costs, market size does not change the number of movies made, leaving all adjustment in S_{kk} to occur along the intensive margin.

Using (16), we can derive the average sales ratio under alternative assumptions for fixed trade costs. If fixed export costs are global, the sales of country-u movies in country k are described by equation (9) so that:

$$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = (1-\sigma)\ln(\frac{t_{uk}}{\delta_{uk}}) + \ln(\frac{A_k}{w_k^{\sigma}}) + C_{u1}, \qquad C_{u1} = \ln[\frac{B}{b}(\underline{\theta}_u)^{\sigma-1}] \ . \qquad (17)$$

The average sales ratio is negatively correlated with variable trade costs, as in (10), and also correlated with importing country characteristics, unlike (10). The latter obtains because domestic movie production adjusts along the extensive margin but movie exports adjust along the intensive margin so that importing country characteristics have different impacts on the average sales of country-u (foreign) and country-k (domestic) movies. On the other hand, if fixed export costs are bilateral, the sales of country-u movies in country k are described by equation (14) such that:

$$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = \ln(\frac{f_{uk}}{b}) \ . \qquad (18)$$

Equation (18) is the prediction of the original setting of Melitz (2003). The average sales ratio is positively correlated with fixed trade costs, as in (15), but uncorrelated with importing country characteristics, unlike (15). Domestic and foreign movie sales each

adjust along the extensive margin only so that importing country characteristics have the same impact on the average sales of both movie types.

Table 1 presents equations (10), (15), (17) and (18) in the form of a 2x2 matrix. Each equation gives the relationship between the average sales ratio, trade costs, and other importing-country characteristics for one of the four models we have considered. The specifications differ across the columns according to the nature of fixed export costs (global versus bilateral) and down the rows according to the nature of sunk production costs (pure versus partial). These specifications are the basis for the estimation.

II.D Empirical Specifications

Let country u be the U.S., S_{ukt} and n_{ukt} be total box-office revenue for U.S. films and total number of U.S. films shown in country k in year t, and S_{kkt} and n_{kkt} be the total box office revenue and total number of domestically produced films shown in k in year t. In Table 1, all four models predict that the average sales ratio, $\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}})$, is correlated with trade costs. The two models with global fixed export costs (in the left column of Table 1) predict *negative* correlations with variable trade costs, while those with bilateral fixed export costs (in the right column of Table 1) predict *positive* correlations with fixed trade costs. Let X_{uk} be a vector of variables that capture barriers to trade in motion pictures between the U.S. and country k. The first regression we estimate is,

$$\ln(\frac{S_{ukt}/n_{ukt}}{S_{kkt}/n_{kkt}}) = \alpha_t + \beta \mathrm{X_{uk}} + \varepsilon_{ukt}, \qquad (19)$$

where α_t represents year fixed effects. Under global fixed export costs X_{uk} should include only variable trade costs, with $\beta < 0$; under bilateral fixed export costs X_{uk} should only includes fixed trade costs, with $\beta > 0$.[9]

In practice, many of the variables one would include in X_{uk} are proxies, rather than direct measures, of bilateral trade costs, such as distance, having a common language, sharing a colonial history, etc. It is difficult to determine whether these factors are associated with fixed or variable barriers. An advantage of the specification in (19) is that we do not need to resolve the fixed-versus-variable trade-cost dilemma. Since global and bilateral fixed export costs give opposite sign predictions for the correlation between the average sales ratio and trade costs, testing one against the other simply involves determining whether the elements of the parameter vector β are positive or negative. Also, the double differencing implicit in the average sales ratio in (19) sweeps out of the estimation the price index, consumption share of movies, and number of movies that could be made for country *k*, all of which are hard to measure.

The second specification we estimate incorporates predictions from theory for the correlation between the average sales ratio, importing country size, and importing country labor costs. Let E_{kt} and W_{kt} be the vectors of variables that measure movie expenditures and wages in country k. We augment the specification in (19) to obtain

$$\ln\left(\frac{S_{ukt}/n_{ukt}}{S_{kkt}/n_{kkt}}\right) = \alpha_t + \beta \mathrm{X_{uk}} + \gamma_1 \mathrm{E_{kt}} + \gamma_2 \mathrm{W_{kt}} + \varepsilon_{ukt}. \qquad (20)$$

The dependent variable (the average sales ratio) is the intensive margin of movie exports relative to the intensive margin of domestic movie production. By Table l, when the

[9] Recent work examines the correlation between the normalized number of firms exporting to a given country and the size of the importing country (e.g., Eaton, Kortum and Kramarz, 2004; Arkolakis, 2007). In the Appendix, we show that this correlation does not help us distinguish the standard heterogeneity model from the alternative heterogeneity model and so we do not look at this correlation for movies.

margin of adjustment for movie exports matches that for domestic movie production, importing country characteristics other than trade costs have symmetric impacts on movie exports and domestic movie production. These characteristics are thus uncorrelated with the average sales ratio, implying $\gamma_1 = \gamma_2 = 0$. This occurs along the diagonal of Table 1, either with global fixed trade costs and pure sunk costs or bilateral fixed trade costs and partial sunk costs. Alternatively, where the margin of adjustment for movie exports and domestic movie production do not align, importing-country characteristics have differential effects on foreign and domestic movie revenues, implying that $\gamma_1 \neq 0$ and $\gamma_2 \neq 0$, as occurs along the off-diagonal of Table 1.

In section IV, we estimate equations (19) and (20) using data on domestic movie production and imports of U.S. movies for a panel of medium to large countries. We first test whether trade barriers are positively or negatively correlated with the average sales ratio, which amounts to seeing whether the specifications in the left column or right column of Table 1 better match the data. Then, we introduce correlates of importing-country size and labor costs, to further refine model selection.

III. Data

III.A Exports of U.S. Motion Pictures

We evaluate the demand for U.S. films and domestically made films using data on box-office revenues by country and year.[10] Box-office revenues are equivalent to the c.i.f. (customs, insurance, freight) value of motion-picture services consumed in cinemas,

[10] Individuals consume services of new movie releases through cinemas and previous movie releases through video rentals, video purchases, or pay TV. Distributors tend to release movies to cinemas first and to other outlets later, suggesting for a given film these services do not compete contemporaneously. Data on revenues by country from non-cinema movie distribution are difficult to obtain.

plus retail markups. These revenues include import duties, transport costs, and other trade costs incurred in delivering the service to the consumer, as well as sales taxes and exhibition fees collected by cinemas. They are consistent with the trade-cost-inclusive measure of sales used in the models developed in section II.

Data on box-office revenues for 44 countries over the period 1995-2005 are available from Screendigest.com. In each country, Screendigest.com reports the number of films screened, total film attendance, and total box-office revenues for films imported from the United States and films produced domestically.[11] For larger European countries, data coverage begins in 1995, while for other countries coverage begins later in the sample. Data are compiled from government agencies, national film bodies, film exhibitor and distributor associations, and company spokespeople.[12]

An important issue in using data on box-office revenues is how to classify the nationality of a film. Screendigest.com defines the origin country for a film by the location of the company that produces the film. Production companies oversee the writing or purchase of screenplays and musical scores; casting; costume and set design; animation, filming, sound recording, and editing; marketing and distribution; and financing.[13] These are largely fixed-cost activities. For a given movie, production may occur in multiple countries. *Titanic* (1997), for instance, was filmed in Canada, Mexico

[11] Most box-office revenues are earned shortly after a film is released (De Vany and Walls, 1999 and 1997), suggesting that revenues reported in a given year match the movies released in that year. Some revenue data are available for films imported from countries other than the U.S., but the countries covered vary across destinations (e.g., while the U.K. is a major importer of movies from India, Spain is not).

[12] Data on international trade in motion pictures (or other information services) are difficult to obtain. The U.S. Bureau of Economic Analysis does not publish bilateral trade flows for the film industry. The U.N.'s Comtrade lists motion-picture trade as a commodity, Cinematographic Film Exposed or Developed (SITC 883), which is the reported value of physical shipments of exposed film across borders. The value of physical film shipments appears to vastly understate film revenues. For instance, Comtrade reports 2000 U.S. exposed film exports of $0.5 million to France, $0.5 million to Germany, and $6.5 million to the U.K., while Screendigest.com reports 2000 box-office revenues for U.S. films of $513 million in France, $615 million in Germany, and $429 million in the U.K. (Hancock and Jones, 2003).

[13] Independent exhibition companies oversee the screening of movies to consumers.

and the United States, with most other production activities occurring in Los Angeles. Screendigest.com considers the movie to be U.S. in origin because the production companies, 20th Century Fox and Paramount, are based in the United States. Despite *Titanic*'s filming locations, it is clearly a U.S. movie. The dialogue is in English, it was first released in the U.S. market, and its cultural themes were targeted to a U.S. audience. The cultural discount involved in exporting *Titanic* to, say, Italy would logically have the U.S. as the reference point, such that these costs would be measured by the linguistic and cultural distance between Italy and the United States.

III.B Trade Barriers in Motion Picture Trade

The empirical method for testing the Melitz model that we develop in section II calls for all relevant trade costs to be included in the estimation. We include measures of geographic distance, cultural distance, levies on film imports, quantitative restrictions on film imports, and the protection of intellectual property rights.

For cultural trade costs between the United States and its trading partners, we use indicators of linguistic and religious dissimilarity between countries. Following Fearon (2003) and Wacziarg and Spolare (2006), we calculate linguistic distance as 1 minus the expected value of a linguistic similarity factor between a person randomly drawn from the United States and one randomly drawn from country *k*:

$$LD_{uk} = 1 - \sum_l \sum_o p_{lu} p_{ok} \sqrt{G_{lo}/15}\,, \tag{22}$$

where l indexes the ethnic groups that speak different languages in the U.S., o indexes those in country k and p_{lu} and p_{ok} are the population shares of language groups l and o in the U.S. and country k. The linguistic similarity factor is $\sqrt{G_{lo}/15}$, where G_{lo} is the

number of branches of the language tree that groups l and o share and 15 is the maximum number of branches. Linguistic similarity is concave with respect to G_{lo} because early divergence in the language tree (e.g., Indo-European vs. Japanese language families) is likely to signify greater cultural difference than later divergence (e.g., Italic vs. Germanic languages). Our metric of religion distance is similar:

$$RD_{uk} = 1 - \sum_l \sum_o p_{lu} p_{ok} \sqrt{R_{lo} / 4}\,, \tag{23}$$

where R_{lo} is the number of common branches of the religion tree shared by groups l and o and 4 is the maximal number of branches. Data on the global language tree is from Fearon (2003) and on the global religion tree is from Fearon and Mecham (2007). We also experiment with alternative measures of cultural ties between countries.

One measure of policy trade barriers for the film industry is a country's MFN tariff on Cinematographic Film Exposed and Developed (HS 3706), which is the product category that covers trade in film prints across borders, from the UN Trains dataset. Since tariff data are unavailable in later years and reported inconsistently across countries in earlier years, we measure tariffs as the average value over the 1990-1998 period. For the countries in our sample, the average MFN tariff on film imports is 5.6%. A second source of data on trade barriers is an annual report by the Motion Pictures Association of America (MPAA) to the U.S. Trade Representative. The MPAA report covers over 100 countries, listing for each the policies its members claim adversely affect their business interests. These policies fall into three broad categories: tariffs and levies (e.g., tariffs on film imports, taxes on royalties for foreign films, levies on sales of foreign videos), quantitative restrictions (e.g., import quotas on foreign films, minimum screen time for domestic films, requirements that domestic short subjects be shown with foreign films),

and other restrictions (e.g., subsidies to domestic movie producers, requirements that foreign films be printed locally, mandates that foreign-language movies be dubbed, restrictions on foreign investment in film or TV). There is considerable heterogeneity across countries in how barriers are defined, which complicates constructing continuous policy measures. Our approach is to use dummy variables to indicate whether a specific type of barrier is in place in 2001 (MPAA 2002), which is the mid point in our sample period. A Data Appendix describes the data on trade barriers in more detail.

The protection of intellectual property rights (IPRs) may be important for exports of motion pictures. Movie producers complain that many countries devote insufficient effort to preventing individuals from selling pirated DVDs of U.S. movies (Siwek, 2006). McCalman (2005) finds that while moderate IPR protection encourages the spread of U.S. movies, either very weak or very strong IPR protections decrease the speed with which U.S. movies are released abroad.[14] As a first measure of IPR protection, we use the Ginarte-Park (1997) index of patent protection in either 1995 or 2000.[15] As a second measure of IPR protection we use an indicator for whether the U.S. Trade Representative has placed a country on the Priority Watch List for inadequate protection of intellectual property rights in a given year under a congressionally mandated annual review process known as Special 301. Over the 1995-2005 period an average of 14.4% of the countries in our sample were on the Priority Watch List in any given year.[16] As a third measure, we use an indicator for whether a country has entered into force the World Copyright

[14] In related work, McCalman (2004) finds that while Hollywood studios are more likely to use licensing arrangements in countries with moderate IPR protection, they tend to use more integrated governance structures in countries with either high or low IPR protection.

[15] Since the index is highly correlated over time within countries, the choice of year is unimportant. The index is also correlated with other measures of IPR protection and enforcement of commercial contracts, such as those contained in the Global Competitiveness Report produced by the World Economic Forum.

[16] There is also a Special 301 Watch List. However, too many countries are on the watch list to provide a meaningful indicator of IPR protection.

Treaty of the World Intellectual Property Organization (WIPO).[17] By 2005, 31.6% of countries in our sample had activated the WIPO treaty.

III.C Preliminary Data Analysis

For the countries in our sample, the United States is by far and away the largest source country for movie imports. For 2001 to 2004, during which we have complete data for most countries, the U.S. share of box office revenues earned by foreign movies ranges from a low of 66% in Switzerland to a high of 98% in New Zealand. Figure 1 shows that U.S. movies account for over 60 percent of total box office revenues (domestic plus foreign movie sales) in all countries except France and South Korea. In all but five countries, the U.S. accounts for over 40 percent of the movies exhibited. That the U.S. share of box office revenues exceeds the U.S. share of movies exhibited indicates, unsurprisingly, that U.S. movies tend to have relatively high revenues.

Table 2 gives summary statistics for the key variables used in the analysis and a data appendix shows mean values for the numbers of U.S. and domestic films exhibited and box office revenues per film for U.S. and domestic films over 2001-2004. During this period, 320 new domestically produced movies were shown on average in the United States each year. Consistent with the presence of fixed exports costs of some kind, the typical country in our sample imports less than half of U.S. movies produced annually, with the mean number of U.S. movies exhibited equal to 141. Most countries are clustered around this mean, with the country at the 20th percentile (Indonesia) importing 114 U.S. movies annually and the country at the 80th percentile (Lithuania) importing 163

[17] The WIPO Copyright Treaty (adopted in 1996) commits signatories to abide by specific definitions of copyrighted material and to enforce property rights over this material. See http://www.wipo.int/.

movies. In contrast, box-office revenues per movie show wide variation. Mean revenues per movie are $0.92 million (in 2000 U.S. dollars), with the country occupying the 20th percentile (Czech Republic) at $0.16 million and the country occupying the 80th percentile (S. Korea) at $1.73 million. While the ratio of the 80th to the 20th percentile for number of U.S. movies imported is 1.4, for box office revenues per U.S. film it is 10.8. This suggests that variation in U.S. film exports occurs more at the intensive margin (revenues per film) than the extensive margin (number of films). The wider variation in the intensive over the extensive margin is also seen in Figure 2, which plots log revenues per U.S. movie against log number of U.S. movies (each expressed as the deviation from sample means), averaged by country over 2001-2004. The standard deviation for revenues per movie is 1.40 compared to 0.23 for number of movies.

As is the case with most products, the value of film imports is strongly increasing in the importer's GDP. Most of the variation in imports associated with market size occurs along the intensive margin. Figures 3a and 3b plot the number of U.S. movies imported and box-office revenues per U.S. movie against importing-country GDP.[18] There is a weak positive relationship between number of U.S. films and GDP (slope coefficient of 0.08), and a strong positive relationship between revenues per U.S. film and GDP (slope coefficient of 0.92). While a country that doubled in size would tend to import 6% more U.S. movies, it would spend 64% more on each movie. Figures 3c and 3d show that GDP is positively correlated with both revenues per domestic movie (slope coefficient 0.69) and number of domestic movies exhibited (slope coefficient 0.72). Not surprisingly, larger countries produce more movies and have higher sales per movie.

[18] All variables are expressed relative to the mean value across countries.

The theoretical results presented in section II suggest that a simple way to identify the nature of fixed trade costs is to examine the sign of the correlation between trade costs (be they fixed or variable) and the average sales ratio (average revenue per U.S. movie relative to average revenue per domestically made movie). Figures 4a and 4b plot the average sales ratio – which is the dependent variable in the specifications shown in Table 1 – against two measures of trade barriers, distance to the U.S. and linguistic dissimilarity with the U.S. Geographic and linguistic distance each have a negative correlation with the average sales ratio, which is consistent with global fixed export costs (as shown in the first column of Table 1) and inconsistent with bilateral fixed export costs (as shown in the second column of Table 1).

We do not know whether geographic distance and linguistic distance affect variable or fixed trade charges. In all likelihood they affect both. Yet, on the basis of the theoretical predictions in Table 1, it appears that distance affects trade primarily along the intensive margin, such that in motion pictures the relevance of distance for trade is in how it affects variable trade costs. In the next section, we examine whether the negative correlation between sales per film and trade costs holds up once we expand the time period and introduce additional controls into the estimation.

IV. Estimation Results

IV.A Main Results

Table 3 presents the results of estimating (19). The dependent variable is the average sales ratio, the average box office revenue per U.S. movie normalized by the average box office revenue per domestic movie. Our sample covers 42 countries for the

years 1995-2005.[19] The different specifications in Table 3 include various measures of linguistic and geographic distance. In all specifications, the average sales ratio is negatively correlated with linguistic and geographic distance from the U.S. Based on the theoretical predictions in Table 1, these results suggest that fixed export costs are global in nature and that movie exports adjust primarily along the intensive margin.

Columns 1-3 examine the role of linguistic distance. We first consider the linguistic dissimilarity index of equation (22);[20] its coefficient is negative and precisely estimated in all specifications. To see whether this result is driven by the use of English, column 2 includes a dummy variable that equals 1 if a country has English as its primary language[21] (and so has *low* trade costs). The English dummy is positive but only significant at the 10% level. In column 3, we include both variables. The English dummy loses significance while the linguistic dissimilarity index remains precisely estimated with a coefficient very similar to that in column 1. In all subsequent specifications, we use the linguistic dissimilarity index to measure linguistic distance.

Columns 4-6 examine the role of geographical distance. The coefficient of the linguistic dissimilarity index becomes smaller in magnitude with the inclusion of geographic distance variables but remains precisely estimated. The first geographic distance variable is a dummy that equals 1 if a country is an island (and so has *low* trade costs); its coefficient is positive and precisely estimated in all specifications. We then

[19] We lose two countries from the total of 44 in the sample because the U.S. cannot appear as an import destination and we lack data on some regressors for Taiwan.

[20] The U.S. has two major linguistic groups, English and Spanish. English goes down to branch-level 6 (out of a possible 15) on the language tree and Spanish goes down to level 10. By construction, the linguistic similarity index for the U.S. never reaches its minimum value, meaning we might exaggerate true linguistic distance. We considered three alternative metrics (aggregating the language tree up to 10, 6, or 2 levels) and in each case obtained similar results to those in Table 3.

[21] In unreported results, we experimented with alternative language dummy variables (whether a country has English as an official language, English as the most common language, or English as any commonly spoken language). The results were similar to those for the English dummy in Table 3.

consider two sets of variables, great circle distance to the U.S. and the absolute values of longitudinal and latitudinal differences with those of the U.S. Longitude and latitude differences appear in column 4; great circle distance appears in column 5. In both cases, their coefficients are negative and precisely estimated. In column 6, which includes both sets of distance variables, great circle distance loses its significance while the longitude and latitude differences remain precisely estimated. In subsequent specifications, we use longitude and latitude differences to measure geographic distance.

Consistent with Figure 4, the regression results show that the average sales ratio is negatively correlated with common measures of trade barriers. Countries that are more distant from the U.S. – either in terms of geography or language – have lower sales per U.S. movie (relative to sales of domestic movies). This is consistent with geographic and linguistic distance affecting trade through their impact on variable trade costs, rather than through their impact on fixed trade costs. These results confirm that adjustment in motion picture trade primarily occurs along the intensive margin. In Table 1, the data prefer specifications in the first column over those in the second column.

Table 4 presents the results of estimating (20). The different specifications include the same variables for trade costs – the linguistic similarity index, the island dummy and the longitude and latitude differences – and additional variables that measure movie expenditures and wages of the importing countries. These variables include GDP (with or without adjusting for PPP), population, the average wage for low-wage industries, the average wage of high-wage industries relative to low-wage industries,[22] the fraction of the population that is urban, and the number of cinemas. These variables

[22] High-wage industries are ISIC 351, 384 and 385. Low-wage industries are ISIC 321, 322 and 324. The average is for 1994-1998.

enter the regressions separately and jointly. None of these variables has a precisely estimated coefficient. The average sales ratio appears to be uncorrelated with national income, labor costs, or the size of the domestic movie market. Based on Table 1, this suggests that the margin of adjustment for domestic movie production matches that for movie exports. On the other hand, just as in Table 3, the coefficients of the trade cost variables are significant and have similar estimates in all specifications. Table 4 implies that both domestic movie production and movie exports adjust primarily along the intensive margin, consistent with pure sunk costs and global fixed export costs. In Table 1, the data prefer the model in the upper-left cell over the other specifications.

IV.B Additional Results

The specifications in (19) and (20) require that we include all relevant trade costs in the regression. Clearly, factors besides distance may affect motion picture trade. We examine correlates of how intensively countries protect intellectual property rights and whether countries have erected trade barriers to imports of motion pictures.

Table 5 examines the role of IPR protection in imports of U.S. movies. We include as regressors the Ginarte-Park index for patent protection, whether a country is on the USTR Priority Watch List for inadequate protection of intellectual property rights (under Special 301 annual review), whether a country has entered into force the World Copyright Treaty of the World Intellectual Property Organization, and the MFN tariff on film imports (SITC 883), as discussed in section III.B. We also consider two variables from the Global Competitiveness Report of 1997-1999, as compiled by the World

Economic Forum: whether a country's legal system enforces commercial contracts and whether intellectual property rights (IPR) are well protected.

In no specification do measures of IPR protection have a statistically significant correlation with the average sales ratio. While GDP and population remain insignificant, the coefficients on the trade cost variables continue to be precisely estimated, with magnitudes similar to those in Tables 3 and 4.

Table 6 examines the role of broad categories of policy trade barriers from the Motion Pictures Association of America (MPAA) annual reports. As discussed in section III.B, these are dummy variables for levies and tariffs on movies, quantitative restrictions on movies and other restrictions on movies. None of these variables has a precisely estimated coefficient; other aspects of the findings are similar to Tables 4 and 5. These results may seem surprising, in that one would expect policy barriers to imports of motion pictures to impede trade. One interpretation of the results is that the MPAA exaggerates the presence of trade barriers (in order to provoke the USTR into action), leaving the measures they produce subject to measurement error.

In unreported results, we examined the correlation of the average sales ratio with religion and immigration. For religion we use the religion dissimilarity index of equation (23). For migration, we consider the number of emigrants to North America (either in levels or as a share of the source country population), as documented by Docquier and Marfouk (2006). None of these variables has a precisely estimated coefficient. We also examine the 11 narrow categories of MPAA-reported trade barriers discussed in section III.B. Nine of them are insignificant. The dummies for requiring a domestic short movie to be shown prior to a full-length foreign feature films and for having tariffs on foreign

films (as a service, distinct from the tariff on films as a good under SITC 883) have positive and significant coefficients when they enter into the regression separately. However, these results appear to be equivalent to a dummy for Argentina.[23] When the two variables are included together they are statistically insignificant.

The rest of Table 7 examines the correlation of relative box office revenues and relative numbers of movies with trade costs and country size. In Column 1, the dependent variable is the average sales ratio, in Column 2 the dependent variable is box office revenues of U.S. movies relative to box office revenues of domestic movies, and in column 3 the dependent variable is the number of U.S. movies relative to the number of domestic movies. Linguistic and geographic distance have precisely estimated coefficients for relative box office revenues but not for relative numbers of movies. Country size and other policy trade barriers have similar coefficients for relative box office revenues and for relative numbers of movies. This suggests that the results for our double difference specifications using the average sales ratio as the dependent variable are driven by the correlations with relative box office revenues and not relative number of movies. This is further evidence that movie exports and domestic movie production each tend to adjust along the intensive margins.

V. **Conclusion** (tentative)

In this paper, we develop a simple empirical method to test two alternative versions of the Melitz (2003) model, which we apply to data on imports of U.S. motion pictures in 42 countries. In one model, fixed export costs are bilateral; in the other, they

[23] The short movie dummy equals one for only Argentina and the tariff restriction dummy equals one for only Argentina, Russia, and Thailand.

are global. Adjustment in motion picture trade occurs primarily along the intensive margin. Average revenues per U.S. film (relative to average revenues per domestic film) are decreasing in geographic distance, linguistic distance, and other measures of trade costs. This is consistent with geographic and linguistic distance affecting trade through their impact on variable trade costs, rather than through their impact on fixed trade costs. The data reject the bilateral fixed export cost model in favor of a model with global fixed export costs. The specification the Melitz model preferred by the data is quite similar to that for the standard monopolistic-competition model.

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Data Appendix

Country	Number of Domestic Films	Number of US Films	Revenue per Domestic Film	Revenue per US Film
Argentina	53	152	0.311	0.738
Australia	22	176	1.019	2.125
Austria	20	126	0.303	0.544
Belgium	36	224	0.068	0.326
Brazil	40	144	0.956	1.408
Canada	74	189	0.262	2.928
Czech Republic	19	99	0.208	0.155
Denmark	21	109	0.903	0.520
Estonia	7	81	0.047	0.037
Finland	12	107	0.600	0.295
France	214	167	1.510	2.791
Germany	109	151	1.126	4.209
Greece	17	140	0.532	0.303
Hungary	20	116	0.105	0.200
Iceland	6	128	0.143	0.075
Indonesia	11	114	1.000	0.373
Ireland	4	102	0.253	0.507
Italy	105	175	0.849	1.571
Lithuania	2	163	0.033	0.020
Malaysia	11	164	0.396	0.078
Mexico	19	158	1.583	2.065
Netherlands	30	129	0.410	0.683
New Zealand	5	152	0.694	0.367
Norway	15	119	0.721	0.470
Poland	22	116	0.627	0.447
Portugal	15	125	0.100	0.345
Romania	9	110	0.038	0.039
Russia	60	128	0.102	0.970
Singapore	6	154	0.384	0.306
Slovak Republic	4	98	0.009	0.035
Slovenia	4	117	0.022	0.063
South Korea	65	133	3.702	1.726
Spain	109	219	0.680	1.657
Sweden	26	118	1.050	0.740
Switzerland	41	121	0.130	0.749
Taiwan	22	194	--	--
Thailand	21	143	0.807	0.341
Turkey	16	119	0.971	0.442
UK	85	148	2.587	5.186
US	320	--	26.288	--

Revenues per film are in millions of 2000 U.S. dollars.

Table 1:
Predictions for Sales per Foreign Movie Relative to Sales per Domestic Movie

	Global Fixed Export Costs	**Bilateral Fixed Export Costs**
Pure Sunk Costs **(before θ draw)**	$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = (1-\sigma)\ln(\frac{t_{uk}}{\delta_{uk}}) + \ln C_u$ (equation (10))	$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = \ln(f_{uk}) + \ln\frac{w_k^{\sigma}}{A_k} + C_3$ (equation (15))
Partial Sunk Costs **(after θ draw)**	$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = (1-\sigma)\ln(\frac{t_{uk}}{\delta_{uk}}) + \ln(\frac{A_k}{w_k^{\sigma}}) + C_{u1}$ (equation (17))	$\ln(\frac{S_{uk}/n_{uk}}{S_{kk}/n_{kk}}) = \ln(\frac{f_{uk}}{b})$ (equation (18))

Table 2: Summary Statistics

Variable	Mean	St. Dev.
Number of US films	141.490	41.622
Number of domestic films	43.961	51.748
Revenue per US film	1.268	1.500
Revenue per domestic film	0.836	0.937
Log average sales ratio	0.406	1.013
Linguistic dissimilarity index	0.751	0.144
English official language	0.097	0.296
Island	0.081	0.273
Latitude difference with US	16.759	16.933
Longitude difference with US	104.632	48.325
Log distance to US	8.907	0.403
Log GDP	26.543	1.128
Log population	16.727	1.176
Log number of cinemas	6.674	1.073
Log Ginarte-Park index	1.270	0.256
Log intellectual property protection	1.635	0.174
Super 301 action	0.147	0.355
Log enforcement	1.298	0.265
WCT signatory	0.282	0.451
Log tariff on film product	0.023	0.069
Levies tariff on movies	0.359	0.481
Has quantitative restrictions on movies	0.425	0.495
Has other restrictions on movies	0.402	0.491

Sample is 264 observations on 41 countries over period 1995-2005 (with data on 15 countries over whole sample period and data on other countries for different subperiods).

Table 3: Average Sales Ratio and Trade Costs
(t-statistics in parentheses)

Linguistic dissimilarity	**-2.020**		**-2.166**	**-1.427**	**-1.302**	**-1.421**
	(-3.09)		(-2.67)	(-2.62)	(-2.21)	(-2.65)
English official language		**0.529**	**-0.183**			
		(1.79)	(-0.43)			
Island				**2.457**	**1.328**	**2.449**
				(3.98)	(2.40)	(3.74)
Latitude diff. with US				**-0.019**		**-0.019**
				(-3.44)		(-3.06)
Longitude diff. with US				**-0.010**		**-0.010**
				(-4.57)		(-2.87)
Log distance to US					**-0.977**	**-0.026**
					(-4.29)	(-0.08)
R^2	0.176	0.063	0.178	0.389	0.301	0.389
N	259	264	259	259	259	259

The specification is that in equation (19). The dependent variable is sales per U.S. movie relative to sales per domestic movie. See the text and Table 1 for variable definitions.

Table 4: Average Sales Ratio, Country Size, and Labor Costs
(t-statistics in parentheses)

Linguistic dissimilarity	**-1.605**	**-1.699**	**-1.532**	**-1.668**	**-1.690**	**-1.359**	**-1.328**	**-1.466**
	(-2.92)	(-3.19)	(-2.97)	(-3.06)	(-3.28)	(-2.33)	(-2.12)	(-2.49)
Island	**1.760**	**1.808**	**1.762**	**1.639**	**1.765**	**2.427**	**1.629**	**1.666**
	(5.69)	(5.71)	(4.80)	(4.43)	(3.96)	(3.90)	(3.61)	(3.43)
Latitude diff. with US	**-0.014**	**-0.014**	**-0.013**	**-0.013**	**-0.015**	**-0.019**	**-0.010**	**-0.012**
	(-3.35)	(-3.68)	(-3.27)	(-3.53)	(-3.59)	(-3.28)	(-1.44)	(-2.39)
Longitude diff. with US	**-0.009**	**-0.009**	**-0.009**	**-0.008**	**-0.009**	**-0.010**	**-0.009**	**-0.009**
	(-5.06)	(-4.95)	(-4.77)	(-4.08)	(-4.47)	(-4.41)	(-4.89)	(-4.40)
Log GDP	**0.064**						**0.450**	**0.178**
	(0.81)						(0.74)	(0.58)
Log population		**0.046**					**-0.221**	**-0.021**
		(0.59)					(-0.41)	(-0.10)
Log wage, low wage industries			**0.018**				**-0.119**	
			(0.15)				(-0.40)	
Log relative wage high-low				**-0.364**				**-0.156**
				(-0.76)				(-0.28)
Log urbanization					**0.068**		**0.173**	**0.134**
					(0.10)		(0.22)	(0.17)
Log number of cinemas						**0.037**	**-0.141**	**-0.102**
						(0.39)	(-0.59)	(-0.37)
R^2	0.393	0.391	0.383	0.387	0.388	0.39	0.396	0.395
N	255	255	243	243	255	259	243	243

Table 5: Average Sales Ratio and Protection of Intellectual Property
(t-statistics in parentheses)

Linguistic dissimilarity	**-1.564**	**-1.483**	**-1.470**	**-1.465**	**-1.505**	**-1.679**
	(-2.72)	(-2.42)	(-2.61)	(-2.30)	(-2.70)	(-2.38)
Island	**1.704**	**1.676**	**1.700**	**1.873**	**1.696**	**1.992**
	(4.28)	(4.17)	(4.39)	(4.14)	(4.23)	(3.75)
Latitude diff. with US	**-0.013**	**-0.013**	**-0.013**	**-0.014**	**-0.013**	**-0.016**
	(-2.21)	(-1.96)	(-2.43)	(-1.97)	(-2.42)	(-2.48)
Longitude diff. with US	**-0.009**	**-0.009**	**-0.009**	**-0.010**	**-0.009**	**-0.009**
	(-4.85)	(-4.77)	(-5.05)	(-5.52)	(-5.22)	(-4.35)
Log GDP	**-0.208**	**0.106**	**0.127**	**0.137**	**0.138**	**0.124**
	(-0.45)	(0.28)	(0.61)	(0.46)	(0.70)	(0.42)
Log population	**0.287**	**-0.015**	**-0.056**	**-0.013**	**-0.073**	**-0.056**
	(0.66)	(-0.04)	(-0.26)	(-0.05)	(-0.36)	(-0.21)
Log Ginarte-Park index	**0.789**					
	(1.21)					
Log IPR protection		**0.263**				
		(0.24)				
Super 301 Action			**-0.075**			
			(-0.45)			
Log enforcement				**0.239**		
				(0.56)		
WCT signatory					**0.003**	
					(0.01)	
Log film tariff						**0.947**
						(0.89)
R^2	0.415	0.408	0.394	0.416	0.393	0.463
N	237	237	255	232	255	209

Table 6: Average Sales Ratio and MPAA Trade Barriers
(t-statistics in parentheses)

Linguistic dissimilarity	**-1.631**	**-1.436**	**-1.617**
	(-2.79)	(-2.49)	(-2.91)
Island	**1.884**	**1.769**	**1.708**
	(4.04)	(4.36)	(4.45)
Latitude diff. with US	**-0.016**	**-0.013**	**-0.013**
	(-2.33)	(-2.48)	(-2.52)
Longitude diff. with US	**-0.009**	**-0.009**	**-0.009**
	(-5.06)	(-4.77)	(-5.38)
Log GDP	**0.065**	**0.086**	**0.142**
	(0.30)	(0.46)	(0.69)
Log population	**-0.030**	**0.013**	**-0.105**
	(-0.15)	(0.06)	(-0.50)
Levies tariff on movies	**0.179**		
	(0.55)		
Quantitative restrictions on movies		**-0.183**	
		(-0.81)	
Other restrictions on movies			**0.103**
			(0.37)
R^2	0.399	0.399	0.394
N	255	255	255

Table 7:
Relative Sales per Movie, Relative Movie Sales, Relative Number of Movies
(t-statistics in parentheses)

	1	2	3
Linguistic dissimilarity	**-1.637**	**-2.027**	**-0.389**
	(-2.86)	(-2.90)	(-0.82)
Island	**1.864**	**2.378**	**0.514**
	(4.67)	(4.78)	(1.27)
Latitude diff. with US	**-0.017**	**-0.009**	**0.008**
	(-2.86)	(-1.19)	(1.61)
Longitude diff. with US	**-0.009**	**-0.010**	**-0.001**
	(-4.77)	(-5.00)	(-0.59)
Log GDP	**0.152**	**-1.072**	**-1.223**
	(0.73)	(-3.64)	(-6.98)
Log population	**-0.106**	**0.485**	**0.591**
	(-0.51)	(1.78)	(4.01)
Domestic short movie requirem.	**0.111**	**-1.268**	**-1.379**
	(0.20)	(-2.39)	(-3.77)
Tariffs on film imports	**0.620**	**0.812**	**0.191**
	(1.48)	(2.33)	(0.92)
R^2	0.406	0.452	0.755
N	255	255	255

The dependent variables are the average sales ratio (sales per U.S. movie/sales per domestic movie) in column 1; relative movie sales (total U.S. sales/total domestic movie sales) in column 2; and relative number of movies (number of U.S. movies exhibited/number of domestic movies exhibited) in column 3.

Figure 1: Share of U.S. films in national movie consumption, 2001-2004

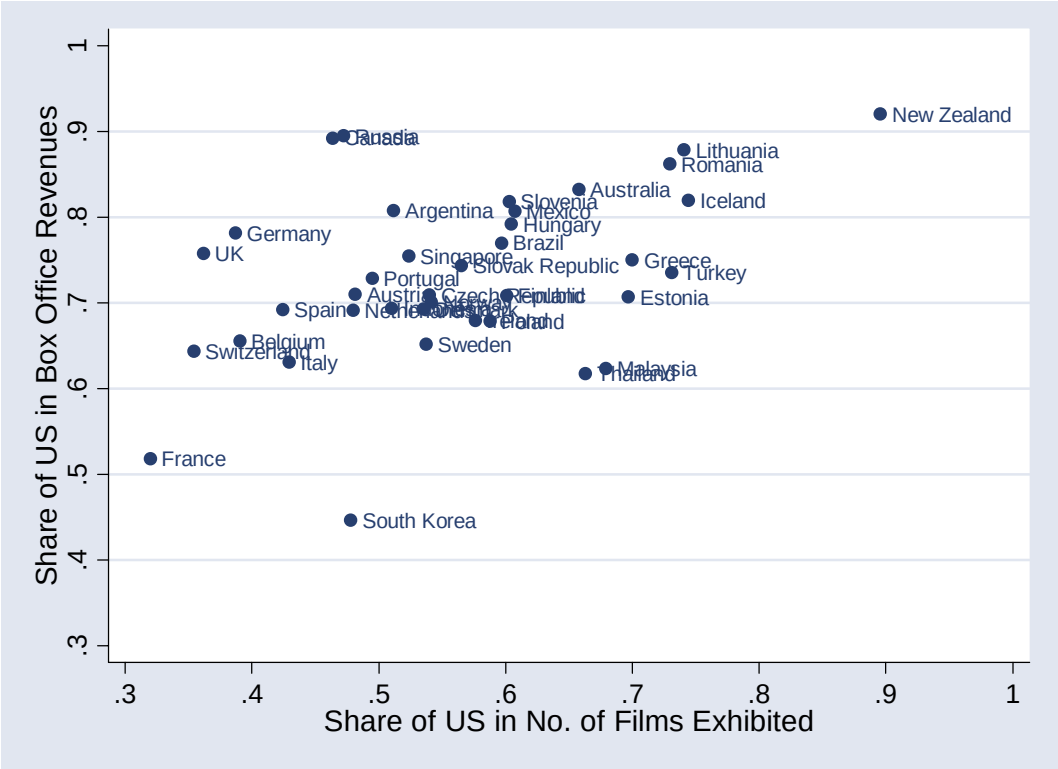


Figure 2: Intensive versus Extensive Margin of Movie Imports, 2001-2004

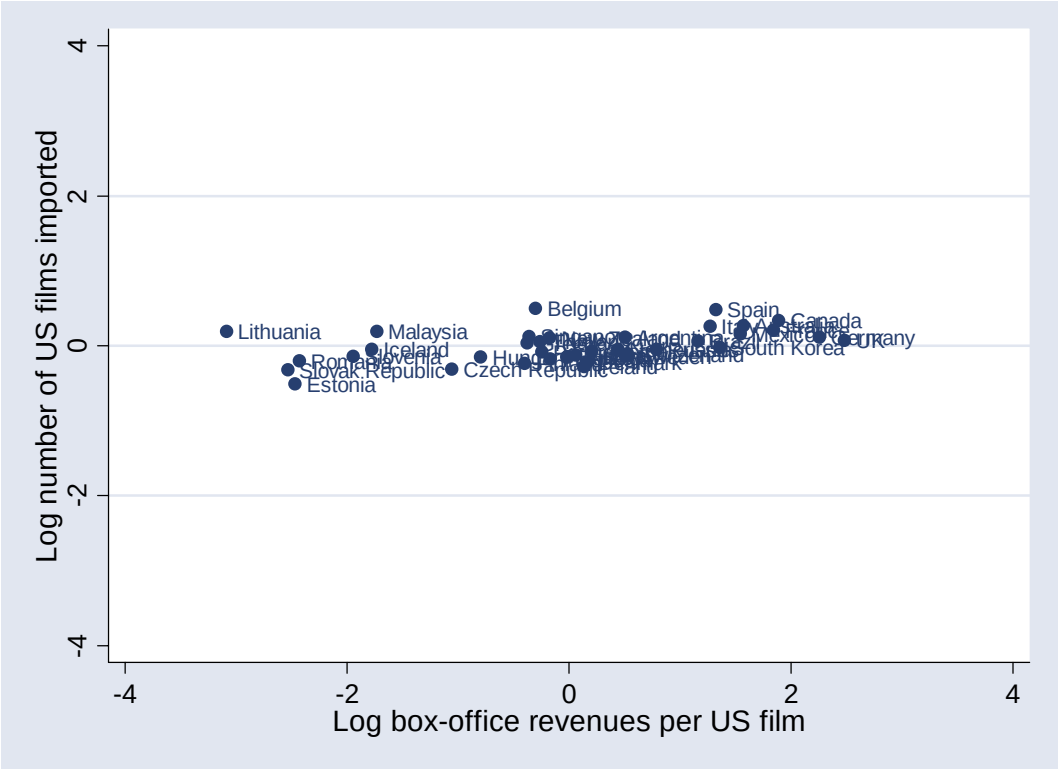
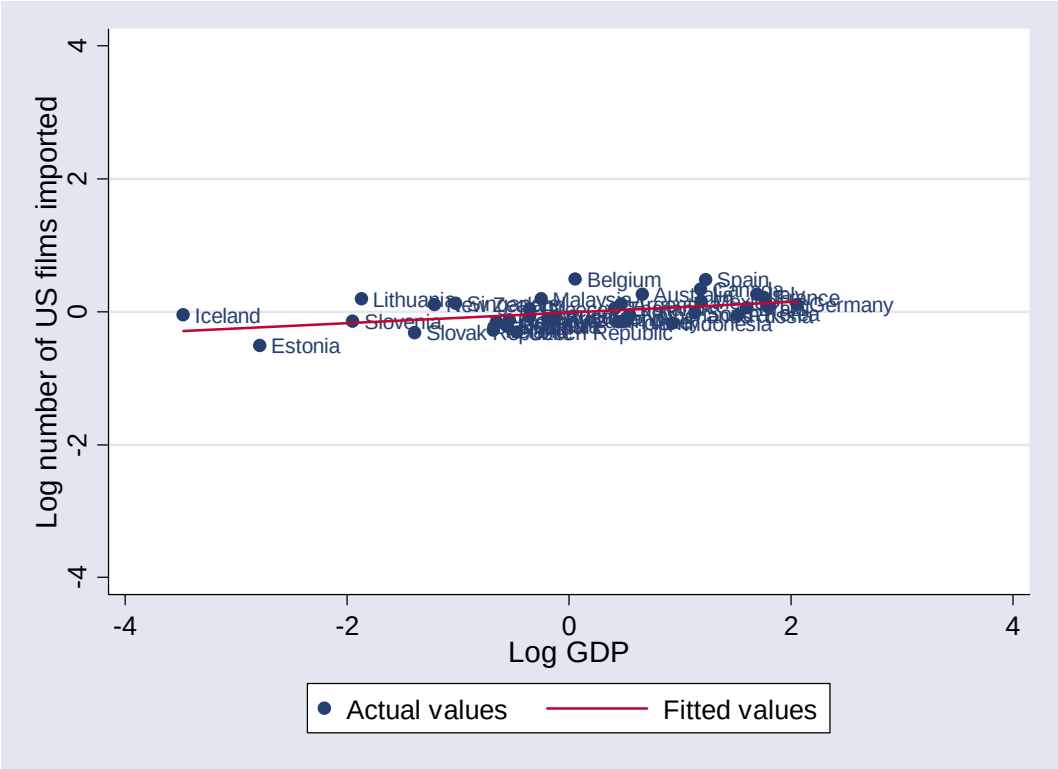


Figure 3: Movie imports and country size, 2001-2004

(a) Number of movies imported



(b) Box-office revenues per movie

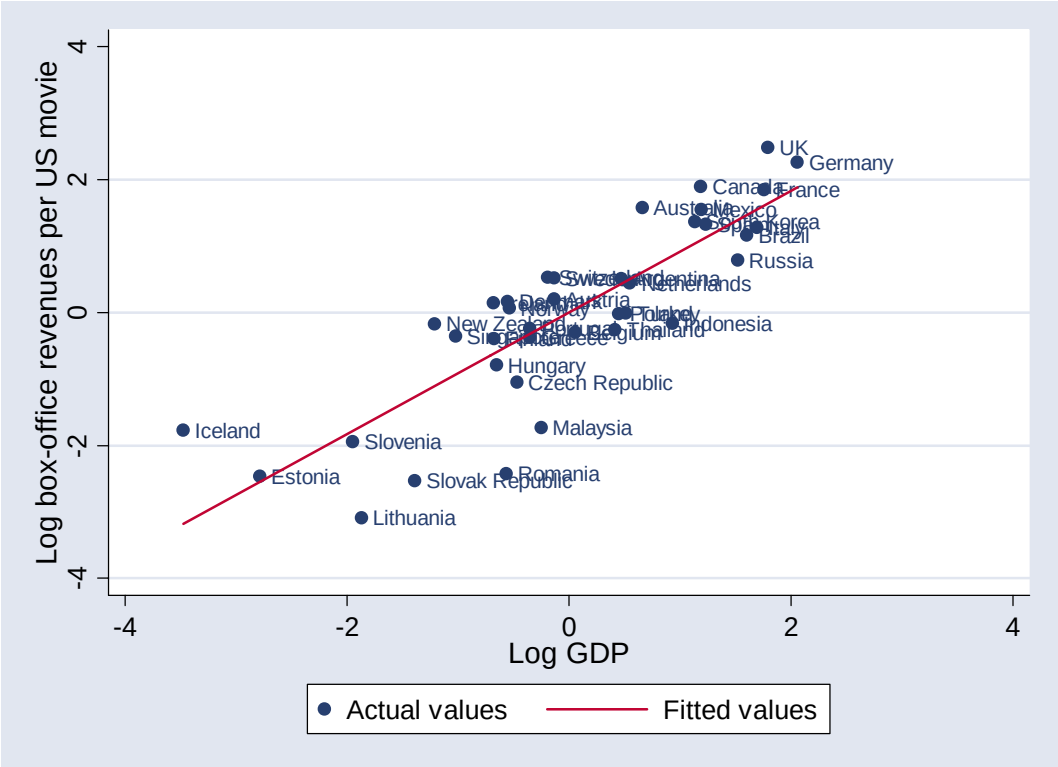
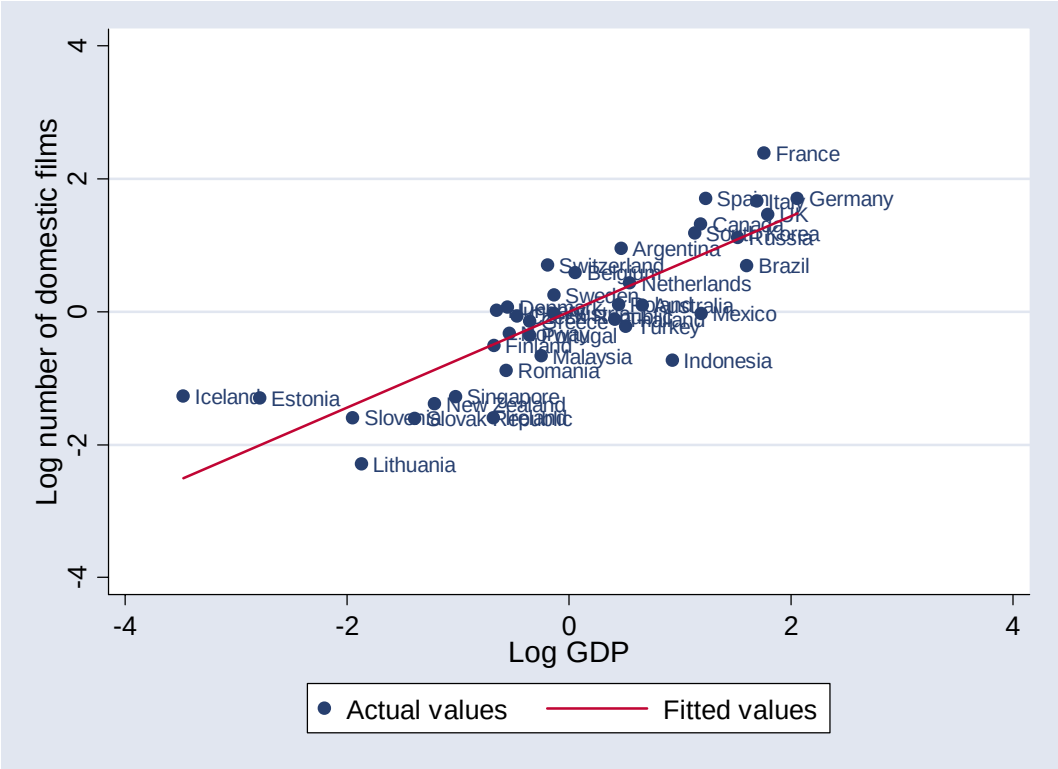


Figure 3: Domestic movie production and country size, 2001-2004

(c) Number of movies exhibited



(d) Box-office revenues per movie

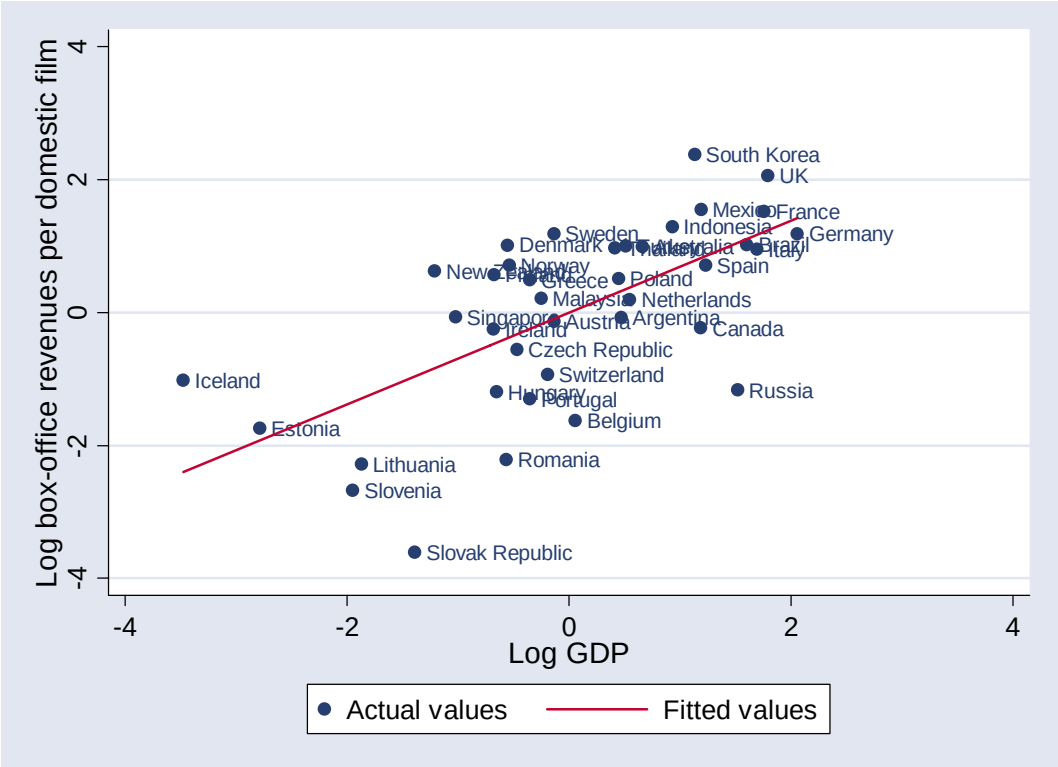
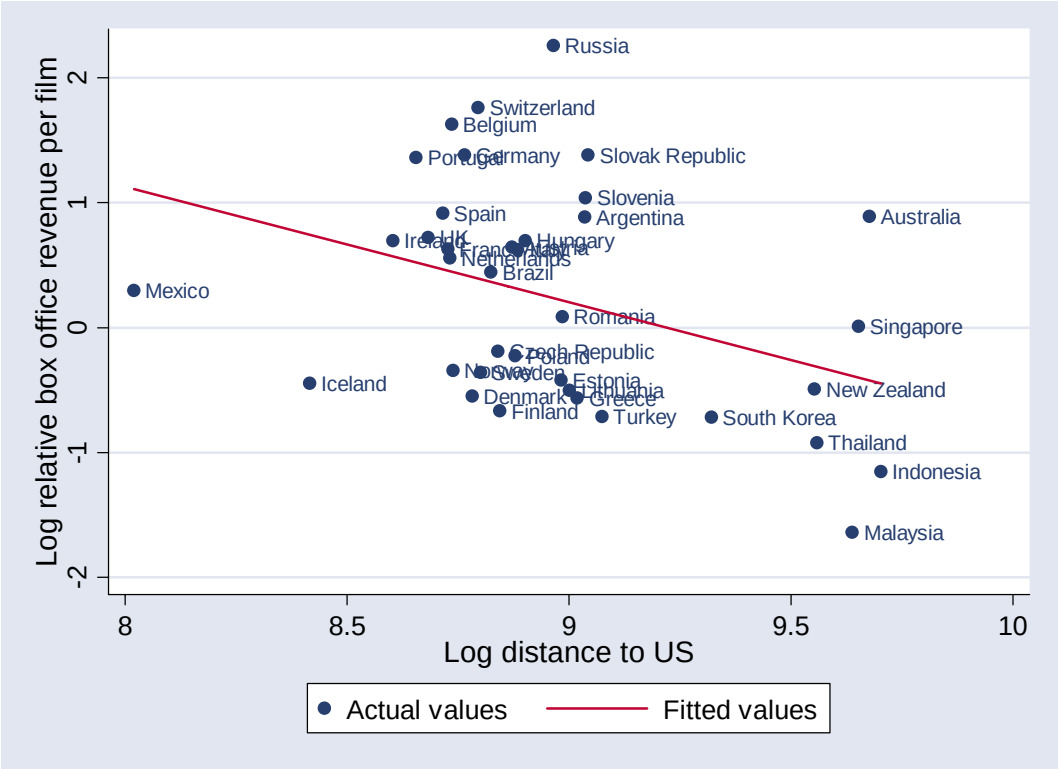


Figure 4: Relative average revenue per U.S. movie and trade barriers, 2001-2004

(a) Distance to the U.S.



(b) Linguistic dissimilarity with the U.S.