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Anti-Dumping with Heterogeneous Firms: New Protectionism for the New-New Trade Theory*

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Abstract:

This paper analyzes anti-dumping (AD) policies in a two-country model with heterogeneous firms in monopolistic competition. Effective AD legislation in one country imposes a no-dumping condition on firms exporting from the other country, altering their pricing both domestically and abroad. Some firms with intermediate productivities cease export activity, and entry shifts towards the AD protected country, which has now become relatively more attractive. Protecting firms with AD therefore increases the number of firms entering and eventually increases competition, and the consumers enjoy welfare gains. In the country without AD legislation, there is a welfare loss due to fewer entrants.

Keywords: Trade policy, anti-dumping, monopolistic competition, heterogeneous firms

JEL-codes: F12, F13

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1 Introduction

Studies trying to assess the economy-wide consequences of anti-dumping (AD) typically find large, negative welfare effects of AD legislation. One commonly cited example is the CGE modeling of Galloway, Blonigen and Flynn (1999), where it is estimated that the welfare loss caused by the AD tariffs that the USA had in place in 1993 was of the order of \$ 3.95 bn. On top of these welfare losses from AD tariffs, Vandenbussche and Zanardi (2006) show how AD depresses trade flows beyond the 2-5% of world trade flows directly affected by AD investigations or tariffs.

Keeping these results in mind, it is important to study what can be driving so many countries to adopt AD legislation, and quite a few of them to use it intensively. Does political economy tell the whole story? This paper shows theoretically that enforcing AD legislation may lead to welfare gains, concentrating on indirect (i.e. non-tariff and non-investigation) effects of AD, accruing from firms complying with the AD legislation (“learning to behave” in the language of Vandenbussche and Zanardi (2006)).

The framework used here is that of monopolistic competition models with heterogeneous firms, specifically the two-country model in Melitz and Ottaviano (2008). The key addition to, for example, Melitz (2003), is the changed preference structure. Instead of the customary CES preferences, quadratic utility as in Ottaviano, Tabuchi and Thisse (2002) is used, giving rise to linear demand curves for each variety and non-constant markups. Accordingly, the model features reciprocal dumping, implying that any exporting firm is violating AD legislation.¹

In most theoretical treatment of AD, oligopolistic models are used, modeling the strategic use of, and response to, AD legislation.² . In contrast, the monopolistic competition framework that this paper uses excludes strategic interactions between firms to be able to analyze selection, entry and exit. One contribution of this paper is an analysis of AD at a level of analysis that fills the gap between the detailed oligopolistic approach, where the consequences are hard to assess, and the economy-wide estimates, where the consequences of AD can be measured, but where the mechanisms at work are hard or impossible to single out.

In the present paper, to disentangle how both countries in the two-country model are affected by one country’s AD policy, an asymmetric AD regime scenario is analyzed, where one country (Foreign) has AD legislation, whereas the other country (Home) has not.

The indirect affects of AD, arising from firms wishing to avoid the risk of an AD petition, is modeled by letting exporters in Home be subject to a no-dumping constraint: When exporting, they must price such that they cannot be found guilty of dumping by Foreign’s AD authorities. The outcome of this pricing may be interpreted as an evaluation of the AD legislation in Foreign: it is what the AD legislation is trying to achieve.

The analysis arrives at the following results:

To be able to set a lower export price subject to the no-dumping constraint, it is optimal for exporters in Home to incur ‘domestic distortion’, that is, to lower the domestic price below the market’s optimal

¹Melitz and Ottaviano (2008) demonstrate how the model features reciprocal dumping, but do not introduce AD

²E.g. Prusa (1992), Prusa (1994), Reitzes (1993), , Pauwels, Vandenbussche and Weverbergh (2001)

price. The degree of domestic distortion depends on relative market size, the larger the relative size of the export market, the more the domestic market is distorted. For some firms, however, exporting is no longer attractive. This is the case for firms with intermediate productivity, who in the free trade equilibrium³ earned relatively little on the export market compared to the domestic profits. For these firms, the profits lost from domestic distortion would surpass the potential export profits, and they therefore decide to serve the domestic market only.

These reduced export prospects lowers the attractiveness of setting up a firm in Home. Eventually, fewer firms will therefore choose to enter Home compared to the free trade equilibrium. In the AD regime Foreign, on the contrary, the reduced imports mean that more firms can enter before the expected profit of entry is driven to zero.

These reallocations of entering firms have the following effects: In Home, competition falls with the reduced number of entrants. Consumers have access to fewer varieties, and consumption shifts towards imported varieties. The average price of the varieties increases from the reduced competition, but domestic distortion enables consumers to concentrate their consumption on varieties that are also exported. The AD policy in Foreign causes consumer welfare to fall in Home, but the domestic distortion mitigates some of the welfare loss.

In Foreign, the increased entry will lead to increased competition in the long run. Quite counter-intuitively, shielding firms from import competition leads to increased competition in the long run: The excess profits that AD protected firms earn is more than absorbed by new entrants. More varieties are available to consumers, and they are to a higher degree domestically produced. Overall, Foreign consumers enjoy a welfare gain from lower average prices and more varieties. However, due to fewer and more expensive imports, consumers can no longer substitute towards cheap imported varieties, and this absorbs some of the welfare gain.

The next section briefly reviews the two-country model of Melitz and Ottaviano (2008), introducing its free trade equilibrium for comparison with the AD regime.

2 The Free Trade Equilibrium

Consider two countries, Home (H) and Foreign (F). There are L^l representative consumers in country $l = H, F$, each supplying one unit of labor. Utility for the representative consumer is:

$$U = q_0^c + \alpha \int_{i \in \Omega} q_i^c di - \frac{1}{2} \gamma \int_{i \in \Omega} (q_i^c)^2 di - \frac{1}{2} \eta \left(\int_{i \in \Omega} q_i^c di \right)^2. \quad (1)$$

The numeraire good q_0^c is supplied at constant returns to scale with perfect competition and traded costlessly, wages in both countries are therefore fixed at unity. Ω is the set of possible varieties of the differentiated good, where q_i^c indicates quantity consumed of variety i . α and η determine the size of the differentiated goods industry compared to the numeraire industry, γ governs the degree of differentiation between varieties.

³ “Free trade equilibrium will in the text refer to the equilibrium of the two-country model derived in Melitz and Ottaviano (2008)

The demand for variety i in country l , resulting from the L^l representative consumers' utility maximization subject to the budget constraint $q_0^c + \int_{i \in \Omega} q_i^c di \leq 1$, is

$$q_i^l \equiv L^l q_i^c = \frac{\alpha L^l}{\gamma + \eta N^l} - \frac{L^l}{\gamma} p_i^l + \frac{\eta N^l}{\gamma + \eta N^l} \frac{L^l}{\gamma} \bar{p}^l, \quad (2)$$

where p_i^l is the variety's price, N^l is the number of firms operating in market l , and $\bar{p}^l = (\int_{i \in \Omega} p_i^l di) / N^l$ is the average price of varieties on the market. With the linear demand, there is a 'choke price' on a market, for which demand for a given variety is zero:

$$p^l = \frac{1}{\gamma + \eta N^l} (\gamma \alpha + \eta N^l \bar{p}^l).$$

To set up a firm, a fixed entry cost f_E must be paid, which is thereafter sunk. The entering firm then learns its marginal cost c , drawn from the distribution $G(c) = (c/c_M)^k$ (c_M is the maximal cost draw, k is the pareto shape parameter). The firm may thereafter produce with cost function $C(q) = cq$. The "domestic cost cutoff" in country l ,

$$c_D^l = \frac{1}{\gamma + \eta N^l} (\gamma \alpha + \eta N^l \bar{p}^l), \quad (3)$$

is the cost draw that is so high that a firm with this marginal cost will sell zero units if it sets price equal to marginal cost. A firm with cost draw higher than c_D^l will not be able to cover its marginal costs and exits immediately upon entry. Since f_E is sunk, any firm with $c < c_D^l$ will serve its domestic market.

Export of the varieties is costly, in order for one unit of a variety to arrive abroad, $\tau^l > 1$ units must be shipped. The iceberg cost τ^l is country-specific, it may be more costly to export from Home to Foreign than the other way round. In addition to capturing geographical barriers, τ^l is also seen as a variable that country l to some degree can change through trade policies.

The marginal cost for a firm in l of exporting a good to $h = H, F$, $h \neq l$ is therefore $\tau^h c$. The "export cost cutoff", the cost draw for which a firm will sell zero units abroad, is therefore defined as

$$c_X^l = \frac{c_D^h}{\tau^h}. \quad (4)$$

Firms with cost draws equal to or lower than c_X^l will export.

The profit-maximizing prices and quantities⁴ of a firm's domestic and export market can be expressed using the cutoffs, as:

$$p_D^l(c) = \frac{1}{2} (c_D^l + c), \quad p_X^l(c) = \frac{\tau^h}{2} (c_X^l + c) \quad (5)$$

$$q_D^l(c) = \frac{L^l}{2\gamma} (c_D^l - c), \quad q_X^l(c) = \frac{L^h}{2\gamma} \tau^h (c_X^l + c). \quad (6)$$

From (5), it holds that $p_D^l(c) > p_X^l(c)/\tau^h$, as the export cutoff must be lower than the domestic cutoff in the equilibrium where both countries produce varieties of the differentiated good⁵. By the legal definition in AD legislation, in which trade costs may be deducted from the export price in order to achieve "factory gate prices", any exporting firm is dumping.

⁴As a firm and its variety are completely characterized by a firm's marginal cost c , the variety subscript i can be dropped.

⁵See appendix A.4 in Melitz and Ottaviano (2008).

Prices and quantities give rise to profits

$$\pi_D^l(c) = \frac{L^l}{4\gamma} (c_D^l - c)^2, \quad \pi_X^l(c) = \frac{L^l}{4\gamma} (\tau^h)^2 (c_X^l - c)^2. \quad (7)$$

Naturally, a firm only operates on a market if it has non-negative profits there. All firms operating on market l have lower profits if the domestic cutoff c_D^l is reduced, the domestic cutoff thus summarizes the degree of competition on a market.

Firms will continue to enter in l until the expected profit of domestic and export sales is driven down to the entry cost f_E :

$$\int_0^{c_D^l} \pi_D^l(c) dG(c) + \int_0^{c_X^l} \pi_X^l(c) dG(c) = f_E. \quad (8)$$

The cutoffs, containing information about the average price and number of active firms, will adjust to make this relation hold. With the pareto distribution, the two free entry conditions can be solved for the two unknowns, the domestic cutoffs, as:

$$c_D^l = \left[\frac{\gamma\phi}{L^l} \frac{1 - \rho^h}{1 - \rho^l \rho^h} \right]^{\frac{1}{k+2}} \quad (9)$$

where $\rho^l = (\tau^l)^{-k}$, $\rho^l \in (0, 1)$, indicates the 'freeness' of trade, a lower ρ^l means a more open market. $\phi = 2(k+1)(k+2)(c_M)^k f_E$ captures technology-related variables. In the closed economy, corresponding to $\rho^l = 0$, $c_D^l = (\gamma\phi/L^l)^{1/(k+2)}$, the cutoff falls with more trade freeness, reflecting the increased import competition.

With the cutoffs determined, the average price in l can be computed. Prices of domestic and imported goods on the market follow the same distribution,

$$p_D^l = \frac{1}{2} (c_D^l + c), \quad c \in [0, c_D^l]; \quad p_X^l = \frac{1}{2} (c_D^l + \tau^l c), \quad c \in [0, c_D^l/\tau^l],$$

giving the average price

$$\bar{p}^l = \frac{2k+1}{2k+2} c_D^l. \quad (10)$$

Combining (10) with the expression for the cutoff in (3) gives the number of firms operating in l ,

$$N^l = \frac{2(k+1)\gamma}{\eta} \frac{\alpha - c_D^l}{c_D^l}. \quad (11)$$

The number of firms trying to enter in l , N_E^l , can be found by solving the two equations

$$N_E^h G(c_D^l/\tau^l) + N_E^l G(c_D^l) = N^l,$$

giving

$$N_E^l = \frac{2(k+1)\gamma(c_M)^k}{\eta(1 - \rho^h \rho^l)} \left[\frac{\alpha - c_D^l}{(c_D^l)^{k+1}} - \rho^l \frac{\alpha - c_D^h}{(c_D^h)^{k+1}} \right]. \quad (12)$$

Welfare can be assessed using the indirect utility function

$$U^l = 1 + \frac{1}{2} \left(\eta + \frac{\gamma}{N^l} \right)^{-1} (\alpha - \bar{p}^l)^2 + \frac{1}{2} \frac{N^l}{\gamma} \sigma_{p,l}^2, \quad (13)$$

where $\sigma_{p,l}^2$ is the price variance: For a given average price, if the price variance is higher, some varieties are cheaper, and consumers can get more total consumption by buying more of these.

In this equilibrium, welfare can be expressed in terms of the domestic cutoff only:

$$U^l = 1 + \frac{1}{2\eta} (\alpha - c_D^l) \left(\alpha - \frac{k+1}{k+2} c_D^l \right). \quad (14)$$

Welfare increases with lower domestic cutoff, reflecting lower average prices and more variety access.

3 The Anti-Dumping Regime

The AD regime I analyze is one, where only one of the two countries (Foreign, to fix ideas) has acquired AD legislation. In Foreign, the AD legislation is so effective that firms in Home face a no-dumping constraint on their export market. All the effects of AD found in the following are therefore due to these "threat effects" of AD and not from AD filings and tariffs. The perspective is the long run, the changed conditions for Home exporters have been in place long enough to affect entry and exit of firms. The asymmetric regime is chosen in order to disentangle the different consequences AD has in the country implementing the legislation and in its trading partner.

In principle, this scenario may be more common than one would expect at first sight. If the threat and associated expected cost of an AD petition are perceived as high, it may well be optimal to price in a manner that avoids dumping investigations. The strong reputation effects found by Vandebussche and Zanardi (2006) accruing to frequent ("tough") users of AD legislation point in this direction, and as that paper also documents, AD has effects on trade flows beyond the flows directly affected by AD tariffs or investigations. The regime I here analyze provides a framework for examining these indirect threat effects, from firms complying with the AD legislation to avoid petitions.

Whenever I write 'AD' in the following, I refer only to this specific regime, unless otherwise stated.

The firms directly affected by the AD are Home exporters, and due to the non-strategic nature of the monopolistic competition models, these are the only firms to react directly. In order to be sure to avoid anti-dumping investigations, a firm in Home that wishes to export, must set its export price as $p_{XA}^H \geq \tau^F p_{DA}^H$.⁶ This leads to a new, constrained profit maximization problem:

$$\begin{aligned} \max_{p_{XA}^H, p_{DA}^H} \pi^H(p_{XA}^H, p_{DA}^H) &= \pi_{XA}^H(p_{XA}^H) + \pi_{DA}^H(p_{DA}^H) \\ \text{subject to } p_{XA}^H &\geq \tau^F p_{DA}^H \end{aligned}$$

Maximizing the constrained profits leads to:

Result 1: Optimal Domestic Distortion

To avoid dumping, the optimal pricing strategy is to set domestic and export prices as:

$$p_{DA}^H(c) = \frac{1}{2} \left[\beta^H c_X^H + (1 - \beta^H) c_D^H + c \right], \quad p_{XA}^H(c) = \frac{\tau^F}{2} \left[\beta^H c_X^H + (1 - \beta^H) c_D^H + c \right], \quad (15)$$

⁶I use subscript *A* to indicate the anti-dumping scenario

where

$$\beta^H = \frac{L^F (\tau^F)^2}{L^F (\tau^F)^2 + L^H} = \frac{1}{1 + \frac{L^H}{L^F (\tau^F)^2}}, \quad \beta^H \in (0, 1) \quad (16)$$

For an exporting firm facing a no-dumping constraint, it is optimal to distort prices downwards on the domestic market to be able to set a lower export price.

The degree of domestic distortion is governed by the parameter β^H , weighting the importance of the export market relative to the domestic market. If the export market has more consumers, $L^F > L^H$, β^H will tend to one, the AD export price tends to the unconstrained export price. A bit counterintuitively, β^H increases with Foreign's iceberg cost τ^F , higher trade barriers means more domestic distortion. The reason is that part of the trade cost is absorbed into the domestic price; when the trade cost increases, the absolute amount absorbed into the domestic price increases.

The results of this paper are all consequences of result 1. There are two levels of effects, before and after the domestic cutoffs have been determined by free entry. Effects prior to the determination of cutoffs are described just below.

The AD prices lead to quantities for a Home exporter

$$q_{DA}^H(c) = \frac{L^H}{2\gamma} \left[c_D^H - c + \beta^H (c_D^H - c_X^H) \right], \quad q_{XA}^H(c) = \frac{L^F}{2\gamma} \tau^F \left[c_X^H - c - (1 - \beta^H) (c_D^H - c_X^H) \right], \quad (17)$$

Compared to the free trade equilibrium, (6) quantities increase on the domestic market as function of the lower price, and decline on the export market. Profits are

$$\begin{aligned} \pi_{DA}^H(c) &= \frac{L^H}{4\gamma} \left[(c_D^H - c)^2 - (\beta^H)^2 (c_D^H - c_X^H)^2 \right], \\ \pi_{XA}^H(c) &= \frac{L^F}{4\gamma} (\tau^F)^2 \left[(c_X^H - c)^2 - (1 - \beta^H)^2 (c_D^H - c_X^H)^2 \right]. \end{aligned} \quad (18)$$

Due to the constrained optimization problem, profits are naturally smaller than in the free trade equilibrium. On the domestic market, the profit loss is associated with a decrease in the deadweight loss, due to the lower price and higher quantity, so isolated from the dynamic consequences, there is a pro-competitive effect of the AD policy on the export market. On the export market, the deadweight loss increases.

A firm in Home can always choose to serve only its domestic market. It can then get 'regular' profits $\pi_D^H(c)$ as given in (??). Due to the reduction of domestic profits that is associated with exporting, an exporting firm, who earns relatively little on the export market, may get more profits with this strategy. Firms will serve only their domestic market if

$$\pi_D^H(c) > \pi_{DA}^H(c) + \pi_{XA}^H(c) \Leftrightarrow c > c_X^H - \sqrt{1 - \beta^H} (c_D^H - c_X^H). \quad ^7$$

Result 2: The export cutoff cost for firms who must avoid dumping is given by:

$$c_{XA}^H = c_X^H - \sqrt{1 - \beta^H} (c_D^H - c_X^H) < c_X^H \quad (19)$$

Firms must be more productive to export to the anti-dumping regime than exporters in free trade economy equilibrium.

⁷From (15), to be able to set an export price lower than the export cutoff, an exporting firm's marginal cost must satisfy $c \leq c_X^H - (1 - \beta^H) (c_D^H - c_X^H)$. The present condition is stronger, as $(1 - \beta^H) < \sqrt{1 - \beta}$.

This novel implication of AD legislation, that some firms simply stop exporting to avoid AD petitions, can only be found using the recent models with heterogeneous firms. Models with homogeneous firms can only predict changes to the intensive margin of export, not the extensive margin of exports as found here.

The anti-dumping regime in Foreign has reduced the export potential for firms in Home. This leads to reduced expected profits prior to entry, and fewer firms will enter in Home, it takes fewer active firms to drive the expected operating profit down to the entry cost f_E . Both the decreased profits and the reduced probability of being productive enough to become an exporter are reflected in the new free entry condition:

$$\int_0^{c_D^H} \pi_D^H(c) dG(c) + \int_0^{c_{XA}^H} [\pi_{DA}^H(c) + \pi_{XA}^H(c) - \pi_D^H(c)] dG(c) = f_E. \quad (20)$$

In Foreign, where there are no direct effects of the AD enforcement, the free entry condition is still given by

$$\int_0^{c_D^F} \pi_D^F(c) dG(c) + \int_0^{c_X^F} \pi_X^F(c) dG(c) = f_E.$$

The two free entry conditions again give two equation in two unknowns, the domestic cutoffs, but these can now only be determined numerically.

Expressions for average prices, varieties and the number of entrants as functions of the cutoffs can be computed, but since no insights can be gained from inspecting them directly, computations are placed in Appendix 1. Welfare is computed from (13), as (14) is no longer valid.

The effects of AD regime compared to the model's free trade equilibrium after taking into account the effect of entry and exit are summarized in result 3 and 4, which have been obtained through simulations, also enabling a quantitative assessment.⁸ Graphs comparing the two outcomes are found in appendix 2.

Result 3: Post entry effects of trading partner's anti-dumping enforcement

The domestic cutoff in Home increases. With less market opportunities awaiting an entering firm, a higher domestic cost cutoff is sufficient to keep the expected operating profit equal to the entry cost f_E . The domestic competitiveness is reduced by the protectionist policy on the export market. Note, however, that as average price and price variance no longer is a function of the domestic cutoff only, the cutoff is a supply side measure of competitiveness; for the demand side the relevant measures are average price and price variance.

The export cutoff falls dramatically, the export propensity is much lower compared to the free trade equilibrium. The large drop in the probability of becoming an exporter is the main driver behind the model's results. As a consequence of the reduced export propensity, the number of firms attempting entry into Home falls substantially. This, in turn, leads to the reduced competition captured by the increased domestic cutoff: as fewer firms attempt entry, less productive firms are able to survive on the domestic market.

⁸Given the format of the equations that determine cutoffs, two $k + 2$ polynomials with cross terms, one could worry that there might be multiple equilibria. This, fortunately, is not the case. The solving algorithm converges without problems, and there are never multiple solutions within the restrictions that cutoffs must obey.

As a consequence of the fewer entrants, consumers suffer from a fall in variety access. There is a large shift towards consumption of imported rather than domestically produced varieties. Home's net export of varieties decreases, both as a result of the increased imports and as a consequence of the two-fold decrease in exports: The export selection is much tougher, and there are fewer firms attempting entry, meaning fewer firms that end up being productive enough to export.

Prices are affected both by the reduced prices of Home exporters and by the reduced competition on the market. The latter effect dominates the average price which increases. The price variance increases as well, a result of the downward shift in Home exporters' domestic prices and of the increased domestic cutoff.

Due to the decreased variety access and increased average prices, welfare falls in Home. The effect is softened somewhat, though, as domestic distortion by Home exporters enable consumers to concentrate consumption on the cheaper varieties which are also exported.

Result 4: Post entry effects to a country enforcing anti-dumping

Although the expression for the free entry condition in Foreign remains unchanged, tough enforcement of the AD policy has wide consequences there because of the lower attractiveness of entering Home. In the long run, as setting up a firm in Foreign and exporting to Home has become much more attractive than doing the opposite, entry in Foreign will increase and the domestic cutoff will increase. There are much fewer imports, so more domestic entrants are needed before the market potential is satisfied. This, in turn, results in tougher selection, as more entering firms means more firms with low marginal cost draws. Quite counterintuitively, the long run effect of protecting Foreign producers with AD legislation is increased competition. On the export market, conditions are easier. The export cutoff follows Home's domestic cutoff up, the decreased competition in Home enables less efficient Foreign exporters to survive there.

Following the increased number of entrants, variety access for Foreign consumers increase. Due to the sub-optimal pricing of Home exporters, domestic varieties must replace imported varieties more than one for one to absorb the entire profit potential in Foreign. Variety consumption is shifted towards domestic varieties, and net exports of varieties increase.

Total entry, $N_E^H + N_E^F$, is always lower under anti-dumping than in the free trade equilibrium. Some firms in Home are now benefiting less from their cost draw, and this profit destruction reduces total entry.

The increased prices of Home exporters are not sufficient to outweigh the price reductions from increased competition, the average price increases. For the price variance, however, the shrinking distribution of Home exporters reduces the variance of prices in Foreign.

The overall welfare effects in Foreign are positive: Consumers enjoy lower average prices and more varieties. Some of the welfare gain, however, is cancelled by the increased price variance: In the free trade equilibrium, some imported varieties were relatively cheap, and

consumers were able to shift consumption towards these. As imports now are fewer and more expensive, this is possible to a much lower degree in the AD regime.

4 Discussion

The implications outlined above are what happens in the vast majority of the simulations. The results are insensitive to changes in technology parameters k , f_E and c_M and "scale of variety industry" preference parameters α and η . Changing these parameters shift both the free trade equilibrium and the AD regime in the same direction, even the quantitative impact of AD policies remain roughly the same. Increasing γ , meaning a higher degree of differentiation in the goods, implies that consumers become less willing to concentrate consumption on certain varieties. They therefore gain less from an increased price variance (for a given average price), an expensive (or unavailable) variety cannot to the same degree be substituted by consuming more of a cheap one (this is also captured in (13), a higher γ means less welfare weight on the price variance). The welfare losses are higher in Home and lower in Foreign when γ is higher.

It should be noted that country size, L^l , remains the main determinant of the market variables in the anti-dumping scenario. The number of firms selling on a market needed, before there are no more potential profits to entrants, is determined by the amount of sales a firm can make there, and these are largely determined by the number of consumers.

The impact of the AD enforcement is larger the more integrated are the two economies (lower τ s); the lower the trade barriers, the more attractive it is or use Foreign as an export base. If Home is large relative to Foreign, it is less sensitive to the AD policies on the export market.

In some rather extreme situations, the effects of AD policy may be reversed: If the Home exporters still make out a large share of the firms operating in Home and Foreign, and if varieties are rather close substitutes (low γ), the price variance effect may dominate. This can occur if Home is much larger than Foreign, $L^H \gg L^F$ and if Home has much higher trade barriers, $\tau^H \gg \tau^F$. Foreign's AD enforcement may then cause welfare to increase in Home and fall in Foreign.

Although the potential positive welfare effects of enforcing AD contradict much of the existing AD literature, the effects are not unfamiliar to this framework. Similar, but not identical, effects arise if one country unilaterally increases its iceberg cost τ^l . As mentioned in section 2, when both countries simultaneously increase their openness to trade, competition increases in both countries, leading to welfare gains. If only one country changes its openness to trade, however, the mechanisms are rather different: The long-run solution for c_D^l (after entry has taken place) is seen in (9) to be increasing in a country's own openness parameter ρ^l , competition is reduced when a country liberalizes trade. The reason is entry: Unilaterally liberalizing trade makes the other country relatively more attractive for a potential entrant. Setting up a firm in the still-protected country and exporting to the liberalizing country gives more expected profits than setting up a firm in the liberalizing country.

Conversely, if a country restricts import competition, increasing its trade barriers, it will become relatively more attractive for potential entrants, and in the long run, as more firms enter, competition will

increase, leading to welfare gains. These welfare gains are on the expense of the other country, as fewer firms enter there, leading to less competition and variety access for consumers. The basic mechanism is the same as for AD enforcement: When a market is protected behind trade barriers, be they from increased iceberg cost or through AD enforcement, its relative profit potential increases, more firms enter and competition increases, leading to welfare gains.

With the simulations at hand, it is possible to do a quantitative comparison of the two policies. The first insight is that the AD regime corresponds to a quite severe trade restriction. As both set of effects being compared depend on parameter values, the exact increase is also sensitive to the parameter specification, but the necessary trade restrictions are of the order of an increase in the iceberg cost of 30 per cent. Also worth noting is that the overall welfare effects from a unilateral trade restriction are less murky, there is no potential for reversed effects as described just above.

I choose a reference trade restriction as the increase in the iceberg cost that generates the same decrease in c_D^F as the AD enforcement. The effect on c_D^H turns out to be roughly similar, so AD has very similar implications for competitiveness in the two countries as a quite strong unilateral trade restriction. Entry patterns, however, are distorted substantively more by the AD enforcement than by the reference trade restriction, to obtain the same entry distortion, τ^F must typically be increased by 50 per cent. And even this larger trade restriction reduces total entry in the two markets by less.

Trade flows are also distorted more by the AD regime than by the reference trade restriction. The drop in the export cutoff in Home caused by AD is larger, and in combination with the larger effects on entry patterns, the number of varieties exported ($N_E^H G(c_{XA}^H)$ for Home and $N_E^F G(c_X^F)$ for Foreign) are distorted by what generally corresponds to a 60 per cent increase in τ^F .

Welfare, in the two countries, however, is less affected. In Foreign, the welfare increase is similar to or smaller than that occurring from the reference trade restriction. In Home the welfare loss is generally lower, of the magnitude of what would happen if Foreign increased its iceberg cost by 15 per cent. AD's dampening effects from the increased price variances are seen here.

The concept of domestic distortion from result 1, that an exporting firm may wish to change its domestic pricing behavior has some precedents in the existing literature. Essentially the same effect is found in Reitzes (1993), in a partial equilibrium setting with a monopolist exporting to a country with AD legislation. Gallaway, Blonigen and Flynn (1999) and Pauwels, Vandebussche and Weverbergh (2001), on the other hand, both argue that firms are unlikely to distort their domestic market to avoid AD accusations. It is possible to analyze this "no domestic distortion" in my setting, simply setting $\beta^H = 0$ gives that result. Indications in favor of domestic distortion exist, however:

The consultant Cliff Stevenson, who is behind the website antidumpingpublishing.com recommends exactly this strategy: "for high risk products/markets, there are simple strategies that can reduce the risk of anti-dumping problems [...] [such as] [P]rice cutting: if you are dumping, can you cut domestic prices to reduce the dumping margin?"⁹ Moreover, both Gallaway, Blonigen and Flynn (1999) and Pauwels, Vandebussche and Weverbergh. (2001) have their own motivations for assuming no domestic distortion.

⁹Cited from: Strategies to Avoid Dumping by Cliff Stevenson, available at www.antidumpingpublishing.com

The welfare loss found in Gallaway, Blonigen and Flynn.(1999) is lower with a magnitude of ten if all price distortion takes place outside the US ($\beta^H = 1$ in my model, so this is also a special case, "full domestic distortion"). For Pauwels et al. (2001), letting the normal value be exogenous is a simplifying assumption. The argument that the export market is relatively less important is already accounted for by the weight β^H , which indicates the relative importance of the export market and therefore the degree of domestic distortion.

Results 3 and 4 hinge on AD protection having long run effects on firm entry and exit behavior. The effects of trade liberalizations on firm "de-location" have been studied extensively (in Melitz and Ottaviano (2008) is quoted Venables, 1985, 1987; Horstmann and Markusen, 1986; and the synthesis in Helpman and Krugman, 1989, ch. 7; and Baldwin et al., 2003, ch. 12).), but this is not the case for AD in particular. Empirically assessing whether AD actually may affect entry is an interesting, but likely difficult, exercise.

5 Conclusion

This paper has examined the effects of AD in the recently introduced class of monopolistic competition models with heterogeneous firms. As has been shown, AD has wide consequences at the industry level, such as export selection and reallocations of firms, which are difficult to capture in the traditional strategic oligopolistic modeling. The present paper has analyzed a specific AD regime, where AD in one of the two countries is so heavily enforced that firms exporting to the country are subject to a no-dumping condition, and a series of novel AD effects are found:

For the firms in Home, the country exporting to an AD regime, the export prospects are severely reduced, and this leads to reduced entry there in the long run. The incumbent firms in Home, who are too inefficient to export in the free trade equilibrium, actually gain from the AD policies on the export market: competition in Home is reduced, so their profits go up. Firms in Home that lose the export status that they had in the free trade equilibrium are quite naturally worse off, export profits are lost. Firms who are productive enough to export in the AD regime also lose, both on their domestic and export market. AD in the trading partner thus favors the least productive firms.

In Foreign, the AD regime, the AD enforcement renders the market more attractive, so more firms wish to enter there. In the long run, this has the somewhat counterintuitive implication that competition rises because of the AD protection. For firms who are not productive enough to export, the long run effects of AD enforcement is therefore reduced profits. Due to decreased competition on the export market, however, more firms are able to export, and those that do, earn more export profits. In the long run, the most productive firms benefit from AD protection.

These results are only a first take on industry level effects from AD that can be examined in the new class of models. They provide new possible explanations of why AD has become such a frequent policy tool. In opposition to most of the AD literature, where short run welfare losses from worsened terms of trade, higher import prices and reduced competition are stressed, this paper has shown that in

the long run, successful AD protection may in fact lead to welfare gains via industry reallocations. The policy maker may also be interested in attracting variety producing firms and associated jobs, and in the increased net export of variety, these objectives can be achieved as long run consequences of tough AD enforcement. Like other trade protectionist measures, however, the gains accruing from enforcing AD come on expense of trading partners. But, due to softening effects from exporters to the AD regime wanting to incur some of the forced price distortion domestically, AD has smaller effects on welfare than trade protection by other means.

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Appendix 1: Deriving the number of entrants, varieties, the average prices and welfare:

Foreign:

Domestic goods are still priced as:

$$p_D^F(c) = \frac{1}{2} (c_D^F + c), \quad c \in [0, c_D^F]$$

whereas imported goods are priced as:

$$p_{XA}^H(c) = \frac{1}{2} \left[\beta^H c_D^F + (1 - \beta^H) \tau^F c_D^H + \tau^F c \right], \quad c \in [0, c_{XA}^H]$$

Fraction of imported goods: $\frac{N_E^H G(c_{XA}^H)}{N^F}$. Fraction of domestic goods: $\frac{N_E^H G(c_D^F)}{N^F}$.

The average price is therefore given as:

$$\begin{aligned} \bar{p}^F &= \frac{N_E^F G(c_D^F)}{N^F} \int_0^{c_D^F} \frac{p_D^F(c)}{G(c_D^F)} dG(c) + \frac{N_E^H G(c_{XA}^H)}{N^F} \int_0^{c_{XA}^H} \frac{p_{XA}^H(c)}{G(c_{XA}^H)} dG(c) \Leftrightarrow \\ N^F \bar{p}^F &= N_E^F \frac{2k+1}{2k+2} c_D^F G(c_D^F) + N_E^H \left\{ \frac{\tau^F}{2} \left[\beta^H c_X^H + (1 - \beta^H) c_D^H \right] G(c_{XA}^H) + \frac{\tau^F}{2} \frac{k}{k+1} c_{XA}^H G(c_{XA}^H) \right\} \end{aligned}$$

Combining the expression for the average price with the threshold price condition $N^F c_D^F - N^F \bar{p}^F = \frac{\gamma}{\eta} (\alpha - c_D^F)$ and the number of active firms $N^F = N_E^F G(c_D^F) + N_E^H G(c_{XA}^H)$ gives:

$$\begin{aligned} N_E^F c_D^F G(c_D^F) + N_E^H c_D^F G(c_{XA}^H) - N_E^F \frac{2k+1}{2k+2} c_D^F G(c_D^F) - \\ N_E^H \left\{ \frac{\tau^F}{2} \left[\beta^H c_X^H + (1 - \beta^H) c_D^H \right] G(c_{XA}^H) + \frac{\tau^F}{2} \frac{k}{k+1} c_{XA}^H G(c_{XA}^H) \right\} = \frac{\gamma}{\eta} (\alpha - c_D^F) \Leftrightarrow \end{aligned}$$

$$N_E^F c_D^F G(c_D^F) \frac{1}{2k+2} + N_E^H G(c_{XA}^H) \left[c_D^F - \frac{1}{2} \beta^H c_D^F - \frac{\tau^F}{2} (1 - \beta^H) c_D^H - \frac{\tau^F}{2} \frac{k}{k+1} c_{XA}^H \right] = \frac{\gamma}{\eta} (\alpha - c_D^F) \Leftrightarrow$$

$$N_E^F c_D^F G(c_D^F) + N_E^H G(c_{XA}^H) \left[(k+1) \left(c_D^F + (1 - \beta^H) (c_D^F - \tau^F c_D^H) - \tau^F k c_{XA}^H \right) \right] = 2(k+1) \frac{\gamma}{\eta} (\alpha - c_D^F) \Leftrightarrow$$

$$N_E^F (c_D^F)^{k+1} + N_E^H (c_{XA}^H)^k \left[(k+1) \left(c_D^F + (1 - \beta^H) (c_D^F - \tau^F c_D^H) - \tau^F k c_{XA}^H \right) \right] = 2(k+1) \frac{\gamma}{\eta} (\alpha - c_D^F) (c_M)^k \Leftrightarrow$$

$$N_E^F + N_E^H \left(\frac{c_{XA}^H}{c_D^F} \right)^k \left\{ (k+1) \left[1 + (1 - \beta^H) \left(1 - \frac{\tau^F}{c_D^F} c_D^H \right) \right] - \frac{\tau^F}{c_D^F} k c_{XA}^H \right\} = 2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}}$$

Home:

Home non-exporters set prices as $p_D^H(c) = \frac{1}{2} (c_D^H + c)$, $c \in [0, c_D^H]$. Fraction of goods: $\frac{N_E^H [G(c_D^H) - G(c_{XA}^H)]}{N^H}$

Home exporters set prices as $p_{DA}^H(c) = \frac{1}{2} \left[\beta^H c_X^H + (1 - \beta^H) c_D^H + c \right]$, $c \in [0, c_{XA}^H]$. Fraction of goods: $\frac{N_E^H G(c_{XA}^H)}{N^H}$

Foreign exporters set prices as $p_X^F(c) = \frac{1}{2} (c_D^H + \tau^H c)$, $c \in [0, c_D^H/\tau^H]$. Fraction of goods: $\frac{N_E^F G(c_D^H/\tau^H)}{N^H}$

The average price is therefore given as:

$$\bar{p}^H = \frac{N_E^H [G(c_D^H) - G(c_{XA}^H)]}{N^H} \int_{c_{XA}^H}^{c_D^H} \frac{p_D^H(c)}{[G(c_D^H) - G(c_{XA}^H)]} dG(c) + \frac{N_E^H G(c_{XA}^H)}{N^H} \int_0^{c_{XA}^H} \frac{p_{DA}^H(c)}{G(c_{XA}^H)} dG(c) + \frac{N_E^F G(c_D^H/\tau^H)}{N^H} \int_0^{c_D^H/\tau^H} \frac{p_X^F(c)}{G(c_D^H/\tau^H)} dG(c) \Leftrightarrow$$

$$\begin{aligned}
N^H \bar{p}^H &= N_E^H \int_{c_{XA}^H}^{c_D^H} p_D^H(c) dG(c) + N_E^H \int_0^{c_{XA}^H} p_{XA}^H(c) dG(c) + N_E^F \int_0^{c_D^H/\tau^F} p_X^F(c) dG(c) \Leftrightarrow \\
N^H \bar{p}^H &= N_E^H \int_0^{c_D^H} p_D^H(c) dG(c) - N_E^H \int_0^{c_{XA}^H} [p_D^H(c) - p_{XA}^H(c)] dG(c) + N_E^F \int_0^{c_D^H/\tau^H} p_X^F(c) dG(c) \Leftrightarrow \\
N^H \bar{p}^H &= N_E^H \frac{2k+1}{2k+2} c_D^H G(c_D^H) - N_E^H \int_0^{c_{XA}^H} \frac{1}{2} \beta^H (c_D^H - c_X^H) dG(c) + N_E^F \frac{2k+1}{2k+2} c_D^H G(c_D^H/\tau^H) \Leftrightarrow \\
N^H \bar{p}^H &= N_E^H \frac{2k+1}{2k+2} c_D^H G(c_D^H) - N_E^H \int_0^{c_{XA}^H} \frac{1}{2} \beta^H (c_D^H - c_X^H) dG(c) + N_E^F \frac{2k+1}{2k+2} c_D^H G(c_D^H/\tau^H) \Leftrightarrow \\
N^H \bar{p}^H &= N_E^H \frac{2k+1}{2k+2} c_D^H G(c_D^H) - N_E^H \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) + N_E^F \frac{2k+1}{2k+2} c_D^H G(c_D^H/\tau^H)
\end{aligned}$$

Using the same procedure as for Foreign: Inserting into the threshold price condition $N^H c_D^H - N^H \bar{p}^H = \frac{\gamma}{\eta} (\alpha - c_D^H)$ and the number of active firms $N^H = N_E^H G(c_D^H) + N_E^F G(c_D^H/\tau^H)$ gives:

$$\begin{aligned}
N_E^H G(c_D^H) c_D^H + N_E^F G(c_D^H/\tau^H) c_D^H - N_E^H \frac{2k+1}{2k+2} c_D^H G(c_D^H) + N_E^H \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) - N_E^F \frac{2k+1}{2k+2} c_D^H G(c_D^H/\tau^H) = \\
\frac{\gamma}{\eta} (\alpha - c_D^H) \Leftrightarrow
\end{aligned}$$

$$\begin{aligned}
N_E^H \left[\frac{1}{2(k+1)} c_D^H G(c_D^H) + \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) \right] + \rho^H N_E^F \frac{1}{2(k+1)} c_D^H G(c_D^H) &= \frac{\gamma}{\eta} (\alpha - c_D^H) \Leftrightarrow \\
N_E^H \left[\frac{1}{2(k+1)} c_D^H G(c_D^H) + \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) \right] + \rho^H N_E^F \frac{1}{2(k+1)} c_D^H G(c_D^H) &= \frac{\gamma}{\eta} (\alpha - c_D^H) \Leftrightarrow
\end{aligned}$$

$$N_E^H \left[1 + (k+1) \beta^H \left(1 - \frac{c_D^F}{\tau^F} \frac{1}{c_D^H} \right) \left(\frac{c_{XA}^H}{c_D^H} \right)^k \right] + \rho^H N_E^F = 2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}}$$

Solving for the number of entrants in Home:

The goal is to get something that looks like the number of entrants in the open economy. The system has been reduced to two equations in two unknowns, N_E^H and N_E^F .

Let $A = \left[1 + (k+1) \beta^H \left(1 - \frac{c_D^F}{\tau^F} \frac{1}{c_D^H} \right) \left(\frac{c_{XA}^H}{c_D^H} \right)^k \right]$ and $B = \left(\frac{c_{XA}^H}{c_D^H} \right)^k \left\{ (k+1) \left[1 + \left(1 - \beta^H \right) \left(1 - \frac{\tau^F}{c_D^H} c_D^H \right) \right] - \frac{\tau^F}{c_D^H} k c_{XA}^H \right\}$. Rewrite the two equations as

$$\begin{aligned}
N_E^F + N_E^H B &= 2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \\
N_E^H A + \rho^H N_E^F &= 2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}}
\end{aligned}$$

Isolating for N_E^F in the upper equation, and inserting into the lower gives:

$$2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \rho^H - N_E^H B \rho^H + N_E^H A = 2(k+1) (c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \Leftrightarrow$$

$$N_E^H = \frac{1}{A - B \rho^H} \frac{2(k+1) (c_M)^k \gamma}{\eta} \left[\frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} - \rho^H \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \right]$$

The expression is somewhat similar to (??), rewriting gives:

$$N_E^H = \left[\frac{1 - \rho^H \rho^F}{A - B \rho^H} \right] \frac{2(k+1) (c_M)^k \gamma}{\eta (1 - \rho^H \rho^F)} \left[\frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} - \rho^H \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \right]$$

which is similar to the open economy number of entrants, corrected with $\left[\frac{1 - \rho^H \rho^F}{A - B \rho^H} \right]$. Entry distortions not only take place through changes in cutoffs, but also through this term. In all simulation specifications, $\left[\frac{1 - \rho^H \rho^F}{A - B \rho^H} \right] < 1$, entry is reduced in Home.

The number of entrants in Foreign:

$$N_E^F + N_E^H B = 2(k+1)(c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}}, \text{ inserting } N_E^H:$$

$$N_E^F + \frac{B}{A - B\rho^H} \frac{2(k+1)(c_M)^k \gamma}{\eta} \left[\frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} - \rho^H \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}} \right] = 2(k+1)(c_M)^k \frac{\gamma}{\eta} \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}} \Leftrightarrow$$

$$N_E^F = \frac{2(k+1)(c_M)^k \gamma}{\eta} \frac{1}{A - B\rho^H} \left[A \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}} - B \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \right]$$

Again, some similarities to the open economy number of entrants, rewriting to clarify this:

$$N_E^F = \frac{2(k+1)(c_M)^k \gamma}{\eta(1 - \rho^H \rho^F)} \left[\frac{1 - \rho^H \rho^F}{A - B\rho^H} \right] \left[A \frac{(\alpha - c_D^F)}{(c_D^F)^{k+1}} - \frac{B}{\rho^F} \rho^F \frac{(\alpha - c_D^H)}{(c_D^H)^{k+1}} \right]$$

Entrants and Average prices

With the expressions for the entrants at hand, and numerical solutions for the cutoffs, N^H and N^F can be found numerically as:

$$N^F = N_E^F G(c_D^F) + N_E^H G(c_{XA}^H)$$

and

$$N^H = N_E^H G(c_D^H) + N_E^F G(c_D^H/\tau^H)$$

Average prices can then also be found numerically, as:

$$\begin{aligned} \bar{p}^H &= \frac{N_E^H G(c_D^H)}{N^H} \frac{2k+1}{2k+2} c_D^H - \frac{N_E^H}{N^H} \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) + \frac{N_E^F G(c_D^H/\tau^H)}{N^H} \frac{2k+1}{2k+2} c_D^H \\ &= \frac{2k+1}{2k+2} c_D^H - \frac{N_E^H}{N^H} \frac{1}{2} \beta^H (c_D^H - c_X^H) G(c_{XA}^H) \end{aligned}$$

and

$$\bar{p}^F = \frac{N_E^F G(c_D^F)}{N^F} \frac{2k+1}{2k+2} c_D^F + \frac{N_E^H G(c_{XA}^H)}{N^F} \frac{\tau^F}{2} \left\{ \left[\beta^H c_X^H + (1 - \beta^H) c_D^H \right] + \frac{k}{k+1} c_{XA}^H \right\}$$

Computing Welfare under Anti-Dumping

Welfare is given by:

$$U^l = 1 + \frac{1}{2} \left(\eta + \frac{\gamma}{N^l} \right)^{-1} (\alpha - \bar{p}^l)^2 + \frac{1}{2} \frac{N^l}{\gamma} \sigma_{p^l}^2, \quad l = H, F$$

The price variance is given by $\sigma_p^2 = E(p^2) - \bar{p}^2$, where \bar{p} has been derived for each country above.

Computing $E(p^2)$:

Foreign:

$E[p^F(c)^2]$ is given by:

$$\begin{aligned}
E[p^F(c)^2] &= \frac{N_E^F G(c_D^F)}{N^F} \int_0^{c_D^F} [p_D^F(c)]^2 dG(c | c \leq c_D^F) + \frac{N_E^H G(c_{XA}^H)}{N^F} \int_0^{c_{XA}^H} [p_{XA}^H(c)]^2 dG(c | c \leq c_{XA}^H) \\
&= \frac{N_E^F G(c_D^F)}{N^F} \int_0^{c_D^F} \frac{1}{4} (c_D^F + c)^2 \frac{kc^{k-1}}{(c_D^F)^k} dc + \\
&\quad \frac{N_E^H G(c_{XA}^H)}{N^F} \int_0^{c_{XA}^H} \frac{(\tau^F)^2}{4} \left[\beta^H c_D^F / \tau^F + (1 - \beta^H) c_D^H + c \right]^2 \frac{kc^{k-1}}{(c_{XA}^H)^k} dc
\end{aligned}$$

The integrals give:

$$\begin{aligned}
\int_0^{c_D^F} \frac{1}{4} (c_D^F + c)^2 \frac{kc^{k-1}}{(c_D^F)^k} dc &= \frac{1}{2} (c_D^F)^2 \frac{(1 + 4k + 2k^2)}{(1 + k)(2 + k)} \\
\int_0^{c_{XA}^H} \frac{(\tau^F)^2}{4} \left[\beta^H c_D^F / \tau^F + (1 - \beta^H) c_D^H + c \right]^2 \frac{kc^{k-1}}{(c_{XA}^H)^k} dc &= \\
\frac{(\tau^F)^2}{4} \left(M^2 + \frac{k}{k+2} (c_{XA}^H)^2 + 2M \frac{k}{k+1} c_{XA}^H \right) &: \quad \text{where } M = \beta^H c_D^F / \tau^F + (1 - \beta^H) c_D^H
\end{aligned}$$

With all the components determined, Welfare in Foreign can be computed with numerical values for cutoff..

Home:

$E[p^H(c)^2]$ is given by:

$$\begin{aligned}
E[p^H(c)^2] &= \frac{N_E^H [G(c_D^H) - G(c_{XA}^H)]}{N^H} \int_{c_{XA}^H}^{c_D^H} [p_D^H(c)]^2 dG(c | c_{XA}^H < c \leq c_D^H) + \\
&\frac{N_E^H G(c_D^H)}{N^H} \int_0^{c_{XA}^H} [p_{DA}^H(c)]^2 dG(c | c \leq c_{XA}^H) + \frac{N_E^H G(c_{XA}^H)}{N^H} \int_0^{c_X^F} [p_X^F(c)]^2 dG(c | c \leq c_X^F) \\
&= \frac{N_E^H}{N^H} \int_{c_{XA}^H}^{c_D^H} [p_D^H(c)]^2 \frac{kc^{k-1}}{(c_M)^k} dc + \frac{N_E^H}{N^H} \int_0^{c_{XA}^H} [p_{DA}^H(c)]^2 \frac{kc^{k-1}}{(c_M)^k} dc + \frac{N_E^F G(c_{XA}^H)}{N^H} \int_0^{c_X^F} [p_X^F(c)]^2 \frac{kc^{k-1}}{(c_X^F)^k} dc \\
&= \frac{N_E^H}{N^H} \left[\int_0^{c_D^H} [p_D^H(c)]^2 \frac{kc^{k-1}}{(c_M)^k} dc - \int_0^{c_{XA}^H} \left([p_D^H(c)]^2 - [p_{DA}^H(c)]^2 \right) \frac{kc^{k-1}}{(c_M)^k} dc \right] + \frac{N_E^F G(c_{XA}^H)}{N^H} \int_0^{c_X^F} [p_X^F(c)]^2 \frac{kc^{k-1}}{(c_X^F)^k} dc
\end{aligned}$$

Reducing the term in the second integral:

$$\begin{aligned}
[p_D^H(c)]^2 - [p_{DA}^H(c)]^2 &= (c_D^H + c)^2 - \left((c_D^H + c) - \beta^H (c_D^H - c_D^F / \tau^F) \right)^2 \\
&= (c_D^H + c)^2 - (c_D^H + c)^2 - (\beta^H)^2 (c_D^H - c_D^F / \tau^F)^2 + 2\beta^H (c_D^H - c_D^F / \tau^F) (c_D^H + c) \\
&= -(\beta^H)^2 (c_D^H - c_D^F / \tau^F)^2 + 2\beta^H (c_D^H - c_D^F / \tau^F) (c_D^H + c)
\end{aligned}$$

$$\int_0^{c_{XA}^H} \frac{1}{4} \left(-(\beta^H)^2 (c_D^H - c_D^F / \tau^F)^2 + 2\beta^H (c_D^H - c_D^F / \tau^F) (c_D^H + c) \right) \frac{kc^{k-1}}{(c_M)^k} dc$$

So $E[p^H(c)^2]$ can be written as:

$$\begin{aligned}
&= \frac{N_E^H}{N^H} \left[\int_0^{c_D^H} \frac{1}{4} (c_D^H + c)^2 \frac{kc^{k-1}}{(c_M)^k} dc - \int_0^{c_{XA}^H} \left(-(\beta^H)^2 (c_D^H - c_D^F / \tau^F)^2 + 2\beta^H (c_D^H - c_D^F / \tau^F) (c_D^H + c) \right) \frac{kc^{k-1}}{(c_M)^k} dc \right] \\
&+ \frac{N_E^F G(c_{XA}^H)}{N^H} \int_0^{c_X^F} \frac{\tau^H}{4} (c_X^F + c)^2 \frac{kc^{k-1}}{(c_X^F)^k} dc
\end{aligned}$$

The first integral:

$$\int_0^{c_D^H} \frac{1}{4} (c_D^H + c)^2 \frac{k c^{k-1}}{(c_M)^k} dc = \frac{1}{2} (c_D^H)^2 \frac{(1 + 4k + 2k^2)}{(1+k)(2+k)} \frac{(c_D^H)^k}{(c_M)^k} = \frac{1}{2} (c_D^H)^2 \frac{(1 + 4k + 2k^2)}{(1+k)(2+k)} G(c_D^H)$$

The second integral:

$$\begin{aligned} & - \int_0^{c_{XA}^H} \left((\beta^H)^2 (c_D^H - c_D^F/\tau^F)^2 - 2\beta^H (c_D^H - c_D^F/\tau^F) (c_D^H + c) \right) \frac{k c^{k-1}}{(c_M)^k} dc \\ & = \frac{1}{4} G(c_{XA}^H) (\beta^H) (c_D^H - c_D^F/\tau^F) \left((\beta^H) (c_D^H - c_D^F/\tau^F) - 2c_D^H - 2c_{XA}^H \frac{k}{1+k} \right) \end{aligned}$$

where $V = (\beta^H) (c_D^H - c_D^F/\tau^F)$ (The expression could be reduced a bit further, but since I insert the results in a simulation program, the exact expression matters little).

The third integral:

$$\int_0^{c_X^F} \frac{\tau^H}{4} (c_X^F + c)^2 \frac{k c^{k-1}}{(c_X^F)^k} dc = \frac{1}{2} (c_D^H)^2 \frac{1 + 4k + k^2}{(1+k)(2+k)}$$

(using $(c_X^F)^2 (\tau^H)^2 = (c_D^H)^2$).

Weighting and summing the three integrals, the first and the third simplify each other:

$$E[p^H(c)^2] = \frac{1}{2} (c_D^H)^2 \frac{1 + 4k + k^2}{(1+k)(2+k)} + \frac{1}{4} \frac{N_E^H}{N^H} G(c_{XA}^H) V \left(V - 2c_D^H - 2c_{XA}^H \frac{k}{1+k} \right)$$

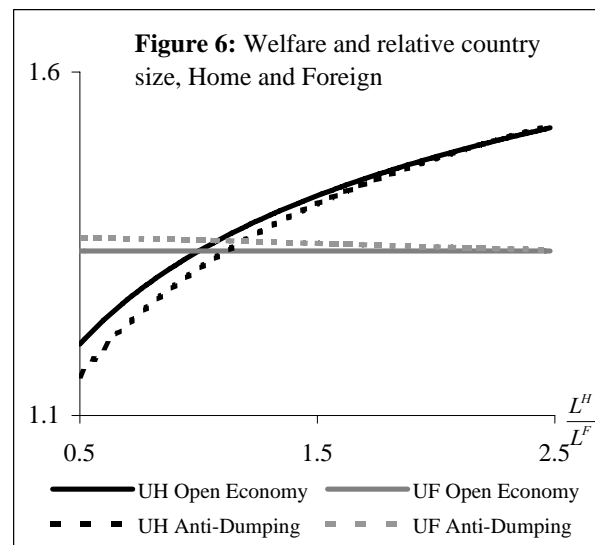
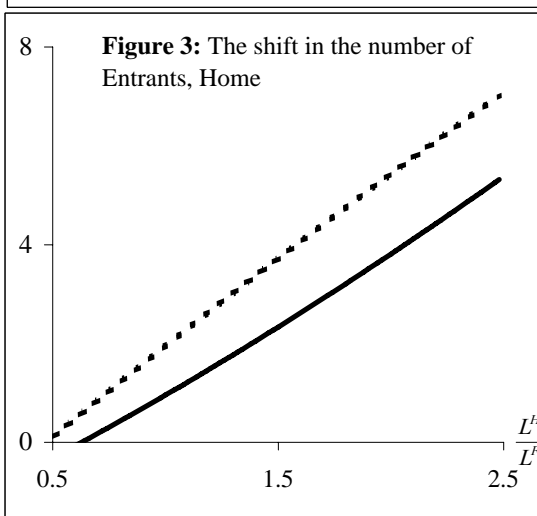
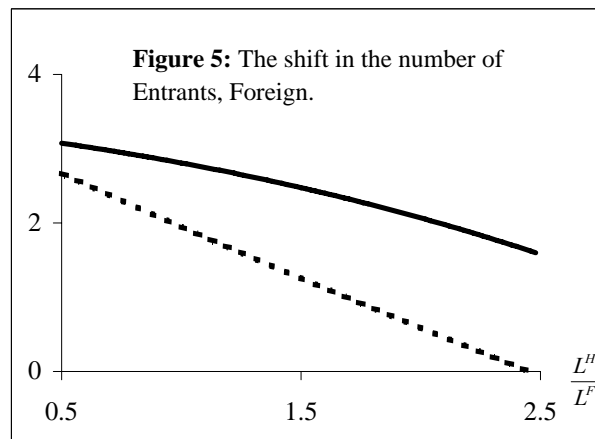
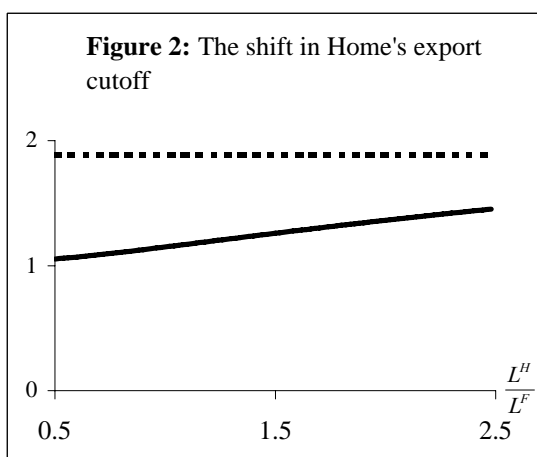
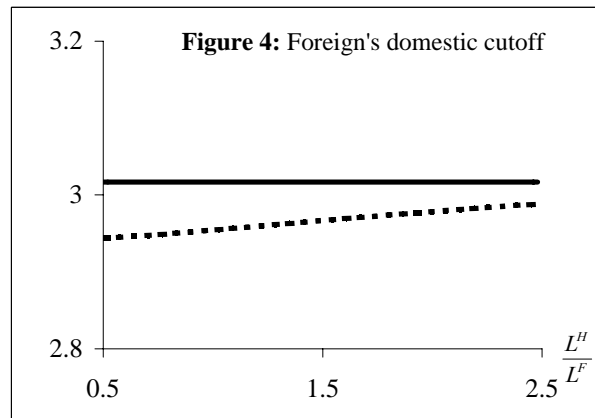
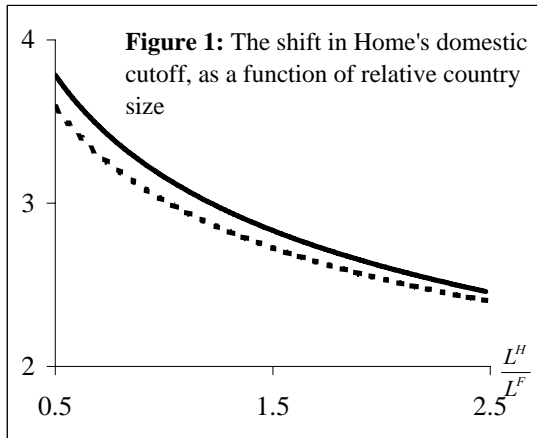
Welfare for Home can now be computed numerically as well, by inserting all the components in the expression for welfare, above.

Appendix 2. Graphs from simulations.

The graphs illustrate some of the points made in results 3 and 4: Market competition in Home decreases, as captured by increase in the domestic cutoff (Figure 1). Home's export cutoff is reduced quite substantially (figure 2), along with the fall in the number of firms attempting entry (figure 3).

In Foreign, the domestic competition increases (figure 4) as more firms attempt entry (figure 5). A comparison of the overall welfare effects and their magnitudes for the employed parameter values is given by figure 6.

The simulation code is available from the author upon request. Unless otherwise stated, parameter values are: $\alpha=5, \gamma=2, \eta=8, k=2, c_M=5$ and $f_E=1$. L^F is fixed at $L^F=10$ and L^H is the running variable.



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