Royale with Cheese: Globalization, Tourism, and the Variety of Goods*

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Abstract

The key result of the so-called "New Trade Theory" is that countries gain from falling trade costs by an increase in the number of varieties available to consumers. Though the number of varieties in a given country rises, many models predict that global variety decreases as imported varieties drive out local varieties. This is potentially worrisome when consumers care about non-exported foreign varieties either due to tourism (especially when foreign varieties are highly desired) or through an existence value (a common tool in environmental economics where simply knowing that a species exists provides utility). Since lowering trade costs induces additional varieties to export and drives out some non-exported varieties, these modifications result in welfare losses not accounted for in the existing literature. Nevertheless, it is only through the existence value that welfare falls as a result of declining trade barriers.

Keywords: Trade Theory; Globalization; Variety; Tourism

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1 Introduction

Since Krugman (1979), the impact of globalization on the varieties available to consumers has become a key feature in the debate over the merits of increased international trade. Because falling trade barriers increase the set of varieties available within a country, consumers benefit as the influx of imported varieties more than compensates for domestic varieties that are driven from the market. Further, Melitz (2003) and others show that when firms differ in productivities, three is a selection effect wherein resources are reallocated to more productive firms as the less productive ones are driven from the market. Arkolakis, Costinot, and Rodriguez-Clare (forthcoming) demonstrate that these welfare gains hold in a variety of settings.

Nevertheless, the existing literature assumes that consumers only care about the varieties available within their country of residence despite the fact that they do care about overseas varieties, most notably through tourism. As Table 1 shows, across OECD countries an average of 3% of GDP is spent while an overseas tourist, amounting to more than \$604 billion in 2009.[1] Thus, although not the dominant feature of economic activity, tourism is non-negligible and, just as variety matters for consumption at home, it matters for consumption while overseas. In particular, tourists often prefer varieties available in the overseas country relative to those available at home. For example, it is not unusual for tourists to seek out "something local" when dining or purchasing souvenirs and gifts. Such a link between local varieties and tourism revenue even led Lucca, Italy to ban non-local restaurants from its borders in order to maintain its unique charms and continue to attract tourists (Donadio, 2009). Furthermore, even in the absence of direct consumption of foreign non-exported varieties, there can be value to simply knowing of their existence (what we refer to as the "existence value").[2] When trade barriers fall, this reduces the number of varieties only available while

[1] Tourism expenditure is the average of years available as obtained from the World Tourism Organization (UNWTO) and country GDP was obtained from the IMF's World Economic Outlook Database available at http://www.imf.org/external/pubs/ft/weo/2011/01/weodata/index.aspx.

[2] "Existence value" is sometimes referred to as "passive use value".

on holiday (either because they are driven out by the entry of additional varieties from home or because they begin to be exported), potentially lowering tourism generated welfare. In addition, if falling trade barriers reduce the number of varieties worldwide, this lowers the existence value. These potential welfare losses are missing from the existing literature. This paper therefore incorporates them into a model of endogenous entry and monopolistic competition. We demonstrate that, even when there is a preference for foreign varieties over exported domestic varieties, that welfare from consumption (which includes that at home and overseas) and income increases as trade costs fall. This is countered by a decline in the existence value. However, unless consumers attach a sufficiently high benefit to the existence value relative to the benefits arising from domestic consumption, this potential downside of globalization is overridden by its benefits.

Table 1: Percent of GDP spent on Tourism

Country	1999-2009 average	Country	1999-2009 average
Australia	2.12	Japan	0.89
Austria	3.62	Korea	1.88
Belgium	4.36	Luxembourg	8.56
Canada	2.07	Malta	5.42
Cyprus	6.07	Netherlands	2.90
Czech Republic	2.23	Norway	3.17
Denmark	2.46	Portugal	2.05
Finland	1.92	Slovak Republic	2.14
France	1.80	Slovenia	2.80
Germany	2.94	Spain	1.47
Greece	2.91	Sweden	3.28
Iceland	5.62	Switzerland	2.75
Ireland	3.17	United Kingdom	3.11
Israel	2.73	United States	0.81
Italy	1.56	**Simple Average**	**2.99**

In our model, the preference structure for overseas consumption modifies the basic Dixit-Stiglitz setup in which all varieties are equally valued. Instead, we assume that, for equal quantities, the utility a home consumer in the foreign country derives from a foreign, non-exported variety is greater than or equal to that from a foreign, exported variety. This in turn is greater than or equal to the utility derived from a home-produced, exported variety. To make the comparisons more concrete, consider an American in Ireland. Whereas the standard Dixit-Stiglitz preferences would have the consumer view a pint of Budweiser (an American variety exported to Ireland) the same as a pint of Guinness (an Irish variety available in America) or a pint of Porterhouse (an Irish variety only available in Ireland), we allow for the possibility that the consumer strictly prefers drinking Porterhouse to Guinness due to its "foreignness" and likewise that a Guinness is preferable to Budweiser. Thus, all else equal, if an American variety drives out an Irish variety, this is a net utility loss, a loss that is especially acute if that Irish variety is only available while in Ireland. Therefore, if there is an increase in globalization, modeled as a fall in trade costs, this would tend to imply a welfare loss as additional American varieties, such as Miller, drive out indigenous, hard to find Irish microbrews such as Porterhouse.

In addition to tourism, we introduce an existence value; i.e. a benefit that arises simply from knowing that a variety exists even if it is never used or consumed. The use of existence values in environmental economics dates back to Krutilla (1967).[3] In that literature, they appeal to the notion that species, forests, or other natural resources provide benefit simply from knowing that they are out there. Here, one could attribute such utility to travel shows or the like, i.e. even though a consumer will never travel to a given country and consume their non-exported products, she benefits from knowing that those varieties exist. Thus, if trade costs fall, lowering the number of varieties available in the world as a whole, as occurs in Melitz (2003), this would result in a welfare decrease.[4] Baldwin and Forslid (2010) additionally find that lower trade costs lead to both an anti-variety production *and* a consumption effect which is most pronounced for small countries. This dual anti-variety effect is also highlighted in Cole (2011) for certain parameterizations.

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[3]Horowitz et al. (2008) provide a recent overview of existence values in environmental economics.

[4]Note that this decrease in the total mass of varieties result is not universal in the New Trade Theory. In Krugman (1980) the number of varieties is independent of trade costs. In Baldwin and Robert-Nicoud (2008) trade can be growth-enhancing or growth reducing in varieties, depending on the nature of spillovers (which are absent from our model).

Despite these changes, however, we find that welfare from consumption will rise as trade costs fall. A fall in trade costs results in three things from the perspective of a home consumer. First, there is an increase in imports to home from foreign (i.e. more Guinness in America). This effect increases welfare and has been well documented elsewhere. Second, and something not found in the literature, there is an increase in exports from home to foreign (i.e. more Budweiser in Ireland) which results in an ambiguous welfare effect for Home's agents. This ambiguity arises because, although highly-prized non-exported foreign varieties are driven from the market causing a welfare loss, the lower cost of domestic exports somewhat offsets this. While the net effect is ambiguous it indicates that welfare derived from tourism can fall as trade costs decline. Nevertheless, the combined welfare impact of the home and foreign market changes is unambiguously positive, that is, the benefits to domestic consumption outweigh any potential losses from overseas consumption. Finally, there is a third effect through the existence value. Since in our model increased trade reduces the number of varieties across the globe, this represents a welfare loss. However, for increased globalization to lower welfare, it must be the case that this indirect loss outweighs the welfare gains from direct consumption (which obviously cannot happen if there is no existence value).

Our focus on the varieties available overseas has a parallel to the small, but growing strand of literature focusing on the protection of "cultural goods" where the set of varieties available within a country is of primary concern. The focus of this literature is often to identify channels by which trade liberalization can lead to welfare declines.[5] For example, Francois and van Ypersele (2002) construct a model in which there is a homogenous good valued by all consumers (Hollywood blockbusters for example) and a heterogenous good valued only by consumers in its country of origin (i.e. US independent films are only valued by Americans and vice versa for the French). They show that when goods are produced using increasing returns to scale and there is sufficient heterogeneity across consumers for independent films,

[5] Although it is clearly difficult to measure welfare loses in practice, Disdier, Head, and Mayer (2010) investigate the effect of exposure to foreign media on the naming patterns in France. Their research suggests that exposure to foreign media has only affected the names of less than 5% of French babies and has a positive welfare effect on parents.

aggregate welfare can decline when trade barriers for the homogenous good fall. This is because, due to a first mover advantage for the homogenous goods producer, a reduction in trade costs for this firm can lead it to reduce prices so that small firms are unable to profitably produce, harming consumers with a strong preference for such films. In contrast, Durbin (2002) assumes that all firms move at the same time. Under this alternative, although agents with a strong preference for independent cinema may lose out from liberalization, there is not the predatory pricing motive that can result in lower aggregate welfare.

Janeba (2007) takes a different approach to the idea of culture by modeling “cultural identity”, which is derived from matching the consumption of others, in a Ricardian model. Because of consumer heterogeneity, two distinct tribes will form. With liberalization, consumption patterns change, altering the size of the tribes and potentially lowering welfare. Oliver, Thoenig and Verdier (2008) extend this idea to include endogenous preference formation. These results stand in contrast to Kubota (1999) who follows a similar approach but uses homogeneous agents, implying that with trade liberalization, only one tribe emerges in equilibrium and world welfare improves.[6]

Rauch and Trinidad’s (2009) externality comes about through a dynamic effect where the varieties produced in one period affect the benefit in the future by impacting the innovation and quality of future cultural goods. With trade liberalization, this results in homogenization of cultural goods negatively impacting their future quality, potentially resulting in a welfare loss. Thus, it is a failure of present day producers to account for their spillovers on future producers that causes a market failure exacerbated by trade. In any case, they show that since the welfare loss is derived from a reduction in the number of cultural varieties, a policy of subsidizing cultural goods dominates trade protection against the homogeneous one.

In all of these, however, it is only the set of goods available to consumers within their own

[6] Nevertheless, she shows that a country that imports this common good may find it unilaterally beneficial to restrict trade in order to protect domestic industry. Implicitly since trade in cinema is one-way in their model’s equilibrium, Francois and van Ypersele (2002) also consider a unilateral trade liberalization. By way of contrast, we model bilateral liberalization.

borders that matters for their welfare.[7] As such, the disappearance of a non-traded variety in the other nation does not matter to a consumer. This is quite different from the phenomenon we seek to model in which those varieties are valued. Furthermore, in direct contrast to the assumptions of Francois and van Ypersele (2002), we assume that while overseas there is a preference for foreign-made varieties over domestically-made ones. Finally, unlike the existing literature, we assume heterogeneous firms which introduces welfare-improving selection effects from trade (Melitz, 2003). Thus, our work complements the existing cultural goods literature since, without the externalities it relies on, we find that consumption-based welfare unambiguously rises with trade liberalization.

The rest of the paper proceeds as follows. Section 2 lays out the basic model and its equilibrium, illustrating the role of tourism and the existence value. Section 3 analyzes the change in welfare arising from a fall in trade costs. Section 4 concludes.

2 The Model

Our model builds off of the well-known Melitz (2003) model. There are two countries, Home and Foreign. We will refer to the home country as the domestic country to ease discussion. Foreign variables will be labeled with *s. Home (Foreign) is exogenously endowed with $\bar{L}$ ($\bar{L}^*$) units of labor which is the sole factor of production. There are two sectors. Sector 1 is the numeraire and consists of a homogeneous good (y) that is produced under constant returns to scale, freely traded, and sold in a perfectly competitive market. Sector 2 consists of a continuum of differentiated goods, each variety of which is indexed by i. In contrast to Durbin (2002), different firms may have different unit labor costs. As is standard in the Melitz model, this is produced under increasing returns to scale in a monopolistically competitive market with free entry. Unlike sector 1, this market faces trade barriers. Countries are identical. Therefore, analyzing the situation for Home informs us of the analogous situation

[7] The exception being Rauch and Trinidad (2009) where the quality in period t in a country can also depend on past varieties in the other. As described below, this is related to the existence value in the current paper.

for Foreign and we will refer to the foreign country only when necessary.

2.1 Sector 1

The price of y is normalized to 1. Assuming that one unit of labor is needed for production, this normalizes the wage in each country to unity. Finally, we assume that in equilibrium a positive amount of y is produced and consumed in each country.[8]

2.2 Consumers

Let the utility function for the representative agent in home take the following form

$$U = \mu_1 \ln(X_1) + \mu_2 \ln(X_2) + \Phi(\Omega) + Y \tag{1}$$

where

$$X_1 = \left(\int_{i \in \Omega_1} x_k(i)^\rho di \right)^{\frac{1}{\rho}}, \tag{2}$$

$$X_2 = \left[\alpha^{\frac{1}{\varepsilon}} \left(\int_{i \in \Omega_2} x(i)^\rho di \right) + \beta^{\frac{1}{\varepsilon}} \left(\int_{i \in \Omega_3} x(i)^\rho di \right) + \gamma^{\frac{1}{\varepsilon}} \left(\int_{i \in \Omega_4} x(i)^\rho di \right) \right]^{\frac{1}{\rho}}, \tag{3}$$

$\mu_1 > 0$, $\mu_2 \geq 0$, and $0 \leq \alpha \leq \beta \leq \gamma$, $\varepsilon = 1/(1-\rho)$ is the elasticity of substitution, and Ω is the set of varieties available world-wide.[9] Thus preferences admit a quasi-linear form that is linear in the numeraire and non-linear in domestic consumption (X_1), overseas consumption through tourism (X_2), and the existence value ($\Phi(\Omega)$, which is increasing in the size of the set of varieties in production).[10] The set of varieties Ω can be broken down as

[8] This avoids corner solutions in production and consumption.

[9] Instead of a representative agent, as with the cultural goods literature, we could assume a distribution of consumer types within a country (that is identical across countries) resulting in a normative representative consumer with this utility function, the maximization of which yields aggregate demand for our various goods and represents aggregate welfare (accounting for the aggregation across individual utilities). As discussed below, this alternative approach can result in losers from trade liberalization, however it does not overturn the result that reducing trade barriers improves *aggregate* welfare.

[10] In Rauch and Trinidad (2009), they assume that the quality of the cultural good in year t is a function $Q(n_{t-1}, n^*_{t-1})$ that is increasing in the number of varieties at home and abroad in year $t-1$ (n_{t-1} and

follows. Ω_1 is the set of varieties available to a home-based consumer for consumption in the home country. This set is comprised of domestically produced varieties and imported foreign varieties. Using the analogy from the introduction, Ω_1 would include Budweiser (an exported American variety), Rogue (an American variety not exported to Ireland), and Guinness (an exported Irish variety). This is standard in the new trade theory. Ω_2 is the set of varieties available for consumption in Foreign that originate in Home (i.e. Budweiser).[11] Ω_3 is the set of varieties available for consumption in both Home and Foreign that originate in Foreign (i.e. Guinness). Ω_4 is the set of varieties available for consumption *only* in Foreign (i.e. Porterhouse). These varieties are obviously made in Foreign. Note that by assuming that $\gamma \geq \beta \geq \alpha$, we are allowing both for the possibility that a home consumer treats all varieties available in Foreign equally and for a possibility in which she prefers Foreign-made varieties while in in Foreign.[12] Finally, recognize that Ω, the set of varieties world-wide, is the union of Ω_1 through Ω_4.

Demand of each good for a consumer of Home nationality is the following:

$$x_1(i) = \frac{p(i)^{-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}} \tag{4}$$

$$x_2(i) = \frac{p^*(i)^{-\varepsilon}\alpha\mu_2}{\mathcal{P}_2{}^{1-\varepsilon}} \rightarrow \text{ Budweiser} \tag{5}$$

$$x_3(i) = \frac{p^*(i)^{-\varepsilon}\beta\mu_2}{\mathcal{P}_2{}^{1-\varepsilon}} \rightarrow \text{ Guinness} \tag{6}$$

$$x_4(i) = \frac{p^*(i)^{-\varepsilon}\gamma\mu_2}{\mathcal{P}_2{}^{1-\varepsilon}} \rightarrow \text{ Porterhouse} \tag{7}$$

where $p(i)$ is the price of variety i sold in home, $p^*(i)$ is the price of variety i sold in foreign,

n^*_{t-1} respectively. This then has a parallel to our existence value. Alternatively, one could imagine that the greater the mass of varieties across the globe the lower fixed entry costs, again resulting in a similar term in equilibrium where the existence value would capture the fixed cost savings from variety. Baldwin and Robert-Nicoud (2008) explore a variety of such formulations.

[11] Note that $\Omega_2 = \Omega_3^*$, i.e. Budweiser to an American in Ireland is comparable to Guinness to an Irish person in America. Similarly, $\Omega_3 = \Omega_2^*$.

[12] Alternatively, we could assume that a Home consumer in Foreign prefers Home-made varieties (i.e. that there is "homesickness"). Since lower trade costs increase the set of such goods available in Foreign, this would lead to a rise in welfare with liberalization.

and[13]

$$\mathcal{P}_1{}^{1-\varepsilon} = \int_{i\in\Omega_1} p(i)^{1-\varepsilon} di \tag{8}$$

$$\mathcal{P}_2{}^{1-\varepsilon} = \alpha \int_{i\in\Omega_2} p^*(i)^{1-\varepsilon} di + \beta \int_{i\in\Omega_3} p^*(i)^{1-\varepsilon} di + \gamma \int_{i\in\Omega_4} p^*(i)^{1-\varepsilon} di. \tag{9}$$

Thus, aggregate Home demand for variety i produced and sold by a home country firm is as follows:

$$Q_D(i) = \begin{cases} x_1(i) + x_4^*(i) & \forall i \in \Omega_4^* \\ x_1(i) + x_3^*(i) & \forall i \in \Omega_2 \end{cases}, \tag{10}$$

and aggregate Foreign demand for variety i produced and sold by a home country firm (i.e. this firm's export demand) is

$$Q_X(i) = x_1^*(i) + x_2(i) \ \forall i \in \Omega_2. \tag{11}$$

2.3 Heterogeneous Firms

A firm must pay a fixed cost f_E (measured in units of labor) in order to enter the industry. If this cost is paid, the firm then draws a constant output-per-unit-labor coefficient $1/a$ from the Pareto distribution $G(a)$ with a shape parameter k.[14] Once this coefficient is observed, a firm decides to exit and not produce or remain. If it chooses to remain, it must then decide whether to serve only the domestic market, only the foreign market, or both. By serving the domestic market the firm must incur an additional fixed cost f_D. If it chooses to export to the foreign market, it must pay $f_X > f_D$. Production exhibits constant returns to scale with labor as the only factor of production.

The decision to become a firm and which market to service depends on the associated

[13]Note that the price index for Home's consumption *in* Foreign is *not* the same as the price index for Foreign's consumption in Foreign. These are different because while a Foreign consumer weights each variety she consumes in Foreign the same, the Home tourist weighs certain varieties consumed in Foreign differently.

[14]The Pareto distribution has the following cumulative distribution function: $G(a) = \left(\frac{a}{a_U}\right)^k$, $0 < a < a_U$. We follow Helpman et al. (2004) and Chor (2009) and assume the $k > \varepsilon - 1$.

profit for each type. Recall that the numeraire yields wages equal to one in both countries, thus the operating profits for a Home firm with variety i selling only domestically is

$$\begin{aligned}
\pi_D(i) &= \big[p(i) - a_i\big] Q_D(i) - f_D \quad \forall i \in \Omega_4^* \\
&= \big[p(i) - a_i\big] \left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\gamma\mu_2}{\mathcal{P}_2^{*1-\varepsilon}}\right] p_k(i)^{-\varepsilon} - f_D.
\end{aligned}$$

Note that a firm does not realize it can affect $\mathcal{P}_1$ or $\mathcal{P}_2^*$. Thus, a firm selling domestically will charge a price equal to a constant markup over marginal cost, $p(i) = \frac{a_i}{\rho}$. Therefore, the operating profit function for a purely domestic firm is

$$\pi_D(i) = a_i^{1-\varepsilon} B_D - f_D \tag{12}$$

where

$$B_D = \frac{1}{\varepsilon\rho^{1-\varepsilon}} \left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\gamma\mu_2}{\mathcal{P}_2^{*1-\varepsilon}}\right].$$

Firms that want to become an exporter pay an additional fixed cost f_X and face symmetric trade costs in the form of melting-iceberg transport cost $\tau > 1$.[15] Moveover their demand at home is different because the demand from a foreign tourist changes, i.e. once Guinness is available in America, this changes how an American in Ireland views the beer. Thus, the operating profit (*new* domestic plus *additional* operating export profits) for a firm that exports is

$$\pi_X = a_i^{1-\varepsilon} B_X - f_D - f_X \;\forall i \in \Omega_2. \tag{13}$$

where

$$B_X = \frac{1}{\varepsilon\rho^{1-\varepsilon}} \left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\beta\mu_2}{\mathcal{P}^*{}_2^{1-\varepsilon}}\right] + \frac{1}{\varepsilon}\left(\frac{\tau}{\rho}\right)^{1-\varepsilon} \left[\frac{\mu_1}{\mathcal{P}_1^{*1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2{}^{1-\varepsilon}}\right].$$

Note that since $f_X > f_D$, any exporting firm will also find it strictly profitable to sell domestically. In the context of firm heterogeneity, it also ensures that varieties driven out by

[15] A firm must ship τ units for one unit to arrive.

globalization are precisely those small overseas producers whose product is available only in their local market, highlighting the possibility that tourists seeking out relatively unknown, non-traded varieties while overseas may be negatively impacted by globalization.

2.4 Equilibrium

In terms of firm activity, we have three equilibrium conditions. First, a firm will produce domestically if there exists nonnegative profits. This yields a cutoff productivity level a_D which represents the firm indifferent between supplying the domestic market and exiting. Noting that since trade costs (τ) and expenditures on the heterogeneous good (μ_1 and μ_2) are identical across countries we can appeal to symmetry and drop the country indicator (*) for notational ease, this is implicitly given by:

$$\frac{1}{\varepsilon}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}+\frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right]=f_D. \tag{14}$$

Firms that are more productive than this cutoff will serve the domestic market, which includes both local consumers and tourists from overseas. Firms that are less productive will not enter. Recalling that Ω is the union of Ω_1 through Ω_4, the mass of varieties worldwide can be written as a function of a_D and a_D^*. This allows us to rewrite the existence value as $\Phi(a_D, a_D^*)$ which is increasing in these cutoffs.

Second, a firm will become an exporter if the profits from becoming an exporter are at least as big as the decrease in domestic profits. This decrease in domestic profits results from $\beta \leq \gamma$, which implies that when a firm starts to export, it potentially loses some of its appeal to foreign tourists.[16] This results in a cutoff a_X for which firms at least as productive as this will export and those that are less productive than this will serve at most the domestic

[16] Note that if $\beta > \gamma$, there exists the possibility that a firm would choose to export at a loss because it is then a familiar variety to tourists from overseas (i.e. it switches from a γ to a β variety), raising profits from domestic sales to tourists. However, this scenario is beyond the scope of the issue we are addressing.

market only. This is implicitly given by:

$$\frac{1}{\varepsilon}\left(\frac{a_X}{\rho}\right)^{1-\varepsilon}\left[\frac{\left(\beta-\gamma+\tau^{1-\varepsilon}\alpha\right)\mu_2}{\mathcal{P}_2^{1-\varepsilon}}+\frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\right]=f_X. \tag{15}$$

Figure 1 uses these firm cutoffs to illustrate the firm indices/varieties that belong to each particular set of varieties. It can be seen that a Home consumer, while in Home, consumes all varieties produced in Home ($0 < a \leq a_D$) along with the varieties produced in Foreign and exported to Home ($0 < a^* \leq a_X^*$). Similarly, when an agent from Home travels to Foreign and consumes as a tourist, she consumes varieties that are produced in Home and exported to Foreign ($0 < a \leq a_X$), as well as all varieties produced in Foreign. However, we have allowed for the agent to weight varieties that are available to them at home ($0 < a^* \leq a_X^*$) differently than those varieties only available in Foreign ($a_X^* < a \leq a_D^*$).

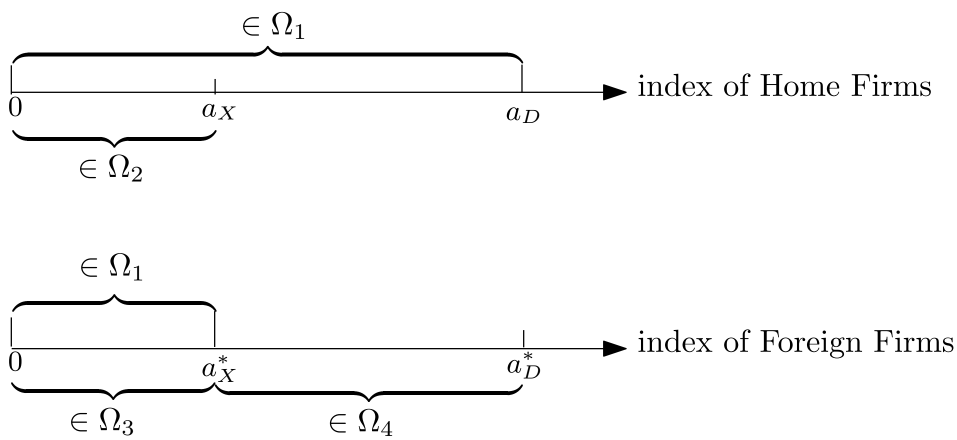

Figure 1: Home's Consumption in Equilibrium with Trade

Third, an entrepreneur will take a draw as long as the expectation of profits $\bar{\pi}$ is positive.[17] This results in a free entry condition given by:[18]

$$\frac{(\varepsilon-1)[a_D^k f_D + a_X^k f_X]}{[k-\varepsilon+1]a_U^k}=f_E. \tag{16}$$

[17]For simplicity, we assume the "probability of death" in Melitz (2003) in each period is equal to one, making our model a one shot version of his.

[18]Detailed derivations are in Appendix A.

Finally, the equilibrium price indices are:

$$\begin{aligned}\mathcal{P}_1^{1-\varepsilon} &= \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[a_D^{k+1-\varepsilon}+\tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right] &(17)\\ \mathcal{P}_2^{1-\varepsilon} &= \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[\gamma a_D^{k+1-\varepsilon}+(\beta+\alpha\tau^{1-\varepsilon}-\gamma)a_X^{k+1-\varepsilon}\right] &(18)\end{aligned}$$

where $\theta=\frac{k}{(k-\varepsilon+1)}$ and N_E denotes the number (mass) of entrants; i.e. those taking a draw but not necessarily operating.[19] Furthermore, by utilizing the equilibrium conditions, we can explicitly solve for the mass of entrants,

$$N_E=\frac{\rho}{f_E k}\left[\mu_1+\mu_2\right], \tag{19}$$

as a function of exogenous variables. This leaves us with four equations ((14), (15), (17), and (18)) and four unknowns (a_D, a_X, $\mathcal{P}_1$, and $\mathcal{P}_2$).

3 The Welfare Impact of Freer Trade

In order to determine the impact of falling trade costs on welfare, we must derive the comparative statics of the above system of equations.[20] First, in order to present cleaner results, we define variables denoted with "hats" to represent percentage changes with respect to a change in trade costs. Totally differentiating (14), (15), (17), and (18), we derive the

[19]The number (mass) of domestic and exported varieties are the respectively:

$$N_D=G(a_D)N_E=\left(\frac{a_D}{a_U}\right)^k N_E \qquad \text{and} \qquad N_X=G(a_X)N_E=\left(\frac{a_X}{a_U}\right)^k N_E.$$

[20]Note that τ is the trade cost for goods trade whereas tourism itself is costless. In equilibrium, tourism expenditures are $\mathcal{P}_2X_2=\mu_2$ which do not depend on trade costs. Thus, the propensity for tourism is unaffected by trade liberalization. If falling trade costs make tourism (i.e. "trade" in people) less difficult, all else equal, this might increase overseas expenditures, in a sense making μ_2 a function of τ. The welfare implications of such a possibility, including how it interacts with changes in the varieties overseas, is left for future research.

following set of comparative statics.

$$\hat{a}_D = \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1 + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2\right] > 0 \tag{20}$$

$$\hat{a}_X = \frac{1}{\varepsilon f_X}\left(\frac{a_X}{\rho}\right)^{1-\varepsilon}\left[\frac{\delta\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2 + \frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1 - \tau^{-\varepsilon}\left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\right] < 0 \tag{21}$$

$$\hat{\mathcal{P}}_1 = \left[\frac{\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[a_D^{k+1-\varepsilon} + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right]}\right] > 0 \tag{22}$$

$$\hat{\mathcal{P}}_2 = \left[\frac{\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D + (\beta + \alpha\tau^{1-\varepsilon} - \gamma)a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\alpha\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[\gamma a_D^{k+1+\varepsilon} + (\beta + \alpha\tau^{1-\varepsilon} - \gamma)a_X^{k+1+\varepsilon}\right]}\right] \lesseqgtr 0 \tag{23}$$

The proofs for these signs are in Appendix B, however, these results are intuitive. As trade barriers fall, firms that were not interested in exporting begin doing so, increasing the exporter cutoff a_X. This added competition drives some low productivity firms from the market, lowering a_D. The net effect of this is to reduce the price index for domestic consumption $\mathcal{P}_1$. These results match those found elsewhere. In our model, through tourism, we additionally have the impact of falling trade barriers on the overseas price index $\mathcal{P}_2$. This change is ambiguous because although the falling trade barriers tend to decrease $\mathcal{P}_2$, one must consider changes in the mix of varieties overseas. First, the increase in home exports drives out some foreign non-traded varieties. Since foreign non-traded varieties are more valued than home-made varieties, this tends to increase $\mathcal{P}_2$. In addition, this is reinforced by the increase in exported foreign-made varieties, moving some foreign varieties from the treasured Ω_4 set to the less valued Ω_3 set. This is illustrated in Figure 2; as trade barriers lower, the varieties in the sets Ω_2 and Ω_3 increase, while the varieties belonging to Ω_4 diminish as this set is eroded from both sides. Which effect dominates depends on parameter values and most obviously on the ranking of α, β, and γ. If we assume that $\alpha = \beta = \gamma$, this second effect disappears and, as with domestic consumption, $\mathcal{P}_2$ strictly decreases as trade barriers fall.

Since a_D falls with the decline in trade barriers, as in Melitz (2003), Baldwin and Forslid (2010), and Cole (2011), the mass of varieties available across the planet will fall. Nev-

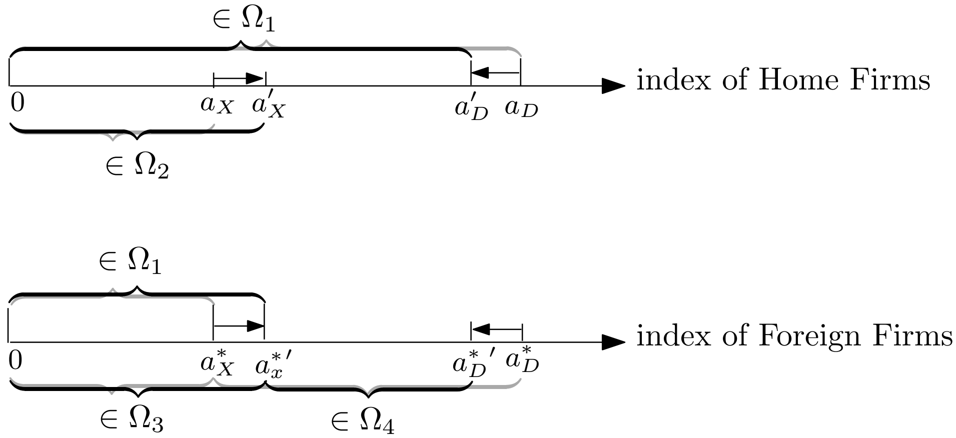

Figure 2: Home's Consumption with Lower Trade Barriers

ertheless, as has been highlighted elsewhere, this does not necessarily mean that the mass of varieties in a given location declines. This depends on whether or not new exporters offsets the decline in domestic varieties. Defining the total mass of varieties available for consumption in a particular country as $N_C = N_D + N_X$, the effect of trade barriers is

$$\begin{aligned} \frac{\partial N_C}{\partial \tau} &= \frac{k a_D^{k-1} N_E}{a_U^k} \frac{\partial a_D}{\partial \tau} + \frac{k a_X^{k-1} N_E}{a_U^k} \frac{\partial a_X}{\partial \tau} \\ &= \frac{k N_E}{a_U^k} \left[a_D^{k-1} \frac{\partial a_D}{\partial \tau} - \frac{a_D^{k-1} f_D}{f_X} \frac{\partial a_D}{\partial \tau} \right] \\ &= k N_D \hat{a}_D \left[\frac{f_X - f_D}{f_X} \right] > 0 \end{aligned}$$

and the mass of varieties within a country falls along with trade barriers. Note that this does not imply lower welfare since this loss must be weighed against lower prices resulting from lower transport costs for imported varieties which, by virtue of those firms' greater productivities, form a larger part of the consumption basket.

Recalling that since by free entry average profits are zero and that in equilibrium $\mathcal{P}_i X_i = \mu_i$ for $i \in \{1, 2\}$, the indirect utility function for the representative consumer is:[21]

$$V_k = \mu_1 \ln \left(\frac{\mu_1}{\mathcal{P}_1} \right) + \mu_2 \ln \left(\frac{\mu_2}{\mathcal{P}_2} \right) + \Phi(a_D, a_D^*) + I - \mu_1 - \mu_2. \tag{24}$$

[21]Note that since $\mathcal{P}_2 X_2 = \mu_2$, the data in Table 1 would suggest that $\mu_2 = 0.03L$ for OECD countries.

Note that the labor endowment only enters this through the consumption of the numeraire good, indicating that our results do not depend on absolute country size. Differentiating (24) with respect to τ and noting that $a_D = a_D^*$ yields:

$$\frac{\partial V}{\partial \tau} = -\mu_1 \hat{\mathcal{P}}_1 - \mu_2 \hat{\mathcal{P}}_2 + 2\Phi'(a_D, a_D^*) \frac{\partial a_D}{\partial \tau}. \tag{25}$$

Through the algebra shown in Appendix C, (25) becomes

$$\frac{\partial V}{\partial \tau} = \frac{-\theta N_X}{\tau} \left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha \mu_2}{\mathcal{P}_2^{1-\varepsilon}} \right] \left(\frac{\tau a_X}{\rho} \right)^{1-\varepsilon} + 2\Phi'(a_D, a_D^*) \frac{\partial a_D}{\partial \tau}. \tag{26}$$

Thus, the sum of the first two terms in (25) is negative. This means that, ignoring changes in the existence value, welfare is decreasing in trade costs. Thus, as trade becomes freer, welfare improves. This is because the losses associated with the decrease in set of highly valued non-tradable foreign varieties (both through exit and switching to exported varieties) are more than overcome by the gains associated with cheaper exports (be they foreign varieties in home or home varieties in foreign). This is the result of two things. The first is a realization of the finding of Dixit and Stiglitz (1977) who find that the mass of firms arising in equilibrium is welfare maximizing subject to the constraint that no firm can earn negative profits. This finding is reiterated and extended by Arkolakis, Costinot, and Rodriguez-Clare (forthcoming). In essence, as firms endogenously choose whether to produce, their decisions compare the social benefit of the variety's existence net of production costs (the left hand side of (14)) with the cost of adding the variety to the set of those in production (the right hand side of (14)). In other words, if society finds the production variety sufficiently valuable relative to its cost, the variety will be produced. A similar intuition holds for the exporting choice. Second, as is common in models of heterogeneous firms, lower trade barriers result in a welfare-improving selection effect that increases average productivity. As a result of these two effects, consumption-based welfare rises as trade costs fall. Finally, note that by symmetry, this also implies a decline in trade costs results in a consumption-based welfare gain for the world. Thus the welfare improvements found elsewhere extend to a model with tourism.

It is important to note the role of homogenous consumers in interpreting this result. In our model of homogenous consumers, average, individual, and aggregate welfares are all equivalent. This is not the case in models such as Francois and van Ypersele (2002) and others. If we did have heterogeneous consumers and assumed that (1) is a representative consumer's utility function that results in aggregate demand and aggregate welfare, then some consumers may well lose from trade liberalization even as the nation as a whole gains. For example, suppose that only a subset of consumers travel, meaning they put more weight on X_2 than the "average" representative consumer. Since, as noted above, $\hat{\mathcal{P}}_2$ and thus the change in welfare while overseas is ambiguous, such an agent's utility may decline even as the aggregate welfare increases with trade liberalization. Thus, there could well be winners and losers from reductions in trade costs since, while (26) is positive for the representative consumer, it need not be for individuals with large μ_2s and low αs. Nevertheless when social welfare is proportional to (1), as is the case in Durbin (2002), then aggregate consumption-based welfare rises as a result of falling trade costs.

The existence value effect, however, is unambiguously negative since there is a decline in the mass of varieties worldwide. This is akin to the finding of Rauch and Trinidad (2009) where the exit of varieties in one period lowers the quality of what is available in the future. Therefore, the net impact on welfare of a decline in trade costs is ambiguous. However, for it to be negative, in our model it must be the case that the welfare effect of the decline in the existence value is greater than the gains from actual consumption. Thus, although theoretically possible, this would require potentially extreme assumptions on parameter values. Alternatively, one could introduce other market failures that are exacerbated by trade, including those used by Rauch and Trinidad (2009), Janeba (2007) or Francois and van Ypersele (2002) for which, under certain parameter values, trade liberalization can lower welfare.

4 Conclusion

The purpose of this paper has been to consider the possibility that because typical trade models do not consider the value consumers place on overseas varieties, they may overstate the benefits resulting from trade liberalization. We address this by incorporating both tourism (in which consumers may prefer non-exported overseas varieties to those available at home) and an existence value (through which they care about the total mass of varieties across the globe). We find that, although a fall in trade costs can lower the welfare from overseas consumption, any potential negative effect is more than offset by a rise in welfare from domestic consumption, resulting in an unambiguous consumption-driven welfare gain. This then indicates that the results of the existing literature (as summarized by Arkolakis, Costinot, and Rodriguez-Clare (forthcoming)) extend to a setting with tourism. This, however, is countered by a decline in the existence value as the mass of varieties falls. Nevertheless, for the net effect on welfare to be negative, it must be that this existence value dominates the welfare gains arising from the actual consumption of overseas varieties.

This should not be taken to mean that there are no losses from liberalization. First, since the existence value falls, one can argue that the welfare gains of lowered trade costs are overstated, even if the net effect is still a welfare increase. Second, this is but one avenue by which trade could impact welfare. There exists a plethora of models by which allowing freer trade can lead to lower equilibrium welfare including the literature on cultural goods. Therefore, while it is not our contention that there is no scope for lower trade costs to lower equilibrium welfare, our results do suggest that it may be necessary to consider alternative channels in order to argue against lowering trade barriers.

APPENDIX

A Free Entry

The free entry condition implies that expected profits $\bar{\pi}$ must be zero. Thus the free entry condition is

$$[V(a_D) - V(a_X)]B_D - [G(a_D) - G(a_X)]f_D + V(a_X)B_X - G(a_X)[f_X + f_D] = f_E \qquad \text{(A-1)}$$

where

$$V(z) = \int_0^z a^{1-\varepsilon} dG(a).$$

In order to provide analytical solutions, we assume $G(a)$ follows the Pareto distribution:

$$\begin{aligned} G(a) &= \left(\frac{a}{a_U}\right)^k, \ 0 < a < a_U & \text{(A-2)} \\ V(a) &= \frac{k}{k - \varepsilon + 1}\left(\frac{a}{a_U}\right)^k a^{1-\varepsilon}, \ 0 < a < a_U. & \text{(A-3)} \end{aligned}$$

Plugging this into the free entry condition yields:

$$\begin{aligned} f_E = \frac{1}{\varepsilon a_U^k} \Bigg\{ & \frac{k\rho^{\varepsilon-1}}{k-\varepsilon+1} \left(a_D^{1-\varepsilon+k} \left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}} \right] + a_X^{1-\varepsilon+k} \left[\frac{\big(\beta - \gamma + \tau^{1-\varepsilon}\alpha\big)\mu_2}{\mathcal{P}_2^{1-\varepsilon}} + \frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}} \right] \right) \\ & - \varepsilon(a_D^k f_D + a_X^k f_X) \Bigg\}. \end{aligned}$$

Using the equilibrium conditions (14) and (15), this can simplify to

$$f_E = \frac{(\varepsilon - 1)[a_D^k f_D + a_X^k f_X]}{[k - \varepsilon + 1]a_U^k}. \qquad \text{(A-4)}$$

B Comparative Statics

In this section we prove our claims regarding the signs of the comparative statics.

B.1 Equilibrium Conditions

To begin we make the following definitions to condense our equations:

$$\theta \equiv \frac{k}{(k+1-\varepsilon)} \tag{B-1}$$

$$\delta \equiv \big(\beta + \tau^{1-\varepsilon}\alpha - \gamma\big). \tag{B-2}$$

The equilibrium conditions are

$$f_D = \frac{1}{\varepsilon}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right] \tag{B-3}$$

$$f_X = \frac{1}{\varepsilon}\left(\frac{a_X}{\rho}\right)^{1-\varepsilon}\left[\frac{\big(\beta + \tau^{1-\varepsilon}\alpha - \gamma\big)\mu_2}{\mathcal{P}_2^{1-\varepsilon}} + \frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\right] \tag{B-4}$$

$$f_E = \frac{(\varepsilon-1)[a_D^k f_D + a_X^k f_X]}{[k+1-\varepsilon]a_U^k} \tag{B-5}$$

$$\mathcal{P}_1^{1-\varepsilon} = \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[a_D^{k+1-\varepsilon} + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right] \tag{B-6}$$

$$\mathcal{P}_2^{1-\varepsilon} = \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[\gamma a_D^{k+1-\varepsilon} + (\beta + \alpha\tau^{1-\varepsilon} - \gamma)a_X^{k+1-\varepsilon}\right] \tag{B-7}$$

Using these equilibrium conditions we can show that the mass of entrants, N_E is a constant:

$$
\begin{aligned}
f_E &= \frac{(\varepsilon-1)\theta[a_D^k f_D + a_X^k f_X]}{k a_U^k} \\
&= \frac{\rho\varepsilon\theta}{k a_U^k}\left[a_D^k \frac{1}{\varepsilon}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{P_1}+\frac{\gamma\mu_2}{P_2}\right] + a_X^k \frac{1}{\varepsilon}\left(\frac{a_X}{\rho}\right)^{1-\varepsilon}\left[\frac{\delta\mu_2}{P_2}+\frac{\tau^{1-\varepsilon}\mu_1}{P_1}\right]\right] \\
&= \frac{\rho\varepsilon\theta}{k a_U^k}\frac{1}{\varepsilon\rho^{1-\varepsilon}}\left[\frac{\mu_1}{P_1}\left[a_D^{k-\varepsilon+1}+\tau^{1-\varepsilon}a_X^{k-\varepsilon+1}\right]+\frac{\mu_2}{P_2}\left[\gamma a_D^{k+1-\varepsilon}+\delta a_X^{k+1-\varepsilon}\right]\right] \\
&= \frac{\rho\theta}{k a_U^k}\frac{1}{\rho^{1-\varepsilon}}\left[\frac{\mu_1\rho^{1-\varepsilon}a_U^k}{N_E\theta}+\frac{\mu_2\rho^{1-\varepsilon}a_U^k}{N_E\theta}\right] \\
&= \frac{\rho}{N_E k}\left[\mu_1+\mu_2\right]
\end{aligned}
$$

$$
\therefore N_E = \frac{\rho}{f_E k}\left[\mu_1+\mu_2\right]. \tag{B-8}
$$

B.2 Comparative Statics

Let variables with "hats" denote the percentage change resulting from a change in trade costs; i.e. $\hat{a}_D = \frac{1}{a_D}\frac{\partial a_D}{\partial \tau}$. Totally differentiating equations (B-3)-(B-7) yields the following comparative statics:

$$
\hat{a}_D = \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1+\frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2\right] \tag{B-9}
$$

$$
\hat{a}_X = \frac{1}{\varepsilon f_X}\left(\frac{a_X}{\rho}\right)^{1-\varepsilon}\left[\frac{\delta\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2+\frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1-\tau^{-\varepsilon}\left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}+\frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\right] \tag{B-10}
$$

$$
\hat{a}_X = \frac{-a_D^k f_D}{a_X^k f_X}\hat{a}_D \tag{B-11}
$$

$$
\hat{\mathcal{P}}_1 = \left[\frac{\left[a_D^{k+1-\varepsilon}\hat{a}_D+\tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right]k+\theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[a_D^{k+1-\varepsilon}+\tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right]}\right] \tag{B-12}
$$

$$
\hat{\mathcal{P}}_2 = \left[\frac{\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D+\delta a_X^{k+1-\varepsilon}\hat{a}_X\right]k+\theta(1-\varepsilon)\alpha\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[\gamma a_D^{k+1-\varepsilon}+\delta a_X^{k+1-\varepsilon}\right]}\right]. \tag{B-13}
$$

These are not closed form solutions. We break each comparative static into a separate proposition and proof.

Proposition B1. *The following relationship holds:*

$$\frac{1}{a_D}\frac{\partial a_D}{\partial \tau} = \hat{a}_D > 0. \tag{B-14}$$

Proof. Writing out $\hat{a}_D$ explicitly yields:

$$\begin{aligned}
\hat{a}_D &= \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1 + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2\right] \\
&= \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left\{\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\left[\frac{\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[a_D^{k+1-\varepsilon} + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right]}\right]\right. \\
&\qquad \left. + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\left[\frac{\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D + \delta a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\alpha\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[\gamma a_D^{k+1-\varepsilon} + \delta a_X^{k+1-\varepsilon}\right]}\right]\right\} \\
&= \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\left\{\left[\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2} + \frac{\alpha\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\right]\frac{N_E\theta}{\rho^{1-\varepsilon}a_U^k}\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right. \\
&\qquad \left. - \left(\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2}\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right] + \frac{\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D + \delta a_X^{k+1-\varepsilon}\hat{a}_X\right]\right)\frac{k}{\varepsilon\rho}\frac{N_E}{\rho^{1-\varepsilon}a_U^k}\right\} \\
&= \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\frac{N_E}{\rho^{1-\varepsilon}a_U^k}\left\{\left[\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2} + \frac{\alpha\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\right]\theta\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right. \\
&\qquad \left. - \left(\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2}\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right] + \frac{\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D + \delta a_X^{k+1-\varepsilon}\hat{a}_X\right]\right)\frac{k}{\varepsilon\rho}\right\}.
\end{aligned}$$

Using the total differential of the Free Entry conditions, (B-11), we can rewrite this as:

$$\begin{aligned}
\hat{a}_D = \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\frac{N_E}{\rho^{1-\varepsilon}a_U^k}&\left\{\left[\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2} + \frac{\alpha\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\right]\theta\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right. \\
&\left. - \left(\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2}\left[\frac{a_D^{1-\varepsilon}}{f_D} - \frac{\tau^{1-\varepsilon}a_X^{1-\varepsilon}}{f_X}\right]f_D a_D^k + \frac{\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\left[\frac{\gamma a_D^{1-\varepsilon}}{f_D} - \frac{\delta a_X^{1-\varepsilon}}{f_X}\right]f_D a_D^k\right)\frac{k\hat{a}_D}{\varepsilon\rho}\right\}.
\end{aligned}$$

Using the equilibrium conditions (B-3) and (B-4), it can be shown that

$$\frac{a_D^{1-\varepsilon}}{f_D} - \frac{\tau^{1-\varepsilon}a_X^{1-\varepsilon}}{f_X} = \frac{\varepsilon\rho^{1-\varepsilon}\mathcal{P}_2^{1-\varepsilon}\mathcal{P}_1^{2(1-\varepsilon)}\mu_2(\delta - \gamma\tau^{1-\varepsilon})}{\left[\mathcal{P}_2^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\gamma\mu_2\right]\left[\mathcal{P}_2^{1-\varepsilon}\tau^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\delta\mu_2\right]}, \tag{B-15}$$

$$\frac{\gamma a_D^{1-\varepsilon}}{f_D} - \frac{\delta a_X^{1-\varepsilon}}{f_X} = \frac{\varepsilon\rho^{1-\varepsilon}\mathcal{P}_1^{1-\varepsilon}\mathcal{P}_2^{2(1-\varepsilon)}\mu_1(\gamma\tau^{1-\varepsilon} - \delta)}{\left[\mathcal{P}_2^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\gamma\mu_2\right]\left[\mathcal{P}_2^{1-\varepsilon}\tau^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\delta\mu_2\right]}. \tag{B-16}$$

Let

$$\Gamma \equiv \left[\mathcal{P}_2^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\gamma\mu_2\right]\left[\mathcal{P}_2^{1-\varepsilon}\tau^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\delta\mu_2\right],$$

then

$$\begin{aligned}\hat{a}_D = \frac{1}{\varepsilon f_D}\left(\frac{a_D}{\rho}\right)^{1-\varepsilon}\frac{N_E}{\rho^{1-\varepsilon}a_U^k}\Bigg\{&\left[\frac{\mu_1}{\left(\mathcal{P}_1^{1-\varepsilon}\right)^2} + \frac{\alpha\gamma\mu_2}{\left(\mathcal{P}_2^{1-\varepsilon}\right)^2}\right]\theta\tau^{-\varepsilon}a_X^{k+1-\varepsilon} \\ &- \underbrace{\left[\mathcal{P}_2^{1-\varepsilon}(\delta-\gamma\tau^{1-\varepsilon}) + \gamma\mathcal{P}_1^{1-\varepsilon}(\gamma\tau^{1-\varepsilon}-\delta)\right]}\frac{\mu_1\mu_2 k f_D a_D^k}{\Gamma\rho^\varepsilon}\hat{a}_D\Bigg\}.\end{aligned}$$

For $\hat{a}_D$ to be greater than zero, it is sufficient to show that the underbraced term is positive. The underbraced term is equal to

$$\begin{aligned}&= \mathcal{P}_2^{1-\varepsilon}(\delta-\gamma\tau^{1-\varepsilon}) + \gamma\mathcal{P}_1^{1-\varepsilon}(\gamma\tau^{1-\varepsilon}-\delta) \\ &= \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[\delta^2 - 2\tau^{1-\varepsilon}\delta\gamma + (\gamma\tau^{1-\varepsilon})^2\right]a_X^{k+1-\varepsilon} \\ &= \frac{N_E}{\rho^{1-\varepsilon}}\left(\frac{\theta}{a_U^k}\right)\left[\delta - \tau^{1-\varepsilon}\gamma\right]^2 a_X^{k+1-\varepsilon} > 0.\end{aligned}$$

□

Proposition B2. *The following relationship holds:*

$$\frac{1}{a_X}\frac{\partial a_X}{\partial \tau} = \hat{a}_X < 0 \tag{B-17}$$

Proof. From the Free Entry condition, as illustrated by (B-11), and from Proposition 1, we know that $\hat{a}_D > 0$. Furthermore, since $\frac{a_D^k}{a_X^k} > 0$ and $\frac{f_D}{f_X} > 0$, it must be the case that $\hat{a}_X < 0$. □

Proposition B3. *The following relationship holds:*

$$\frac{1}{\mathcal{P}_1}\frac{\partial \mathcal{P}_1}{\partial \tau} = \hat{\mathcal{P}}_1 > 0. \tag{B-18}$$

Proof. Writing out $\hat{\mathcal{P}}_1$ explicitly yields:

$$
\begin{aligned}
\hat{\mathcal{P}}_1 &= \left[\frac{\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[a_D^{k+1-\varepsilon} + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\right]}\right] \\
&= \frac{N_E}{\rho^{1-\varepsilon}a_U^k}\frac{1}{(1-\varepsilon)\mathcal{P}_1^{1-\varepsilon}}\left[\left[a_D^{k+1-\varepsilon}\hat{a}_D + \tau^{1-\varepsilon}a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right] \\
&= \frac{N_E}{\rho^{1-\varepsilon}a_U^k}\frac{1}{(1-\varepsilon)\mathcal{P}_1^{1-\varepsilon}}\left[\left[\frac{a_D^{1-\varepsilon}}{f_D} - \frac{\tau^{1-\varepsilon}a_X^{1-\varepsilon}}{f_X}\right]f_D a_D^k k + \theta(1-\varepsilon)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right] \\
&= \frac{N_E}{\rho^{1-\varepsilon}a_U^k}\frac{-1}{(\varepsilon\rho)\mathcal{P}_1^{1-\varepsilon}}\left[\left[\frac{\varepsilon\rho^{1-\varepsilon}\mathcal{P}_2^{1-\varepsilon}\mathcal{P}_1^{2(1-\varepsilon)}\mu_2(\delta-\gamma\tau^{1-\varepsilon})}{\left[\mathcal{P}_2^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\gamma\mu_2\right]\left[\mathcal{P}_2^{1-\varepsilon}\tau^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\delta\mu_2\right]}\right]f_D a_D^k k - \theta(\varepsilon\rho)\tau^{-\varepsilon}a_X^{k+1-\varepsilon}\right] \\
&= \frac{N_E}{\rho^{1-\varepsilon}a_U^k}\left[\left[\frac{\rho^{-\varepsilon}\mathcal{P}_2^{1-\varepsilon}\mathcal{P}_1^{1-\varepsilon}\mu_2\overbrace{(\gamma\tau^{1-\varepsilon}-\delta)}}{\left[\mathcal{P}_2^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\gamma\mu_2\right]\left[\mathcal{P}_2^{1-\varepsilon}\tau^{1-\varepsilon}\mu_1 + \mathcal{P}_1^{1-\varepsilon}\delta\mu_2\right]}\right]f_D a_D^k k + \frac{\theta\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\mathcal{P}_1^{1-\varepsilon}}\right].
\end{aligned}
$$

By the assumption $\alpha \leq \beta \leq \gamma$, it follows that $\gamma\tau^{1-\varepsilon} > \delta$ (the overbraced term in the last line) and thus $\hat{\mathcal{P}}_1 > 0$. Note that if $\alpha = \beta = \gamma$, then this price index expression would collapse to:

$$
\hat{\mathcal{P}}_1 = \frac{\theta N_X}{\tau}\left(\frac{\tau a_X}{\rho\mathcal{P}_1}\right)^{1-\varepsilon}.
$$

□

Proposition B4. *The term $\hat{\mathcal{P}}_2$ has an ambiguous sign.*

Proof. Writing out $\hat{\mathcal{P}}_2$ explicitly yields:

$$
\hat{\mathcal{P}}_2 = \left[\frac{\left[\gamma a_D^{k+1-\varepsilon}\hat{a}_D + \left(\beta + \tau^{1-\varepsilon}\alpha - \gamma\right)a_X^{k+1-\varepsilon}\hat{a}_X\right]k + \theta(1-\varepsilon)\alpha\tau^{-\varepsilon}a_X^{k+1-\varepsilon}}{\theta(1-\varepsilon)\left[\gamma a_D^{k+1-\varepsilon} + \left(\beta + \tau^{1-\varepsilon}\alpha - \gamma\right)a_X^{k+1-\varepsilon}\right]}\right].
$$

Now, we look at the extreme values for our parameters, α, β, and γ. First, suppose that, when abroad, the agent puts zero weight on products she could consume back home and thus only wants to consume goods *only* available in the foreign country; i.e. $\alpha = \beta = 0$, and $\gamma > 0$. Under this scenario, we have:

$$
\hat{\mathcal{P}}_2 = \frac{\left[a_D^{k+1-\varepsilon}\hat{a}_D - a_X^{k+1-\varepsilon}\hat{a}_X\right]k}{\theta(1-\varepsilon)\left[a_D^{k+1-\varepsilon} - a_X^{k+1-\varepsilon}\right]} < 0. \tag{B-19}
$$

This inequality follows from the fact that $\varepsilon > 1$, $\hat{a}_X < 0$, and $0 < a_X < a_D$.

Next, we take the other extreme where the agent puts zero weight on goods *not* available at home; i.e. $\gamma = 0$ and $\beta > 0$ and $\alpha > 0$. Under this scenario, we have:

$$\hat{\mathcal{P}}_2 = \frac{k\hat{a}_X}{\theta(1-\varepsilon)} + \frac{\alpha}{\tau^{\varepsilon}\left[\beta + \tau^{1-\varepsilon}\alpha\right]} > 0. \tag{B-20}$$

This inequality follows from the fact that $\varepsilon > 1$, and $\hat{a}_X < 0$. $\square$

C Welfare

The indirect utility function for the representative consumer is

$$V = \mu_1 \ln\left(\frac{\mu_1}{\mathcal{P}_1}\right) + \mu_2 \ln\left(\frac{\mu_2}{\mathcal{P}_2}\right) + \Phi(a_D, a_D^*) + I - \mu_1 - \mu_2 \tag{C-1}$$

with $I = L + N_D\bar{\pi}_D + N_X\bar{\pi}_X$, where $\bar{\pi}$ is average profit. By free entry, average profit is zero. Differentiating with respect to τ yields:

$$\frac{\partial V}{\partial \tau} = -\mu_1\hat{\mathcal{P}}_1 - \mu_2\hat{\mathcal{P}}_2 + 2\Phi'(a_D, a_D^*)\frac{\partial a_D}{\partial \tau}. \tag{C-2}$$

From the free entry condition $a_X^k\hat{a}_X f_X = -a_D^k\hat{a}_D f_D$ and the definition of the price indices, it can be shown that

$$\begin{aligned}
a_X^{k+1-\varepsilon}\left[\frac{\delta\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2 + \frac{\tau^{1-\varepsilon}\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1 - \tau^{-\varepsilon}\left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\right] &= -a_D^{k+1-\varepsilon}\left[\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}}\hat{\mathcal{P}}_1 + \frac{\gamma\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\hat{\mathcal{P}}_2\right] \\
\left[\frac{\rho^{1-\varepsilon}a_U^k}{\theta N_E}\right]\left[\mu_2\hat{\mathcal{P}}_2 + \mu_1\hat{\mathcal{P}}_1\right] &= \left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\frac{a_X^{k+1-\varepsilon}}{\tau^{\varepsilon}} \\
\mu_1\hat{\mathcal{P}}_1 + \mu_2\hat{\mathcal{P}}_2 &= \left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\frac{\theta N_X}{\tau}\left(\frac{\tau a_X}{\rho}\right)^{1-\varepsilon}.
\end{aligned}$$

Plugging this into the derivative of our welfare function, equation (C-2), yields:

$$\frac{\partial V}{\partial \tau} = -\left(\frac{\mu_1}{\mathcal{P}_1^{1-\varepsilon}} + \frac{\alpha\mu_2}{\mathcal{P}_2^{1-\varepsilon}}\right)\frac{\theta N_X}{\tau}\left(\frac{\tau a_X}{\rho}\right)^{1-\varepsilon} + 2\Phi'(a_D, a_D^*)\frac{\partial a_D}{\partial \tau}. \tag{C-3}$$

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