Advanced Macroeconomics

Trade with heterogeneous firms

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Export participation

Table 2

Exporting By U.S. Manufacturing Firms, 2002

NAICS industry	*Percent of firms*	*Percent of firms that export*	*Mean exports as a percent of total shipments*
311 Food Manufacturing	6.8	12	15
312 Beverage and Tobacco Product	0.7	23	7
313 Textile Mills	1.0	25	13
314 Textile Product Mills	1.9	12	12
315 Apparel Manufacturing	3.2	8	14
316 Leather and Allied Product	0.4	24	13
321 Wood Product Manufacturing	5.5	8	19
322 Paper Manufacturing	1.4	24	9
323 Printing and Related Support	11.9	5	14
324 Petroleum and Coal Products	0.4	18	12
325 Chemical Manufacturing	3.1	36	14
326 Plastics and Rubber Products	4.4	28	10
327 Nonmetallic Mineral Product	4.0	9	12
331 Primary Metal Manufacturing	1.5	30	10
332 Fabricated Metal Product	19.9	14	12
333 Machinery Manufacturing	9.0	33	16
334 Computer and Electronic Product	4.5	38	21
335 Electrical Equipment, Appliance	1.7	38	13
336 Transportation Equipment	3.4	28	13
337 Furniture and Related Product	6.4	7	10
339 Miscellaneous Manufacturing	9.1	2	15
Aggregate manufacturing	**100**	**18**	**14**

Notes: 2002 U.S. Census of Manufactures.
Source: Bernard, Jensen, Redding, and Schott (2007)

Labor productivity, by export status

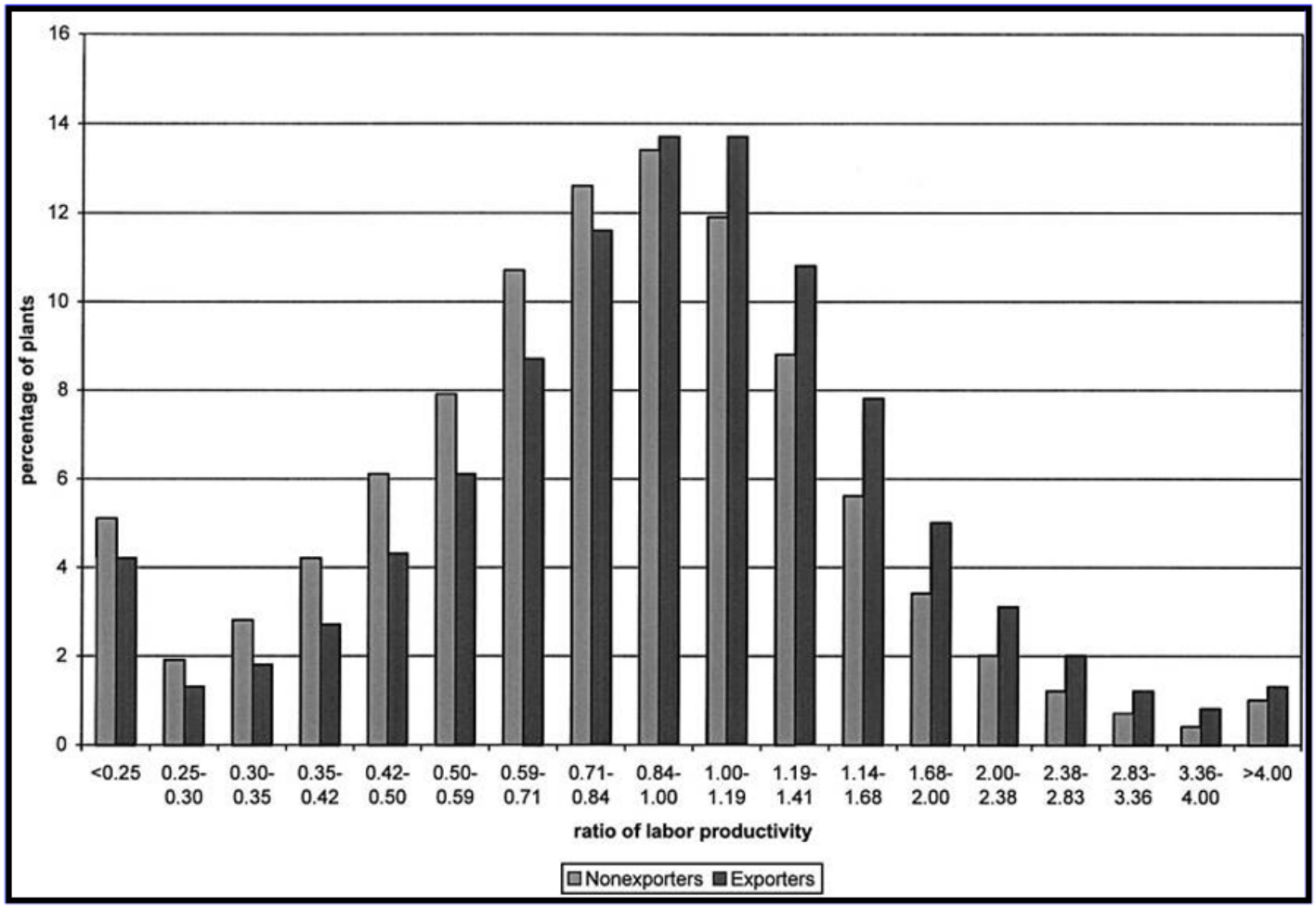


FIGURE 2B. RATIO OF PLANT LABOR PRODUCTIVITY TO 4-DIGIT INDUSTRY MEAN

Notes: Labor productivity = value added x worker
Data: 1992 U.S. Census of Manufactures
Source: Bernard, Eaton, Jensen and Kortum (2003)

Within-industry productivity dispersion

TABLE 2—PLANT-LEVEL PRODUCTIVITY FACTS

Productivity measure (value added per worker)	Variability (standard deviation of log productivity)	Advantage of exporters (exporter less nonexporter average log productivity, percent)
Unconditional	0.75	33
Within 4-digit industries	0.66	15
Within capital-intensity bins	0.67	20
Within production labor-share bins	0.73	25
Within industries (capital bins)	0.60	9
Within industries (production labor bins)	0.64	11

Notes: The statistics are calculated from all plants in the 1992 Census of Manufactures. The "within" measures subtract the mean value of log productivity for each category. There are 450 4-digit industries, 500 capital-intensity bins (based on total assets per worker), 500 production labor-share bins (based on payments to production workers as a share of total labor cost). When appearing within industries there are 10 capital-intensity bins or 10 production labor-share bins.

Notes: 1992 U.S. Census of Manufactures.
Source: Bernard, Eaton, Jensen and Kortum (2003)

Table 3

Exporter Premia in U.S. Manufacturing, 2002

	Exporter premia		
	(1)	*(2)*	*(3)*
Log employment	1.19	0.97	
Log shipments	1.48	1.08	0.08
Log value-added per worker	0.26	0.11	0.10
Log TFP	0.02	0.03	0.05
Log wage	0.17	0.06	0.06
Log capital per worker	0.32	0.12	0.04
Log skill per worker	0.19	0.11	0.19
Additional covariates	None	Industry fixed effects	Industry fixed effects, log employment

Notes: 2002 U.S. Census of Manufactures.
Source: Bernard, Jensen, Redding, and Schott (2007)

Trade costs

Table 1
Ad valorem trade costs by two-digit SIC industry and year

Two-digit SIC industry	Tariff rate (d_{it}) (%)			Freight rate (f_{it}) (%)			Total rate ($d_{it}+f_{it}$) (%)		
	1982	1987	1992	1982	1987	1992	1982	1987	1992
20 Food	5.7	5.1	4.4	10.2	9.7	8.9	15.9	14.8	13.4
21 Tobacco	10.4	14.1	16.7	5.9	5.2	2.9	16.3	19.3	19.5
22 Textile	17.0	13.2	11.2	6.0	6.4	5.4	23.1	19.6	16.6
23 Apparel	23.3	20.7	16.9	8.6	7.6	6.3	31.8	28.3	23.2
24 Lumber	3.2	2.3	1.7	11.1	6.5	7.5	14.2	8.8	9.2
25 Furniture	5.9	4.1	4.1	9.4	8.6	8.5	15.3	12.8	12.6
26 Paper	0.9	0.8	0.6	3.9	3.1	4.4	4.7	4.0	4.9
27 Printing	1.7	1.2	1.1	5.9	5.5	5.1	7.5	6.6	6.2
28 Chemicals	3.8	4.3	4.4	6.4	4.8	4.5	10.1	9.1	9.0
29 Petroleum	0.4	0.5	0.9	5.2	5.1	8.3	5.6	5.5	9.3
30 Rubber	7.4	7.9	11.3	7.5	6.8	6.9	14.9	14.7	18.2
31 Leather	9.0	10.7	11.2	8.3	7.2	5.5	17.3	17.8	16.7
32 Stone	8.9	6.4	6.5	12.0	11.1	9.6	20.9	17.5	16.1
33 Primary metal	4.6	3.8	3.4	6.9	6.3	6.0	11.5	10.1	9.4
34 Fabricated metal	6.6	5.1	4.3	6.8	5.9	5.0	13.4	11.0	9.3
35 Industrial machinery	4.2	3.9	2.4	4.0	4.0	2.9	8.2	7.9	5.3
36 Electronic	5.0	4.6	3.3	3.4	3.1	2.4	8.3	7.6	5.6
37 Transportation	1.9	1.6	2.3	4.5	2.5	3.1	6.4	4.1	5.4
38 Instruments	6.8	5.2	4.3	2.7	2.8	2.5	9.5	8.0	6.8
39 Miscellaneous	9.6	5.7	5.2	5.0	4.9	3.6	14.6	10.6	8.8
Average	4.8	4.4	4.2	5.6	4.4	4.1	10.4	8.8	8.3

Notes: 2002 U.S. Census of Manufactures.
Source: Bernard, Jensen, and Schott (2006)

Trade costs and export participation

- Firm-level regression of export participation, 1^x_{jt}, on past change in industry trade costs C_{it-5}

$$1^x_{it} = \phi(\alpha + \beta \mathrm{C}_{it-5} + \delta_i + \delta_t)$$

with industry- and time-fixed effects, δ_i and δ_t

Table 4
Probability of entering the export market, 1987–1997

Regressor	Logit export next	Logit export next	Logit export next
Change in trade cost	−8.933*	−8.621*	−8.223*
	(5.018)	(5.033)	(4.947)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	124,019	124,019	124,019
Log likelihood	−41,874	−41,846	−39,309

Notes: Plant-level logistic regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable indicates whether a non-exporting plant in 1987 becomes an exporter between the 1987 and 1992 Censuses. First regressor is the change in total trade costs between years $t-5$ and t. Regressions cover two panels: 1982–1987 and 1987–1992. Coefficients for the regression constant and dummy variables are suppressed.

Source: Bernard, Jensen, and Schott (2006)

- Industry-level regression of changes in productivity TFP_{it} on past change in industry trade costs C_{it-5}

$$\Delta\text{TFP}_{it} = \alpha + \beta\text{C}_{it-5} + \delta_i + \delta_t + \epsilon_{it}$$

with industry- and time-fixed effects, δ_i and δ_t

Table 2
Industry productive growth, 1982–1997

Regressor	Change in TFP	Change in TFP
Change in trade cost	−0.152*	−0.190*
	(0.079)	(0.104)
Year fixed effects	Yes	Yes
Industry fixed effects	No	Yes
Observations	1,153	1,153
R^2	0.00	0.02

Notes: Industry-level OLS regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable is the average annualized change in Bartelsman et al. (2000) five-factor total factor productivity from years $t+1$ to $t+5$. Regressor is the change in total trade costs between years $t-5$ and t. Regressions cover 1972–1996. Coefficients for the regression constant and dummy variables are suppressed.

Source: Bernard, Jensen, and Schott (2006)

- Firm-level regression of firm$-j$ exit 1^o_{jt} on past change in industry trade costs C_{it-5}

$$1^o_{jt} = \phi(\alpha + \beta \mathrm{C}_{it-5} + \delta_i + \delta_t)$$

with industry- and time-fixed effects, δ_i and δ_t

Table 3
Probability of death, 1987–1997

Regressor	Logit plant death	Logit plant death	Logit plant death
Change in trade cost	−5.664*	−6.388**	−6.669**
	(3.148)	(2.782)	(2.937)
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	210,664	210,664	210,664
Log likelihood	−115,329	−109,734	−109,713

Notes: Plant-level logistic regression results. Robust standard errors adjusted for clustering at the four-digit SIC level are in parentheses. Industry fixed effects are for two-digit SICs. Dependent variable indicates plant death between years t and $t+5$. First regressor is the change in total trade costs between years $t-5$ and t. Regressions cover two panels: 1982–1987 and 1987–1992. Coefficients for the regression constant and dummy variables are suppressed.

Source: Bernard, Jensen, and Schott (2006)

- Within-industry firm heterogeneity in productivity
- Exporting is relatively rare
  - of the 6 millions firms operating in the US in 2000, only 4 percent were exporters
- Exporters are larger, more productive, more capital and labor intensive
  - differences exist even before exporting begins
- Reduction in trade costs reforms leads to intra-industry reallocation of firms
- Trade liberalization episodes are followed by aggregate productivity growth driven by
  - contraction and exit of low-productivity firms
  - expansion and entry into export markets of high productivity firms

- Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. econometrica, 71(6), 1695-1725.
  - Build a model to with
    - firm-level heterogeneity
    - fixed cost of exporting
  - Two main building blocks:
    - Krugman (1980): CES, IRS technology, monopolistic competition
    - Hopenhayn (1992): equilibrium model of entry and exit
  - Explain evidence on export participation, trade-induced reallocation and productivity growth

- Discrete time
- Representative household with CES preferences over differentiated varieties ω
- Heterogeneous firms
  - idiosyncratic productivity z
  - differentiated variety ω
- Monopolistic competition in product market
- Increasing returns to scale in aggregate production
  - fixed operating costs + constant marginal cost
- Fixed exporting costs
  - only high productivity firms can cover fixed costs of operating *and* fixed costs of exporting

- L units of labor supplies inelastically
- consumption of each variety, $c(\omega)$ chosen to

$$C = \max_{c(\omega)} \quad \left(\int_{\Omega} c(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}} \qquad \sigma > 1$$

$$\text{s.t.} \quad \int_{\Omega} c(\omega) p(\omega) d\omega \leq I$$

  where I is aggregate (nominal) income

- demand for variety ω

$$c(\omega) = \left(\frac{p(\omega)}{P} \right)^{-\sigma} \frac{I}{P} \quad \omega \in \Omega$$

  where $P = \left(\int_{\Omega} p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$

- Labor only production factor and numeraire $\implies w = 1$
- Labor requirement to produce q units of output for firm z

$$\ell(z) = f + \frac{q(z)}{z}$$

- Pricing strategy with CES demand: $p(z) = \frac{\sigma}{\sigma-1}\frac{1}{z}$
- Quantity produced: $q(z) = \left(\frac{\frac{\sigma}{\sigma-1}\frac{1}{z}}{P}\right)^{-\sigma}\frac{I}{P} = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma} IP^{\sigma-1}z^{\sigma}$
- Revenues: $r(z) = p(z)q(z) = \left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} IP^{\sigma-1}z^{\sigma-1}$
- Profits $\pi(z) = \frac{r(z)}{\sigma} - f$

- Higher physical productivity z implies higher revenue productivity

$$\frac{r(z)}{\ell(z)} = \frac{\sigma}{\sigma - 1}\left[1 - \frac{f}{\ell(z)}\right]$$

- More productive firms produce more

$$\frac{q(z_i)}{q(z_j)} = \left(\frac{z_i}{z_j}\right)^{\sigma}$$

- More productive earn higher revenues

$$\frac{r(z_i)}{r(z_j)} = \left(\frac{z_i}{z_j}\right)^{\sigma-1}$$

- All firms with same z charge same price despite variety ω

$$P = \left(\int_{\Omega} p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}} = \left(M \int_{0}^{\infty} p(z)^{1-\sigma} \mu(z) dz \right)^{\frac{1}{1-\sigma}}$$

where
  - $M = \int_{\Omega} d\omega$: equilibrium measure of firms
  - $\mu(z)$: equilibrium distribution of firm-productivity

- Price index: $P = M^{\frac{1}{1-\sigma}} \underbrace{\frac{\sigma}{\sigma - 1} \underbrace{\frac{1}{\underbrace{\left(\int_{0}^{\infty} z^{\sigma-1} \mu(z) dz \right)^{\frac{1}{\sigma-1}}}_{\tilde{z}\text{: aggregate productivity}}}}_{p(\tilde{z})}}$

$$Q = \int_\Omega q(\omega)d\omega = M^{\frac{1}{1-\sigma}} \underbrace{\left(\frac{\sigma-1}{\sigma}\right)^\sigma IP^{\sigma-1}\tilde{z}^\sigma}_{q(\tilde{z})} = M^{\frac{1}{1-\sigma}} q(\tilde{z})$$

$$R = \int_\Omega r(\omega)d\omega = M \underbrace{\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} IP^{\sigma-1}\tilde{z}^{\sigma-1}}_{r(\tilde{z})} = Mr(\tilde{z})$$

$$\Pi = \int_\Omega \pi(\omega)d\omega = M\left(\frac{r(\tilde{z})}{\sigma} - f\right)$$

- Krugman (1980) is a sub-case with a mass M of identical firms with exogenous productivity $\tilde{z}$
- However now productivity $\tilde{z}$ is endogenous
  - it depends on $\mu(z)$, which is endogenous
  - it can responds to changes in trade cost, leading to aggregate productivity changes

- There is a large pool of identical potential entrants deciding whether to become active or not
- Before operating, firms face uncertainty regarding their productivity level, z
- Upon entry, they pay a fixed cost, f_e (in units of labor), and draw their productivity level, $z \sim g(z)$, cdf $G(z)$
- After observing their productivity they decide whether to exit the market or not
- If entering, every period there is an exogenous probability of exit, δ

Exit decision (after observing z)

- The value of a firm z:

$$v(z) = \max\left\{0, \sum_{t=0}^{\infty} \delta^t \pi(z)\right\} = \max\left\{0, \frac{\pi(z)}{\delta}\right\} \quad \beta \in (0,1)$$

- Because of the fixed costs f, there exists z^* s.t. $\pi(z) = 0$, i.e.

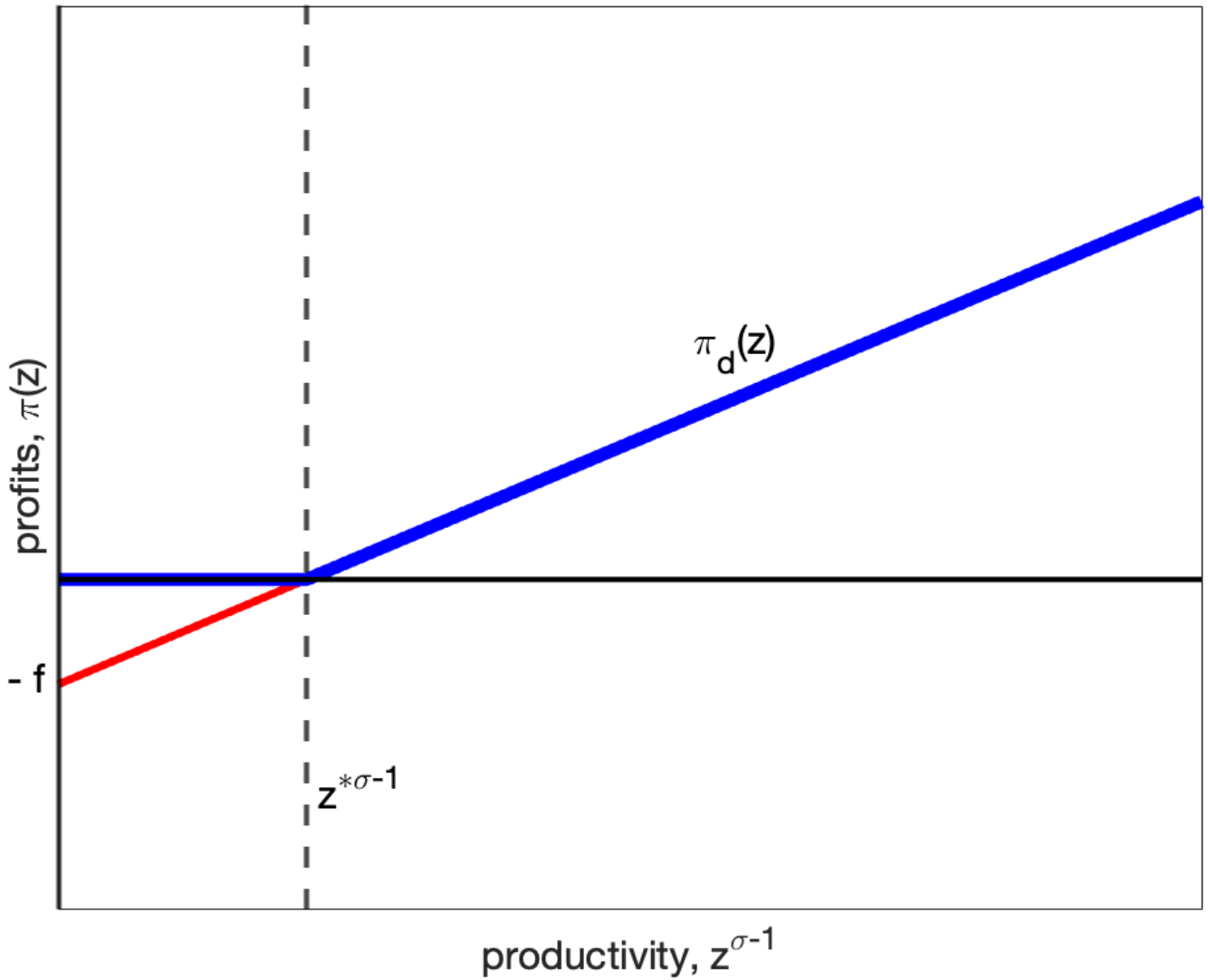
  Zero-Profit Cutoff (ZPC): $\implies \frac{r(z^*)}{\sigma} - f = 0 \implies r(z^*) = \sigma f$

- A firm below z^* will exit $\implies$ endogenous distribution of active firms over productivity $\mu(z)$ truncated at z^*

$$\mu(z) = \frac{g(z)}{1 - G(z^*)} \quad z \geq z^*$$

- Productivity index: $\tilde{z}(z^*) = \left[\frac{1}{1-G(z^*)} \int_{z^*}^{\infty} z^{\sigma-1} g(z) dz\right]^{\frac{1}{\sigma-1}}$

Productivity cutoffs



Entry decision (before observing z)

- Expected value of entry:

$$v^e = \int_0^\infty v(z)g(z)dz = \int_0^{z^*} 0g(z)dz + \int_{z^*}^\infty \pi(z)g(z)dz =$$
$$= (1 - G(z^*)) \int_{z^*}^\infty \pi(z)\mu(z)dz = (1 - G(z^*))\frac{\bar{\pi}}{\delta}$$

  - Infinite measure of potential entrants drives expected value of entry equal to cost of entry

- Free-Entry (FE): $v^e = f_e \implies \bar{\pi} = \frac{\delta f_e}{(1-G(z^*))}$
  - holding constant the f_e, if firms are less likely to survive $G(z^*) \uparrow$, they need to be compensated by higher average profits

- From ZPC and definition of aggregate profits

$$\bar{\pi} = \frac{\Pi}{M} = f\left(\frac{\tilde{z}(z^*)}{z^*} - 1\right)$$

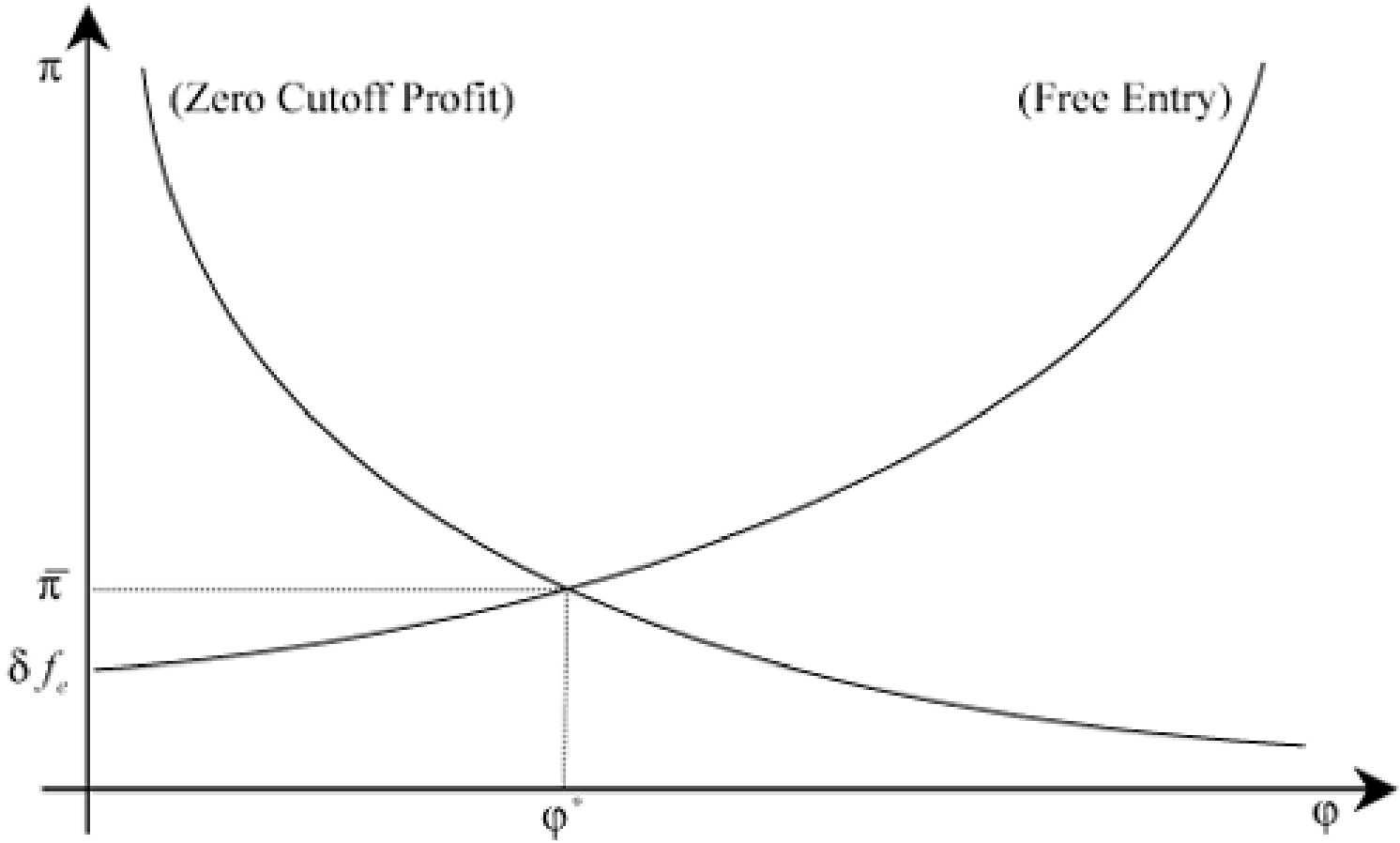


FIGURE 1.—Determination of the equilibrium cutoff φ^* and average profit $\bar{\pi}$.

- FE is upwards sloping
  - $G'(z^*) > 0$
  - the higher is the cutoff the higher the probability of exit, thus of making zero profits, then the higher must be expected profits in the case of success to make it profitable to pay the sunk entry cost
- ZCP is downward sloping *but*
  - an increase in z^* has ambiguous effect on expected profits, $\tilde{z}(z^*)$
    - it increases the productivity of surviving firms, which increases firm's expected profits
    - it increases the productivity of rivals, which reduces firm's profits
  - whether ZCP is downward sloping depends the relative effects
    - if $G()$ has a fat enough right tail the latter effect will dominate

- Stationarity condition:

$$\overbrace{(1-G(z^*))\underbrace{M_e}_{\substack{\text{new}\\ \text{entrant}}}}^{\text{successfull new entrants}} = \overbrace{\delta \underbrace{M}_{\text{incumbents}}}^{\text{exiters}}$$

  - measure of successful entrants must replace exiting firms
  - distribution $\mu(z)$ not affected by M (linear homogeneity)

- Labor market clearing:

$$\underbrace{\int_0^\infty \ell(z)\mu(z)dz}_{=R-\Pi} + \underbrace{M_e}_{\frac{\delta M}{(1-G(z^*))}} \underbrace{f_e}_{\frac{\bar{\pi}(1-G(z^*)))}{\delta}} = L \implies R = L$$

  - in equilibrium aggregate profits are zero, $\Pi = 0$

- Measure of firms:

$$M = \frac{R}{\bar{r}} = \frac{L}{\bar{r}} = \frac{L}{\sigma(\bar{\pi} + f)}$$

- Price index:

$$P = M^{\frac{1}{1-\sigma}} \frac{\sigma}{\sigma - 1} \frac{1}{\tilde{z}(z^*)} = \frac{L^{\frac{1}{1-\sigma}}}{\sigma^{\frac{1}{1-\sigma}} (\bar{\pi} + f)^{\frac{1}{1-\sigma}}} \frac{\sigma}{\sigma - 1} \frac{1}{\tilde{z}(z^*)}$$

- Income per worker (welfare) equals

$$\mathcal{W} = \frac{I}{L} = \frac{1}{P}$$

- 2 symmetric countries j
  - same labor force in each country, $L_j = L \forall j$
  - numeraire, $w_j = 1 \forall j$

- Firms choose whether to export their variety abroad
- Consumers have foreign varieties available to consume

- Trade frictions
  - variable costs of the "iceberg" form: for every $\tau \geq 1$ units shipped, only 1 unit arrives
  - fixed cost of exporting, f_x (in units of labor)

- Markets are internatioally segmented
- Domestic and foreign pricing strategy:

$$p_d(z) = \frac{\sigma}{\sigma - 1}\frac{1}{z} \qquad p_x(z) = \tau p_d(z)$$

- Country symmetry $\implies$ $I_d = I_x = I$, and $P_d = P_x = P$
- Domestic and foreign revenues:

$$r_d(z) = \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma-1} IP^{\sigma-1}z^{\sigma-1} \qquad r_x(z) = \tau^{1-\sigma} r_d(z)$$

- Total revenues: $r(z) = r_d(z) + r_x(z) = r_d(z)\left(1 + \mathbf{1}^x(z)\tau^{1-\sigma}\right)$ where $\mathbf{1}^x(z)$ is an indicator for export participation
  - any exporting firm will also produce for domestic market, but not all firms will export

Export decision (after observing z)

- Each firm's profit can be separated into
  - portions earned from domestic sales $\pi_d(z) = \frac{r_d(z)}{\sigma} - f$
  - export sales, $\pi_x(z) = \frac{r_x(z)}{\sigma} - f_x = \tau^{1-\sigma}\frac{r_d(z)}{\sigma} - f_x$,
- Total profits equal to

$$\pi(z) = \frac{r_d(z)}{\sigma} - f + \max\left\{0, \tau^{1-\sigma}\frac{r_d(z)}{\sigma} - f_x\right\}$$

- Because of fixed costs f_x, there exists z^{**} s.t. $\pi(z) = \pi_d(z)$, i.e.

$$\begin{aligned}\text{Export Cutoff (EC):} \implies & \tau^{1-\sigma}\frac{r_d(z^{**})}{\sigma} - f_x = 0 \\ \implies & r_d(z^{**}) = \sigma\tau^{\sigma-1}f_x\end{aligned}$$

- A firm with productivity below z^{**} will not export

Exit decision (after observing z)

- Recall that there also exists z^* s.t. $\pi(z) = 0$, i.e.

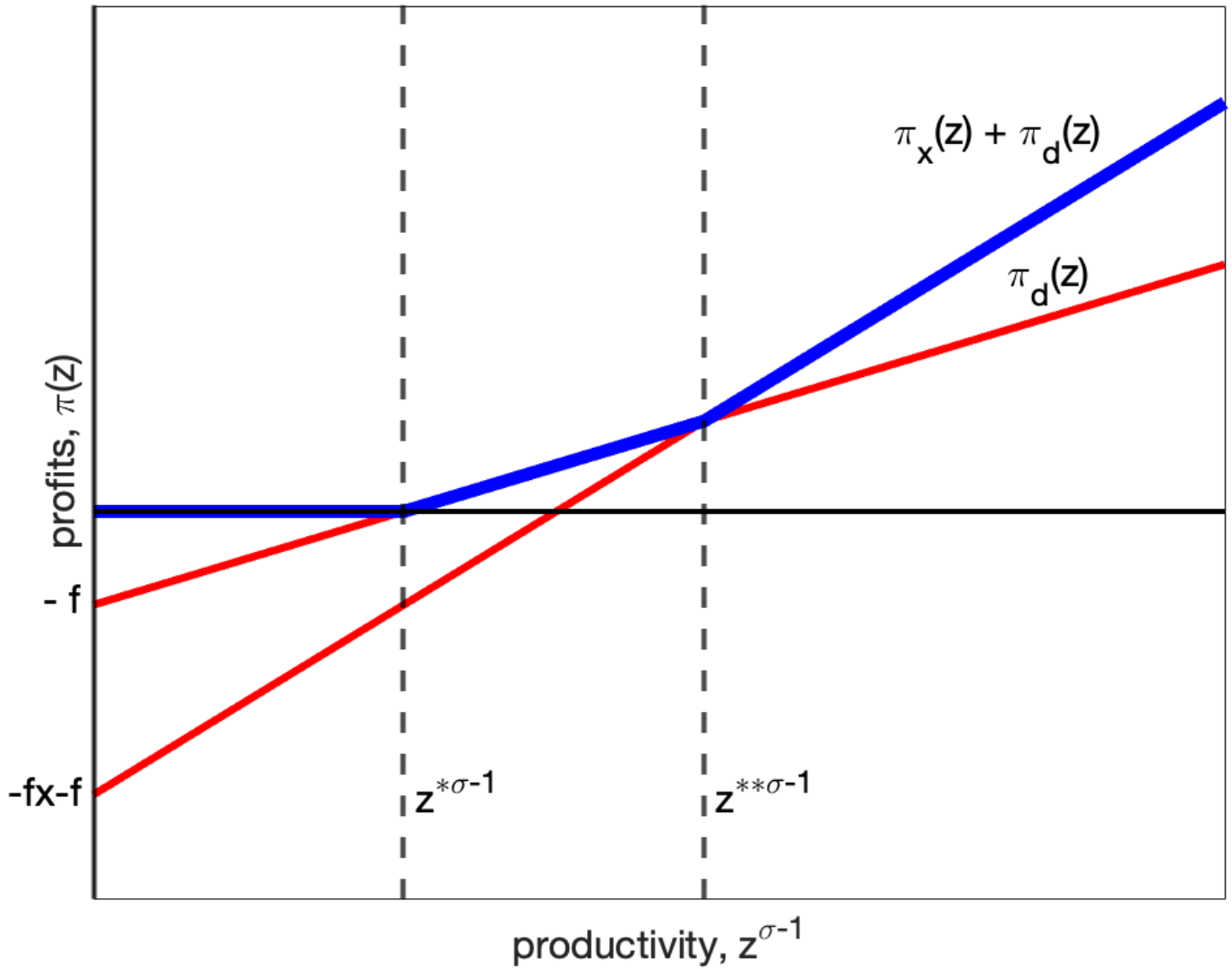
  Zero-Profit Cutoff (ZPC): $\implies \dfrac{r_d(z^*)}{\sigma} - f = 0 \implies r_d(z^*) = \sigma f$

- Taking the ratio between profits evaluated at ZPC and EC:

$$\frac{z^{**}}{z^*} = \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\sigma - 1}}$$

- Case 1 - no selection into export: $\tau^{\sigma-1} f_x = f \implies z^{**} = z^*$
  - all firms that operate also export
- Case 2 - tough selection into export: $\tau^{\sigma-1} f_x > f \implies z^{**} > z^*$
  - only the most productive firms will export

Productivity cutoffs



Entry decision (before observing z)

- Recall Free-Entry (FE): $v^e = f_e \implies \bar{\pi} = \frac{\delta f_e}{(1-G(z^*))}$
- With export participation,
  - average profits:

$$\bar{\pi} = \frac{\Pi}{M} = f\left(\frac{\tilde{z}(z^*)}{z^*} - 1\right) + f_x \underbrace{\frac{1-G(z^{**})}{1-G(z^*)}}_{\substack{\text{probability of exporting} \\ \text{conditional on entry}}} \left(\frac{\tilde{z}(z^{**})}{z^{**}} - 1\right)$$

  - average productivity across all firms:

$$\tilde{z}(z^*) = \left[\frac{1}{(1-G(z^*))}\int_{z^*}^{\infty} z^{\sigma-1}\mu(z)dz\right]^{\frac{1}{\sigma-1}}$$

  - average productivity of exporters:

$$\tilde{z}(z^*z^*) = \left[\frac{1}{(1-G(z^{**}))}\int_{z^*z^*}^{\infty} z^{\sigma-1}\mu(z)dz\right]^{\frac{1}{\sigma-1}}$$

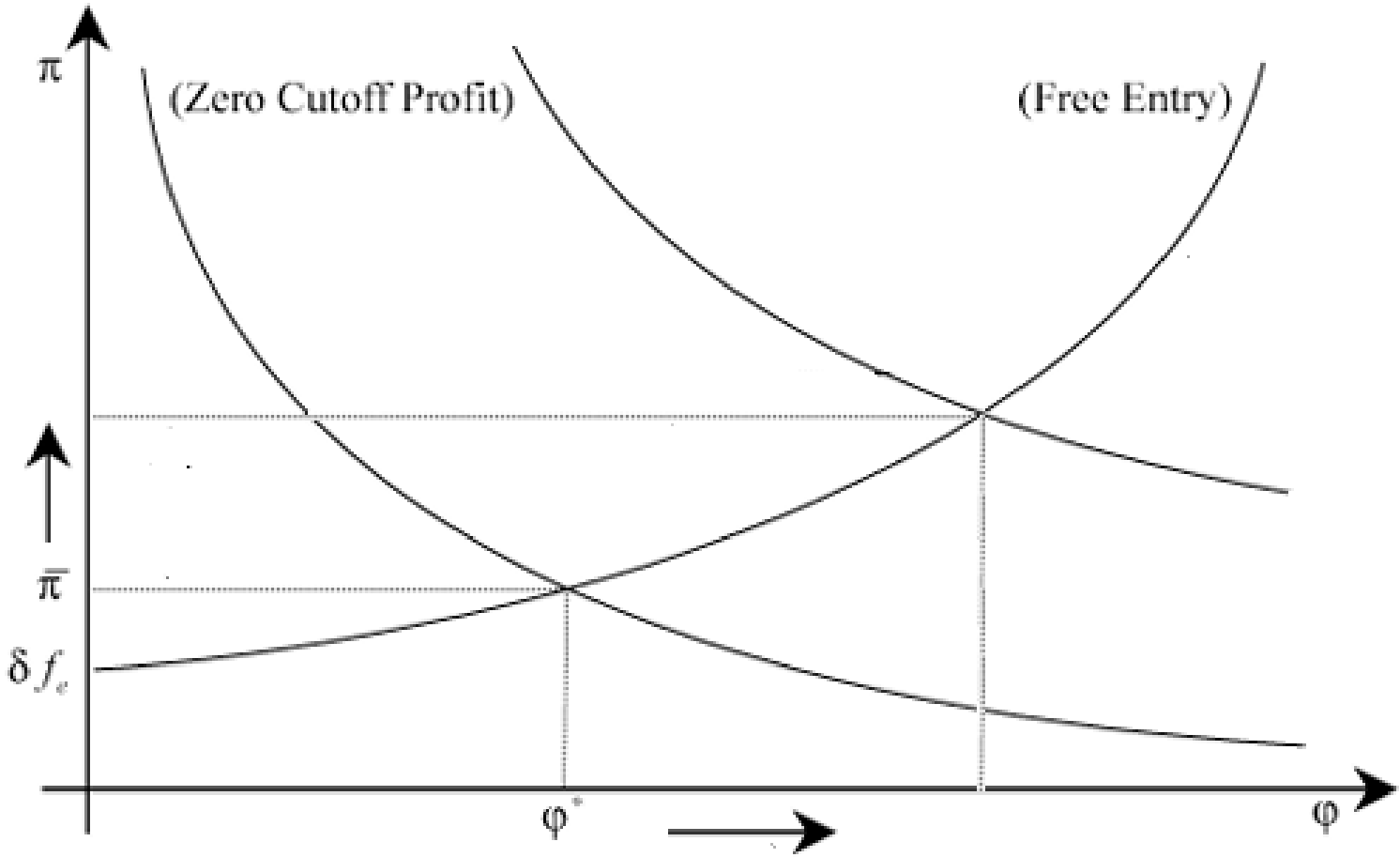


FIGURE 1.—Determination of the equilibrium cutoff φ^* and average profit $\bar{\pi}$.

- Labor market clearing $\implies R = L$
- Measure of firms in a country:

$$M = \frac{R}{\bar{r}} = \frac{L}{\sigma(\bar{\pi} + f + (1 - G(z^{**)})f_x))}$$

- Measures of varieties available in a country:

$$\underbrace{M}_{\text{domestic firms}} + \underbrace{(1 - G(z^{**}))M}_{\text{foreign firms exporting}}$$

- Price Index:

$$P = [M + (1 - G(z^{**}))M]^{\frac{1}{1-\sigma}} \frac{\sigma}{\sigma - 1} \frac{1}{\tilde{z}(z^*)}$$

- Is welfare in open economy higher?

- Open economy cutoff higher than autarky
  - higher average productivity (greater selection)
  - higher measure of available varieties
    - lower number of domestic firms operating domestically

$$M^{\text{open}} < M^{\text{aut}}$$

$$\frac{L}{\sigma(\pi^{\text{o}\bar{\text{p}}\text{en}} + f + (1 + G(z^{**}))f_x)} < \frac{L}{\sigma(\pi^{\text{aut}} + f)}$$

$$\pi^{\text{aut}} < \pi^{\text{o}\bar{\text{p}}\text{en}} + (1 - G(z^{**}))f_x$$

    - but higher number of available varieties (if f_x not too high)

$$[M^{\text{open}} + (1 - G(z^{**}))M^{\text{open}}] > M^{\text{aut}}$$

  - lower price index in both countries and higher real wages (welfare)

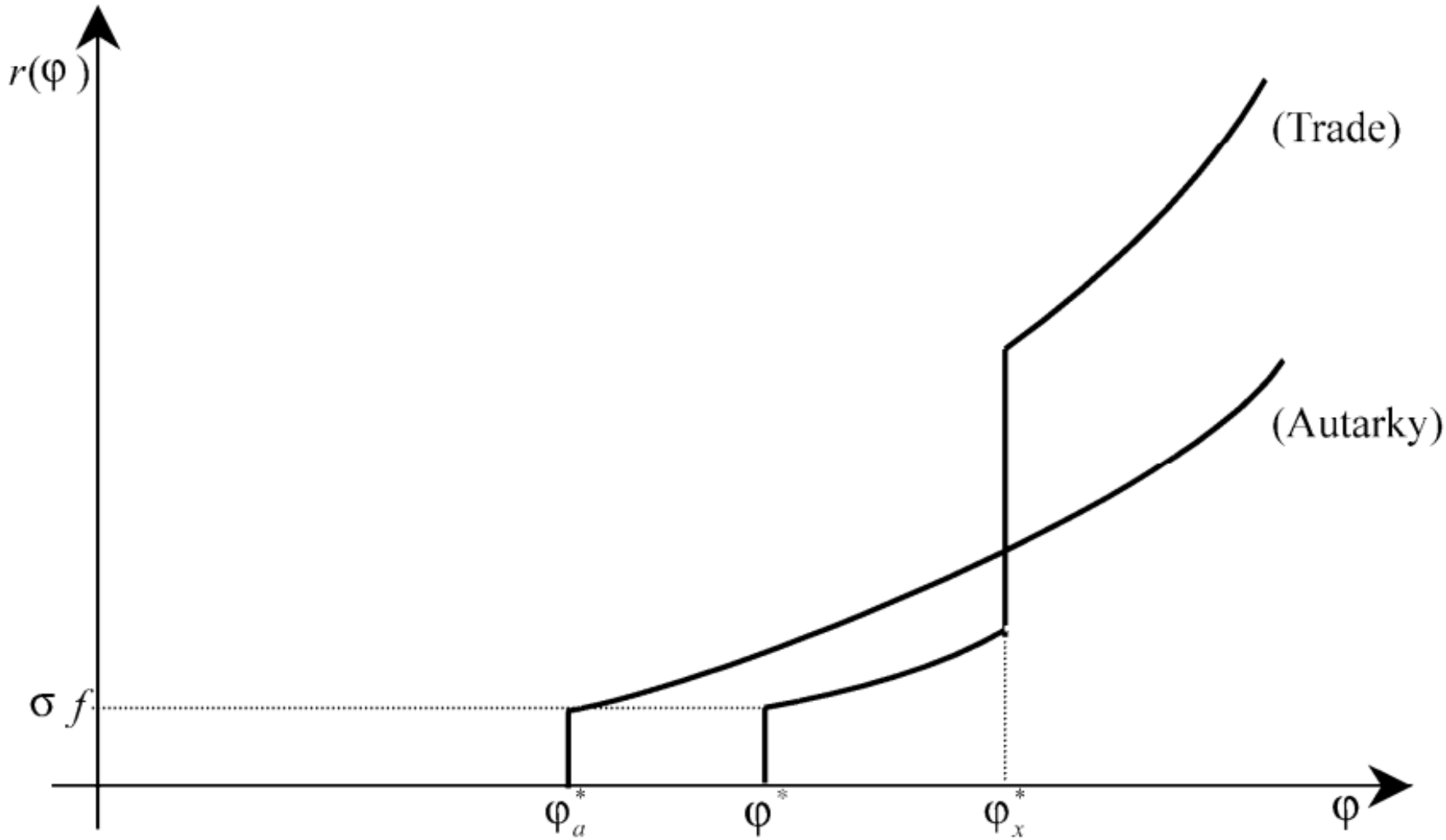


FIGURE 2.—The reallocation of market shares

- Market shares reallocates from domestic producers to exporters

$$r_d(z) \leq r(z) \leq r_d(z) + \tau^{1-\sigma} r_d(z)$$

  - First inequality true because of higher exit cutoff
  - Second inequality true because, since trade induces expected profits to increase, it must be that exporters are making higher revenues than in autarky
    - Note that while trade increases profits for the most productive firms, some exporters face a loss as their increased revenues is not enough to compensate for the fixed exporting costs

- Factor market competition
  - The option to trade increases profitability of the most productive firms that can afford the fixed exporting cost relative to the least productive firms that just serve the domestic market
  - There is entry of new firms attracted by the higher potential benefits associated with a high productivity draw
  - Both expansion of more productive firms and entry increase labor demand and the real wage, forcing the least productive firms to exit.
- Product market competition
  - There is no change in markups (CES)
  - But trade reduces the price index due to i) higher average productivity of firms serving the market and ii) higher number of firms serving each market
  - the marginal firms serving the domestic market make negative profits and exit

Taking stock

- Fixed costs of exports alters the distribution gains from trade across firms
  - most efficient firms reap benefits from trade
  - least efficient firms driven out of the industry
- Intra-industry reallocation across firms is a transmission channel of trade openness
  - productivity gains from trade without direct improvement of firm idiosyncratic productivity