Multinational production vs trade in an endogenous growth model with heterogeneous firms

Hibret Maemir Thomas Ziesemer

UNU-MERIT

UNU-MERIT 25-Years Anniversary Conference.
November 28, 2014

UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

1. Motivation
2. The Model
3. Steady State Equilibrium
4. Calibration
5. Concluding Remarks

Motivation

- Following the seminal work of Melitz (2003), a number of scholars have incorporated firm heterogeneity into trade models.
- But, static steady-state models - abstract from the long-run economic growth effect.
- Main question: Would this increase in productivity through reallocation lead to an increase in the long-run growth rate?

Motivation

- The seminal open-economy endogenous growth models - assume away firm-level differences within sector.
- More recently, models with endogenous growth with firm heterogeneity
- But, all these models focus one a single foreign market entry mode i.e. export.

This Paper

- Empirical evidence suggest instead that FDI grows faster than trade and it is an important conduit of international technology spillovers.
- This paper:
  - Constructs a model of endogenous growth with international trade and multinational production. with firm heterogeneity.
  - Endogenous international technology spillover.
  - Generates endogenous and semi-endogenous growth without *scale-effect*.

Primitives

- The setting is a symmetric two-country framework.
- Each country consists of two sectors
- Final goods produced by competitive firms according to:

$$Y_t = AL_{Yt}^{1-\alpha} \sum_{c=H,F} \int_{\Omega^c} q_t^c(\phi)^\alpha dG^c(\phi) \tag{1}$$

UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

Intermediate goods sector

- Firms engage in R&D to discover new varieties of good as in Romer (1990).
- The main departure is that firms draw their ex-post productivity from a distribution in the spirit of Melitz (2003)
- A firm needs to incur additional fixed costs to adapt to domestic and foreign market conditions: domestic (f_d), export (f_x) and set-up foreign subsidiary (f_m).
- These costs are interpreted as involving units of 'knowledge'.

$$\xi_t = \frac{L_t^v}{(1+\Theta)^\gamma N_{dt}^\gamma L_{It}^{\lambda-1}} \tag{2}$$

Productivity cutoffs

- A firm that has already sunk its start-up cost f_e will enter a particular market if the benefit of doing so exceeds the cost.
- The minimum levels of ϕ for which firms choose to sell at home, export, and produce abroad.

$$v_j(\phi) = w\xi f_j \text{ where } j = d, x, m \tag{3}$$

- Multinational cutoff

$$v_m(\phi_m^*) - w\xi f_m = v_x(\phi_m^*) - w\xi f_x$$

UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

Productivity cutoffs

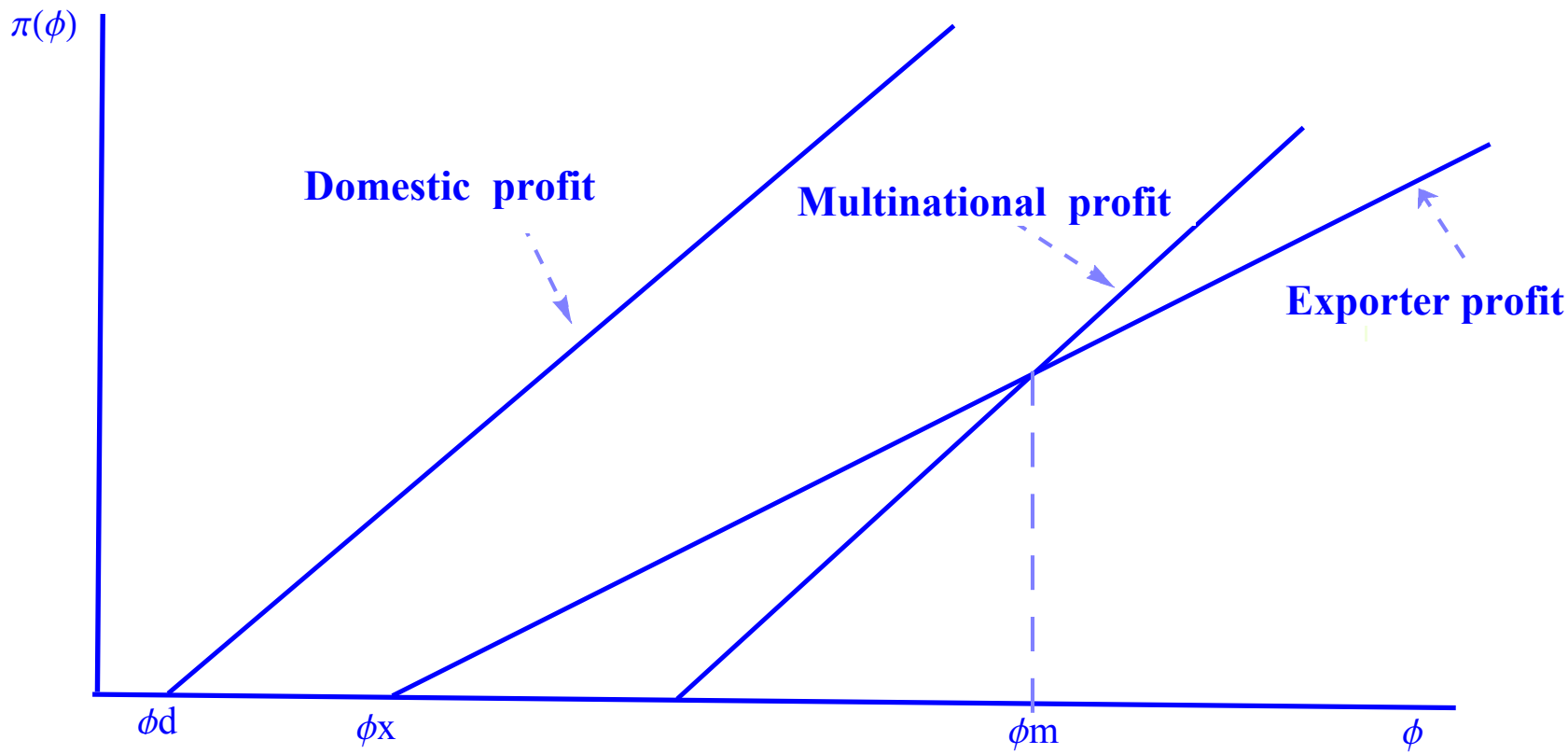


Figure : Domestic, Export and FDI cut-off

Free entry condition

- Having solved for when firms choose to sell in the domestic market, export or serve through FDI, solving the model backward- to determine the incentives to entry
- Firms are ex-ante identical - decision to create new varieties depends on the *ex-ante* expected value of entry to the expected fixed cost of entry.

$$\int_{\phi_d^*}^{\infty}(v_d(\phi)-w\xi f_d)g(\phi)d\phi+\int_{\phi_x^*}^{\phi_m}(v_x(\phi)-w\xi f_x)g(\phi)d\phi$$
$$+\int_{\phi_m^*}^{\infty}(v_m(\phi)-w\xi f_m)g(\phi)d\phi=w\xi f_e \tag{4}$$

Flow of new varieties

- The growth rate of new varieties is dictated by the free-entry condition.
- The aggregate flow of new intermediate varieties produced

$$\dot{N}_d = \frac{(1+\Theta)^{\gamma} N_d^{\gamma}}{\mathrm{F}} \frac{L_I^{\lambda}}{L^{\upsilon}} \tag{5}$$

where

$$\mathrm{F} = \frac{f_e}{1-G(\phi_d^*)} + f_d + \eta_x f_x + \eta_m f_m \tag{6}$$

$\eta_x \equiv \frac{G(\phi_m^*)-G(\phi_x^*)}{1-G(\phi_d)}$ and $\eta_m \equiv \frac{1-G(\phi_m^*)}{1-G(\phi_d^*)}$

UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

Closed form solution with Pareto distribution

- Assume firm productivity follow a Pareto distribution with CDF $G(\phi) = 1 - \left(\frac{\underline{\phi}}{\phi}\right)^k$ and the corresponding PDF $k\underline{\phi}^k \phi^{-(k+1)}$

Assumption 1

$\beta = \frac{k}{\sigma - 1} > 1$

- Solving the model yields the domestic productivity cutoff

$$\phi_d^* = \underline{\phi} \left[\frac{f_d}{f_e(\beta - 1)} \{1 + \Lambda_{\mathrm{x}} + \Lambda_{\mathrm{m}}\} \right]^{\frac{1}{k}} \tag{7}$$

where, $\Lambda_{\mathrm{x}} = h^\beta \left(\frac{f_x}{f_d}\right)^{1-\beta}$, $\Lambda_{\mathrm{m}} = \left(\frac{f_m - f_x}{f_d}\right)^{1-\beta} (1-h)^\beta$.

UNITED NATIONS UNIVERSITY UNU-MERIT

Maastricht University

Aggregate Productivity

- The aggregate productivity:

$$y = A^{\sigma}\alpha^{2(\sigma-1)}N_d\Phi(1-\mathtt{s_I}) \tag{8}$$

- Weighted average productivity

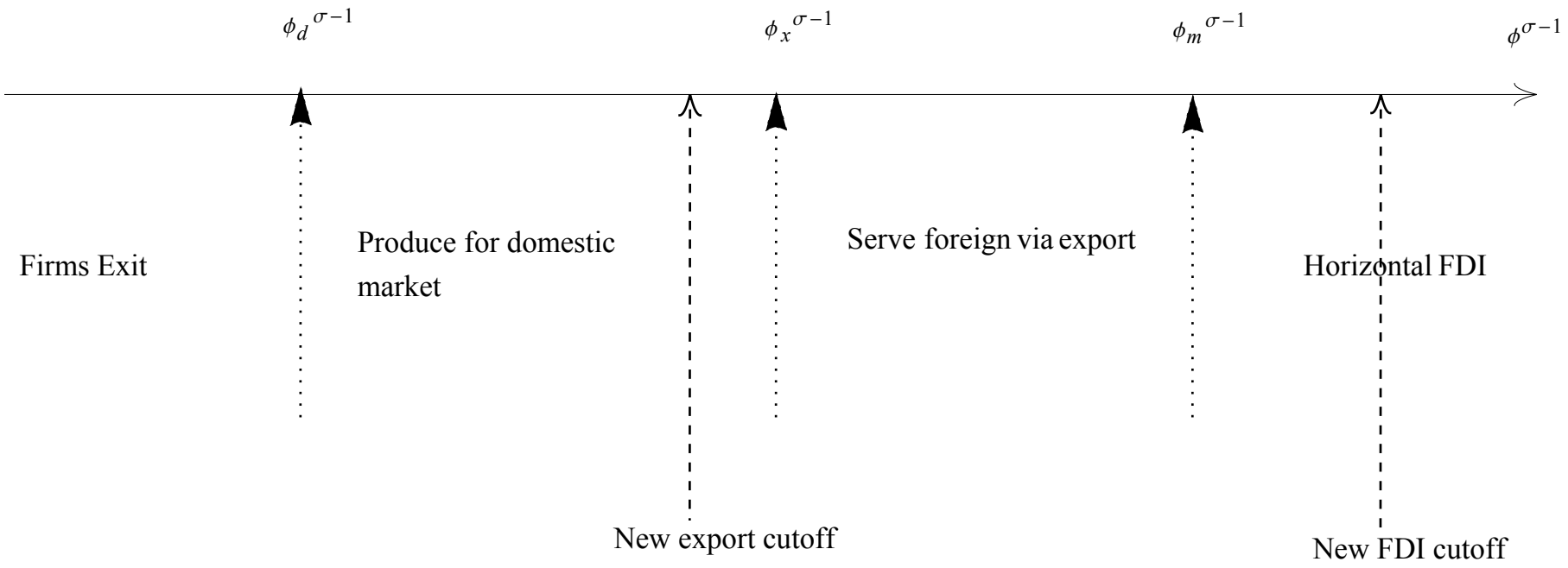
$$\Phi = \beta\frac{f_e}{f_d}\left(\frac{\phi_d^*}{\phi}\right)^k\phi_d^{*\sigma-1} \tag{9}$$

Reallocation Effect

Proposition 1

Given assumption (1): **(a)** *Freer trade* ($dh > 0$ *and/or* $df_x < 0$) *leads to a decrease in export cutoff* ($d\phi_x^* < 0$) *and increase in FDI cutoff* ($d\phi_m^* > 0$). *The domestic productivity cutoff and the weighted average productivity* Φ *increases for parameter values* $f_x/f_m < h$. *The productivity gain from trade cost reduction, however, is strictly lower than trade-only model;* **(b)** *Openness to MP in the form of reduction in* f_m *lead to an increase in export cutoff* $d\phi_x^* > 0$, *a decrease FDI cutoff* $d\phi_m^* < 0$. *This will unambiguously lead to an increase in domestic productivity cutoff* $d\phi_d^* > 0$ *and weighted average productivity* Φ.

Reallocation effect



UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

Growth Effect

- No long-run growth effects but has level effects
- The steady-state number of varieties:

$$N_d^* = \left\{ L^{\lambda - \upsilon} \frac{s_I^{*\lambda}}{g^*} \left[\frac{(1+\Theta)^\gamma}{\mathrm{F}} \right] \right\}^{\frac{1}{1-\gamma}} \tag{10}$$

- The expected fixed cost of developing a new variety:

$$\mathrm{F} = \beta f_e \left(\frac{\phi_d^*}{\phi} \right)^k \tag{11}$$

- International technology spillovers:

$$\Theta = 1 - \left(\frac{1}{(\beta - 1)\frac{\mathrm{f_e}}{\mathrm{f_d}} \left(\frac{\phi_\mathrm{d}^*}{\phi} \right)^\mathrm{k}} \right) \tag{12}$$

UNITED NATIONS UNIVERSITY
UNU-MERIT

Maastricht University

Variety Effect

Proposition 2

When the return to knowledge is weak in the spirit of Jones(1995) in which $\gamma < 1$ *and if assumption (1) is satisfied:* **(a)** *a fall in trade cost reduces the steady-state level of domestic varieties for* $f_x/f_m < h < 1$*. But the elasticity of steady-state number of varieties with respect to trade cost is lower than the trade-only model;* **(b)** *the stronger the degree of inter-temporal spillover (high* γ*) implies a larger elasticity of the steady-state number of varieties with respect to a reduction in trade costs.*

- Both F and Θ increases in response to $h(\tau^{1-\sigma})$. But the negative resource cost effect dominate the spillover effect under this specification.

Steady-state Welfare

Proposition 3

If $\gamma < 1$ in the spirit of, if Assumption (1) holds:

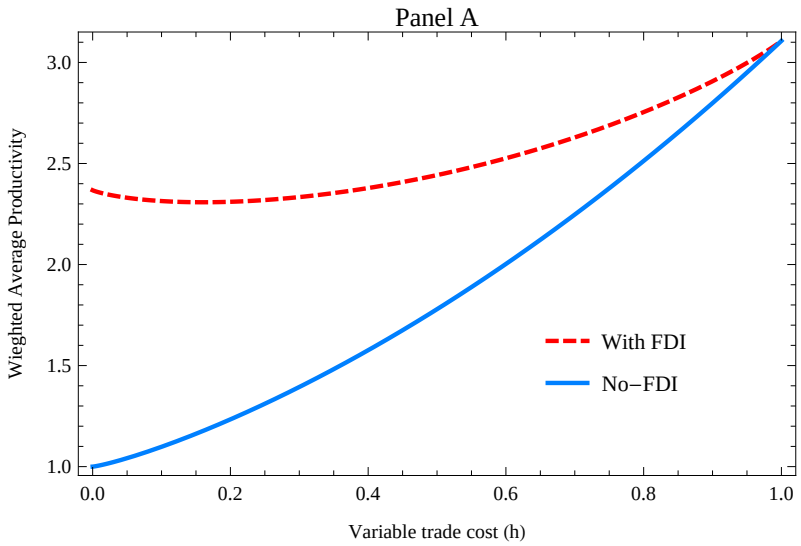
1. *Exogenous spillover - a reduction in trade cost ($\uparrow h$ and/or $\downarrow f_x$) lead to a an increase in long-run per-capita output iff $k < (\sigma - 1)\left(\frac{1}{\gamma} - 1\right)$ for $f_x/f_m < h < 1$. But in the presence of MP the elasticity of steady-state per-capita output with respect to trade cost reduction is lower.*
2. *Exogenous spillover - welfare improves with freer trade iff $\gamma < \frac{\sigma-1}{\sigma-1+k\left(1-\frac{1}{1+2\Lambda_x+2\Lambda_m}\right)} \equiv \bar{\nabla}$ for $f_x/f_m < h < 1$.*

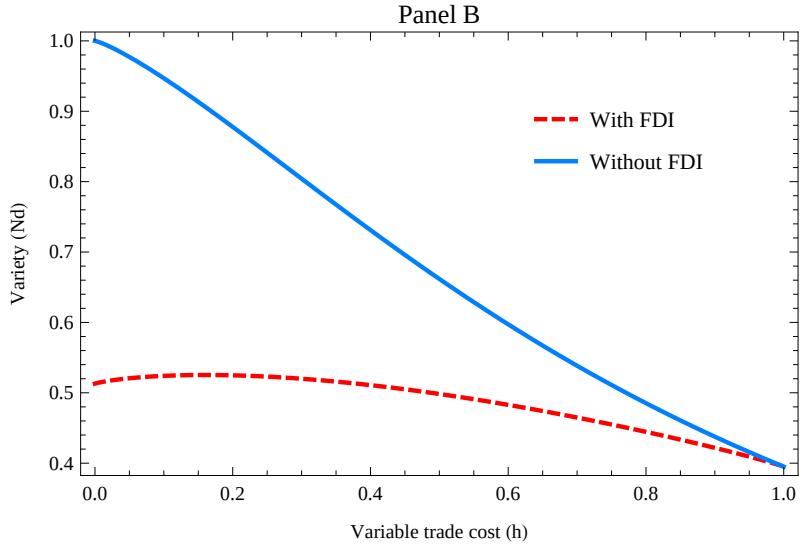
Heterogeneity and Welfare

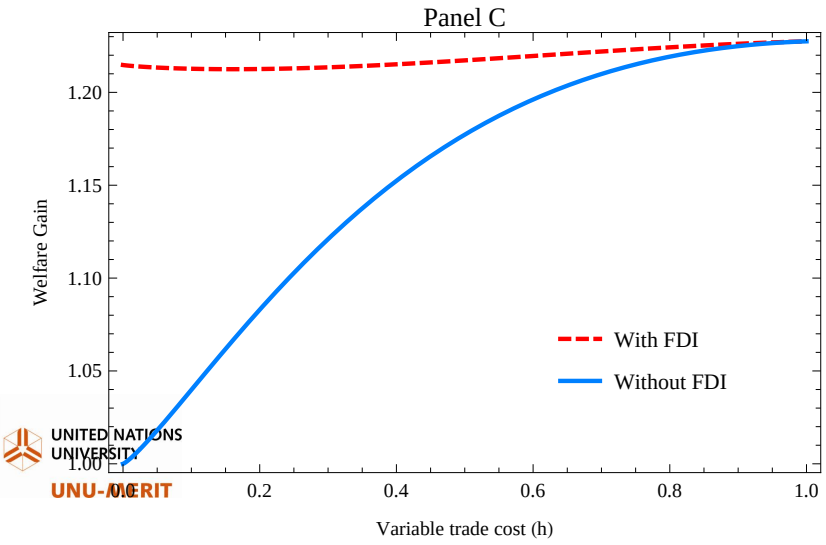
Proposition 4 (**Heterogeneity and welfare**)

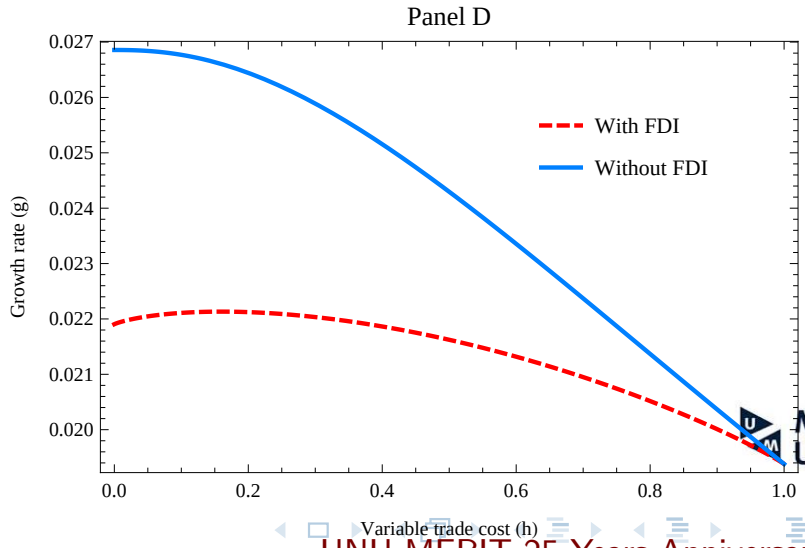
If productivity of firms in the intermediate goods sector follow a Pareto distribution with shape parameter $k > \sigma - 1$ *and assuming endogenous selection for firms into domestic and foreign markets i.e.* $\epsilon > 1$ *and* $\ell > 1$*, the greater the dispersion of firm productivity (smaller k),* **(a)** *the larger the welfare if and only if* $k < (\sigma - 1)\left(\frac{1}{\gamma} - 1\right)$*, (***b***) the larger the gains from a reduction in trade costs due to reallocation effect, (***c***) the larger the welfare loss from a reduction in variable trade costs due to variety effect.*

Calibration









Conclusion

- Implication of change in trade and FDI costs in dynamic general equilibrium mode with firm-level productivity differences.
- Trade cost change can have substantial reallocation effect, but this is partly offset by a decrease in variety.
- The aggregate welfare effects turn out to depend critically on the degree of firm heterogeneity and the magnitude of technology spillover parameters.
- For wide range of parameters - openness lead to higher welfare.