# On the Trade and Price Effects of Preferential Trade Agreements

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[WORK IN PROGRESS]

# Introduction

- The number of PTAs has grown rapidly, with countries now members of multiple PTAs
  - The number has risen from around 25 in 1970 to nearly 300 in 2010 (WTO, 2011)
  - On average WTO countries are in 13 PTAs, up from 2 in 1985 (WTO, 2011)
  - Around half of PTAs are not strictly regional (WTO, 2011)
- Discussion of the impact on trade of PTAs usually couched in terms of Viner's concept of trade creation and diversion
  - Trade creation: PTA partners can now compete with domestic producers free of trade barriers
  - Trade Diversion: PTA partners now have preferential access to the domestic market relative to third parties

# Introduction

- Most empirical studies of the PTAs-Trade relationship use some version of the gravity model
- PTA presence is usually captured by a dummy variable
  - A single PTA dummy taking the value one whenever two trade partners share a PTA
  - A number of dummies – one for each PTA – taking the value one whenever two trade partners are in a particular PTA
- The coefficient on the dummy variable gives a measure of the extent of trade creation
- Trade diversion may be captured by a separate set of dummies taking the value one if only one of the trade partners is in a particular PTA
- Now a considerable literature empirically estimating the effects of preferential trading arrangements (PTAs) on aggregate trade flows (e.g. Frankel et al, 1995 and 1996; Baier et al, 2008; Baier and Bergstrand, 2008,….)
  - PTAs are found to increase trade when a single PTA dummy is used, with recent results suggesting that trade is doubled
  - A wide variety of results are found when individual PTA dummies are used (i.e. trade creation, trade diversion, open bloc trade creation, no significant effect)
- Recently empirical studies have considered the impact of PTAs on other aspects of trade, such as trade specialisation (Martincus et al, 2009), trade structure (Egger et al, 2008; Foster et al, 2011), and the variety of trade (Foster et al, 2011)

# Introduction

- It is recognised that the dummy cannot capture all the effects of PTA membership (Fugazza and Nicita, 2010; Anderson and Yotov, 2011)
- In particular, it does not capture the effects on bilateral trade flows not covered by the PTA.
  - PTAs are formed in the expectation that there will be preferential access for exports
  - The extent of preferential access will depend on whether competitors have access through this or other PTAs
- Can we do better than this and/or can we say something on how well the dummy approach is likely to work?
- Can we use a standard model to derive the relevant effects?

# What Do We Do?

- Use a standard model to derive the effects of PTA membership on bilateral trade flows
    - general case
    - special case (not in this version)
- Infer PTA variables
- Present some preliminary estimates using the PTA variables in the general case

# Model

- “Gravity with Gravitas” (Anderson and van Wincoop, AER, 2003)
- General equilibrium model
- n+1 countries – each produces its own good – fixed real output.
- Output of country 0 treated as numeraire
- Countries have identical CES preferences

# Demand

- Value of Exports from country i to j

$$X_{ij} = \frac{[\beta_i p_i t_{ij}]^{1-\sigma}}{R_j} p_j \bar{y}_j \qquad (1)$$

where $R_j = \sum_{k=0}^{n} [\beta_k p_k t_{kj}]^{1-\sigma}$ is a price index;

$\beta_i$ is a demand parameter, $\bar{y}_j$ is real output of j

$p_j$ is the price of j's output; $t_{ij} \geq 1$ is the unit trade cost factor between i and j

# Market Clearing

- Market clearing for output i

$$p_i \bar{y}_i = \sum_{k=0}^{n} X_{ik} = [\beta_i p_i]^{1-\sigma} \sum_{k=0}^{n} t_{ik}^{1-\sigma} \frac{p_k}{R_k} \bar{y}_k \qquad (2)$$

- Anderson and van Wincoop use market clearing to solve for $[\beta_i p_i]^{1-\sigma}$

  which they then substitute in (1) to obtain the gravity equation

# Gravity Equation 1

Gravity $$X_{ij} = \frac{Y_i Y_j}{Y_W} \frac{t_{ij}^{1-\sigma}}{\Pi_i P_j}$$

where $$\Pi_i \equiv \sum_{k=0}^{n} t_{ik}^{1-\sigma} \frac{\theta_k}{P_k}$$

and $$P_j \equiv \sum_{k=0}^{n} t_{kj}^{1-\sigma} \frac{\theta_k}{\Pi_k}$$

are 'Multilateral Resistance' (MR) terms

$\theta_k$ is the share of world income of country k

$Y_i$ is the (numeraire) income of country i

# Gravity Equation 2

- Bilateral trade costs appear both directly and in MR terms
- MR terms captured in country(-time) fixed effects
- Estimate direct effects with standard variables – distance, borders, common language etc.
- PTAs reduce trade costs – dummy variable for PTA membership in gravity equation – picks up the direct effects (i.e. on $t_{ij}$)
- But what of indirect effects?
  - through $\Pi_i$ and $P_j$

# Solve for Trade Cost Effects 1

Use equations (1) and (2) to explicitly solve for the effects of changes in trade costs on bilateral trade flows.

Note: holding real outputs constant

From (1) $$\hat{X}_{ij} = -[\sigma - 1][\hat{p}_i + \hat{t}_{ij}] + \hat{p}_j - \hat{R}_j$$

where $$\hat{R}_j = -[\sigma - 1] \sum_{k=0}^{n} m_{kj} [\hat{p}_k + \hat{t}_{kj}]$$

# Solve for Trade Cost Effects 2

Substituting

$$\hat{X}_{ij} = \underbrace{-[\sigma-1]\left[\hat{t}_{ij} - \sum_{k=0}^{n} m_{kj}\hat{t}_{kj}\right]}_{direct\ effect} \underbrace{-[\sigma-1]\left[\hat{p}_i - \sum_{k=1}^{n} m_{kj}\hat{p}_k\right]}_{relative\ price\ effect} \underbrace{+\hat{p}_j}_{expenditure\ effect}$$

- where $\hat{y} = dy/y$ and $m_{ij}$ is the share of country i in j's market
- The relative price changes will also depend on the trade cost changes.
- In principle we can solve for these from the market clearing conditions

# Solve for Trade Cost Effects 3

From (2) $$\hat{p}_i = [1-\sigma]\hat{p}_i + \sum_{k=0}^{n} e_{ik}\left[[1-\sigma]\hat{t}_{ik} + \hat{p}_k - \hat{R}_k\right]$$

where $e_{ij} \equiv \frac{X_{ij}}{p_i \bar{y}_i}$ is the (export) share of country j in the output of country i.

Substituting

$$\sigma\hat{p}_i - \sum_{k=0}^{n} e_{ik}\left[\hat{p}_k + [\sigma-1]\sum_{j=1}^{n} m_{jk}\hat{p}_j\right] = -[\sigma-1]\sum_{k=0}^{n} e_{ik}\left[\hat{t}_{ik} - \sum_{j=0}^{n} m_{jk}\hat{t}_{jk}\right]$$

# Solve for Trade Cost Effects 4

Can write system of equations as

$$[D(\sigma) - S]\hat{p} = -D(\sigma - 1)[\hat{t}^{e} - E\hat{t}^{m}]$$

Which can be solved for the changes in relative prices as

$$\hat{p} = -D(\sigma - 1)[D(\sigma) - S]^{-1}[\hat{t}^{e} - E\hat{t}^{m}]$$

# PTA 1

Suppose PTA membership reduces trade costs by proportion γ – i.e. $\hat{t}_{ij} = -\gamma$ if i and j are in a PTA

We can solve for $\hat{p}_i = b_i \gamma$ from market clearing

Let $\bar{X}_{ij}$ denote the pre-PTA value of exports of i to j.

Then $$X_{ij} = \bar{X}_{ij} + dX_{ij} = \bar{X}_{ij}\left[1 + \hat{X}_{ij}\right]$$

# PTA 2

So $\ln X_{ij} \cong \ln \bar{X}_{ij} + \hat{X}_{ij}$

$$= \ln \bar{X}_{ij} + [\sigma - 1][I_{ij} - \bar{m}_j]\gamma - \left\{[\sigma - 1]\left[b_i - \sum_{k=0}^{n} m_{kj} b_k\right] - b_j\right\}\gamma$$

- where $I_{ij} = 1$ if i and j are in a PTA, = 0 otherwise
- $\bar{m}_j$ is the pre-PTA market share of countries in a PTA with j – a measure of the preferential access offered by j

# General Case 1

Equation is

$$= ln\bar{X}_{ij} + [\sigma - 1][I_{ij} - \bar{m}_j]\gamma - \left\{[\sigma - 1]\left[b_i - \sum_{k=0}^{n} m_{kj} b_k\right] - b_j\right\}\gamma$$

Direct effect $DE_{ijt} = [\sigma - 1][I_{ijt} - \bar{m}_{jt}]$

Relative price effect $RE_{ijt} = -[\sigma - 1]\left[b_{it} - \sum_{k=1}^{n} m_{kjt} b_{kt}\right]$

Expenditure effect $EE_{jt} = b_{jt}$

Combined price effects $CE_{ijt} = RE_{ijt} + EE_{jt}$

Total PTA effects $TE_{ijt} = DE_{ijt} + CE_{ijt}$

# Correlation Matrix for PTA Effects 2006

| | DE | RE | EE | TE |
|---|---|---|---|---|
| DE | 1 | | | |
| RE | -0.0079 | 1 | | |
| EE | 0.0567 | 0.6828 | 1 | |
| TE | 0.7078 | 0.6991 | 0.5577 | 1 |

# General Case 2

Estimating equation

$$lnEXP_{ijt} = \alpha_0 + \alpha_1 lnGDP_{it} + \alpha_2 lnGDP_{jt} + \alpha_3 lnPOP_{it} + \alpha_4 lnPOP_{jt} + \alpha_5 lnDIST_{ij} + \alpha_6 LANG_{ij} + \alpha_7 ADJ_{ij} + \alpha_8 LOCK_{ij} + \Gamma Z_t + \delta_{i(t)} + \omega_{j(t)} + \tau_t + \vartheta_{ij} + u_{ijt}$$

Where $Z_t$ is the vector of PTA terms

# Data

Data on (up to) 183 countries over the period 1976-2006

Trade data from COMTRADE via WITS

Other data from WDI, CEPII.

PTAs from WTO and GPTAD.

# Econometric Issues

- Recent developments in the estimation of gravity models (Baldwin and Taglioni, 2006; Helpman et al, 2008; Santos-Silva and Tenreyro, 2006)
  - Particularly in the case of time-varying panels
- Account for zero trade flows
  - Using modified Heckman procedure or poisson regression
- Inclusion of a number of fixed effects
  - Time
  - Importer and Exporter (MR)
  - Time-varying importer and exporter (MR)
  - Bilateral-pair (endogeneity)

# General Case 3

First add variable(s) to a standard gravity equation

1. Include $I_{ijt}$ and $\bar{m}_{jt}$ separately – as trade creation and trade diversion effects ; or
2. Include $I_{ijt} - \bar{m}_{jt}$ as a single PTA variable.

This includes only the direct effects – the indirect effects are to be captured by country fixed effects.

Then add other effects

# Results: PTA Dummy vs Direct Effect

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| PTA | 0.350*** | 0.441*** | 0.421*** | 0.297*** | 0.408*** | 0.245*** |
| | (0.0122) | (0.0122) | (0.0124) | (0.0188) | (0.0126) | (0.0197) |
| PTA | 0.345*** | 0.405*** | 0.423*** | 0.313*** | 0.410*** | 0.252*** |
| | (0.0124) | (0.0123) | (0.0125) | (0.0192) | (0.0126) | (0.0199) |
| $\bar{m}$ | 0.165** | 1.495*** | -0.222** | -0.303*** | -0.358* | -0.350*** |
| | (0.0644) | (0.0655) | (0.107) | (0.0764) | (0.193) | (0.135) |
| $\overline{I - \bar{m}}$ | -0.401*** | -1.747*** | -0.111 | 0.0442 | 0.00762 | 0.131 |
| | (0.0634) | (0.0647) | (0.106) | (0.0748) | (0.193) | (0.134) |
| | | | | | | |
| Fixed effects | | | | | | |
| Time | No | Yes | Yes | Yes | Yes | Yes |
| Imp/Exp | No | No | Yes | No | No | No |
| Country Pair | No | No | No | Yes | No | Yes |
| Imp -Time<br>Exp -Time | No | No | No | No | Yes | Yes |

# PTA Effects Separately

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DE | 0.0496*** | 0.0550*** | 0.0603*** | 0.0448*** | 0.0585*** | 0.0360*** |
| | (0.00178) | (0.00177) | (0.00179) | (0.00274) | (0.00181) | (0.00284) |
| RE | -0.0134*** | -0.0128*** | -0.00301 | 0.00763*** | -0.0186*** | -0.00772*** |
| | (0.00212) | (0.00210) | (0.00273) | (0.00188) | (0.00403) | (0.00273) |
| EE | 0.308*** | 0.284*** | 0.0723** | -0.0675*** | 0.192*** | 0.106*** |
| | (0.0233) | (0.0231) | (0.0288) | (0.0204) | (0.0440) | (0.0298) |
| | | | | | | |
| Fixed Effects | | | | | | |
| Time | No | Yes | Yes | Yes | Yes | Yes |
| Imp / Exp | No | No | Yes | No | No | No |
| Country-Pair | No | No | No | Yes | No | Yes |
| Imp-Time<br>Exp-Time | No | No | No | No | Yes | Yes |

# PTA Effects Combined 1

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| DE | 0.0485*** | 0.0540*** | 0.0603*** | 0.0446*** | 0.0585*** | 0.0360*** |
| | (0.00177) | (0.00177) | (0.00179) | (0.00274) | (0.00181) | (0.00284) |
| CE | 0.00547*** | 0.00466*** | 0.00107 | 0.00341** | -0.00699** | -0.00133 |
| | (0.00155) | (0.00154) | (0.00205) | (0.00143) | (0.00303) | (0.00208) |
| | | | | | | |
| Fixed Effects | | | | | | |
| Time | No | Yes | Yes | Yes | Yes | Yes |
| Imp /Exp | No | No | Yes | No | No | No |
| Country-Pair | No | No | No | Yes | No | Yes |
| Imp-Time<br>Exp-Time | No | No | No | No | Yes | Yes |

# PTA Effects Combined 2

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| TE | 0.0240***<br>(0.00119) | 0.0259***<br>(0.00118) | 0.0342***<br>(0.00139) | 0.0123***<br>(0.00127) | 0.0416***<br>(0.00156) | 0.0117***<br>(0.00168) |
| | | | | | | |
| Fixed Effects | | | | | | |
| Time | No | Yes | Yes | Yes | Yes | Yes |
| Imp /Exp | No | No | Yes | No | No | No |
| Country-Pair | No | No | No | Yes | No | Yes |
| Imp-Time<br>Exp-Time | No | No | No | No | Yes | Yes |

# Conclusions

The presence of PTAs has 3 effects on bilateral trade flows

- Direct effect
- Relative price effect
- Expenditure effect

Only (an approximation to) the direct effect captured by a PTA dummy

Direct effect does not seem to be highly correlated with the other (price) effects