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

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

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 $i$

$$p_i y_i = \sum_{k=0}^{n} X_{ik} = [\beta_i p_i]^{1-\sigma} \sum_{k=0}^{n} t_{ik}^{1-\sigma} \frac{p_k}{R_k}$$

• 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

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

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)

\[ \hat{X}_{ij} = -[\sigma - 1] \left[ \hat{p}_i + \hat{t}_{ij} \right] + \hat{p}_j - \hat{R}_j \]

where

\[ \hat{R}_j = -[\sigma - 1] \sum_{k=0}^{n} m_{kj} \left[ \hat{p}_k + \hat{t}_{kj} \right] \]
Solve for Trade Cost Effects 2

Substituting

\[ \hat{X}_{ij} = -[\sigma - 1] \left[ t_{ij} - \sum_{k=0}^{n} m_{kj} \hat{t}_{kj} \right] -[\sigma - 1] \left[ \hat{p}_i - \sum_{k=1}^{n} m_{kj} \hat{p}_k \right] + \hat{p}_j \]

- where \( \hat{y} = \frac{dy}{y} \) 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

\[
[D(\sigma) - S] \hat{\rho} = -D(\sigma - 1)[\hat{\epsilon}^e - E\hat{\epsilon}^m]
\]

Which can be solved for the changes in relative prices as

\[
\hat{\rho} = -D(\sigma - 1)[D(\sigma) - S]^{-1}[\hat{\epsilon}^e - E\hat{\epsilon}^m]
\]
Suppose PTA membership reduces trade costs by proportion $\gamma$ – 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

$$X_{ij} = \bar{X}_{ij} + dX_{ij} = \bar{X}_{ij} [1 + \hat{X}_{ij}]$$
PTA 2

So

\[ \ln X_{ij} \equiv \ln \bar{X}_{ij} + \hat{X}_{ij} \]

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

- 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

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

Direct effect

\[
DE_{ijt} = [\sigma - 1][l_{ijt} - \bar{m}_{jt}]
\]

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

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General Case 2

Estimating equation

\[
\ln EXP_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln POP_{it} + \alpha_4 \ln POP_{jt} + \alpha_5 \ln DIST_{ij} \\
+ \alpha_6 \text{LANG}_{ij} + \alpha_7 \text{ADJ}_{ij} + \alpha_8 \text{LOCK}_{ij} + \Gamma Z_t + \delta_{i(t)} + \omega_{j(t)} + \tau_t + \theta_{ij} \\
+ u_{ijt}
\]

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 $l_{ijt}$ and $m_{jt}$ separately – as trade creation and trade diversion effects; or

2. Include $l_{ijt} - m_{jt}$ 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

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### Fixed effects

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## PTA Effects Separately

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**Fixed Effects**

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**Fixed Effects**

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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