Far Apart: The UK and Pacific Trade

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- We aim to develop a model following Caliendo & Parro (2015), (henceforth referred to also as CP) to analyze the entrance of UK into the CPTPP.
- The CPTPP (Comprehensive and Progressive Agreement for Trans-Pacific Partnership) is an FTA established between 11 countries accounting for 13.4% of global GDP.
- The agreement was signed in 2016 but the US resigned immediately during the first Trump administration, leading to a restructuring of the agreements' priorities.
- The UK signed the agreement in 2023 and ratified it in 2024 as the first European member of the FTA.

Why Caliendo-Parro?

- Most models have tariffs and non tariffs cost reduction but do not consider FTAs as hedging and strategical instruments.
- Moreover, E-K did not present some features crucial in analysing FTAs, such as multiple sectors, I-O linkages across such sectors and intermediate inputs from domestic and foreign sources.

Answer

- C-P allows for the multiple interactions of countries and sectors.
  - The model accounts for input-output linkages and intermediate inputs.
  - Accounts for direct and indirect effect of tariff reduction and to compute welfare effects.
  - The heterogeneity across sectors allows to disentangle the role of sectoral linkages in transmitting trade policy shocks.

Previous applications of C-P to FTAs

- **Goods and Factor Market Integration: A Quantitative Assessment of the EU Enlargement** (Caliendo, Opromolla, Parro and Sforza, 2021). The authors build a multicountry dynamic general equilibrium model to study the economic effects of the 2004 enlargement of the European Union. Similarly to C-P, they build on E-K to model trade with different productivities across sectors. The dynamic multicountry GE model allows for the modelling of migration, the novelty of the setting.

Previous applications of C-P to FTAs

- **Exploring the welfare effects of RCEP - a quantitative analysis based on a structural model** (Lin, Lv, Yang, Li, 2024). Based on Caliendo and Parro's general equilibrium model, this study uses the Regional Comprehensive Economic Partnership (RCEP) tariff reduction schedule to quantify the trade and welfare effects of the RCEP in south-east Asia on its members at different points in time, calculating the welfare for the counterfactuals of India's accession to the RCEP and tariff reductions in other parts of the world.

Previous applications of C-P to FTAs

- **Long-Run Effects on Chinese GDP from U.S.-China Tariff Hikes** (Ferraro and Van Leemput, 2019). The model employs a particular model of trade policy effects following Caliendo and Parro (2015) that focuses on the role of tariffs in spurring **adverse resource reallocations**. Higher U.S. tariffs on imports from China increases the production cost for U.S. frms as intermediate inputs become more expensive, thus lowering U.S. productivity and GDP. In China, tariffs decrease demand for those products where China is most productive, pushing resources into less productive sectors and lowering overall GDP.

Old Memories

- We have already seen the C-P model in the lectures and in the PS hence we just refresh it.
- Why is it important? Add I-O linkages and sectors, but fundamentally is an EK. It is not a black box **CGE** model.
- **3 types of agents**:
  1. Consumers: $u(C_n) = \prod_{j=1}^{J} C_n^{j\alpha_n^j}$, where $\sum_{j=1}^{J} \alpha_n^j = 1$ with income I_n derived from work (ω_n) and rebate of tariffs.
  2. Intermediate Goods: $q_n^j(\omega^j) = z_n^j(\omega^j)\left[l_n^j(\omega^j)\right]^{\gamma_n^j} \prod_{k=1}^{J}\left[m_n^{k,j}(\omega^j)\right]^{\gamma_n^{k,j}}$, $\sum_{k=1}^{J}\gamma_n^{k,j} + \gamma_n^j = 1$
  3. Composite Intermediate Producers: $Q_n^j = \left[\int r_n^j(\omega^j)^{1-1/\sigma^j} d\omega^j\right]^{\sigma^j/(\sigma^j-1)}$
- input bundle cost is: $c_n^j = \Upsilon_n^j w_n^{\gamma_n^j} \prod_{k=1}^{J} P_n^{k\gamma_n^{k,j}}$, $\Upsilon_n^j \equiv \prod_{k=1}^{J}\left(\gamma_n^{k,j}\right)^{-\gamma_n^{k,j}}\left(\gamma_n^j\right)^{-\gamma_n^j}$ (1)
- **Where do we have I-O linkages?** [HINT:] $Q_n^j = C_n^j + \sum_{k=1}^{J}\int m_n^{j,k}(\omega^k)\, d\omega^k$.

EK with a Twist...More Algebra

Recall that pricing was in the form of $p^j_{n,i}(z^j_i) = \frac{c^j_i \kappa^j_{n,i}}{z^j_i}$. Indeed it's immediate to get that:

$$\text{Prob}\left[p^j_{n,i}(z^j_i) \leq p\right] = 1 - e^{-T^j_{ni} p^{\theta j}}$$

Where $T^j_{ni} = \lambda^j_i \left(c^j_i \kappa^j_{ni}\right)^{-\theta^j}$. What is the distribution of the minimum price when a country goes shopping?

$\left[\text{HINT: Prob}\left[p^j_n \leq \min_{i \in I} p^j_{n,i}\right] = 1 - \prod_{i \in I} \text{prob}(p^j_{n,i})\text{. Under what Assumption?}\right]$ Hence we get that:

$$\text{Prob}\left[p^j_n \leq p\right] = 1 - e^{-\phi^j_n p^{\theta j}}$$

Where clearly $\Phi^j_n = \sum_{i=1}^N T^j_{ni} = \sum_{i=1}^N \lambda^j_i \left(c^j_i \kappa^j_{ni}\right)^{-\theta^j}$

What happens in non tradable sectors $\kappa^j_{i,n} = \infty$?

EK with a Twist...More Algebra II

Theorem

$p_n^j(\omega^j)^{\theta^j}$ *has an exponential distribution.*

Proof.

Define $g(x) = x^{\theta^j}$ where x has a Frechet distribution with parameters Φ_n^j and shape θ^j hence $f_x(x) = \theta^j \Phi_n^j x^{\theta^j - 1} e^{-\Phi_n^j x^{\theta^j}}$. It follows that the density function of $y = g(x)$ is given by $f_y(y) = f_x\left(g^{-1}(y)\right)\left|\frac{\partial g^{-1}(y)}{\partial y}\right|$. Then since $g^{-1}(y) = y^{\frac{1}{\theta^j}}$, and $\frac{\partial g^{-1}(y)}{\partial y} = \frac{1}{\theta^j} y^{\frac{1}{\theta^j} - 1}$, the density function of y is $f_y(y) = \Phi_n^j e^{-\Phi_n^j y}$, which is an exponential distribution with parameter Φ_n^j. □

Now it's immediate to claim that:

$$\left(P_n^j\right)^{1-\eta^j} = \int \Phi_n^j y^{\left(1-\eta^j\right)/\theta^j} e^{-y\Phi_n^j} dy$$

EK with a Twist...More Algebra III

Now consider the change of variable $u = \Phi_n^j y$ then we get that:

$$\left(P_n^j\right)^{1-\sigma^j} = \left(\Phi_n^j\right)^{-\left(1-\sigma^j\right)/\theta^j} \int u^{\left(1-\sigma^j\right)/\theta^j} e^{-u} du$$

[HINT: Recall that $\Gamma(a) = \int_0^\infty u^{a-1} e^u du$]
From wich it should follow immediately that:

$$\text{Tradable} : P_n^j = A^j \Phi_n^{j-1/\theta^j} \tag{2}$$

$$\text{Non Tradable} : P_n^j = A^j \lambda_n^j \left(c_n^j\right)^{-\theta^j}$$

Where $A^j = \Gamma\left(\xi^j\right)^{1/(1-\sigma)}$, and $\Gamma\left(\xi^j\right)$ is a Gamma function evaluated at $\xi^j = 1 + \left(1-\sigma^j\right)/\theta^j$.

EK with a Twist...More Algebra IV

Again we can derive the expenditure shares $\pi^j_{n,i} = X^j_{n,i}/X^j_n$ as:

$$X^j_{ni} = \Pr\left[\frac{c^j_i \kappa^j_{ni}}{z^j_i(\omega^j)} \leq \min_{h\neq i} \frac{c^j_h \kappa^j_{nh}}{z^j_h(\omega^j)}\right] X^j_n$$

[HINT: Recall that we have CES Preferences otherwise $X^j_n = \sum_{k=1}^J \xi^{j,k}_n \sum_{i=1}^N X^k_i \frac{\pi^k_{in}}{1+\tau^k_{in}} + \alpha^j_n I_n,$]
From wich is easy to get that:

$$X^j_{ni} = \frac{T^j_{ni}}{\Phi^j_n}\left[\int_0^\infty \Phi^j_n e^{-\Phi^j_n p^{\theta^j}} \theta^j p^{\theta^j - 1} dp\right] X^j_n = \frac{\lambda^j_i \left(c^j_i \kappa^j_{ni}\right)^{-\theta^j}}{\sum_{i=1}^N \lambda^j_i \left(c^j_i \kappa^j_{ni}\right)^{-\theta^j}} X^j_n, \tag{3}$$

Recall in fact the law of minima for independent draws $\pi^j_{ni} = \int_0^\infty \prod_{s\neq i}\left[1 - G^j_{ns}(p)\right] dG^j_{ni}(p)$

Another Twist: Trade Deficits

We get that:

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} X_i^k \frac{\pi_{in}^k}{1+\tau_{in}^k} + \alpha_n^j I_n, \tag{4}$$

$$I_n = w_n L_n + R_n + D_n,$$

Then using the definition of expenditure and trade deficit we get that:

$$\sum_{j=1}^{J}\sum_{i=1}^{N} X_n^j \frac{\pi_{ni}^j}{1+\tau_{ni}^j} - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N} X_i^j \frac{\pi_{in}^j}{1+\tau_{in}^j} \tag{5}$$

Definition

Given L_n, D_n, λ_n^j and d_{ni}^j, an equilibrium under tariff structure τ is a wage vector $\mathbf{w} \in \mathbf{R}_{++}^N$ and prices $\left\{P_n^j\right\}_{j=1,n=1}^{J,N}$ that satisfy equilibrium conditions (1), (2), (3), (4), and (5) for all j, n.

Log Linearize or Relative Changes?

- In macro we usually log linearize models hence we taylor approximate and then study the problem locally. This implies looking at % variations locally. E.g. $1 = R_{t+1}\beta\left(C_{t+1}/C_t\right)^{-\gamma}$ becomes

$$c_t \simeq -\sigma r_{t+1} + c_{t+1}$$

- So working on % changes (locally and around the ss) is something deeply diffused in DSGE.
- Do we need to do something similar even in our simplified CGE? While in macro we have a necessity to solve highly non linear and dynamic equations, in our model it's not about computational complexity. As a side effect calibration and IRFs is easier BUT comes with a great cost: losing second order effects (HANKS literature).
- **IDEA**: take the benefits (calibration, IRFs, loss of difficult to estimate parameters) and leave the costs (first order approximation).

$$\hat{c}_n^j = \hat{w}_n^{\gamma_n^j} \prod_{k=1}^{J} \hat{P}_n^{k\gamma_n^{k,j}}. \tag{6}$$

$$\hat{P}_n^j = \left[\sum_{i=1}^{N} \pi_{ni}^j \left[\hat{\kappa}_{ni}^j \hat{c}_i^j \right]^{-\theta^j} \right]^{-1/\theta^j} \tag{7}$$

$$\hat{\pi}_{ni}^j = \left[\frac{\hat{c}_i^j \hat{\kappa}_{ni}^j}{\hat{P}_n^j} \right]^{-\theta^j} \tag{8}$$

$$X_n^{j'} = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} \frac{\pi_{in}^{k'}}{1+\tau_{in}^{k'}} X_i^{k'} + \alpha_n^j I_n' \tag{9}$$

$$\sum_{j=1}^{J} \sum_{i=1}^{N} \frac{\pi_{ni}^{j\prime}}{1+\tau_{ni}^{j\prime}} X_n^{j\prime} - D_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \frac{\pi_{in}^{j\prime}}{1+\tau_{in}^{j\prime}} X_i^{j\prime} \tag{10}$$

We Know, But We Don't

- During lectures we gave the intuitions on how to solve it, namely:
  1. guess a $\hat{w} = 1$.
  2. Combine (6) and (7). This is a NxJ system in NxJ unknowns. We get that we can find $\hat{p}_n(\hat{w})$ and hence $\hat{c}_n^j(\hat{\omega})$ (conditional on our guess)
  3. Use the information on π_{ni}^J and θ^j together with the solutions to $\hat{p}_n^j(\hat{w})$ and $\hat{c}_n^J(\hat{w})$ from step 2 and solve for $\pi_{ni}^{j'}(\hat{w})$ using (8).
  4. Given $\pi_{ni}^{j'}(\hat{w}), \tau', \gamma_n^j, \gamma_n^{j,k}$ and α_n^j, solve for total expenditure in each sector j and country $n, X_n^{j'}(\hat{w})$ consistent with the vector of wages $\hat{w}$ using (9).
  5. Substituting $\pi_{in}^{j'}(\hat{w}), X_n^{j'}(\hat{w}), \tau'$, and D_n into (10) verify if the trade balance holds.
  6. If not, adjust guess of $\hat{w}$ until equilibrium condition is obtained.
- How do we do step 4? Who is I_n'? Is it tedious to ask if $x_n j\prime$ depend just on $\hat{\omega}$?
- How do we adjust the guess ensuring convergence?

Small Work

Note that we can re write eq. (9) as:

$$X_n^{j\prime} = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} \frac{\pi_{in}^{k}(\hat{\mathbf{w}})}{1+\tau_{in}^{k\prime}} X_i^{k\prime} + \alpha_n^j \left(\widehat{w}_n w_n L_n + \sum_{j=1}^{J} \sum_{i=1}^{N} \tau_{ni}^{j\prime} M_{ni}^{j\prime}(\hat{\mathbf{w}}) + D_n' \right).$$

Or in matrix form:

$$\mathbf{\Omega}(\hat{\mathbf{w}})\mathbf{X} = \mathbf{\Delta}(\hat{\mathbf{w}}) \longleftrightarrow \mathbf{X}(\hat{\mathbf{w}}) = \mathbf{\Omega}^{-1}(\hat{\mathbf{w}})\mathbf{\Delta}(\hat{\mathbf{w}})$$

- This is the **TRICK**! We have equilibrium conditions transformed as functions of our guess!
- how do we ensure convergence? Use a newton like like $w_n^{(t+1)} = w_n^{(t)} \cdot \left(1 - v \cdot \frac{S_n'}{VA_n}\right)$ works.

Data

- The countries in the CPTPP are: Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Perù, Singapore, the United Kingdom and Vietnam.
- In general, we used data from Caliendo and Parro (2015), in which only Australia, Canada, Chile, Japan, Mexico, New Zealand and the UK are presented among them.
- The sectors are the same as the 20 tradable and 20 non-tradable sectors in CP.

Data

The main information needed to run the model is:

- **Gross output by sector**: a 40 x 31 matrix were rows are sectors and columns are countries
- **Share of Value Added by sector**: a 40 x 31 matrix with the same order
- **Tarrifs before the UK accession**: This is a 620 x 31 matrix, containing data about bilateral tariffs between countries by sector.
- **The share of each sector in final demand by country**: A 40 x 31 matrix like above
- **Sectoral trade elasticities**: a 20 x 1 vector containing elasticities for all sectors
- **Input-Ouput tables**: a 1240 x 40 matrix, whose 40 x 40 submatrices represent the IO tables for each individual country.

Sources

We made an attempt at building out own dataset using the following sources:

- The Industrial Statistics database (INDSTAT2) and the Trade in Value Added TiVA dataset for the gross output by sector and the value added shares by sector.
- the OECD and the World Integrated Trade Solutions (WITS) for tariffs
- COMTRADE for the IO tables and bilateral trade volums.

Sadly, we were not able to perform the study with our dataset, due to gaps in the data.

Hence, we chose to use the data provide by CP for 2005, pushing to zero the tariffs before the entrance of the UK in CPTPP agreement for countries that were already in the patnership.

What is Welfare?

- in this model changes of real wages are **NOT** changes in welfare.
- To study the effect of changes in the counterfactual wee need to study the effect of $W_n = \frac{I_n}{P_n}$ where we already encountered I_n while P_n is the consumption price index given by $P_n = \prod_{j=1}^{J} \left(P_n^j / \alpha_n^j \right)^{\alpha_n^j}$. Now totally diffeerentiating we get that:

$$d \ln W_n = \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\left(E_{ni}^j d \ln c_n^j - M_{ni}^j d \ln c_i^j \right)}_{\text{Terms of trade}} + \frac{1}{I_n} \sum_{j=1}^{J} \sum_{i=1}^{N} \underbrace{\tau_{ni}^j M_{ni}^j \left(d \ln M_{ni}^j - d \ln c_i^j \right)}_{\text{Volume of trade}},$$

- Algebra is becoming a bit too much and it's not the focus but if we want to indulge... bureaucratic fever

What is Welfare?

- All this work to find that there is fundamentally 0 welfare improvement for anyone from the uk entrance, not even for uk
- Disappointment?
  1. Tariffs are not changing much only on very limited products they vary
  2. We did not estimate the lowering of non tariffs barriers
  3. UK DBT analysis provides evidence that we are not wrong in our computations, very limited gains even with non tariffs costs
- So this leaves us with a question, why did UK join?

Strategic considerations

Given that both in the official assessment of the UK Department for Trade & Business and in our results the welfare effects are not sizable, why bother negotiating anyway?

Possible Answers:

- Access to the CPTPP can be viewed as strategically significant for the "Indo-Pacific Tilt" of post-brexit Britain.
- Long-run development of the popoulous countries present in the agreement, such as Malaysia or Japan.
- Politics: formation of a "rallying point", alternative to the WTO.

In what follows we present some explanation from political economics:

Network theory

Basic idea: Trade deals create networks of countries and strengthen geopolitical relationships.

- Empirics on the relation between conflict and trade give mixed results: there is a clear negative correlation, but the direction of causation can not be inferred and there is great heterogeneity [Glick & Taylor, 2010]
- Jackson & Nei (2015) developed a model that uses network theory to show
  1. how stable networks fail to exist, unless trade considerations are present.
  2. A trade deal which cuts across political coalitions allows for political coordination between blocs (read China).
- Previous models predeicted that only grand-coalitions of interests can stabilize networks (Bloch, Sanchez-Pages, Souberian; 2006. for example).
- They find empirical validation in the data.

Networks Centrality

- Numerous witnesses for the policy proposal at the House of Lords suggested that the agreement would bolster the reputation of the UK, possibly attracting FDIs (Dr. Inu Manak, Dr. Holger Hestermeyer)
- The CPTPP agreement is impressive for its scope. It covers:
  1. Labor rights standards
  2. environmental standards
  3. Protection of property rights and free circulation of information

  It has been suggested that participation to the agreement provides the UK with a seat at the table where important decisions are taken on this subjects.

Coalition formation models

- Cao, Fu & Wang (2024) developed a model for Coalition formation. They find that trade agreements allow smaller countries to "escape" political coalitions when power asymmetries keep them in the sphere of influence of other countries (read China, but also USA for Chile and Peru).
- It has been suggested that the CPTPP could grow with time to include more and more countries.
  This way it could become a "smart" WTO that goes around the obstructionism of the US and China.
  One obvious objection to this is whether a WTO without the two largest economies in the world would make sense in the first place.

Conclusions

- The gains from trade expressed in terms of welfare gains in our model fail to provide sizeable advantages for UK industries and consumers.
- Our results are in line with the impact assessment conducted by the UK department for business and trade, which predicted a meager 2 billion pounds each year when compared to projected levels of GDP in 2040 in the absence of the FTA in real wage gains.
- The advantage of joining the deal can be seen when accounting for non-measurable gains, such as lower unobserved transaction costs, and for the geopolitical strategy of the British government in the region

Limitations & Suggestions

Limitations

1. Data
2. We do not account for the reduction of non-tariff barriers and for the facilitation of investments
3. The model doesn't count the reduction in negative externalities in terms of pollution that the environemntal clauses of the deal bring about

Suggestions for future research

1. Test the interaction of the effect of the patnership with other FTA that are being decide, such as the new commercial patnership between the UK and India.
2. Use the gains of trade to ameliorate endogenous variables in models based on network theories.