Quantification of non-tariff measures as tariff equivalents on a commodity level

Technical presentation to the February 2019 annual conference of the Australasian Agricultural and Resource Economics Society

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ABARES Technical Presentation, February 2019

This is a technical academic presentation by James Fell delivered at the annual conference of the Australasian Agricultural and Resource Economics Society (AARES) on 14 February 2019. The presentation includes both the slides and speaking notes used. This presentation was based on internal research prepared by Sally Thorpe and James Fell.

The presentation described the challenges of quantifying non-tariff measures as ad valorem tariff equivalents at the commodity level. Conference participants were invited to provide expert advice on the topic.
Quantification of non-tariff measures as tariff equivalents on a commodity level

James Fell
Australian Bureau of Agricultural and Resource Economics and Sciences
February 2019
There are potentially tens of thousands of non-tariff measures being imposed on Australian grains by destination countries. While typical trade barriers, such as tariffs, are easily quantifiable, less so are non-tariff measures (NTMs). These are policies applied to imports or exports that potentially affect the quantity and price of the goods traded.

Policy makers want to know how much these measures affect prices and quantities. In doing so, they often are interested in expressing this effect in a manner comparable to a tariff. We have asked that very question in regard to wheat markets. While conceptually simple, it's actually a very challenging task and we get counter-intuitive results.

There are a number of ways to approach the problem, and in doing so we run into a number of issues, some of which remain unresolved. And that is why I am here today, to seek your expertise. AARES is a great forum for feedback. I invite and encourage your interaction after the presentation.
Non-tariff measures

NTMs can be trade reducing or trade promoting
Marginal cost of compliance may vary by origin

NTMs increase compliance costs

But consumer signalling can promote trade

e.g. tariff-equivalent
We need to start with some basics. In an elementary framework for thinking about NTMs, we can consider an NTM to increase compliance costs. How might we model that? Well, it’s an increase in the marginal cost of supplying the product. What we are essentially doing here, in terms of NTM quantification, is to quantify the shift in the supply curve. But the response to an NTM can be different for each exporter and that's what's shown here. Each exporter can have a different fixed cost and different marginal cost structure when it comes to complying with the NTM.

What may come immediately to mind is that not all of these non-tariff measures are trade-reducing. For example, if a consumer receives a signal that the product is safe (for example, due to a food safety-related measure, like requiring that imported ham be free from listeria, salmonella and staph, thereby making it safe), the demand will increase above where it otherwise would have been without the assurance. The increase in demand could be large enough to more than offset any negative quantity effect from the leftward shift in supply. We can see that there can be ambiguity on the quantity effect. When we are looking at the NTM effect, we are essentially quantifying the shift in quantity traded or the increase in price.

Importantly, we do not have the before and after, so we cannot compare before and after for the purposes of quantification.

Another straightforward way of approaching the task is that you could compare the price of a product with the NTM to the price of a product without the NTM. However, identification of such products with otherwise identical characteristics across data is difficult.
A starting point: basic gravity foundations

These are the underlying ideas behind the gravity approach.

$i$ is export origin and $j$ is import destination, $Q$ is volume, $P$ is price, $S$ is supply, $D$ is demand, $A$ represents a parameter, $\sigma$ is the elasticity of substitution and $tcosts$ is the unit cost of trading over the border between $i$ and $j$ including the unit costs of the tariff equivalent NTMs.

\[ QS_i = AS_iPS_i^{\varepsilon S_i} \quad (1) \]

\[ QGD_j = AD_jPGD_j^{\varepsilon D_j} \quad (2) \]

\[ PGD_j^{1-\sigma_j} = \sum_i A_{ij} PD_{ij}^{1-\sigma_j} \quad (3) \]

\[ QD_{ij} = QGD_jA_{ij}(PD_{ij}/PGD_j)^{-\sigma_j} \quad (4) \]

\[ PD_{ij} = PS_i(1 + tcosts_{ij}) \quad (5) \]

\[ QS_i = \sum_j(1 + tcosts_{ij})QD_{ij} \quad (6) \]
At this point we need to start thinking further about an approach to quantifying NTMs, preferably as a tariff-equivalent.

The gravity approach is most prominent in the literature. We need to understand some background to a lot of the gravity modelling.

The simplest structural version of the gravity model is commodity-specific and comes from the iceberg version of a bilateral trade model. This is a simultaneous equations system and the outcomes are a function of the full set of equations that I'm about to show.

Now, I just want to point out that you do not need to be on top of all the detail to understand the rest of the presentation. The key messages that I'll give to you on the next slide are important.

There is a supply curve for each source.
< eq. 1>

There is a demand function for each destination.
< eq. 2>

There is a CES unit price of demand for a composite good.
< eq. 3>

Here is the first order condition for the volume of bilateral trade.
< eq. 4>

The consumer price is the producer price marked up by the bilateral trade cost, which includes the NTM.
< eq. 5>

The market quantity for each supply source is the sum of all the exports sent out to all sources.
< eq. 6>
Basic gravity foundations: key insights

1. Trade costs appear in (5) & (6) but not their causes

2. Relative prices matter

3. The price $PD_{ij}$ and volume $QD_{ij}$ of bilateral trade depends on all parameters $\hat{A}$ and all tariffs/NTMs trade costs.
We gain important insight here from equations 4, 5 and 6.

In (5) & (6), we see that the NTM appears as a trade cost, just like a tariff. But the trade cost is not explained. Moreover, whilst the NTM could be applied multilaterally, we need to understand that the cost of the NTM to different exporters could be different, which contrasts to a tariff.

In (4) we get the important insight that the volume of bilateral trade depends on all parameters and all tariffs/NTMs. Likewise for price. Price and quantity traded in a particular bilateral market depends not just on what's happening directly in this market, but also what's happening in other markets. This means that relative prices are very important.

So another point of showing you all this is to demonstrate the underlying ideas for a trade value equation covered by Anderson and van Wincoop (2003).
Gravity approach to quantification

This structure leads to a trade value equation (Anderson & van Wincoop):

$$VD_{ij} = VS_i VGD_j \left( \frac{tcosts_{ij}}{PGD_i PGD_j} \right)^{1-\sigma}$$

where $VD$ is value of trade between exporter $i$ and importer $j$, $VS$ is production value, $VGD$ is expenditure.

⇒ Restrictive assumptions are required
⇒ Trade depends on relative prices, production value, expenditure, trade costs
⇒ Need variables that explain trade costs
From restrictions, Anderson and van Wincoop used (5), (6) and (3) (from slide 3) to derive a pseudo-reduced form for (4) as a trade value. In turn, they substitute out for tcosts as a simple function of bilateral distance and estimate the trade value equation jointly with the composite price equation (3). This value equation says that what is important to the bilateral value of trade is the bilateral trade costs, composite prices, aggregate expenditure of a commodity and the value of aggregate production. The composite prices depend on what happens in all countries that supply imports to the country in question. So it's not bilateral prices that matter, it's what's happening in all countries that matters.

<see the value equation on slide>

A key insight is that we need to have variables that explain this trade cost. Often researchers will use distance between origin and destination, and gravity variables, like bilateral historical and cultural relationships such as a common language or legal system. We also need to include tariffs and NTM indicator variables.

But what is very important is the restrictive assumptions that are required to get to this point:

The parameters $A_{ij}$ all become $A_i$.

$\sigma_j$ are all the same

Border costs are symmetric so $t_{ij} = t_{ji}$. This is unrealistic for an NTM, but might be ok for a transport cost.
Gravity approach to quantification

Taking logs:

$$\log VD_{ij} = \log(VS_i) + \log(VGD_j) + (1 - \sigma) \log(tcosts_{ij}) - (1 - \sigma) \log PGD_i - (1 - \sigma) \log PGD_j$$

How close is this to an econometric specification?

- $PGD_i$ and $PGD_j$: Fixed effects? Calculate? Estimate?
- NTM data vary only in $j$. And we seek the trade cost in $ij$
- Challenges:
  - Specification must make economic sense
  - Multilateral policies: multicollinearity, identification
If we take the log of both sides we can see this on the slide as \( \log(\text{value}) = \log(\text{___}) \) ......

With some rearranging we get an econometric specification, with value on the left hand side. This was the technique employed by Kee et al. (2009), who wrote a seminal paper in the field of NTM quantification. The OECD has also done some recent work in the field, led by Olivier Cadot.

Other researchers choose to use price or quantity on the left hand side of the equation, and we see from the structural equations on the slide 5, that these should be fundamentally related.

<see equation on slide>

We can see from this particular logs equation that some terms vary only in \( i \). Other terms vary only in \( j \). It might therefore be tempting to use fixed effects. But what if there are multilateral policies that vary only in \( j \)? I'll come to that soon.

There is also the issue of an econometric specification that makes economic sense. An important consideration is that the traditional structural gravity model includes these price indices. These price indices include trade costs. Anderson and van Wincoop referred to these terms as multilateral resistance. The lesson here is that all trade costs in an econometric specification need to have multilateral resistance terms (MRTs) attached to them. And it reminds us that quantification needs to be guided by theory. If not accounting for MRTs, we have a misspecification problem.

A third matter is zero trade flows. I will not be exploring this today, instead I will be focussing on the big issue of multilateral policies.
The key gravity challenge: multilateral policies

- We want to find bilateral effects
- Most tariffs and NTMs are multilateral (but impacts can be bilateral!)
- Multicollinearity problem
- Identification problem (if pure multilateral effect):

$$\frac{Q_{D_{Aj}}}{Q_{D_{Bj}}} = \frac{Q_{GD_j} A_{QD_{Aj}} \left(\frac{P_{D_{Aj}}}{P_{GD_j}}\right)^{-\sigma}}{Q_{GD_j} A_{QD_{Bj}} \left(\frac{P_{D_{Bj}}}{P_{GD_j}}\right)^{-\sigma}} = \frac{A_{QD_{Aj}}}{A_{QD_{Bj}}} \left(\frac{P_{SA}(1+t_{costs_A})}{P_{SB}(1+t_{costs_B})}\right)^{-\sigma}$$

$\Rightarrow$ Trade costs cancel out in the presence of non-discriminatory trade policies if the policy has purely multilateral effects.
The basic idea in this slide is that you need variation in the data to be able to ascertain what is going on. Recall that the basic model incorporates trade costs. Often these can be captured by fixed effects. But remember that we want to try to find bilateral effects of the NTMs. NTMs and tariffs are usually imposed by the importer multilaterally, i.e. without discrimination. There is the problem of multicollinearity: if we were to just use dummy variables for the NTM, for example, then it would be correlated with all the other $j$ terms. Of course, the problem is clearest if using fixed effects because, on the importer side, these trade costs and the fixed effect only vary in $j$.

There is also an identification issue, which I will just show here on the slide (7). Fundamentally, we need to think about the importance of relative prices. We know that prices and quantities depend on what is happening in all other markets. What happens from an importer’s perspective, and when the econometrics is effectively comparing observations, is that the tariffs cancel each other out in the relative prices or quantities, so you cannot identify what effect a multilateral tariff actually has. This means that if an NTM has a purely multilateral effect, like an MFN tariff, then you also run into that issue. This is really important if you choose to use dummy variables for NTMs. But we believe that countries may have different marginal costs of compliance, so if we believe correctly, then the NTM variables would not cancel out.
Gravity challenges:
Towards solutions – multicollinearity, identifications problems

• Create bilateral variation in trade cost terms
  
  **Need to identify explainors of marginal cost of compliance on a bilateral level**

• Extending the OECD approach creates bilateral variation (using import and export shares; also proxies MRTs)
  
  **But no link to a theory of marginal cost of compliance**

• A link to a theory of marginal cost of compliance is essential
Ideally, to deal with the multilateral policies problem we would use bilateral NTM interaction terms that account for countries' comparative advantages in NTM compliance, and this would create bilateral variation in the data. It would also help avoid a dummy variable trap with any fixed effects.

To generate some bilateral variation in the data, Cadot, Gourdon and van Tongeren (2018) in an OECD paper have interacted import shares and export shares with the NTM categories. Kee et al. (2009) did something similar. This is a valuable approach and creates variation in the data. We extended this approach to apply to all trade costs that are multilateral because variation in the data is required for all those variables.

This also has the result of proxying MRTs on trade costs. But interacting import shares and export shares has no link to a theory of marginal cost of compliance. We would need to be able to explain why import shares and export shares are actually relevant explanators of NTM compliance costs. So you can see that we need this link to a theory of marginal cost of compliance.
Gravity:
Results show negative tariff-equivalents

- Many estimated tariff equivalents are negative
  “Price falls when NTM is imposed”

- Occurs in quantity-based approach and price-based approach

- Also occurs in different specifications

- This is counter intuitive
So, we made all these adjustments and ran regressions. We calculated the ad valorem equivalents (AVEs) using the price-based approach and quantity-based approach. But ultimately our results are counter-intuitive. Many of the results suggest a negative tariff-equivalent for NTMs for Australia for wheat.

This is counter-intuitive because we know that NTMs are associated with a cost of compliance and increase the price. When we tried variations on the specifications and we included different trade costs, we still ended up with negative tariff-equivalents.
Gravity challenges:
Negative tariff-equivalents – future pathways

• Need an appropriate model
  Marginal costs of compliance
  Demand parameters could shift with NTM presence
  What variables are explanators?
• Fixed costs model?
• Estibration
• Account for domestic market
  Increases degrees of freedom, provides important counterfactual
  Useful if policy has purely multilateral effects (like an MFN tariff)
Negative AVEs present somewhat of a conundrum. Why do we get negative AVEs? We know that there is an area that is incomplete: it's essential to have a link to a theory of marginal cost of compliance. The demand parameters could also shift in the presence of an NTM. And that’s also an area for exploration.

Or is it that the entire model could be incomplete? Is it the case that there are fixed costs of compliance, which could create a barrier to entry? This would mean that the imposition of an NTM squeezes some exporting countries out of a market, but sees other exporting countries increase their exports and move down the cost curve due to increasing returns to scale. This means that we would need to augment the model to include such variables. This would be a path of accounting for fixed costs to entry.

Another approach is *estibration*, where we calibrate what we can calibrate, we can estimate what we don't know, and also impose some kind of structure. An example of elaboration on the estibration approach is in Anderson, Larch and Yotov (2015). The value in this approach comes from imposing a bottom-up structure to the analysis.

Another approach is to utilise some counterfactuals to the presence of an NTM and include observations of the domestic market where the NTM does not apply. This potentially resolves near multicollinearity and the identification issue, but only when the NTM has a pure multilateral effect. If not, we still need to explain different exporters’ marginal costs of compliance. If you can get hold of accurate domestic data, then this could show a promising path.
Summary

• Gravity econometrics for NTM quantification:
  Traditional model is restrictive
  Technical challenges arise from multilateral policies
  Marginal cost of NTM compliance needs to be explained

• Lessons from New Trade Theory?
• Insights on marginal cost of compliance from environmental economics?
• Suggestions?
We have established that a typical approach to NTM quantification using the gravity model—at least using wheat as a case study—presents challenges.

We need to have that strong link to a theory of marginal cost of compliance because that will provide an economically coherent explanation of NTMs and also provide justifiable variables that give bilateral variation. Are there insights on marginal cost of compliance from environmental economics?

Throughout the presentation, I have emphasised the importance of understanding the choice of model. The traditional model is so restrictive. And that is where we see future work: developing a model that fits the market. Are there insights from new trade theory, for example in relation to fixed costs that can be used here?
References


