Modelling Local Content Requirements:

Quantitative Restrictions in a CGE Model

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Abstract

In this paper we describe the implementation of a new model structure to measure the impact of local content requirements. This is a novel approach to quantitative restrictions in trade model, implementing the policy behind-the-border. We show that local content requirements increase output and value added in the affected sector, but at the expense of other sectors, leading to declines in GDP and trade across the economy. We then compare this modelling approach to more traditional tariff equivalents and show the differences in outcomes to be significant.

JEL: LCR, NTM, CGE-Model, trade

Contents

I Introduction

In the wake of the economic crisis in 2008, governments came under intense pressure to provide quick solutions to large employment problems. At the same time, many governments felt at a loss to effectively stimulate domestic activities given the large influence global value chains (GVCs) and international fragmentation were seen to have in domestic production. However, as the crisis itself so starkly illustrated, the inter-reliance of economies has never been greater and the traditional go-to remedy of previous downturns, i.e. tariff increases, suddenly became a self-defeating policy.

The implementation of tariffs or quotas was further inhibited by the monitoring process that was put in place under the auspices of the G20. The G20 came to prominence in the wake of the crisis and was quick to condemn any use of trade distorting tariff measures: *We underscore the critical importance of rejecting protectionism and not turning inward in times of financial uncertainty. In this regard, within the next 12 months, we will refrain from raising new barriers to investment or to trade in goods and services, imposing new export restrictions, or implementing World Trade Organization (WTO) inconsistent measures to stimulate exports (*G20 Statement released 15 November 2008*).* This pledge has been repeated at the majority of subsequent G20 meeting.

However, as time passed and recoveries faltered, governments began to seek other ways to promote domestic economies. In a time of budgetary austerity, various types of localisation requirements began to be seen as a way to boost domestic industry without incurring significant fiscal outlay. By mandating local sourcing of goods and services, the real cost of these policies is born by a large group of purchasers and competing international suppliers, and thus are difficult to measure or track. However, because these measures are so pervasive and at the same time opaque, the identification and measurement of their costs is an important trade policy concern.

The purpose of this paper is to outline a new approach to the measurement of localisation barriers to trade, specifically in the form of local content requirements. The paper will proceed by first discussing the rise in the use of local content requirements as a trade policy tool. It will then describe a quantitative approach to modelling these policies in a CGE framework. Finally, an illustrative example of the implementation of the procedure will be presented and compared to the application of a tariff equivalent.

II Local Content Requirements

The incidence of non-tariff measures (NTMs), while applied in varying forms for years, has been growing since the crisis. In fact, there is evidence that the rise in globalisation, through GVCs and other cross-border interactions, has contributed to both the rise in the use of NTMs as well as to their cost (Osgood 2012). In this world of GVCs, the cost of protection can be higher than generally thought (Miroudot et al., 2013). As intermediate inputs are traded across borders multiple times, downstream firms end up paying higher costs for imported inputs in addition to the barriers they face on their own exports. The effective burden for the exporter can thus be several orders of magnitude

over what nominal tariffs or NTMs show. Consequently, firms are campaigning vigorously for the monitoring and elimination of a variety of NTMs.[1]

Among the fastest growing NTMs are local content requirements (LCRs). Historically LCRs were attached to foreign direct investment (FDI) as means of generating domestic jobs. By mandating a certain percentage of inputs to be purchased domestically, or a certain percentage of people employed locally, domestic governments were looking to guarantee the realisation of the anticipated spillovers from these projects.[2] However, the motivation for many of the LCRs put in place since the 2008 crisis has gone beyond job creation. Today, LCRs are being used as a way to develop expertise in emerging high technology and renewable energy sectors, for example. Related to this is the desire to obtain a portion of the vast and lucrative business associated with large multinationals and GVC trade (Hufbauer et al., 2013).

LCRs are similar to import quotas in that they use quantities rather than prices to influence the geographic distribution of business. The political appeal of LCRs is strong as they represent no explicit financial outlays. As opposed to price preferences for domestic firms, tariffs and subsidies, the cost imposed on purchasers (whether they be households or firms) is opaque and often totally hidden with LCRs. The WTO and many RTA agreements remain unclear with respect to quantity restrictions. For example, quantity restrictions only violate provisions under the Government Procurement Agreement (GPA) of the WTO for a set of specific activities agreed to in the GPA. LCRs tied to services seldom conflict with obligations under GATS because, for the most part, those commitments are limited to pre-existing market access.

Various sources estimate that between 90 and 200 new LCR measures have been put in place since 2008[3]. According to Hufbauer et al. (2013), countries have considered or implemented almost 120 new LCRs. They define these LCRs as follows:

1. Classic mandatory LCRs set as percentages of goods or services;
2. Tax, tariff or price concessions conditioned on local procurement;
3. Import licensing procedures tailored to encourage domestic purchases of certain products;
4. Certain lines of business that can be conducted only by domestic firms; and
5. Data that must be store and analysed locally or products that must be tested locally.

The study notes that LCR-using countries have larger than average GDPs and are less reliant on foreign trade and investment as a share of GDP. Because these countries have a wider array of local suppliers, they may be less mindful of the costs associated with LCR policies. Indeed, the costs of these policies can be much lower than they would be for a small economy.

Empirical studies examining the impact of LCRs on trade are rare. Following on from the seminal work of Grossman (1981) there were a number of studies examining the welfare impacts of these

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1. For recent discussions of this topic see:
http://www.oecd.org/tad/tradedev/internationalbusinessdialogue2013.htm and
http://www.digitaleurope.org/DocumentDownload.aspx?Command=Core_Download&EntryId=615

2. LCRs had the added benefit of generating greater support in the domestic market for many investment projects. See for example, Görg and Greenaway (2004) for a review.

3 See, for example, Hufbauer et al (2004), Global Trade Alert and European Commission's Market Access Database.

measures. Almost all of these studies found welfare losses.[4] More recent studies examining the effect of LCRs are even rarer. Indeed, Hufbauer et al. (2013) represent the first major attempt to quantify these measures since the crisis.

There are numerous difficulties surrounding the quantification of LCRs. First, many of the measures are vaguely worded, making it difficult to determine which industries are affected and how. From the policy perspective this maximizes flexibility in implementation but minimises transparency. Second, some measures are targeted at specific deals and thus have limited relevance for sector-level trade flows. Third, it is difficult to judge the counter-factual, i.e. how much trade would have taken place without these measures. In addition, many LCRs have effects beyond trade flows, directly and indirectly affecting investment (and perceptions of risk), services, and employment. Further, 'affecting' does not necessarily translate into a one-for-one reduction in trade or investment.

Identifying LCRs

Local content requirements fall under the broad heading of quantitative restrictions which are *specific limits on the quantity or value of goods that can be imported (or exported) during a specific time period* (WTO 2014). However, most LCRs have no time stipulation and generally do not target imports *per se*, but rather target an amount of domestic consumption that must be fulfilled. Some LCRs resemble tariff rate quotas in that when firms purchase the required domestic quantities they are charged lower (import duty, taxes, interest, etc) rates, than those who do not. However, many of the policies put in place since 2008 require domestic content for market access, a requirement rather than a preference.

Obtaining consistent and accurate data on LCRs is exceedingly difficult. There are no institutions systemically collecting information on local content requirements. While there are official WTO notification procedures under TRIMS, these are not always clear and notification outside this agreement remains murky. For example, between June 2008 and October 2013 the WTO reports 31 cases of LCRs, 7 of which remain unconfirmed. Of the 117 cases identified by Hufbaeur et al. (2013), only 47 were determined to be 'quantifiable'. That is, the LCR explicitly targets a subset of products that are identifiable and traded internationally. The study then 'guesstimate' that these 47 measures affect over USD 370 billion in trade yet hasten to qualify this number by stating that it is "…a matter of great speculation."

III LCRs: Quantities versus prices

Studies of LCRs, to date, have relied on analysing their impact through their effect on prices. They are usually converted to *ad valorem* equivalents or treated as shadow prices. Jensen and Tarr (2008) in a recent attempt to measure LCR impacts, examined the oil and gas sector in Kazakhstan. They represent the Kazakh local content policies as a 20 percent price preference (subsidy) by multinationals for domestic inputs, which is financed out of the gross revenues of multinational oil firms. They find that the elimination of these local content policies results in a gain in welfare equal to 0.2 percent of consumption.

[4] See for example, Davidson, Matusz and Kreinin (1986) and Lopez de Silanes, Markusen and Rutherford (1996). Veloso (2006) provides an overview of these early studies.

The use of *ad valorem* equivalents in the context of LCRs suffers from two major problems: first, there are no estimates of the size of a possible ad valorem equivalent. Accordingly, Hufbauer, et al., (2013) simply apply an ad valorem equivalent of 10%. Second, as noted above, LCRs use quantities rather than prices to influence the geographic distribution of purchases, hence, LCRs are not price instruments. Rather they affect the quantity which then influences prices. This implies different market adjustment processes. To estimate effects of these policies we develop an approach based on quantity effects to include LCRs in a CGE framework.

This new approach is implemented in the trade model currently being developed at the OECD. This model incorporates features of the OECD TiVA (trade-in-value-added) database to better reflect trade along global value chains (GVCs). The OECD model is an augmented version of the GLOBE model developed by McDonald, Thierfelder and Walmsley (2013). GLOBE is a SAM based global CGE model calibrated using the GTAP database (Narayanan et al., 2012).

Detailed information on the OECD model and the underlying database can be found in Flaig, Stone and Van Tongeren (2014).The model distinguishes trade flows and domestic commodity flows by use category into commodities designed for intermediate use, use by households, government consumption and investment commodities. Imports are imperfect substitutes and depicted with a nested three level CES-function. Exports are imperfectly substitutable, too, modelled with a three level CET function. The producing activity uses intermediate goods and domestic value added, which are imperfectly substitutable, and intermediate inputs are used in fixed shares.

Table 1 Data aggregation: Regions, sectors and factors

Region	Commodity/Sector	Factors
Argentina	Agriculture	Skilled labour
Brazil	Coal, oil, gas, mining	Unskilled labour
China	Food	Capital
European Union	Textiles	Land
India	Motor vehicles	Natural resources
Indonesia	Electronic equipment	
Russia	Other Manufacturing	
United States	Water transport	
Rest of G20[5]	Other transport	
Rest of the OECD[6]	Utilities	
Venezuela	Construction	
Kazakhstan	Insurance	
Rest of the World	Other services	
GLOBE region		

As noted, the database developed for the OECD trade model differentiates imports (and by default exports) by 4 use categories: (1) intermediate use, (2) private consumption, (3) government consumption and (4) investment consumption. In addition, we differentiate tariffs, export taxes, sales taxes and margins by use.[7] Accordingly, the commodity account is split to identify imported and

[5] Australia, Japan, Korea, Canada, Mexico, Saudi Arabia, Turkey, South Africa.

[6] New Zealand, Chile, Switzerland, Norway, Israel.

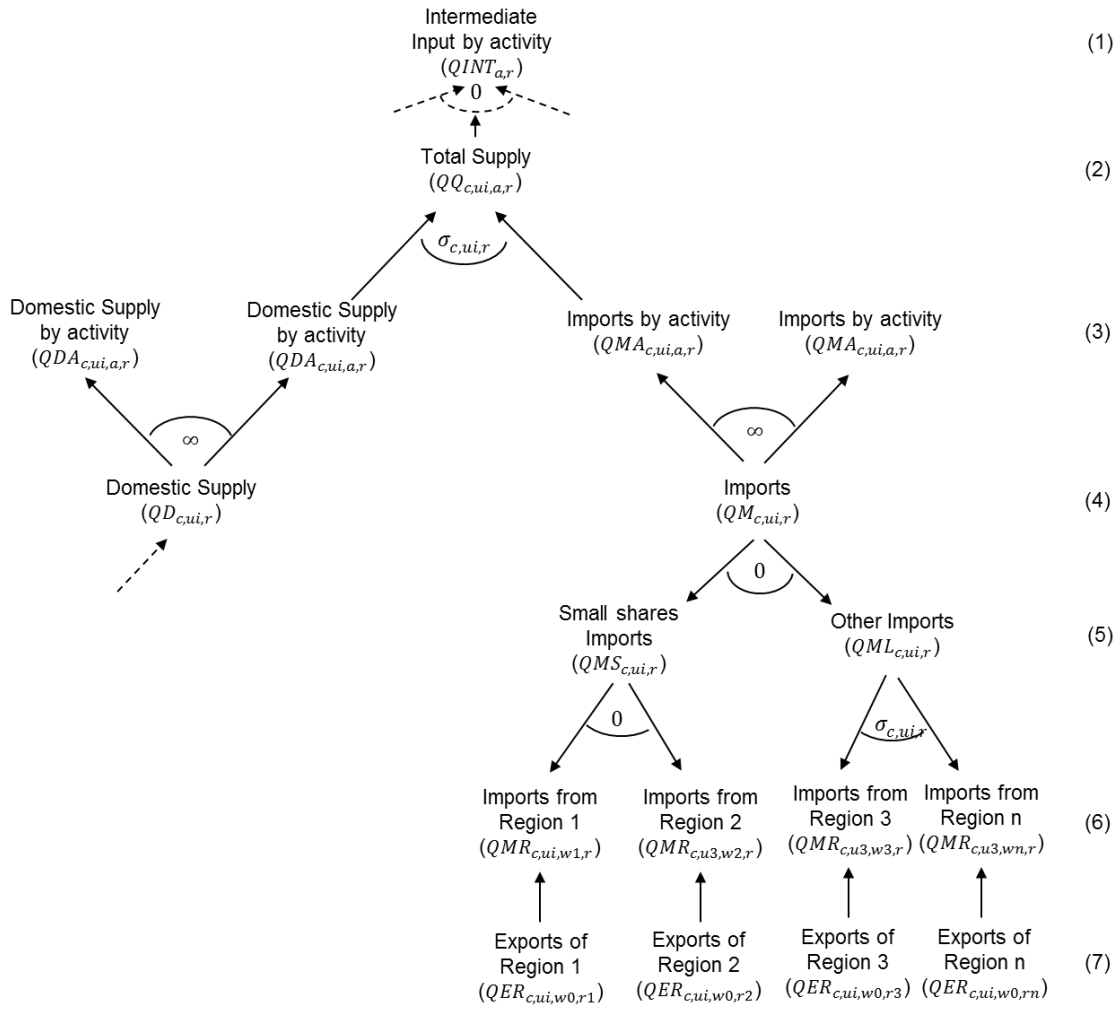
[7] Currently tax and tariff rates remain the same across users but future developments of the database will include differentiation of these accounts.

domestic goods. This split is based on the new OECD data on use categories of imports and exports as opposed to the widely applied proportionality assumption.[8] This study is based on a database which differentiates 13 regions and 13 commodities as displayed in Table 1.[9]

The alternate intermediate input nesting

LCRs are typically targeted on the imported input use of a specific activity. To analyse these policy measures, the alternate intermediate nesting identifies activity specific imports and domestic supply.

Figure 1 Alternate intermediate input nesting - quantities



Source: Authors' compilation.

In the base model, imports and domestic supply are first aggregated and then composite intermediate inputs are distributed over activities. The alternate intermediate nesting shifts the Armington equation,

[8] While the proportionality assumption was applied in the development of the OECD-ICIO, it was combined with additional detailed country and sector specific information which rendered the final statistics more robust.

[9] This aggregation is based on current on-going work at the OECD. The full dataset consists of all 57 GTAP sectors and 56 regions.

which combines imports and domestic supply, one level up and locates it directly at the activity specific demand for intermediate inputs.

The import branch on the lower right of Figure 1, illustrates the new nesting structure. Similar to the base model and other use categories, bilateral imports of commodities (c) for intermediate use (ui) by region (r) are aggregated distinguishing small share imports (Levels 7-4). Aggregate imports ($QM_{c,ui,r}$) are then split by activity (a, $QMA_{c,ui,a,r}$) (Level 3) applying share information from the base data. We maintain the implicit assumption from the base model and assume perfect substitutability between the activities (Eq. 1 and Eq. 2), hence the import price ($PM_{c,ui,r}$) and the activity specific import price ($PMA_{c,ui,a,r}$) are equal (Figure 2).

$$QM_{c,ui,r} = \sum_a QMA_{c,ui,a,r} \quad \text{(Eq. 1)}$$

$$PM_{c,ui,r} = PMA_{c,ui,a,r} \quad \text{(Eq. 2)}$$

In the domestic branch, at the left of Figure 1, domestic supply is split by activity similar to the imports branch.

$$QD_{c,ui,r} = \sum_a QDA_{c,ui,a,r} \quad \text{(Eq. 3)}$$

$$PD_{c,ui,r} = PDA_{c,ui,a,r} \quad \text{(Eq. 4)}$$

With $QD_{c,ui,r}$= domestic supply
$QDA_{c,ui,a,r}$= domestic supply by activity
$PD_{c,ui,r}$ = Prices for domestic supply
$PDA_{c,ui,a,r}$= activity specific price for domestic supply

Activity specific imports and activity specific domestic supply are aggregated with the Armington equation forming an aggregate activity and commodity specific intermediate input supply ($QQ_{c,ui,a,r}$).

$$QQ_{c,ui,a,r} = \alpha_{c,ui,a,r}\left(\delta_{c,ui,a,r} * QMA_{c,ui,a,r}^{-\rho_{c,ui,r}} + \left(1-\delta_{c,ui,a,r}\right) * QDA_{c,ui,a,r}^{-\rho_{c,ui,r}}\right)^{-1/\rho_{c,ui,r}} \quad \text{(Eq. 5)}$$

With: $\alpha_{c,ui,a,r}$ is the shift parameter, $\delta_{c,ui,a,r}$ the share parameter and $\rho_{c,ui,r}$ the elasticity parameter for the Armington CES-function.

The optimal ratio of imports and domestic supply is determined by the first order condition.

$$QMA_{c,ui,a,r} = QDA_{c,ui,a,r}\left(\frac{PDA_{c,ui,a,r}}{PMA_{c,ui,a,r}} * \frac{\delta_{c,ui,a,r}}{\left(1-\delta_{c,ui,a,r}\right)}\right)^{\frac{1}{1+\rho_{c,ui,r}}} \quad \text{(Eq. 6)}$$

The basic supply price ($PS_{c,ui,a,r}^{INT}$) is the weighted average of import and domestic supply prices.

$$PS_{c,ui,a,r}^{INT} * QQ_{c,a,r} = PDA_{c,ui,a,r} * QDA_{c,ui,a,r} + PMA_{c,ui,a,r} * QMA_{c,ui,a,r} \quad \text{(Eq. 7)}$$

The purchaser price of intermediate inputs ($PD_{c,ui,a,r}^{INT}$) includes the sales tax rate ($tsa_{c,ui,a,r}$).

$$PD_{c,ui,a,r}^{INT} = PS_{c,ui,a,r}^{INT} * \left(1 + tsa_{c,ui,a,r}\right) \quad \text{(Eq. 8)}$$

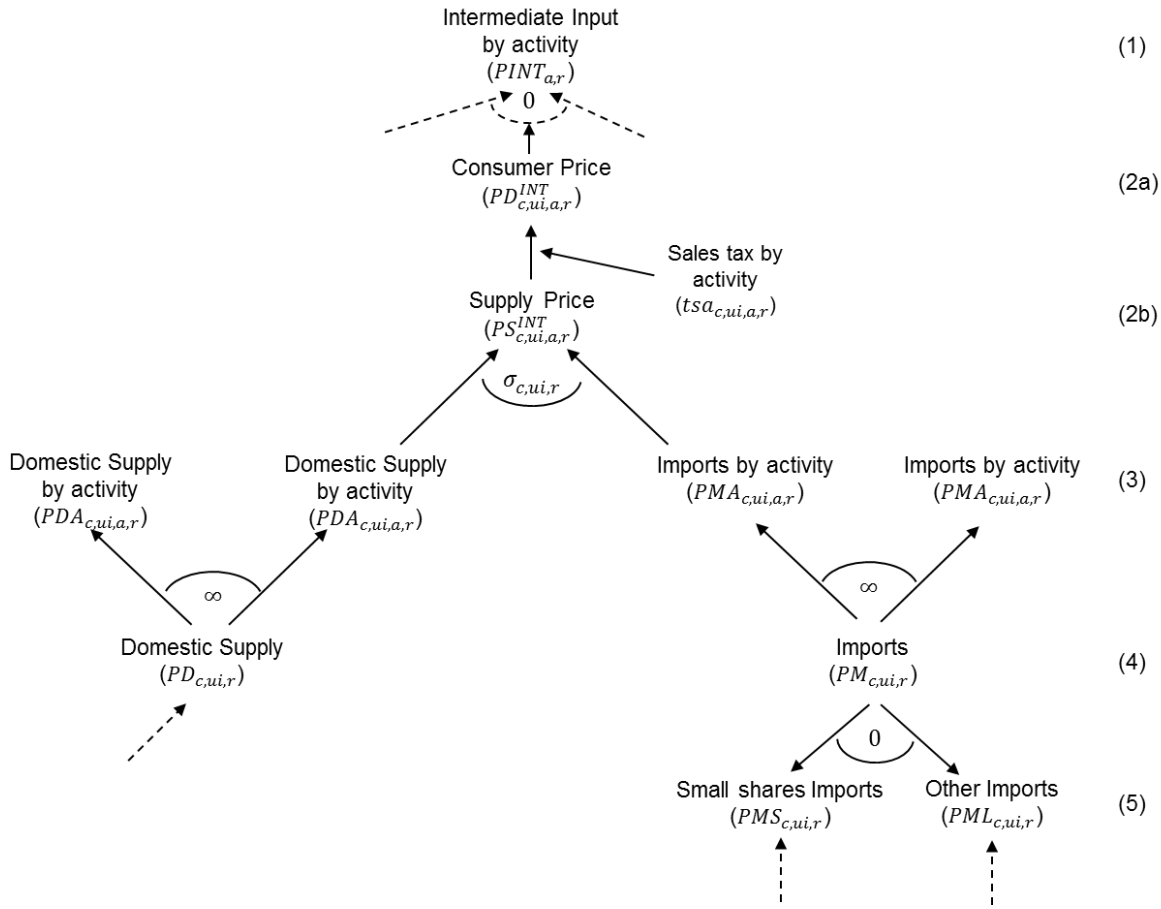
Finally, on level 1 of Figure 1, activities use intermediate input commodities in fixed shares.

$$PINT_{a,r} = \sum_{c,ui}\left(a_{c,a,r} * PD_{c,ui,a,r}^{INT}\right) \quad \text{(Eq. 9)}$$

$$QQ_{c,ui,a,r} = a_{c,a,r} * QINT_{a,r} \quad \text{(Eq. 10)}$$

With $a_{c,a,r}$being the intermediate input output coefficients

Figure 2 Alternate intermediate input nesting - prices



Source: Authors' compilation.

Modelling LCRs behind the border

Many LCRs are defined as a percentage share of inputs and are assumed to affect imports only when a specific LCR is binding. The underlying assumption of the model is that the company's observed intermediate input use is based on optimal allocation at given prices and thus it will change this input allocation only if prices change or it is required to because of the LCR policy put in place. As long as a company is already fulfilling the LCR, it is not binding. For example if the current domestic content in inputs is 60% and the relating LCR is 50%, there will be no need to adjust the composition of imported and domestically produced intermediate inputs. When the LCR becomes binding – for example if the current domestic content in inputs is 40% and the relating LCR is 50% – the company must reduce its imports use and increase inputs sourced from domestic production to a minimum of 50%.

To capture this reality of LCR policy, we model domestically produced supply (QDA) in two components. The first component is the quantity which would be supplied without the LCR (QD^{NL}) (in the base situation the 40% in the example). The second component is the quantity which is

additionally needed to fulfil the LCR (QD^{LCR}) (10%). This feature can be applied for both the case of commodity specific LCRs *and* for activity and commodity specific LCRs.

$$QDA = QD^{LCR} + QD^{NL} \quad \text{(Eq. 11)}$$

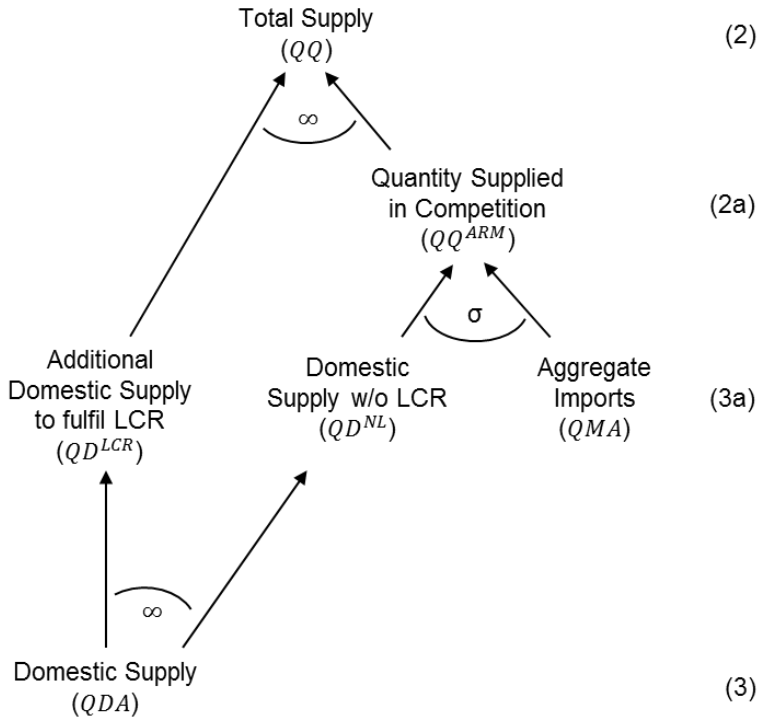
As noted above if domestic sources meet or surpass the LCR, QDA = QD^{NL}.

Total supply is likewise broken into two components, the quantity which is supplied through competition (QQ^{ARM}) between imports (*QMA*) and domestically produced commodities, and the additional quantity of domestic supply to fulfil the LCR.

$$QQ = QD^{LCR} + QQ^{ARM} \quad \text{(Eq. 12)}$$

The share going to fill the LCR is cut out prior to the Armington function (Figure 3), because this part of the domestic supply must be supplied domestically irrespective to the relative prices and thus is not in competition to imports. If an LCR is binding, a part of total supply is now supplied through the LCR channel, what decreases the demand for goods which are supplied through the Armington nest. Relative prices adjust leading to changes in the mix of competitively supplied imports and domestic quantities. As the domestic competition supply and total supply are subject to change, the additional quantity needed to meet the LCR is variable and defines the additional domestic supply necessary to fulfil the LCR in the new equilibrium.

Figure 3 LCR in the model



Source: Authors' compilation.

The Armington equation defines the total supplied in competition and at market prices (QQ^{ARM}), which is an aggregate of the domestic production that is supplied without the LCR (QD^{NL}) and

aggregate imports (*QMA*), where δ is the share parameter, ρ the elasticity parameter and α a shift parameter:

$$QQ^{ARM} = \alpha * \left[\delta * QMA^{-\rho} + (1-\delta) * QD^{NL^{-\rho}}\right]^{-1/\rho} \quad \text{(Eq. 13)}$$

The optimal combination of imports and domestic supply is determined by the first order condition and depends on the relative prices of imports (*PMA*) to domestic commodities (*PDA*). Domestic supplied commodities are assumed homogeneous, irrespective the channel through which they are supplied.

$$QMA = QD^{NL} * \left[\frac{PDA}{PMA} * \frac{\delta}{1-\delta}\right]^{1/(1+\rho)} \quad \text{(Eq. 14)}$$

The quantity of local content required (*QLCR*) is defined as share (*lcrsh*) of the total supply in the base ($\overline{QQ}$). Where *lcrsh* is defined as the share of total supply which must be of local content and thus constitutes the policy parameter.

$$QLCR = \overline{QQ} * lcrsh \quad \text{(Eq. 15)}$$

The LCR is implemented as Mixed Complimentary Problem (MCP), with a regime switch between the situation where the LCR is not binding and the situation where it becomes binding. When the LCR is binding, the base market outcome is not supplying the required domestic production (through the market via the 'normal' Armington function,QD^{NL}), and additional domestic quantity needs to be supplied to fulfil the LCR (which is QD^{LCR}). The quantity supplied domestically (*QDA*) must always be greater or equal the quantity of local content required (*QLCR*), hence the slack variable (*s*) is by definition negative. The slack variable reports the amount of domestic supplied quantity which is supplied in surplus to the LCR

$$s = QLCR - QDA \quad \text{(Eq. 16)}$$

and

$$s \leq 0 \; with \; QD^{LCR} \geq 0 \quad \text{(Eq. 17)}$$

IV Simulation

We choose one recent LCR as an illustrative example as how the modelling strategy works. In 2010, Russia implemented a policy that in order to qualify for duty-free import, local content of components of motor vehicle producers must reach 60% by 2020. According to the model database, currently 5% of inputs (i.e. parts and components) to the Russian motor vehicle industry are locally sourced. Thus to meet the LCR, this share would need to increase by 55 percentage points. This specific LCR on the Russian motor vehicle sector is chosen because it is one of the largest worldwide and at the same time narrowly targeted which makes it a convenient example to show LCR effects.

We proceed in two steps. First, we apply the LCR as a quantitative measure as outlined above. Second, assuming that LCRs are imposed to increase domestic value added, we simulate a corresponding standard ad valorem tariff equivalent to compare the adjustment processes., The import tariff for intermediate input use for motor vehicles and parts is set to 89% (compared to a base level between 7% and 12%). This tariff reduces motor vehicles and parts for intermediate input use imports by -14.1%, the same amount as the LCR.

This use of import reduction as point of reference might be challenged. However, given we assume imperfect substitutability between imports and domestic products, applying the Armington assumption, it is not possible to increase domestic supply on mv-components with a tariff on mv-components, where the import share is as high as 95%, with a reasonable set of parameters. This is true not only for the enormous tariff increase applied in our analysis, but also to more 'moderate' increases, e.g. 50%[10]. Without additional domestic policy support for the targeted producing sector, to help cope with input price increases, demand for the more expensive intermediate inputs decreases dramatically. With the LCR, the domestic supply adjustments are possible because the required additional quantity is not going through the Armington function.

We apply these simulations to a database with a base year of 2007. Thus, the LCR is not reflected in the underlying equilibrium conditions reflected in the model's base case.

The macroeconomic closures are modelled as follows: all factors are fully employed and mobile; the external balance is fixed for all regions and the exchange rates balance the regional capital account. The model is investment driven, hence, saving rates adjust to maintain the capital market balanced, and the consumer price indices serve as regional numeraire. The internal balances of the governments are fixed and the income tax adjusts to maintain the balance.

V Results

LCR results

Effects on the Russian motor vehicles sector

The LCR increases the domestic share of motor vehicle components (intermediate inputs, hereafter mv-components) in the Russian motor vehicle production (hereafter mv-production) from 5% to 60%. To comply with the restriction, domestic intermediate input use of mv-components in mv-production is boosted by 1100% with imports decrease accordingly by -38.2% (bottom two lines of Table 2). The huge increase of domestic supply originates from 3 sources: reallocation between sectors, reallocation between uses and increasing production. First, domestic intermediate supply of mv-components is reallocated from other production sectors, like transport services and construction, to mv-production (Level 3 in Figure 1). This first reallocation accounts for only 56.4% of the 1100% boost while the rest is supplied by the other two sources. Assuming homogeneity, mv-production produces a composite good, which is then distributed among the four use categories. Thus, the remaining two sources for boosting domestic mv-components are an increase in domestic production of mv-components, by 19.2%, and reallocation between use categories. The production increase is fully absorbed by the intermediate use category, which increases its supply by 265.9% (Table 2). Production supply of other use categories decreases between 0.9% and 9.9%. In total, the redistribution between uses accounts only for 38.6% of the 265.9% increase in the intermediate use category. Intermediate mv-component imports are reallocated between activities, too, and decrease by -14.1%. Total imports of mv-components across all uses declines by -7.8%.

[10] It would be possible to assume perfect substitutability, but, especially in the motor vehicles sector, trade is characterised by quality differences, and differentiation between product origins seems reasonable.

Table 2 Effects of the LCR on the motor vehicle sector in Russia, % changes

	quantity	Total	Use category				price	Use category			
			Intermediate inputs	Household consumption	Government consumption	Capital goods		Intermediate inputs	Household consumption	Government consumption	Capital goods
Production		19.17	265.91	-2.93	-0.89	-9.88		2.39	2.39	2.39	2.39
Exports		29.73	101.33	-5.68	-5.74	-10.45		-17.29	1.34	0.57	2.16
Domestic		16.39	421.29	-2.85	-0.61	-8.46		16.18	2.41	2.49	2.96
Imports		-7.75	-14.07	3.43	5.25	0.45		-2.96	0.15	0.41	-0.40
Total demand		-	7.55	-2.20	0.00	0.00		-2.20; mv: 6.81	2.17	2.27	-0.24

Intermediate input use of motor vehicle components by producing sector

	Agriculture	Coal, oil, gas, mining	Food	Textiles	Motor vehicles	Electronic equipment	Other Manufacturing	Water transport	Other transport	Utilities	Construction	Insurance	Other services
Domestic	-38.32	-38.43	-38.35	-38.50	1100.00	-37.53	-38.35	-38.13	-38.20	-38.16	-38.34	-38.26	-38.13
Imports	2.10	1.91	2.06	1.80	-38.22	3.40	2.06	2.40	2.30	2.36	2.07	2.20	2.40

Mv-components are an important intermediate input into mv-production, accounting for 39.8% of total intermediate input use, and at the same time are produced by mv-production itself. Thus the LCR increases, through the demand for intermediate inputs, the production of the targeted sector[11]. However, as only intermediate input production increases, there is a structural change within the sector with expansion of the input-supplying activities at the expense of other end-users in the motor vehicles sector in Russia.

Thus the politically induced increase in demand increases mv-production, despite the increasing costs of intermediate inputs of 2.8% which are driven by a strong increase in domestic mv-component supply prices. Production costs increase by 2.4% while the domestic supply price of mv-components for intermediate use increases by 16.2%. We assume a (domestic) competitive market, where firms do not make excess profits. Thus, as domestic intermediate use mv-component prices increase, producers are able to lower export prices and increase their exports by 101.3%.

Economy wide effects in Russia

As mv-production expands, production factors shift from other sectors to mv-production leading to a decline in most of the other sectors. The value of mv-component imports decreases, the value of mv-component exports increases and the exchange rate appreciates 0.5% to balance the capital account and maintain the current account balance. As mv-component production captures more of domestic capacity, all but mv-component imports increase. However, the decline in mv-component imports dominates and the total value of imports decreases by -0.9%. On the export side, the increase of mv-exports is not strong enough to dominate total exports, which decrease by -0.7%. Overall, Russian GDP decreases by -0.05% (Figure 4).

The increased output of mv-production increases factor demand. As mv-production is relative labour intensive, overall wages increase (0.04%). However, these do not offset the declines in returns of other factors due to decreasing output in other sectors across the economy. Overall factor return in Russia decreases -0.1%.

Effects on other regions

[11] This outcome is a function of the level of aggregation in the model.

Macroeconomic effects on other regions are small (e.g. GDP) with most of the impact being felt specifically in mv-production (Table 3). Viewing bilateral trade between all regions for mv-components (Table 4), exports to Russia decrease across the board. In addition, Russia is able to strongly extend its exports to India, Kazakhstan and the Rest of the World displacing other trade partners. This change in mv-components trade results in decreasing production of intermediate mv-components in all regions (except Russia), by up to 11.5% (bottom of Table 3). Effects on Kazakhstan are relatively strong, as Russia is its main trading partner. While the production of intermediate inputs (mv-components) decreases, in general there is an increase in the production of final goods and the overall contracting effects are considerably less.

Together these results illustrate the unintended consequences these policies can have on the imposing country's domestic market as well as on that of their trading partners. While LCRs can increase the domestic output in the affected sector, they can also undermine the export capacity of other sectors, and lower overall exports for the country. They also risk a series of retaliatory policies as those countries whose exports are negatively affected by the LCR might consider similar action to protect their markets.

Table 3 Effects of LCR on other regions, % changes.

	Argentina	Brazil	India	Indonesia	United States	Venezuela	Kazakhstan	China	Rest of G20	Rest of OECD	European Union	Rest of World
GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.01
Imports	0.00	0.00	0.00	0.00	0.00	0.01	-0.05	-0.01	-0.02	0.00	-0.01	-0.01
Exports	-0.01	0.00	-0.01	0.01	0.00	0.00	-0.05	-0.01	-0.02	-0.01	-0.01	-0.01
Exchange rate	-0.03	-0.03	-0.02	-0.01	-0.01	-0.03	-0.09	-0.02	0.00	-0.03	-0.02	-0.02
Motor vehicles sector												
Production	-0.02	-0.02	-0.17	-0.10	-0.04	-0.01	16.86	-0.06	-0.34	-0.04	-0.18	-0.25
Motor vehicle production by use category												
Intermediate inputs	-0.06	-0.04	-0.33	-0.53	-0.28	0.01	-11.49	-0.11	-0.58	-0.11	-0.45	-1.73
Household consumption	0.00	-0.01	-0.02	0.01	-0.02	-0.01	22.23	0.00	0.00	0.01	-0.02	0.17
Government consumption	-0.18	0.00	-0.41	0.00	-0.02	-0.46	1.62	-0.18	0.01	-0.03	-0.01	0.04
Capital goods	0.00	0.00	-0.04	0.00	0.00	-0.04	24.29	0.01	0.02	0.00	0.02	0.57

Table 4 Bilateral trade effects of LCR in motor vehicle components (intermediate inputs), % changes.

		Destination												
		Argentina	Brazil	India	Indonesia	Russia	United States	Venezuela	Kazakhstan	China	Rest of G20	Rest of OECD	European Union	Rest of World
Source	Argentina		0.05	-0.01	-0.89	-14.07	-0.03	0.06	2.76	-0.07	-0.06	0.12	-0.12	-1.68
	Brazil	0.12	-0.05	0.26	-0.82	-14.47	0.18	0.13	2.76	0.15	0.01	0.20	0.10	-1.62
	India	0.14	0.14		-0.80	-14.07	-0.03	-0.04	2.76	0.16	0.03	0.21	-0.12	-1.58
	Indonesia	-0.06	-0.05	0.08		-14.07	0.00	-0.05	2.76	-0.07	-0.16	0.01	-0.07	-1.78
	Russia	-0.02	-0.05	-0.01	132.99		-0.03	-0.04	63.29	-0.07	-0.16	-0.02	-0.12	128.96
	United States	-0.02	-0.01	0.12	-0.95	-14.05		-0.01	-29.19	0.01	-0.12	0.06	-0.04	-1.73
	Venezuela	-0.02	-0.05	-0.01	0.44	-14.07	-0.03		2.76	-0.07	-0.16	-0.02	-0.12	0.25
	Kazakhstan	-0.02	-0.05	-0.01	0.44	-14.07	-0.03	-0.04		-0.07	-0.16	-0.02	-0.12	0.25
	China	0.37	0.38	0.51	-0.57	-13.81	0.43	0.38	-29.24	-0.07	0.27	0.45	0.35	-1.37
	Rest of G20	-0.09	-0.09	0.05	-1.03	-14.03	-0.04	-0.08	-29.48	-0.06	-0.20	-0.02	-0.10	-1.81
	Rest of OECD	0.04	0.05	0.17	-0.90	-14.07	0.10	0.06	-29.17	0.07	-0.06	0.11	0.02	-1.69
	European Union	-0.11	-0.11	0.02	-1.05	-14.11	-0.06	-0.10	-29.50	-0.09	-0.22	-0.04	-0.13	-1.84
	Rest of World	-0.29	-0.29	-0.16	-1.23	-14.30	-0.24	-0.29	-29.77	-0.27	-0.40	-0.22	-0.31	-2.01

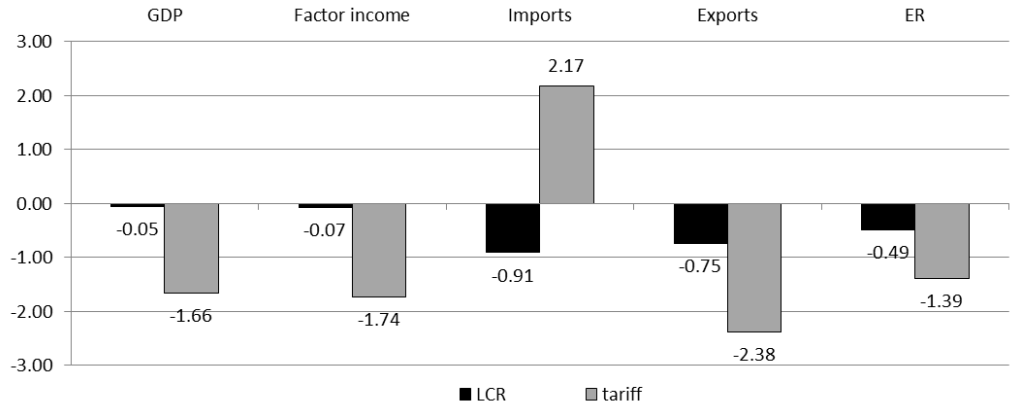
Comparison of tariff effects and the LCR

As discussed above, we implemented a tariff increase in order to simulate effects of a similar order of magnitude on imports. The traditional approach to measuring non-tariff measures, such as LCRs, is to convert them to tariff equivalents. Yet, we are aware of no systematic analysis involving estimations of tariff equivalents for LCRs.[12] However, as it is our goal here to illustrate the difference in outcomes when one attempts to convert essentially quantitative measures to a price equivalent, we have estimated a tariff which will provide a similar trade shock as that induced by the LCR. Thus, the simulation increases tariffs on mv-components in Russia from a base level between 7% and 12%, to 89%. A tariff of this size induces the same import decrease, 14.1%, of mv-components as the LCR.

Comparing effects of the LCR with the effects of a tariff illustrates the large differences between the two modelling approaches. On the one hand, the LCR seems to fulfil the goals of the government by increasing domestic value added in mv-production. Other sectors contract and general effects on the economy are overall slightly negative. However, as displayed in Figure 4, the declines in GDP in the tariff simulation are greater than those using the quantitative approach. We also see an increase in total imports, 2.2%, after a tariff increase versus a small decline in total imports from the LCR. Finally, exports decrease, -2.4%, more strongly and the exchange rate appreciation is also stronger, 1.4%, than in the LCR simulation.

Implementing a quantitative change through the LCR module leads to a contraction of other sectors, mainly caused by factor reallocation. This implies the possibility for positive effects in a framework with unemployment. The tariff, on the other hand, mainly increases prices, causing domestic production to decline, leading to overall larger declines in factor incomes (Figure 4).

Figure 4 Macroeconomic effects of LCR on Russia, LCR and tariff equivalent, % changes.[13]



In addition to the macro-economic outcomes described above, there are implications regarding rents generated with the two policies. Rents from the tariff are realised by the government. In the closure applied, here, governments maintain their expenditure levels and are thus a tariff increase allows for a lower income tax burden on households. This helps alleviate decreasing factor income. In the LCR,

[12] The Study by Jensen and Tarr (2008) apply a 20% subsidy for domestic supply firms, citing theoretical work by Grossman (1981). Hufbauer et al (2013) stating that they are unaware of any way to estimate these measures, apply a simple 10% AVE.

[13] Exchange rate is in price notation, decrease indicates appreciation and increase depreciation.

the rents from the policy are absorbed fully by the mv-production which increases its output and, through price discrimination, gain export market share. Of course the danger of such a policy is that the sector will become reliant on these artificial market conditions and never become truly competitive. Thus this policy has the potential to protect an inefficient sector while discriminating against other sectors.

The first-order effect of an import tariff is to increase the import price, while an LCR primarily increases domestic production or domestic value added. Results show that with both policy instruments, decreasing imports the same amount, domestic supply effects differ strongly. With a tariff, domestic supply is still determined through the imperfect substitutability between import and domestic products, applying the Armington assumption.

This does not cut off imports implicitly, but makes them more expensive and allows domestic firms to increases prices as well. The tariff increases the import price of mv-components by 64.4% and decreases imports by 14.1% (Table 5, 4th row). The import price increase strongly raises production costs of mv-production. Due to an additional increase of demand for domestic supply, 54.3%, this effect is even stronger for mv-components, for which the domestic supply price increases 33.4% (third row in Table 5). The increase in mv-supply is sourced from other use categories and total motor vehicle production decreases by 20.1%. However, we do not see the price discrimination emerge in the tariff scenario. Here, exports actually decline due to domestic price increases.

Tariff effects on other regions are small and slightly more negative than with the LCR (Table 6). The rest of G20, the rest of the EU and the rest of the world are Russia's main importers and experience a decrease in mv-production. Kazakhstan, which has strong trade connections with Russia, is negatively affected by the general Russian downturn.

With an LCR, the large increase of domestic supply is possible because the required additional quantity is not going through the Armington function. This limits the contestability of the markets for imports and relative prices only come into play after the LCR is fulfilled. This can be seen in the difference in the impact of other uses. Both the LCR and tariff increases were targeted at intermediate inputs. The input of the LCR was, by and large, limited to the intermediate input market (Table 2). However, the increase in imported price due to the tariff, spills-over into other end-users who all experienced much larger price increases than they did in the LCR approach (Table 5). This outcome casts suspicion on the use of tariff equivalents in measuring the impact of many types of NTMs.

Table 5 Effects of the tariff on the Russian motor vehicles sector, %changes

	quantity	Total	Use category				price	Use category			
			Intermediate inputs	Household consumption	Government consumption	Capital goods		Intermediate inputs	Household consumption	Government consumption	Capital goods
Production		-20.12	16.59	-20.26	-6.05	-50.02		20.97	20.97	20.97	20.97
Exports		-38.28	-19.94	-34.87	-34.01	-53.07		5.52	12.85	6.71	19.24
Domestic		-17.73	54.30	-20.54	-4.75	-46.44		33.38	21.16	21.66	25.00
Imports		-5.36	-14.08	25.35	43.63	2.72		64.40	2.96	5.06	-0.93
Total demand		-	-11.00	-16.07	0.00	0.00		62.35	18.82	19.56	0.02

Table 6 Effects of tariff on other regions, % changes.

	Argentina	Brazil	India	Indonesia	United States	Venezuela	Kazakhstan	China	Rest of G20	Rest of OECD	European Union	Rest of World
GDP	0.00	0.00	-0.01	0.00	0.00	-0.02	-0.27	0.00	0.00	-0.01	0.00	-0.02
Imports	0.00	0.00	-0.01	-0.01	0.00	-0.04	-0.18	0.00	-0.01	-0.01	-0.01	0.00
Exports	0.00	0.00	-0.01	-0.01	0.01	-0.03	-0.17	0.00	-0.01	0.00	-0.01	0.00
Exchange rate	-0.01	0.00	0.01	-0.01	-0.01	0.02	-0.04	0.00	0.00	0.00	-0.01	0.02
Motor vehicles sector												
Production	0.10	0.06	0.22	0.07	0.03	0.11	8.60	0.03	-0.01	0.13	-0.04	-0.41
Motor vehicle production by use category												
Intermediate inputs	0.10	0.10	0.29	0.24	0.09	0.15	3.18	-0.02	-0.22	0.14	-0.22	-2.40
Household consumption	0.00	0.00	0.16	0.01	0.03	0.16	5.77	0.18	0.31	0.08	0.03	-0.04
Government consumption	-0.12	0.00	0.60	0.00	0.18	0.58	2.28	0.20	0.06	-0.03	0.12	0.03
Capital goods	0.15	0.08	0.15	0.02	0.01	0.03	19.16	0.08	0.26	0.20	0.22	1.15

VI Conclusions

This paper describes the process of implementing a quantitative analysis of LCRs in a CGE framework. We apply a unique approach by allowing these measures to enter as quantitative restrictions, as opposed to ad valorem equivalents, the approach applied in most studies to date. We apply this quantitative restriction behind the border, which is more consistent with how the policies are actually implemented.

There are some important insights gained through this exercise. The model allows us to illustrate important domestic effects, as well as the effects on trade partners, from imposing an LCR. While the LCR allows domestic suppliers to increase domestic market share, it also has the effect of increasing domestic prices. This then raises the input prices to downstream producers who are deprived of potentially cheaper imports, which raises costs. The economy-wide effects are negative as prices increase and total exports fall. We are able to demonstrate the flow-on effects to export markets of these import policies. LCRs allow the imposing industry the opportunity to price discriminate between domestic and export markets, expanding their share of export markets. Thus trade partners suffer twice: a direct loss in reduced exports as a result of the LCR as well as indirectly through loss of market share in third markets.

The comparison with a tariff shows strong differences in the adjustment mechanisms between these two policies. We show that a tariff that achieves the same initial reduction of imports has a greater effect on domestic prices than the LCR. While tariffs are considered to be more transparent, and in that sense preferable to LCRs, LCRs seems able to expand domestic value added, are better targeted and therefore impose fewer overall costs on the economy than a tariff. LCRs seem beneficial in a context where learning and technological spillovers, scale economies and entry barriers play a major role (Veloso, 2006). However, the long run implication of these policies is that the sector will be able to reach competitiveness and phase out the LCR.

The magnitude of the outcomes for the motor vehicles sector may have been affected by the level of aggregation applied in the model. Given that components produced by this sector are a large input into the end product, the tariff increase increases production costs as well as final use costs. This effect is more limited in the LCR approach where the impact on relative price nesting via the Armington nesting is by-passed. Finally, while the analysis shows clear results, outcomes might differ in other frameworks with different structural setups, e.g. trade shares, use distribution, regional integration and production. Therefore a comprehensive analysis of a set of LCRs will be conducted in near future.

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