Quantifying the Impacts of Local Content Requirements

An Analysis on Indonesia

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Increasing Usage of LCR as Commercial Policies

- The fragmentation of the value chain across the globe increases the foreign content of goods produced
- **Policymakers**: What are the effective incentives to encourage usages of local factor & input to promote local production and employment?
- Increasing use of local content requirements (LCRs): a minimum required level of domestically-produced inputs in the production or value added
  - FTAs adopt LCRs (or regional content requirements) and ROOs (rules of origins)
  - FDI host countries require a certain % of local factors & inputs to be used
- Evaluating a commercial policy requires quantifying the impacts of LCR

In This Chapter

1. We attempt to quantify the impacts of LCR on Indonesian manufacturing firms and sectors
2. We introduce LCR compliance decisions faced by manufacturing firms into the model of Blaum et al. (2018)
3. We calibrate the initial equilibrium to Indonesian economy prior to the LCR introduced in 2012
4. We then study the impacts of the LCR in our quantitative exercise

Indonesia's Local Content Requirement (LCR) Policy

- Indonesia adopted LCRs to promote domestic goods & services since 2010
- **LCR primary goal**: reduce dependence on imports, protect domestic industries, promote employment
- Focus on MEMR Regulation No.15 of 2013
  - targets the upstream oil and gas (OG) sector dominated by the government
  - mandates firms in the sector to prioritize domestic products/inputs
  - sets minimum percentages of local content in procurement for OG projects
  - price preferences to compliant firms & non-compliance fees on others
- The upstream OG sector accounts for 8.3% of gross output, 11.9% of value added, 4.5% of intermediate input spending, 1% of employment in 2012

LCR Compliance Is a Decision

- **Cost of non-compliance**: 15% fee when selling to the OG sector
- **Cost of compliance**: restricted imports that leads to inefficient sourcing
- The compliance decision depends on firm's reliance on imported inputs
  - E.g., a drilling pipe manufacturer using imported steel may opt not to comply due to high costs
- Compliance may be preferred if the OG sector is a major revenue source
- Firms might misreport compliance to avoid fees and import restrictions, risking administrative sanctions if caught

AnExample of LCRs in the OG Sector

Goods	Target LCR level (%)		
	Short-term (2013–2016)	Medium-term (2017–2020)	Long-term (2021–2025)
1. Drilling pipe			
a. High-grade	25	40	55
b. Low-grade	15	25	40
2. Distribution pipe (line pipe)			
a. Spiral/SAW	50	65	80
b. ERW	50	65	80
c. Seamless pipe	10	30	50
3. Drilling mud, cement and chemicals	40	55	70

Related Literature

- The implications of local and regional content requirements
  - Theoretical studies: Grossman (1981), Krishna and Itoh (1988), Ju and Krishna (2005), Lahiri and Ono (1998), Qiu and Tao (2001)
  - Empirical and quantitative studies: Conconi et al. (2018), Yang (2021), Head et al. (2022)
- Imported intermediate inputs, global sourcing, and firm-level efficiency
  - Empirical studies: Amiti and Konings (2007), Goldberg et al. (2010), Fan et al. (2015), De Loecker et al. (2016), Brandt et al. (2017)
  - Model and quantitative studies: Gopinath and Neiman (2014), Antras et al. (2017), Blaum et al. (2018)

Roadmap

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Data and Key Variable

- Annual survey of Indonesian manufacturers from Statistics Indonesia (BPS)
  - covers large and medium-sized manufacturing firms
  - contains information on production output, number of workers, wages, capital, expenditure on domestic materials, expenditure on foreign materials
  - provides information on production at the firm-product level
- A firm i's local content λ_i is:

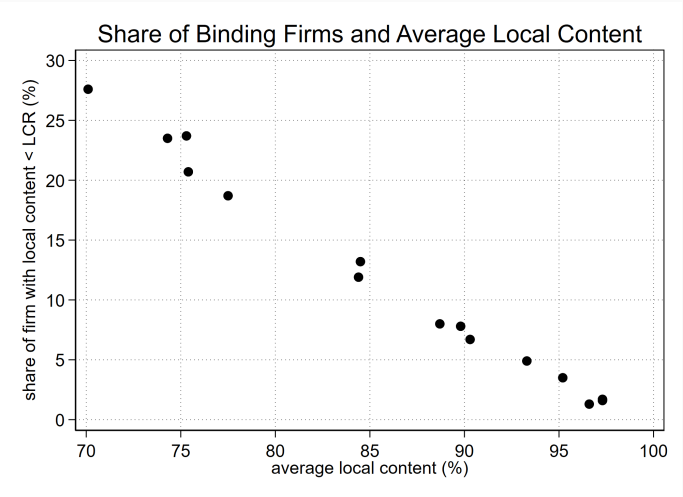
$$\lambda_i = \frac{c_{D,i}M_{D,i} + wL_i}{c_{D,i}M_{D,i} + c_{F,i}M_{F,i} + wL_i}$$

$c_{D,i}M_{D,i}$, $c_{F,i}M_{F,i}$, and wL_i: firm i's expenditure on domestic materials, imported materials, and wage bill.

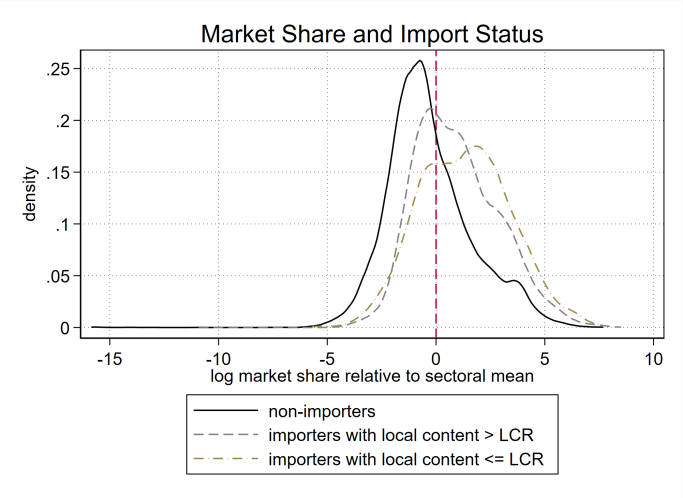
Firm-Level Local Content by Sector, 2012

Manufacturing Sector	No. of firms	Avg. local content (%)	Share of importers (%)	Local content < LCR (%)
Food & Beverages	6,772	97.3	13.5	1.7
Textile & Apparel	3,910	90.3	21.2	6.7
Wood Products	1,015	97.3	16.1	1.6
Paper Products	447	89.8	22.1	7.8
Printing & Reproduction	461	96.6	18.9	1.3
Coke & Refined Petroleum	67	84.4	29.9	11.9
Chemicals & Medicine	1,053	75.4	46.0	20.7
Rubber & Plastic	1,553	88.7	26.4	8.0
Non-metallic Minerals	1,610	95.2	14.3	3.5
Basic Metals	241	75.3	47.3	23.7
Fabricated Metals	750	84.5	31.2	13.2
Electronic & Equipment	785	70.1	48.3	27.6
Motor Vehicles	267	77.5	40.4	18.7
Other Transportation Equipment	217	74.3	43.3	23.5
Other Manufacturing	1,930	93.3	19.1	4.9
All Firms	21,078	91.3	21.5	6.7

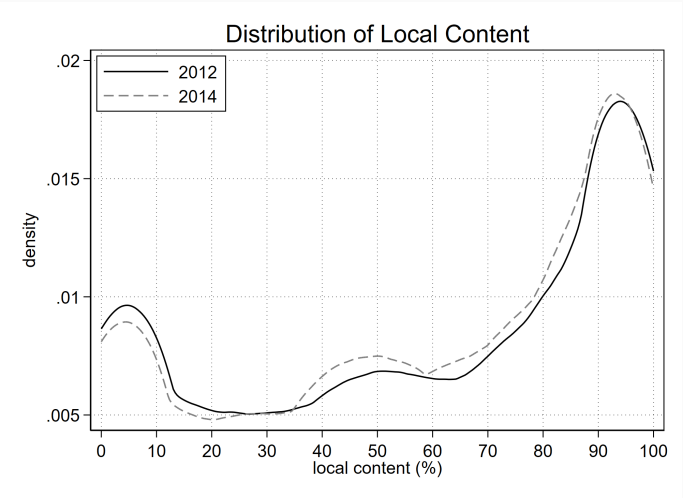
Fewer Firms Bound by LCR if Avg. Local Content is High



Larger Firms Seem More Likely to be LCR-bound



Compliance Seems to Become More Common Over Time



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Overview of the Model

- Local content & foreign content are imperfect substitutes in a firm's production function
  - local content: domestic inputs + labor; foreign content: imported inputs
- In the case of "binding compliance"
  - **Cost**: a cost penalty due to distorted sourcing decision
  - **Benefit**: avoid paying an *ad valorem* non-compliance fee of 15% when selling to the upstream OG sector
  - Such a firm would have chosen a higher foreign content share absent the LCR
- These cost changes of the LCR-bound firms transmit to the rest of the economy through I/O linkages

Benchmark: Firm-level Sourcing without LCR

- Firm i combines local content $M_{D,i}$ & foreign content $M_{F,i}$ to produce Y_i:

$$Y_i = \varphi_i[(a_{D,i} \cdot M_{D,i})^{\frac{\theta-1}{\theta}} + (a_{F,i} \cdot M_{F,i})^{\frac{\theta-1}{\theta}}]^{\frac{\theta}{\theta-1}} \tag{1}$$

  - $\theta > 1$: EoS b/w local & foreign contents
  - $a_{D,i}$ & $a_{F,i}$: firm i's efficiencies in using local (D) & foreign (F) content

- The cost share of local content of firm i:

$$\lambda_i = \frac{(c_{D,i}/a_{D,i})^{1-\theta}}{(c_{D,i}/a_{D,i})^{1-\theta} + (c_{F,i}/a_{F,i})^{1-\theta}} = \frac{1}{1+\delta_i^{1-\theta}}, \quad \delta_i = \frac{c_{F,i}/a_{F,i}}{c_{D,i}/a_{D,i}} \tag{2}$$

δ_i: firm-specific relative (efficiency-adjusted) cost of foreign content.

Benchmark: Firm-level Unit Cost without LCR

- The unit cost of firm i without LCR is

$$c_i = \frac{c_{D,i}}{\varphi_i a_{D,i}} \cdot \lambda_i^{\frac{1}{\theta-1}}. \tag{3}$$

- **Implication**: Conditional on local content cost $c_{D,i}$ and productivity φ_i, the observed firm-level λ_i is a sufficient statistic for the firm-level unit cost c_i
- This theoretical result is similar to that of Gopinath and Neiman (2014), Antras et al. (2017), and Blaum et al. (2018)
- LCR may increase firm-level unit cost by forcing firm i to deviate from its optimal λ_i

Firm-level Sourcing and Unit Cost with Binding LCR

- If the LCR is binding for firm i (so $\lambda_i \leq \underline{\lambda}_i$) and the firm decides to comply with it, its sourcing decision is determined by

$$\frac{M_{D,i}}{M_{F,i}} = \frac{\underline{\lambda}_i}{1-\underline{\lambda}_i}\frac{c_{F,i}}{c_{D,i}}. \tag{4}$$

- Such a sourcing decision implies the following unit cost of Y_i,

$$\kappa_i \times c_i, \tag{5}$$

where

$$\kappa_i = \left[\underline{\lambda}_i\left(\frac{\lambda_i}{\underline{\lambda}_i}\right)^{\frac{1}{\theta}} + (1-\underline{\lambda}_i)\left(\frac{1-\lambda_i}{1-\underline{\lambda}_i}\right)^{\frac{1}{\theta}}\right]^{\frac{\theta}{1-\theta}}, \quad \lambda_i \leq \underline{\lambda}_i. \tag{6}$$

- When i complies with the binding LCR, it is subject to a cost penalty $\kappa_i \geq 1$ if its "unconstrained" λ_i is lower than the one required by the LCR

Demand across Sectors and Firm-level Profit

- Assume that firms are monopolistic competitors and demands from each sector k, including final consumers, are CES:

$$q_i^{k,s} = (p_i^s)^{-\sigma^s}(z^{k,s})^{\sigma^s-1}(P_D^{k,s})^{\sigma^s-1}X^{k,s}, \tag{7}$$

  $X^{k,s}$: sector k's input expenditure spent on sector s; $P_D^{k,s}$: the price index

- Let

$$\Gamma^{k,s} = \frac{(\sigma^s-1)^{\sigma^s-1}}{(\sigma^s)^{\sigma^s}}(P_D^{k,s})^{\sigma^s-1}X^{k,s}$$

  collects several sector-specific constants and variables

Firm-level Profit and Compliance

- Firm-level profit under non-compliance (s indicates the sector of firm i):

$$\pi^{s}_{\text{NC},i} = (c_i)^{1-\sigma^s}[\Gamma^{\text{OG},s}(z^{\text{OG},s})^{\sigma^s-1}\tau^{1-\sigma^s} + \sum_{k\neq \text{OG}} \Gamma^{k,s}(z^{k,s})^{\sigma^s-1}] \tag{8}$$

  Non-compliance is subject to an *ad valorem* non-compliance fee $\tau > 1$ charged by the government when selling to the upstream OG sector

- Firm-level profit under binding compliance:

$$\pi^{s}_{\text{C},i} = (\kappa_i c_i)^{1-\sigma^s}[\sum_{k} \Gamma^{k,s}(z^{k,s})^{\sigma^s-1}]. \tag{9}$$

  Compliance avoids paying the non-compliance fee of selling to the upstream OG sector but incurs a cost penalty κ_i if the LCR is binding

Compliance Decision

- A firm complies with the LCR if and only if

$$\pi^s_{\mathrm{C},i} > \pi^s_{\mathrm{NC},i} \iff S^{\mathrm{OG},s} > \frac{1-\kappa_i^{1-\sigma^s-1}}{1-\tau^{1-\sigma^s}}, \tag{10}$$

  where

$$S^{\mathrm{OG},s} = \frac{\Gamma^{\mathrm{OG},s}(z^{\mathrm{OG},s})^{\sigma^s-1}}{\sum_k \Gamma^{k,s}(z^{k,s})^{\sigma^s-1}}$$

  is firm's revenue share generated by the upstream OG sector

- A larger size of the upstream OG sector $S^{\mathrm{OG},s}$ and a higher non-compliance fee τ induce a stronger incentive to comply
- A higher compliance cost penalty κ_i reduces willingness to comply

Summarizing Compliance Decision

- Firm-level profit under "unbindingness", i.e. $\lambda_i > \underline{\lambda}_i$

$$\pi^s_{\mathsf{NB},i} = (c_i)^{1-\sigma^s}[\sum_k \Gamma^{k,s}(z^{k,s})^{\sigma^s-1}]. \tag{11}$$

- Firm i's compliance decision and the associated profit is determined by

$$\pi^s_i = \begin{cases} \pi^s_{\mathsf{C},i}, & \lambda_i < \underline{\lambda}_i \ \& \ S^{\mathsf{OG},s} > \frac{1-\kappa_i^{1-\sigma^s}}{1-\tau^{1-\sigma^s}}, \\ \pi^s_{\mathsf{NC},i}, & \lambda_i < \underline{\lambda}_i \ \& \ S^{\mathsf{OG},s} \leq \frac{1-\kappa_i^{1-\sigma^s}}{1-\tau^{1-\sigma^s}}, \\ \pi^s_{\mathsf{NB},i}, & \lambda_i \geq \underline{\lambda}_i. \end{cases} \tag{12}$$

Summary of the Equilibrium

- In the equilibrium, the price index of the composite domestic input produced by sector k using sector-s outputs depends on prices of all firms in sector s
- The LCR raises the prices of compliers by distorting their foreign sourcing decisions and the prices of non-compliers due to the non-compliance fee.
- The prices of composite domestic inputs also affect the sourcing and compliance decisions of all firms (GE effect)
- Goods market clearing suggests that demands for outputs produced by each sector consist of intermediate input demands and the final demand
- With the equilibrium defined, we can evaluate the effects of imposing the MEMR LCR on firms and the economy

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Calibration: Data Sournce

- We calibrate the model to the Indonesian economy before the imposition of MEMR LCR regulation, the year of 2012
- Two main data sources:
  1. Indonesian manufacturing firm survey data provided by the BPS
  2. World Input-Output Table (WIOT), to obtain the input-output coefficients and calibrate the basic features of non-manufacturing sectors
- The upstream OG business sector matches well with the “mining sector” in the WIOT classification

Calibration: Overview

1. Firm-level local content λ_i and LCR level $\underline{\lambda}_i$ for manufacturing firms calculated from the BPS firm survey data
2. Assume that firms in the agriculture sector, the OG (mining) sector, and the service sector are identical and calibrate them using the WIOT information
3. Calculate $S^{k,s}$ for each $\{k, s\}$ pair using the WIOT data and impute firm i's sales to sector k as $Y_i^{k,s} = S^{k,s} \times Y_i$
4. Calibrate the elasticity of substitution σ^s for sector s as profit margin: $\frac{\sum_{i \in \Omega^s} Y_i}{\sum_{i \in \Omega^s} (c_{D,i} M_{D,i} + c_{F,i} M_{F,i} + w L_i)} = \frac{\sigma^s}{\sigma^s - 1}$
5. EoS b/w local content and foreign content $\theta = 2.38$, a preferred estimate obtained by Blaum et al. (2018)

Varying Importance of OG as a Revenue Source

Selling sector	Share of sales to OG (%)
Agriculture	0.01
Oil & Gas	17.23
Food & Beverages	0.09
Textile & Apparel	0.14
Wood Products	0.03
Paper Products	1.04
Printing & Reproduction	0.39
Coke & Refined Petroleum	2.96
Chemicals & Medicine	2.65
Rubber & Plastic	0.08
Non-metallic Minerals	0.00
Basic Metals	0.10
Fabricated Metals	0.09
Electronic & Equipment	3.56
Motor Vehicles	1.04
Other Transportation Equipment	0.18
Other Manufacturing	1.77
Service	4.05

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Firm-level Compliance Decisions

Sector	Number of:		
	Non-binding firms	Compliers	Non-compliers
Food & Beverages	6,655	6	111
Textile & Apparel	3,648	7	255
Wood Products	999	0	16
Paper Products	412	0	35
Printing & Reproduction	455	0	6
Coke & Refined Petroleum	59	0	8
Chemicals & Medicine	835	28	190
Rubber & Plastic	1,427	1	125
Non-metallic Minerals	1,553	0	57
Basic Metals	184	0	57
Fabricated Metals	651	6	93
Electronic & Equipment	567	29	189
Motor Vehicles	217	4	46
Other Transportation Equipment	166	2	49
Other Manufacturing	1,835	12	83
All	19,663	95	1320

Firm Characteristics by Compliance Status

- Compliers and non-compliers are relatively larger
- Non-compliers are subject to high cost penalties if complying

Firm type:	Compliers	Non-binding firms	Non-compliers
Before LCR imposition:			
Average market share per firm (%)	0.27	0.07	0.28
Average local content (%)	37.1	96.9	11.9
After LCR imposition:			
Average change in unit cost (%)	0.04	0.07	0.01
Average cost penalty κ	1.00	1	1.24

Changes in Sales to Different Sectors

Significant reallocation in the sales to the OG sector after the LCR imposition:

- Non-compliers see declines of their sales to the OG sector
- Compliers and non-binding firms increase market shares in the OG sector

Firm type:	Compliers	Non-binding firms	Non-compliers
		To non-OG sector:	
Average change in sales (%)	-0.5	-0.2	0.1
Change in total sales (%)	-0.2	-0.3	0.1
		To OG sector:	
Average change in sales (%)	13.3	5.8	-34.0
Change in total sales (%)	14.6	0.1	-24.3

Changes in Sales, Value-added and Employment

- The aggregate effect is generally small
- Compliers gain more in employment

Firm type:	Compliers	Non-binding firms	Non-compliers
Change in:			
Total sales (%)	0.1	-0.2	-0.1
Total value-added (%)	0.1	-0.2	-0.1
Total employment (%)	10.8	-0.1	-0.2
		All firms	
Change in the whole economy:			
Total sales (%)		-0.2	
Total value-added (%)		-0.2	
Total employment (%)		-0.1	

Changes in Firm-level and Aggregate Local content

- The increase in LC of compliers is counterbalanced by the small decrease in LC of more numerous non-binding firms and non-compliers
- This is due to the GE effect of LCR that raised domestic input prices

	(1)	(2)	(3)	(4)
	Avg. local content (%)		Agg. local content (%)	
Firm type:	*without LCR*	*with LCR*	*without LCR*	*with LCR*
Compliers	37.13	40.00	36.09	40.00
Non-binding firms	96.92	96.91	91.01	91.00
Non-compliers	11.92	11.91	11.69	11.66
The whole economy			83.96	83.95
OG sector			87.91	87.83

Significant Rises in Price Indexes of Goods Sold to OG Sector

Change in price index (%):	(1) To non-OG	(2) To OG
Selling sector:		
Agriculture	0.01	0.01
Oil & Gas	0.44	0.44
Food & Beverages	0.02	0.75
Textile & Apparel	0.03	3.98
Wood Products	0.04	0.65
Paper Products	0.05	1.19
Printing & Reproduction	0.05	0.24
Coke & Refined Petroleum	0.21	6.46
Chemicals & Medicine	0.13	3.96
Rubber & Plastic	0.06	0.61
Non-metallic Minerals	0.19	2.86
Basic Metals	0.16	5.64
Fabricated Metals	0.12	4.07
Electronic & Equipment	0.04	4.15
Motor Vehicles	0.06	4.34
Other Transportation Equipment	0.03	5.32
Other Manufacturing	0.06	2.03
Service	0.05	0.05

The Effects on Domestic Input Costs and Consumer Price Are Small

Change in domestic input cost (%)	All inputs	Tradeable inputs
Agriculture	0.04	0.04
Oil & Gas	0.79	1.29
Food & Beverages	0.02	0.02
Textile & Apparel	0.06	0.06
Wood Products	0.04	0.04
Paper Products	0.06	0.06
Printing & Reproduction	0.06	0.08
Coke & Refined Petroleum	0.39	0.43
Chemicals & Medicine	0.20	0.26
Rubber & Plastic	0.08	0.09
Non-metallic Minerals	0.26	0.35
Basic Metals	0.28	0.36
Fabricated Metals	0.20	0.28
Electronic & Equipment	0.05	0.06
Motor Vehicles	0.06	0.07
Other Transportation Equipment	0.06	0.07
Other Manufacturing	0.07	0.10
Service	0.10	0.15
Change in domestic price (%)	All goods	Tradeable goods
Final Consumption	0.04	0.04

Concluding Remarks

- We develop a model to quantify the impacts of LCRs, focusing on Indonesia's LCR that promotes the use of domestic content in its upstream OG sector
- The LCR causes substantial reallocation of firm-level sales to the OG sector, but yields small effects on aggregate sales, value-added, and employment
- The LCR imposition raises the average LC of compliers, but slightly depresses the LC of other firms due to higher domestic input costs
- An attempt to increase aggregate local content by imposing LCR may result in unintended consequences

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