Policy Note

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The Potential of Backward Linkages in Rwanda: A Data-Driven Approach to Supplier Development Programmes

In brief

- By fostering linkages between large anchor firms and domestic suppliers, a Supplier Development Programme (SDP) can raise sales, product quality and firm productivity.
- We offer a data-driven approach to SDPs, aimed at selecting high-potential anchor firms and dominant local suppliers, using a new dataset on Rwanda's firm inputs and production.
- Large potential benefits exist from local sourcing of leading domestic products (incl. cement, mattresses, and steel tubes).
- A case-study of the cement industry illustrates why some firms import rather than source locally. Our findings stress that Rwanda should not restrict firms from importing given imports provide vital price competition. Instead, the SDP can be used to better understand the current quality and price constraints of domestic suppliers. This allows for targeted assistance to raise product quality, which offers the most benefit to both anchor firms and domestic suppliers.

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1. Introduction

In recent years, the Government of Rwanda has proposed the establishment of a "Supplier Development Programme" (SDP), which seeks to promote nascent industries and boost the productivity of domestic manufacturing firms by connecting new investors with potential local suppliers. This would be a matchmaking service offered to investors, while also allowing investors to share their requirements and receive quotes from local suppliers (MINEACOM, 2017). Such an SDP holds considerable promise for Rwanda but may be difficult to initiate. The aim of this document is to support such an SDP and suggest a data-driven method to identify target buyer and supplier firms.

In section two, we begin with a brief overview of the potential benefits for improving linkages between anchor firms and local suppliers, and the importance of establishing a supplier development programme.

In section three, we argue that Rwanda can use data from its "Electronic Billing Machines" (EBMs) to better understand each firm's sourcing strategy and production. We will introduce this dataset, and demonstrate how this gives unique insights into Rwanda's firm inputs and production.

Next, section four introduces a new data-driven approach to establishing such an SDP. This could either be done through a product-oriented approach or an FDI-oriented approach. We then offer the main results for both approaches, illustrating which products are dominantly produced in Rwanda, and which goods multinational corporations import goods which most other firms source locally.

Finally, section five presents a case-study of the cement industry to better consider the potential of backward linkages for a specific product. Here we dive into the sector and look more closely at the reasons why some firms choose to import rather than source domestically. Our findings stress that Rwanda should not prevent firms from importing, but should instead use the SDP to better understand the current quality and price constraints of domestic suppliers. This allows for targeted assistance to raise product quality, which offers the most benefit to both anchor firms and domestic suppliers.

2. The Potential Benefits from Promoting Firm Linkages

In recent years, several large multinational firms have started operations in Rwanda (including several big manufacturing plants, agro-processors, airlines and international hotel chains). The economic benefit of such anchor firms could extend significantly if they would increase their share of inputs and supplies purchased locally. When firms choose to increase their share of local content, it provides important direct benefits for domestic producers. Domestic suppliers that have stronger links to large, exporting firms tend to experience larger increases in their overall output and productivity (Spray, 2017).

Improving linkages between domestic suppliers and large exporting firms also brings with it important medium-term learning benefits for domestic suppliers. To meet the high demands of foreign buyers, exporters also require high-quality inputs. To receive these, they tend to be more demanding of domestic suppliers, who in turn are required to learn to produce higher-quality goods (Kugler and Verhoogen, 2012, Bastos, Silva and Verhoogen, 2016). For that reason, Sutton (2014) argues that "the most powerful engine of capability building lies in firm-to-firm interactions in supply chains". Importantly, empirical assessments suggest that vertical supplier relationships, where domestic firms supply goods and services to large exporting firms, are more conducive for generating positive externalities through backward linkages than horizontal intra-industry interactions between domestic firms and exporters (Javorcik, 2004). These medium-term productivity benefits can be considered even more important than the direct effects on increased output, as they tend to drive economic growth, and by signalling the competence of Rwandan industry could even attract additional multinationals to settle in Rwanda (Sen and Logan, 2016).

While large multinationals often express a strong interest in increasing their share of local content, two main challenges prevent them from doing so (Sutton, 2014).

- **Information Asymmetries:** Newly established (international) firms often do not have extensive local networks, and so are unfamiliar with all the inputs that domestic suppliers may be able to provide. As a result, firms rely on their previous set of trusted international suppliers.

- **Quality-constrained local suppliers.** Many firms rely on imports because the specific types of high-quality technical inputs *cannot be found domestically*. Improved local sourcing would thus only be possible if domestic supplies are of comparable quality to imported goods and can therefore function as substitutes.

Improving backward linkages

One approach commonly adopted in countries to stimulate local content use is to rely on *local content regulation* (Sutton, 2014). An example of this can be found in Latin America's car industries, which often had strict local purchase rules for all producers (e.g. x% of certain goods must be purchased from domestic firms). Such rules were generally unsuccessful and had negligible effects on local content use for two reasons. Firstly, it is easy to circumvent such policies through creative accounting practices and deceptive statistics (Sutton, 2014). They are difficult for governments to enforce and raise administrative costs considerably. Secondly, this policy did not explicitly address either of the two constraints to improving local content use mentioned above, namely information asymmetries and quality-constrained local suppliers. Instead, it would force producers to use higher-cost and lower-quality domestic inputs, creating market inefficiencies that would thus *reduce* the overall productivity and competitiveness of the export sector (Spray, 2017). This both discourages foreign investment in the host country and also raises costs to local consumers (Johnson, 2016).

The other approach is to try to use long-term dialogue and training by a designated government agency in order to persuade and facilitate improved local content use for multinationals: the *Supplier Development Programme*. As argued by Sutton, "*What is needed is a small, highly professional team that can liaise with Multinational Firms in a co-operative manner, and with a deep understanding of both (a) local capabilities, and (b) the feasible modes of engagement of local firms in supply-chains"* (Sutton, 2014). Such a facilitation approach is considered superior to regulation because its voluntary nature requires the government to understand and engage with the multinational's current constraints to local content use and provide a solution that aligns with their business interests. To do so, it would tackle both constraints identified above:

- **Address information asymmetries by suggesting local suppliers (firm linkages)**. The SDP would use its knowledge and relationships with local suppliers to 'suggest' possible new linkages.
- **Quality-upgrade local suppliers (firm-specific trainings)**. Based on initially explored potential linkages, the SDP would further work together with the anchor firm to ensure the potential Rwandan supplier receives the appropriate training and capability building to produce the required input specifications and meet the input quality standards.

In contrast to local content regulation, the government's active involvement in matching domestic firms to large exporters ensures improved implementation and monitoring of the use of local suppliers.

The Potential of Supplier Development Programmes

Recent empirical evidence supports the potential of SDPs to improve firm productivity. In Chile, a programme that combined matchmaking services with subsidized credit was found to significantly increase sales, employment, and the sustainability of SMEs (Arraiz et al, 2013). Similarly, a Czech SDP was found to increase sales for about one-third of all participating firms, and for another twenty percent, the programme either helped them to initiate exports or obtain contracts for higher-value-added content (Mariscal, and Taglioni, 2017).

For more detail about the potential reasons for establishing an SDP, and for best-practice on the institutional set-up of such a programme, see Steenbergen and Spray (2017).

3. New Dataset on Firm-Level Sourcing and Production (EBM)

An important part of any SDP is to 'suggest' possible new linkages between firms. However, which 'buyer' firms and 'local suppliers' should be short-listed for potential participation in an SDP? Answering this question requires a deep knowledge of both the sourcing strategy of firms (imports and local content) and

the production and market shares of existing suppliers. While such information could be obtained from a series of firm interviews, such an exercise can be costly and time-consuming. We believe this process can also be undertaken using a new source of economic statistics: Electronic Billing Machines (EBMs).

EBM Dataset

In Rwanda, all VAT-registered companies (exceeding RWF 20 million in annual sales) are required to have an EBM to help in filing their VAT declarations. The EBMs produce official receipts which contain the supplier's tax identification number (TIN), a description of the product sold, its price and quantity. If the product is purchased by another VAT-registered firm, the receipt would also register the TIN of the client. By providing a full census of all formal transactions between VAT-registered businesses, this dataset offers a unique insight into firm-level sourcing (business-to-business transactions) and which products are made domestically. Two challenges have so far prevented the use of EBM data for economic analysis, which have recently been addressed by the IGC: *product classification* and *identifying production from sales*.

The first issue comes from firms manually entering product names onto their EBM receipt. This creates a wide range of different product names, spelling errors and language differences, making it near-impossible to aggregate across different products (e.g. all carbonated drinks). To create a standardised dataset suitable for analysis, every single item description was extracted and classified using a machine-learning algorithm into a 4-digit Harmonised Systems code.[1] Some products were unable to be classified because of missing information, while the algorithm failed to recognise other, more unique items. In total, the classification algorithm was able to recognise around 75-80% of all products sold, with around 80-90% accuracy for each recognised item. In total, 285 different HS4-codes were identified in Rwanda (out of 1250 available codes).

A second challenge for the EBM data is that we only observe sales, rather than production. Taking such observations at face-value would double-count each individual input in final production, therefore overestimating the total estimated amount of goods produced. To account for this, we create a new dataset providing *firm-level estimates of value-added per product*. The challenge here is that while we know how much a firm uses as inputs (from its EBM purchases) and how much it sells (from EBM sales), but we do not know how much inputs are used across all its different sales. To approximate value added per product flow, we therefore use two separate methods. We first assume a constant profit margin for firm S. Multiplying this margin with each product flow gives a value added per flow, defined here as:

(1) $$\text{Constant Profit Margin}_{s} = \frac{(\sum Sales_{S_{EBM}} - \sum Purchases_{S_{EBM}})}{\sum Sales_{S_{EBM}})}$$

(2) $$\text{Product Value Added}_{sp}(\text{constant profit margin}) = \text{Profit Margin}_{s} * \text{Total Sales}_{sp}$$

The second method takes these margins and averages them per product type, per sector. This provides an average profit margin per product per sector, which offers a more realistic and robust approximation of a unit's value added. Using these sector-averaged product profit-margins, we can again define the value added of product p, for firm s, in sector x:

(3) $$\text{Sector/Product Profit Margin}_{px} = \frac{\sum \frac{(\sum Sales_{SX_{EBM}} - \sum Purchases_{SX_{EBM}})}{\sum Sales_{SX_{EBM}})}}{N_X}$$

(4) $$\text{Product Value Added}_{sp}(\text{Sector/product profit margin}) = \text{Profit Margin}_{px} * \text{Total Sales}_{sp}$$

Together, this produces a new value-added dataset for each supplier/client transaction, which we will use as the basis for analysis in the remainder of this paper.

4. A Data-Driven Approach to Supplier Development Programmes

In this section, we illustrate what a data-driven approach to SDPs would resemble. The aim here is to make use of available economic statistics to help identify target firms for an SDP. Next, the programme can then

[1] This is done through a two-step process. A pre-processing stage first 'cleans' the item descriptions by adjusting for spelling errors or translating into English (if the names were in French or Kinyarwanda). The resulting database is then classified to a 4-digit Harmonised Systems code using a Random Forest Classifier (for details, see Nijhoff, 2018).

follow up with these target firms to better understand their constraints (for sourcing or production) and reflect on what type of support would be required to initiate new supplier contracts. We can define two ways to identify target firms for an SDP: a product-oriented approach and an MNC-oriented approach.

Product-Oriented Approach

A product-oriented approach starts from a list of all products (defined by a 4-digit Harmonised Systems code) that are both produced in Rwanda and imported from abroad. For each of these products, we consider the *national share produced domestically* versus imported. We argue that if a dominant share of a product is produced in Rwanda (e.g. >50%), this demonstrates a **domestic revealed comparative advantage** in that product.[2] Rwandan firms have therefore shown a capability to produce this product, highlighting an opportunity for additional (possibly higher-value) production of this good for firms importing this product.

To estimate each product's national share of domestic production, we use our value-added dataset from 2017 EBM transactions. This prevents possible double-counting from using firm inputs (see below). Next, to focus on the potential for domestic sourcing, we restrict the dataset to value added from Business-to-Business (B2B) transactions only. For product p, we then compare this domestic production to imports:

(5) $$\text{Product Share Produced Domestically}_{\text{p}} = \frac{\sum Value\_Added\_Sales_{B2B_p}}{(\sum Value\_Added\_Sales_{B2B_p} + \sum Imports_p)}$$

(6) Firm's Product Share of Domestic Production (Market Share): $$\frac{Value\_Added\_Sales_{B2B_p}}{(\sum Value\_Added\_Sales_{B2B_p} + \sum Imports_p)}$$

To identify the highest-potential products, we restrict the dataset to only those products for which Rwanda has produced at least 50% domestically. We then rank the products by the total value of imports in 2017. Products with high imports and a high share of domestic production seem a good place to start an SDP.

Once the priority goods have been selected, target firms can also be identified. From the buying side, we can consider the biggest importers of that good to understand why they import despite a dominant domestic market. For the supplying side, the SDP could select firms based on market share (e.g. all those with at least 5% market share, or the top three producers). The SDP could interview such firms to better appreciate possible supply-constraints and assess what would be necessary to meet the demands of importers.

Our focus indicator to identify sourcing firms is *each firm's product share that is sourced domestically*. Ideally, for any input, we would use the sum of domestic value-added, compared to imports. Unfortunately, we cannot identify the full value chain for each individual purchase. Instead, we make an adjustment for individual purchases for each client/supplier relationship. For example, if a supplier's imports account for 30% of its sales, and a client purchases $1000, we then assume their total 'domestic purchase' equals 70% of $1000 ($700). Formally, we define 'domestic purchase' (for client c, supplier s) as:

(7) Domestic Purchases: $$\frac{Sales_{scp}}{\sum Sales_{sp})} * (\sum Sales_{sp} - \sum Imports_{sp})$$

The share of product p sourced domestically by firm c can then be defined as:

(8) $$\text{Product Share Sourced Domestically}_{\text{s}} = \frac{Domestic\_Purchase_{cp}}{(Domestic\_Purchase_{cp} + Imports_{cp})}$$

We can then identify potentials for domestic sourcing by comparing each firm's product share sourced domestically to the national share sourced domestically. For products where this ratio exceeds 1, we define the firm as a 'dominant local sourcer'. If this ratio is below 1, we classify it as a 'dominant importer':

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[2] This is analogous to the concept of 'Revealed Comparative Advantage' in international economics. This is used to understand the relative advantage of a certain country in exporting a certain class of goods or services as evidenced by trade flows. In particular, Balassa (1965) defines the revealed comparative advantage of country c in product p by:

$$RCA_{cp} = \frac{E_{cp} / \sum_{p' \in P} E_{cp'}}{\sum_{c' \in C} E_{c'p} / \sum_{c' \in C, p' \in P} E_{c'p'}}$$

where: E = exports, c = country index, C = set of countries. p = commodity index. P = set of commodities. The RCA is equal to the proportion of the country's exports of product p, divided by the proportion of world exports of product p. A comparative advantage is "revealed" if RCA>1. If RCA is less than unity, the country is said to have a comparative disadvantage in the product.

(9) Firm's Product (Dominant Local Sourcer): $\frac{Firm\ Share\ Sourced\ Domestically_p}{National\ Share\ Sourced\ Domestically_p} > 1$

(10) Firm's Product (Dominant Importer): $\frac{Firm\ Share\ Sourced\ Domestically_p}{National\ Share\ Sourced\ Domestically_p} < 1$

General Findings

The main results of the product-oriented approach (top 20) are demonstrated in Table 1. Here we see that there are a wide number of different products that are both imported and extensively produced in Rwanda. Most of these products are consumer products (e.g. bread, milk, beer, mattresses). However, a number of them are business inputs (e.g. cement, yeast and steel tubes). A key example of a 'target product' is cement, where domestic firms imported almost RwF 5 billion in 2017, but for which the domestic market (as defined by EBM data) accounts for around 55% of total production. For almost all the products, we also see that there are a large number of firms which exclusively source locally. In contrast, there are generally a much smaller number of firms importing (often importing in large quantities). The firms appearing in the final column would make for obvious participants in any SDP.

Table 1: Top 20 Potential Target Products / Buying Firms (Product-Oriented Approach)

Hs4	Product Description	Imports in 2017 (RwF Million)	Domestic Share of Production	# Firms 'Dominant Local Sourcer'	# Firms 'Dominant Importer'
2523	Cement	4,844	55%	4,438	100
1905	Bread, Pastry Cakes.	3,415	58%	18,349	126
2202	Waters, Sweetened.	2,840	66%	14,933	329
2009	Fruit & Veg Juice	1,643	51%	8,788	57
2102	Yeasts, Dead Sing-Cell Micro-Org.	1,252	62%	3,451	27
0401	Milk And Cream	1,023	65%	5,076	51
2203	Beer Made From Malt	955	98%	28,547	35
1101	Wheat Or Meslin Flour	613	74%	429	29
9404	Mattress and Bedding	608	79%	7,794	562
7304	Tubes, Pipes (Iron and Steel)	467	70%	1,787	46
4817	Envelopes, Postcards, Stationery	321	77%	6,809	107
6202	Women's or Girls' Overcoats	163	82%	602	46
2005	Prepared Vegetables, Not Frozen	129	84%	3,366	60
1518	Animal/Veg Fats & Oils, Inedible	128	98%	9,472	22
6206	Women's Blouses, Shirts (Not Knitted)	100	82%	711	220
0405	Butter And Other Fats From Milk	67	72%	2,448	26
0709	Vegetables, Fresh Or Chilled	54	79%	1,166	38
2002	Tomatoes, Prepared Or Preserved	54	92%	3,921	39
0210	Meat & Offal, Salted or Dried	53	75%	3,439	5
6106	Women's Blouses, Shirts (Not Knitted)	52	93%	1,537	128

FDI-Oriented Approach

SDPs are often considered effective in helping domestic suppliers link up with international firms. This is because the higher requirements in scale, quality and timeliness of such multinationals can improve the productivity of suppliers and help prepare them to start exporting. If this is the aim, then it would be sensible to initiate an SDP based on the sourcing strategies of large multinationals directly. Follow-up discussions could then help illustrate why these firms import such products despite an existing domestic market, and what would be required for them to source locally. For the supplying side, the SDP could then focus on the selected products, and select firms based on market share (e.g. those with at least 5% market share, or top three producers). The SDP could interview these firms to understand supply-constraints and assess what would be necessary to meet the demands of the MNCs.

To identify the target firms, we replicate the overall approach described above but restrict the sample to MNCs based in Rwanda. Next, we consider all the products imported by MNCs that are also partly produced domestically (e.g. >20% produced domestically). The MNCs which import the highest value of products for which Rwanda has domestic production offer a good target audience for an SDP. Focusing on a small number of highly imported products would then seem most sensible.

General Findings

The overall results of the MNC-oriented approach are presented in Table 2. Here we focus on seven MNCs which have high imports of products that are also produced in Rwanda. This list includes three international hotels, and MNCs in catering, mining, construction and agro-processing. For each dominant item they import, we demonstrate the average domestic share of production and the specific share which the MNC sources locally (rather than imports). Here we see a number of the same products as identified in the previous section (e.g. cement, steel tubes and mattresses), but also reflects a wide range of other inputs such as soaps, textile sacks and bags (packing materials), and steel and iron sheets.

Interestingly enough, this list shows that many MNCs source *some* of their products locally, while simultaneously importing (almost) everything for specific other products. This provides further evidence of the fact that MNCs are willing to source locally, but may not know that domestic suppliers exist. In some other cases (e.g. one of the international hotels), the company appears to import almost every product. This may thus reflect a particularly quality-restricted sourcing strategy. If the SDP could understand which types of product specifications and quality certificates would be needed to meet the demands of such an MNC, it could work together with domestic suppliers to meet these minimum standards. This would likely allow the supplier to source to that MNC, but maybe also export to other international hotels in the region.

Table 2: Potential Target MNCs / Products for Backward Linkages (MNC-Oriented Approach)

MNC	Product Description	Imports in 2017 (RwF Million)	Domestic Share of Production	Firm's Domestic Sourcing Share
CATERING MNC	Meat & Ed Offal Of Poultry	33	88%	0%
	Cheese And Curd	6.9	37%	5%
	Carrots, Turnips & Other Edible Roots	0.3	69%	0%
	Coffee, Coffee Husks	1	95%	0%
	Cereal Flours	0.2	37%	29%
	Veg Fats & Oils	0.5	52%	0%
	Sausages	16.8	35%	0%
	Pasta, Prepared Or Not	0.4	28%	53%
	Bread, Pastry Cakes.	125.2	58%	0%
	Tomatoes, Prepared Or Preserved	5.2	92%	7%
	Prepared Vegetables, Not Frozen	2.8	84%	1%
	Fruit & Veg Juice	0.4	51%	71%
	Food Preparations Nesoi	69.1	41%	1%
	Women's Blouses & Shirts	1	93%	0%
MINING MNC	Cement	71.3	55%	8%
	Articles Of Plastics (Inc Polymers & Resins)	0.4	26%	32%
	Textile Sacks & Bags (Packing Goods)	10.4	40%	0%
	Footwear	2.2	28%	0%
	Flat-Roll Iron and Steel (600Mm)	9.1	26%	4%
	Tubes, Pipes (Iron and Steel)	150.3	70%	0%
	Household Articles (Iron and Steel)	0.5	26%	0%
CONSTRUCTION MNC	Vegetables, Fresh Or Chilled	0.3	79%	28%
	Dried Fruit, Mixtures Of Nuts & Fruit	0.2	22%	9%
	Sausages	0.2	35%	53%
	Pasta, Prepared Or Not	1.6	28%	34%
	Food Preparations Nesoi	0.8	41%	92%
	Cement	133.6	55%	47%
	Paint & Varnish	4	20%	0%
	Soap	1.4	22%	22%
	Articles Of Plastics (Inc Polymers & Resins)	0.4	26%	53%
	Toilet Paper, Paper Tissues, Towels	1	85%	45%
	Ceramic Tableware	1.1	28%	24%
	Tubes, Pipes (Iron and Steel)	2.5	70%	0%
	Household Articles (Iron and Steel)	3.8	26%	2%
	Mattress and Bedding	1.3	79%	61%
INTERNATIONAL HOTEL	Paint & Varnish	20.7	20%	0%
	Plastic Floor Cover (Rolls & Tiles) & Wall Cover	44.8	45%	0%
	Articles Of Plastics (Inc Polymers & Resins)	5.5	26%	0%
	Wooden Tools & Brooms	1.8	73%	0%
	Articles Of Wood	1.5	39%	0%
	Ceramic Tableware	12.9	28%	0%
	Tubes, Pipes (Iron and Steel)	7.8	70%	0%
	Household Articles (Iron and Steel)	17.7	26%	0%
	Mattress and Bedding	26.9	79%	0%

Table 2: Potential Target MNCs / Products for Backward Linkages (MNC-Oriented Approach) - Continued

MNC	Product Description	Imports in 2017 (RwF Million)	Domestic Share of Production	Firm's Domestic Sourcing Share
INTERNATIONAL HOTEL	Birds' Eggs	1.9	21%	0%
	Cement	26.2	55%	52%
	Paint & Varnish	0.9	20%	1%
	Plastic Floor Cover (Rolls & Tiles) & Wall Cover	1.3	45%	0%
	Articles Of Plastics (Inc Polymers & Resins)	18.9	26%	1%
	Articles Of Wood	3.7	39%	0%
	Toilet Paper, Paper Tissues, Towels	1.2	85%	50%
	Ceramic Tableware	1	28%	20%
	Flat-Roll Iron and Steel (600Mm)	6	26%	1%
	Household Articles (Iron and Steel)	59.3	26%	0%
	Mattress and Bedding	7.6	79%	25%
INTERNATIONAL HOTEL	Paint & Varnish	0.3	20%	0%
	Soap	12	22%	1%
	Articles Of Plastics (Inc Polymers & Resins)	4	26%	4%
	Men's underpants	3.5	42%	0%
	Ceramic Tableware	16	28%	1%
	Household Articles (Iron and Steel)	47.4	26%	0%
	Mattress and Bedding	30.8	79%	4%
AGRO-PROCESSING MNC	Cereal Flours	38.9	37%	0%
	Food Preparations Nesoi	33.5	41%	52%
	Articles Of Plastics (Inc Polymers & Resins)	6.1	26%	6%
	Textile Sacks & Bags (Packing Goods)	1.4	40%	0%
	Ceramic Tableware	1.9	28%	5%
	Flat-Roll Iron and Steel (600Mm)	1.6	26%	9%
	Tubes, Pipes (Iron and Steel)	8.1	70%	0%

5. Case-Study: Cement

In this section, we look in detail at one particular product which was highlighted in both the FDI- and product-oriented approach as a key sector with potential for domestic growth. Indeed, the Rwandan government included construction materials in the Domestic Market Recapturing Strategy (2015) given expected high demand growth[3], available raw materials and domestic capabilities[4], and Rwanda's location making imported cement relatively uncompetitive.[5]

In this section, we argue that cement is an excellent product to target for domestic market recapturing for these reasons, and just as importantly, cement has an extremely large influence on upstream and downstream sectors.

We then show that the current price of Rwandan cement is high relative to the import price and the price of cement in Uganda. This hurts consumers and producers using cement as an input. We provide some tentative evidence that this difference in price may be connected to a lack of competition given prices paid by firms in different locations and in different sectors differ markedly.

Finally, we look at which firms are the largest importers of cement showing that firms that Rwanda has supported through investment incentives import more than those which have not.

We therefore suggest a policy of encouraging further entrants into the cement sector to increase competition while also working with investors to try to encourage them to source locally. We do not suggest any policy to directly increase the cost of imported cement as we believe imported cement is helping to keep prices low for consumers.

[3] Demand for construction materials is extremely high and likely to grow. Rwanda anticipates greater demand in future years driven by the building boom especially in the tourism industry and due to rapid population growth.
[4] Rwanda already has expertise in the construction materials sector making growth in the sector more feasible. CIMERWA has existed since 1982 and has an annual capacity of 600,000 tonnes per year alongside other suppliers such as Kigali Cement.
[5] Importing building materials is extremely expensive given they are bulky and relatively low value. However, the raw materials are available locally, giving Rwandan firms an advantage in production given they are protected by Rwanda's geographical location.

Investment in cement has key benefits beyond the direct effect on the factory

A key benefit of growth in the construction sector is its long-reaching impact on other firms. Figure 1 demonstrates this point by looking at trade from Rwandan cement factories with their immediate customers and suppliers. The two blue dots represent cement factories that we observed in the EBM data. These firms purchase inputs such as iron ore and service inputs from 109 different firms (denoted in orange). They also sell cement to 122 different customer firms (denoted in green), these are mostly wholesale outlets and large construction firms. Without the presence of the cement factories as anchors to the economy, it is likely that many of these 231 companies wouldn't exist.

Figure 1: Cement factories, their suppliers and customer

Cement input suppliers (orange) *Cement Factories (blue)* *Cement customer firms (green)*

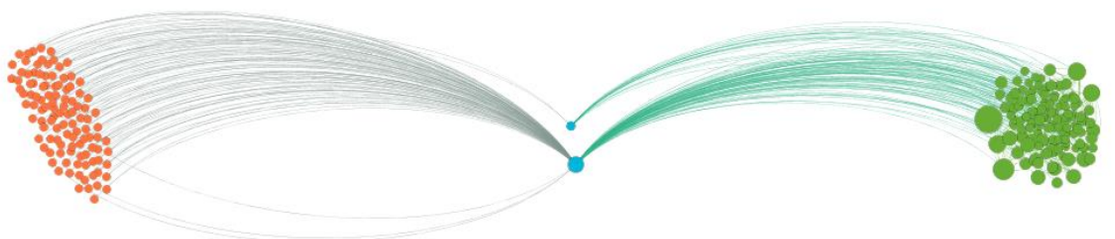

Figure generated using data from EBM machines. Each node indicates a firm: blue dots denote cement factories, orange dots denote cement input suppliers, and green dots denote firms who purchase from the cement factory. Node size indicates the number of firm connections.

Figure 2: Cement factories, their suppliers, customers and customers-customers

Cement input suppliers (orange) *Cement factories (blue)* *Factory customers (green)* *Customers of factory customers (purple)*

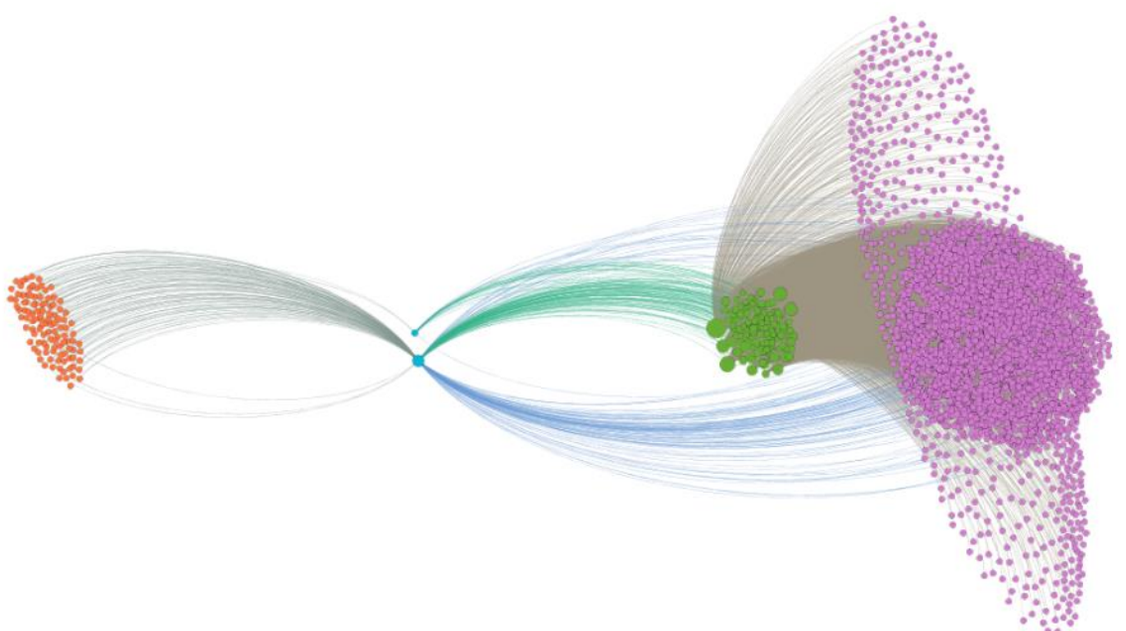

Figure generated using data from EBM machines. Each node indicates a firm: blue dots denote cement factories, orange dots denote cement input suppliers, and green dots denote firms who purchase from the cement factory. Node size indicates the number of firm connections.

The far-reaching effects of cement factories are highlighted even more clearly in Figure 2 which includes an additional layer of firms which are customers of the cement factories customers (denoted in purple).

These firms are mostly small retail outlets or smaller construction companies which purchase cement from the larger wholesalers in the third layer. In total there are 5431 of these firms, making the total sum of firms directly or indirectly connected to cement factories equal to 5664. Each of these firms provides a vital input into the economy as well as providing jobs and incomes and demonstrate how vital the cement producers are to the Rwandan economy.

Import price substantially cheaper than price on the domestic market

While there are clear positives to targeting the cement sector. One major concern for growing the sector is that the price paid for imported cement by importers is substantially below the market price of cement. Figure 3 shows the distribution of the import price of cement compared with the distribution of domestic price for cement. You can clearly see that the average price on the domestic market (8488RWF) is close to double the average import price (4484RWF) and 1.3 times the price in the Ugandan market (6612RWF)[6] and 1.9 times the price on the Tanzanian market (4377RWF)[7]. Naturally, we would expect import prices to be lower than retail prices given firms must pay transport costs, transaction costs and make some profit margin. However, the difference in price is stark and could indicate a lack of domestic competitiveness or firms abusing their market power. Both of which should be a major concern.

Figure 3 Cement import and market price

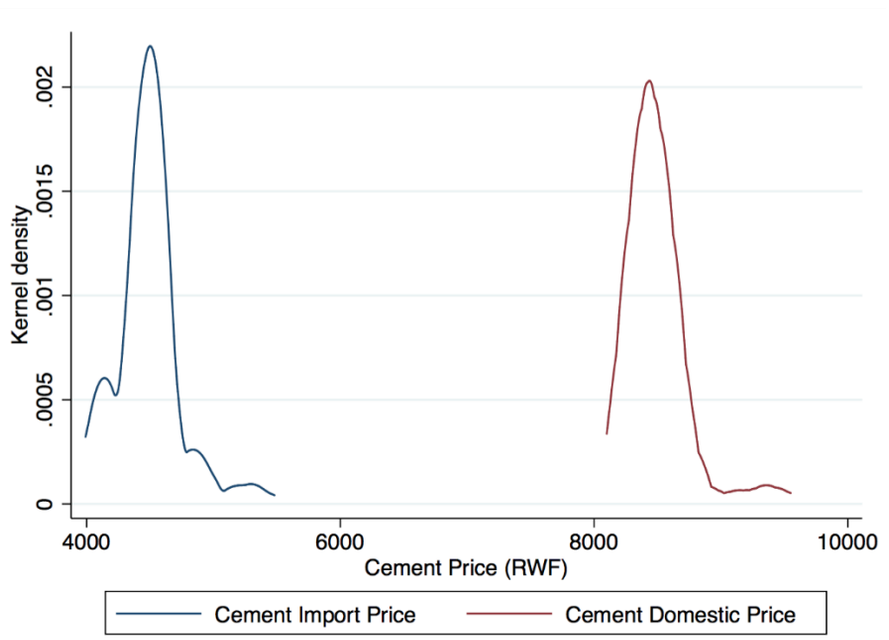

Figure generated using data from EBM machines and ASYCUDA customs data. The x-axis shows the average price of cement in RWF, the y-axis shows the density of observations of this price.

Prices remain high and vary across the country and within sectors

One piece of evidence consistent with firms having market power is setting different prices for different segments of the market in order to extract a higher price from those more willing to pay. In a competitive market, these rents are undercut by competitors offering lower prices. Figure 4 shows the distribution of cement prices in different regions of the country. The average price for a 50kg bag of cement was

[6] MTIC Brief on Cement Prices (2018), Old Prices, http://www.mtic.go.ug/index.php?option=com_content&view=article&id=286:brief-on-cement-prices&catid=10:current-news&Itemid=118

[7] http://www.thecitizen.co.tz/News/Business/Cement-prices-escalate-on-rising-production-costs/1840414-4050146-7nk1o6/index.html

8488RWF, however, this hides substantially variability in price across the country. Average cement prices in Kigali City are 126 RWF cheaper than the most expensive province in the South. Variation in price across provinces could hurt deprived areas of the country which crucially need access to cement inputs. One possibility is that the price difference is simply a function of higher transportation costs, However, Figure 4 also shows that even within each region there is substantial price variability. To demonstrate this consider that the medium price for a bag of cement in Kigali is 8400RWF, however, the price paid in 10% of cases is greater than 8700RWF.

Figure 4 Cement prices in different provinces of Rwanda

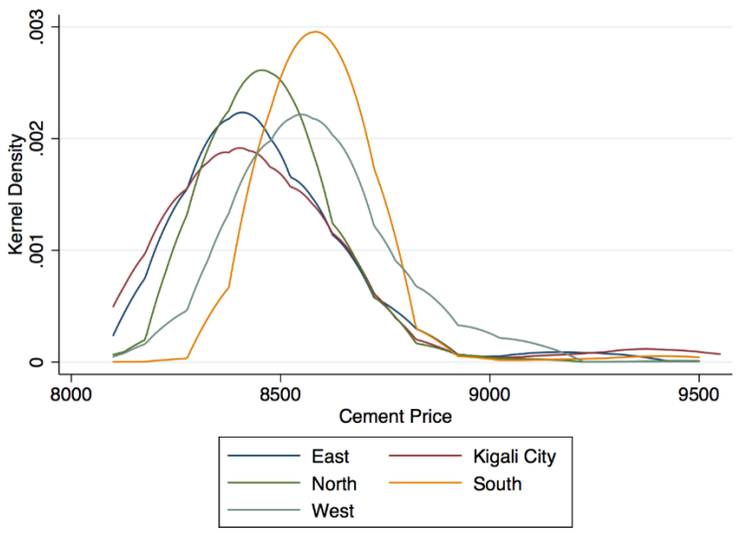

Figure generated using data from EBM machines. The x-axis shows the price of cement in RWF, the y-axis shows the density of observations of this price.

This price variability also exists across different buyer sectors. Figure 5 shows the average price paid by different client sectors for cement. Whereas wholesale and retail trade, transportation and storage, and large infrastructure sectors (electricity, water and gas) pay below the average price, other sectors such as education, health and mining pay above the average market price. This type of variable pricing could hurt sectors which are unable to negotiate lower prices and may indicate some level of market power among cement retailers.

Figure 5 Average cement price by buyer sector

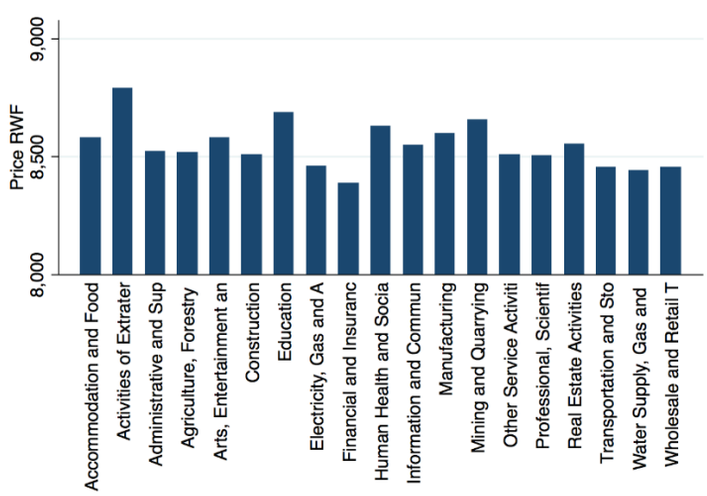

Figure generated using data from EBM machines. The y-axis shows the average price of cement in RWF, the x-axis shows the buying firms sector.

Still a substantial proportion imported. What distinguishes these firms?

As noted above, there is still a substantial proportion of imported cement on the market and this cement may well be cheaper than domestically produced cement. In this last section, we consider what characterises importers of cement.

Figure 6 shows the proportion of firms who directly import 0% cement, between 1-50% of their cement and between 51-100% of cement broken down into whether or not this firm is a domestic, foreign or not an investor. The first thing to note is that the vast majority of firms do not import any cement. This is true for both domestic, foreign and non-investors.

Firms that import 1-50% of cement are more likely to be international investors. This could be because these firms are sufficiently large enough to pay the fixed costs of importing or maybe a consequence of investment incentives.

Firms that import 51-100% of cement are more likely to be domestic investors, especially in the wholesale and retail trade.

Table 3 breaks down the 21 firms which import greater than 50% of their cement inputs into their main sector. Unsurprisingly, the largest sector with 8 firms is the wholesale and retail trade sector. This is consistent with firms importing cement to sell on the domestic market. The construction sector is the second biggest followed by the manufacturing sector. These are likely to be large firms who may have received investment incentives. What is interesting to note is that in all of these sectors some firms are choosing to buy local cement whereas others are choosing to purchase imported cement suggesting a viable sourcing strategy is to use locally produced cement.

Figure 3 Fraction of firms who import x% of cement by investor type

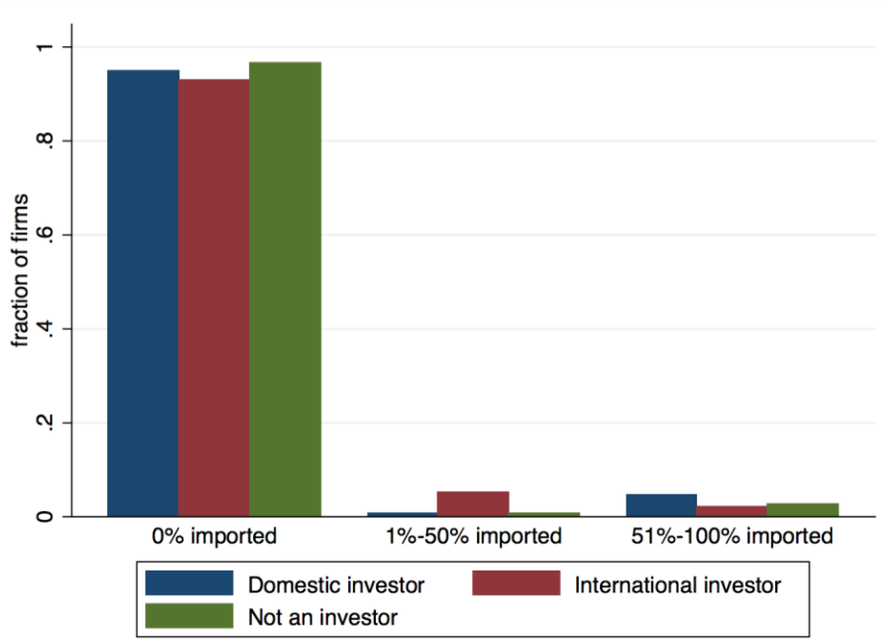

Figure generated using data from EBM machines, ASYCUDA customs data, and investor database. The x-axis shows the proportion of purchased cement which is imported separately calculated by whether the firm is a domestic investor, foreign investor or not an investor.

Table 3: Sector of firms which import >50% of cement

Sector	Frequency	Percent
Accommodation and Food	1	4.76
Construction	3	14.29
Education	1	4.76
Manufacturing	2	9.52
Mining and Quarrying	1	4.76
Other Service Activities	1	4.76
Professional, Scientific	2	9.52
Real Estate Activities	1	4.76
Water Supply, Gas and	1	4.76
Wholesale and Retail Trade	8	38.10
Total	21	100.00

Table generated using data from EBM machines and ASYCUDA customs data.

Cement Case Study Conclusions

This case study shows that cement is a crucial sector for the Rwandan economy and an excellent sector to target for domestic recapturing due to its large number of backward and forward linkages. However, prices of cement on the Rwandan market are extremely high when compared to import prices and retail prices in neighbouring Uganda and Tanzania. One likely explanation for this is market power among cement retailers in Rwanda which is supported by evidence of firms setting different prices to different sectors of the market and by the relatively small number of firms operating in this sector. Another possible explanation is low productivity of factories, although this should be addressed by recent large investments by CIMERWA[8]. Finally, this paper showed that only a small number of firms import a large amount of cement. However, these firms are over-represented by both domestic and international investors perhaps indicating government investment incentives allow these firms to cheaply import.

In order to further the government's goals of boosting cement production and competitiveness in Rwanda we advocate for three policy goals:

1) Encourage further entry into the sector to reduce market power and increase competition in order to drive down prices.
2) Consider removing investment incentives on duty-free imported cement. However, we do not suggest putting up further barriers to importing as imported cement provides a crucial level of competition to domestic producers ensuring prices do not rise further.
3) Working with large cement importers to see if their demand might be met by the local producer.

6. Future research using EBM data

We hope that this small piece of research is useful to the government in internalising the rich set of projects that can be undertaken by utilising the EBM dataset. We think that more work could be undertaken with close collaboration with the RRA, RDB and MINICOM. Below we propose two new projects.

[8] The East African, 2018, http://www.theeastafrican.co.ke/business/Cimerwa-resumes-cement-production-after-break-/2560-4492450-13vko83z/index.html

1) Impact of exchange-rate depreciation on firm pricing

The steady nominal depreciation of Rwandan Franc has been an important concern for the Rwandan economy. Against the US Dollar, the Franc has depreciated to almost three fourths over the last five years. Some have argued that the depreciation may increase the price of imported products, leading to an increase in consumer prices as well as production costs for domestic producers and exporters (IMF, 2017). Others have argued that this is a natural reflection of the increasing import demand (The East African, 2017), and may help to spur export competitiveness (Newfarmer, 2010). Hence, to understand the real economic impact of the depreciation (or more generally, exchange rate fluctuations), it is necessary to understand how **nominal exchange rate fluctuations pass through to input and final goods prices along the supply chain networks.**

To investigate this issue, we will analyse **firm-to-firm and firm-to-consumer receipts level data from the Electronic Billing Machines (EBMs) in Rwanda**. More concretely, the analysis takes the following steps:

(i) **Analyse whether and how much the nominal exchange rate fluctuations affect the import prices.** Border prices may respond to exchange rates if the prices that exporters to Rwanda charge do not adjust flexibly *in foreign currency*. This is a necessary condition for exchange rate fluctuations to affect domestic prices.

(ii) **Analyse whether the changes in border prices affect prices that final goods consumers incur.** Depending on the supply chain structure, there may be multiple layers of firms (i.e., production stages) between the border and the final goods consumers.

(iii) **Analyse how these patterns of price pass-throughs are mediated by changes in the domestic and international trading network**. For example, if the border prices of raw materials from the US become more expensive due to the depreciation of Rwandan Franc relative to USD, firms may switch to domestic suppliers, or towards EAC exporters (given the Rwandan Franc appreciated against regional partners over the same period). Understanding how firms and consumers substitute to different inputs and final goods could also inform the design of import substitution policies (e.g. Made in Rwanda Initiative).

2) Publicly available supplier-database

The Made in Rwanda initiative makes a strong argument for making some information about firms publicly available.

"*A history of profitability verified by income tax receipts may convince a bank to offer more lenient repayment terms, and a bank may be less averse to lending to an emerging sector if reliable information is available about business trends. Similarly, a track record of large supply contracts evidenced by VAT receipts may convince an international investor that a local company has the supply capacity to deliver on large orders. Such integration of information gleaned from tax data may also have the additional benefit of making it more attractive for companies to report accurate turnovers and incomes in order to improve their standing with potential buyers*." Made in Rwanda, p.39, 2017.

We understand from the RDB that work is underway to implement such a database but could be **supported by assistance from outside researchers to implement best practice in both the design and evaluation of the project**. We suggest undertaking the following strategy:

i) **Make a high-quality website with search features in a similar vein to the Yellow Pages or Yelp** and incorporates basic information about firms including firm name, location, contact details, sector, and main products.

ii) **Consider adding additional information such as a summary of trades made by firms to other firms, the value of the transaction, details on the recipient firm (whether they are**

an exporter, FDI, etc.), and quality certification from RSB. This information could provide buyers with crucial information about the firm's previous reliability, their ability to meet big contracts from exporters or foreign firms, and their years of experience.

iii) **We suggest running a pilot phase of the programme where only some industries are included and only including firms above a designated size.** This will ensure the project can be properly evaluated and ensure that firms included in the database are of sufficient quality.

iv) **We suggest training firms on the use of website through designated training days.** The IGC could support this training activity. In order to evaluate the project, we suggest only training a subset of firms.

We are happy to assist with setting up and evaluating this project using best practice academic research techniques.

7. Conclusion

This paper had three aims.

First, to consider whether Government of Rwanda tax data can be used to target products and firms in a Supplier Development Programme. Utilising this new data we were able to create a new index of product viability for domestic market recapturing based on a combination of the current import volume, domestic share of production, the number of firms which source more than average locally. We were able to identify twenty products which are suitable for development based on this index with cement coming top of the list.

Second, we considered which products foreign investors could source locally. We focused on seven MNCs which have high imports of products that are also produced in Rwanda. We observed that target products were similar to the previous section (e.g. cement, steel tubes and mattresses), but also reflects a wide range of other inputs such as soaps, textile sacks and bags (packing materials), and steel and iron sheets. We observed that MNCs source *some* of their products locally, providing strong evidence of the fact that MNCs are willing to source locally, but may not know that domestic suppliers exist. In some other cases, the company appears to import almost every product. This may thus reflect a particularly quality-restricted sourcing strategy. If the SDP could understand which types of product specifications and quality certificates would be needed to meet the demands of such an MNC, it could work together with domestic suppliers to meet these minimum standards. This would likely allow the supplier to source to that MNC, but maybe also export to other international hotels in the region.

Third, we looked in detail at a product which was clearly highlighted as having high growth potential by both the product- and FDI-oriented approached, cement. We showed that cement makes sense to target given its many links to the rest of the economy. However, we identified the high price with respect to imported cement as a key constraint to further growth. We found suggestive evidence of market power as a potential cause of these high prices. We therefore suggest encouraging further entry into the sector and not restricting import products as imported cement provides vital competition. We identified a list of large local and foreign-owned companies which source a large amount of imported cement. We suggest working as an intermediary between these companies and the main cement producers to see what constrains cement being sourced locally.

Finally, we would like to continue to provide the Government of Rwanda research utilising this rich data. We have suggested two potential projects which may be of use in identifying and addressing some of the constraints identified in this report.

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