CHAPTER 5

Estimated Impacts and Political Economy of Long Dwell Times

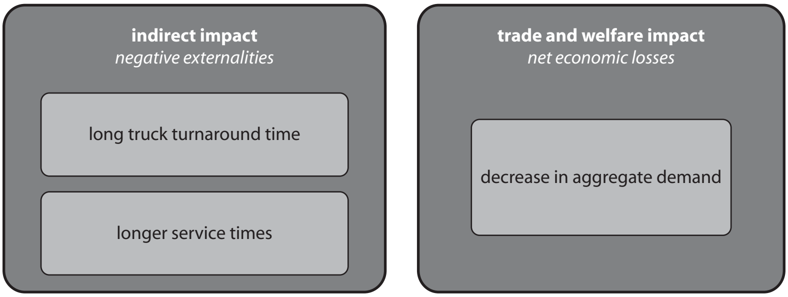
We now analyze the indirect and extended impacts of long dwell times, which are not negligible, especially for the consumer (figure 5.1).

Indirect Impact

The indirect impact of long dwell times, defined as the impact on other containers stored in the yard, can be measured in terms of service time (yard productivity) and truck turnaround time (gate productivity). Long container dwell times increase the congestion factor (defined as the ratio of waiting time to service time) and generate additional idle time in the physical handling of operations. At the same time, high occupancy rates hamper rehandling productivity because they lead to higher storage density and stacking heights and thus longer delays in delivery.

Indirect congestion costs are difficult to measure. We need to estimate, for example, precisely what increase in unit service time is strictly imputable to higher capacity utilization and what is imputable to other factors, such as shift or equipment productivity. In addition, in a multiple-stage process such as port clearance, serial queuing occurs, and congestion at one stage can have a serial effect on other stages.

Figure 5.1 Summary of Main Negative Impacts of Long Container Dwell Times in Sub-Saharan African Ports



Source: Authors.

Berth Congestion

We start by applying the widely used queuing models to estimate the impact of long dwell times on berth queuing. Queuing models are generally defined using an *X*/*Y*/*n* notation, where *X* denotes the arrival profile, *Y* denotes the departure profile, and *n* denotes the number of service channels. Models used in the port literature generally assume that berths are identical and that a homogeneous fleet of ships calls in the port on a first-come, first-served basis (Fourgeaud n.d.). The pattern of arrival and the distribution of service times are often simulated using an implicit statistical law called Erlang distribution, starting from the basic random distribution (Erlang 1) and moving to increasingly regular ones (Erlang 2, 3…) . Using the E2/E2/2 queuing model, for example, in a two-berth port, the congestion factor simulated with an average occupancy rate of 70 percent would be 41 percent, meaning that the average berth waiting time represents about 41 percent of the average berth service time.

Yard Congestion

Other patterns of congestion are also evident at the yard level, and these patterns have received little academic attention. Nevertheless, high occupancy creates congestion effects and eventually affects the service time of containers. We can model these effects using the theory of highway congestion, with service time in port being the equivalent of travel time on highways. Highway congestion models of the following form have been developed with the objective of estimating congestion factors caused by heavy traffic, and they can be used in a similar manner in port congestion analysis (see Sanders, Verhaeghe, and Dekker 2005 for similar work). The equation of service time is of the following form:

$$t = t_{ff}\left(1 + b\left(\tfrac{N}{K}\right)^k\right), \tag{5.1}$$

where t_{ff} is free-flow service time, N is traffic volume, K is design capacity, and b, k are parameters. If we assume, for example, a "free-flow service time" of about 120 minutes (truck movements, reachstacker movements, container handling, and stiffing) and an occupancy rate of 90 percent,[1] service time would peak at 194 minutes as a result of high occupancy. The additional service time as a result of long dwell times is therefore estimated at 74 minutes per container transiting through the yard.

To convert this congestion effect into monetary terms, we again use an estimate of average daily cargo opportunity cost of FCFA 50,000, and the resulting indirect congestion effect is of FCFA 2,570 per container in the yard.

Rehandling and Final Delivery Costs

An additional indirect cost of high dwell times is the rehandling cost caused by higher yard occupancy rates. When yard occupancy increases, stacking height and storage density also increase and the delivery of containers onto trucks may require additional moves. In an attempt to estimate this number of additional rehandles, Huynh (2006) distinguishes between two stacking configurations: nonmixed storage and mixed storage.[2] In a high-occupancy context, the terminal operator has no choice but to adopt mixed storage with stacking heights of three to four containers or higher. The increasing container dwell times result in a sharp decrease in rehandling productivity that is all the more significant because containers at the bottom of each stack are more likely to be scheduled for delivery first. Using Huynh's model, there would be an average of three rehandles for each delivery in congested Sub-Saharan African ports, which would have a substantial impact on both cost to the operator and truck turnaround time. Cost to the operator can be estimated as half of the handling cost charged to the client (average FCFA 27,500 observed in the ports studied), while the impact on truck turnaround time alone is quite significant (two daily rotations of a truck between the city and the port instead of three), resulting in higher delivery costs.[3] Therefore, we estimate that because of these rehandling issues and longer servicing times, rehandling costs of about FCFA 13,750 are charged to the client, while the truck deliveries per container are 33 percent higher, with a corresponding cost of about FCFA 42,900 per container.[4]

Aggregate Indirect Impact of Long Cargo Dwell Times in the Port of Douala

Our estimate of the aggregate indirect impact of long cargo dwell times in Douala is FCFA 68,019 per container—that is, an average 0.7 percent of cargo value or approximately one–quarter of port charges at Douala (table 5.1).

Trade and Welfare Impact

Beyond cost considerations, longer dwell times also have consequences for trade and welfare. Long dwell times can first be treated as a technical barrier to trade because of the additional cost of imports and exports. USAID (2004), for example, estimates this cost to be US$18 per 20-foot equivalent unit (TEU) for the port of Puerto Limón, Costa Rica, and computes an additional tariff of 0.517 percent on container imports and exports. A general equilibrium model is then used to aggregate the impact of this tariff on the whole Central American region; the net welfare impact that would result from a reduction in dwell time in the port of Puerto Limón is estimated to be US$76.5 million annually.

The net welfare impact is therefore treated as the combination of two factors: an additional cost on imports (equivalent to a tariff increase) and a subsequent reduction in trade volume. We treat these two effects separately. We estimate the additional cost on imports in the two previous sections (direct and indirect cost effects). To measure the impact of long cargo dwell times on trade volume, we now estimate (a) the impact of

Table 5.1 Indirect Effects of Long Cargo Dwell Times on Other Containers Stored in the Yard of Douala Port

Indirect effect	*Estimated cost (FCFA)*	*% of cargo value*
Berth congestion	22,550	n.a.
Yard congestion	2,569	n.a.
Rehandling	13,750	n.a.
Truck delivery	42,900	n.a.
Total per container	68,019	n.a.
% of cargo value	n.a.	0.7

Source: Authors.
Note: n.a. = Not applicable.

long dwell times on prices, (b) the price elasticity of demand, and (c) the net loss in volume that is a consequence of both factors.

Impact of High Dwell Times on Prices

The impact of high dwell times on prices depends on the competitive context in which firms operate. In the case of monopolistic or oligopolistic companies that operate as price setters, the increase in factory prices as a result of longer dwell times may be fully reflected in final prices, with a limited impact on market share. The conclusion is, however, different in the case of price-taking companies in perfect competition, where market players refrain from increasing prices even if logistics costs are higher because they are afraid of losing market share to their competitors. These considerations of the short-term impact of long dwell times do not prevent us from assuming that higher dwell times inevitably result in upward pressure on prices in the medium term. Market players would eventually reflect the full logistics costs of products in their final prices. We assume, therefore, that in all situations considered, the perceived cost of long dwell times is fully reflected in final prices.[5]

Price Elasticity of Demand

To derive the impact of additional logistics costs on trade volume, we now estimate the price elasticity of demand. Scarce data are available on the price elasticity of demand in Sub-Saharan African economies. Agbola (2003), using household surveys conducted in South Africa, concludes that price elasticity would be in the range of 0.67–1.25 for food products. In their review of the literature on trade policy in South Africa, Edwards, Cassim, and Seventer (2009) find that estimated aggregate import price elasticities range from −0.53 to −1.04 and update these studies using cointegration analysis with quarterly data from 1962 through 2004. They include a measure of tariff protection, using collection duties, in the import demand function and control for the effect of domestic income and import prices relative to domestic producer prices. Their estimates indicate a long-run import price elasticity of –0.98. Unfortunately, little similar work has been performed for other Sub-Saharan African countries, and therefore, we use this value as a conservative estimate of the price elasticity of demand in lower-income African countries.

A representative value of average dwell times in Sub-Saharan African ports is 20 days. Using FCFA 9.37 million as the average value of cargo and assuming that additional costs are fully reflected in final prices, as discussed in the previous section, long dwell times therefore lead to an estimated price increase of about 10.3 percent in our example. In addition, there is an extra indirect cost of about 0.7 percent. In total, the price increase due to long dwell times is estimated as 11 percent of the market price. Given the price elasticity of demand of 0.98, assumed above, we can therefore broadly estimate that long cargo dwell times in a typical Sub-Saharan African port would lead to an average decrease of about 10.78 percent in the aggregate demand for imports of containerized cargo in Sub-Saharan African countries. This is a pure loss to the economy.

Containers account for about half of the total volume of imports in Sub-Saharan African countries (UNCTAD 2009). The net welfare loss to the economy of 20 days average container dwell time in Sub-Saharan African ports, as opposed to average dwell times shorter than seven days in most developed economies, is therefore considered equivalent to the net welfare loss that would result from a 5.39 percent reduction in the volume of total imports. This loss is estimated in monetary terms as the net difference between market prices and consumer willingness to pay (consumer surplus) and market prices and purchasing costs (trader surplus). Market prices only tell us the minimum amount that people who buy the good would be willing to pay for it; in practice, the economic benefit they get from buying the good is higher. Accordingly, traders benefit from their sales by applying a markup to their purchasing cost.

It is challenging to estimate losses in both consumer surplus and producer surplus resulting from a 5.39 percent decrease in total imports without having actual information on products and markets. Nevertheless, it is possible to conclude that the net welfare loss to the economy accrues to a significant portion of the market value of the total imports of a country.[6]

The Political Economy of Dwell Time in Sub-Saharan Africa

If we exclude Durban and, to a lesser extent, Mombasa, most ports in Sub-Saharan Africa have average cargo dwell times of longer than 15 days (compared to three to four days in most large international ports).

The main findings of the previous chapters demonstrate that the level of professionalism of importers and clearing and forwarding (C&F) agents and the strategies of shippers have a major impact on cargo dwell time.

Even more important, market structure of the private sector explains the hysteresis of cargo dwell time. For instance, C&F concentration has two main adverse effects on dwell times: (a) the weak negotiating power of clients with these main C&F agents, which leads to a low level of service, and (b) the development of low-cost unprofessional C&F agents who have no choice but to compete for the rest of the market on price at the expense of quality.

Firm analysis and case studies have also demonstrated that low competency and cash constraints explain why most importers do not seek to reduce cargo dwell time because, in most cases, doing so would increase their input costs. Moreover, monopolists-cartels may have a stronger incentive to reduce cargo dwell time, but the goal is to maximize profit (and not to adjust prices downward).

Most ports in Sub-Saharan Africa suffer from a vicious circle in which long cargo dwell time (two to three weeks) benefits the stakeholders and constitutes a strong barrier to entry in global markets. It also explains why most industries, which are not time-sensitive, such as exports of raw materials or minerals, prosper and why time-sensitive ones (those that add value) do not.

This also explains why cargo dwell times have not declined substantially for years: the pressure from the private sector is not real in most cases and enables some importers to remain competitive by avoiding worldwide competition. It could also explain why most trade facilitation measures, such as community-based systems in ports, have faced so many difficulties in implementation in Sub-Saharan Africa. Transparency in this environment is synonymous with reducing multiple rents and increasing real competition. There is then a coalition of interests in favor of the status quo; unless some practices are amended in the public and private sectors, long cargo dwell time and lack of assembling trade will persist.

Moreover, terminal operators may have incentives that also affect dwell time. Given that storage tariffs generate revenue for the port operator, the optimal policy could be to increase dwell time for terminal operators in Sub-Saharan Africa, especially when there is no congestion.

Finally, in a competitive environment, port authorities want to reduce dwell times and increase the overall efficiency of port operations for attracting more traffic. However, port authorities might be interested in increasing dwell times for the following reasons: (a) because employees receive informal payments as total revenues in the port increase and (b) longer dwell time provides an excellent justification for increasing port capacity, which means additional funding for infrastructure investments (all the more if donors are ready to finance infrastructure investments). In this context, importers, terminal operators, and port authorities do not have a strong incentive to reduce cargo dwell time.

The potential number of actors who may drive change both in private industry and in the logistics business is therefore much lower than generally anticipated, all the more so because the adjustments (including for these potential allies) are significant and do not guarantee an impact, as all players need to contribute for any system to yield results.

Notes

1. Yard occupancy rate observed, for example, in Douala in October 2010.
2. In nonmixed storage, every containership load is stored separately in the terminal; in mixed storage, new containers can be stacked on top of containers already stored in the yard. Nonmixed storage is generally more efficient.
3. Handling costs are set by the concession agreement and cannot be increased, regardless of the additional number of rehandles (interviews with trucking companies in Douala, October 2010).
4. FCFA is the franc Communauté Financière Africaine. This is 5 percent of the median delivery cost in the Douala area, where delivery costs range between FCFA 100,000 and FCFA 160,000 (according to delivery zone).
5. Perceived cost is computed as the sum of parking fees and demurrage charges. Field investigation has confirmed that most shippers have only a limited knowledge of their full inventory costs and calculate factory prices on the basis of purchasing costs, production costs, and direct transport and clearance charges. Neither inventory costs nor opportunity costs are fully valued.
6. Sub-Saharan African markets are generally not competitive because of supplier concentration, so producer surplus alone is expected to be superior to 10 percent of the corresponding value, that is, about 0.5 percent of the total value of imports to the country.

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