



Economic Policy Papers

EXECUTIVE SUMMARY

Most U.S. imports from Asia arrive in giant 40-foot shipping containers on the decks of massive ocean-going vessels. As such, the containers are powerful symbols of globalization, and the economics of using them has contributed to both the rapid growth of large U.S. retailers and the explosion of Chinese imports.

This paper reports on the advantage that large importers have in ensuring that shipping containers are packed to capacity. Proliferation of product varieties and short order cycles have led importers to combine various kinds of products, often from different suppliers, to completely fill containers. Our analysis of detailed data on millions of import containers reveals significant scale economies in shipping.

To the extent that such scale economies are important, policies that limit or impede the growth of large firms may be undesirable for society.

Container Imports and the Advantage of Size

Large retailers have used the scale economies of shipping containers to expand sales and imports

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Introduction

International trade has been revolutionized by shipping containers: huge 40-foot boxes filled with products, lifted by cranes onto the decks of enormous ocean-going vessels and sent across the globe. The container system replaces an earlier era when individual cartons were loaded by longshoremen into the holds of (usually smaller) ships. Goods instead are now loaded into containers in factories and warehouses far from the ship, and then transported by truck or train to major urban ports.

While the container system has created vast efficiencies, it has also introduced a new problem: What happens when a firm's desired shipment does not completely fill a 40-foot container? A standard container may hold 10,000 pairs of shoes, for example. If a shoe manufacturer wants to ship only 5,000 pairs, the container is half empty. So the firm must either send out a container with a lot of wasted empty space or somehow combine its shoes with other products, perhaps from its own factories or from another company. Half-size containers do exist, but smaller sizes aren't feasible. In this sense, the

shipping container is a perfect example of what economists call an “indivisible” good.

In a recent Federal Reserve working paper (Holmes and Singer 2017), we show how large importers use their size to “break” the indivisibility of containers. Large firms are able to do this in a way that small firms cannot. This economy of scale thus leads naturally to consideration of the costs and benefits of policies that regulate or otherwise influence firm size. But measuring these costs and benefits is difficult without a complete understanding of the channels through which scale economies operate. In this study, we examine the micro-details of one particular mechanism for scale economies and find the benefits of scale are quite substantial; indeed, they’re not completely exhausted even at very large scales.

This research also relates to trade policy. The United States has pursued a policy of relative openness to trade, and this has contributed significantly to the explosion of imports from China in recent decades. Our research sheds light on how the massive scale of Chinese imports has affected the efficiency of product shipping and potentially the balance between big and small retail firms.

Walmart’s containers

Our study uses publicly released U.S. customs records on container imports where we can determine the origins of the containers, their destinations and the contents. We focus on Walmart, and we use information on approximately 2 million containers that Walmart imported from 2007 to 2015. We also have a second sample covering the container imports of *all* companies, for a select set of 18 months, consisting of 16.8 million containers.

The vast majority of containers imported by Walmart originate in relatively few places, making it easy for Walmart to consolidate merchandise. Nearly half of Walmart’s container imports originate in a single city: Shenzhen, China. A handful of other port cities account for most of the rest. While some shipments start out at the exact size to fit in one or multiple containers, many do not, and these are often consolidated with other orders to fill containers.

Walmart’s large size—implying significant sales of many distinct items—enables it to place multiple orders of different products with the same firm. Combining multiple orders from the same firm into one container is one way Walmart ensures that containers are full; indeed, about half of all its containers consolidate multiple orders from one company. Importantly, Walmart shipments also combine orders from *different* suppliers—about 12 percent of its total container count, and close to half of those (5 percent of the total) are filled with products from four or more suppliers.

Our data also allow us to estimate how full the containers are, and we find that all of this consolidation enables Walmart to ship its containers quite full. Data for other large retailers like Target and Gap show that they similarly consolidate shipments, and their containers go out quite full.

The small firm story

Small firms lack the scale that enables Walmart's consolidation methods, but they have access to other consolidation options. Specialist firms, called freight forwarders, work with shippers to handle their logistics and generally offer shippers the option of "less than container load" service, where shipments get consolidated with other shipments.¹

Our key finding is that despite such possibilities, the actual level of shipping consolidation by small firms is quite modest. Only 8 percent of containers shipped by freight forwarders combine multiple orders, and only 4 percent combine multiple firms (compared with the analogous figures of 50 percent and 12 percent for Walmart).

Shippers that use freight forwarders are tiny relative to Walmart, so one might reasonably expect *more* consolidation of their shipments, not less. Instead, small shippers are far more likely to use half-size containers, despite their higher cost per cubic foot of capacity. (Cost saving is typically only 25 percent.) Furthermore, there is often empty space in the containers shipped by small firms, even when they use the half-size option. In short, we find that small importers usually do not break the container indivisibility problem.

Microwaves, macro shipping

Even the largest importers that bring in hundreds of thousands of containers per year are affected by the indivisibility issue. A close look at Walmart's microwave shipment data explains why. In 2015, the leading product imported by Walmart, in terms of volume of containers, was a Hamilton Beach 1.1 cubic foot, black microwave. Walmart imported 828 shipping containers of these in 2015; each container held exactly 640 microwaves.

At such an enormous volume, the indivisibility issue is unlikely to matter for this particular product, but three key points are important. First, to minimize transportation costs *within* the United States, Walmart brings its imports through five import distribution centers (Los Angeles, Houston, Savannah, Norfolk and Chicago). This means that whatever gets sent to the United States must be divided approximately five ways. This takes us from a shipment of 828 containers to approximately 166 ($=828/5$).

Second, it isn't efficient for Walmart to ship a whole year's worth at one time. In fact, Walmart averaged twice-a-month shipments to each distribution center for this product. Average shipment size by date and destination distribution center was approximately 7 containers ($=166/24$), and now things are getting down to a smaller number of containers.

Third, this example has used the *highest* volume good for Walmart's entire year. The distribution of shipment sizes is very skewed with a relatively small number of goods shipped in high volumes and the majority in low volumes. The median annual product volume in our data, aggregating all destinations, is only three-quarters of a container, and the median on a per-shipment basis is only 16 percent of a container.

In summary, Walmart and other large retailers have a strategy of (1) dividing orders over *space* to lower transportation cost, (2) dividing orders over *time* to improve inventory management and (3) dividing orders to increase *product variety*. Together, these make indivisibility an issue even for firms as vast as Walmart. This becomes evident when we compare Walmart's practices in China with those in India. Volume is substantially lower out of India, and Walmart is unable to efficiently fill containers there the way it does out of China.

Larger lessons

We conclude by drawing some larger lessons from the research. One lesson has to do with the costs of policies that impede the growth of large firms. One obvious policy that can put a brake on firm size is antitrust policy to limit mergers. Other policies potentially tilting the balance away from big firms to small include health care mandates and minimum wage laws that apply to big firms and not small. A third group of policies that apply more specifically to retail include local zoning regulations that limit Walmart expansion to protect incumbent retailers.

To evaluate these public policies, we must weight costs and benefits. Our analysis highlights a potential economic cost of policies that limit the size of large importers. A relevant point here is that as big as Walmart is, even it has not fully exhausted potential returns to scale: In the smaller markets where it sources imports, its containers are not quite as full as they are in its larger markets.

Another lesson is an observation about two of the major developments in the U.S. economy over the past two decades. The first development is the vast expansion of discount retailers, as they replaced smaller, often locally owned competitors. The second is the vast increase in imports from China. These two trends have distinct stories. The trend toward discount stores is a long-term development, starting well before the explosion in Chinese imports. And imports from China have penetrated a number of sectors of the U.S. economy, beyond discount retail. While these two trends are distinct, they interact. The import system of Walmart, with half of its containers loaded in Shenzhen and shuttled to five separate import distribution systems is a machine for moving goods from factories in Asia to store shelves in the United States. Undoubtedly, the high efficiency of this machine has accentuated the rise in imports. And the advantage that large firms like Walmart and Target have in running such a machine clearly contributes to their success over smaller rivals.

Endnote

¹ In our data, we can see whether importing firms work with freight forwarders or whether they deal directly with shipping companies. The latter firms are called beneficial cargo owners, and all big importers like Walmart and Target are in this category. Freight forwarders account for just under half of container imports. For our results on small firms, we include all firms working with freight forwarders.

Reference

Holmes, Thomas J., and Ethan Singer. 2017. “Indivisibilities in Distribution.” Working Paper 739, Federal Reserve Bank of Minneapolis.

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