Putting a Smiley Face on the Dragon: Wal-Mart as Catalyst to U.S.-China Trade

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Abstract

Retail chains and the volume of imports of consumer goods from developing countries have grown sharply over the past 25 years. Wal-Mart’s sales, which currently account for 15% of U.S. imports of consumer goods from China, grew 90-fold over this period, while U.S. imports from China increased 30-fold. We relate these trends using a model in which scale economies in retail interact with scale economies in the import process. Combined, these scale economies amplify the effects of technological change and trade liberalization, creating a two-way relationship between the chain’s size and its sourcing choice. Falling trade barriers increase imports not only through direct reduction of input costs but also through an expanded chain and higher investment in technology.

JEL Codes: L11, L81, F12

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1 Introduction

In this paper, we study the relationship between the structure of retail markets in the U.S. and the volume and source of consumer-goods imports. The most striking change in retail markets over the past 25 years has been an increase in the size and prevalence of “big box” chains, most spectacularly among them Wal-Mart. Imports from developing countries have also increased dramatically over this period; China’s imports to the U.S. expanded 30-fold in real terms. Wal-Mart’s imports have increased even faster: while the chain now handles 6.5% of U.S. retail sales, it accounts for over 15% of U.S. imports of consumer goods from China. We present a theory that links these trends and show that there is a two-way relationship between the size of a dominant retailer and imports of consumer goods. The model can explain a number of observed patterns, including the concurrent and accelerating expansion of Wal-Mart and U.S. imports from China despite only modest reductions in trade barriers.

We focus on Wal-Mart because it has become the canonical example of a large retail chain and because the claim has been made repeatedly in the popular press that Wal-Mart imports more than other retailers and that its purchasing decisions have influenced trade patterns. A 2003 Pulitzer Prize-winning series on Wal-Mart in the Los Angeles Times claimed that “Wal-Mart is so powerful that it moves the economies of entire countries, bringing profit and pain,” and, more specifically, that Wal-Mart “has hastened the flight of U.S. manufacturing jobs overseas” (Goldman and Cleeland, 2003). The Economist argues that “the emergence of China as a centre of low-cost production is playing to [Wal-Mart’s] strengths” (The Economist, 2004). These arguments are consistent with Bernard, Jensen, and Schott’s (2009) finding, using the Longitudinal Business Database and detailed firm-level data on trade transactions, that larger firms are disproportionately engaged in trade: they import (and export) more products, from more countries, and at much higher rates per worker than smaller firms.

In our model, the relationship between chain size and imports emerges from an interaction between economies of scale in retailing and economies of scale in the import process.
We focus on a chain retailer with a “chaining” technology that determines its cost of logistics and distribution. The chain has economies of scale in marketing, which we model as a declining marginal cost. A second source of economies of scale arises because there are two input markets, one domestic and one foreign, and there is a fixed cost associated with purchasing the input from the foreign market. As a result, the chain needs to reach a threshold size before it begins to import. These factors combine to generate an equilibrium that depends on the chain’s technology. Technological improvements increase the chain’s optimal size, reducing its marginal input cost; the lower retail price that results increases quantity demanded in each of the chain’s stores. When the chain becomes sufficiently large it switches from domestic to offshore suppliers. The movement of production overseas further reduces marginal cost, increasing the chain’s profit per store and giving it an added incentive to expand. When we extend the model to include many foreign locations, trade liberalization and improvements in the chain’s technology push the chain to import from ever-farther locations, increasingly taking advantage of lower production costs. These results obtain also when we relax the assumption that retailers must import directly and allow an intermediary importer to sell imported goods to smaller retailers.

The relationship between these two scale economies amplifies the effect of trade liberalization on import volume. A lower tariff not only expands imports through the usual effect on price but also causes the retailer to expand the chain. Accounting for the chain’s expansion more than doubles the effective elasticity of demand for imports relative to standard models that only consider the direct effect of a tariff reduction.

The expansion of the chain increases both market size and feeds on this larger market. The idea that market size affects production patterns, which dates back to Adam Smith, has been studied extensively in the trade literature.\(^1\) We build on it using a model similar to Jones and Kierzkowski (1990) in which production is described as a set of blocks linked

\(^1\)See for example Helpman and Krugman (1985), Ethier (1979), and Belassa (1967).
to form a supply chain. Outsourcing a production block entails a fixed linking cost, so the size of the market determines the extent of outsourcing. In our model, the extent of outsourcing also affects the size of the market, operating through the chain store.

As a result, trade liberalization increases the retailer’s incentive to expand and leads to increased downstream concentration. This result is similar to one obtained by Raff and Schmitt (2008) in a general-equilibrium framework. The main difference between our papers is that our analysis highlights the role that technological innovations play in increasing trade volume and the interaction between trade liberalization and technological change. Our model also complements models by Alessandria and Choi (2007), Melitz (2003), and Bernard, Redding, and Schott (2006), all of which find effects of productivity shocks and trade liberalization on exporting firms.

A few papers have analyzed the relationship between retailing and imports empirically. Campbell and Lapham (2004) use county-level data to show a relationship between U.S.-Canada exchange rate movements and the number of retailers operating in border counties. Our setting allows for exchange rate and other input cost fluctuations to affect a much wider swath of consumers because the chain, as importer, brings goods to all its stores. Evans and Harrigan (2005) find that the characteristics of the retailer can influence the pattern of international trade. Using proprietary data from a major chain of department stores, they establish that the retailer’s demand for just-in-time deliveries influences its choice of source countries. Finally, Basker and Van (2010) find that the largest chains in each retail sub-sector import disproportionately more from less-developed countries, and less from rich countries, than smaller retailers.

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\(^2\) See also Wan (2005) and Long, Riezman, and Souberyan (2005) for models extending this idea.

\(^3\) To focus on the main issues of this paper we ignore the distinctions among the different forms these links can assume, i.e., whether the foreign producer is a subsidiary, subcontractor, or independent exporter, etc. Several recent papers have examined these contractual arrangements in detail (see Antràs, 2003; Antràs and Helpman, 2004; Grossman and Helpman, 2002a,b). Of particular interest for our context are Feenstra and Hanson’s (2005) study of outsourcing in China and Javorcik, Keller, and Tybout’s (2006) paper on the effect of Wal-Mart’s Mexican operations on the that country’s soap and detergent industry.
The remainder of this paper is organized as follows. Section 2 provides some facts about the recent growth of chains and imports that serve as background to our model. Section 3 describes the basic model and analyzes the effects of technological change and trade liberalization, along with extensions. Section 4 concludes.

2 Background: Chains and Imports

Retail chains have grown dramatically over the past half-century, while single-store (“mom-and-pop”) retailers have been declining. A recent study using establishment-level data from the Census Bureau covering the period 1975–2000 shows that retail chains were the driving force behind the growth in the number of retail stores and the sole source of growth in retail employment over this period. Among retail chains, national chains grew the fastest (Jarmin, Klimek, and Miranda, 2009).

Table 1 shows the increase in the size and dominance of chains over the period 1948–2002. In the first three columns we report, respectively, the fraction of retail firms that operate chains, the share of all retail stores that belong to chains, and chains’ share of all retail sales. All three measures rise over time, with a distinct rise in the share of chain stores since the early 1970s. In the last three columns we report the same three measures but for large chains (with 100 or more stores) relative to all chains; large chains have been gaining market share relative to smaller chains throughout this period.

These trends may be explained by advances in technology that increasingly raise chains’ cost advantage over smaller retailers. Chains are more productive than single-store retailers and they invest more in information technology (Doms, Jarmin, and Klimek, 2004). Foster, Haltiwanger, and Krizan (2002) show that the bulk of productivity growth in the U.S. retail sector in the 1990s came from the expansion of more-productive retail chains and the contraction and exit of less-productive retailers, and that the retail sector exhibits large and persistent productivity differences across establishments within narrow (4-digit) industries.
Wal-Mart, the largest retail chain in the United States (and the world), has expanded steadily since opening its first store in 1962. By 2004, Wal-Mart had more than 3,000 stores in all 50 states and about 800,000 employees in the U.S. and accounted for 6.5% of all U.S. retail sales. Figure 1 shows U.S. Wal-Mart sales in real 2002 dollars over the period 1978–2004 as a thick line (using the right-hand axis). Figure 2 separates Wal-Mart’s sales growth since 1985 into two components: the rise in the number of Wal-Mart stores (solid line, left axis) and sales per store (dotted line, right axis). Since part of the growth in sales per store has been fueled by increased grocery sales, we also compute sales per store excluding groceries. All of these rise over time.


Concurrent with Wal-Mart’s expansion, U.S. imports from the rest of the world, and from less-developed countries (LDCs) in particular, have surged. Between 1984 and 2004, U.S. imports from China increased more than 30-fold in real terms. Imports from China are shown in Figure 1 as a thin solid line, using the right-hand axis, on the same scale as U.S. Wal-Mart sales. The emergence of private label apparel that competes directly with
U.S. apparel manufacturing and global sourcing of apparel production also coincided with these trends (Gereffi, 1999). This rise in imports has occurred although import tariffs on Chinese goods have fallen only modestly since 1980, when China was granted Most Favored Nation (now Normal Trade Relations, or NTR) status with the U.S. The dotted line in Figure 1 shows, using the left-hand axis, the average (unweighted) U.S. tariff rate applicable to products exported from China for the period 1978–2000.\textsuperscript{7,8}

Many observers have speculated on a link between these concurrent trends in retailing and importing. The role of big retailers in “organizing and channeling” demand for cheap imports has been noted by Petrovic and Hamilton (2005) and Feenstra and Hamilton (2006). Wal-Mart does not regularly release its import figures, but it has acknowledged importing $18 billion in goods from China in 2004, representing over 15% of U.S. consumer-goods imports from China that year; about half of this amount refers to direct imports, the rest coming through its suppliers (The Economist, 2004). Wal-Mart accounted for 6.5% of U.S. retail sales in 2004 (Basker, 2007), so this figure implies it imported from China at over twice the rate of the retail sector as a whole.

This figure is consistent with other findings on direct imports and sales of imported goods by big retail firms. Bernard, Jensen, and Schott (2009) find that the size distribution of importing firms is much more skewed than the overall size distribution of firms; the largest firms import disproportionately more than their size would suggest. In a study across retail sectors, Basker and Van (2010) find that the largest retail chains are substantially more likely than smaller retailers to import from less-developed countries (LDCs). On average across all retail sectors, the largest chains’ propensity to import from LDCs is 27 percentage points

\textsuperscript{7}We thank John Romalis for providing these data from Romalis (2005). Figures for 2001–2004 are not available but do not include any sharp breaks.

\textsuperscript{8}The increase in imports from China reflects increases in imports of intermediate goods and capital goods in addition to consumer goods. While our story applies directly only to consumer goods, the mechanism we describe, which operates through economies of scale and increased market size, may apply more broadly. If there are increasing returns to scale in manufacturing, then declines in the cost of intermediary goods can be amplified in that sector too through a similar mechanism to the one described in this paper.
higher than that of smaller firms.

3 Model

3.1 Setup

There are \( N \) locations or retail markets which are \textit{ex ante} identical. Each location is served by a monopolist retailer selling a single consumption good. Market demand in each location, \( x(p) \), is downward-sloping.

We focus on the partial-equilibrium choices of a single retailer. The retailer has access to “chaining technology” that enables it to operate a chain of \( k \geq 0 \) stores at a cost \( \frac{c(k)}{\delta} \), where \( \delta > 0 \) and \( c(\cdot) \) is increasing and convex (\( c'(\cdot) > 0, c''(\cdot) > 0, c(0) = 0 \)). We think of \( c(k) \) as capturing the costs of adding truck routes, distribution center inventory, etc. The motivation for a positive second derivative on \( c(\cdot) \) is that each additional store is accommodated by re-optimizing distribution facilities, inventory management and trucking routes, and this process becomes increasingly complex and costly as the network expands. Westerman (2001), for example, discusses the complications for Wal-Mart’s replenishment system caused by “the growth of the company . . . [into] different time zones” (p. 182). The parameter \( \delta \) captures the chain’s technology: if \( \delta \) is very high, then the cost of chaining is very low. We begin by treating \( \delta \) as exogenous; we endogenize it in Section 3.3.

The retailer buys the consumption good from a manufacturer and sells it to consumers. The retailer’s cost consists of two elements: the input cost of the consumption good and a marketing cost. If the retailer has \( k \geq 0 \) stores, each of which sells \( x \geq 0 \) units, total marketing cost is \( S(kx) \), where \( S(\cdot) \) increasing but concave.\(^9\)

A good can be produced in one of two locations: domestic or foreign (we allow for a continuum of possible production locations in Section 3.4). In each location there are

\(^9\)Formally, \( S(0) = 0, S'(\cdot) > 0, S''(\cdot) < 0, \) and \( S'''(\cdot) > 0 \) so that marginal cost is declining in \( kx \), but at a decreasing rate.
many identical manufacturers with a constant-returns production technology, and pricing is competitive. The domestic manufacturing sector’s competitive price is $\alpha_0$.$^{10}$ The foreign manufacturing sector has lower marginal production cost $\tilde{\alpha}_1 \ll \alpha_0$, but there is a transportation cost (normalized to zero for the domestically-produced good) and tariff that sum to $\tau$ per unit. Let $\alpha_1 \equiv \tilde{\alpha}_1 + \tau < \alpha_0$ be the marginal input cost if the good is produced offshore.

In addition to the production and transportation cost/tariff, the retailer must incur a fixed cost $F > 0$ in order to purchase input from a foreign manufacturer. This fixed cost includes the cost of setting up a production facility or a relationship with a producer in a foreign country, or a network of buyers such as the one that Wal-Mart has in China, and possibly any non-pecuniary costs such as backlash from domestic residents.$^{11}$ For now, we assume that the retailer, not the manufacturer, bears the cost $F$; we allow for the possibility that an intermediary pays the cost in Section 3.5. As mentioned earlier, approximately 50% of Wal-Mart’s imports are direct imports through its contracts with foreign manufacturers. In these cases, it seems reasonable to assume that Wal-Mart bears any fixed cost.$^{12}$

The chain’s maximization problem is

$$\max_{k,x,\theta} \pi(k,x,\theta) = kx(p(x) - (1 - \theta)\alpha_0 - \theta\alpha_1) - S(kx) - \frac{c(k)}{\delta} - \theta F$$

subject to $k \in [0,N]; \quad x \geq 0; \quad \theta \in \{0,1\},$

where the sourcing decision is represented by $\theta$, which equals 0 if the input is purchased from domestic producers and 1 if the input is imported. Since the choice of $\theta$ is discrete, to solve this problem the chain compares its maximized profit if it purchases the input from domestic suppliers with profit when it purchases the input from foreign manufacturers. Letting $(k^*_\theta, x^*_\theta)$

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$^{10}$Our analysis would not change if retailing technology involved two or more inputs, used in fixed proportions, if those inputs were supplied by competitive markets. For the types of products that Wal-Mart sells — apparel, footwear, furniture and fixtures — there is no systematic evidence of increasing returns to scale in production (Antweiler and Trefler, 2002).

$^{11}$Swenson (2005) offers evidence from the U.S. Offshore Assembly Program (OAP) consistent with the presence of a fixed cost, which she attributes to search and product development.

$^{12}$Petrovic and Hamilton (2005) estimate that Wal-Mart’s private label brands make up 40% of its revenue.
be the optimum for a given $\theta$, the chain compares $\pi(k_0^*, x_0^*, 0)$ and $\pi(k_1^*, x_1^*, 1)$; the choice of $\theta$ depends on whether the increase in profit from obtaining a lower-price input fully offsets the fixed cost of importing $F$.

The solution is shown graphically in Figure 3. An interior solution $(k_0^*, x_0^*)$ is shown at the intersection of the solid thick and thin curves representing $k_0^*(x; \delta)$ and $x_0^*(k)$. The alternative solution $(k_1^*, x_1^*)$ is shown at the intersection of the dashed thick and thin lines. Because $\alpha_1 < \alpha_0$, the chain earns a larger variable profit per store if the input is imported than if it is purchased domestically, so conditional on $\theta = 1$ (and therefore a sunk cost $F$), for any level of sales per store $x > 0$ the chain chooses a larger chain size $k^*(x)$. The curve $x^*(k)$ also depends on $\theta$, because the lower marginal cost associated with the imported product increases the value of $x$ at which marginal cost equals marginal revenue.

The following lemma formally establishes that the optimal chain size conditional on the chain purchasing input from offshore producers is larger than the optimal chain size conditional on its purchasing input from domestic producers.

**Lemma 1.** $k_1^* \geq k_0^*$, and $k_1^* > k_0^*$ except when $k_0^* = N$.

All proofs are in Appendix A.

Let $\pi^*(\alpha, F, \delta)$ be optimized profit given parameters $(\alpha, F, \delta)$, and let

$$G(\alpha_1, \delta) \equiv \pi^*(\alpha_1, 0, \delta) - \pi^*(\alpha_0, 0, \delta)$$

be the difference, net of the fixed cost of importing $F$, between the chain’s profit conditional on foreign sourcing (with the conditionally-optimal chain size $k_1^*$ selling the conditionally-optimal number of units $x_1^*$ per store) and the chain’s profit conditional on domestic sourcing (with the conditionally optimal chain having size $k_0^*$ with sales $x_0^*$ per store). Because $G(\cdot, \cdot)$ is the difference between the conditional optimized profits, net of $F$, it depends only on the parameters of the model and not on any decision variables. The optimal input source is $\theta^* = 1$ if and only if $G(\cdot, \cdot) \geq F$. 

9
3.2 Technological Change and Trade Liberalization

We can now analyze the effect of an improvement in the chain’s technology (a rise in $\delta$) on imports. We continue to abstract from the technology-investment decision and treat the technology parameter $\delta$ as exogenous. The next result establishes that the decision to purchase input from offshore producers depends on $\delta$: the chain only imports its input if its technological advantage is sufficiently large.

Result 1 (Technological Change).

1. The chain’s size, units sold per store, total sales volume ($kx$) and sales value ($kxp(x)$) all increase with $\delta$.

2. If $F$ is not too high, there exists some $\delta_m < \infty$ such that the chain purchases the input domestically when $\delta < \delta_m$ and imports the input once its chaining technology exceeds this level.

Result 1 says that the chain grows with $\delta$ and chooses to import its input if $\delta$ is sufficiently high. Because we have only one good in this model, there is only one extensive margin, beyond which further increases in $\delta$ increase the chain’s total sales and, therefore, total imports (on the intensive margin). With a continuum of goods with different parameter values, increases in $\delta$ would affect both the intensive and extensive margins of importing. By Lemma 1, the chain’s size ($k$ and $x$) increases discretely at $\delta = \delta_m$. This result holds only if $F$ is not too large; if the fixed cost $F$ of importing is too high, the variable-cost savings from importing the input can never be justified. In that case, $\delta_m$ would be infinite and the input would be purchased domestically regardless the chain’s technology level.

Result 1 is consistent with the experience of Wal-Mart in the late 1980s and early 1990s. Between 1985 and 1995, Wal-Mart’s chaining technology improved dramatically with the introduction of “Retail Link,” an innovative distribution system connecting its stores, distribution centers, headquarters and suppliers. Wal-Mart more than doubled in size over this period, transitioning from a regional chain with 745 stores in 20 states to a national chain.
with 2,200 stores in 49 states. And, at the same time, Wal-Mart launched, then retreated from, a massive “Buy American” campaign.

This result is also consistent with the simultaneous increase in U.S. Wal-Mart sales and U.S. imports from China, shown in Figure 1. Over the period 1984–2004, Wal-Mart’s share of U.S. retail sales rose from 0.1% to 6.5%; imports from China have grown at an even faster rate, and prices of clothes, toys and electronics — items increasingly imported from China and other LDCs — have fallen considerably. Apparel prices, for example, fell 82% relative to the overall price level between 1984 and 2004 and real toy prices fell 47% over this period.

Like technological change, trade liberalization affects both the extensive and intensive margins of the chain’s importing decision. To analyze the effect of a reduction in tariffs on \( k^* \) and \( x^* \), we explicitly write the unit input cost of the imported good as \( \tilde{\alpha}_1 + \tau \), with \( \tilde{\alpha}_1 \) the production cost and \( \tau \) the combined import tariff and transport cost.

**Result 2 (Trade Liberalization).** *If \( F \) is not too high, there is some \( \tau_m < \infty \) such that:*

1. *The chain purchases the input domestically when \( \tau > \tau_m \) and imports the input once the tariff falls below this level;*

2. *\( \tau_m \) is increasing in \( \delta \);*

3. *For \( \tau \leq \tau_m \), the chain’s size, units sold per store, and total import volume and value all increase as \( \tau \) declines.*

This result is a consequence of the fixed cost of purchasing the input from offshore producers, which creates a threshold market size for offshore production. As the cost advantage of foreign producers increases (because of a decline in trade costs), the threshold market size declines. Improvements in the chain’s technology increase its market size and raise the upper bound on trade barriers that can support trade. Once \( \tau \) falls below this upper bound (at which point the chain begins to import and increases discretely in size), any further trade liberalization also increases the chain’s size.
For $\tau \leq \tau_m$, we decompose the elasticity of total imports with respect to trade barriers as follows:

$$
\frac{d(kx)}{d\tau} \frac{\tau}{kx} = \frac{\partial x}{\partial \tau} x \left( 1 + \frac{\partial k}{\partial x} \frac{x}{k} \right) + \frac{\partial k}{\partial \tau} k \left( 1 + \frac{\partial x}{\partial k} \frac{k}{x} \right)
$$

(2)

This decomposition allows us to identify three distinct effects:

1. **Demand Effect**: $\frac{\partial x}{\partial \tau} x$. This is the “conventional” effect, which works through the increase in demand at a fixed number of locations due to lower unit cost.

2. **Expansion Effect**: $\frac{\partial k}{\partial \tau} k$. This effect works through the expansion of the chain. In our simple model, retailers in locations not served by the chain do not import at all, while the chain sells imported goods exclusively. More generally, as long as other retailers sell fewer imports than the chain, the expansion of the chain increases imports.

3. **Scale Effect**: $\left( \frac{\partial k}{\partial x} \frac{x}{k} \right) \frac{\partial x}{\partial \tau} x + \left( \frac{\partial x}{\partial k} \frac{k}{x} \right) \frac{\partial k}{\partial \tau} k$. As the chain expands, its marginal marketing cost falls, which further lowers its retail price and increases import, amplifying both the demand effect and the expansion effect.

All three of these effects work in the same direction. Together, they provide an alternative explanation for the “tariff elasticity puzzle” of Yi (2003). Yi argues that the response of trade volumes to tariff reductions over the past two decades implies an implausibly high price elasticity of demand. Here, the existence and expansion of the chain amplifies the demand effect.

A further amplification of the effect of tariffs on imports can arise through the chaining technology, and in particular, through the interaction between trade liberalization and technological change. This channel provides a complementary mechanism through which a tariff reduction can have not only an amplified effect on imports, but one that increases over time, consistent with the observation that the relationship between tariff reductions and trade has become more pronounced over time.

As implied by Results 1 and 2, if $\delta$ is very low the chain purchases its input domestically regardless of $\tau$. As the chain’s technology improves, the range of values of $\tau$ for which
the chain prefers foreign sourcing increases, and a small reduction in tariff is increasingly likely to shift the optimal input source from domestic to foreign manufacturers. Thus, the improvements in Wal-Mart’s chaining technology and gradual reductions in tariffs may have worked together to bring about the large increase in Chinese imports observed in the 1990s. Once $\tau$ falls below $\tau_m(\delta)$, further increases in $\delta$ increase imports continuously.

While our discussion has focused on the effect of a reduction in tariffs, the analysis applies equally to other cost reductions. An increasing share of international trade has shifted from ocean shipping, whose costs have been roughly constant since the 1950s, towards air transport, whose costs have declined sharply since the 1970s (Hummels, 1999). Combined, these trends imply a decline in average shipping costs, which will have the same effect as a decline in tariffs in our model. The analysis also applies to reductions in production costs. A decrease in the offshore production cost $\tilde{\alpha}_1$, for example due to learning-by-doing or cost-reducing investment in human capital, or a depreciation of the foreign currency would induce chain expansion, which amplifies its effect on imports.

3.3 Induced Technical Change

So far, we have treated $\delta$ as an exogenous parameter. In reality, a retailer chooses its technology level. Wal-Mart chose to invest in computers in its early years, in the “Retail Link” software in the 1980s and 1990s, and currently in RFID technology. Endogenizing the retailer’s technology level further amplifies the effect of lower trade barriers on imports.

Assume that to achieve a technology level $\delta$, the retailer must invest an amount $I$ where $I(\delta)$ is increasing and convex in $\delta$ ($I'(\cdot) > 0, I''(\cdot) > 0, I(0) = 0$). The retail chain’s choice of $\delta$ satisfies the marginal condition

$$\delta^2 I'(\delta) = c(k),$$

with the first-order conditions for the chain’s choices of $k, x, \theta$ unaffected. Assume an interior
solution exists. Since $I''(\cdot) > 0$ and $c(k) > 0$, the optimal choice of $\delta$ increases with $k$. This adds an additional effect of lower trade barriers (a reduction in $\tau$) on total imports. As in the earlier analysis with exogenous $\delta$, a decrease in $\tau$ increases chain size. Now, however, the effect on $k^*$ can be decomposed into two parts: holding $\delta$ fixed, there is an increase in $k^*(\delta)$, as explained above. In addition, because $\delta^*$ is an increasing function of $k$, a tariff reduction also leads to higher investment in technology, which indirectly increases $k^*$ further.

This result is akin to the idea of “directed technical change” in recent models of endogenous technological change (see Acemoglu, 2002). Imports are an input for the chain retailer; reductions in the cost of this input create an incentive to invest in technology that uses it more intensively. In our context the technology takes the form of improvements in the organization and logistics of the chain, which complements the increasingly-abundant cheap imports.

### 3.4 Product Cycle

In this section we generalize our model by adding many potential production locations in order to analyze the relationship among trade policy, chain size, and the product cycle. We show that the product cycle — the migration of sourcing from one country to the next — is accelerated by the existence of the chain and adds another layer to the effect of a tariff reduction on import volume.

Assume a continuum of possible production locations parameterized by its input cost $\alpha$ (inclusive of tariff) and let $F(\alpha)$ be the lowest possible fixed cost of importing from a location with marginal cost $\alpha$. We assume that $F$ is decreasing in $\alpha$ and that the domestic location is the only one where $F = 0$. The retail chain chooses the production location, or $\alpha$ to maximize profit, $G(\alpha, \delta) - F(\alpha)$, where $G(\cdot, \cdot)$ is defined in Equation (1) and the discrete variable $\theta$ is replaced by a continuous choice represented by $\alpha$.

The function $F(\alpha)$ is shown as the thick curve in Figure 4. We can also represent $G(\alpha; \delta)$ in Figure 4. By construction, $G(\alpha_0, \delta) \equiv 0$ for all values of $\delta$. By the envelope theorem,
\( \frac{\partial G}{\partial \alpha} < 0 \) and \( \frac{\partial G}{\partial \delta} > 0 \) for interior solutions when \( \alpha < \alpha_0 \), so \( G(\alpha, \delta) \) is downward-sloping and becomes steeper, rotating clockwise about the point \((\alpha_0, 0)\), as \( \delta \) increases.

Figure 4 shows the curves \( G(\alpha, \delta) \) for three different values of \( \delta \) (\( \delta_1 < \delta_2 < \delta_3 \)). The optimal choice of \( \alpha \) for each value of \( \delta \) (which is again treated as exogenous) maximizes the vertical gap between the curves \( G(\alpha, \delta) \) and \( F(\alpha) \). For low values of \( \delta \), such as \( \delta = \delta_1 \), the optimum is point A: domestic production. When \( \delta \) reaches a sufficiently high level, the retailer begins to source the good from a foreign location; at \( \delta = \delta_2 \), the retailer purchases input from the location denoted by point B. As the chaining technology improves further (\( \delta = \delta_3 \)), sourcing moves to another location denoted by point C.

We can also use Figure 4 to analyze the effect of a uniform tariff reduction. Suppose that all locations (except the domestic location) have the same tariff \( \tau \) and redefine the horizontal axis of Figure 4 to be \( \bar{\alpha} = \alpha - \tau \). The effect of a decrease in \( \tau \) in this setting is similar to an increase in the chain’s efficiency \( \delta \). Thus, a uniform reduction in tariff for all trading partners increases the chain’s market size and moves the optimal input source to a country with lower unit costs, further increasing profit per store and inducing an additional increase in the size of the chain and sales per store. This result could explain the empirical observation that China’s share of U.S. imports has increased — and Latin America’s has fallen — despite broadly similar tariff treatment in the 1980s and 1990s (see, e.g., Moreira, 2007). A high uniform tariff that applies to all non-domestic producers therefore protects not only domestic manufacturers, but also incumbent suppliers that are “close” to the domestic market on the \( F(\alpha) \) locus.\(^{13}\)

### 3.5 Indirect Imports

So far, we have assumed that the retailer makes the import decision and contracts directly with a low-cost overseas supplier. A direct, but unappealing and easily invalidated, impli-
cation of this assumption is that non-chain retailers do not sell any imported goods. The alternative specification described in this section allows for the presence of an intermediary importer or merchandising firm, which purchases the product from producers in the foreign location (incurring a cost $F$ to do so) and sells it to any demanding retailer at a markup.

Several aspects of the legal and institutional arrangements matter here. First, we assume that the intermediary can price discriminate among different retailers. Second, the intermediary possesses all the market power and can charge the retail chain its reservation price. In terms of timing, this is equivalent to assuming that the intermediary sets prices first and the retailer can buy as much (or as little) from it as it wants at the announced price. We assume that the retail chain chooses $x$ and $k$ after it observes the intermediary’s price, and the intermediary anticipates this choice.

Finally, we assume that the retail chain also has the option of importing directly by duplicating the fixed cost $F$. This determines the outside option of the chain, which we assume is binding for the intermediary. The markup the intermediary charges the retail chain, denoted $m$, is therefore determined by the identity

$$\pi^*(\alpha_1 + m, 0, \delta) \equiv \pi^*(\alpha_1, F, \delta)$$

where, as before $\pi^*(\alpha, F, \delta)$ is optimized profit given parameters $(\alpha, F, \delta)$.

The following result establishes some properties of the intermediary’s markup.

**Result 3 (Intermediary’s Markup).** The intermediary’s markup satisfies:

1. $m > 0$;

2. For $\delta \geq \delta_m$, $m$ is decreasing in $\delta$;

3. For $\tau \leq \tau_m$, $m$ is increasing in $\tau$.

Part 1 of Result 3 is due to the fact that by saving the retailer the fixed investment, $F$, the intermediary can charge the retailer a higher price while holding its profit constant. While
the chain’s profit is the same under both direct and indirect imports (by the assumptions that the intermediary possesses all the market power and that the price constraint is binding), the fact that marginal cost is different under direct and indirect importing implies that the retailer’s size and prices will not be the same. Specifically, direct imports would result in a larger retail chain and lower consumer prices.

The intuition for Part 2 of Result 3 is that an exogenous increase in $\delta$ increases the profit the chain can earn from direct imports. To stay indifferent between direct and indirect imports the chain’s profit from indirect imports must also increase. This is achieved by lowering the markup charged by the intermediary. This result is consistent with anecdotal evidence that the price Wal-Mart pays suppliers has fallen as the chain has grown and is lower than the price other buyers pay. Fishman (2006), for example, cites claims by manufacturers of “consistent, irresistible requests” for annual price cuts (p. 77).

The intuition for Part 3 of Result 3 is that a reduction in tariff that increases the profitability of direct imports would lead the chain to expand if it imported directly, increasing its profit above and beyond the increase that would come from the cost reduction alone. To keep the chain from exercising this option, the intermediary must offer the chain a lower price that similarly increases its profit.

4 Concluding Remarks

Our goal in this paper has been to suggest a link between recent trends in the U.S. retail sector and trends in imports of consumer goods to the U.S. We show that the interaction between scale economies in the retail sector and scale economies in the import process generates a two-way relationship between import volume and chain size; this interaction has implications for trade volume and the sensitivity of imports to tariff reductions. Technological innovations in the retail sector increase chain size and, by increasing market size, also increase imports. Likewise, reductions in the cost of merchandise (due, for example, to tariff reductions or
foreign currency devaluations) increase both imports and the size of the dominant retailer. When the retailer’s level of investment in the chaining technology is endogenized, we obtain a result akin to “directed technical change” in that the retailer’s investment in chaining technology increases as imports become cheaper and more abundant.

While our discussion has centered on the effect of a decline in tariffs on chain size and import volume, the feedback effect the chain exerts on imports is also present when foreign production costs fall. Any decline in the cost of production in China, for example due to investment in human or physical capital, relaxation of regulation, or learning, increases the optimal size of the retail chain and so increases imports not only through the direct demand effect but also by expanding the chain and its level of investment in “chaining” technology.

The implications of our model extend to a situation with many goods or industries. Suppose that the chain retailer sells many goods, which vary with respect to the gap in unit production costs between domestic and foreign manufacturers. This variable gap may reflect different degrees of “maturity” of the goods. When the chain is small, only goods for which the gap in unit production cost is sufficiently large are produced offshore, with the remaining goods produced domestically. As the chain expands — e.g., in response to trade liberalization — more and more products are sourced offshore. The offshoring of each good creates a “wake” as it leads the chain to expand and increases the benefit of offshoring additional goods. This interpretation allows reductions in the tariff, $\tau$, to affect unit input cost, $\alpha$, continuously even if there is just one foreign production location.

In conclusion, we note that our model highlights a mechanism not usually mentioned in popular discourse. There is a common perception that Wal-Mart and trade with China are related. But the discussion of the relationship between Wal-Mart’s growth and import growth tends to focus on Wal-Mart’s monopsony power implied in the often-made claim that Wal-Mart “forces” suppliers to move production overseas in order to cut costs. In a model with increasing marginal cost, a monopsonist who cannot price-discriminate depresses production to extract a lower input price. Such a model counter-intuitively implies that in the absence
of Wal-Mart and other large chains, imports would have grown at a rate even faster than
the one we have observed over the past two decades. While we do not deny the importance
of issues arising from Wal-Mart’s market power beyond its role as seller, discussions of such
issues are taking place without the benefit of formal analysis. Our model is a starting point
from which to bring economic analysis into the debate surrounding Wal-Mart’s role in an
increasingly-globalized setting.
A Proofs

Existence of Equilibrium. Assume that only domestic production is possible. The chain retailer solves the following problem

\[
\max_{k,x} \quad \pi(k, x) = kx(p(x) - \alpha) - S(kx) - \frac{c(k)}{\delta} \\
\text{subject to} \quad k \in [0, N] \quad x \geq 0.
\]

The corner solution \((k, x) = (0, 0)\) guarantees zero profit for all \(\delta > 0\). If an interior solution \((k^*, x^*)\) exists, it must satisfy the first-order conditions

\[
x \cdot (p(x) - \alpha - S'(kx)) - \frac{c'(k)}{\delta} = 0 \quad (4) \\
k \cdot (p'(x)x + p(x) - \alpha - S'(kx)) = 0, \quad (5)
\]

along with second-order conditions.

The second-order conditions are derived from the condition that the Hessian matrix is negative semi-definite:

\[
\pi_{xx} = k(p''(x)x + 2p'(x) - kS''(kx)) < 0 \quad (6) \\
\pi_{kk} = -\left(x^2S''(kx) + \frac{c''(k)}{\delta}\right) < 0 \quad (7) \\
\pi_{xx}\pi_{kk} - \pi_{kx}^2 = -k(p''(x)x + 2p'(x) - kS''(kx)) \left(x^2S''(kx) + \frac{c''(k)}{\delta}\right) \left(p'(x)x + p(x) - \alpha - S'(kx) - kxS''(kx)\right)^2 > 0. \quad (8)
\]

One way to interpret these conditions is as a set of restrictions on the magnitude of \(S''(\cdot)\), or the degree of increasing-returns in the chain’s marketing technology. The marketing component of marginal cost, \(S'(kx)\), falls when either \(k\) or \(x\) increases; an interior optimum
can only exist if it does not fall too rapidly. Equation (6) bounds the extent of increasing returns due to increasing \( x \) relative to the decline in marginal revenue from increasing \( x \), holding \( k \) constant. Equation (7) bounds the extent of increasing returns due to increasing \( k \) (now holding \( x \) constant) relative to the increased chaining cost entailed in increasing \( k \). Equation (8) bounds the extent of increasing returns when \( x \) and \( k \) are allowed to co-vary. Since \( x \) and \( k \) move together (see below), for some functional-form assumptions this condition is sufficient and implies the previous two.

An interior intersection of \( k^*(x) \) and \( x^*(k) \) occurs if:

1. \( x^*(0) \geq k^{*-1}(0) \);
2. \( \frac{dx^*(k)}{dk} > 0, \frac{dk^*(x)}{dx} > 0 \) over all the relevant range; and
3. \( \frac{1}{dk^*(x)/dx} > \frac{dx^*(k)}{dk} \).

To see that the first condition is satisfied, from Equation (5), note that for \( k = 0 \), \( x^* \) is undefined but nonnegative; and from Equation (4), for \( x = 0 \), \( k^* = 0 \). For the second condition, differentiate the two first-order conditions to get:

\[
\frac{dk^*(x)}{dx} = \frac{\pi_x/k - kxS''(kx)}{-\pi_{kk}} \quad (9) \\
\frac{dx^*(k)}{dk} = \frac{xS''(kx)}{\pi_{xx}/k} \quad (10)
\]

The denominator of Equation (9) is positive by second-order condition (7). For \( x < x^*(k) \), \( \pi_x > 0 \) so the numerator is also positive and \( \frac{dk^*(x)}{dx} > 0 \). For \( x > x^*(k) \), \( \pi_x < 0 \), but in the neighborhood of \( x^* \), \( \pi_x \) is not too negative, so the numerator remains positive. As \( x \) increases beyond some level, \( \pi_x \) becomes sufficiently negative that \( \frac{dk^*(x)}{dx} \) turns negative. By the second-order condition (6) and concavity of \( S(\cdot) \), both the numerator and the denominator of Equation (10) are negative, so \( \frac{dx^*(k)}{dk} > 0 \).
The third condition, \( \frac{dx^{*}(k)}{dk} > \frac{dx^{*}(x)}{dx} \), can be written explicitly as

\[
\frac{-\pi_{kk}}{\pi_{x}/k - k\pi S''(kx)} > \frac{xS''(kx)}{\pi_{xx}/k},
\]

and, after some algebraic manipulation, as

\[
\pi_{xx}\pi_{kk} - \left( \frac{\pi_{x}}{k} - k\pi S''(kx) \right)^2 > \left( k\pi S''(kx) - \frac{\pi_{x}}{k} \right) \frac{\pi_{x}}{k}.
\]

The term on the left-hand side is positive by second-order condition (8). The right-hand side is negative for \( x < x^{*}(k) \), equals zero at \( x = x^{*}(k) \) and turns positive for \( x > x^{*}(k) \). In the neighborhood of \( x^{*} \) the RHS term is not too positive, so the inequality holds.

Existence of equilibrium when foreign sourcing is allowed follows analogously.

Proof of Lemma 1. Define \( \Gamma_{\theta}(k) \) to be the marginal benefit of expanding the chain conditional on an input source \( \theta \in \{0, 1\} \) and choosing the optimal number of units to sell in each of the chain’s locations, \( x^{*}_{\theta}(k) \):

\[
\Gamma_{\theta}(k) \equiv \frac{d}{dk} \left( \pi(k, x^{*}_{\theta}(k), \theta) + \frac{c(k)}{\delta} \right) = x^{*}_{\theta}(k)(p(x^{*}_{\theta}(k)) - (1 - \theta)a_{0} - \thetaa_{1} - S'(k \cdot x^{*}_{\theta}(k))). \tag{11}
\]

An interior solution \( k^{*}_{\theta} \) — the optimal chain size conditional on the input source — equates \( \Gamma_{\theta}(k) \) with the marginal cost of expanding the chain, \( \frac{c(k)}{\delta} \). Since the marginal cost of chain expansion is increasing in \( k \), for interior solutions it is sufficient to show that \( \Gamma_{1}(k) > \Gamma_{0}(k) \).

By the envelope theorem, \( \frac{dx}{ds} = \frac{dF}{ds} = -x^{*}(k) \). Since the first-order condition (5) implies that \( x^{*}_{1}(k) > x^{*}_{0}(k) \) in the unconstrained optimization problem, \( \Gamma_{1}(k) > \Gamma_{0}(k) \), and \( k^{*}_{1} > k^{*}_{0} \) for all interior \( k^{*}_{0} \).

Finally, since \( k^{*}_{1} > 1 \) for all \( x > 0 \), but \( k^{*}_{0} = 1 \) for \( x \leq x_{s} \), and since \( x^{*}(k) > 0 \) regardless
of \( \theta \), whenever \( k^*_0 = 1 \) then \( k^*_1 > 1 \). Also, since \( N \) is the upper bound for chain size, whenever \( k^*_0 = N \) then \( k^*_1 = N \). \hfill \square

**Proof of Result 1.2.** To conserve on notation, we write \( G(\delta) \) taking \( \alpha_1 \) as a constant. We need to show that there is some value \( \delta_m < \infty \) such that \( F > G(\delta) \) for \( \delta < \delta_m \) and \( F < G(\delta) \) for \( \delta > \delta_m \).

For values of \( \delta \) such that \( k^*_1(\delta) < N \), \( \frac{dG}{d\delta} = \frac{c(k^*_1) - c(k^*_0)}{\delta^2} > 0 \) (by the envelope theorem and Lemma 1), so the benefit of importing increases with the firm’s technology parameter (for interior values of \( k \)). Also, for values of \( \delta \) such that \( k^*_1(\delta) = N \) but \( k^*_0(\delta) < N \), by the envelope theorem \( \frac{dG}{d\delta} = \frac{c(N)}{\delta^2} + \frac{c(k^*_0)}{\delta} \frac{dk^*_0}{d\delta} \), which is also positive (since we have already shown that \( \frac{dk^*_0}{d\delta} > 0 \)). For values of \( \delta \) such that \( k^*_0(\delta) = k^*_1(\delta) = N \), \( \frac{dG}{d\delta} = 0 \). Define \( \delta_N \equiv \min \{ \delta : k^*_0(\delta) = N \} \). Since \( \delta_m \) is defined by \( G(\delta_m) = F \), such a threshold exists if \( F < G(\delta_N) \). \hfill \square

**Proof of Results 2.1 and 2.2.** We need to show that there is some value \( \tau_m < \infty \) such that \( F > G(\tilde{\alpha}_1 + \tau, \delta) \) for \( \tau > \tau_m \) and \( F < G(\tilde{\alpha}_1 + \tau, \delta) \) for \( \tau < \tau_m \).

By construction, \( G(\tilde{\alpha}_1 + \tau, \delta) \) is positive whenever \( \tau < \alpha_0 - \tilde{\alpha}_1 \), which holds by assumption; and \( \lim_{\tau \to (\alpha_0 - \tilde{\alpha}_1)} G(\tilde{\alpha}_1 + \tau, \delta) = 0 \). By the envelope theorem,

\[
\frac{\partial G(\tilde{\alpha}_1 + \tau, \delta)}{\partial \tau} = \frac{\partial \pi^*(k^*_1, x^*_1, 1; \alpha_1, \delta)}{\partial \alpha_1} < 0,
\]

so as \( \tau \) decreases, \( G \) gets larger, reaching a maximum (for a given \( \delta \)) at \( \tau = 0 \).

Define \( \tau_m \) by \( G(\tilde{\alpha}_1 + \tau_m, \delta) \equiv F \). For \( F < G(\tilde{\alpha}_1 + 0, \delta) \), there exists \( \tau_m \in (0, \alpha_0 - \tilde{\alpha}_1) \) such that \( G(\delta, \tilde{\alpha}_1 + \tau) < F \) if and only if \( \tau > \tau_m \).

Differentiating \( G(\tilde{\alpha}_1 + \tau_m, \delta) \equiv F \) implicitly with respect to \( \delta \) and rearranging yields

\[
\frac{d\tau_m}{d\delta} = -\frac{\partial G/\partial \delta}{\partial G/\partial \tau}.
\]
Since the numerator is positive (see Result 1.1) and the denominator is negative, \( \frac{d\tau}{d\delta} > 0 \). □

**Proof of Results 1.1 and 2.3.** When production has moved offshore, we replace \( \alpha \) with \( \tilde{\alpha}_1 + \tau \) and write the first order conditions as:

\[
\begin{align*}
\pi_x &= k(p'(x)x + p(x) - (\tilde{\alpha}_1 + \tau) - S'(kx)) = 0 \\
\pi_k &= p(x)x - (\tilde{\alpha}_1 + \tau)x - S'(kx)x - \frac{c'(k)}{\delta} = 0.
\end{align*}
\]

Differentiating with respect to \( \delta \) and \( \tau \), we obtain the following system of equations:

\[
\begin{pmatrix}
\pi_{xx} & \pi_{xk} \\
\pi_{kx} & \pi_{kk}
\end{pmatrix}
\begin{pmatrix}
\frac{dx}{d\tau} \\
\frac{dk}{d\tau} \\
\frac{dx}{d\delta} \\
\frac{dk}{d\delta}
\end{pmatrix} =
\begin{pmatrix}
\frac{-\partial \pi_x}{\partial \tau} & \frac{-\partial \pi_x}{\partial \delta} \\
\frac{-\partial \pi_k}{\partial \tau} & \frac{-\partial \pi_k}{\partial \delta}
\end{pmatrix}
= \begin{pmatrix}
k & 0 \\
x & -\frac{c'(k)}{\delta^2}
\end{pmatrix},
\]

which we solve using Cramer’s Rule to obtain:

\[
\begin{pmatrix}
\frac{dx}{d\tau} \\
\frac{dk}{d\tau} \\
\frac{dx}{d\delta} \\
\frac{dk}{d\delta}
\end{pmatrix} = \frac{1}{|H|}
\begin{pmatrix}
k\pi_{kk} - x\pi_{xk} \\
x\pi_{kk} - k\pi_{xk} \\
\frac{c'(k)}{\delta} - \pi_{xk} \\
-\frac{c'(k)}{\delta} - \pi_{xx}
\end{pmatrix}
= \frac{1}{|H|}
\begin{pmatrix}
-ke''(k) \\
kx(p''(x)x + 2p'(x)) \\
-\frac{c'(k)}{\delta^2}kxS''(kx) \\
-\frac{c'(k)}{\delta^2}k(p''(x)x + 2p'(x) - kS''(kx))
\end{pmatrix},
\]

where \( |H| \) is the determinant of the Hessian matrix,

\[
|H| \equiv \pi_{xx}\pi_{kk} - \pi_{xk}^2
= -k(p''(x)x + 2p'(x) - kS''(kx)) \left( x^2S''(kx) + \frac{e''(k)}{\delta} \right)
- \left( p'(x)x + p(x) - (\tilde{\alpha}_1 + \tau) - S'(kx) - kxS''(kx) \right)^2.
\]

At the optimum, this expression simplifies since \( p'(x)x + p(x) - (\tilde{\alpha}_1 + \tau) - S'(kx) = 0 \).

By the second-order condition, \( |H| > 0 \), so \( \frac{dk}{d\tau} < 0 \), \( \frac{dx}{d\tau} < 0 \) and \( \frac{dk}{d\delta} > 0 \), \( \frac{dx}{d\delta} > 0 \).

Therefore, total import volume increases with \( \delta \) and falls with \( \tau \): \( \frac{d(k^*x^*)}{d\tau} < 0 \) and \( \frac{d(k^*x^*)}{d\delta} > 0 \).
Import value also moves in the same direction:

\[
\frac{d(k^*x^*p(x^*))}{d\tau} = k^*(p(x^*) + x^*p'(x^*)) \frac{dx^*}{d\tau} + x^*p(x^*) \frac{dk^*}{d\tau} < 0
\]

\[
\frac{d(k^*x^*p(x^*))}{d\delta} = k^*(p(x^*) + x^*p'(x^*)) \frac{dx^*}{d\delta} + x^*p(x^*) \frac{dk^*}{d\delta} > 0.
\]

\[\square\]

**Proof of Result 3.** Part 1 follows from applications of the envelope theorem to Equation 3, to obtain \(\frac{d\pi^*}{d\alpha} < 0\) and \(\frac{d\pi^*}{dF} < 0\).

Parts 2 and 3 follow from differentiating both sides of Equation (3) with respect to \(\delta\) and \(\alpha_1\), applying the envelope theorem, and rearranging:

\[
\frac{dm}{d\delta} = \left(\frac{c(k^*(\alpha_1 + m)) - c(k^*(\alpha_1))}{\delta^2 \cdot k^*(\alpha_1 + m) \cdot x^*(\alpha_1 + m)}\right) < 0
\]

\[
\frac{dm}{d\alpha_1} = \frac{k^*(\alpha_1) \cdot x^*(\alpha_1) - k^*(\alpha_1 + m) \cdot x^*(\alpha_1 + m)}{k^*(\alpha_1 + m) \cdot x^*(\alpha_1 + m)} > 0
\]

The numerator of \(\frac{dm}{d\delta}\) is positive because \(m > 0\) and (from Lemma 1) \(k^*\) is decreasing in \(\alpha\). Similarly, \(\frac{dm}{d\alpha_1}\) is positive since \(m > 0\) and (again from Lemma 1) both \(k^*\) and \(x^*\) are decreasing in \(\alpha\).

\[\square\]
References


Wal-Mart Stores, Inc. (various years) *Wal-Mart Annual Report*.


Figure 1. U.S. Tariff on Chinese Imports, U.S. Imports from China and U.S. Wal-Mart Sales

Figure 2. Wal-Mart’s Growth: Stores and Average Sales per Store, 1985–2005
Figure 3. Equilibrium Chain Size and Quantity: Domestic vs. Foreign Production

Figure 4. Location of Production and Chaining Technology
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Source: authors’ calculations from Census of Business (various years) and Census of Retail Trade (various years)<sup>a</sup>

<sup>a</sup> Chains include multi-unit retailers with more than one unit; large chains include chains with 101+ stores for 1948–1972, 100+ stores in 1982–2002.

<sup>b</sup> Classification by SIC 1948–1992, NAICS thereafter.