The Rise of Modern Retail in China: An Anatomy of the Footwear Industry*

Very Preliminary and Incomplete

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Abstract

We analyze the structural change from manufacturing to retail within a set of Chinese footwear manufacturing firms. We combine administrative and survey data to document the substantial increase in these firms' retail activities, primarily driven by the establishment of local retail stores. We empirically illustrate that entrepreneur's comparative advantage determines their growth and specialization patterns in manufacturing vs. retail. We then construct and quantify a model of entrepreneurial heterogeneity, retail technology, and industry dynamics that account for the salient features of this transition process. We find that capital deepening contributed to about two-thirds of the rise of modern retail in the data.

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1 Introduction

There is large cross-country productivity differences in retail trade. Using comprehensive nationally representative surveys of establishments from six developing countries, Lagakos (2016) shows that these economies have retail productivity, measured as value added per worker, far below the U.S level. In particular, a large fraction of this difference is explained by the lack of modern retail segment in developing countries.[1]

This paper investigates the rising modern retail segment in China. With China's income per capita level quickly approached that of the upper middle-income countries, it provides a unique opportunity to study the transition process from a traditional, localized retail system to "modern retail" that primarily relies on chain stores. We combine administrative and survey data to document the related empirical patterns in the Chinese footwear industry. We characterize the individual firm-level manufacturing and retail activities both in the cross-section and overtime. We then construct and quantify a model of entrepreneurial heterogeneity, retail technology adoption, and industry dynamics that account for the salient features of this transition process

Explaining the retail productivity is important to understand internal market frictions in developing economies. While the retail chain expansion started decades ago in developed countries like the U.S.(Jarmin et al, 2009, Basker et al, 2012), this process started much later in emerging and developing countries. Our paper contributes to the understanding of this phenomenon by modelling and quantifying several distinctive economic forces in a fast-growing economy like China. In our model, the modern retail technology is more capital intensive than the traditional channel. Entrepreneurs of different comparative advantages in traditional and modern retail gradually reallocate their resources in response to changing factor market prices in the economy. Meanwhile, the manufactured goods are traded both home and abroad. Thus the domestic retail format also interacts with the manufactured good price and export demand. In sum, the capital accumulation, tighter labor market, and declining relative export demand all contribute to the rising modern retail in the Chinese footwear industry.

Our analysis proceeds in three steps. We first provide descriptive evidence that the Chinese footwear producers substantially increased their retail activities in the past decade. This increase is primarily driven by the establishment and utilization of retail stores, while the traditional channel experienced less growth. We also show that the firms which build on their retail stores increasingly specialized and outsourced a large share of the goods sold. Overall, the industry also had much faster growth in its domestic sales relative to exports.

[1] Lagakos (2016) defines the "modern retail" primarily by establishment size of 20 employees or more.

Second, we use a set of regressions to empirically illustrate that entrepreneurs differ in terms of their comparative advantage both within retail and versus manufacturing. We find that, firms with larger retail capital tends to outsource while firms of higher physical efficiency focus on production. As a consequence, for firms that use primarily the modern retail technology, their physical efficiency explains little of the variation in domestic sales. Their retail capital, proxied by the number of retail stores, on the other hand is highly correlated with domestic sales both in level and growth. In contrast, physical efficiency is the key determinant of firms which specialize in goods production and exporting.

Third and most importantly, we develop a model to quantify the importance of capital accumulation, labor cost escalation, and export demand in the transition from manufacturing to retail. We first utilize our detailed survey of each firm's production output and input information to measure each firm's physical efficiency. We then use our model to explain the firm's activity allocation, the choice of retail technology, as well as the joint distribution of sales, production, physical efficiency, and retail capital in the data. We implement the Simulated Method of Moments to estimate the structural parameters of our model. Our estimates imply that rising wage rate and falling interest rate play an important role in the rise of modern retail. Quantitatively our model mechanisms can account for half of the rising share of retail sales vs production in the Chinese footwear industry from 2006 to 2013. It can also account for about two-thirds of the growth of the modern retail sector during the same period.

Our paper contributes to a broad set of literature. First, our work is related to the literature that investigates the changing retail technology, in particular, the small literature that focused on developing economies. Basker (2012), Foster, Haltiwanger, and Krizan (2006), Hortascu and Syverson (2015) systematically investigated the role of new formats and technologies (such as chains and scanners) in productivity growth in the U.S. retail sector. In the developing country context, Atkin et al (2018) evaluated the welfare gains of consumers due to entry of large foreign retail chains like Walmart. Lagakos (2016) uses establishment level data across six developing countries and illustrates that the lack of modernization can be driven by the lack of complementary transportation methods. Our data and model complements those studies by providing a more detailed and dynamic characterization of how the modern retail segment grew overtime and identify additional forces behind it.

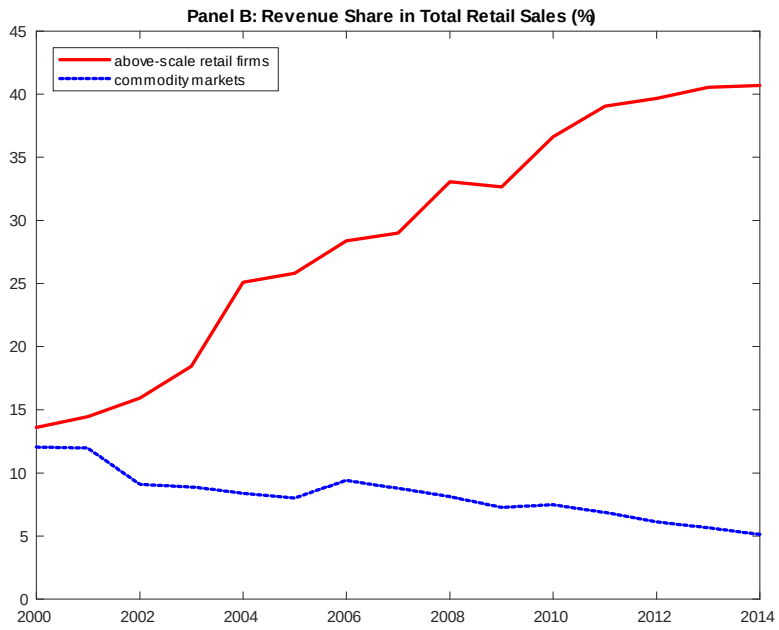
Second, our work also contributes to the literature that emphasizes demand as the major driving force of firm's survival and growth. Foster, Haltiwanger, and Syverson (2008) pioneered this empirical investigation with the U.S Census data. They find that firm's demand shifter instead of physical efficiency is more important to explain new entrant growth and long-run survival. Their findings were confirmed in Hottman, Redding, and Weinstein (2016) using detailed bar-code data of a large number of products. These empirical patterns motivate the theoretical models of Arkolakis (2010), Gourio and Rudanko (2014), Fitzgerald, Haller, and Yedid-Levi (2017) that put customer capital at the center

of firm dynamics. However, since only total sales, and sometimes total quantity, are used in these studies, it is hard to evaluate the mechanisms of how demand evolve differently across entrepreneurs and overtime. Our unique survey provides both production and retail channel information for each firm, thus allowing us to directly micro-found and quantify the specific mechanism.

Finally, The broad transformation from the goods producing manufacturing sector to the service sector happened in a large number of developed economies (Herrrendorf et al, 2014). Although our focus is on the retail segment of a specific industry, we believe our theoretical channels are applicable to a much broader set of consumption goods industries. Our theoretical channel is especially related to Acemoglu and Guerrieri (2008) which relies on cross-sector capital intensity differences to generate the relative price effect. Although we rely on entrepreneur's allocation of resources within her firm and quantify these decisions using our micro-level data.

2 Basic Facts

China's retail sector has been undergoing dramatic transformations over the past two decades. The solid line in Figure 2 shows a fast-growing retail sector that is composed of retail firms with sales above 10 million Yuan. The above-scale retail firms include big supermarkets, department stores and chain stores. In 2000, the above-scale retail firms accounted for barely 14% of the total retail revenue in China. Their sales share increased to 41% in 2014. The rise of the above-scale retail firms came at the cost of a declining more traditional retail sector. For instance, commodity markets, which are typically those places for individuals to trade consumer goods, used to be an important component in the retail sector. The dotted line in Figure 2 shows that the sales share of commodity markets fell from 12% to 5% between 2000 and 2014.



We observe a similar trend in our survey on Chinese footwear manufacturers. To see it, we first categorize firms into three types. The first type is the pure OEMs – i.e., the firms that specialize in OEM. The pure OEMs only sell " intermediate goods" that need to be converted into final goods (by, for instance, adding a brand name) before reaching consumers. The proportion of pure OEM declined in our sample period. Among a total of 251 firms in the balanced panel, there were 141 and 112 pure OEMs in 2006 and 2013, respectively. The trend is less dramatic in the full sample, indicating that new firms are more likely to be OEM. Most pure OEMs are also pure exporters (about 90% of their goods are exported).

Table: Firm Numbers

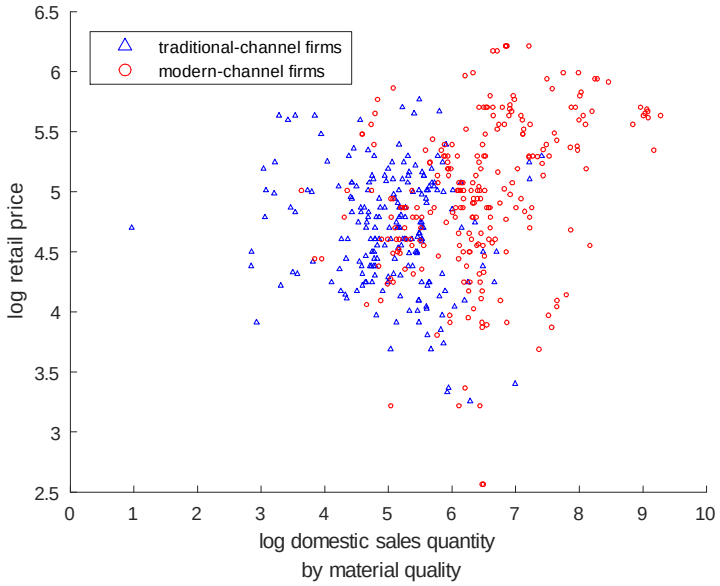
	Full Sample				Balanced Panel			
	All Firms	Pure OEMs	Firms with Sales Channels		All Firms	Pure OEMs	Firms with Sales Channels	
			Traditional	Modern			Traditional	Modern
2006	251	141	65	45	251	141	65	45
2009	275	144	75	56	251	126	69	56
2011	294	148	72	74	251	117	63	71
2012	302	148	73	81	251	112	61	78
2013	303	148	63	92	251	112	52	87

Table: Domestic Non-OEM Sales (unit: million pairs)

	Full Sample			Balanced Panel		
	Traditional	Modern	Modern Share	Traditional	Modern	Modern Share
2006	31.3	89.6	74.1%	31.3	89.6	74.1%
2009	37.7	141.3	79.0%	36.2	141.3	79.6%
2011	41.3	197.6	82.7%	37.5	194.3	83.3%
2012	48.6	208.6	81.1%	41.3	206.1	83.3%
2013	44.7	224.8	83.5%	34.9	221.0	86.4%

By definition, the firms that are not pure OEM sell products directly to consumers through their own sales channels. In contrast to most manufacturing firm surveys that ignore retail activities, our survey was designed to shed lights on the channels through which manufactured goods are sold to consumers. In particular, we asked detailed questions about stores (including direct and franchised stores) controlled by the manufacturers. Since there is not much of heterogeneities in store size and rent, we simply use the number of store as a key measure of retail capital. We then divide non-pure OEMs into two groups. Those with more than 100 stores are referred to as private- or modern-channel firms, while those with less than or equal to 100 stores as public- or traditional-channel firms. All our results are robust to alternative cutoffs. The appendix reports the main results with cutoffs of 50 and 200, respectively.

The growing number of private-channel firms and their sales share are entirely consistent with the overall pattern in the aggregate data. There were 45 private-channel firms in 2006 in the balanced panel. The number nearely doubled in 2013. Private-channel firms accounted for 74% of domestic sales in 2006. Their share increased to 86% in 2013. The changes turn out to be a bit less dramatic in the full sample, indicating that new firms are more likely to adopt traditional retail technology.



Retail Price and Sales

Another important advantage of our survey is that we know the average material costs of shoes each manufacturer produces, their factory-gate and retail prices. It turns out that private-channel firms are not only larger, but also able to sell their products at higher prices even after controling for quality. Figure 2 plots log retail price against log sales quantity (adjusted by quality, see below for details). We observe the following three facts:

- Private-channel firms are much larger.
- Private-channel firms charge higher prices
- Retail price and sales quantity are negative correlated among public-channel firms, while the correlation turns positive among private-channel firms.

XXX Adding regression results XXX

3 Data Analysis

In this section, we document several empirical facts that are informative about the mechanisms highlighted in the theoretical model.

3.1 Production Function

Consistent with the model, we have the value-added production function that

$$ln[q_{it}(e_i)] = \alpha ln(k_{it}) + \beta ln(l_{it}) - \gamma ln(e_i) + ln(z_{it})$$

We can use two alternative empirical strategies to control for quality differences e_i. First, if we believe that quality is slow-evolving, then we can treat e_i as a permanent unobserved heterogeneity in a panel data setup. Second, we can also utilize material's unit input cost $c_m(e_i) = p_m \times e_i^{\gamma_m}$. Since we surveyed c_m, we can substitute $ln(e_i) = \frac{1}{\gamma_m}[ln(c_m(e_i)) - ln(p_m)]$, thus

$$ln[q_{it}(e_i)] = c_0 + \alpha ln(k_{it}) + \beta ln(l_{it}) - \frac{\gamma}{\gamma_m} ln(c_m(e_i)) + ln(z_{it})$$

In Table XXX, we report the production function estimates. It implies a labor coefficient $\beta = 0.534$ and capital coefficient $\alpha = 0.428$. We then can construct each producer's quality-adjusted physical efficiency as $ln(\hat{z_{it}})$.

	(1) With Input Cost	(2) W/O Input Cost
L.lnv	0.603***	0.616***
	(0.094)	(0.092)
lnl	0.517***	0.534***
	(0.144)	(0.129)
L.lnl	-0.309**	-0.321***
	(0.123)	(0.115)
lnk	0.412***	0.428***
	(0.133)	(0.107)
L.lnk	-0.247**	-0.259**
	(0.125)	(0.117)
lnpm	-0.026	
	(0.102)	
L.lnpm	0.013	
	(0.107)	
Observations	866	869

Standard errors in parentheses

*$p < .1$, **$p < .05$, ***$p < .01$

3.2 TFP and Sales Ranking

We start with providing a few descriptive statistics of various types of firms. Corresponding to our model, we have firms that primarily use the private retail channel, that primarily use the public retail channel, and that only produce for the goods market. In table XXX, we provide some descriptives of four distinctive types of the firms. In the first panel, we include the firms that own their brand name retail stores. In the second panel, we have the firms that use distributors with primarily retail stores. Both of these two cases map into the key feature of the private retail channel: the rental of retail capital to be able to make sales. In the third panel, we include the firms that use distributors primarily operating in the wholesale market. We consider these firms using public channel to make sales. In the fourth panel, we have the firms that either completely export or exclusively OEM for other domestic firms. This is the clear counterpart of our goods market.

When we compare across these four types of firms, interesting pattern emerges. First, the firms with their own domestic retail stores turn out be the largest overall. Some of them export, but they primarily make large sales domestically. The firms that use retail distributors are similar, but with less sales and stores. The perhaps surprising finding is that these two groups of firms turn out to have lower physical TFP despite their larger scale. This indicate that sales channel and its related retail capital play a major role in explaining domestic sales with firm's own brand name. Second, the firms that use

wholesale distributors have higher physical TFP, but by definition have much less stores. They make sales through the public channel. Their total sales are smaller than the first two types. Finally, we find that the fourth type of firms are larger those that use wholesale distributors, but their physical TFP is quite comparable. Overall, the later two types have much higher (15% - 20%) physical TFP, but weaker in the retail capital.

	Sales (10,000CNY)	Domestic Sales (10,000CNY)	Physical TFP	Number of Stores p25
		Firms with Own Stores		
p25	13296	6467	-.553	105
p50	33025	23643	-.384	685
p75	59578.49	45980	-.025	1300
		Firms with Retail Distributors		
p25	5528	3176	-.407	100
p50	9618	7000	-.264	342.5
p75	19073	12715	-.115	781
		Firms with Wholesale Distributors		
p25	1800	1530	-.336	42
p50	2793	2400	-.116	72
p75	4300	3730	0.125	110
		Exporting and OEM Firms with No Stores		
p25	2100	0	-.349	0
p50	3909	0	-.148	0
p75	7280	0	0.062	0

3.3 The Determinants of Sales Growth

The model has interesting implication for the determinants of firm's sales growth. When a firm uses public channel, its growth predominantly depends on physical efficiency. In contrast, when a firm uses private channel, both physical efficiency and the retail capital will play a role in the growth of sales. If we treat export market as a special case of the public channel[2], one would expect the response of sales growth is more elastic with respect to physical efficiency in exporting than domestic. Table XX illustrates that this is indeed the case in our data. In column 1 and 2, we regress the growth of domestic sales in quantity on the change of physical efficiency, controlling for a full set of year dummies and input prices. To have a clean comparison, in column 1, we report the result for firms that sell *only* to domestic market. In column 2, we report the result for those that *only* export. We observe that export sales respond more strongly to the physical efficiency changes. (Note to ourselves, have to be careful with variable markups and price variation).

In Table XXX, we zoom in for the firms that sell *only* to the domestic market. We dissect their domestic sales into proxies for the relative importance of private vs public channels. In column 1, we

[2]There is a large literature of documenting barriers to exporting and the importance of customer capital in international trade markets. Although our survey indicates that these barriers, mostly related to matching with a foreign wholesale/retail importer, are still relatively small compared with firms themselves breaking into domestic retail market.

report the result for the firms that own their brand name retail stores. For these firms, we observe that the number of stores, a measure of retail capital, play the most important role for sales growth. Firm efficiency is positive but not significant from zero. This is the group that contrasts most with exporters. In column 2 and 3, we look at the same regression for the firms that use domestic distributors instead of their own retail stores. Although most distributors have their own stores, they have varying degrees of retail exposure. In column 2 we report the regression for the firms which have primarily retail distributors while in column 3 we have the firms which have primarily wholesale distributors. Firm's sales growth is more elastic to physical efficiency change if they sell to a wholesale distributor, conceptually a close proxy for public channel. In addition, we include the distributor's number of stores as a control for retail capital that is indirectly utilized. We find that firm's sales growth is a lot more sensitive to retail distributor's store change. The contrast between columns (1) - (3) illustrate the increasing (decreasing) impact of physical efficiency (retail capital) when public channel becomes the primary source of firm sales. Finally we report in column 4 the regression result for the firms which take outsourcing orders from other manufacturers (and have no own brands, i.e. OEM), as in the case for most exporters. The coefficient on physical efficiency is very close to both column (3) and the overall elasticity for exporters, indicating that indeed low cost is the key for success in the goods market.

	(1)	(2)
	sales_growth_1	sales_growth_2
dtfp	0.850***	1.099***
	(0.168)	(0.203)
dlnpm	0.065	-0.030
	(0.096)	(0.051)
Observations	384	313

Standard errors in parentheses
$^{*}p < .1$, $^{**}p < .05$, $^{***}p < .01$

	(1)	(2)	(3)	(4)
	store_growth_1	store_growth_2	store_growth_3	store_growth_4
dtfp	0.134	0.834***	1.259***	1.061***
	(0.166)	(0.274)	(0.218)	(0.314)
dlnpm	0.212**	0.153	-0.229*	-0.223
	(0.101)	(0.106)	(0.123)	(0.161)
dlnstore	0.943***	0.202***	0.110	
	(0.204)	(0.049)	(0.158)	
Observations	45	128	138	73

Standard errors in parentheses
$^{*}p < .1$, $^{**}p < .05$, $^{***}p < .01$

3.4 Outsourcing and OEM

Another important prediction of our model is that firm's sales are not necessarily the same as their total production. (Note: It will be useful to derive decision based on fundamental heterogeneity z_i^d and z_i) In particular, the firms with higher retail ability will use more retail capital to make sales. If their retail efficiency z_i^d is high relative to their production efficiency z_i, the firm will outsource part of their product from the goods market. Meanwhile, the firms with lower retail ability will use less retail capital or completely rely on the public channel. Their sales is low. However, if their production efficiency is relatively higher, they will perform OEM and directly produce for the other high retail ability firms in the goods market. These predictions are confirmed by our data. In table XXX, we report the cross-sectional pattern of firm's outsourcing and OEM decisions.[3] In column, we report the coefficients of a Probit model of the firm's discrete outsourcing decision. We find that it is positively related to the number of retail stores, the proxy for retail capital. Meanwhile, conditioning on the same amount of retail capital, the probability is negatively related to physical efficiency. Both are consistent with our model predictions. On the other hand, column (2) provides the Probit estimates of the discrete OEM decision. Again consistent with our model, it is positively correlated with physical efficiency but negatively correlated with retail capital.

We also report the overtime variation in the intensive margin for the outsourcing and OEM firms in table XXX. The abundance of retail capital again seems to be an important determinant of the change in outsourcing and OEM as a share of domestic sales. The growth in retail capital increases the share of a firm's outsourcing and decreases the share of a firm's OEM. Physical efficiency is more noisily estimated and only affects the share of a firm's OEM positively.

	(1)	(2)
	prob_out_oem_1	prob_out_oem_2
main		
lnstore	0.883***	-0.536***
	(0.200)	(0.044)
tfp	-0.578	1.104***
	(0.419)	(0.239)
lnpm	0.401	1.138***
	(0.300)	(0.175)
Observations	512	512

Standard errors in parentheses

*$p < .1$, **$p < .05$, ***$p < .01$

[3] These decisions are quite persistent in our data and potentially involve long-term considerations and sunk costs, thus it is hard to investigate overtime changes with a short panel.

	(1) int_out_oem_1	(2) int_out_oem_2
lnstore	0.233**	-0.117***
	(0.085)	(0.014)
tfp	-0.003	0.131
	(0.058)	(0.083)
lnpm	0.084	0.179***
	(0.076)	(0.054)
Observations	44	224

Standard errors in parentheses

$^{*}p < .1,\ ^{*}*p < .05,\ ^{*}**p < .01$

4 The Benchmark Model

We consider an economy where factor prices are exogenous. In the benchmark model, we assume a representative manufacture that produces Q homogenous intermediate goods. Q will be endogenously determined by firm production in the full-blown model. There are a continuum of firms defined on the interval of $[0, 1]$ that produce differentiated final goods indexed by $i \in [0, 1]$. Firms can convert intermediate goods costlessly into final goods in a one-to-one fashion. The right of making differentiated final goods is exclusive: Final goods i can only be produced by firm i. Such an exclusive right grants each firm the monopoly power over its own goods. Design, brand name and sales network are among many channels through which firm can build up the exclusive right.

4.1 Households

The representative household has a CES preference over two sets of differentiated consumption goods: x_i^c sold by public channels and x_i^d sold by private channels:

$$U = \left(\int_{i \in C} \chi_i^c (x_i^c)^{\frac{\sigma-1}{\sigma}} di + \int_{i \in D} \chi_i^d (x_i^d)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

Here, C and D represent the two sets of final goods. $\sigma > 1$ is the elasticity of substitution for goods sold by public channels. We will introduce markup heterogeneity in the full-blown model. We allow the preference intensity to be both firm- and channel-specific. We will assume below that firms can affect χ_i^d by retail capital in the private sales channel.

As will be shown below, C and D are endogenous. We assume both x_i^c and x_i^d are produced by firm i. We will consider two different cases: (i) C and D are mutually exclusive and (ii) C and D may overlap. In the first case, firms can only choose one sales channel. The second case allows firms to use both public and private channels.

The budget constraint is

$$R = \int_C p_i^c x_i^c di + \int_D p_i^d x_i^d di,$$

where R is the total income of the household. For notational convenience, we define

$$\tilde{X}^j \equiv \left(\int_J \chi_i^j (x_i^j)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where $j \in \{c, d\}$ and $J \in \{C, D\}$. The price indices follow $P^j X^j = \int_J p_i^j x_i^j di$. Then, the household problem becomes

$$\max X = \left((\tilde{X}^c)^{\frac{\sigma-1}{\sigma}} + (\tilde{X}^d)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{3}$$

subject to

$$PX = P^c \tilde{X}^c + P^d \tilde{X}^d = R,$$

where the aggregate price indices are $P = \left((P^c)^{1-\sigma} + \left(P^d\right)^{1-\sigma} \right)^{1/(1-\sigma)}$, $P^j = \left(\int_J \left(\chi_i^j \right)^{\sigma} (p_i^j)^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}$. This gives the expenditure share:

$$\frac{R^j}{R} = \left(\frac{P^j}{P} \right)^{1-\sigma}, \tag{4}$$

where $R^j \equiv P^j \tilde{X}^j$ and $i \neq j$. Substituting the above equations back into the problem (3) solves

$$\frac{p_i^j}{P^j} = \chi_i^j \left(\frac{x_i^j}{\tilde{X}^j} \right)^{-\frac{1}{\sigma}}, \tag{5}$$

4.2 Sales Channels

Firm i converts the intermediate goods (either produced by themselves or purchased from OEM) into the ith final goods and then choose to sell it through public or private channels. For public channel, the sales technology is

$$x_i^c = z^c l_i^c, \tag{6}$$

where x_i^c and l_i^c denote the quantity of goods sold through the public channel and the labor input for the public channel. z^c is the efficiency of the public channel. An example of public channel is the "commodity exchange markets" described above. The unit sales cost of public channel is w/z^c.

Firms may also use their own sales channel such as direct sales stores. Our interviews with Chinese footwear entrepreneurs suggest that private channel plays a critical role in blocking counterfeit goods, building up brand name, gathering and processing consumer feedback, and improving logistics management. Despite all these advantages over public channel, private channel was not adopted by most footwear manufacturers in the 1990s, a period when most shoes were sold through public channel. The proportion of the footwear manufacturers using private channel as their main sales channel increased to

about a quarter in 2013 when the survey was conducted. For the private channel, the sales technology is

$$x_i^d = z^d k_i^d, \tag{7}$$

where x_i^d is the quantity of goods sold through private channel, k_i^d denotes retail capital for private channel and z^d is the efficiency of the private channel. The unit sales cost of private channel is r/z^d.

Two remarks are in order. First, we use the number of retail store as the defining element for private channel in the above empirical exercises. Yet, both sales channels may use retail capital and more specifically, retail stores. The stark assumptions on sales technology are introduced to obtain analytical results that may shed light on our main mechanism. The full-blown model will adopt Cobb-Douglas sales technology with capital and labor for both public and private channels. Second, we assume away firm heterogeneity in z^c and z^d, which will be introduced into the full-blown model for quantitative purposes.

The optimal sales of public channel is determined by

$$\max_{\left\{x_i^c, l_i^c\right\}} p_i^c x_i^c - x_i^c - w l_i^c,$$

subject to (5) and (6). The optimal sales of private channel solves

$$\max_{\left\{x_i^d, k_i^d, l_i^d\right\}} p_i^d x_i^d - x_i^d - r k_i^d,$$

subject to (5) and (7).

The FOCs lead to

$$x_i^j = (1 - \frac{1}{\sigma})^\sigma \left(\chi_i^j\right)^\sigma \left(\frac{uc^j}{P^j}\right)^{-\sigma} \frac{R^j}{P^j}, \tag{8}$$

and

$$p_i^j = \frac{\sigma}{\sigma - 1} uc^j, \tag{9}$$

where

$$uc^j = \begin{cases} p + \frac{w}{z^c} & \text{if } j = c \\ p + \frac{r}{z^d} & \text{if } j = d \end{cases} \tag{10}$$

represent the unit cost of public- and private-channel goods (including production and sales cost). The sales profits from public and private channel are

$$\pi_i^j = p_i^j x_i^j - uc_i^j x_i^j = \frac{(\sigma - 1)^{\sigma - 1}}{\sigma^\sigma} \left(\chi_i^j\right)^\sigma \left(\frac{P^j}{uc^j}\right)^{\sigma - 1} R^j, \tag{11}$$

We assume that firms can only operate in one sales channel (i.e., C and D are mutually exclusive). This assumption is consistent with the fact that most firms specialize in one sales channel in our sample. It also simplifies substantially the following analysis. We will allow firms to operate in both

sales channels as a robustness check (see Appendix XXX for details). Under the assumption that firms have to choose between public and private channels, their choice will simply depend on which sales channel delivers more profits. Specifically, (9) and (11) show that firm i would choose private channel if

$$\chi_i^d > \tilde{\chi}_i^d,$$

where the cutoff for χ_i^d is defined as

$$\tilde{\chi}_i^d \equiv \left(\frac{p + r/z^d}{p + w/z^c}\right)^{\frac{\sigma-1}{\sigma}} \chi_i^c. \tag{12}$$

It is straightforward that $\partial\tilde{\chi}^d/\partial r < 0$ and $\partial\tilde{\chi}^d/\partial w > 0$ – i.e., lower interest rate or higher wage rate would push more firms to choose private channel. The effect of p is ambiguous. In what follows, we will consider a special case where the unit sales cost is equlized across the two sales channels: $r/z^d = w/z^c$. There, $\partial\tilde{\chi}^d/\partial p = 0$.

4.3 Aggregation

The total expenditure on final goods is $R = R^c + R^d$, which is exogenous in the model. R^c and R^d follow (4). Define $X^j \equiv \int_J x_i^j di$ the total demand for intermediate goods from the specific sales channel. The goods market clearing condition is

$$\begin{aligned} Q - Q^e &= X^c + X^d \\ &= (1 - \frac{1}{\sigma})^\sigma \frac{R^c}{P^c} \left(\frac{p + w/z^c}{P^c}\right)^{-\sigma} \int_{\chi^c} \int_{\chi^d \leq \tilde{\chi}^d} f\left(\chi^c, \chi^d\right) d\chi^d d\chi^c \\ &+ (1 - \frac{1}{\sigma})^\sigma \frac{R^d}{P^d} \left(\frac{p + r/z^d}{P^d}\right)^{-\sigma} \int_{\chi^c} \int_{\chi^d > \tilde{\chi}^d} f\left(\chi^c, \chi^d\right) d\chi^d d\chi^c. \end{aligned} \tag{13}$$

Here, Q and Q^e denote the intermediate goods produced by the representative manufacturer and the net exports of the intermediate goods, respectively. $f\left(\chi^c, \chi^d\right)$ is the probability density function. We assume both Q and Q^e are constant in the simple model.

The aggregate price indices are

$$P^j = \frac{\sigma}{\sigma - 1} uc^j \left(\int_{\chi^c} \int_{\chi^d \leq \tilde{\chi}^d} (\chi^c)^\sigma f\left(\chi^c, \chi^d\right) d\chi^d d\chi^c\right)^{\frac{1}{1-\sigma}}. \tag{14}$$

Lemma 1 *The equilibrium intermediate goods price exists and is unique.*

The detailed proof is in the appendix. The idea is to show that the RHS of (27) is strictly decreasing in p. Intuitively, a higher intermediate goods price would push up retail prices and, hence, suppress the demand for intermediate goods.

Lemma 2 *Fixing p, $\partial X^d/\partial r < 0$ and $\partial X^d/\partial w > 0$.*

To see the results, let us differentiating X^d with respect to r yields

$$\frac{\partial X^d}{\partial r} = \underbrace{(1-\frac{1}{\sigma})^{\sigma}\frac{R^d}{P^d}\left(\frac{p+r/z^d}{P^d}\right)^{-\sigma}\frac{\partial \tilde{\chi}^d}{\partial r}\int_{\chi^c}\left(\tilde{\chi}^d\right)^{\sigma} f\left(\chi^c,\tilde{\chi}^d\right)dz^d d\chi^c}_{\text{extensive margin}} \tag{15}$$

$$+\underbrace{(1-\frac{1}{\sigma})^{\sigma}\frac{R^d}{P^d}\frac{\partial\left(\left(p+r/z^d\right)/P^d\right)^{-\sigma}}{\partial r}\int_{\chi^c}\int_{\chi^d>\tilde{\chi}^d}\left(\tilde{\chi}^d\right)^{\sigma} f(\chi^c,\chi^d)d\chi^d d\chi^c}_{\text{intensive margin}}$$

$$+\underbrace{(1-\frac{1}{\sigma})^{\sigma}\frac{d(R^d/P^d)}{dr}\left(\frac{p+r/z^d}{P^d}\right)^{-\sigma}\int_{\chi^c}\int_{\chi^d>\tilde{\chi}^d}\left(\tilde{\chi}^d\right)^{\sigma} f\left(\chi^c,\chi^d\right)d\chi^d dz^d}_{\text{aggregate demand effect}}.$$

(15) illustrates three channels through which r may affect X^d. The first term on the RHS captures the effect that moves firms between public and private channels. As discussed above, a lower r would make more firms to switch from public to private channel. This would increase X^d. The second term captures the intensive margin. A lower r lowers both firm's unit cost of private-channel goods and the aggregate price of private-channel goods. The effect on the relative price is ambiguous. The third term is the aggregate demand effect, which is always negative.[4] Intuitively, a lower r would lower P^d and, hence, increase the aggregate demand for private-channel goods. The appendix shows that the sum of the second and third terms is always negative. This confirms that $\partial X^d/\partial r < 0$. The proof for $\partial X^d/\partial w > 0$ is analogous.

The effects of r and w on X^d under endogenous p is more involved. For instance,

$$\frac{dX^d}{dr} = \frac{\partial X^d}{\partial r} + \frac{\partial X^d}{\partial p}\frac{dp}{dr},$$

where the signs of $\partial X^d/\partial p$ and dp/dr are both ambiguous. We invoke the assumption of equal unit sales cost across public and private channels, $r/z^d = w/z^c$, to guarantee $dp/dr < 0$ amd $dp/dw < 0$. In the neighborhood of equal unit sales costs, increasing r or w would always lower the equilibrium intermediate price. This establishes our main proposition.

Proposition 1 *In the neighborhood of $r/z^d = w/z^c$, $dX^d/dr < 0$ and $dX^d/dw > 0$.*

Following (4), we can also look at the expenditure on private-channel goods:

$$R^d = \int_{\chi^c}\int_{\chi^d>\tilde{\chi}^d}\left(\chi^d\right)^{\sigma} f\left(\chi^c,\chi^d\right)d\chi^d d\chi^c, \tag{16}$$

where we have used the assumption that $r/z^d = w/z^c$. It is immediate $dR^d/dr < 0$ and $dR^d/dw > 0$. Since $Q - Q^e$ and R are both constant, the above results shows that lower r or higher w will lead to an expansion of the private channel, regardless of how its size is measured.

[4] One can show that $d\left(P^d/P^c\right)/dr > 0$ would be sufficient for $d\left(R^d/P^d\right)/dr < 0$. It is immediate from (??) and (28) that $d\left(P^d/P^c\right)/dr > 0$.

5 The Full-Blown Model

We enrich the simple model by introducing the following elements: (i) firm production of intermediate goods; (ii) heterogeneity of sales efficiency in both public and private channels; (iii) markups heterogeneity. The full-blown model will serve as a workhorse for quantitative exercises in the next section.

5.1 Production

There are a continuum of firms defined on the interval of $[0, 1]$. They produce two types of goods: (i) differentiated final goods indexed by $i \in [0, 1]$ and (ii) homogenous intermediate goods. We maintain the assumption that each firm can costlessly convert the intermediate goods into its own final goods in a one-to-one fashion. The right of making differentiated final goods is exclusive: Final goods i can only be produced by firm i. Such an exclusive right grants each firm the monopoly power over its own goods. Design, brand name and sales network are among many channels through which firm can build up the exclusive right.

Denote x_i the quantity of final good i. Firms with $q_i \neq x_i$ will trade in the intermediate goods market. Those with $q_i > x_i$ sell the intermediate goods and, hence, are considered as OEMs. Those with $q_i < x_i$ undertake outsourcing. $x_i = x_i^c + x_i^d$, where x_i^c and x_i^d denote the quantity of final good i sold by public and private channel, respectively. The aggregate intermediate goods output is

$$Q = \int q_i di. \tag{17}$$

All firms can produce the common intermediate goods with a Cobb-Douglas production technology:

$$\hat{q}_i = e_i^{-\gamma} k_i^{\alpha} \left(z_i l_i\right)^{\beta},$$

where $\alpha > 0$, $\beta > 0$, $\gamma > 0$, $\alpha + \beta \in (0, 1)$; $\hat{q}_i$, k_i, and l_i denote the quantity of intermediate goods produced by firm i, its production capital and labor; z_i captures the labor-augmented technology; e_i represents the quality of the intermediate goods. The intermediate goods market is competitive. Denote p the price of the "standard" intermediate goods (with $e_i = 1$) to one. The price of the ith intermediate goods is equal to $e_i^{\gamma} p$. The intermediate goods adjusted by quality are perfectly substitutable. In the following theoretical analysis, we will use quality adjusted output, $q \equiv e_i^{\gamma} \hat{q}_i$, and drop e_i for notional convenience.

Denote $\tilde{r}$ the rental price for production capital, which may differ from the rental price for retail capital r. Firms choose k_i and l_i by

$$\max_{\{k_i, l_i\}} p k_i^{\alpha} \left(z_i l_i\right)^{\beta} - \tilde{r} k_i - w l_i.$$

The FOCs imply

$$q_i = p^{\frac{\alpha+\beta}{1-\alpha-\beta}} \left(\frac{\alpha^{\alpha}\beta^{\beta}}{\tilde{r}^{\alpha} w^{\beta}}\right)^{\frac{1}{1-\alpha-\beta}} z_i^{\frac{\beta}{1-\alpha-\beta}}. \tag{18}$$

5.2 Heterogeneous Markups

We next extend (1) by introducing markups hetergeneity into private- and public-channel goods.

$$U = \left(\int_{i \in C} \chi_i^c (x_i^c)^{\frac{\sigma-1}{\sigma}} di + \left(\int_{i \in D} \chi_i^d (x_i^d)^{(1-\zeta)\frac{\sigma-1}{\sigma}} di \right)^{\frac{1}{1-\zeta}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{19}$$

where $\zeta \in [0,1]$. For notational convenience, we let $\sigma^c \equiv \sigma$ and

$$\sigma^d \equiv \frac{\sigma}{1+\zeta(\sigma-1)} \in [1, \sigma]. \tag{20}$$

σ^d is the elasticity of substitution for goods sold by private channel. By construction, $\sigma^d \leq \sigma^c$ – i.e., private channel allows firms to charge higher markups than private channel. X^c still follows (2) but X^d is redefined as

$$X^d \equiv \left(\int_D \chi_i (x_i^d)^{(1-\zeta)\frac{\sigma-1}{\sigma}} di \right)^{\frac{1}{1-\zeta}\frac{\sigma}{\sigma-1}}.$$

One can still rewrite the problem as (3). The only difference is that $P^j = \left(\int_J \left(\chi_i^j \right)^{\sigma^j} (p_i^j)^{1-\sigma^j} di \right)^{\frac{1}{1-\sigma^j}}$. (4) holds true, while (5) becomes

$$\frac{p_i^j}{P^j} = \chi_i^j \left(\frac{x_i^j}{X^j} \right)^{-\frac{1}{\sigma^j}}. \tag{21}$$

5.3 Sales Channels

We allow both sales channels to adopt Cobb-Douglas technology. Specifically,

$$x_i^j = \left(k_i^j \right)^{\omega^j} \left(\hat{z}_i^j l_i^j \right)^{1-\omega^j}, \tag{22}$$

where k_i^j, l_i^j denote capital and labor input for the corresponding sales channel, $\hat{z}_i^j$ is labor-augmenting sales technology and ω^j captures capital intensity of sales channel. The unit sales cost of sales channel is $r^{\omega^j} w^{1-\omega^j} / z_i^j$, where $z_i^j \equiv \omega^{j\omega^j}((1-\omega^j)\hat{z}_i^j)^{1-\omega^j}$.

The optimal sales of private channel solves

$$\max_{\{x_i^j, k_i^j, l_i^j\}} p_i^j x_i^j - x_i^j - r k_i^j - w l_i^j,$$

subject to (21) and (22). The FOCs lead to

$$x_i^j = (1 - \frac{1}{\sigma^j})^{\sigma^j} \left(\chi_i^d \right)^{\sigma^j} \left(\frac{P^j}{p + r^{\omega^j} w^{1-\omega^j} / z_i^j} \right)^{\sigma^j} \frac{R^j}{P^j}, \tag{23}$$

and

$$p_i^j = \frac{\sigma^j}{\sigma^j - 1} \left(p + \frac{r^{\omega^j} w^{1-\omega^j}}{z_i^j} \right). \tag{24}$$

Retail capital follows

$$k_i^j = \omega^j \left(\frac{w}{r}\right)^{1-\omega^j} \frac{x_i^j}{z_i^j}. \tag{25}$$

The sales profits from public and private channel are

$$\pi_i^j = p_i^j x_i^j - \left(1 + \frac{r^{\omega^j} w^{1-\omega^j}}{z_i^j}\right) x_i^j = \frac{\left(\sigma^j - 1\right)^{\sigma^j - 1}}{\left(\sigma^j\right)^{\sigma^j}} \left(\chi_i^j\right)^{\sigma^j} \left(\frac{P^j}{p + r^{\omega^j} w^{1-\omega^j} / z_i^j}\right)^{\sigma^j - 1} R^j. \tag{26}$$

The cutoff for χ^d in (12) is defined as

$$\tilde{\chi}^d \equiv \left(\frac{\left(\sigma^d\right)^{\sigma^d} / (\sigma^d - 1)^{\sigma^d - 1}}{\left(\sigma^c\right)^{\sigma^c} / (\sigma^c - 1)^{\sigma^c - 1}} \frac{\left(p + r^{\omega^d} w^{1-\omega^d} / z^d\right)^{\sigma^d - 1}}{\left(p + r^{\omega^c} w^{1-\omega^c} / z^c\right)^{\sigma^c - 1}}\right)^{\frac{1}{\sigma^d}} \left(\chi^c\right)^{\frac{\sigma^c}{\sigma^d}} \left(P^d\right)^{\frac{\sigma^c - \sigma^d}{\sigma^d}},$$

where P^d follows (28). The following table summarizs the conditions for firms to undertake outsourcing or OEM and to use public or private sales channel.

Table 1: Patterns of Production and Sales

	$\pi_i^c \geq \pi_i^d$	$\pi_i^c < \pi_i^d$
$x_i < q_i$	OEM + public channel	OEM + private channel
$x_i > q_i$	outsourcing + public channel	outsourcing + private channel

5.4 Aggregation

The total expenditure on final goods is $R = R^c + R^d$, which is exogenous in the model. R^c and R^d follow (4). The goods market clearing condition is

$$Q - Q^e = \int_C x_i^c di + \int_D x_i^d di, \tag{27}$$

where $Q \equiv \int q_i di$, q_i, x_i^c and x_i^d follow (**??**), (**??**) and (**??**); Q^e represents net exports of the intermediate goods and is assumed to be a constant for simplicity. We assume Q is a constant in the benchmark model. Firm production will be introduced in the quantitative exercise

The aggregate price indices are

$$P^j \equiv \left(\int_D \left(\chi_i^j\right)^{\sigma^j} \left(p_i^j\right)^{1-\sigma^j} di\right)^{\frac{1}{1-\sigma^j}} = \frac{\sigma^j}{\sigma^j - 1} \left(\int_J \left(\chi^j\right)^{\sigma^j} \left(p + \frac{r^{\omega^j} w^{1-\omega^j}}{z^j}\right)^{1-\sigma^j} f^j\left(\chi^j, z^j\right) d\chi^j dz^j\right)^{\frac{1}{1-\sigma^j}}. \tag{28}$$

XXX

We now consider the four types of firms classified in the above table. Among public-channel firms with $\chi^d \leq \tilde{\chi}^d$, they tend to have higher z_i^c or χ_i^c (conditional on χ_i^j). XXX we need to figure out under what conditions they are more likely to do OEM (i.e., $x_i^c < q_i$) as compared to private-channel firms.

XXX Since public-channel firms are more likely to do OEM, their sales would be more responsive to firm TFP shocks. These predictions are all consistent with the empirical facts in Section 3.

XXX

It should also be noticed that a lower r leads to a structural transformation in the retail sector. A rise of private channel is associated with a decline of public channel. Moreover, such transformation also leads to a rising retail sector as a whole. A novel feature of the model is that the lower r will lower the cost of private sales channel, pushing capital to flow from manufacturing to retail. As a consequence, private channel arises, while public channel shrinks.

XXX

We can also compute the share of retail value added. To link the model to the data, let us distinguish value added created by manufacturing and retail. The manufacturing value added is $\int pq_i di$, while the public- and private-channel value added is $\int_C \left(\pi_i^c + wl_i^c\right) di$ and $\int_D \left(\pi_i^d + rk_i^d + wl_i^d\right) di$. We will study how r and w affect retail value added share.

XXX Macro-level evidence:

1. Public channel dominates in the early stage and gradually phases out.
2. Private channel retreats in exports boom.

Firm-level evidence:

1. Firm size is primarily determined by firm physical TFP in the early stage (all firms have exactly the same sales capacity when private channel does not exist).
2. For the firms adopting private channel, their size is also affected by their sales efficiency. Unless firm sales efficiency is perfectly correlated with firm physical TFP, the emergence of private channel would increase the dispersion of firm size distribution.
3. For the firms that undertake OEM and do not own private channel, their revenue growth should be closely associated with physical TFP growth. In contrast, for the firms that undertake outsourcing and have developed private channel as their main sales channel, their revenue growth should be closely associated with the expansion of retail capital.

6 Structual Estimation

We use the 2011-2013 sample (recall that the data before 2011 are primarily based on recollection and, hence, not very precise). To control for year effects, we scale all variables by the corresponding median value in the year.[5]

[5] For the variables that apply to a group of firms, they are scaled by the median value within that group (rather than all firms) in the year. For instance, the number of retail stores is scaled by the median value among private-channel firms

6.1 Calibration

Recall that we use the quality adjusted intermediate output, $q_{it} = \hat{q}_{it}/e_{it}^{\gamma}$, and the normalized price of quality adjusted intermediate goods in the above analysis. To map from the model to the data, we use material cost per pair of shoes to proxy e_{it}. To estimate γ, we regress $\log \hat{q}_{it}$, the log quantity of shoe produced by firm i on its log capital, labor and material cost. Specifically, we use the value of machines and total labor compensations to proxy k_{it} and l_{it}. XXX details about constructing l_{it} XXX We also use electricity as a proxy for k_{it} for robustness check. Table XXX shows that the estimated coefficient of log material cost is 0.39. We then obtain the quality-adjusted quantity by $q_{it} = \hat{q}_{it}/e_{it}^{0.39}$. x_{it} is adjusted in the same way. The underlying assumption is that if a firm produces intermediate goods of quality e_{it}, it will also sell final goods with the same quality. XXX (anecdotal) evidence ? XXX Equivalently, one can maintain the raw production and sales quantity but adjust prices.[6]

In the model, production and retail value added are q_{it} and $p_i x_i - q_{it}$, respectively. One advantage of our data is separation of q_{it} and $p_i x_i - q_{it}$. We measure production value added by production revenue net of intermediate input, where production revenue is the product of the quantity of shoes and the price at factory gate. Retail value added is the difference between sales net of intermediate inputs and production value added. Table XXX shows that labor share is stable among the footwear manufacturers over the sample period. β is thus calibrated to 0.51 to match the average labor share. $\alpha + \beta$ is set to 0.90, implying $\alpha = 0.39$. XXX estimating α and β XXX We assume $\log z_i$ to follow normal distribution with mean zero and variance σ_z^2, which is calibrated to match the standard deviation of $\log q_{it}$. Since $1 - \alpha - \beta = 0.1$, we get $\sigma_z = 0.094$.[7]

$\tilde{r} = r = 0.15$ to match the aggregate capital return of 10% plus capital depreciation of 5% (see, e.g., Bai, Hsieh and Qian, 2006; Hsieh and Song, 2015). w is calibrated to match the observed aggregate capital-labor ratio of 0.93 for production. Since $K/L = (\alpha w/(\beta r))^{1-\alpha-\beta}$, we have $w = 0.13$. We set Q^e such that exports account for 32% of the total intermediate goods.

Figure 1 shows that the number of retail stores (direct and franchanised stores) and sales quantity are highly correlated (with a correlation coefficient of 0.74). We regress $\log k_{it}^j$ (proxied by the number of retail stores) on $\log x_{it}^j$, with year dummies included, and the interaction term between the dummy variable (1 for private channel and 0 for public channel) and $\log x_{it}^j$. The coefficients of $\log k_{it}^c$ and the interaction term are 0.50 and 0.30 (with standard error of 0.09 and 0.10). This implies $\omega^c = 0.50$ and $\omega^d = 0.80$. We can also run regressions separately for public- and private-channel firms. The results

in the year. Using the original values delivers essentially the same results.

[6] The price of intermediate goods will be set to $m_{it}^{0.39}$ in the model and the retail prices in the data will be scaled by $m_{it}^{0.39}$.

[7] Alternatively, we can directly back out firm TFP by $q_{it}/k_{it}^{0.39} l_{it}^{0.51}$. This would imply a much larger dispersion of firm TFP (with standard deviation of 0.538). To match the output dispersion, we would also need to introduce capital and labor wedges a la Hsieh and Klenow (2009). Our main findings are robust to the alternative specification (see Appendix XXX)

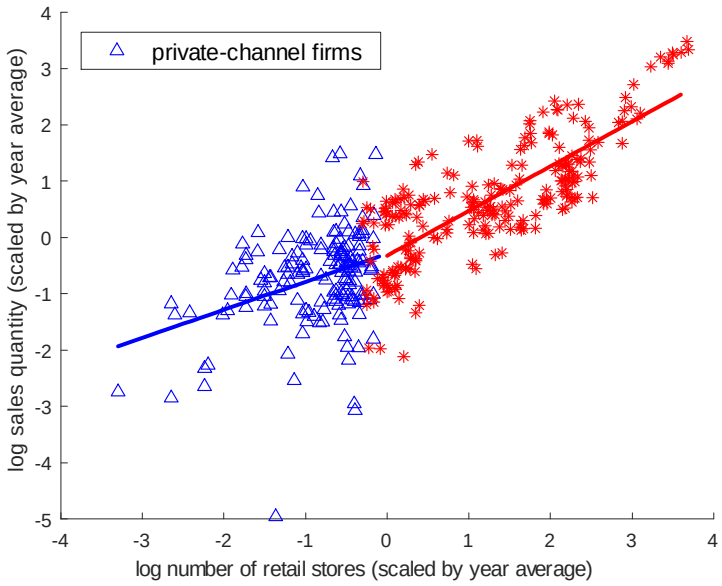


Figure 1: Retail Store Number and Sales Quantity

are very robust (see table XXX).

In the benchmark case, we set $\sigma = \eta = 7$, which corresponds to markups of 1.16, very close to the estimates in the literature (XXX). We next try $\eta = 5$ and 3.5. Our main findings turn out to be robust to different η.

6.2 Structural Estimation

We structually estimate eight parameters that govern the distributions of unobservable sales efficiency and preferences in public and private channels. Specifically, we assume that $\log z_i^c$ and $\log \hat{z}_i^d$ are drawn from two i.i.d. normal distributions with variance $\sigma^2_{\log z^c}$ and $\sigma^2_{\log z^d}$, respectively. The mean of $\log \hat{z}_i^d$ is $E_{\log z^d}$ and the mean of $\log z_i^c$ is normalized to zero. We also assume $\log \chi_i^c$ and $\log \chi_i^d$ to follow two i.i.d. normal distributions with variance $\sigma^2_{\log \chi^c}$ and $\sigma^2_{\log \chi^d}$, respectively. The mean of $\log \chi_i^d$ is $E_{\log \chi^d}$ and the mean of $\log \chi_i^c$ is also normalized to zero. We allow $\log z_i^c$ and $\log z_i^d$ to be correlated with $\log z_i$. Denote $\rho_{\log z^c, \log z}$ ($\rho_{\log z^d, \log z}$) the correlation coefficients between $\log z_i^c$ ($\log z_i^d$) and $\log z_i$.

We target eleven empirical moments. For both public- and private-channel firms, we use the standard deviation of their sales quantity ($\log x_i^c$ or $\log x_i^d$) and the correlation between sales ($\log x_i^c$ or $\log x_i^d$) and TFP ($\log z_i$). (**??**) and (**??**) show that the sales dispersion disciplines the preference dispersion, $\sigma_{\log \chi^c}$ or $\sigma_{\log \chi d}$, and the sales efficiency dispersion, $\sigma_{\log z^c}$ or $\sigma_{\log z^d}$. The correlation helps to identify $\rho_{\log z, \log z^c}$ or $\rho_{\log z, \log z^d}$. For private-channel firms, we also use the standard deviation of their retail stores, which helps to identify $\sigma_{\log z^d}$ by (**??**).

We next use the proportion of private-channel firms and their sales share. The two moments are

informative for $E_{\log z^d}$ and $E_{\log \chi^d}$, the difference of the average preference and sales efficiency between the public and private channels. The observed difference of the average log TFP between private- and public-channel firms is used to discipline $\rho_{\log z^c, \log z}$ and $\rho_{\log z^d, \log z}$. The observed ratio of the average retail price between private- and public-channel firms is used to discipline $E_{\log z^d}$ $\sigma^2_{\log z^c}$ and $\sigma^2_{\log z^d}$ that affect the sales cost difference as implied by (**??**) and (**??**).

Finally, we run the following regression:

$$\log p^c_{it} = b_0 + b_1 \log x^c_{it} + \varepsilon_{it}. \tag{29}$$

Year dummies are added. We ask the model to fit the estimated b_1. Note that the model predicts

$$\log p^c_i = \text{constant} - \frac{1}{\sigma} \log x^c_i + \log \chi^c_i,$$

Since χ^c_i is correlated with x^c_i, the estimate of b_1 would be biased away from $1/\sigma$. That is the reason why we cannot directly back out σ by the simple regression.

$$\begin{aligned} p\lim \hat{b}_1 &= \frac{1}{\sigma} + \frac{\text{cov}\left(\log x^c_i, \log \chi^c_i\right)}{\text{var}\left(\log x^d_i\right)} \\ &= \frac{1}{\sigma} + \eta \frac{\text{var}\left(\log \chi^c_i\right) - \text{cov}\left(\log\left(p + w/z^c_i\right), \log \chi^c_i\right)}{\text{var}\left(\log x^c_i\right)}. \end{aligned}$$

As we assume χ^c_i to be uncorrelated with z^c_i (i.e., $\text{cov}(\log\left(p + w/z^c_i\right), \log \chi^c_i) = 0$), the estimate would be biased towards zero. We can in principle do the same thing for private-channel firms and and target the estimated coefficient of $\log x^d_i$, which turns out to be positive and highly significant and can never be fit in our benchmark model. Section XXX will allow a positive correlation between χ^d_i and z^d_i, which could turn the estimate positive. There, we will add the estimate as an additional moment to target.

We use Simulated Method of Moments (SMM) to estimate the eight parameters by targeting the ten moments. Appendix 9 lays out the detailed procedures for implementing SMM. The results are reported in Table XXX.

Table: Estimated Parameters

		$\sigma = \eta = 7$		$\sigma = 7$, $\eta = 3.5$	
		Estimates	S.E.	Estimates	S.E.
σ_{z^c}	Standard deviation of $\log z^c_i$	0.924	0.337	0.902	0.228
$\rho_{z^c, z}$	Correlation between $\log z^c_i$ and $\log z_i$	0.426	0.109	0.373	0.118
$E_{\log z^d}$	Mean of $\log z^d_i$	-2.089	0.340	-2.253	0.302
σ_{z^d}	Standard deviation of $\log z^d_i$	0.103	0.335	0.100	1.047
$\rho_{z^d, z}$	Correlation between $\log z^d_i$ and $\log z_i$	0.119	0.552	0.106	1.510
σ_{χ^c}	Standard deviation of $\log \chi^c_i$	0.098	0.029	0.092	0.047
$E_{\log \chi^d}$	Mean of $\log \chi^d_i$	0.345	0.051	0.253	0.062
σ_{χ^d}	Standard deviation of $\log \chi^d_i$	0.255	0.011	0.375	0.027

Table: Targeted and Simulated Moments

	Data	Model	
		$\sigma = \eta = 7$	$\sigma = 7$, $\eta = 3.5$
Standard deviation of $\log x_i^c$	0.925	0.846	0.742
Correlation between $\log x_i^c$ and $\log z_i$	0.256	0.245	0.265
Standard deviation of sales quantity ($\log x_i^d$)	1.158	1.327	1.394
Correlation between $\log x_i^d$ and $\log z_i$	0.087	0.136	0.124
Standard deviation of retail capital ($\log k_i^d$)	1.284	1.325	1.393
Proportion of private-channel firms	0.511	0.526	0.551
Sum of x_i^d / Sum of x_i^c and x_i^d	0.803	0.803	0.818
Difference of $\log z_i$ between two channels	-0.110	-0.019	-0.019
Mean of p_i^d / Mean of p_i^c	1.791	1.494	1.649
Estimated b_1 in (29)	-0.194	-0.061	-0.097
Sum of weighted distance		42.612	57.383

Our estimates confirm that public and private channels are very different on both demand and supply sides. In the benchmark case where $\sigma = \eta$, the dispersion of public-channel efficiency is 0.92, while the dispersion of private-channel efficiency is merely 0.10 and statistically insignificant. Firm's public-channel efficiency appears to be positively correlated with its TFP, with a correlation of 0.43. In contrast, the correlation between firm's private-channel efficiency and its TFP is much weaker. The correlation is 0.12 and insignificant. On the demand side, the preference heterogeneity over private-channel goods is about 1.5 times larger than that over public-channel goods. The model with $\eta = 3.5$ delivers essentially the same results. The only significant difference is that the estimated preference heterogeneity over private-channel goods is even larger. This is intuitive as the model with lower elasticity of substitution asks for more preference heterogeneity to match the observed sales distribution in the data.

6.3 Counterfactuals

Our model suggests that changes in factor prices may contribute to the growing number of private-channel firms and the rising share of private-channel sales since 2006. We then conduct a model-based accounting exercise to illustrate the quantitative importance of each force. First of all, China experienced a rapid real wage growth over the past two decades. According to China Statistical Yearbook, the average wage growth is 13.9% per annum for urban workers between 2006 and 2013. The median wage in our survey suggests a more modest annual growth of 9.4%. Second, our survey shows that production capital grew in tandem with revenue of intermediate goods (calculated by factory gate price). The median marginal revenue product of capital declined by barely one percent from 2006 to 2013. Some recent estimates show a dramatic decline in China's aggregate returns to capital since the mid 2000s (i.e., Bai and Zhang, 2016; Bai et al., 2018). This is primarily driven by the financial deregulation on local governments, which mainly benefit state-owned enterprises.[8] The capital cost of the firms in our survey remained unaffected is consistent with the fact that these firms are all privately

[8] See Bai, Hsieh and Song (2016) and the literature discussed in Song and Wei (2018).

owned. In contrast, our survey shows a dramatic increase of 70% in the rental price for retail stores (annual growth of 7.8%) in the sample period, which is in line with the housing price boom in China since the early 2000.[9] In summary, we calibrate w and r in 2006 so that w_{13}/w_{06} and r_{13}/r_{06} match the median wage and rental price growth in our survey. The rental price for production capital, $\tilde{r}_{06}$, is set equal to $\tilde{r}_{13}$, to be consistent with roughly the same marginal revenue product of production capital during the sample period.

The mean of z_i in 2006 is calibrated to match the annual TFP growth of 1.2% between 2006 and 2013. Similarly, R in 2006 is calibrated to match the annual domestic sales revenue growth of 14.2%. We introduce an output wedge to the production of intermediate goods for all firms in 2006: $q_i = (1-\tau)\, k_i^{\alpha} \left(z_i l_i\right)^{\beta}$. τ is calibrated to match the annual growth of 5.2% in the intermediate goods. Alternatively, we can introduce an wedge in the sale functions for both private and public channels: $x_i^j = (1-\tau)\left(k_i^j\right)^{\omega^j}\left(\hat{z}_i^j l_i^j\right)^{1-\omega^j}$. τ will also be calibrated to match the same intermediate goods growth. The results are very robust and reported in the appendix. Finally, Q^e is also adjusted to match the export share in 2006.

The following table reports the results. The proportion of private-channel firms and their sales quantity increase by 22 and 12 percentage points in our sample and by 13 and 10 percentage points in our estimated model. In words, our model can explain about 60 percent of the increase in the retail share by firm number and about 80% of the increase by sales quantity. If there is only increase in the rental price of retail stores, the proportion of private-channel firms and sales quantity would decline by 23 and 27 percentage points. If there is only increase in the wage rate, these shares would increase by 24 and 22 percentage points.

Table: Couterfactual Exercises

	Data		Model	
	2006	2013	low r and w	benchmark
Proportion of private-channel firms	0.41	0.63	0.54	0.67
Proportion of private-channel sales	0.74	0.86	0.68	0.78

Table: Model-Based Decomposition

	low r and w	high r only	high w only	high r and w (benchmark)
Proportion of private-channel firms	0.54	0.31	0.78	0.67
Proportion of private-channel sales	0.68	0.41	0.90	0.78

7 Conclusion

The structural change from manufacturing to services is happening in a large number of emerging economies. China is no exception. However, the detailed mechanisms behind it have not been empiri-

[9] Fang, Gu, Xiong, and Zhou (2015) show that housing prices in real terms grew at an annual rate of 13.1% in the first-tier cities, 10.5% in the second-tier cities, and 7.9% in the third-tier cities between 2003 and 2013.

cally investigated so far. Our paper provides one of the first micro-level studies of this process in the footwear industry of China. We illustrate novel empirical patterns of within- rm transition based on entrepreneurial comparative advantage. We also quanitfy the role of capital deepening in the overtime growths of the industry level retail activities.

Despite the fact that our study relies primarily on data from one specific industry, we believe our model mechanisms can be applied to the broader manufacturing sector. A natural next step is to extend our data e ort to a more comprehensive set of industries and endogenize the key equilibrium objects sucn as interest rate and wages.

The other important lesson we learned from our analysis is how government policies a ect the speed of structural change. Since the export market and the domestic retail market is instricincally related due to entrepreneur's investment and production decision, trade policies such as export subidies can have the unintended consequence of slowing down domestic market integration.

8 Appendix: Alternative Cutoffs for Private-Channel Firms

Table: Firm Numbers

	Full Sample				Balanced Panel			
	Cutoff: 50 Stores		Cutoff: 200 Stores		Cutoff: 50 Stores		Cutoff: 200 Stores	
	Traditional	Modern	Traditional	Modern	Traditional	Modern	Traditional	Modern
2006	42	68	79	31	42	68	79	31
2009	38	93	89	42	34	91	83	42
2011	32	114	99	47	28	106	87	47
2012	32	122	102	52	27	112	87	52
2013	27	128	101	54	24	115	85	54

Table: Modern Retail Share

	Full Sample		Balanced Panel	
	Cutoff: 50 Stores	Cutoff: 200 Stores	Cutoff: 50 Stores	Cutoff: 200 Stores
2006	87.2%	61.6%	87.2%	61.6%
2009	92.9%	69.0%	93.2%	69.5%
2011	94.4%	69.7%	94.5%	71.9%
2012	93.2%	70.1%	94.4%	72.8%
2013	95.6%	69.1%	95.7%	72.6%

9 Appendix: Simulated Method of Moments

This appendix explains our procedures for Simulated Method of Moments (see, e.g., Bloom, 2009).

1. Bootstrap: Denote K the total number of random samples generated by bootstrap. We use $K = 500$. Denote $g_{m,k}$ the mth moment in the kth sample. We will target $\frac{1}{K}\sum_k^K g_{m,k}$ – i.e., the moment averaged across K samples.

2. Generate the variance-covariance matrix of the bootstrapped moments, Ω. Under the estimating null, Ω is proportional to the variance-covariance matrix of the simulated moments.

3. Minimizing the weighted sum of the distance between the empirical and simulated moments:

$$\theta = \arg\min_{\theta} h(\theta)' \Omega^{-1} h(\theta)$$

   where $h(\theta)$ is a vector with M elements and $h_m(\theta) = g_m(\theta) - \frac{1}{K}\sum_k^K g_{m,k}$.

4. The difference between the true and estimated parameter follows asymptotically a normal distribution with mean zero and the variance-covariance matrix of V, where $V = \left(DW^{-1}D'\right)^{-1}$ and $D = \frac{\partial h(\theta)}{\partial \theta}|_{\theta=\theta}$, Note that D is a $N \times M$ matrix and V is a $N \times N$ matrix. The variance of the estimated parameters are on the diagonal of V.

10 Appendix: Endogenous Factor Prices

We then introduce endogenous factor prices and their dynamics. Assume that capital is owned by a representative financial intermediary, who earns rents and "consumes" investment goods. The intertemporal choice solves

$$\max_{\{C_t, I_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \rho^t d_t, \tag{30}$$

subject to

$$d_t = r_t K_t - I_t \geq 0, \tag{31}$$

$$K_{t+1} = I_t + (1-\delta) K_t, \tag{32}$$

where $\rho \in (0,1)$ is the discount factor, d_t stands for the "consumption" of the financial intermediary and δ is the capital depreciation rate. The subscript for time t is dropped when there is no source of confusion. The financial intermediary cannot borrow from outside, as shown by the inequality in (31).

Thanks to the linearity of the preference, the financial intermediary will save all its rental income if

$$\rho (1 + r_{t+1}) > 1. \tag{33}$$

So, $d_t = 0$ and $I_t = (r_t - \delta) K_t$ if (33) is satisfied. If the condition in (33) is reversed, the financial intermediary will downsize capital by selling it to the intermediate goods market until (33) becomes an equality.

Now we are ready to characterize the dynamics. Consider an economy with the initial capital stock $K_0 \to 0$. It is immediate that $r_0 \to \infty$. (33) is satisfied and capital grows according to (32), where $I_t = (r_t - \delta) K_t$ and $r_t = \alpha K_t^{\alpha-1} L^{1-\alpha} + \delta$. The economy will reach the steady state when $r^* \equiv 1/\rho - 1$. Denote $\hat{\chi}^{\max}$ the upperbound of $\hat{\chi}_i$. In the benchmark model, if $\hat{\chi}^{\max} < \hat{\chi}^*$, where $\hat{\chi}^*$ refers to $\hat{\chi}$ with $r = r^*$, there would be no private channel in equilibrium dynamics. The whole dynamics would thus be similar to those in a standard neo-classical growth model.

If, instead, $\hat{\chi}^{\max} > \hat{\chi}^*$, there exists period t when r_t is sufficiently low such that the firms with $\hat{\chi}_i < \hat{\chi}^{\max}$ will switch from public to private channel. Moreover, capital will evolve according to (32), where $I_t = (r_t - \delta) K_t$ and $r_t = \alpha K_t^{\alpha-1} L^{1-\alpha} + \delta$. The rise of public channel pushes capital out of the production sector, slows down the decline of the interest rate but speeds up the transition. The transitional dynamics will exhibit rising wage rate, falling interest rate, sales reallocation from public to private channel, and capital reallocation from production sector to sales. The transition will be complete when $r_t = r^*$.