IKEA: A MODEL FOR MULTINATIONAL PRICING

by **Anthony Landry**

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Abstract

This paper sheds light on the products management and pricing behavior of one of the largest multinational retailers: IKEA. First, using a novel dataset of IKEA products and catalogs prices from seven countries over the period 2002 to 2017, I document a series of empirical facts: i. Hazard rates of product life are U-shaped and identical across countries, ii. Products entry and exit are synchronized across countries, iii. Hazard rates of price changes are flat, but volatile across countries, iv. Negative price changes are more synchronized across countries than positive ones, and v. IKEA set prices with a local-currency point, even when products enter countries. Then, I develop and study a partial equilibrium menu-cost model with products entry and exit, and test this model against these empirical facts. Because IKEA's business strategy is standardized, coordinated, and integrated across countries, with minimal degrees of adaptation to local market peculiarities, I focus on factors other than differences in taste across countries to solve, simulate, and estimate the model. In particular, I focus on the interaction between marginal cost and exchange rate movements to explain the dynamic properties of the data.

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1 Introduction

Production and international trade are concentrated within a handful of large multinationals supplying many products to many destinations (Bernard et al. (2009)). Although recent research emphasizes firm-level decisions in understanding the cause and consequences of aggregate production and international trade (Melitz and Redding (2014) and Antras and Yeaple (2014)), little is known about the products management and pricing behavior of multinational firms across countries. This paper fills this gap by shedding light on the products management and pricing behavior of one of the biggest multinational retailers: IKEA (Deloitte (2017)).

I document IKEA products management and pricing behavior using the entire population of products and varieties advertised in 112 IKEA catalogs from seven countries between 2001 and 2016 (which corresponds to the 2002 to 2017 catalogs). This long time span allows me to get precise estimates of products life and price spells. The seven countries in my sample are Canada, Germany, France, Italy, Sweden, the United Kingdom, and the United States, which are IKEA's biggest markets by revenues. In addition, the products advertised in these catalogs are identical, shared across countries, and are likely coming from the same manufacturing plants–which implies that they have the same marginal cost.

The first part of the paper documents a series of empirical facts on IKEA products management, pricing behavior, and international price differentials. First, I document the life cycle of products through the lens of a non-parametric Kaplan-Meier function. I find that the life cycle of products display a U-shaped hazard function, which suggests that there is an important amount of products selection during the first few years of a product life, potentially arising from changes in production cost. An interesting feature of the data is that these U-shaped hazard functions look similar across countries. In fact, I cannot reject the hypothesis that the survival ratios are statistically identical across countries.

Second, I provide new evidence on the synchronization in products entry and exit across countries. I find that products entry and exit are extremely synchronized across countries. Conditional on observing identical products across countries at some point in time, the probability of observing synchronized entries ranges between 87 and 94 percent, while the probability of observing synchronized exits ranges between 93 and 96 percent. These results suggest that if a product shows up in two (or more) countries over the sample period, it usually shows up at the same time. Perhaps, this is not surprising as IKEA tries to reap economies of scale with suppliers by selling standardized products across countries. The fact that the dynamics of products life cycle and the synchronization in products entry and exit are similar across countries points to a dominating force in the subsidiary's product management decision that is common across countries.

Third, I document stylize facts on price spells and price changes. I find that the price-spells survival ratios have an exponential form, which leads to constant hazard ratios of price changes oscillating around 50 percent per year–up to an horizon of 9 years where the probability of observing a price change increases dramatically. This implies that the probability of a price change is unrelated to the time since that last price change. These findings echoes the results reported by Klenow and Kryvtsov (2008), Nakamura and Steinsson (2008), and others who studied the dynamics of consumer prices, and Midrigan (2011), Eichenbaum et al. (2011), and Gopinath et al. (2011) and others who studied the prices dynamic of large food and drug retailers.

Fourth, I provide new evidence on the synchronization in price changes across countries. I define synchronization in price changes as the average probability of observing a positive/negative price change in country i conditional on observing a positive/negative price change in country j over the unconditional probability of observing a positive/negative price change in country i. For example, I find that IKEA is 1.8 times more likely to increase prices in Canada when it increases prices in the U.S. This measure of synchronization in positive price changes ranges from 0.74 to 1.9. The fact that there are no synchronization in price changes between a few bilateral pairs suggests that there are forces other than movements in marginal cost (in source currency) shaping the subsidiaries price decision. I look at the role of exchange rate movements between the source and the destination as a driving force in the model section of the paper. I also find that positive and negative price changes are more synchronized across clusters of countries that are geographically close, and that price changes within the Eurozone are not more synchronized than those within Europe. This suggests that there are also forces other than exchange rate movements at play in the multinational pricing decision.

Finally, with our understanding of IKEA's products management and pricing decisions, I look at international price differences. I find that, on average, the product-level real exchange rate moves 0.66 log point for every full percentage point in the nominal exchange rate. This metric is little change if I condition my empirical analysis to simultaneous product entry. These results echoes Cavallo et al. (2014) and suggests that IKEA's subsidiaries price with a local-currency point, even when products enters a country and despite large movements in nominal exchange rates. I found, however, that simultaneous price changes (and especially simultaneous decreases) correct some of the real exchange rate deviations. For example, conditional on a simultaneous price changes, the product-level real exchange rate moves 0.44 log point for every full percentage point in the nominal exchange rate. This result, again, highlights the role of a common driving force at play when subsidiaries choose to change prices.

In the second part of the paper, I use the empirical analysis above as a case study to better understand the key features driving the multinational products management and pricing behavior using a partial equilibrium model of multinational pricing. The model is a simple extension of standard menu-cost models with multiple products that incorporates products entry and exit. Because IKEA business strategy is standardized, coordinated, and integrated across countries, with minimal degrees of adaptation to local market peculiarities, I focus on factors other than differences in taste across countries to solve, simulate, and estimate the model. In particular, I focus on the interaction between marginal cost and exchange rate movements to explain the dynamic properties of the data.

2 The Dataset

In this paper, I study the entire population of products and varieties advertised in 112 IKEA catalogs from seven countries between 2001 and 2016 (which corresponds to the 2002 to 2017 catalogs). The seven countries are Canada (CA), Germany (DE), France (FR), Italy (IT), Sweden (SE), the United Kingdom (UK), and the United States (US). Together, these seven countries have represented over 60 percent of IKEA's annual revenues since 2001. The dataset contains all available information presented in the catalogs, including the year, country, page, product name, description, local-currency price, dimensions, color and/or finish, and product ID number. I used all this information (together with the product id number, when available) to accurately trace products across time and countries.[1] [2]

2.1 IKEA and its Annual Catalog

IKEA is a private multinational company that designs, produces and sells furniture, appliances and home accessories. Founded in Sweden in 1943, IKEA has grown rapidly to become one of the largest multinational retailers in the world Deloitte (2017). IKEA is headquartered in the Netherland and is own and operated by a complicated corporate structure.[3] The company has chosen to mostly enter markets through wholly owned subsidiaries in order to maintain their brand image. The headquarter overviews the operating procedures, core products range (e.g., the BILLY bookcases range), and standardize marketing operations (including the IKEA catalog) for all subsidiaries around the world. In turn, the subsidiaries manage products (e.g., IKEA subsidiaries can choose to stock certain products for the local market) and make pricing decisions (Frynas and Mellahi (2015) and Jonsson and Foss (2011)).

The IKEA catalog was launched in 1951 and has remained the main marketing strategies used by the multinational to reach consumers. IKEA utilizes catalog marketing to reach a wider audience and uses its large mail-order catalog as ways to connect with customers. Even as people purchase products online more often, many still use the catalog as their preferred source of information about IKEA products. In fact, over 200 millions catalogs are printed every year, in many different versions and languages. Among other U.S. household-furnishing brands having successful catalog businesses are Pottery Barn, Restoration Hardware, and Crate & Barrel.

There are several good reasons to work with IKEA catalog products. First, the size and the scope of the products range. IKEA products range is significantly larger than most other retailers (Cavallo et al. (2014)), which allow me to compute statistics on products management and pricing behavior on a large amount of products. For example, the global range of products advertised each year averaged well over 3,000 products in the dataset. Although the entire IKEA products range may not be advertised in the catalogs, each store most carry all catalog products.[4] In addition, IKEA offers a wide variety of products available at different price points to fit everybody's budget.

Second, catalog prices remain unchanged for one year. The IKEA catalogs are distributed at the end of every summer, and prices advertised in the catalogs remain unchanged over the course of the catalog year.

[1] The IKEA product ID number is not sufficient to trace products across time and countries. Identical ID numbers guarantee that products are identical, but identical products may share more than one IDs. In my dataset, about 12 percent of the products share more than one IDs. These products usually have a long time-series and are available in many countries–which highlights the importance to use other metrics to correctly identify products across time and countries.

[2] I have significantly extended and improved the dataset used in Baxter and Landry (2012).

[3] IKEA is owned and operated by a complicated array of corporations. The corporate structure is divided into two parts, operations and franchising. Most of IKEA's operations, including the management of the majority of its stores, the design and manufacture of its furniture, and purchasing and supply functions are overseen by INGKA Holding, a private, for-profit Dutch company. The stores represented by the seven countries catalogs in this paper are owned and operated by INGKA Holding.

[4] IKEA claimed a product range consisting of about 9,500 products (IKEA (2016)). Each store carries a selection of these 9,500 products depending on stores's size. The core range of products is the same worldwide.

This implies that catalog prices are an excellent measure of transaction prices.[5] Third, IKEA has a national pricing policy. The prices advertised in a country's catalog are the posted prices in all IKEA stores. This implies that there in no within-country variation in prices.

Forth, IKEA's products are homogenous across countries. IKEA business strategy is to sell standardized furniture and home furnishing products at low prices. To do so, IKEA stuck with the vision that the company should sell a basic products range that is homogeneous across markets.[6] Hence, IKEA global expansion strategy has paid minimal attention to local tastes and preferences to keep costs down. Selling the same products throughout the world allow suppliers to reap economies of scales.

Finally, each product is likely to come from the same manufacturing plant at the same marginal cost. IKEA's products are designed in Sweden and manufactured around the world (see Appendix A: IKEA Facts and Figures). Although IKEA's products are manufactured around the world, most products come from one plant before being shipped to the destination markets. For example, BILLY bookcases are manufactured in Sweden (by the same supplier since 1978) before being sent to IKEA stores worldwide.

2.2 Summary Statistics and Methodology

Before presenting the empirical results, this subsection provides a glimpse into the dataset and defines some key variables that we will be using to derive our statistics and to describe the patterns of product management and pricing decisions. While some of the terms and variables may seem straightforward, I believe that it is important to clearly define them as there are a number of important issues to be considered.

In this paper, a product has a unique variety (e.g. colors and finishes). For example, HEMNES three-drawer chests with identical dimensions but with different colors (e.g., white versus black-brown) or finishes (white versus white stain) are treated as different products. I choose to define a product as a product-variety pair because I observe different products management, price quotes, and price dynamics across colors and finishes of identical products. Table 1 displays the basic summary statistics. The dataset includes 223,848 observations spanning 24,570 products in 246 varieties.[7] This corresponds to 32,798 product-variety pairs, which hereafter I called products.

Figure 1 graphically illustrates the product management and price dynamics of a popular product: a black-brown EXPEDIT bookcase made in Poland and advertised in all seven-countries catalogs from 2007 to 2014. The top panel shows the EXPEDIT bookcase's price dynamic in the US, while the bottom panel shows the local-currency price dynamics for all seven countries. First, the bookcase entry and exit across countries is generally synchronized: as for the EXPEDIT bookcase, products tend to enter and exit the dataset at the same time. Second, price changes are infrequent. For example, the number of price changes over the life of the bookcase varies from zero to three as we look at the different local-currency price dynamics across countries. A quick introspection at Figure 1 also shows the importance of a common time component as the local-currency prices seem to move around a common time trend. The Figure also shows the influence of the nominal exchange rate against the source. For example, the US bookcase price dropped in 2014 as the dollar gained value against the Polish zloty (not shown in the Figure). These observations are typical of what I observe in the dataset and will constitute the building blocs of the model presented in Section 4.

[5]Sales are few and far between at IKEA and usually only involve a few products over a short amount of time, although the scope and frequency of sales has intensified over the past couple of years. IKEA has also recently launched a loyalty card that may be used to obtain discounts on a special range of products over a specific time period.

[6]An important exception is the North American market, where the multinational had to adapt its strategy to offer a greater range of products tailored to local taste (e.g. deeper wardrobes in the US). For example, some years include a large range of products under the name AKURUM in North America and FAKTUM in the rest of the world. Although these products have similar design as the ones offer elsewhere, they come in different sizes and varieties.

[7]31 percent of the products have more than one variety.

Table 1: **IKEA Dataset Summary Statistics**
2002-2017 Catalogs

Number of observations	
Total number of observations	223,848
Average number of observations per catalog	1,999
Number of products and varieties	
Total number of products	24,570
Total number of varieties (e.g., colors and finishes)	246
Total number of product-variety pairs	32,798

Next, I define the key variables that we will be using to derive our statistics and to describe the patterns of product management and pricing decisions. The top panel of Figure 1 illustrates the variables that we will be using at the country level (e.g., US), while the bottom panel illustrates these variables at the global level (across all countries). First, the statistics on products management depend on the time when a product enters and exits the dataset. The entry variable takes a value of 1 when a product enters the dataset and 0 afterward until the product exit. The entry variable is not recorded in 2002 because I do not observe a product status beforehand. The exit variable takes a value of 1 when the product exits the dataset and 0 beforehand. Similarly, the exit variable is not recorded in 2017 because I do not observe any products status afterward. In addition, I use an age and a life variable for each product. The age variable is a serial time variable. It takes a value of 1 when a product enters the dataset and increases in increment of 1 with the catalog years until the product exits. The age variable continues to increase when products are missing for a number of years, but ultimately returns before the end of the sample period. The life variable is equal to the age of a product when it exits. The entry, exit, age, and life of products variables are computed at the country and at the global level.

Second, the statistics on pricing depends on price spells, the age of price spells, and on a price change variable. The price-spell variable indicates the number of different prices that a product experienced. The age of a price spell is a serial time variable. It takes a value of 1 when a product enters or when a new price is set, and increases in increment of 1 until the product exits or until I observe a price change in the following catalog year. The price change variable takes a value of +1 when I observe a positive price change, -1 when I observe a negative price change, and 0 if I observe no price change. The price change variable is not recorded when a product enters the dataset because the product has not yet had a price change opportunity. [8]

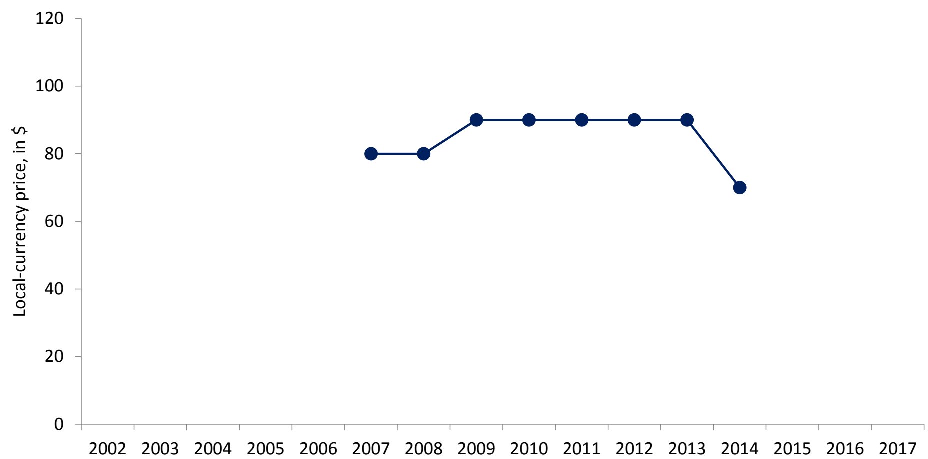
Finally, IKEA publishes prices in local currency units, inclusive of Value Added Tax (VAT) in countries that impose this tax. These adjustments are infrequent, but may distort IKEA's pricing decision by changing the price received by the sale of products. I define a VAT dummy that takes the value of 1 for the catalog that follows a VAT rate adjustment and 0 otherwise. For example, the French VAT rate adjustment of January 2014 do not affect the 2014 catalog (because this catalog was issued in the summer of 2013, before the implementation of the VAT rate adjustment) but affect the 2015 catalog. Consequently, my VAT dummy takes the value of 0 for the France 2014 catalogs, and 1 for the France 2015 catalog.[9]

[8] When necessary, I carry forward prices for products that are missing for a number of years but ultimately returns in the dataset. Carrying prices forward or backward do not affect the statistics presented in this paper.

[9] Since price adjustments are forward looking, one could argue that firm's prices should respond to the announcement instead of the implementation of a VAT rate adjustment. For example, the French VAT rate adjustment of January 2014 was announced in December of 2012, before the publication of the 2014 catalog. I looked at the effect of announcement date versus implementation date of VAT rate adjustments, and found that defining my VAT dummy with respect to the implementation date was less distortionary on the price statistics. This is consistent with other studies (e.g., Danninger and Carare (2008)) that found that most of the effect of VAT rate adjustment happens on implementation and not shortly after an announcement.

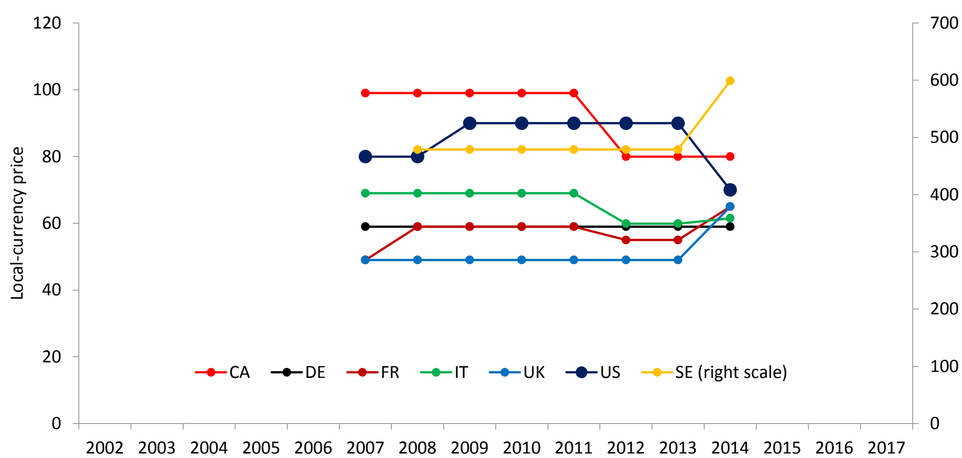
Figure 1: **Definition of variables for a product**

Product: EXPEDIT, **Description**: Bookcase, **Color**: black-brown, **Source**: Poland



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Entry	.	.	.	.	.	1	0	0	0	0	0	0	0	.	.	.
Exit	.	.	.	.	.	0	0	0	0	0	0	0	1	.	.	.
Age	.	.	.	.	.	1	2	3	4	5	6	7	8	.	.	.
life	.	.	.	.	.	8	8	8	8	8	8	8	8	.	.	.
Local-currency price	.	.	.	.	.	$79.99	$79.99	$89.99	$89.99	$89.99	$89.99	$89.99	$69.99	.	.	.
Price spell	.	.	.	.	.	1	1	2	2	2	2	2	3	.	.	.
Age of price spell	.	.	.	.	.	1	2	1	2	3	4	5	1	.	.	.
Price change	.	.	.	.	.	.	0	1	0	0	0	0	1	.	.	.

A. U.S. catalogs



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Global entry	.	.	.	.	.	1	0	0	0	0	0	0	0	.	.	.
Global exit	.	.	.	.	.	0	0	0	0	0	0	0	1	.	.	.
Global age	.	.	.	.	.	1	2	3	4	5	6	7	8	.	.	.
Global life	.	.	.	.	.	8	8	8	8	8	8	8	8	.	.	.

B. All catalogs

2.3 Geographic Distribution of Products

To understand the extent to which products are shared across countries (i.e., subsidiaries), I take a look at the geographical distribution of products in Table 2. Panel A shows the number of products per country, alongside the intersection of the number of products available in one country over the number of products available across all countries (i.e., in the dataset). On average, each country contains 17,539 products, which represents a little more than half of the products range advertised across all countries.

Panel B offers a deeper look into products sharing by looking at the intersection of products range by country pair. This panel reveals that countries share between 40 and 79 percent of products. Countries that are geographically close to each other share more products than countries that are distant. For example, 79 percent of the products available in Canada and in the U.S. are available in both countries. This number ranges between 66 and 77 percent for countries across Europe and between 73 and 77 percent for the Eurozone.

Finally, Panel C looks at the number of products available in a cluster of countries over the entire products range available in the dataset. The share of products available in only one country is 27 percent, while the share of products available in all seven countries is 26 percent. This number goes up to 36 percent if we exclude the AKURUM/FAKTUM series, which are unique to the North American/rest of the world markets. However, because the products that are available in multiple countries tend to be popular products, over 50 percent of all observations are shared across all seven countries as shown in Panel A.

3 Empirical Evidence

This section presents a series of empirical facts on IKEA products management, pricing behavior, and international price differentials. First, I document the life cycle of products. Second, I provide new evidence on the synchronization in products entry and exit across countries. Third, I document some stylize facts on price spells and price changes. Forth, I provide new evidence on the synchronization in price changes across countries. Finally, with an understanding of IKEA products management and pricing behavior, I present a series of facts on international price differentials.

3.1 Products Life Cycle

I look at products life cycle through the lens of the non-parametric Kaplan-Meier function, which allow me to easily deal with censored products and missing observations. The Kaplan-Meier function estimates the probability that a product survives beyond t year(s) and is defined as,

$$\hat{S}_t = \prod_{j|t_j<=t} \left(\frac{n_j - d_j}{n_j} \right) \tag{1}$$

where $\hat{S}_t$ is the probability that a product survives beyond t year(s) (i.e., the survival rate), n_j is the number of age j products at time t, and d_j is the number of age j products that exit at time t. I drop left (e.g., products that were available in 2002) and right (e.g., products that were available in 2017) censored products, because there survival times cannot be accurately determined.[10] For example, the life of products that are available in 2002 is unknown because I do not observe an entry date for these products. Similarly, the life of products that are available in 2017 is also unknown, because I do not observe an exit date for these products. In other words, I only look at the time duration of known survivals that are terminated by an exit.

[10] I also left (2005) and right (2012) censored the AKURUM/FAKTUM series, which is a series of tables published in the 2005 to 2009, and in the 2012 catalogs. Taking out the AKURUM/FAKTUM series altogether does not change the qualitative results, but smoothes out the series.

Table 2: **Geographic Distribution of Products**
2002-2017 Catalogs

A. Number of products per country

Country	Number of products	Fraction of total
Canada (CA)	16,755	0.51
Germany (DE)	17,774	0.54
France (FR)	17,934	0.55
Italy (IT)	17,349	0.54
Sweden (SE)	18,100	0.55
United Kingdom (UK)	17,681	0.54
United States (US)	17,189	0.52
Total (across all countries)	32,798	

B. Products sharing across countries
(intersection/union of products set)

Country	DE	FR	IT	SE	UK	US
Canada (CA)	0.42	0.42	0.42	0.41	0.43	0.79
Germany (DE)	·	0.73	0.74	0.69	0.66	0.40
France (FR)	·	·	0.77	0.73	0.69	0.40
Italy (IT)	·	·	·	0.73	0.70	0.40
Sweden (SE)	·	·	·	·	0.66	0.40
United Kingdom (UK)	·	·	·	·	·	0.42

C. Products available in a cluster
Fraction of total (across all countries)

Cluster	
All countries	0.26
Europe (DE, FR, IT, SE, UK)	0.38
North-America (CA, US)	0.46
Eurozone (DE, FR, IT)	0.44
English-Speaking (CA, UK, US)	0.30
In one country only	0.27

Figure 2 shows the Kaplan-Meier survival and corresponding hazard ratio estimates of products life.[11] Panel A shows the Kaplan-Meier survival and corresponding hazard ratios of products life at the global level (e.g., looking at products entry and exit across countries, regardless of the country in which they appear). There are some important conclusions to draw from these figures. First, the survival ratios lead to a U-shaped hazard function (e.g., hazard ratios of exits that are decreasing in the first few years of a product life). This suggests that there is a important amount of products selection during the first few years of a product life, potentially arising from changes in production cost or from an improvement in production technique. For example, products that survive the first year are more likely to stay in the dataset for a long period of time. Overall, the life expectancy of products is 2.1 years for all products and 3.7 years for products that survive the first year. Correspondingly, the amount of products churning is very important. Globally, only 41 percent of products survive for more than one year, 20 percent of products survive for more than five years, and less than two percent of products survive for more than ten years.[12] These results are robust across different specifications of the dataset (e.g., with or without the AKURUM/FAKTUM series, splitting the sample into different time periods, abstracting from varieties by choosing the cheapest variety in each product line, etc.).[13]

Panel B of Figure 2 shows the Kaplan-Meier survival and corresponding hazard ratio estimates of products life at the country level. We immediately notice that the survival and corresponding hazard ratios look almost identical across countries, especially in the first few years since entry. To check that they are indeed identical, I perform two tests for equality of survivor functions for which the null hypothesis is that the survival ratios are identical across countries: The Log-rank and Wilcoxon tests. The Log-rank test is more standard in the survival analysis literature, but its robustness relies on proportional hazard ratios. The Wilcoxon test does not require proportional hazard ratios, but requires that one group (country) consistently have a higher risk (exit rate) than the other(s). Since the hazard ratios are U-shaped, but that none of my countries appear to display a higher exit rates, I perform and draw conclusions from both tests.

Table 3 displays the Chi-squares and corresponding P-values by clusters of countries. Here, the P-values are the probabilities of obtaining strata of survival ratios that are at least as extreme as the ones that we observe in the data. The test indicates that I cannot reject the hypothesis that survival ratios are statistically identical with a 95 percent certainty, implying that IKEA's products life cycle are identical across countries. The strength of evidence in support of a null hypothesis (as measured by the P-value) is even greater if we focus on certain cluster of countries, such as North-America, the Eurozone, and the English-speaking countries. Interestingly, North America and the Eurozone are also the clusters of countries that have the largest overlap of products.

3.2 Synchronization in Products Entry and Exit

In the previous subsection, we found that the life cycle of products is identical across countries. With this in mind, we can now ask if the timing of products entry and exit is also similar across countries. To answer this question, I run Probit regressions where the probability of a product z entry in country i at time t depends on the simultaneous entry of the same product z in other countries. This is,

$$\Pr(Entry(z)_{i,t} = 1 | \textstyle\sum_{\forall j \neq i} Entry(z)_{j,t}) = \Phi(\alpha + \textstyle\sum_{\forall j \neq i} \beta \cdot Entry(z)_{j,t}) \ \forall \ j \neq i,$$

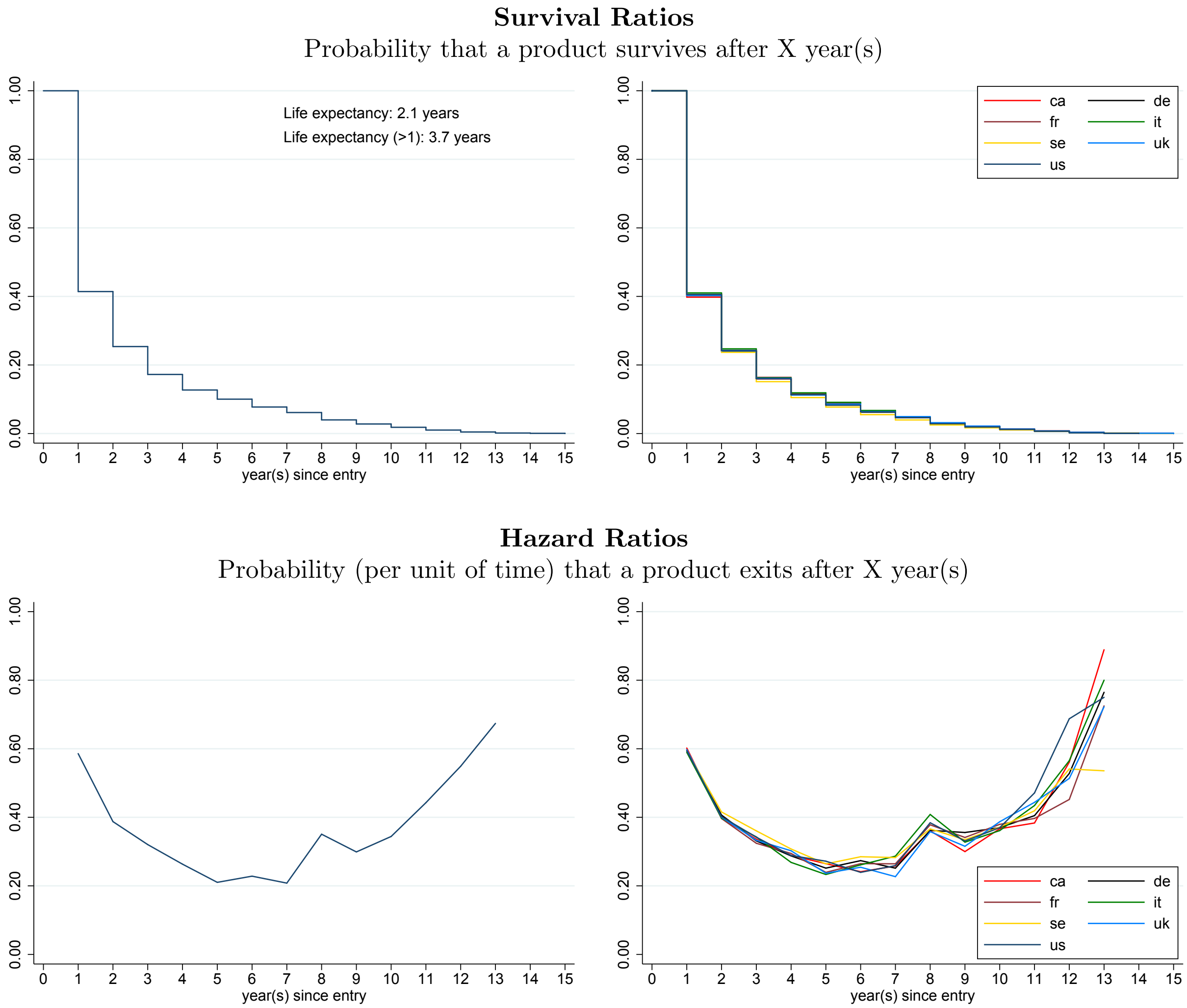
where the dependent variable is the $Entry(z)_{i,t}$ dummy which is equal to 1 if we observe a product z entry in country i at time t and 0 otherwise, the independent variables is the $Entry(z)_{j,t}$ dummy in country j

[11] I display hazard ratios for year-since-entry products that represent more than 0.1 percent of the total number of products per country.

[12] The amount of products churning in catalogs data (59%) is much more important that was recently claimed by IKEA: In their 2016 yearly summary (IKEA (2016)), the company claims launching approximately 2,500 new products over a global range of 9,500 products every year, which corresponds to a products churning rate of 26 percent. As we will see later in this paper, the level of product churning estimated in the model is closer to that claimed by IKEA.

[13] I did find, however, that products that survive longer tend to have more varieties.

Figure 2: **Kaplan-Meier Survival and Hazard Ratios of Products Life**



A. Globally B. by Country

at time t, and Φ is the standard normal cumulative distribution function. To quantify the synchronization in products exit, I perform the same regressions by replacing the product entry dummies by product exit dummies, and by conditioning the regression on country i having already experienced the entry of product z at time t. Then, I look at the bilateral synchronization of products entry and exit by predicting the probability of a product z entry in country i conditional on observing a simultaneous entry in country j. This is,[14]

$$\Pr(Entry(z)_{i,t} = 1 | Entry(z)_{j,t} = 1) \text{ for } j \neq i.$$

[14]As an alternative, I look at results of bilateral regressions. This is $\Pr(Entry(z)_{i,t} = 1|Entry(z)_{j,t}) = \Phi(\alpha + \beta \cdot Entry(z)_{j,t})$, $\forall\ j \neq i$ with $\Pr(Entry(z)_{i,t} = 1|Entry(z)_{j,t} = 1)$ for $j \neq i$. The larger number of observations shared across all countries leads to estimation results that are almost identical. The bilateral regressions contain more observations than the multilateral regressions because more products are shared between country pairs than between all countries. However, I prefer to report results from the multilateral regressions because they mimics the IKEA core range of products being available worldwide and will provide a better comparison to the results from the model in the next section.

Table 3: **Tests for Equality of Survivor Functions**

	Log-rank		**Wilcoxon**	
Cluster	χ^2	P-Value	χ^2	P-Value
All countries	11.69	0.07	5.21	0.52
Europe (DE, FR, IT, SE, UK)	11.48	0.02	3.33	0.50
North-America (CA, US)	0.08	0.77	1.24	0.27
Eurozone (DE, FR, IT)	1.16	0.56	1.74	0.42
English-Speaking (CA, UK, US)	0.45	0.80	1.28	0.53

Table 4 displays the measures of synchronization. Panel A shows the synchronization in products entry between country pairs. It shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, but unconditional on that product entering country i over the sample period. For example, the average probability of observing a product entry in Canada conditional on observing a product entry in the U.S. is 82 percent — unconditional on whether or not that product shows up in Canada over the sample period. Overall, these probabilities range between 48 to 84 percent, suggesting that products entry are fairly synchronized across countries. Once again, we observe stronger synchronization in products entry between clusters of countries (i.e., North America (CA-US) and Europe (DE-FR-IT-SE-UK)). However, this effect is mainly the result of a lack of products sharing between clusters as shown in Panel B.

My other and preferred measure of synchronization in products entry is shown in Panel C. Panel C shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, and conditional on that product entering country i over the sample period. For example, if I condition my measure of synchronization on products that will appear in Canada and in the U.S. over the sample period (Panel B), the average probability of observing a product entry in Canada conditional on observing a product entry in the U.S. becomes 94 percent (i.e., 82 percent/87 percent). Overall, these probabilities range between 87 and 94 percent, indicating that products entry are very synchronized across countries. These results suggest that if a product shows up in both countries over the sample period, it usually shows up at the same time.

Finally, Panel D shows the measure of synchronization in products exit. The panel shows the average probability of observing a product exit in country i conditional on observing a product exit in country j, and conditional on that product having already entered country i. In other words, I only considered the possibility of a simultaneous exit if a product is already available in a pair of countries. For example, the average probability of observing a product exit in Canada conditional on observing a product exit in the U.S. is 96 percent. These probabilities range between 93 and 96 percent. Notice that each probability of simultaneous exit in Panel D is higher than its corresponding probability of simultaneous entry in Panel C, indicating that products exit are more synchronized than products entry. Overall, Table X shows that products entry and exit are highly synchronized across countries. Perhaps, this is not surprising as IKEA tries to reap economies of scale with suppliers by selling standardized products across countries. The fact that the product life cycle and the synchronization in products entry and exit are so similar across countries points to a dominating force in the subsidiary's products management decision that is common across countries (e.g., marginal cost).

These strong measures of synchronization in products entry and exit are not mainly driven by the high level of products churning. Table 5 displays the same Panels as Table 4, but conditioning on products that exit after two years or more (at the global level). Panel A shows that the unconditional probabilities of simultaneous products entry are roughly the same as in Table 4, while Panel B shows that products sharing for longer lived products is slightly higher. Together, Panel A and B leads to slightly lower conditional probabilities of simultaneous entries as shown in Panel C. Finally, Panel D shows the measure of synchronization in products exit, which are once again roughly equals to the synchronization in products entry. These results suggest that products churning has little impact on the synchronization in products entry and exit.

Table 4: **Synchronization of Products Entry and Exit across Countries**
(all products)

A. **Synchronization in products entry**
Probability of observing a product entry in i (row)
conditional on observing a product entry in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.50	0.51	0.51	0.49	0.52	0.82
Germany (DE)	0.53	·	0.78	0.79	0.74	0.73	0.51
France (FR)	0.54	0.78	·	0.82	0.77	0.75	0.52
Italy (IT)	0.53	0.77	0.80	·	0.75	0.75	0.51
Sweden (SE)	0.53	0.75	0.77	0.78	·	0.73	0.51
United Kingdom (UK)	0.55	0.73	0.74	0.76	0.72	·	0.53
United States (US)	0.84	0.50	0.50	0.51	0.49	0.52	·

B. **Products sharing**
Probability of observing a product in i (row)
conditional on observing a product in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.57	0.57	0.58	0.56	0.59	0.87
Germany (DE)	0.61	·	0.84	0.86	0.81	0.80	0.58
France (FR)	0.61	0.85	·	0.89	0.84	0.82	0.59
Italy (IT)	0.60	0.84	0.86	·	0.82	0.82	0.58
Sweden (SE)	0.61	0.82	0.85	0.86	·	0.80	0.59
United Kingdom (UK)	0.62	0.79	0.81	0.83	0.79	·	0.60
United States (US)	0.90	0.57	0.56	0.57	0.56	0.58	·

C. **Synchronization in product entry (conditional)**
Probability of observing a product entry in i (row)
conditional on observing a product entry in j (column) and
conditional on a product entering market i (Table A./Table B.)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.88	0.89	0.89	0.88	0.89	0.94
Germany (DE)	0.88	·	0.92	0.92	0.91	0.92	0.87
France (FR)	0.88	0.92	·	0.93	0.91	0.92	0.88
Italy (IT)	0.88	0.92	0.93	·	0.91	0.92	0.88
Sweden (SE)	0.87	0.91	0.91	0.91	·	0.91	0.87
United Kingdom (UK)	0.89	0.92	0.92	0.92	0.91	·	0.88
United States (US)	0.94	0.88	0.89	0.89	0.87	0.89	·

D. **Synchronization in product exit**
Probability of observing a product exit in i (row)
conditional on observing a product exit in j (column)
and conditional on a product having entered market i

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.94	0.95	0.94	0.93	0.94	0.96
Germany (DE)	0.93	·	0.94	0.94	0.93	0.94	0.93
France (FR)	0.95	0.95	·	0.96	0.94	0.95	0.94
Italy (IT)	0.94	0.95	0.96	·	0.94	0.95	0.94
Sweden (SE)	0.94	0.94	0.94	0.94	·	0.95	0.94
United Kingdom (UK)	0.95	0.95	0.96	0.95	0.95	·	0.94
United States (US)	0.96	0.94	0.95	0.94	0.93	0.94	·

Note: This table shows different measures of bilateral synchronization in products entry and exit from the predictions of Probit regressions. Panel A shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, but unconditional on that product entering country i over the sample period. Panel B shows the average probability of observing a product in country i conditional on observing the same product in country j. Panel C shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, and conditional on that product entering country i over the sample period (i.e., Panel A/Panel B). Panel D shows the average probability of observing a product exit in country i conditional on observing a product exit in country j, and conditional on that product having already entered country i.

Table 5: **Synchronization of Products Entry and Exit across Countries**
(products that exit after 2 years or more, globally)

A. **Synchronization in products entry**
Probability of observing a product entry in i (row)
conditional on observing a product entry in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.47	0.47	0.47	0.46	0.49	0.84
Germany (DE)	0.49	·	0.79	0.79	0.76	0.75	0.48
France (FR)	0.50	0.81	·	0.82	0.78	0.77	0.49
Italy (IT)	0.49	0.79	0.81	·	0.76	0.75	0.48
Sweden (SE)	0.49	0.77	0.78	0.78	·	0.75	0.48
United Kingdom (UK)	0.51	0.75	0.76	0.76	0.73	·	0.50
United States (US)	0.85	0.47	0.46	0.47	0.45	0.48	·

B. **Products sharing**
Probability of observing a product in i (row)
conditional on observing a product in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.61	0.60	0.60	0.60	0.62	0.94
Germany (DE)	0.64	·	0.91	0.92	0.90	0.88	0.63
France (FR)	0.64	0.93	·	0.94	0.92	0.90	0.63
Italy (IT)	0.63	0.92	0.92	·	0.91	0.89	0.62
Sweden (SE)	0.64	0.91	0.92	0.93	·	0.89	0.63
United Kingdom (UK)	0.64	0.88	0.88	0.89	0.87	·	0.63
United States (US)	0.96	0.61	0.60	0.60	0.60	0.62	·

C. **Synchronization in product entry (conditional)**
Probability of observing a product entry in i (row)
conditional on observing a product entry in j (column) and
conditional on a product entering market i (Table A./Table B.)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.78	0.79	0.78	0.76	0.79	0.89
Germany (DE)	0.78	·	0.87	0.86	0.84	0.86	0.77
France (FR)	0.79	0.87	·	0.88	0.85	0.86	0.78
Italy (IT)	0.78	0.86	0.88	·	0.84	0.85	0.78
Sweden (SE)	0.76	0.84	0.85	0.84	·	0.84	0.76
United Kingdom (UK)	0.79	0.86	0.86	0.85	0.84	·	0.79
United States (US)	0.89	0.77	0.78	0.78	0.76	0.79	·

D. **Synchronization in product exit**
Probability of observing a product exit in i (row)
conditional on observing a product exit in j (column)
and conditional on a product having entered market i

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.93	0.94	0.94	0.93	0.94	0.95
Germany (DE)	0.91	·	0.93	0.92	0.91	0.92	0.91
France (FR)	0.94	0.95	·	0.96	0.94	0.95	0.94
Italy (IT)	0.93	0.94	0.95	·	0.93	0.94	0.93
Sweden (SE)	0.92	0.93	0.93	0.93	·	0.93	0.92
United Kingdom (UK)	0.94	0.94	0.95	0.95	0.94	·	0.94
United States (US)	0.95	0.93	0.94	0.94	0.92	0.94	·

Note: This table shows different measures of bilateral synchronization in products entry and exit from the predictions of Probit regressions. Panel A shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, but unconditional on that product entering country i over the sample period. Panel B shows the average probability of observing a product in country i conditional on observing the same product in country j. Panel C shows the average probability of observing a product entry in country i conditional on observing a product entry in country j, and conditional on that product entering country i over the sample period (i.e., Panel A/Panel B). Panel D shows the average probability of observing a product exit in country i conditional on observing a product exit in country j, and conditional on that product having already entered country i.

3.3 Price Spells and Price Changes

In the previous subsections, we study the dynamic of products entry and exit. Conditional on the decision to advertized products, IKEA's subsidiaries now have to set prices. As for the life cycle of products, I study the countries price-spells dynamic through the lens of a Kaplan-Meier function. This time, however, the Kaplan-Meier function estimates the probability that a price spell survives beyond t year(s) and is defined as,

$$\hat{S}_t = \prod_{j|t_j<=t} \left(\frac{n_j - d_j}{n_j} \right) \tag{2}$$

where $\hat{S}_t$ is the probability that a price spell survives beyond t year(s), n_j is the number of age j price spells at time t and d_j is the number of age j price spells that end at time t. As for the life cycle of products, I drop left and right censored price spells because the life of price spells that exists in 2002 or 2017 is unknown.

Figure 3 shows the Kaplan-Meier survival and corresponding hazard ratios estimated across countries.[15] Because of the impact of products exit (which implies that we do not observe price changes for these products) and of the VAT rate adjustments experienced by some European countries (which may have triggered price changes), I look at three different treatments of price spells: all price spells, excluding price spells that end in exit, and excluding price spells that end in exit and those that end with a VAT rate adjustment. I complement Figure 3 with Table 6, which displays statistics on the number of price spells, the mean duration, the frequency of price changes, and the size of price changes across countries for these three different treatments of price spells.

Panel A shows the survival and hazard ratios across all price spells. Under this specification, only 25 to 30 percent of the price spells last more than one year and less than one percent last more than 5 years. The mean duration of price spells across all countries range from 1.47 for the U.K to 1.57 years for the U.S.[16] The corresponding hazard ratios appear to be declining over the first few years for all countries, but this is the consequence of including price spells that end in exit as we will see below. Consistent with the definition of price changes (which excludes products that live for only one year), the corresponding frequency of price changes ranges from 0.42 in the U.S. to 0.53 in the U.K., with a higher frequency of positive than negative price changes for all countries except Italy.[17] The mean size of price changes ranges between -0.01 for Italy to 0.03 for the U.K., with standard deviations oscillating around 0.11. Finally, the median price increase ranges from 0.05 in France to 0.13 in the U.S., while the median price decrease ranges from -0.10 in Sweden and in the U.K. to -0.14 in Italy.[18]

To alleviate the effect of product exits and products churning on IKEA's price statistics, Panel B shows the Kaplan-Meier survival and corresponding hazard ratios by excluding every product's last price spell. To be clear, this specification also excludes all products that exit after one year for which we never observe the possibility of a price change. Under this specification, the mean duration of price spells across all countries is around 1.8 years or 22 months. In contrast with Panel A, the Kaplan-Meier survival ratios roughly have the exponential form which leads to constant hazard ratios of price changes oscillating around 0.5, up to an horizon of 8 to 9 years where the probability of observing a price change increases dramatically. This implies that the probability of observing a price change is unrelated to the time since the last price change. This finding echoes the results reported by Klenow and Kryvtsov (2008). Finally, we observe a greater amount

[15] I display hazard ratios for year-since-last-price-adjustment spells that represents more than 0.1 percent of the total number of spells per country.

[16] The mean duration of U.S. price spells is in line with the mean duration of price spells for the U.S. household-furnishing industry reported by Nakamura and Steinsson (2008).

[17] Remember that products that only last for one year are not included in these statistics. A quick introspection at Table 6 suggests that products that experience price changes have longer price spells (Panel A vs Panel B).

[18] The dataset is also populated by a large number of small price changes, where the number of small price increases are far more numerous than the number of small price decreases. Overall, the large number of small price changes combined with a large median price change echoes the results reported by Midrigan (2011) in grocery store prices and by Klenow and Kryvtsov (2008) in their study of goods in the U.S. CPI.

of heterogeneity across survival and hazard ratios of price spells than across survival and hazard ratios of products life. The log-rank tests for equality of survivor functions are rejected for all clusters, suggesting that the distribution of price spells duration is different across countries.

European prices are inclusive of VAT and some countries have experienced frequent VAT rate adjustments over the sample period. These VAT rate adjustments may have triggered price changes that we would not have observed otherwise. Panel C shows the Kaplan-Meier survival and corresponding hazard ratios by excluding every price spell that end in exit and those that end in VAT rate adjustment. The takeaway is that excluding price spells that end in VAT rate adjustment have little impact on the shape of the hazard ratios.

3.4 Synchronization in Price Changes

One of the defining features of my dataset is the simultaneous opportunity to observe price changes across countries offered by the annual catalogs. Namely, IKEA (through its subsidiaries) set the price of all its products at the same time. With this and the results of the previous sections in mind, we would like to know if the timing of price changes is synchronized across countries.

To answer this question, I first run Probit regressions where the probability of a price change for product z in country i at time t depends on the simultaneous price change of the same product z in country j, conditional on product z being advertized in market i.[19] I run this regression for positive and negative price changes separately. For example, the estimating equation for positive price changes is

$$\Pr(PC(z)_{i,t} = +1 | PC(z)_{j,t}) = \Phi(\alpha + \beta \cdot PC(z)_{j,t} + \textstyle\sum_{k=i,j} \lambda \cdot VAT_{k,t}), \; \forall \; j \neq i,$$

where the dependent variables are the $PC(z)_{i,t}$ variables which is equal to 1 if we observe a positive price change for product z in country i at time t and 0 otherwise. The independent variable are the $PC(z)_{j,t}$ variable which is equal to 1 if we observe a positive price change for product z in country j at time t and 0 otherwise, VAT dummy variables which are equal to 1 if we observe a VAT change in country $k = i, j$ at time t and 0 otherwise, and Φ is the standard normal cumulative distribution function.

Second, I compute the probability of a positive/negative price change for product z in country i conditional on observing a positive/negative price change in country j. This is, for positive price changes,

$$\Pr\left(PC(z)_{i,t} = +1 | PC(z)_{j,t} = +1\right), \text{ for } j \neq i \text{ and controlling for VAT rate adjustments.}$$

Finally, I compare the conditional probability of a positive/negative price change to the unconditional probability of observing a positive/negative price change in country i. In other words, my measure of synchronization in price changes asks how more likely are we to observe a positive/negative price change in country i conditional on observing a positive/negative price change in country j than the unconditional probability of a positive/negative price change in country i.

[19] Prediction results from regressions across all countries (instead of between pairs of countries) are similar. I prefer, however, to report predictions from regressions on bilateral country pairs, since there are few observations left after controlling for the type of price changes (i.e., positive versus negative) and for VAT changes when we include all countries in the regressions.

Table 6: **Statistics on Duration of Price Spells and on the Frequency and Size of Price Changes**

duration in years, frequency and size of price changes in percent

A. **All price spells**

	Number of spells	Mean duration	Frequency of price changes All	Frequency of price changes Positive +	Frequency of price changes Negative −	Size of price changes Mean	Size of price changes Median +	Size of price changes Median −	Size of price changes SD
CA	21,538	1.54	0.47	0.31	0.17	0.01	0.09	-0.12	0.11
DE	22,217	1.55	0.45	0.29	0.16	0.01	0.09	-0.11	0.10
FR	22,892	1.49	0.50	0.29	0.22	0.00	0.05	-0.13	0.11
IT	22,039	1.53	0.46	0.19	0.27	-0.01	0.10	-0.14	0.11
SE	22,083	1.53	0.43	0.23	0.20	0.00	0.09	-0.10	0.10
UK	23,083	1.47	0.53	0.37	0.16	0.03	0.11	-0.10	0.12
US	21,382	1.57	0.42	0.29	0.13	0.02	0.13	-0.13	0.12

B. **Excluding price spells that end in exit**

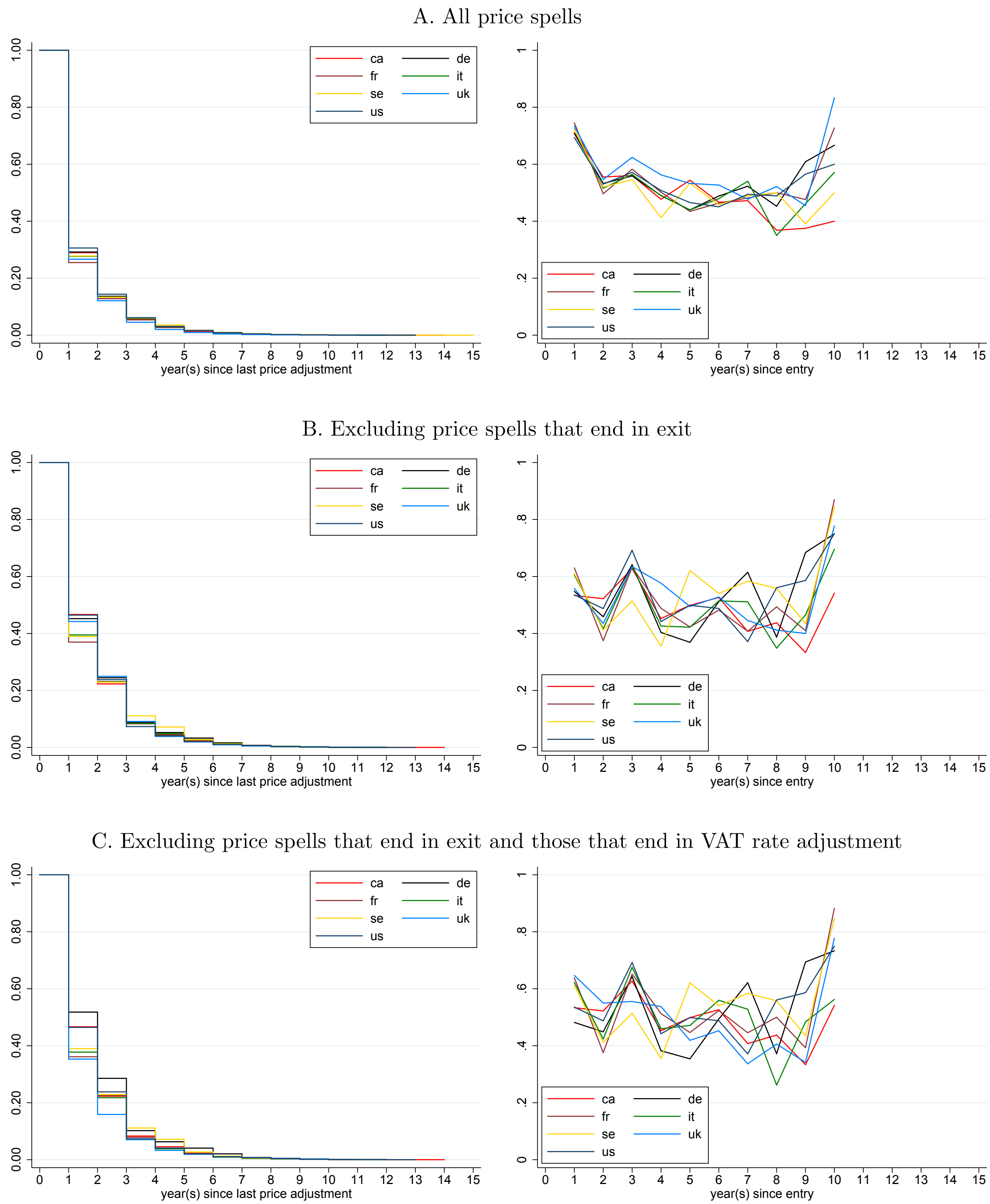
	Number of spells	Mean duration	Frequency of price changes All	Frequency of price changes Positive +	Frequency of price changes Negative −	Size of price changes Mean	Size of price changes Median +	Size of price changes Median −	Size of price changes SD
CA	10,641	1.87	0.55	0.38	0.17	0.01	0.06	-0.10	0.09
DE	8,929	1.90	0.52	0.32	0.20	0.00	0.09	-0.12	0.09
FR	11,668	1.78	0.66	0.40	0.26	-0.01	0.03	-0.12	0.09
IT	10,227	1.81	0.60	0.18	0.42	-0.02	0.10	-0.15	0.10
SE	8,471	1.85	0.53	0.24	0.29	0.00	0.07	-0.08	0.07
UK	11,674	1.86	0.56	0.37	0.19	0.02	0.11	-0.08	0.10
US	9,388	1.86	0.52	0.39	0.14	0.02	0.13	-0.10	0.11

C. **Excluding price spells that end in exit and those that end with a VAT rate adjustment**

	Number of spells	Mean duration	Frequency of price changes All	Frequency of price changes Positive +	Frequency of price changes Negative −	Size of price changes Mean	Size of price changes Median +	Size of price changes Median −	Size of price changes SD
CA	10,641	1.87	0.55	0.38	0.17	0.01	0.06	-0.10	0.09
DE	6,651	2.04	0.44	0.20	0.23	0.00	0.10	-0.11	0.08
FR	11,394	1.75	0.67	0.40	0.26	-0.01	0.03	-0.12	0.09
IT	9,703	1.74	0.63	0.18	0.44	-0.02	0.10	-0.15	0.10
SE	8,471	1.85	0.53	0.24	0.29	0.00	0.07	-0.08	0.07
UK	7,366	1.66	0.56	0.33	0.24	0.01	0.10	-0.07	0.09
US	9,388	1.86	0.52	0.39	0.14	0.02	0.13	-0.10	0.11

Note: The mean durations, frequencies of price changes, and sizes of price changes are averages over time.

Figure 3: **Kaplan-Meier Survival and Hazard Ratios of Price Spells**



Survival Ratios
Probability that a price spell survives after X year(s)

Hazard Ratios
Probability (per unit of time) that a price spell ends after X year(s)

Table 7: **Synchronization of Price Changes across Countries**

A. **Positive Price Changes**

Probability of observing a positive price change in i (row) conditional on observing a positive price change in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.38	0.27	0.29	0.35	0.23	0.54
Germany (DE)	0.28	·	0.39	0.44	0.33	0.46	0.33
France (FR)	0.22	0.39	·	0.48	0.40	0.51	0.29
Italy (IT)	0.17	0.28	0.31	·	0.28	0.30	0.20
Sweden (SE)	0.29	0.30	0.33	0.39	·	0.31	0.23
United Kingdom (UK)	0.27	0.46	0.46	0.53	0.49	·	0.36
United States (US)	0.51	0.27	0.30	0.30	0.23	0.35	·

Unconditional probability of observing a positive price change in i

Country	CA	DE	FR	IT	SE	UK	US
	0.31	0.24	0.29	0.19	0.23	0.30	0.29

Synchronization in positive price changes

Probability of observing a positive price change in i (row) conditional on observing a positive price change in j (column) over the unconditional probability of observing a positive price change in i

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	1.23	0.89	0.93	1.16	0.74	1.75
Germany (DE)	1.17	·	1.61	1.81	1.38	1.90	1.36
France (FR)	0.78	1.35	·	1.67	1.39	1.75	0.99
Italy (IT)	0.88	1.51	1.63	·	1.52	1.59	1.09
Sweden (SE)	1.24	1.32	1.44	1.70	·	1.32	0.97
United Kingdom (UK)	0.91	1.53	1.54	1.76	1.62	·	1.19
United States (US)	1.76	0.94	1.03	1.03	0.80	1.20	·

B. **Negative Price Changes**

Probability of observing a negative price change in i (row) conditional on observing a negative price change in j (column)

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	0.29	0.29	0.25	0.30	0.23	0.42
Germany (DE)	0.27	·	0.43	0.33	0.35	0.37	0.29
France (FR)	0.29	0.59	·	0.44	0.45	0.48	0.32
Italy (IT)	0.30	0.57	0.56	·	0.66	0.61	0.32
Sweden (SE)	0.28	0.46	0.43	0.49	·	0.56	0.29
United Kingdom (UK)	0.27	0.39	0.40	0.33	0.41	·	0.34
United States (US)	0.32	0.22	0.23	0.19	0.21	0.23	·

Unconditional probability of observing a negative price change in i

Country	CA	DE	FR	IT	SE	UK	US
	0.17	0.18	0.22	0.28	0.20	0.18	0.13

Synchronization in negative price changes

Probability of observing a negative price change in i (row) conditional on observing a negative price change in j (column) over the unconditional probability of observing a negative price change in i

Country	CA	DE	FR	IT	SE	UK	US
Canada (CA)	·	1.78	1.76	1.54	1.79	1.42	2.54
Germany (DE)	1.55	·	2.45	1.86	1.98	2.12	1.66
France (FR)	1.30	2.69	·	2.03	2.08	2.20	1.45
Italy (IT)	1.10	2.06	2.04	·	2.40	2.21	1.17
Sweden (SE)	1.42	2.31	2.19	2.45	·	2.83	1.44
United Kingdom (UK)	1.53	2.15	2.22	1.83	2.29	·	1.88
United States (US)	2.49	1.66	1.74	1.49	1.60	1.77	·

Note: The top table of Panel A and B shows the average probability of observing a positive/negative price change in country i conditional on observing a positive/negative price change in country j. The middle table of Panel A and B shows the unconditional probability of observing a positive/negative price change in country i. The unconditional probabilities showed in these tables differ from the one shown in Table X for DE, FR, IT, and UK because of the VAT treatment in the Probit regressions. The bottom table of Panel A and B shows how more likely are we to observe a positive/negative price change in country i conditional on observing a positive/negative price change in country j than the unconditional probability of a positive/negative price change (i.e., top/middle tables of each panel).

Table 7 shows the measure of synchronization for positive and negative price changes. Panel A shows the average probability of observing a positive price change in country i conditional on observing a positive price change in country j. For example, the average probability of observing a positive price change in Canada conditional on observing a positive price change in the U.S. is 54 percent. However, the unconditional probability of observing a positive price change in Canada is 31 percent. This implies that we are 1.75 times more likely to observe a positive price change in Canada when we observe a positive price change in the U.S.

There are a few interesting observations coming from Panel A. First, synchronization in positive price changes ranges from 0.74 (CA conditional on UK) to 1.90 (DE conditional on UK). A number below one implies that we do not observe any synchronization in positive price change between country pairs. This happens in 21 percent (i.e., 9/42 pairs) of the bilateral pairs. It is extremely surprising given that all products face the same marginal cost, and implies that there are other factors either shifting the cost (such as exchange rate movements between the source and the destination) or the demand function. Second, we observe that positive price changes are synchronized within clusters of countries, with the CA-US and DE-FR-IT-SE-UK sharing similar level of positive price synchronization. This suggests that countries that are geographically close are more likely to experience simultaneous price increases, and that distance might explain some of the variations. Third, positive price changes within the Eurozone (DE-FR-IT) are not more synchronized than those within Europe (DE-FR-IT-SE-UK). This suggests that there are forces other than nominal exchange rate movements at play in the subsidiaries decision to increase price.

Panel B of Table X shows the average probability of observing a negative price change in country i conditional on observing a negative price change in country j. For example, the average probability of observing a negative price change in Canada conditional on observing a negative price change in the U.S. is 42 percent. However, the unconditional probability of observing a negative price changes in Canada is 17 percent. This implies that we are 2.54 times more likely to observe a negative price change in Canada when we observe a negative price change in the U.S. In contrast to the synchronization in positive price changes, the synchronization in negative price changes is always greater than one (in fact, it is always greater than 1.1), indicating that negative price changes are always synchronized between bilateral pairs. In addition, negative price changes are always more synchronized than positive ones. Finally, as for the synchronization in positive price changes, countries that are geographically close are much more likely to experience simultaneous price decreases.

3.5 International Price Differentials

In the previous subsections, we look at IKEA products management and pricing behavior. With a better understanding of these topics, we now turn to the behavior of IKEA international price differentials. Throughout this subsection, we will focus on the law of one price as our primary measure of international price differential.

Let $P_{i,t}(z)$ denotes the local-currency price of product z, in country i at time t. This is the price received by IKEA, which is the advertized price excluding the VAT for the countries that impose this tax. $S_{i,j,t}$ is the nominal exchange rate between country i and j at time t, define as number of country i's currency needed to purchase one unit of country j's currency at the time that the catalogs's prices were determined. For the purpose of this paper, $S_{i,j,t}$ is the daily nominal exchange rate averaged over the month of June. These are the latest nominal exchange rate quotes available to subsidiaries before making their pricing decisions: The IKEA catalog has an eight-month development cycle, from the broad concepts starting in September to pricing in June (IKEA (2014)). The log good-level real exchange rate $q_{i,j,t}$ is,

$$q_{i,j,t}(z) = p_{i,t}(z) + s_{i,j,t} - p_{j,t}(z), \tag{3}$$

which is equal to zero when the law of one price holds.

Table 8 shows the means, standard deviations, and quartiles in the good-level RER averaged over time between country pairs. The means of the good-level real exchange rates is roughly around zero, except for

Table 8: Good-Level Real Exchange Rate Statistics
by Country Pair 2002-2017

Pair	# Obs.	Mean	SD	Min.	P25	P50	P75	Max.
CA/DE	19,915	0.20	0.26	-1.25	0.05	0.20	0.35	2.50
CA/FR	20,123	0.19	0.26	-1.08	0.03	0.19	0.33	2.46
CA/IT	19,674	0.19	0.26	-1.37	0.03	0.18	0.34	2.47
CA/SE	19,740	0.20	0.25	-2.26	0.05	0.20	0.34	2.39
CA/UK	20,405	0.16	0.26	-1.34	0.00	0.15	0.31	2.40
CA/US	32,315	0.11	0.24	-1.51	-0.03	0.12	0.25	2.40
DE/FR	31,105	-0.01	0.20	-1.32	-0.11	0.01	0.07	2.10
DE/IT	30,860	0.04	0.24	-2.28	-0.08	0.02	0.16	2.22
DE/SE	29,893	0.00	0.21	-2.40	-0.11	-0.01	0.11	2.41
DE/UK	29,229	0.01	0.25	-1.63	-0.14	0.01	0.15	2.12
DE/US	19,680	-0.08	0.25	-2.16	-0.23	-0.07	0.07	1.26
FR/IT	31,838	0.05	0.21	-2.29	-0.05	0.01	0.18	1.80
FR/SE	30,975	0.01	0.19	-2.48	-0.09	-0.01	0.11	1.85
FR/UK	30,268	0.02	0.24	-1.27	-0.12	0.01	0.16	1.75
FR/US	19,771	-0.07	0.24	-2.06	-0.21	-0.06	0.08	1.62
IT/SE	30,393	-0.04	0.22	-2.57	-0.16	-0.03	0.08	2.25
IT/UK	29,913	-0.03	0.21	-1.42	-0.15	-0.03	0.09	2.03
IT/US	19,482	-0.07	0.25	-1.64	-0.22	-0.06	0.09	1.26
SE/UK	29,406	0.01	0.23	-1.35	-0.12	0.01	0.16	2.52
SE/US	19,548	-0.08	0.25	-2.05	-0.22	-0.06	0.06	2.04
UK/US	20,204	-0.04	0.25	-2.02	-0.18	-0.03	0.11	1.28

Note: The Good-Level Real Exchange Rates are the log deviations of the price received by IKEA (i.e., excluding VAT) translated in Euro using daily nominal exchange rates averaged over the month of June.

the CA and US pairs. The CA pairs range between 0.11 and 0.20, indicating that Canadian prices averaged 11 to 20 percent more than that of other countries over the sample period. The standard deviations oscillate around 0.24, and the support of the distributions are extremely wide, ranging from -2.57 to 2.52

As we saw earlier in this section, products churning is extremely important. In fact, more than half of the price quotes in any given year comes from the entry of new products. This suggests that products entry may be important for understanding good-level real exchange rates as well (see Baxter and Landry (2012) and Cavallo et al. (2014)). For products that exist for more than one year, the frequency of price changes averaged 0.47 across countries. This indicates that, on average, less than half of these products experienced a price changes in any given year. The fact that many products experience no price changes, even when they exist for more than one year, suggests that nominal volatility may also play an important role in real exchange rate volatility.

I formally characterize the dynamics of the real exchange rate by estimating the following regression

$$q_{i,j,t}(z) = \alpha + \beta s_{i,j,t} + \lambda_{i,j} + \theta_t + \nu_{i,j,t} + \epsilon_{i,j,t}, \quad (4)$$

where $\lambda_{i,j}$ represents a country-pair effect, θ_t represents a time effect, and $\nu_{i,j,t}$ captures differential VAT regimes to control for variations in VAT across countries and over time. I run this estimating equation for price-pair combinations on five different specifications: all observations, for simultaneous entry only, for simultaneous price change only, for simultaneous price change conditional on a price increase in country j, and for simultaneous price change conditional on a price decrease in country j. I exclude the Euro pairs from the regressions since there are no variations in the nominal exchange rate for these pairs (i.e., $s_{i,j,t} = 1$). In all these estimating equations, a value $\beta = 0$ would imply that the level of the real exchange rate is unrelated to the level of the nominal exchange rate. For example, the law of one price predicts that $q_{i,j,t}(z) = 0$ and would lead to an estimated coefficient of $\beta = 0$. In contrast, a value $\beta = 1$ would imply that the level of the real exchange rate tracks the level of the nominal exchange rate.

Table 9 reports estimates of β, together with regressions summary statistics. When all the observations are pooled in the regression, the estimated β coefficient is 0.66, which implies that the real exchange rate moves 0.66 log point for every full log-point movements in the nominal exchange rate. In other words, if the bilateral nominal exchange rate appreciates by 10 percent over the course of the year, one would expect IKEA prices to increase by 6.6 percent over the previous year (i.e., relative local currency prices move by 3.4 percent). The rest of the results are consistent with the results shown in Table 8. The estimated β coefficient is 0.65 when I restrict the regression to price pairs with simultaneous entry. This estimate is close to the estimate that I obtain in my previous research with Marianne Baxter (Baxter and Landry (2012)) using an earlier version of the dataset covering IKEA data from 1994 to 2010. It is also consistent with Cavallo et al. (2014) who estimated a similar equation on US price pairs using four large global retailers. It implies that the real exchange rate closely track the nominal exchange rate, even when products simultaneously enters countries.

The last three rows of Table 9 report estimates of β when we observe a simultaneous price change. In this case, the estimated β coefficient is 0.44, which implies that the real exchange rate moves 0.44 log point for every full log-point movements in the nominal exchange rate. This is drastically lower than than the estimated β found when all observations are pooled or when products simultaneously enter countries, and suggest that price changes may correct some of the real exchange rate deviations. Interestingly, the estimated β coefficient is lower if I condition the simultaneous price changes on a price decrease (relative to a price increase), indicating that exchange-rate pass-through is larger for price decreases than it is for price increases.

Overall, IKEA subsidiaries seem to price with a local-currency point, even when products enter a country and despite large movements in nominal exchange rate. Results from the previous sections also points to an important common component with respects to products management and the timing of price changes. In the next section, I develop, simulate, and study a partial equilibrium menu-cost model with products entry and exit, and test this model against the results presented in this section. We will see that most of these empirical results can be rationalized in the context of a relatively simple model where the main source of heterogeneity across subsidiaries are exchange rate movements between the source and the destination.

4 IKEA: A Case Study for Multinational Pricing Models

I use the empirical analysis above as a case study to better understand the key features driving the multinational products management and pricing behavior using a partial equilibrium model of multinational pricing. The model is a simple extension of standard menu-cost models with multiple products that incorporates products entry and exit.[20] Because IKEA business strategy is standardized, coordinated, and integrated across countries, with minimal degrees of adaptation to local market peculiarities, I focus on factors other than differences in taste across countries to solve, simulate, and estimate the model. In particular, I focus on the interaction between marginal cost and exchange rate movements to explain the dynamic properties of the data.

[20]Examples of standard menu-cost models are Dotsey et al. (1999), and Landry (2009)'s and Landry (2010)'s open-economy versions, Golosov and Lucas (2007), and Nakamura and Steinsson (2008). More recent examples of multiproduct menu-cost models are Midrigan (2011) and Alvarez and Lippi (2014).

Table 9: Regressions of Log RER on Log NER
2002-2017

Specifications	β	$Adj.R^2$	# Obs.
All observations	0.66	0.20	440,934
	(.004)		
Simultaneous entry	0.65	0.17	197,092
	(.006)		
Simultaneous price change	0.44	0.26	34,470
	(.019)		
Simultaneous price change	0.54	0.29	21,027
conditional on a price increase in j	(.023)		
Simultaneous price change	0.47	0.29	13,443
conditional on a price decrease in j	(.033)		

Note: The table reports the coefficient of regressions of the log RER on the log NER or price-pair combinations for five different specifications: all observations, for simultaneous entry only, for simultaneous price change only, for simultaneous price change conditional on a price increase in country j, and for simultaneous price change conditional on a price decrease in country j. I exclude the Euro pairs from the regressions since there are no variations in the nominal exchange rate for these pairs.

4.1 A Menu-Cost Model with Products Entry and Exit

Demand Structure

As we saw in Section 3, IKEA's subsidiaries price with a local-currency point, even when products enters a country and despite large movements in nominal exchange rate. In order to account for this feature of the data, I allow for variable markups to differ across subsidiaries through the non-constant demand elasticity schedule proposed by Klenow and Willis (2016). This specification is a useful abstraction for modeling variable markups arising from strategic interactions between monopolistic competitors because the super-elasticity of demand provide a strong incentive for a subsidiary to keep its price close to the industry price level. Specifically, consumers' preferences are represented by an aggregator over the consumption of a continuum of products $z \in [0,1]$ such that the demand for the z^{th} product take the form

$$c_{i,t}(z) = \left(1 - \gamma \ln\left(\frac{P_{i,t}(z)}{P_{i,t}}\right)\right)^{\epsilon/\gamma} c_{i,t}, \tag{5}$$

where $P_{i,t}(z)$ represents the price of product z in country i, $P_{i,t}$ represents the aggregate price level, and $c_{i,t}$ represents aggregate consumption. The parameter $\gamma > 0$ governs the elasticity of demand and $\varepsilon > 1$ the super-elasticity of demand. Together, these two parameters govern the price elasticity of the desired markup $\Gamma_{i,t}(z)$, such that

$$\Gamma_{i,t}(z) = \frac{\gamma}{\varepsilon - 1 + \gamma \ln\left(\frac{P_{i,t}(z)}{P_{i,t}}\right)}. \tag{6}$$

In the steady state, defined as the mean of the long-run stationary distribution, $P_{i,t}(z) = P_{i,t}$ and hence the steady-state markup elasticity is given by $\gamma/\varepsilon - 1$. A useful feature of this demand specification is that it converges to a constant demand elasticity $\gamma \to 0$.

The Multinational and the Subsidiaries's Problem

The multinational operates in i countries by offering a range of products z to subsidiaries at a common real marginal cost $\psi_t(z)$ denoted in the Source currency. In turn, each subsidiary maximizes its value by selecting a range of products and setting local-currency prices. For simplicity, I assume that the subsidiaries maximize the value of each product z, ruling out any supply- or demand-driven complementarities across products within the subsidiary. Thus, the subsidiary's real profit on product z at time t is

$$\pi_{i,t}\left(\frac{P_{i,t}(z)}{P_{i,t}}|\Omega_{i,t}(z)\right) = \left((1-\phi)\frac{P_{i,t}(z)}{P_{i,t}} - S_{j,i,t}\psi_{j,t}(z)\right)c_{i,t}(z) \tag{7}$$

where $S_{j,i,t}$ is the real exchange rate between the Source j and Country i and ϕ is a fixed operating cost (the cost retailing, marketing, etc.). The state of product z in Country i at time t is represented by the variable $\Omega_{i,t}(z)$, which includes the real exchange rate $S_{j,i,t}$, the real marginal cost $\psi_{j,t}(z)$, the aggregate price level $P_{i,t}$, the level of aggregate demand $c_{i,t}$, and the operating cost ϕ. $\Omega_{i,t}(z)$ also carries product z status (i.e., in/out) and its price history $P_{i,t-1}(z)$.

Each subsidiary decides whether or not to adjust product z's price, after observing the state $\Omega_{i,t}(z)$. Accordingly, the value of each product line $v\left(P_{i,t}(z)/P_{i,t}|\Omega_{i,t}(z)\right)$ (replace hereafter by $v_{i,t}(z)$) evolves according to,

$$v_{i,t}(z) = (1 - IN_i(z))\max\{v_{out,i,t}(z), v_{entry,i,t}(z)\} + IN_i(z)\max\{v_{out,i,t}(z), v_{in,i,t}(z)\} \tag{8}$$

where $IN_i(z)$ represents the status of product z in Country i at time $t-1$ and is equal to 1 if the product was offered at time $t-1$ and 0 otherwise. $v_{out,i,t}(z)$ is the value of the product line z if the subsidiary does not offer product z at time t and is equal to,

$$v_{out,i,t}(z) = 0 + \beta E_t \max\{v_{out,i,t+1}(z), v_{entry,i,t+1}(z)\}. \tag{9}$$

where β is the discount factor. In other words, $v_{out,i,t}(z)$ is the value of waiting and it is equal to the expected present discounted value of having the possibility to launch product z at time $t+1$. $v_{entry,i,t}(z)$ is the value of the product line if the subsidiary introduce product z at time t and it is equal to,

$$v_{entry,i,t}(z) = \max_{P^*_{i,t}(z)} \pi_{i,t}\left(\frac{P^*_{i,t}(z)}{P_{i,t}}|\Omega_{i,t}(z)\right) + \beta E_t \max\{v_{out,i,t+1}(z), v_{in,i,t+1}(z)\} - \kappa, \tag{10}$$

where $P^*_{i,t}(z)$ is the profit maximizing price and κ is the sunk entry cost (e.g., market research, etc.). The value of a product at introduction is equal to the profit made this period plus the expected present discounted value of retiring the product after one period or continuing to offer the product next period, minus the sunk entry cost. Finally, the value of continuing to offer the product line is,

$$v_{in,i,t}(z) = \max\{v_{a,i,t}(z), v_{c,i,t}(z)\}. \tag{11}$$

where

$$v_{a,i,t}(z) = \max_{P^*_{i,t}(z)} \pi_{i,t}\left(\frac{P^*_{i,t}(z)}{P_{i,t}}|\Omega_{i,t}(z)\right) + \beta E_t \max\{v_{out,i,t+1}(z), v_{in,i,t+1}(z)\} - \xi, \tag{12}$$

$$v_{c,i,t}(z) = \pi_{i,t}\left(\frac{P_{i,t-1}(z)}{P_{i,t}}|\Omega_{i,t}(z)\right) + \beta E_t \max\{v_{out,i,t+1}(z), v_{in,i,t+1}(z)\}. \tag{13}$$

In these expressions, $v_{a,i,t}(z)$ is the value of adjusting the price of product z, ξ is the menu cost of price change, and $v_{c,i,t}(z)$ is the value of continuing with the price set last period. The value of adjusting product z price this period equals the profit made this period plus the expected future discounted value of product z next period, minus the menu cost of price change. The value of continuing with the price set last period is equal to the profit made this period plus the expected future discounted value of product z next period.

Table 10: **Calibrated Parameter Values**

Parameter	Value	Source
ϵ, elasticity of demand	2.5	US industry average
ϕ, operating cost (fraction of steady-state revenue)	0.318	IKEA income statements
β, annual discount factor	0.98	TIPS average yields
μ_π, trend inflation	0.021	Average US inflation
ρ_S, persistence of exchange rates	0.80	US/DE real exchange rate
σ_χ, standard deviation of exchange rate shocks	0.10	US/DE real exchange rate
σ_η, standard deviation of inflation shocks	0.016	US inflation

4.2 Calibration, Estimation, and Simulation of the Model

I assume that all subsidiaries face the same parameter values which leads to identical value and policy functions. I believe that this is a reasonable assumption given IKEA's minimal degrees of adaptation to local market peculiarities. To save on the dimensionality of the state space, I also assume that the level of aggregate demand is constant across subsidiaries and over time. I believe that this is a reasonable assumption because annual revenues growth has been constant since 2002. Thus, I am left with three sources of variation to explain IKEA products management and pricing decisions: variation in marginal cost at the source, variation in real exchange rate between the source and the destination, and variation in the aggregate price level at the destination. Since each product comes from the same source, however, most of the differences in products management and pricing decisions across subsidiaries stem from variation in the real exchange rates—since small variations in the aggregate price level together with the high level of products churning only marginally affect IKEA products management and pricing decisions.

I solve, simulate, and estimate the model using annual data from June 2001 to June 2016. The calibrated parameters are reported in Table 10. I estimate the remaining parameters using the simulated method of moments detailed below. I calibrate the parameters governing the steady-state markups and the operating cost using available IKEA annual income statements and industry data, for which I provide a summary in Appendix A: IKEA Facts and Figures. First, I set the elasticity of demand ε to 2.5, which implies a steady-state markup of $\varepsilon/(\varepsilon-1)$ of 66.6 percent. This corresponds to the average gross margin reported by the US industry average (SIC 5700, Home Furniture, Furnishings, and Equipment Stores). Second, I set the operating cost ϕ to 0.318, which is the average operating cost reported by IKEA.[21] Finally, I set the discount factor β to 0.98 to match the US Treasury Inflation-Indexed Long-Term Average Yield.

I solve the model by iterating numerically the Bellman operator that yields subsidiaries' value (9) and (11), and policy functions on a discrete grid.[22] I assume that the logarithm of marginal cost follows a first-order autoregressive process according to,

$$log(\psi_t(z)) = \rho_\psi log(\psi_{t-1}(z)) + \nu_t(z),\ \nu_t(z) \sim N(log((\epsilon-1)/\epsilon), \sigma_\nu^2), \tag{14}$$

where the multinational only offers a menu products for which $log(\psi_t(z)) \leq \varphi$ to subsidiaries. In other words, IKEA only offers a menu of low marginal-cost products to its subsidiaries, relative to the industry average. As we will see below, this selection effect will be key in delivering some of the results. I assume that the mean of the marginal cost process is 0.6 to replicate the industry gross margin of 40 percent. The logarithm of the real exchange rate follows a first-order autoregressive process according to

$$log(S_{j,i,t}) = \rho_S log(S_{j,i,t}) + \chi_{j,i,t},\ \chi_{j,i,t} \sim N(0, \sigma_\chi^2). \tag{15}$$

[21] The operating cost includes the steady-state sunk-entry cost κ and the menu cost of price adjustment ξ.

[22] The step of the grid for relative prices, marginal cost shocks, and real exchange rate shocks is one percent.

Table 11: Estimated Parameter Values

Parameter	Value
γ, super-elasticity of demand	3.5
κ, sunk entry cost	0.161
ξ, menu cost	0.027
ρ_ψ, persistence of marginal costs	0.069
σ_ν, standard deviation of marginal cost shocks	0.129
φ, multinational selection parameter	-0.438

I set the persistence of the real exchange rate to 0.802 with a standard deviation of the shocks set to 0.102 to replicate the behavior of the annual bilateral real exchange rate between the US and Germany, which represents IKEA's two biggest invoicing currencies (the sources, by purchasing) and markets (the destinations, by revenues). Since products can live for many years, I also introduce variation in the aggregate price levels by assuming that the logarithm of the aggregate price levels fluctuate around a trend according to,

$$log(P_{i,t}) = \mu_\pi + log(P_{i,t-1}) + \eta_{i,t},\ \ \eta_{i,t} \sim N(0, \sigma_\eta^2). \tag{16}$$

I set the trend to 0.021 with a standard deviation of the shocks set to 0.016. This corresponds to the annual dynamics of US inflation observed over the sample period.

I simulate the seven subsidiaries products and pricing decisions (included in my sample) by feeding 10,000 simulated marginal cost series, paired with observed real exchange rate and inflation shocks from 2001 to 2016. The 10,000 marginal cost series are split into four invoicing currencies according to IKEA average invoicing currencies over the sample period (see Appendix A: IKEA Facts and Figures). For example, I invoice 4,000 marginal cost series in euros, because 40 percent of the products are invoiced in euros. Then, I pair each product with the observed bilateral real exchange rate between the invoicing (the source) and the destination currencies. Finally, I assume that the aggregate price level relevant for the subsidiary's products and pricing decisions evolve as the country's consumer price index (CPI).

I estimate the remaining five parameters to match a series of moments presented in Section 3, using the simulated method of moments. The target groups of moments are the survival ratios of products life across subsidiaries (Figure 2.B, top panel), the synchronization in products entry between subsidiaries (Table X.C)[23], the synchronization in products exit between subsidiaries (Table X.D), the mean, standard deviation, positive and negative median, and positive and negative frequency of price changes across subsidiaries (Table X.A), the conditional probabilities of positive price changes across countries (Table X.A), and the conditional probabilities of negative price changes across countries (Table X.B). The estimated parameter values are the solution to

$$M = min\left(m_t - \hat{m}_t(\gamma, \kappa, \xi, \rho_\psi, \sigma_\eta, \varphi)\right)' \hat{V} \left(m_t - \hat{m}_t(\gamma, \kappa, \xi, \rho_\psi, \sigma_\eta, \varphi)\right), \tag{17}$$

where m_t represents the vector of moments from the data, $\hat{m}_t(\gamma, \kappa, \xi, \rho_\psi, \sigma_\eta, \varphi)$ is the corresponding vector of moments from the model, and $\hat{V}$ is the optimal weighting matrix. Further details about the model's solution, simulation, and estimation are provided in Appendix X: Model's Solution, Simulation, and Estimation.

My preliminary estimation results suggest that the super-elasticity of demand γ is 3.5. With an average gross margin of 45 percent, this implies that IKEA's prices are on average 2 percent below the US industry average. The sunk entry cost κ is 0.161. Given that the life expectancy of product is 2.1 year, this cost

[23] I use the conditional measure of synchronization in products entry to alleviate the impact of the high level of product sharing in the model on the estimation.

represents 7.7 percent of one year of product revenue. The menu-cost of price changes is 0.027. Given that the mean duration of price spell is 1.8 year, this cost represents 1.5 percent of one year of product revenue. The persistence of the marginal cost shocks is 0.069, with a standard deviation of 0.129. Finally, the multinational selection parameters is -0.438. This implies that the multinational doesn't offer products with a marginal cost above 0.646 (i.e., $exp(-0.438)$). This implies that the multinational doesn't offer marginal cost draws above the 63.9 percentile to subsidiaries, relative to the industry average.

Since the system is overidentified, I test the model using a Wald statistic under the hypothesis that my partial equilibrium model and the underlying states ($\Omega_{i,t}(z)$) represents IKEA subsidiaries's problem. The Wald test statistic is,

$$W = T \cdot (m_t - \hat{m}_t(\gamma, \kappa, \xi, \rho_\psi, \sigma_\eta, \varphi))' \, \hat{V} \, (m_t - \hat{m}_t(\gamma, \kappa, \xi, \rho_\psi, \sigma_\eta, \varphi)) \to \chi^2_{295}, \tag{18}$$

where T is the number of moments match, which is equal to 301. With 6 parameters to estimate, the system is overidentified and the test statistic follow a chi-square distribution with 295 degrees of freedom. W is equal to 159 with an associated probability value of 0.999. Therefore, we cannot reject the hypothesis that my partial equilibrium model and the underlying states ($\Omega_{i,t}(z)$) represents IKEA subsidiaries's problem a conventional significance levels.

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A IKEA Facts and Figures

Table A1: IKEA Consolidated Income Statements, 2008-2015
in million of Euros

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Annual Revenues	21,534	21,846	23,539	25,173	27,628	28,506	29,293	32,658	
Cost of Sales	11,802	11,878	12,454	13,773	15,723	15,786	16,372	18,221	
Gross Profit	9,732	9,968	11,085	11,400	11,905	12,720	12,921	14,437	
Operating cost	7,078	7,198	7,888	7,808	8,423	8,709	9,128	10,388	
Operating income	2,654	2,770	3,197	3,592	3,482	4,011	3,793	4,049	
Gross margin (%)	0.45	0.46	0.47	0.45	0.43	0.45	0.44	0.44	**0.45**
Average markup (%)	0.82	0.84	0.89	0.83	0.76	0.81	0.79	0.79	**0.82**
Operating cost (%)	0.33	0.33	0.34	0.31	0.30	0.31	0.31	0.32	**0.32**
Operating margin (%)	0.12	0.13	0.14	0.14	0.13	0.14	0.13	0.12	**0.13**

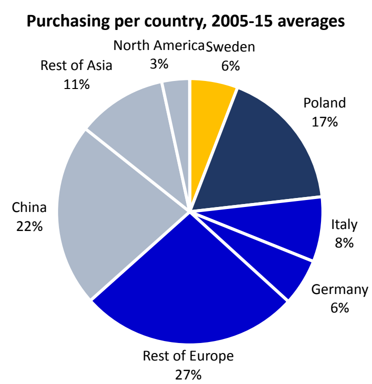
US Industry Average, 2008-2015
SIC 5700: Home Furniture, Furnishing, and Equipment stores

	2008	2009	2010	2011	2012	2013	2014	2015	Average
Gross margin (%)	0.35	0.34	0.38	0.43	0.44	0.44	0.42	0.41	**0.40**
Average markup (%)	0.53	0.52	0.61	0.75	0.77	0.77	0.73	0.68	**0.67**
Operating cost (%)	0.31	0.28	0.28	0.31	0.32	0.32	0.32	0.32	**0.31**
Operating margin (%)	0.03	0.06	0.09	0.12	0.12	0.11	0.10	0.09	**0.09**

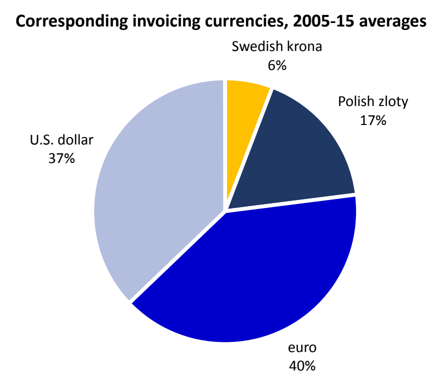
Note: **Gross margin** is sales (annual revenues) minus cost of products sold (cost of sales), as a percentage of sales. The markup is the difference between a product's cost and its selling price. Here, the **average markup** is the difference between the cost of sales and the annual revenues, expressed as a percentage of the cost of sales. The **operating cost** is the cost associated with maintenance and administration. Finally, the **operating margin** shows how much revenues are left after paying for the cost of products sold and the operating cost. The global industry averages (using Compustat Global, which includes a list of companies headquartered in 26 countries) are roughly similar to the US industry average. For example, over the 2008 to 2015 period, the average gross margin is 40 percent and the operating margin is 8 percent.

Figure A1: **IKEA Purchasing and Invoicing Currencies**

2005-2015 averages



A. Purchasing per country



B. Corresponding invoicing currencies