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International Online Retailing of Ikea Products: An Analysis of the Law of One Price and Pass-through

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Macalester College Economics Honors Thesis

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I. Introduction

The Law of One Price, as a key concept in macroeconomics, states that in a perfect market a good would have the same price everywhere[1]. For example, gold, as a homogeneous, valuable, and easily tradable good, is sold at the same price across exchange markets in the world. The law exists because arbitrage opportunities are fully exploited. If the price of an identical good is different in two different countries, arbitrageurs can make profits by buying it in the cheaper country and selling it in the more expensive country. This arbitrage activity will cause the price to fall in the location where it was originally expensive and fall in the location where it was originally cheap.

In real life, however, the law of one price rarely holds perfectly because the international market is not perfectly free and arbitrage opportunities can be limited due to geographical and physical constraints. For example, custom duty and transportation costs can limit arbitrageurs. Failure of the law of one price to hold has important implications for consumer welfare and the efficiency of the international economy. The deviation from the law of one price is a common approach to study the law of one price and analyze public and commercial economic events. The exchange rate pass-through is also widely studied in the literature on the law of one price. Pass-through is a measure of the responsiveness of international prices to changes in exchange rates. Imperfect exchange rate pass-through is one of the causes of the deviation from the law of one price. As exchange rates fluctuate on a very

[1] "Law of one price". Cambridge University Press 2015.

frequent basis, international retailers usually do not adjust their prices perfectly proportional to changes in exchange rates.

Baxter and Landry (2010) studied the deviation from the law of one price and pass-through of Ikea between 1994 and 2010. Ikea, as the world's largest furniture retailer, operates and distributes in 47 countries including most North American and European countries[2]. Baxter and Landry (2010) examined the annual catalogue prices of Ikea products in six countries. They found significant deviations from the law of one price for all six countries, ranging from a negative to positive twenty percent. The scholars also examined exchange rate pass-through. They found significant pass-through for all six countries with the maximum of 1.16 and the minimum of 0.1[3]. Baxter and Landry (2010) observe significant incomplete pass-through for Ikea products annual prices which might have contributed to the deviations from the LOOP.

The goal of this paper is to reexamine the law of one price and the exchange rate pass-through with Ikea's prices. However, in contrast to Baxter and Landry (2010), I focus on its monthly online prices and investigate if the results in Baxter and Landry (2010) still hold. According to the theory, which will be discussed below, the internet is expected to reduce the deviations from the law of one price because the internet helps eliminate transaction costs and thus promote fuller arbitrage. Exchange rate pass-through is also predicted to be higher with the internet as the internet allows the retailer to adjust its prices more frequently and at a lower menu cost.

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[2] "Bringing the Ikea Concept worldwide", Inter Ikea Systems B.V.

[3] A pass-through of 0.1 indicates that prices barely follow changes in exchange rates, while a pass-through of 1.16 indicates an over pass-through: when exchange rate changes for 100%, price changes for 116% in response.

This paper rejects both of the hypotheses. There is no evidence that the internet reduces the deviation from the law of one price. The deviations from the law of one price are stable ranging from a negative to positive twenty percent. The paper also finds no significant relationship between international prices and changes in exchange rates. It is evident that although the internet makes it possible to adjust prices to exchange rate movement more frequently, Ikea does not actually do so in practice. I speculate that other constraints that limit arbitrage and full exchange rate pass-through could not be overcame by the internet.

This paper is organized as follows. First, I will examine previous studies on the deviations from LOOP and exchange rate pass-through. I will in detail discuss Baxter and Landry (2010) and Haskel and Wolf (2004), two papers which I will update in this study. Then I will lay out the theoretical framework of the Law of One Price and exchange rate pass-through. In the following sections, I will summarize the data and calculate deviations from LOOP and exchange rate pass-though of this dataset. In the conclusion, I will discuss the implications of the result and future research opportunities.

II. Literature review

The Law of One Price (LOOP) has been extensively studied by scholars and deviations from the LOOP is commonly observed. There is a lack of empirical work that examines individual internationally traded goods in the early literature because of the difficulty of obtaining price data of identical goods across countries. Early literature, therefore, focused on the deviation from the LOOP in multi-product or market price indices (Hooper and Mann, 1989; Knetter, 1989 and 1993; Marston, 1990; Feenstra, 1989; Feenstra et al., 1993; Harrison,

1993). A majority of these studies found that deviations from the LOOP across countries significantly reflect changes in exchange rates and differences local mark-ups. That is, markets are imperfectly competitive and companies setting prices in foreign markets are unable to offset movements in exchange rates by changing foreign prices because they would lose market share.

Globalization and the fast development of multinational retailers has enabled scholars to obtain price data of individual goods traded across countries by collecting catalogs or label prices. Studies were, therefore, able to investigate the LOOP more adherently to its theory on individual goods. Ghosh and Wolf (1994) studied the label prices of *The Economist* magazine in seven countries between 1973 and 1990. They found a mean absolute price deviation of around 1.03% across countries and 11.12% across years[4]. Crucini et al. (2008) looked at the annual retail prices of a broad cross section of goods what appears in a typical urban consumption basket across 13 EU countries. They concluded an average deviation from the law of one price across all goods of about 28 percent. Baxter and Landry (2010) studied annual catalog prices of Ikea products in six countries from 1994-2010 and reported a mean absolute deviation of around 8 percent across countries and across years. Crucini et al. (2008) also concluded that LOOP deviations are generally around 0 and increase in size the less tradable the good is and the more non-traded inputs that are used to produce the good.

A comparison of previous studies implies that price deviations differ significantly across product categories and across regions. It is therefore necessary to compare the results

[4] Among the seven countries they studied, the average deviations across years is 1.03% (between effects) and among the 27 years they studied, the average deviations across countries is 11.12% (fixed effects).

of the same types of products among the same countries to investigate the effects of the internet. The data of this paper includes a wide variety of products which are comparable with previous studies. They allow the author to further explore deviations from the LOOP of individual internationally traded goods.

The recent growing popularity of online retailing has made it much easier for scholars to collect the prices of identical goods across countries. Online retailing could also have changed the pricing behavior of multinational retailers by giving the sellers higher flexibility to adjust prices and allowing consumers to compare prices across countries more easily. Kannan and Kopalle (2001) compared dynamic pricing behaviors on the internet with those by pre-internet physical channels. They noted that theoretically while prices in conventional channels change over the course of weeks or months, it only takes a few hours or even minutes to change prices on the internet with lower menu costs. They also argued that search costs are lower for customers on the internet than those buying goods through physical channels. As price-comparison websites become available online for consumers to easily find the lowest price for similar or identical goods, retailers have the incentive to reduce price differences or offer product differentiation to be competitive with other retailers. These changes brought by the internet could also affect the extent to which the LOOP holds in the international tradable goods market, which will be discussed in the following paragraphs.

As the internet has reduced search costs for consumers, Cavallo et al. (2014) speculate that it may have facilitated price convergence across counties by allowing easier international price comparison, especially among countries using the same currency. Simonovska (2015) found a cross-country mean deviation of 32% in the online prices of the Spanish apparel brand

Mango among 29 countries in the summer of 2012. This result is significantly higher than the average level of previous estimates. Simonovska (2015), however, was not able to study how the internet affects her result as there are no previous studies available on the same retailer using non-internet data. This paper, therefore, aims to study this topic by using a novel dataset with Ikea's online prices and comparing the results with previous studies which used Ikea catalog prices.

In addition to examining deviations from the LOOP, two other approaches are widely used by scholars to study international pricing. Exchange rate pass-through has been used as a tool to understand retailers' decisions on mark-ups and price stickiness across countries. Exchange rate pass-through is defined as the percentage change in local currency import prices resulting from a one percent change in the exchange rate between the exporting and importing countries. For example, with a full pass-through, when the U.S. dollar depreciates for one percent, Ikea products would increase its prices for one percent to overcome the depreciation of the currency. According to the rigid definition of the LOOP, the currency in which an individual good is priced in is exogenous to the common currency price[5]. For example, the dollar price of McDonald's Big Mac should be the same across countries regardless of in which currency it is originally priced in. In other words, the LOOP assumes that changes in the exchange rate are fully passed to changes in the price, which guarantees that prices of identical good are equalized across countries. For example, the rigid LOOP requires that an identical

[5] The common currency price is the price of a good after converting to a common currency. For example, the common currency price of a Big Mac could be the dollar adjusted price of Big Mac across countries.

good in France and Australia should have the same prices after converting into dollars even though they are priced in different currencies originally.

In reality, however, it is rarely observed that retailers adjust their price perfectly to the exchange rate. For example, if the dollar appreciates against the euro by 10%, the euro price of a Big Mac in Germany only rises by 5%. McDonalds is not able to fully pass-through the exchange rate because the German market in which it appreciates constrains it. That is, raising the euro price of a Big Mac by 10% will cause McDonalds to lose significant market share and profit. Thus it absorbs the exchange rate change in the profit margin. Previous studies all find imperfect pass-throughs. A pass-through below 0.5 is commonly observed in studies which employed annual data (Goldberg and Verboven, 2001; Campa and Goldberg, 2005; Goldberg and Knetter, 1997). The results indicate that retailers are not very responsive to exchange rates in their annual pricing decisions. As the internet gives retailers higher flexibility to adjust their prices with lower menu costs, this paper will investigate if internet increases the exchange rate pass-through of Ikea's online prices compared to previous estimates.

Previous studies also have found that exchange rate pass-through may be affected by the currency in which the good is priced (Beirne and Bijsterbosch, 2009; Baxter and Landry, 2010; Takhtamanova, 2008; Ihrig, Marazzi, and Rothenberg, 2006) or the type of good being traded (Goldberg and Knetter, 1997; Goldberg and Verboven, 2001; Kasa, 1992; Knette, 1989, 1993, and 1995; Marston, 1990). It is commonly observed that exchange rate pass-through varies across countries and across products. As previous studies focused on different geographical areas across different industries, during different time period, there is no consistent pattern found for the exchange rate pass-through for certain countries or industries.

It is, therefore, only justifiable to compare the pass-through in the same industry in the same country when studying the impact of the internet on pass-through. Baxter and Landry (2010) studied exchange rate pass-through of Ikea's catalog prices and found an average pass-through of 0.604. This paper will use the method in Baxter and Landry (2010) to estimate exchange rate pass-through of Ikea's online prices. The model will be discussed in detail in the following theory section. As discussed above, the internet allows retailers to adjust prices more easily. By comparing the result of this paper to the pervious study, the author will explore if online retailing has made Ikea's prices more responsive to changes in the exchange rates.

As discussed above, deviations from the LOOP are commonly observed and changes in exchange rate are often not fully passed to local prices. The next step to study international pricing behavior, therefore, is to look at the role that mark-ups and local costs play in the deviation from the LOOP. There is a very large number of studies looking at factors that might drive the deviation from the LOOP. Rogoff (1996) concluded that the persistence in the deviation may be due to frictions caused by tariffs, transportation costs, and other transaction costs, as the international goods market is not perfectly integrated. Pakko and Pollard (2003) discussed the impact of transportation cost, trade restrictions, taxes, and productivity on the prices across countries. They also considered *pricing to market* as an important driver of the international price differentials. Pricing to market is a pricing strategy used by monopolistically competitive firms in the domestic and foreign market to set different prices and take advantage of international price differences. Scholars have also extensively studied the relationship between price differentials between the base country (the base country is usually the country with the lowest average prices; it is a proxy for the costs of the products) and the comparison

country and the income of the comparison country and found a significant relationship (Pakko and Pollard, 2003; reports of *The Economist* on the Big Mac Index, 2008; Alessandria and Kaboski, 2011; Simonovska, 2015). It is commonly observed in these studies that countries with higher income per capita have higher positive deviations from the average prices. That is, income differences is the main cause of price differences across countries. Difference in productivity (Balassa, 1964; Samuelson, 1964) and thus labor cost (Ashenfelter and Jurajda, 2001) is the main explanation behind this relationship. Several studies, on the other hand, focused on the "border effect" and showed that the dispersion of prices of similar goods increases when there is a border between two trading locations as well as the distance between location pairs (Engel and Rogers, 1996; Gorodnichenko and Tesar, 2009; Parsley and Wei, 2001). For example, the economic effect of a border between the U.S. and Canada on the price deviation is estimated to be equivalent to that of 75,000 miles within the country (Engel and Rogers). The price deviation between Toronto and Buffalo, according this finding, is significantly larger than that between Buffalo and Atlanta, even though Buffalo is much closer to Toronto than Atlanta geographically. There is evidence that shipping and distribution costs, price stickiness, and tariffs contribute to this relationship.

According to the Balassa-Samuelson model, labor is more productive in countries with higher per capita income. Higher productivities of labors in some countries, which are brought by higher education, more advanced technology, etc., result in higher incomes in these countries. The higher labor cost will thus be reflected in the prices of the goods. Countries with higher per capita income, such as Switzerland and Norway, therefore have higher prices than countries with lower per capita income, such as India and Viet Nam. Nowadays international

traded goods under one multinational brand are often produced in different countries and the data of the source of individual goods are limited, scholars have had difficulties estimating how important a role local costs (transportation/distribution costs, tax, tariffs, and wage costs) plays in the deviation from the LOOP on the individual good level. Simonovska (2015), for instance, failed to observe a significant relationship between the online prices of Mango across countries and tax, tariffs, and distance of each retailing country. Haskel and Wolf (2001) proposed a method of comparing and ranking the relative prices of products across categories and across countries[6] to test if local costs is the main reason behind international price differentials. They used the catalogue prices of IKEA in 25 countries between 1995 and 1998 and failed to conclude that local costs explain most of price differentials. This paper will use the method of Haskel and Wolf (2001) to look at a new and richer data set. As the internet increases competition among retailers and gives them incentive to reduce prices (Kannan and Kopalle, 2001), local costs could play a more important role in the deviation from the LOOP as retailers reduce the mark-up in their prices.

Cavallo et al. (2014) carefully studied the dataset this paper will use[7]. They found that the law of one price holds well within a currency union and the real exchange rate equals one. There are, however, large deviations from the law of one price between countries that do not use the same currency. For example, the LOOP holds perfectly between France and Germany; identical goods are usually sold at the same price in euros in both countries. The United States,

[6] The theoretical model Haskel and Wolf (2001) used will be further elaborated later in this paper.
[7] Cavallo et al. (2014) uses a data set which includes daily prices for the four retailers in some subset of 85 countries during some subset of the period from October 2008 to May 2013. This paper only studies Ikea in some subset of xx countries.

however, shows a significant deviation from prices for identical goods. This paper will thus look at deviations from the LOOP both inside and outside the currency union.

This study contributes to the literature on the law of one price by examining exchange rate pass-through and the role of local costs in the deviations from the LOOP of Ikea's online prices. In the context of online retailing, this paper attempts to remedy the recent absence of economic studies on the impact of the internet on international pricing behaviors.

III. Theory and empirical models

This section will explore the theory of the law of one price (LOOP) in detail and establish empirical models to study the deviations from the LOOP. As the main goal of this paper is to compare the result of exchange rate pass-through and the role of local costs to previous studies using a new dataset on the same retailer, the empirical models are based on those in the previous studies. Potential difference in the results, therefore, would not be caused by different estimation models.

As discussed in the introduction, the Law of One Price (LOOP) states that identical products should sell for the same common-currency price across countries (Knetter, 1997). If the LOOP were not true, arbitragers would take advantage of differences in prices in different countries and exploitable profit opportunities would exist. This would drive the prices of the products traded in different locations to be equal. The Law of One Price, therefore, builds on the assumption that all arbitrage would be inevitably eliminated in a free and efficient international market. Assumptions required for the LOOP to hold are thus profit maximization,

perfect information, free markets, and costless transportation, transaction, and distribution. If prices for an individual good are different in two countries and sellers and buyers in both countries are aware of it, sellers have an incentive to sell their goods in the higher-priced country when there is no additional cost. This move will boost supply in that country and reduce supply in the lower-priced country. If demand is constant, the higher supply in the higher-priced country will force the price to decrease, while the lowered supply in the lower-priced country will result in a higher price. Meanwhile, if consumers from the higher-priced country have free and costless access to goods in the lower-priced country, demand will increase in the lower-priced country. Assume that the supply is constant in both countries, prices will increase in the lower priced country because of higher demand whereas prices in the higher priced country will decrease. Prices for an individual good, therefore, will be equal between these two countries. In other words, for every good i in every pair of two countries j and k at date t, the LOOP states that

$$\frac{P_{ijt}}{E_{jt}} = \frac{P_{ikt}}{E_{kt}}, \tag{1}$$

where $P_{ij(k)t}$ is the before Value Added Tax (VAT)[8] price of good i in country j(k) at date t and $E_{j(k)t}$ is the exchange rate between country j and k at date t.

The assumption of costless transaction, transportation, and distribution can be loosened for Ikea's products in this paper. The same products of Ikea are usually produced at one location (Baxter and Landry, 2010); for example, all "Billy" bookcases which are sold across

[8] Value-Added Tax (VAT) is a type of consumption tax that is placed on a product whenever value is added at a stage of production and at final sale. It differs across countries. This paper only reduces the final sale VAT from final prices in countries where VAT is directly added in the price payable for consumers.

the world are produced in China. Ikea would, therefore, still equalize its global common currency prices according to LOOP if local costs (such as transaction cost, transportation, distribution cost, and local labor and utilities costs) are identical across countries and the international market is perfectly competitive and free.

A. Estimate the deviation from the LOOP

Differences in transportation costs and local costs across countries, however, are usually not negligible as things like labor and fuel cost different across countries. Deviations from the LOOP, therefore, are commonly observed. In Baxter and Landry (2010), deviations from the LOOP are defined as the log deviation of each country's common currency price from the cross-country mean price at a given time. The cross-country mean price $\underline{p_{ij}}$ for good i at time t is defined as

$$p_{ij} = N_{it}^{-1} \sum_{j=1}^{N_{it}} (p_{ijt} - e_{jt}), \quad (2)$$

where N_{it} is the number of countries in which good i appears at time t, p_{ijt} is the log price before Value Added Tax (VAT) of good i in country j at date t, and e_{jt} is the log exchange rate between country j and base country k at date t. The deviation from the LOOP for good i at time t in country j d_{ijt} is therefore defined as

$$d_{ijt} = (p_{ijt} - e_{ijt}) - \underline{p_{ij}}, \quad (3)$$

where e_{jt} is the exchange rate at the time the prices are determined. It is commonly observed that deviation from the LOOP varies across countries (Ghosh and Wolf, 1994; Crucini et al., 2008; Baxter and Landry, 2010). The mean law of one price deviation across all goods for country j at time t is defined as

$$\underline{d_{jt}} = N_{jt}^{-1} \sum_{j}^{N_{jt}} d_{ijt}. \quad (4)$$

As discussed in the literature review, this paper hypothesizes that the internet reduces the deviation from the LOOP by making it hold more closely to the assumption of free arbitrage. The internet makes it easier for consumers to compare prices across countries and to buy and sell internationally. The deviation from the LOOP estimated by the equation above, therefore, is expected to be lower than that estimated in previous studies based on prices from catalogues according to the theory.

B. Estimate exchange rate pass-through

The method used in this section to estimate the exchange rate pass-through is also based on that in Baxter and Landry (2010). This method takes possible factors that drive the deviation from the LOOP into the consideration of the retailer's pricing decision. These factors include the good's country-specific local costs, unexpected changes in exchange rate, and mark-up, which can be affected by the demand elasticity.

Assume that C_{it} is the cost of good i at time t in Swedish kronor, u_{ijt} is the country j- and good i- specific markup, and k_{ijt} is the sum of country-specific local costs (distribution cost, transportation cost, and other transaction costs such as tariff), which is assumed proportional to the price. The VAT excluded price of good i at time t in country j, therefore, can be approximately defined as

$$P_{ijt} = C_{it} * (1 + u_{ijt}) * (1 + k_{ijt}) * (E_{it}), \quad (5)$$

Written in logs, with $c_{it}=\ln(C_{it})$,

$$p_{ijt} = c_{it} + (u_{ijt} + k_{ijt}) + (e_{jt}). \quad (6)$$

There are three groups of components in an individual price: c_{it}, which is good specific but country general, ($u_{ijt} + k_{ijt}$), which are good and country specific, and exchange rate e_{jt}, which is country specific but good general. As the production cost of individual goods is not directly observable or available in the dataset, this paper, as done in the comparison study (Baxter and Landry, 2010), uses the price in Sweden as a proxy for the cost and thus a baseline to compare other countries' prices to[9]. Let u_{iSEt} denote the mark-up in Sweden and k_{iSEt} denote the local costs in Sweden. Assume $u'_{ijt} = u_{ijt} - u_{iSEt}$ and $k'_{ijt} = k_{ijt} - k_{iSEt}$, and then equation (6) can be written as

$$p_{ijt} = p_{iSEt} + (u'_{ijt} + k'_{ijt}) + e_{jt}. \quad (7)$$

Based on equation (7), the exchange pass-through is:

$$p_{ijt} = \alpha_j + \beta_j p_{iSEt} + \gamma_j e_{jt} + \delta_{ijt}, \quad (8)$$

where coefficient β_j measures the extent to which good price in country j moves along with prices in Sweden, the baseline country, coefficient γ_j measures the pass-through from the exchange rate between country j and Sweden to the good price in country j, and δ_{ijt} is the error term. According to Knetter (1989, 1993, 1995), theory predicts γ to be 1 if marginal cost is constant.

C. Explanations of the deviations from the Law of One Price

Equation (6) and (7) show that besides imperfect exchange rate pass-through, deviations from the LOOP could reflect either differences in mark-ups or differences in local costs

[9] Baxter and Landry (2010) found that Sweden had the lowest average price, which indicates that it must have the lowest average mark-up as Sweden certainly doesn't have the lowest. Therefore Swedish prices of Ikea is a good proxy of the costs of the products.

(transportation/distribution costs, tax, tariffs, and wage costs) or both. Haskel and Wolf (2001) examined the ordering of prices to investigate which major factor contributes to the deviations. If the ordering of prices between two countries is the same for similar products, local costs make up for most of the deviations. Assume two similar products A and B which are both sold in two countries 1 and 2. The relative price of A to B in country 1 and in country 2 should be similar if local costs is the major explanation of the deviations. Using catalog prices, Haskel and Wolf (2001) rejected this hypothesis, which indicates that markup has a role in the deviations that can not be ignored. As the internet increases competition among retailers and potentially pulls down markups, online prices of Ikea in this paper may fail to reject the initial hypothesis that local costs is the main cause of deviations from LOOP.

IV. Data Summary

The data for Ikea's daily online prices, category and product id, and daily nominal exchange rate between January 2008 and July 2013 come from the Billion Prices Project at MIT, which is an academic initiative that collects prices from online retailers around the world for the purpose of economic research. The data for daily online retail prices, called "scraped data" by its collectors and users, are collected directly from online retailers with specialized software that finds relevant price information on the websites of retailers and stores it automatically in a database (Cavallo, 2015). Compared to traditional data from catalogues or price reports, the scrapped data have no time averaging or imputed prices, which potentially affect pricing statistics and the accuracy of research result. The data of Value Added Tax (VAT) come from the United States Council for International Business. The value of the tax for each

country did not change over the time span of the data. This paper will use the price before VAT as the price variable, which eliminates the effects of different VAT on prices across countries.

The original Ikea data have over one hundred million observations, including nine variables: id of the product, country, id by country, date, category, category id, whether the observation is at the time when the product was first introduced, and the price. Two variables, intro (whether the product is introduced for the first time in this month in this country) and id by country, are dropped because they are not of the interest in this paper. The category variable is dropped because it is empty. The specific category could be found online by searching the category id. There are 32 countries and regions in total and based on data availability, 21 countries will be studied in this paper. These include Austria, Belgium, Canada, Czech Republic, Switzerland, Germany, Denmark, Spain, Finland, France, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Sweden, Slovakia, the United States, and United Kingdom. To compare the result of individual countries with that in previous estimates, six countries are ought to be pulled out for special study as in Baxter and Landry (2010): the United States, United Kingdom, Sweden, France, Germany, and Canada. France and Germany are replaced by Belgium and Italy in this study as data availability of the latter is greater across time and products. Using the same dataset, Cavallo et al. (2014) pointed out that the LOOP holds perfectly within the euro zone. It is therefore reasonable to replace France and Germany with Italy and Belgium.

Ikea, as a furniture retailer, does not change its online prices on a daily basis (even monthly changes are small and not widely observed). For the convenience of research, the data, therefore, are transferred from daily to monthly using the average price of the month as the

observation of the month. The original data range between 2008 and 2013. The data before 2012 are not consistent across months and countries: the data is only available for a small number of months in less than five countries. Therefore, only the data of year 2012 and year 2013 are considered in this paper. The data of the six special countries are available, from January 2012 to July 2013. The data of all countries are available from September 2012 to July 2013.

Table 1 shows a sample of the data. Each observation contains the dollar price of a product in a certain month in a certain country, together with its product category and tax information as well as the exchange rate of this country in this month. Figure 1 also shows a sample of the data: the monthly prices of Billy Bookcase (birch veneer) of five countries between January 2012 and July 2013. It is clear that there are persistent price differences across countries for the same product.

A summary of the panel data is given in Table 2. Based on data availability by country and by time, 139 products across 28 categories were picked for the six special countries. For the entire 21 countries, 822 products across 75 categories are picked. All goods are present in all countries across all time so that there will not be an issue of overrepresentation or underrepresentation. Table 3 shows a sample of product categories in the dataset, which demonstrates a good diversity of products with very different values and functions. Among all countries, the cheapest product with a value of 0.40 US dollars is found in Netherlands, which belongs to the category of mugs, cups, and vacuum flasks. Canada has the most expensive product among all observations, which is a bookcase that costs 1462.17 US dollars. The mean value of the products in this dataset is 30.22, with a big standard deviation of 70.62. The U.S.

and Canada have 0 VAT because as it varies by state, prices displayed online do not contain VAT. Hungary has the highest VAT with a value of 0.27, and Switzerland has the lowest VAT of 0.08 among countries whose prices directly contain VAT. On average, these 21 countries have a VAT of 0.19 with a standard deviation of 0.07. In July 2013, Hungary has the smallest exchange rate against US dollars in absolute value and United Kingdom has the largest.

V. Analysis

A. Estimation Issues

As explained in the theory section, this paper will take the log of prices and exchange rates to study the deviations from the LOOP and exchange rate pass-through. As this paper is not interested in price change across time, the author does not treat the dataset as a panel data and instead takes the time variable as three different years dummy variables. There is one observation for each id in each country in each month. There is, therefore, no concern of serial correlation or nonstationarity in this paper.

The author tested for multicollinearity and heteroskedasticity in the dataset. No strong correlation between the explanatory variables is found. A White Test found heteroskedasticity in the data; the test found a p-value of 0.000 and rejected the null of no heteroscedasticity. To remedy heteroskedasticity, the author runs the regression with the robust estimator to fix the standard errors.

B. Main Results

B1. Deviations from LOOP

This section will estimate the deviation from the LOOP by country and by time. The estimation equation derived above is:

$$\underline{d_{jt}} = N_{jt}^{-1} \sum_{i,j}^{N_{jt}} d_{ijt}. \quad (4)$$

where N_{jt} is the number of countries in which good i appears at time t, d_{ijt} is the law of one price deviation for good i country j at time t.

Table 4 is a summary of the deviations from the LOOP for the six special countries and Figure 1 shows their deviations across time. As commonly observed in previous literature, there is a significant deviation from the LOOP. The magnitude of the deviation varies across countries. As the time period covered the dataset is very small (only 19 months), there is no observable pattern of the deviations across time. Canada, among all six countries, has the highest positive deviation from the LOOP with a mean of 18.4%. In other words, for identical products from Ikea, Canadians pay on average 18.4% more than the average level of these six countries. In contrast, Belgium has the most negative deviation with a mean of -14.9%. United Kingdom has the smallest absolute deviation with a mean of -2.7%.

In comparison to the result in Baxter and Landry (2010), which studied catalogue prices of Ikea between 1994 to 2010 in these six countries (figure 2) , the pattern of the deviation is more stable across time mostly because Baxter and Landry (2010) studied a much longer time period with annual observations, which bears more volatility of prices and the market. Importantly, note that Canada after 2005 in Baxter and Landry (2010) shows a consistent pattern with the result in this paper as the country with the largest positive deviations from the LOOP. On the other hand, Sweden, as the country where Ikea's headquarter is located, is no

longer the country with the highest negative deviation (thus the lowest price) as it was in Baxter and Landry (2010). Euro zone countries replaced Sweden as the location where Ikea products were the least expensive location during the time period of 2012 and 2013. A possible reason for this change is the euro crisis since the end of 2009. The lower purchasing power (lower demand) and depreciations of the euro with respect to the Kroner with imperfect pass-through could potentially explain the low price of Ikea in euro zone countries.

Table 5 and figure 3 shows the deviations from the LOOP of all countries between September 2012 and July 2013. Switzerland exceeds Canada and becomes the country with the largest positive deviation from the LOOP with a mean value of 27%. Poland, Romania, and Hungary have the largest negative deviations, with the mean values of -20.9%, -19.6%, and -17.8%, respectively. It is consistent with Balassa-Samuelsson's theory because Switzerland and Canada as countries with higher income per capita have significantly higher prices than Poland and Romania as countries with relatively lower income per capita. Many countries lie near the 0 line as LOOP predicts, including Germany, Ireland, France, Finland, Austria, Portugal and Italy with an absolute mean deviation below 5%. This relationship could be well explained by the one currency policy in the euro zone, which was fully studied by Cavallo (2013). He found that the LOOP holds perfectly within the single currency union.

There is no evidence, in both sets of results, that the deviation from the LOOP is smaller for online prices than for catalogue prices. This rejected the hypothesis in the theory section that the internet might reduce the deviation by allowing easier arbitrage and price comparison. A possible explanation for rejecting the hypothesis is that Ikea's products are not able to deliver the benefits of the internet to consumers in international retailing as other kind of products.

Even if the internet provides more arbitrage opportunities and price comparison channels, not many consumers will take advantage of these opportunities when purchasing furniture as their arbitrage costs, such as transportation and transaction costs, are likely to be higher than their own values. The internet, therefore, reduces uncertainty about what relative prices are, but does not directly reduce shipping costs.

B2. Exchange Rate Pass-through

This section uses equation (8) from the theory section to estimate exchange rate pass-through of Ikea online prices:

$$p_{ijt} = \alpha_j + \beta_j p_{iSEt} + \gamma_j e_{jt} + \delta_{ijt}. \quad (8)$$

The coefficient β_j measures the extent to which a good price in country j moves along with prices in Sweden, the baseline country, coefficient γ_j measures the pass-through from the exchange rate between country j and Sweden to the good price in country j, and δ_{ijt} is the error term. Table 6 shows the estimated pass-through of exchange rate and Swedish price and table 7 shows the result in Baxter and Landry (2010) for the catalogue prices. Similar to the findings of Baxter and Landry, all six countries exhibit a significant relationship between their Ikea prices and the price in Sweden with values all close to one. It is evident in both papers that for identical products of Ikea, their prices in other countries follow those in Sweden closely.

The exchange rate pass-through estimated in this paper are significantly lower than that in Baxter and Landry. All five countries have insignificant results with very small pass-through value, all below 30%. Baxter and Landry (2010), in comparison, found three out of five countries having a pass-through over 50%, with the higher of 1.16. None of the result of each

country in this paper is consistent with previous estimates. Although the results are insignificant, the lower values of the US and UK imply that Ikea has less market power in these two countries. If Ikea adjusts its prices to exchange rates at a higher frequency, it is risking losing customers and profit.

Table 8 shows the regression results of all 20 countries. Similarly, none of the results of exchange rate pass-through are insignificant and none of these countries have an exchange rate pass-through over 0.2. It is therefore evident that very low exchange rate pass-through for Ikea's monthly online prices is commonly observed across countries. The opportunity to adjust prices perfectly to exchange rates is therefore not very attractive to retailers even when they are given the ability to do so.

It is evident that exchange rate pass-through is significantly lower for online monthly prices than for annual catalogue prices. Although, compared to catalogues, the internet allows retailers to change prices on a daily base and gives them a much larger space to adjust its prices to the exchange rate, they rarely do so. As exchange rates do not vary much from month to month, it is possible that the cost of raising uncertainty to its consumers exceeds what the retailer could benefit from adjusting prices frequently to the exchange rate. Ikea therefore adjusts its prices to the exchange rate on an annual rather than monthly base. As prices in other countries closely follow prices in Sweden, one could speculate that Ikea sets its online prices in different countries mainly following the "main" price in Sweden and adjusting for transportation costs and local mark up when products were first introduced. Due to the limited scope of this paper, the author will not further test this hypothesis.

B3. Explanations of the deviations from the Law of One Price

This section will explore if local costs such as transportation cost, transaction cost, and local labor and utilities cost are the main contributor to the deviation from the LOOP which was found above. According to the theory section, assuming the difference in the local costs for two similar products in the same country is negligible, if price differences of an identical product across countries mainly reflect differences in local costs in different countries, the ordering of prices between two locations should be the same for similar products. In other words, the relative price of A and B, two similar products, should be similar in among countries.

Table 9 shows the price ratios of five pairs of similar Ikea products in twenty countries. For example, the value at the first column first row is the ratio of the prices of two bookcases of the same color and same size with different space division in January 2013 in Austria. These five pairs of products are picked because each pair of products are almost identical. The products in each pair are in the same category and they are selected based on similar functionality, material, and measurements. They have minor differences with which consumers might not evaluate the products differently financially (for example, the color of the storage box).

Figure 5 is a bubble chart of the price ratios. Five pair of products are numbered 1 to 5 and the value of x indicates which pair of products it is. The ratio is represented on the y-axis. The size of the bubble indicates how many countries have the ratio at this value. For example, the big bubble at x=2 and y=1 indicates that for products pair 2 a majority of these 20 countries has a ratio of 1. It is shown that though some products exhibit a relative similar ratio across countries, such as the drawer chests, four out of five pairs selected for this paper found no simple pattern in the price ratios of similar products across countries. Therefore, the hypothesis

that the difference in local costs is the main cause for the deviations from the LOOP is rejected. Mark-ups thus still play an important role in Ikea's international pricing strategies. As some products pairs have a constant ratio across countries and others do not, it is speculated that certain different features between similar products, such as color and shape, are valued differently by consumers across countries. Different consumer demands for similar products with different features thus lead to different mark-ups even when the products are functionally identical.

The result in this paper aligns with that in Haskel and Wolf (2001). The internet, therefore, does not significantly affect the composition of the deviations from the LOOP based on available data. Mark-up is still a major element in the international pricing strategies of Ikea even though the internet potentially increases competition and reduces mark-up power for the retailer.

VI. Conclusion

This paper reexamines the international pricing behavior of Ikea using its monthly online prices. It studies the deviations from the law of one price and the exchange rate pass-through of Ikea's products in 20 countries between 2012 and 2013. It also compares the results with the previous estimates in Baxter and Landry (2010) and Haskel and Wolf (2001).

There are three main findings: (i) there is no evidence that the internet has reduced the deviations from the law of one price compared to the traditional catalogue prices; (ii) even though the internet makes it possible, Ikea does not adjust its international prices to changes in exchange rates on a monthly basis; (iii) mark-ups still play a key role in the international pricing of Ikea, though to what extent varies across products.

As furniture is not highly tradable and relatively low value compared to its transportation costs, Ikea might not be an ideal candidate for studying the law of one price. A further study may examine other products' international pricing behaviors, such as apparels and electronic devices. The result could help better understand if the internet helps converge international prices.

Table 1: Data Sample

Product id	country	month	year	Category id	VAT	Exchange rate (dollar/one currency)	Price in USD
7	at	7	2013	18868	0.2	1.317095	3.69
7	be	7	2013	18868	0.21	1.317095	3.64
7	ca	7	2013	18868	0	0.968192	4.83
7	ch	7	2013	18868	0.08	1.068869	4.87
7	cz	7	2013	18868	0.2	0.051114	4.05
7	de	7	2013	18868	0.19	1.317095	4.79
7	dk	7	2013	18868	0.25	0.176601	3.84
7	fi	7	2013	18868	0.24	1.317095	4.99
7	fr	7	2013	18868	0.2	1.317095	4.20

Table 2: Summary of Statistics

VARIABLES	**All Countries** Sep.2012- July 2013	**Six Special Countries** Jan.2012 – July 2013
	count	count
Country	21	6
ID	822	139
Category ID	75	28
	value	value
Price in USD		
_max	1426.17	1426.17
_min	0.40	0.39
_mean	30.22	45.88
_sd	70.62	117.09
VAT		
_max	0.27	0.25
_min	0	0
_mean	0.19	0.15
_sd	0.07	0.10
Exchange rate		
_max	1.61	1.61
_min	0.0043	0.14
_mean	0.90	1.05
_sd	0.53	0.45

Table 3: Sample List of Product Categories	
• bookcases	• table lamps
• storage boxes & baskets	• wall shelves & shelf brackets
• plants, plant pots & stands	• stools & benches
• bathroom accessories	• clothes organizers & boxes
• Vases & Bowls	• cabinets & sideboards
• shoe, coat & hat racks	• kitchen islands & carts
• candle holders & candles	• clocks
• fabrics & sewings	• curtains & blinds
• frames & pictures	• laundry & cleaning
• light bulbs & batteries	• TV stands & cabinets
• coffee & side tables	• shelving units & systems
• rugs	

Table 4: Percent deviations from the law of one price		
Country		**All Goods**
Belgium	mean	-14.9%
	sd	1.6%
Canada	mean	18.4%
	sd	1.5%
Italy	mean	-11.7%
	sd	1.8%
Sweden	mean	-6.3%
	sd	1.5%
UK	mean	-2.7%
	sd	1.5%
US	mean	5.7%
	sd	1.5%

Table 5: Percent deviations from the law of one price

Country		All Goods	Country		All Goods
Austria	mean	-2.4%	Italy	mean	-1.1%
	sd	0.5%		sd	0.5%
Belgium	mean	-5.8%	Netherlands	mean	-8.6%
	sd	0.5%		sd	1.0%
Canada	mean	20.5%	Norway	mean	6.5%
	sd	1.6%		sd	1.2%
Switzerland	mean	27.0%	Poland	mean	-20.9%
	sd	0.5%		sd	1.0%
Czech	mean	-13.6%	Portugal	mean	-1.9%
	sd	1.0%		sd	0.6%
Germany	mean	1.2%	Romania	mean	-19.6%
	sd	0.5%		sd	1.8%
Denmark	mean	-7.2%	Sweden	mean	2.5%
	sd	0.5%		sd	1.1%
Finland	mean	-2.8%	Slovakia	mean	-13.8%
	sd	0.5%		sd	0.6%
France	mean	3.2%	UK	mean	5.4%
	sd	1.0%		sd	2.4%
Hungary	mean	-17.8%	U.S.	mean	8.1%
	sd	1.8%		sd	1.0%
Ireland	mean	0.3%			
	sd	0.5%			

Table 6: Pass-through regression

Regression on p(j) on p(se) and exchange rate (five countries)

R-squared 0.9774

Independent Variables	**Canada**	**Belgium**	**Italy**	**UK**	**US**
Swedish price	0.96	0.96	0.96	0.94	0.92
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Exchange rate	0.22	0.19	0.17	0.03	0.02
	(0.39)	(0.90)	(0.16)	(0.44)	(0.45)
constant	-2.58	-1.86	-1.74	-2.14	-1.50
	(0.00)	(0.02)	(0.01)	(0.42)	(0.05)
Observations	13205	13205	13205	13205	13205

Notes: numbers of parenthesis show the p-value of each result

Table 7: Pass-through regression

Regression on p(j) on p(se) and exchange rate, Baxter and Landry (2010)

Independent variables	Canada	Germany	France	UK	US
Swedish price	0.99	0.99	0.99	0.99	0.99
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Exchange rate	0.34	0.80	1.16	0.62	0.10
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
constant	-0.91	-0.31	0.46	-0.83	-1.64
	(0.06)	(0.08)	(0.07)	(0.05)	(0.04)
Observations	8007	12660	12761	12765	7504
R-squared	0.97	0.98	0.98	0.98	0.97

Standard errors in parentheses

Table 8: Pass-through regression

Regression on p(j) on p(se) and exchange rate (20 countries)

Adjusted R-squared = 0.9878

	Austria	**Belgium**	**Canada**	**Switzerland**	**Czech**	**Germany**	**Denmark**
Swedish price	0.98	0.98	0.96	0.96	1.00	0.96	0.97
	(0.00)	(0.07)	(0.00)	(0.00)	(0.14)	(0.00)	(0.00)
Exchange rate	-0.02	-0.02	0.07	0.01	0.00	-0.04	-0.02
	(0.94)	(0.99)	(0.67)	(0.89)	(0.96)	(0.95)	(0.93)
constant	-2.14	-2.17	-1.38	-1.46	2.91	-0.12	-2.00
	(0.00)	(0.07)	(0.02)	(0.02)	(0.00)	(0.00)	(0.04)
observations	9042	9042	9042	9042	9042	9042	9042

	Finland	**France**	**Hungary**	**Ireland**	**Italy**	**Netherlands**	**Norway**
Swedish price	0.96	0.95	0.99	0.97	0.95	1.15	0.97
	(0.00)	(0.00)	(0.24)	(0.00)	(0.00)	(0.00)	(0.14)
Exchange rate	-0.04	-0.04	-0.04	-0.03	-0.12	-0.02	-0.05
	(0.99)	(0.37)	(0.94)	(0.94)	(0.97)	(0.69)	(0.98)
constant	*	-2.49	3.45	-2.05	-2.14	-2.51	0.00
	*	(0.05)	(0.00)	(0.08)	(0.91)	(0.05)	(0.00)
observations	9042	9042	9042	9042	9042	9042	9042

	Poland	**Portugal**	**Romania**	**Slovakia**	**UK**	**US**

Swedish price	0.99	0.98	1.00	1.00	0.98	0.95
	(0.00)	(0.14)	(0.00)	(0.00)	(0.03)	(0.00)
Exchange rate	-0.07	0.00	-0.05	-0.06	0.03	-0.05
	(0.90)	(0.84)	(0.94)	(0.91)	(0.86)	(0.83)
constant	-0.93	-2.14	-0.89	-2.12	-2.14	-2.17
	(0.00)	(0.01)	(0.00)	(0.00)	(0.91)	(0.00)
observations	9042	9042	9042	9042	9042	9042

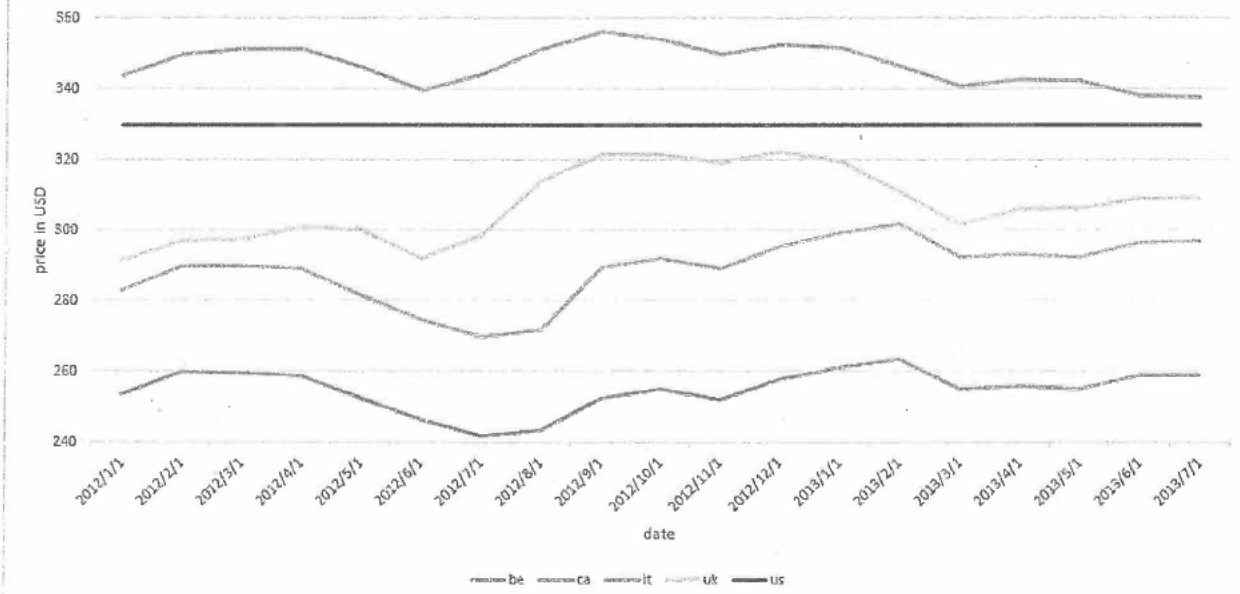
Notes: numbers of parenthesis show the p-value of each result

Table 9: Ratios of similar products under the same category, January 2013

	Bookcase	Drawer Chest	Storage Box	Children's Toys	Mirror
Austria	1.00	1.00	1.15	1.00	1.14
Belgium	0.86	1.00	1.31	1.00	1.14
Canada	0.80	1.00	1.33	1.00	1.00
Switzerland	0.90	1.11	1.59	0.87	1.00
Czech	0.75	1.11	1.00	0.60	1.00
Germany	0.75	1.00	1.23	0.77	1.34
Denmark	0.83	1.00	1.30	1.00	1.20
Finland	1.00	1.00	1.31	1.00	1.00
France	1.00	1.00	1.23	0.91	1.14
Hungary	0.80	1.09	0.89	0.83	1.11
Ireland	0.93	1.00	1.29	0.96	1.56
Italy	0.92	1.00	1.31	1.00	1.06
Netherlands	0.86	1.00	1.31	0.80	1.14
Norway	0.88	1.00	0.76	0.46	1.00
Poland	0.75	1.00	1.17	0.87	1.25
Portugal	1.00	1.00	1.15	1.00	1.29
Romania	0.66	1.14	1.20	1.00	1.27
Slovakia	0.93	1.00	1.00	0.60	1.00
UK	0.85	1.00	1.15	1.00	1.36
US	0.89	1.10	1.31	2.00	0.94

Observations	40	40	40	40	40

Figure 1: Monthly Prices of BILLY
Bookcase (birch veneer) of Five Countries Betwen Jan 2012 and July 2013



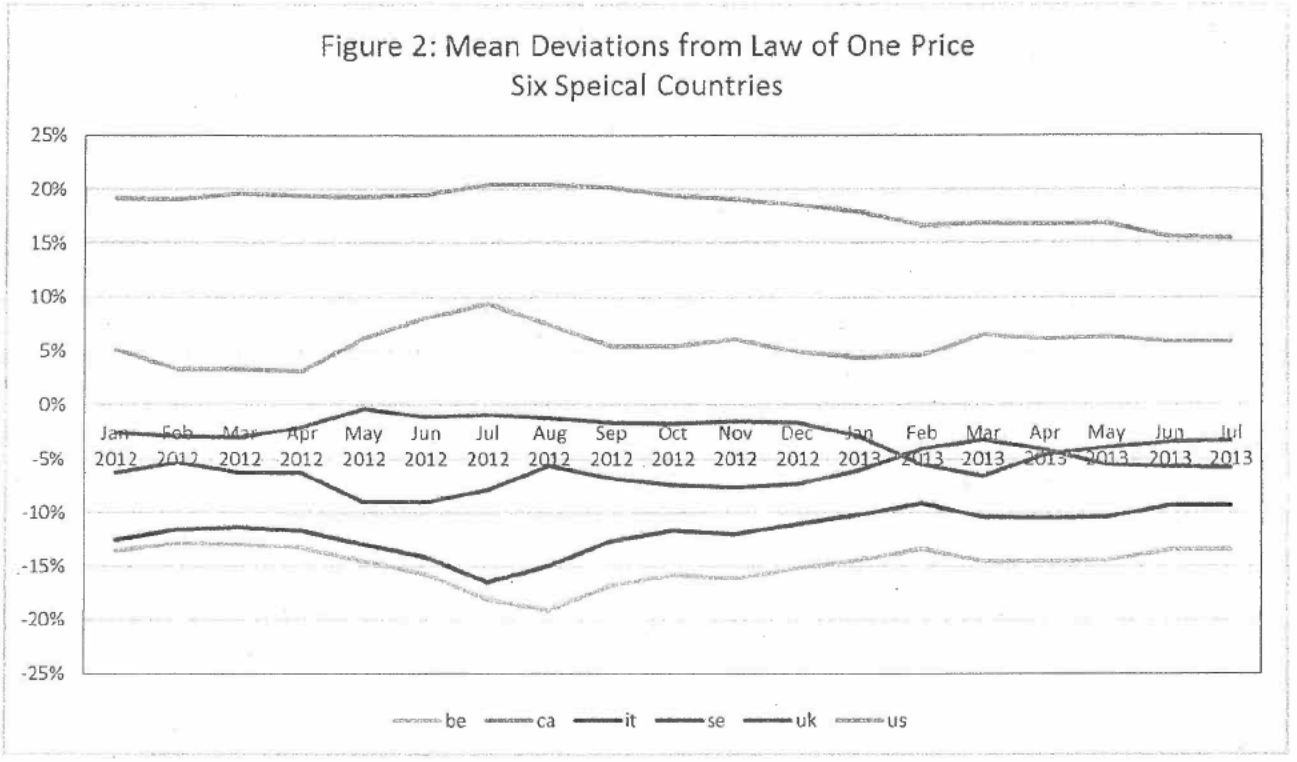


Figure 3: Mean deviation from the LOOP between 1994 and 2010, Baxter and Landry (2010)

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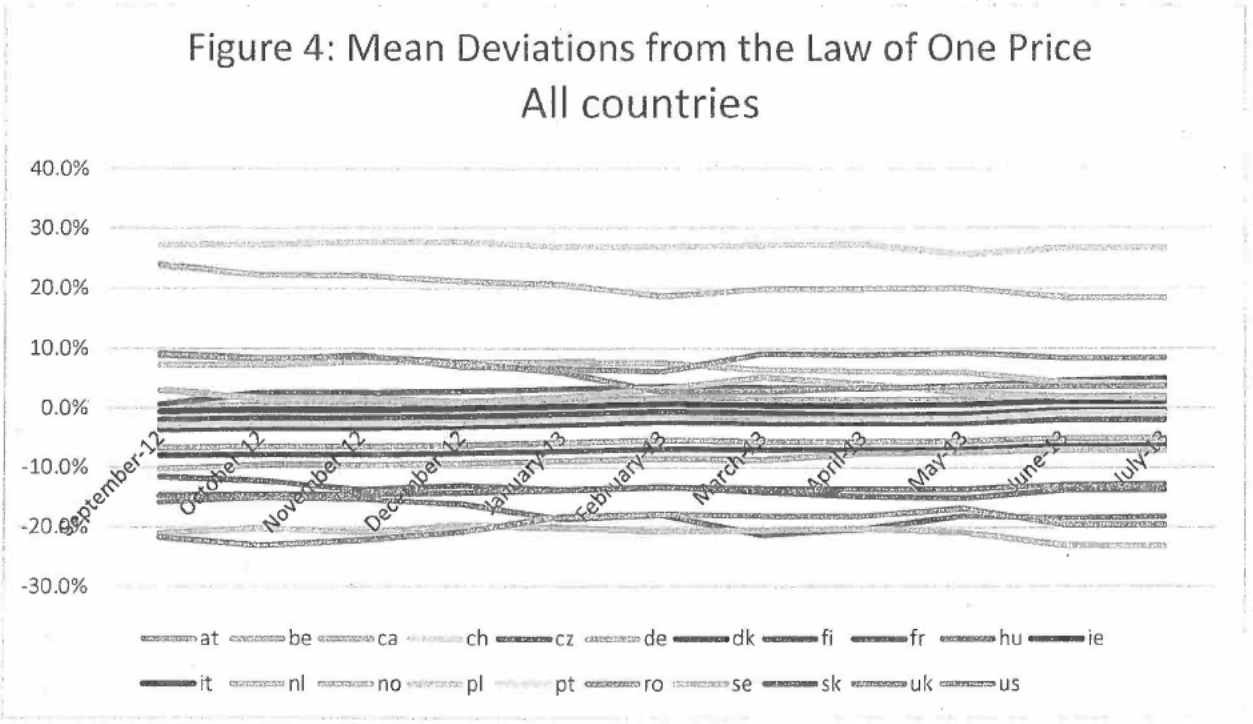
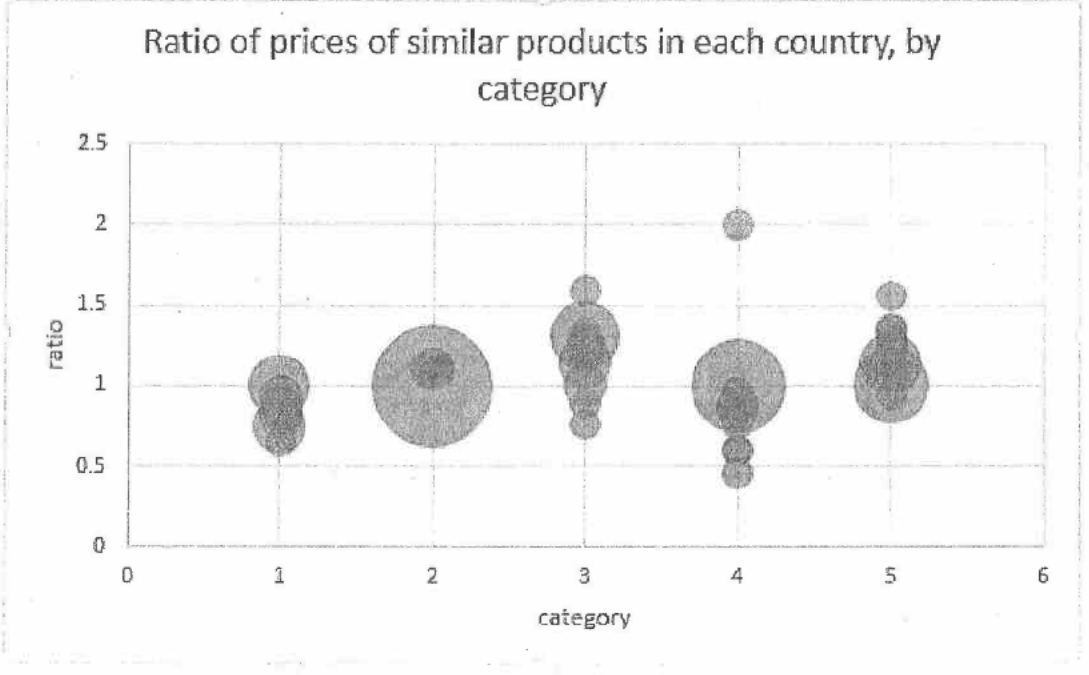


Figure 5: Ratios of similar products under the same category, January 2013



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