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Trade, access to varieties and patterns of consumption

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Abstract

This paper provides empirical evidence that product diversity has driven a part of the evolution of consumers' spending in the U.S. over the 1993-2006's period. The change in number of varieties available has led consumers to allocate a larger share of their budget to sectors subject to greater varieties expansions. I exploit the exogenous change in the range of products available induced by the growth of international trade to identify the causal relation. Using this identification strategy, I show that changes in product diversity had a sizable effect on the evolution of patterns of consumption, especially relative to the price effect.

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1 Introduction

Consumer spending has been a key element of the U.S. economic growth. Its composition has changed over time (McCully (2011). Table 1 shows, for instance, that spending increased in the pharmaceutical, gasoline, recreational sectors between 1988 and 2007 to the detriment of food and motor vehicle.[1] Despite these transformations in the pattern of consumption, little analysis has been done to study the change in its composition in presence of differentiated products. This paper fills the gap by assessing whether those changes in consumer spending have been partly driven by asymmetric shocks in the number of products available to consumers. Over time, the number of products available to consumers have changed in sectors. In sectors that have been subject to larger product expansions, consumers can better match their expenditure to their preferences. One can then expect them to allocate a larger share of their budget to these sectors to the detriment of sectors with a decrease in the products range. Exogenous changes in the range of products available to consumers induced by the growth of international trade is used in order to identify the causal effect of a change in the product diversity on consumption patterns.

The scarcity of disaggregated data as well as the prevalence of the assumption of a constant pattern of consumption in framework modeling differentiated products are likely to explain why this channel of reallocation of resources has never been quantified. New trade theory frameworks that model an economy with differentiated products assume that the changes in income or in the expenditure (due to a taste change) drive the variations in the number of products (Falkinger and Zweimuller (1996), Foellmi, Hepenstrick, and Zweimuller (2010) and Foellmi and Zweimuller (2004)). However, a few papers such as Bils and Klenow (2001) provide evidence of the reverse relation; growth in the number of products available could be a cause of the evolution of the pattern of consumption. This paper aims at studying this second relationship. Given the two potential explanations, such analysis requires to disentangle the effects of supply-side shocks from demand-side ones on the structure of private consumption expenditures.

The growth in international trade is used in this study to circumvent the data limitations as well as to identify an exogenous source of variation in the number of products across sectors. Trade flows have been expanding for many decades and micro-level data have became available for researchers, uncovering new stylized facts. Among those, researchers have observed that the increase in international trade has been accompanied by a rise in the number of imported products.[2] Table 2 shows that in 2006, on average, 20 additional imported varieties were available by sector to American consumers compared to 1993.[3] A large empirical field initiated by Feenstra (1994) and Broda and Weinstein (2006) has

[1] For further information on the changes in the consumption pattern, refer to UNDP (1998) for a worldwide analysis, Konya and Ohashi (2007) for a study on high-income OECD countries and to McCully (2011) for the U.S. case.

[2] I define the concept of "new imported product" as a HS 6-digit good imported from a particular country. A new product is a product that does not have a positive record in a HS 4-digit category previously. The literature uses the word variety instead of product. The two words will be used interchangeably hereafter.

[3] Note that the standard deviation in Table 2 shows that the varieties expansion is heterogeneous across sectors.

subsequently emerged to analyze the impact of globalization on the product diversity (see Debaere and Mostashari (2010),Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008), Kehoe and Ruhl (2013), Feenstra and Weinstein (2017) and Blonigen and Soderbery (2010) for instance). Arkolakis, Costinot, and Rodríguez-Clare (2012) summarizes the state of the art that quantifies the gains from trade. Indeed, these studies quantify the gains from trade without considering their allocation in the economy. Atkin, Faber, and Gonzalez-Navarro (2018) and Fajgelbaum and Khandelwal (2016) go further and analyze the reallocation of these gains across consumers within a country. However, the authors assume that the level of expenditure drives the optimum product diversity.

Moreover, a new strand of literature has explained how the growth in international trade and in the product diversity is, in part, explained by economic reforms and technological shocks. Autor, Dorn, and Hanson (2013) show, for instance, that the growth in low-income country exports during the 90's and the beginning of the 2000's is driven largely by China's transition to a market-oriented economy, by the access for Chinese industries to long banned foreign technologies (Hsieh and Klenow (2009)) and the successive trade reforms. Moreover, Hsieh and Klenow (2009) show that other emerging countries such as India have faced internal productivity growth induced by a better reallocation of inputs across firms, stimulating trade. The growth of trade flows from these countries induced by technological shocks have been in part transmitted through a rise in the number of varieties exported (Colantone and Crinò (2014), Goldberg, Khandelwal, Pavcnik, and Topalova (2010)). Murata (2009) analyzes theoretically how the composition and the degree of diversity are driven by technological feasibility. Hsieh and Ossa (2016) highlight the extensive margin as a new channel through which the productivity shocks can be transmitted. Table 3 shows the ranking of the 30 most important importers to the United States. They are ordered by the number of varieties they export to the U.S.. Emerging economies such as China, Korea or India have risen dramatically in the ranking. Those countries contributed heavily to the increase in available varieties for American consumers. Over the years, China has experienced a growth of 68 % in the varieties it exports to the United States and India has increased the number of exporting varieties by 90 %. Such growth has not been uniform across sectors. Countries export more varieties in sectors where they have a comparative advantage. Therefore, the growth of trade from these countries may explain in part the supply-driven heterogeneous changes in the optimum product diversity available in each sector.

This exogenous source of variety is exploited to identify how the expenditure shares respond to an alteration of the consumer's environment. To guide the empirical analysis, I first present a theoretical framework built on Feenstra (1994) and Broda and Weinstein (2006). Focusing on American trade data over the 1990's and 2000's, I provide evidence of a significant positive correlation between variation in the number of varieties imported and changes in the expenditure share allocated to a particular sector. In particular, a 10 % expansion of variety is associated with an increase in the expenditure share by 12

% in a HS 4-digit sector controlling for the price effect and the income effect. The share of the volume imported rises by 14 %, which then confirms that the changes in the expenditures is not driven either by a fall in price or by measurement errors. To identify the causal effect of the change in the number of varieties on the evolution in the expenditure share, I exploit technological shocks, trade reforms and trade liberalization occurring in emerging economies. These shocks have expanded the number of varieties produced and exported to the destination countries, including the U.S.. This identification strategy speaks in favor of a causal effect of the changes in the number of varieties imported on expenditure shares. This positive relationship proves strongly robust across several alternative specifications.

The paper is organized as follows. The data are described in section 2. A theoretical framework is presented in section 3. Section 4 describes the empirical methodology as well as the identification strategy. Section 5 provides evidence of a positive correlation between changes in the extensive margin and changes in the pattern of consumption and establishes the causal relation. In section 6, the results are assessed through alternative estimations. Finally, section 7 concludes the paper and discusses the implications of the results.

2 Data sources and variables definitions

Data on consumers spending as well as on the range of products available for consumption are scarce. To circumvent their unavailability, I focus the empirical analysis on trade data to analyze the relationship between expenditure shares and the number of varieties. Trade data are available at a disaggregated level and they can be compared across countries. I use this characteristics to identify exogenous sources of the expansion of varieties.

2.1 Trade data

The data on trade come from the UN Comtrade Statistics Database and from the United States International Trade Commission (USITC hereafter). These databases report the trade value as well as the quantity imported at the 6-digit level in the UN Comtrade Statistics database and at the 10-digit level in the USITC in the Harmonized System (HS hereafter) classification. The HS scheme is an internationally standardized system which theoretically covers all commodities in international trade since 1988. Whereas this classification greatly facilitates the comparison of countries in terms of flows of commodities, the recurrent classification changes lead to potential measurement errors. To minimize them, I first focus on commodities expressed in kilos in the HS classification to make products as comparable as possible. Those commodities represent 68.4 % of the whole dataset. Second, I organize the sample in order to make different years truly comparable. The HS nomenclature is amended every four to six years.

The purpose of these amendments is to bring the HS nomenclature in line with the current international trade patterns, technological progresses and customs practices. In 1996 and in 2002, *structural changes* were implemented. Those changes preclude a comparison of commodities over time since one code might not represent the same product from one year to another year. I disregard the commodities that have been redefined or reclassified at the level of aggregation of the analysis, the HS 4-digit level.[4] The sample starts in 1993 to prevent the dissolution of the Soviet Union to affect the results. This historical event has artificially led an increase in the number of countries. This event would affect the computation of the number of varieties. In general, the imports have been removed from countries that have been divided, reunified after 1991 or reclassified in the database. The sample ends in 2006 before the onset of the Great recession that has severely affected international trade.

2.2 Unit value

The price is proxied by the unit value (computed from the Cost Insurance Freight- cif hereafter - trade value). To alleviate the measurement errors in the unit value, I work at the HS 4 digit level. The HS 4-digit unit value is aggregated by taking the average across HS 6-digit products for each country and then take the average unit value over the countries within each HS 4-digit sector. A country is then not counted twice and each average unit value incorporates the information of the intensive margin imported by this particular country. The formalization of this definition is the following:

$$p_{ct}^{HS6} = \frac{1}{I}\sum_{i \in I} p_{ict} \quad \text{and} \quad p_{t}^{HS4} = \frac{1}{C}\sum_{c \in C} p_{HS6ct} \tag{1}$$

where p_{ct}^{HS6} is the average price of HS 6-digit goods for each importer c at time t. $i \in$ I is a particular HS 6-digit good. p_{t}^{HS4} is the average price of HS 6-digit goods across countries for a particular HS 4 sector.

2.3 Number of varieties

I define a new variety as a HS 6-digit product exporter in a HS 4-digit sector that was not recorded before. In other words, a new product can come from a country that already imports other HS 6-digit products in a particular HS 4-digit sector. An exporter can then be counted more than once within a HS 4-digit sector. The formalization of this definition is the following:

$$n_{HS4t} = \sum_{c \in C}\sum_{i \in I} product_{cit}$$

where c is a particular country and i a particular HS 6 product.

[4] Those modifications consist in merging, splitting categories or both at the same time (called complex changes).

The final database includes 562 HS 4-digit sectors and 196 economic entities over the 1993-2006 period. Table 2 reports descriptive statistics on the sample and the variables used for the analysis.

3 Theoretical Framework

In this section, I derive the expression for the changes in the sectoral expenditure share in response to changes in the number of varieties available for consumers in the sector, controlling for price effect. I follow the methodology set up by Feenstra (1994) and Broda and Weinstein (2006) and use a CES framework to derive the relation between the expenditure share and the number of varieties. A recent strand in the literature in international trade assumes an Almost Ideal Demand System (AIDS defined by Deaton and Muellbauer (1980)) to study the impact of income changes on expenditure shares (Hummels and Lee (2018)) or on inequality through the expenditure channel (Fajgelbaum and Khandelwal (2016), Liu and Meissner (2017)). The AIDS expenditure function has the property to allow for both, flexibility in cross price elasticities between goods and non-homothetic preferences. Moreover, it generates a demand system in which unobserved demand characteristics are additively separable from the price and income effects. Despite these useful characteristics, Chaudhuri, Goldberg, and Jia (2006) show that the implementation of this demand system is difficult in presence of a varying number of products because this demand system was developed with broad commodity categories in mind, which are consumed by all consumers every period. Moreover, assuming homothetic preferences on the period analyzed in this study seems reasonable. Indeed, the lower level part in Table 2 shows that during the period analyzed in the study, there was, on average, no reallocation of expenditure at the aggregate level.

In a CES framework, the price index defines a relationship between the change in the product diversity and the variation in the expenditure share for each aggregate CES good controlling for the price. Broda and Weinstein (2006) develop an aggregate exact price index for CES aggregate goods that allows to account for new varieties. The components of an aggregate price index can be explained from a description of the utility function. In this particular analysis, the preferences of a representative consumer are described by a fourth level utility function. The upper-level utility function is specified as the following :

$$U_t^{\kappa} = \left(D_t^{(\kappa-1)/\kappa} + M_t^{(\kappa-1)/\kappa} \right)^{\kappa/(\kappa-1)}; \qquad \kappa > 1 \tag{2}$$

where M_t is the composite imported good at time t which is defined below, D_t is the domestic good, and κ is the elasticity of substitution between domestic goods and imports. This functional form creates a separability between imported and domestic goods that allows to distinguish the import price index from the domestic one. The import price index is the one of interest since the empirical exercise only

focuses on imported goods. As described in the section 2, in this analysis, the relationship between the expenditure share and the number of varieties is inferred from the one between the reallocation of expenditure across imports and the growth of imported varieties due to the scarcity of data on the number of varieties available to consumers.

For sake of clarity, hereafter, I only describe the demand function for an import good. The composite imported good is defined as :

$$M_t = \left(\sum_{j \in J} M_{jt}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} ; \qquad \rho > 1 \tag{3}$$

where M_{jt} is the subutility derived from the consumption of the imported broad category j at time t, ρ denotes the elasticity of substitution among imported goods, and J, the set of broad categories that are imported by the economy.[5] This level of utility is needed because it enables to control for potential time-invariant shocks in the empirical analysis. M_{jt} is defined as the following:

$$M_{jt} = \left(\sum_{g \in G} \theta_g^{\frac{1}{\gamma}} M_{jgt}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}} ; \qquad \gamma > 1 \forall j \in J \tag{4}$$

where M_{jgt} is the subutility derived from the consumption of the imported good g at time t, γ denotes the elasticity of substitution among imported goods, and G is the set of all imported goods in a broad category j. θ_g is a taste parameter. Notice that θ_g is assumed constant over time since the objective of this paper is to quantify how the expansion of varieties reveals better given preferences.[6]

M_{jgt} is defined by a nonsymmetric CES function represented by :

$$M_{jgt} = \left(\sum_{c \in C_{jgt}} \varphi_c^{\frac{1}{\sigma_g}} M_{jgct}^{\frac{\sigma_g-1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g-1}} . \qquad \sigma_g > 1 \forall g \in G \tag{5}$$

where σ_g is the elasticity of substitution between varieties within a particular sector g. As defined in the previous section, a variety c of imported good g is defined by a good imported by a country of origin (or an exporting country) of this good. C_{jgt} is the set of all product-countries exporting goods in sector g at time t. φ_c is a taste parameter.

For a given expenditure on imported category E_{jt}, the expenditure share in sector g is defined as :

$$s_{jgt}(C_{jgt}) = \frac{P_{jgt}^M M_{jgt}}{E_{jt}} = \frac{\theta_g (P_{jgt}^M)^{1-\gamma}}{\sum_{i \in G} \theta_i (P_{jit}^M)^{1-\gamma}}; \tag{6}$$

where P_{jgt}^M, the exact price index for good g, is defined as :

[5] In the empirical analysis, j corresponds to a HS 2-digit category such as all footwear imported in the U.S.

[6] The empirical analysis covers 13 years, therefore assuming constant preference over such a period seems reasonable.

$$P_{jgt}^{M} = \sum_{c \in C_{jgt}} \varphi_c (p_{jgct})^{1-\sigma_g}. \tag{7}$$

The change in the expenditure share is defined by taking the ratio of eq. (6) between two periods, $t-1$ and t:

$$\frac{s_{jgt}}{s_{jgt-1}} = (\pi_{jg,t-1,t}^{F})^{1-\gamma} (\pi_{t-1,t}^{B\&W})^{\gamma-1}; \tag{8}$$

where

$$\pi_{jg,t-1,t}^{F} = \left[\frac{P_{jgt}^{M}}{P_{jgt-1}^{M}} \right]^{1-\gamma} \quad \text{and} \quad \pi_{j,t-1,t}^{B\&W} = \left[\frac{\sum_{i \in G} \theta_i (P_{jit}^{M})^{1-\gamma}}{\sum_{i \in G} \theta_i (P_{jit-1}^{M})^{1-\gamma}} \right]^{-1}. \tag{9}$$

$\pi_{jg,t-1,t}^{F}$ denotes the growth in the aggregate price index for import of the single good, M_{jgt}, and $\pi_{j,t-1,t}^{B\&W}$ characterizes the ratio of the aggregate price index.[7] Feenstra (1994) and Broda and Weinstein (2006) show that the assumptions of monopolistic competition and CES utility function enable to disentangle the "variety" effect from the price effect. I proceed in three steps to define these price index. For sake of clarity, I focus on a particular category j.[8] I first define the standard price index which only captures the price changes. I then describe its generalization made by Feenstra (1994) that also includes a "variety" effect. Last, I describe the aggregation of Feenstra (1994)'s price index made by Broda and Weinstein (2006).

The index theory, from which are derived price index, drew up on Diewert (1976)'s dual theory. This theory defines the representative consumer's problem in terms of the cost required to reach a certain level of satisfaction. Following Diewert (1976), it is more convenient and more intuitive to work with the unit cost function dual to the utility function defined in eq. (5) :

$$c_{gt}(C_{gt}) = \left(\sum_{c \in C_{gt}} p_{gct}^{1-\sigma_g} \right)^{\frac{1}{1-\sigma_g}}. \tag{10}$$

Sato (1976) and Vartia (1976) derive the exact price index in sector g for the set of varieties consumed in both periods t and t-1, C (defined as $C_{t-1} \cap C_t$) and the vector of demand function, $\vec{m}_{gt-1}$ and $\vec{m}_{gt}$ in the case of the CES unit-cost function :

$$\frac{c_{gt}(C)}{c_{gt-1}(C)} = P_{SVg,t-1,t}(\vec{p}_{gt-1}, \vec{p}_{gt}, \vec{m}_{gt-1}, \vec{m}_{gt}) = \prod_{i \in C} \left(\frac{p_{gct}}{p_{gct-1}} \right)^{w_{g,c,t-1,t}(C)}; \tag{11}$$

where

$$w_{g,c,t-1,t}(C) \equiv \frac{\frac{s_{gct} - s_{gct-1}}{ln(s_{gct}) - ln(s_{gct-1})}}{\sum_{c \in C} \frac{s_{gct} - s_{gct-1}}{ln(s_{gct}) - ln(s_{gct-1})}} \quad \text{with} \quad s_{gct} = \frac{p_{gct} m_{gct}}{\sum_{c \in C} p_{gct} m_{gct}}. \tag{12}$$

[7] I remind that a good is characterized by a price index because each good has several varieties.
[8] It enables to drop the index j to simplify the explanation.

This price index corresponds to the geometric mean of the individual variety price changes where the weights are computed using cost shares in the two periods. The limitation of this expression is that it is only defined for the set of varieties available in both periods $t-1$ and t. In other words, any variety exiting or entering in the market will not be taken into account. Feenstra (1994) shows that the assumption of common varieties in both period can be relaxed if one assumes a constant elasticity of substitution for each varieties. To do so, Feenstra (1994) allows for at least one price within the price index formula described in eq. (11) to approach infinity for some periods while the demand for this variety is positive (that can be interpreted as the unavailability of those varieties in that particular period). Therefore, the set of goods includes varieties that do not necessarily exist in both period $t-1$ and t. Feenstra (1994) shows that even under those assumptions the price index get a reasonable limiting value. Feenstra (1994)'s price index, $\pi^{F}_{g,t-1,t}(C_{gt})$ is defined as the following (as long as there is some overlap in the varieties available between the two periods ($C \neq \varnothing$)) :

$$\pi^{F}_{g,t-1,t}(C_g t) = \frac{c(p_{gct}, C_{gt})}{c(p_{gct-1}, C_{gt-1},)} = P_{SV}(\vec{p_{gt-1}}, \vec{p_{gt}}, \vec{m_{gt-1}}, \vec{m_{gt}}) \left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g - 1}}; \tag{13}$$

where λ_{gt-1} and λ_{gt} are defined as the following :

$$\lambda_{gt} = \frac{\sum_{c \in C} p_{gct} m_{gct}}{\sum_{c \in C_{gt}} p_{gct} m_{gct}}. \tag{14}$$

Feenstra's price index with variety changes equals the conventional exact price index multiplied by an additional term, $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g - 1}}$, which captures the role of new and disappearing varieties. $\lambda_{gt} \leq 1$ can be interpreted as the period t expenditure on varieties in the common set C relative to the period t total expenditure. Therefore, $1 - \lambda_{gt}$ can be interpreted as the period t expenditure on new varieties relative to the period t total expenditure. Higher the expenditure share of new varieties in period t, the lower is λ_{gt} and the smaller is the exact price index relative to the conventional price index defined in eq. (11). Notice that Feenstra (1994)'s price index depends on the elasticity of substitution, σ_g. More varieties available lower the cost of reaching a certain level of satisfaction and the magnitude of the decrease in cost depends on how similar is the new variety to the one already consumed. The price index built by Feenstra (1994) enables to disentangle the "variety" effect from the price effect.

However, Feenstra (1994)'s price index is limited to an intra-sectoral analysis and assumes a fixed expenditure share for each sector. Broda and Weinstein (2006) aggregate Feenstra's price index, $\pi^{BW}_{t-1,t}$, to the sector level by taking its geometric mean weighted by the logarithmic mean of the expenditure share allocated across sectors for some overlap in the varieties available between the two periods ($C \neq \varnothing$) and a constant parameter θ_g :

$$\pi_{t-1,t}^{B\&W} = \prod_{g \in G} \left(P_{SV}(p_{g\vec{t-1}}, p_{\vec{gt}}, m_{g\vec{t-1}}, m_{\vec{gt}})\right)^{w_{g,t-1,t}} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{w_{g,t-1,t}}{\sigma_g - 1}} ; \tag{15}$$

where $w_{g,t-1,t}(C) \equiv \frac{s_{gt} - s_{gt-1}/ln(s_{gt}) - ln(s_{gt-1})}{\sum_{i \in G} s_{gt} - s_{gt-1}/ln(s_{gt}) - ln(s_{gt-1})}$. The definitions of both indexes $\pi_{g,t-1,t}^{F}(C_{gt})$ and $\pi_{t-1,t}^{B\&W}$ help to understand how eq. (8) provides a relationship between the extensive margin and the expenditure share devoted to a particular sector g. Other things unchanged, an expansion of the number of varieties available to consumers in a particular sector improves the consumer's ability to match her expenditure to her preferences and then, consequently, decreases her cost of reaching a certain level of satisfaction. It decreases the price index $\pi_{g,t-1,t}^{F}(C_g)$ and increases the expenditure in sector g by an amount that depends on the elasticity of substitution between sectors and decreases the expenditure shares in other sectors.

A decomposition of Feenstra's price index between a price effect and the "variety" effect and a log-linearization of eq. (8) enable to rewrite the changes in import demand in a particular sector g as the following :

$$\begin{aligned} log\left(\frac{s_{jgt}}{s_{jgt-1}}\right) &= (\gamma - 1) log(\pi_{t-1,t}^{B\&W}) + (1 - \gamma) log\left(P_{SV}(\vec{p}_{jgt-1}, \vec{p}_{jgt}, \vec{m}_{jgt-1}, \vec{m}_{jgt})\right) \\ &\quad + \frac{1 - \gamma}{\sigma_g - 1} log\Big(\frac{\lambda_{jgt}}{\lambda_{jgt-1}}\Big). \end{aligned} \tag{16}$$

In a standard monopolistic competition model, all varieties will be equally priced at p_{gct} and consumed in the same quantity. Therefore, the "variety component" becomes the ratio between the number of varieties of good g consumed in periods t and $t-1$ and for a particular category j, eq. (16) can be rewritten as :

$$\begin{aligned} ln\left(\frac{s_{jgt}}{s_{jgt-1}}\right) &= (\gamma - 1) ln(\pi_{t-1,t}^{B\&W}) + (1 - \gamma) ln\left(P_{SV}(\vec{p}_{jgt-1}, \vec{p}_{jgt}, \vec{m}_{jgt-1}, \vec{m}_{jgt})\right) \\ &\quad + \frac{(1 - \gamma)}{\sigma_g - 1} ln\Big(\frac{n_{jgt}(C_{jgt})}{n_{jgt-1}(C_{jgt-1})}\Big). \end{aligned} \tag{17}$$

Eq. (17) describes how expenditure shares change between periods t and $t-1$ in a particular sector g in response to a variation in the number of varieties available in sector g and in prices. A positive correlation is expected between a change in the number of varieties and the evolution of the expenditure shares given that more varieties in a sector decreases the cost to reach a certain level of satisfaction for the consumer. Consequently, one can then expect that the representative consumer will allocate more resources in sectors with more varieties for a particular price.

4 Empirical Analysis

4.1 Baseline specification

The empirical strategy is described in this section. I aim to estimate eq. (17) in order to analyze how the expenditure shares respond to a change in the number of varieties. The empirical work focuses on U.S. import trade observations due to the absence of dataset including the total number of varieties available to consumers. First differences between 1993 and 2006 is taken instead of annual changes. Table 7 in Appendix A shows that the short-run changes in the U.S. imports are largely accounted for by the intensive margin while the long-run decomposition highlights a large growth of the extensive margin (29 %). The short timeline (1993-2006) also does not provide the opportunity to take the first difference annually as Trefler (2004) describes. Moreover, the first difference enables to eliminate any time-invariant preferences shocks, θ_g, other than the one induced by the relative change in the number of varieties. Eq. (17) is augmented by a fixed effect, D_j, in order to capture time invariant income shocks at a level of a broader category j than g. The model assumes homothetic preferences. An assumption that seems reasonable for the time span analyzed (see Table 2). However, demand shocks are unobserved and an income effect in presence of non-homothetic preferences could lead to a change in the reallocation of income across goods. In our framework, this change would be captured in the error term which might be correlated with the independent variables leading to a spurious relationship between the change in the number of varieties and the one in the expenditure share. Eq. (17) is also augmented by the initial value of imports in sector g, $\ln(x_{jg,1993})$ in order to capture the importance of the initial size of sector g at time t and so the relative preference of this sector.

Considering all sectors j, the following equation is then estimated:

$$ln(\frac{s_{jg2006}}{s_{jg1993}}) = \beta_0 + \beta_1 ln(\frac{n_{jg2006}}{n_{jg1993}}) + \beta_2 ln(\frac{p_{jg2006}}{p_{jg1993}}) + ln(x_{jg1993}) + D_j + \epsilon_{jgt} \tag{18}$$

where g represents the sector, s_{jgt} measures either the share of imports expressed in U.S. dollars of product g in year t or the share of the volume (in kilos) imported of this product. The quantity is also analyzed because the unit value is computed from the trade data.The quantity is not affected by potential measurement errors that may alter the relationship between the change in price and the one in the expenditure. The constant, β_0, captures the aggregate price index, $\pi^{B\&W}$ since it affects every expenditure share in an identical way. n_{jgt} is the total number of variety imported in a particular sector g at time t. p_{jgt} represents the unit value of the import at sector g at time t. The coefficient of interest, β_1, captures the elasticity of the expenditure share with respect to the extensive margin.

4.2 Identification Strategy

This section describes the identification strategy used to treat the potential endogeneity issues that may impede the econometric analysis of eq. (18). The empirical setting described in the previous section may, first, suffer from reverse causality. Eq. (18) aims at studying whether the variety growth could be the cause of the evolution in the pattern of consumption as suggested by Bils and Klenow (2001). However, the traditional literature in new trade theory assumes the reverse relationship, that changes in the expenditure drive the variations in the number of varieties. Second, the estimates β_1 and β_2 from eq. (18) may be biased by unobserved time-variant demand shocks that are captured by ϵ_{jgt} and that are also correlated with the changes in the number of varieties and the price changes. These endogeneity issues are controlled by instrumental variables. At least two instruments are required to identify variations in the changes in prices and in the changes in the number of varieties that are exogenous to U.S. demand shocks.

The price changes are instrumented by the changes in variety-specific unit transportation cost for the U.S. as in Khandelwal (2010).[9] The instrument varies across countries, industries and years which makes it possible to use with long-difference.

The change in the number of varieties is instrumented following the strategy in Autor et al. (2013) and Colantone and Crinò (2014). I instrument the change in the number of varieties imported in the U.S. in a particular sector, g, by the average change in the extensive margin imported by eighteen high-income economies other than the U.S. and Canada, from middle-income countries in that sector.[10] Formally, I construct the following variable:

$$\overline{n_{jgt}^{inst}} = \frac{1}{H} \sum_{h \in H} n_{jght}^{\text{emerging}}$$

where H is the group of 18 high-income countries and $n_{jght}^{\text{emerging}}$, the number of varieties imported by country $h \in H$ in sector g at time t from middle-income countries.[11] The underlying assumption behind this strategy is that the growth in the number of varieties exported by middle-income countries captures, in part, the productivity gains and institutional reforms occurring in these countries. Autor et al. (2013) show that the growth in low-income country exports during the 90's and the beginning of the 2000's is driven largely by China's transition to a market-oriented economy, by the access for

[9] Those data are sourced from Feenstra, Romalis, and Schott (2002).

[10] These countries are the ones that have comparable trade data covering the sample period and exclude Canada due to the similarities this country shares with the U.S.. These countries are New Zealand, Australia, Greece, Austria, Norway, Portugal, Hungary, Iceland, Ireland, Japan, Korea, Spain, Sweden, Switzerland, Finland, Netherlands, Denmark and the United Kingdom. They are selected based on the World Bank classification of high economies.

[11] The selection of middle-income countries are based on the income classification of countries by the World Bank in 2006. I include countries classified as lower-middle and upper-middle income countries.

Chinese industries to long banned foreign technologies (Hsieh and Klenow (2009)). Successive trade reforms which have increased linkages with other countries and have decreased trade costs as well have also increased exports. Hsieh and Klenow (2009) show that other emerging countries such as India have faced internal productivity growth induced by a better reallocation of inputs across firms, stimulating trade. The growth of those trade flows in middle-income countries does not only reflect the growth of the intensive margin but also the growth in the extensive margin as highlighted in Table 3.[12]

The change in the extensive margin from these countries must capture a part of these economic and institutional reforms in these countries but it can also be driven by a change in the U.S. demand towards the products exported by these countries. To exclude this potential correlation, I use the global nature of the growth of exports from middle-income countries (as di Giovanni, Levchenko, and Zhang (2014) underline with the Chinese exports for instance), and only consider the evolution of the extensive margin imported in other high-income countries than the U.S.. Moreover, I take the *average* of the number of varieties imported by these eighteen countries in order to alleviate the potential correlation of demand shocks between those countries. Figure 1 shows the evolution of the share of American imports and of this "average high-income economy". One can observe the clear positive trend for the U.S. which is absent for the average economy used as instrument.

Additional patterns are assessed to guarantee the exogeneity of the instrument. A potential correlation could have come from a conversion of a part of the U.S. growth in the 90's into an increase in the U.S. imports from all countries including high-income economies. Then, those economies may have allocated the incremental income induced by these additional exports towards the U.S. into the purchase of new varieties. In that case, the changes in the number of varieties imported by these high-income economies should have been correlated with the American income increase (and potentially any change in expenditure shares if the preferences are non-homothetic). Such potential correlation should be treated by the time effect (captured by the first difference) if all sectors were affected in the same way and by the sector fixed effect, D_j, otherwise. Moreover, Table 4 shows an absence of correlation between growth of exports in the U.S. in the 90's (which proxies the U.S. economic growth) and the average number of varieties imported by the high-income countries selected to build the instrument. Another issue could have been the correlation between the U.S. economic growth and the expansion of exports in emerging economies. Indeed, the economic growth in the U.S. could have boosted the exports to China and been the source of a technological shock in emerging economies such as China (Goldberg et al. (2010),Colantone and Crinò (2014)). For this particular case, we know that the U.S. is not an important exporter to China. Almost 60% of the Chinese imports comes from other Asian countries (Ghosh and

[12] Those results are in line with the observations made by Feenstra (1994), Broda and Weinstein (2006) and Debaere and Mostashari (2010).

Rao (2010)). Additional testing have been done (see section 6) to guarantee that unobserved demand shocks in the U.S. are not correlated with the instrument variables of the changes in the number of varieties in a particular sector.

5 Results

Table 5 shows the results for the estimation of eq. (18). The empirical setting enables to disentangle the "variety effect" from the price and income effects (captured by the fixed effect D_j) on the expenditure share in a particular HS 4-digit sector. The errors are clustered at the sector level to account for serial correlation across sectors and to adjust for potential heteroscedasticity.

The first two columns in Table 5 report OLS estimators. Column (1) reports the results for the analysis of the impact of the extensive margin and the price on the trade value whereas Column (2) estimates the quantity expressed in kilos. The first two columns show a positive correlation between the change in the number of varieties and the change in the expenditure share. A given growth in the number of varieties by 10 % in sector g is associated with a growth in the expenditure share by 12.5 %. The prices' coefficient is not significant when the expenditure share is analyzed. This result can be explained by the fact that the unit value is computed from trade values and by the level of aggregation. At the HS 4-digit level, the unit value is quite noisy. However, there is negative and significant impact of the price when the dependent variable is the quantity and potentially less affected by measurement errors. Finally, one can observe the negative and significant impact of the initial market size on the expenditure. Sectors that were small in 1993 experience larger effects through the extensive margin. Those results indicate that there is a positive correlation between the change in the extensive margin and the expenditure share. Moreover, the impact of the extensive margin is larger than that of the price (and then the intensive margin effect).

Columns (3) and (4) in Table 5 estimate eq. (18) by Two-Stage Least Squares (2SLS). Figure 2 reveals the high predictive power of the instruments. Kleibergen-Paap Wald F statistic is above the critical value compiled by Stock and Yogo (2005), rejecting the assumption of weak instrument. Column (4) shows that the quality of instrument is weaker when the quantity is assessed. An endogeneity test is also run in order to control for the exogeneity of the instruments. The null hypothesis that the specified endogenous regressors can actually be treated as exogenous is not rejected.[13] The results reported in Columns (3) and (4) confirm the positive and significant impact of the product diversity on the expenditure share. However, the results found for the extensive margin are unexpected. Indeed, the coefficient is higher

[13] Under conditional homoskedasticity, this endogeneity test statistic is numerically equal to a Hausman test statistic (Hayashi (2000)).

than the one derived with an OLS estimation. It means that the demand shock downward biases the effect. In other words, the sectors analyzed were affected by a negative demand sectoral taste shock that has changed over time.

Different explanations can clarify the above results. First, I proxy the changes in the pattern of consumption with the changes in the pattern of expenditure in the import sector. Such a method limits the ability to observe changes in taste towards domestic goods. Those sectors may have been subject to a reallocation of expenditure from imported varieties to domestic varieties within each sector. Another explanation could be a reallocation of the expenditure from manufacturing sectors to services/non-tradable sectors. Between 1988 and 2007, the expenditure share in the service sector has grown by 6 % to the detriment of manufacturing sectors. However, its growth has been driven by the one of the price (+3.5 %) while the manufacturing sector has been subject to a growth of consumption in terms of quantity (+3.3 %). Therefore, the sectors considered for this analysis (manufacturing and goods expressed in kilos) may have been subject to negative demand shocks and reallocations of their expenditure towards services such as medical care. Such an explanation would explain why the value of the estimates by OLS of the extensive margin are lower than the one derived by 2SLS.

The 2SLS estimation is necessary, and when the analysis is purged from demand variations, the conclusions still hold. The results reported in Columns (3) and (4) in Table 5 speak in favor of a causal effect of the changes in the number of varieties on the evolution of the U.S. pattern of consumption. Consumers have drawn resources away from sectors subject to a small variety expansion towards sectors expanding in their number of products.

6 Sensitivity Analysis

Table 6 describes the results of analysis assessing the robustness of the positive relation between the number of varieties and the expenditure shares found in the previous section. In the first six columns, I follow Autor et al. (2013) and regress eq. (18) on sub-samples that exclude sectors in which demand shocks are likely to be correlated. In Columns (1) and (2), eq. (18) is estimated on a sub-sample that excludes the sectors of steel, glass, and cement industries (which may have been subject to a positive demand shock due to the housing boom) whereas in Columns (3) and (4), apparel, footwear, and textiles are excluded.[14] Columns (5) and (6) report the results when all of those sectors are dropped out. The null hypothesis that the specified endogenous regressors can actually be treated as exogenous is not rejected. However, the instruments are identified as weak in Column (2) and Column (6) when the quantity is assessed instead of the expenditure. Beside the results in these two columns that must be

[14] Computers are also considered as problematic. However, those sectors were already dropped because they have been modified by structural changes by the Harmonized System Committee.

interpreted with caution, dropping sectors that may have been subject to unobserved demand shocks over that period does not affect the main results that the extensive margin has a strong positive effect on the expenditure share.

In the last two columns in Table 6, I trim the distribution of each variable by disregarding observations for which the trade values and quantities belongs to the 5th and the 95th percentiles. The results are only slightly larger suggesting that this positive relationship is not driven by outliers.

7 Conclusion

Consumer spending has been a key element of the U.S. economic growth. Its composition has changed over time but little analysis has been done to study its causes in presence of differentiated products. This analysis aims to study whether the changes in the product diversity has driven the evolution in the U.S. expenditure share relative to the price effect and the income effect. The expansion of variety provides the opportunity to consumers to better match their taste to their consumption. Therefore, if the variety expansion is asymmetric across sectors, one can expect the consumers to allocate more resources in sectors subject to relatively larger variety growth. In this study, I exploit the exogenous change in the range of products available to consumers induced by the growth of exports in low and middle-income countries in order to identify a causal relationship. The development of emerging countries and incremental trade liberalization are examples of factors that increase the number of varieties available in a particular economy in an asymmetric way. Using public database and after capturing the potential identification issues, I show the significant and positive effect of the changes in the extensive margin on the changes in the expenditure share. This empirical analysis also shows that the product diversity effect is stronger than the price effect. A variety expansion by 1 % increases the expenditure share of this sector by 2.3 % controlling for the price effect, the invariant sectoral shocks, initial size of the market as well as potential income effect. The identification strategy enables to highlight two additional relevant results. First, it shows that goods sectors exposed to trade has been subjected to negative demand shocks in the 90's and 2000's. This reallocation of expenditure from goods sectors towards services sectors seems to have been driven by the fast growth in price in the medical care sector. Second, the identification strategy enables to highlight a new channel through which economic reforms and technological shocks in a country can affect its trading partners. Finally, I note that this analysis infers the reallocation of expenditure across sectors using import data. An analysis covering all final products would be preferable. However, the concordance between the classification of production data and imports one does not exist yet for the U.S. A recent work by Feenstra, Luck, Obstfeld, and Russ (2018) have matched these two datasets for 191 goods which is not enough for the present analysis. Working on the concordance of

classifications between import products and production one remains a fruitful avenue for future research.

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Table 1: Changes in the pattern of expenditure of non-durable goods in the U.S. between 1988 and 2007

Category	**1988**	**2007**	**Change in share**
Expenditure share of non-durable goods	**35.5**	**35.3**	**-0.2**
Motor vehicles and parts	15.1	11.9	-3.2
New motor vehicles	10.3	6.9	-3.4
Net purchases of used motor vehicles	2.8	3.5	0.7
Furnishings and durable household equipment	8.6	8.1	-0.5
Furniture and furnishings	5.0	4.8	-0.3
Household appliances	1.7	1.3	-0.4
Recreational goods and vehicles	7.5	10.4	2.9
Video, audio, information processing	4.1	6.3	2.2
Other durable goods	4.3	5.0	0.7
Jewelry and watches	2.1	1.9	-0.2
Therapeutic appliances and equipment	1.1	1.5	0.3
Telephone and facsimile equipment	0.1	0.4	0.3
Nondurable goods	64.5	64.7	0.2
Food and beverages purchased	25.6	21.1	-4.5
Clothing and footwear	13.3	10.0	-3.4
Garments	11.0	8.1	-2.9
Women's and girls' clothing	6.6	4.9	-1.7
Gasoline and other energy goods	7.5	10.8	3.4
Motor vehicle fuels, lubricants, and fluids	6.6	10.2	3.6
Other nondurable goods	18.1	22.7	4.7
Pharmaceutical and other medical products	3.4	8.7	5.2
Recreational items	3.2	4.0	0.9

Source: NIPAs, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 2: Descriptive Statistics

Variables	**Categories**	**Mean**	**Std Dev.**	**Min**	**Max**
HS 4-digit sectors					
Change in the number of varieties by HS 4-digit sector between 1993 and 2006	562	19.84	33.91	-35	344
Change in log (expenditure between 1993 and 2006)	562	1.00	1.09	-8.19	4.49
Change in log (quantity between 1993 and 2006)	562	0.78	1.41	-14.41 5.54	
Change in log (unit value between 1993 and 2006)	562	0.27	0.74	-3.31	6.37
HS 2-digit categories					
Growth rate of deflated expenditure	71	100. %	88 %	-0.43 %	3.44 %
Percentage points difference in the expenditure share	71	0.0	0.77	-1.83	2.61

Source: UN Comtrade Statistics Database

The number of categories corresponds to the number of observations since I take a first difference.

The change in the number of varieties is reported for sake of clarity whereas the logarithm is provided for the other variables because some first differences in level are large in unit value, expenditure and volume.

U.S. CPI is used to deflate the expenditure.

Table 3: Ranking of the top 30 importers in terms of number of goods imported by the United States

	Ranking by year						
Country	1992	1996	2004	Country	1992	1996	2004
Canada	1	1	1	Switzerland	11	11	15
Germany	2	2	3	*Korea, Rep.*	12	13	**10**
United Kingdom	3	3	4	Belgium-Luxembourg	13	12	14
Japan	4	4	6	Hong Kong, China	14	17	19
France	5	5	5	Brazil	15	18	16
Italy	6	6	7	Spain	16	14	13
Mexico	7	7	8	Sweden	17	16	18
China	8	8	**2**	*India*	18	15	**11**
Taiwan, China	9	10	9	Austria	19	20	21
Netherlands	10	9	12	Australia	20	19	17

Source: UN Comtrade Statistics Database

Table 4: Correlations between developed economies

	(1) $\Delta ln(x)$ HS4 level
$\Delta ln(n)$	0.224
	(0.142)
Constant	0.016
	(0.022)
Observations	762
R^2	0.005

Standard errors in parentheses

* p<0.1, ** p<0.05, *** p<0.01

Table 5: Main results

	Baseline specification		2SLS	
	(1)	(2)	(3)	(4)
	Δ lnx	Δ lnx	Δ lnx	Δ lnx
	value	quantity	value	quantity
Δ ln(n)	1.248***	1.394***	2.283***	2.502**
	(0.301)	(0.359)	(0.688)	(1.007)
Δ ln(p)	-0.024	-0.418**	0.142	-0.234
	(0.090)	(0.176)	(0.260)	(0.380)
$\ln(x_{1993})$	-0.066**	-0.103***	-0.036	-0.092***
	(0.026)	(0.028)	(0.033)	(0.027)
Observations	562	562	562	562
R^2	0.249	0.301	0.111	0.208
Kleibergen-Paap			12.675	7.370
Endogeneity test			p-value= 0.2611	p-value=0.5476
sample period	1993-2006	1993-2006	1993-2006	1993-2006
sector FE	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit
Estimator	FD-OLS	FD-OLS	FD-2SLS	FD-2SLS

Robust standard errors, clustered at the HS 2-digit sector are in in parentheses.

The Stock-Yogo weak ID test critical values is 7.03 for 10% maximal IV size.

* p<0.1, ** p<0.05, *** p<0.01

Table 6: Sensitivity analysis

	Alleviate potential demand shocks across sectors						Excluding outliers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ lnx	Δ lnx	Δ lnx	Δ lnx	Δ lnx	Δ lnx	Δ lnx	Δ lnx
	value	quantity	value	quantity	value	quantity	value	quantity
Δ ln(n)	2.205**	2.427*	2.514***	2.645***	2.540***	2.618*	2.437***	2.543***
	(0.880)	(1.390)	(0.673)	(0.975)	(0.912)	(1.390)	(0.518)	(0.702)
Δ ln(p)	0.090	-0.265	0.283	-0.183	0.256	-0.201	0.305	-0.197
	(0.299)	(0.486)	(0.242)	(0.357)	(0.269)	(0.452)	(0.222)	(0.305)
$\ln(x_{1993})$	-0.042	-0.095***	-0.028	-0.102***	-0.029	-0.106***	-0.038	-0.103***
	(0.046)	(0.032)	(0.028)	(0.033)	(0.038)	(0.032)	(0.037)	(0.034)
Observations	491	491	447	447	376	376	560	560
R^2	0.141	0.250	0.033	0.188	0.036	0.230	0.126	0.205
Kleibergen-Paap	7.957	4.042	11.963	9.259	7.056	4.884	15.138	8.347
Endogeneity test	p-value=0.4120	p-value=0.7363	p-value=0.5087	p-value=0.1556	p-value=0.2723	p-value=0.7062	p-value= 0.1055	p-value = 0.3271
sample period	1993-2006	1993-2006	1993-2006	1993-2006	1993-2006	1993-2006	1993-2006	1993-2006
sector FE	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit	HS 2-digit
Estimator	FD-2SLS	FD-2SLS	FD-2SLS	FD-2SLS	FD-2SLS	FD-2SLS	FD-2SLS	FD-2SLS
Sectors dropped	Steel, glass and cement indus.	Steel, glass and cement indus.	Apparel, footwear and textiles	Apparel, footwear and textiles	Drop all	Drop all	Drop outliers	Drop outliers

Robust standard errors, clustered at the HS 2-digit sector are in in parentheses.

The Stock-Yogo weak ID test critical values is 7.03 for 10% maximal IV size.

* p<0.1, ** p<0.05, *** p<0.01

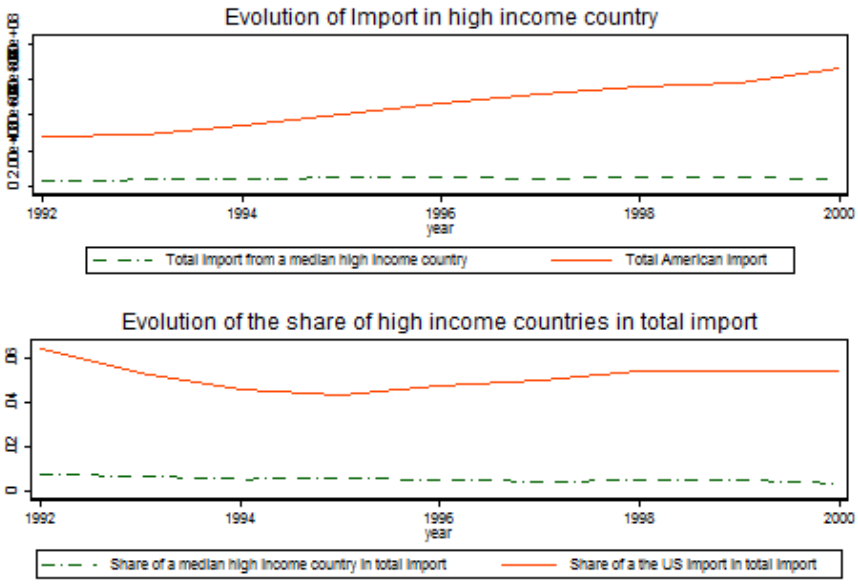

Figure 1: Evolution of the U.S. relative to the average developed economy

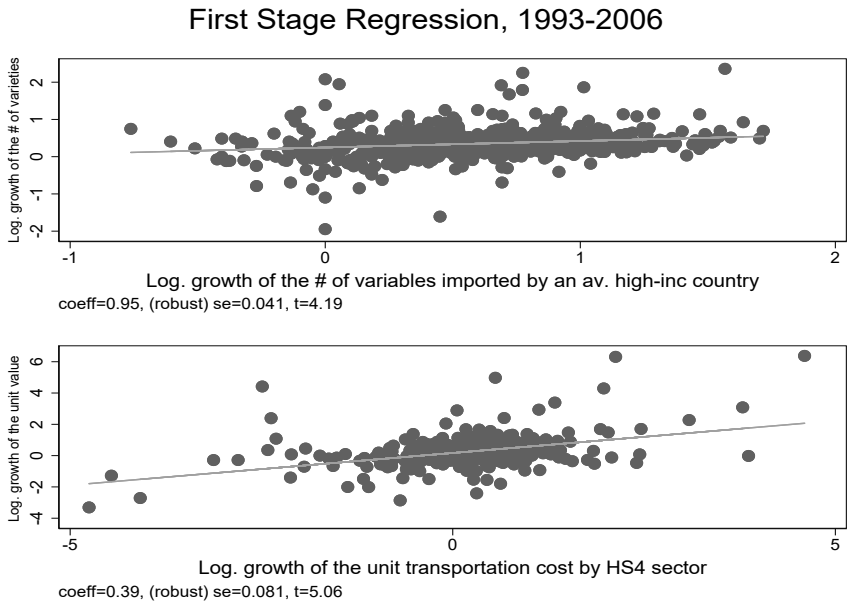

Figure 2: First-Stage predictions

A Long differences Vs annual changes

I follow Bernard and al. (2009)'s methodology to decompose the change in aggregate U.S. trade between period t-1 and t. Let $\triangle x_t$ denotes the change in the total U.S. imports between t-1 and t. $\triangle x_t$ can be decomposed into the increase due to the entry of new variety, the decrease due to the exit of existing importers, and the change due to increases or decreases in trade for the continuing firms.

$$\triangle x_t = \underbrace{\sum_{c \in N} x_{ct} - \sum_{c \in E} x_{ct-1}}_{\text{extensive margins}} + \underbrace{\sum_{c \in G} \triangle x_{ct}}_{\text{intensive margin}} \tag{19}$$

where c is the trading country, N is the set of new trade countries, E is the set of existing trade countries exiting and G is the set of countries continuing to trade. Table 7 decomposes the total U.S. import variation into the contribution of the margins described above from 1992 to 2004. The first 12 columns report annual changes, the next two report 7 years changes (from 1992 to 1998 and from 1998 to 2004) and the last column reports the 12 years change (from 1992 and 2004).

Table 7 shows a positive growth in the number of varieties over time except for the period corresponding to the American economic recession (2001-2002) which explains why the net entry is so low between 1998 and 2004. The exceptional growth in 1995-1996 was driven by the imports of vehicle and aircraft accessories mainly from European countries, Mexico and Taiwan.[15]

As Bernard and al. (2009), I find that the short-run changes in the U.S. imports are largely accounted for by the intensive margin while the long-run decomposition highlights a large growth of the extensive margin (29 %). These observations explain why I will concentrate the analysis on long differences instead of annual changes.

Table 7: Decomposition in the variations of U.S. imports over time

	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	92-98	98-04	92-04
Extensive Margins															
New varieties (%)	38.26	21.22	32.54	83.75	11	14.42	14.36	13.67	21.09	-	11.39	9.22	40.16	17.26	29
Exit (%)	-30.50	-8.99	-6.84	-11.46	-6.48	-7.11	-13.75	-5.36	-46.58	-	-5.23	-6.12	-2.48	-16.43	-9
Net Entry (%)	7.76	12.23	25.7	72.29	4.52	7.31	0.61	8.31	-25.49	-	6.16	3.1	37.68	0.83	20
Intensive margin	92.24	87.77	74.30	27.71	95.44	92.68	99.4	91.67	-74.51	-	93.84	96.9	62.32	99.17	80
Total change in import															
percentage	6.5	15	18.59	15.9	10.99	7.8	4.9	12.86	-3	0	9.8	17.4	102	47.67	149.67
$ billion	0.88	22.6	31.1	31.7	25.4	20	13.6	87.3	-9.97	0	31.1	60.6	140	132	272

[15] Such large growth may have been driven by the European demand for aircrafts. Indeed, neither the MFN nor the Mexican tariffs in those sectors have fallen by a large amount. However, from 1993 to 1997, Europe has deregulated its sky and has seen the emergence of low cost companies using American aircrafts. Outsourcing might be another explanation.