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Welfare Gains from the Variety Growth[☆]

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Abstract

We estimate the variety gains of trade in Estonia, Latvia and Lithuania following the fall of the iron curtain more than a quarter of a century ago. We apply the methodology of Feenstra (1994); Broda and Weinstein (2006); Ardelean and Lugovskyy (2010) and Soderbery (2015) to domestic and international trade data for the period 1988-1997. Although, there was a decline in the number of local varieties during this period, an increase in the number of import varieties from the EU more than outweighed this decline. The increasing variety of imported goods from EU countries substantially lowered the cost of living, resulting in welfare gains to consumers that range from 0.73% in Latvia to 1.28% of GDP per year in Estonia.

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JEL code: C68, F12, F14, F17, R12, R23.

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1. Introduction

The fall of the iron curtain more than a quarter of a century ago has led to one of the largest and most abrupt trade policy liberalisations in the postwar European history. Virtually overnight, around a dozen of former centrally planned economies in Central and Eastern Europe (CEE) opened up their markets to the world trading system. The trade liberalisation coincided with several other radical changes and policies in CEE countries, such as structural reforms (price liberalisation and privatisation) and macroeconomic stabilisation policies, which have attracted plenty of attention from economists (Shleifer and Vishny, 1991; Svejnar, 2002). Attempts towards assessing the impact of the trade liberalisation on CEE economies have been limited to classical gains from trade (Baldwin *et al.*, 1997; Levchenko and Zhang, 2012). However, entirely new goods and varieties that became available in formerly centrally planned economies through the rapidly growing foreign trade with the West created additional welfare effects, which are not captured by these neoclassical models. To the best of our knowledge, the present paper is the first to estimate the welfare effects operating through changes in the choice set of consumers following the fall of the iron curtain in the CEE.

The neoclassical trade theory predicts large gains from the trade integration of countries with large differences in endowments in terms of labour, capital, skills and natural resources or technological differences between countries and sectors; such as eastern and western European countries. Using a neoclassical framework, welfare impacts of the CEE's trade liberalisation following the fall of the iron curtain have been assessed e.g. by Baldwin *et al.* (1997); Levchenko and Zhang (2012). The majority of these studies simulate the trade integration between the East and West using CGE models, and subsequently evaluate welfare gains relative to a hypothetical scenario, where the foreign trade remains highly restricted. These studies find substantial welfare gains from the CEE's trade liberalisation with the West (cumulative gains up to 15% of the GDP), stemming mostly from countries specialising in sectors where they have a comparative advantage, and reaping the gains through trade.

More recent theories of the international trade rather emphasise the importance of trade-induced changes in the variety of goods, quality, scope, markups, firm productivity and cost structure, which act as important channels of welfare gains (Hottman *et al.*, 2016). These effects are not captured by neoclassical models with homogeneous goods used in above studies.[1] Krugman (1980) was among the first to derive a model illustrating

[1]Models of international trade with imperfect competition often offer three additional sources of gains

how trade can increase the welfare of consumers through the availability of new goods or an enhanced set of differentiated varieties of the same good. Since then, both the methodology (Romer, 1994; Feenstra, 1994; Feenstra and Kee, 2004; Feenstra, 2004; Broda and Weinstein, 2006; Arkolakis *et al.*, 2008; Ardelean and Lugovskyy, 2010; Soderbery, 2015; Feenstra, 2018), and the empirical framework (Broda and Weinstein, 2004; Hummels and Klenow, 2005; Broda and Weinstein, 2010; Kancs, 2010; Blonigen and Soderbery, 2010; Hottman *et al.*, 2016; Lewrick *et al.*, 2016; Amiti *et al.*, 2017) have improved significantly. These empirical studies mostly estimate variety gains from globalisation for OECD economies and typically find substantial welfare gains ranging between 0.1 and 0.5 percent of GDP per year.[2] These variety gains from trade are in addition to classical gains from trade (exploiting comparative advantages), suggesting that the actual gains from the trade integration are considerably larger than typically estimated in neoclassical trade models.

The existing empirical work on the variety growth from globalisation and trade integration has been focussed on developed countries, and marginal/gradual changes in the foreign trade policy liberalisation. However, due to the size of the foreign trade policy liberalisation in the CEE (the number of imported goods/varieties from the West increased by factor 4 to 6 within few years, see Figure 1), the welfare gains due to the variety growth in these countries are likely to be considerably larger compared to developed countries, where the set of goods and varieties available to consumers has been already very large. It seems intuitive that a sudden availability of many new goods in the CEE must have been very relevant to consumer welfare, as many commodities, such as exotic fruits or cars of a reasonable quality where chronically short in supply or unavailable in the eastern block (see section 2.2). Although, the image of East German citizens queuing West German supermarkets for cosmetics and banana's is firmly stamped in the collective memory of the days following the fall of the iron curtain, any quantitative assessment of the welfare effects of this expansion of the choice set is still missing after a quarter of a century.

In order to narrow this research gap in the empirical trade literature on welfare gains due to the variety growth, this paper uses the example of Baltic countries – Estonia, Latvia

from trade that do not arise in competitive models: expansion of product variety; a pro-competitive reduction in the markups charged by firms; and the self-selection of more efficient firms into exporting.

[2]For example, Broda and Weinstein (2006) find that the previously unaccounted growth in product variety has been an important source of welfare gains from trade in the US over the 1972-2001 period. They estimate that the bias in the conventional price index for imports was 28% (1.2% per year) and the cumulative welfare gains were equal to 2.6% of GDP.

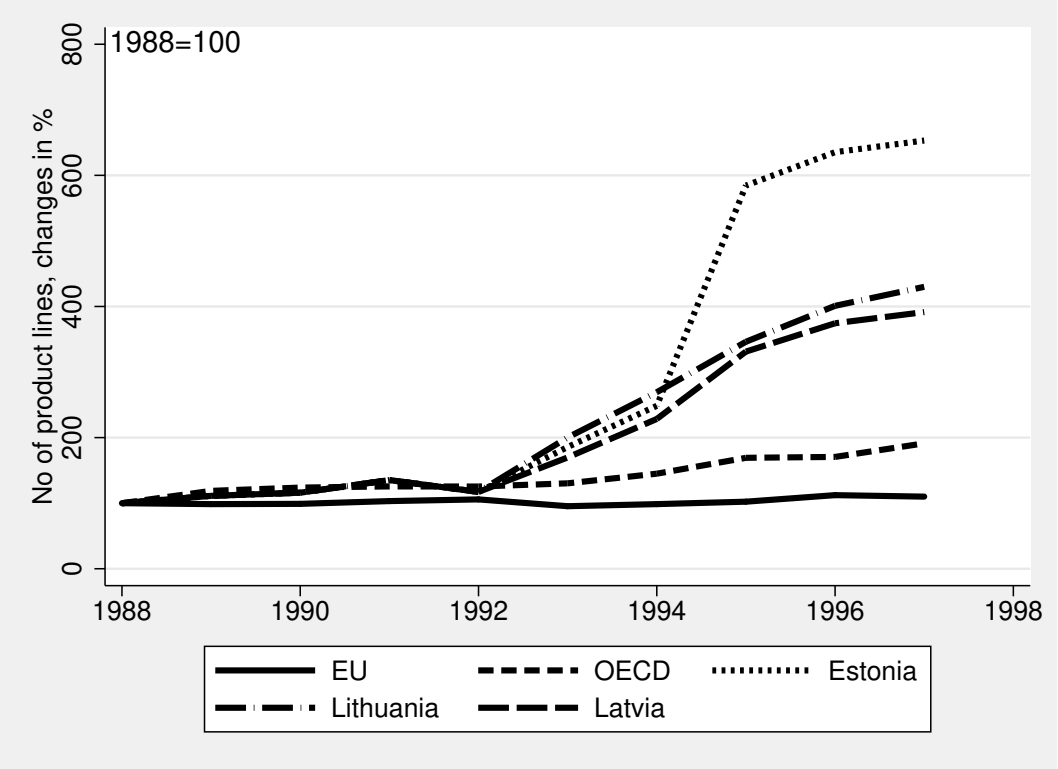

Figure 1: Changes in the number of imported product lines at the CN 7-digit level from the EU, 1988-1997. Source: ComExt Extra-EU trade data.

and Lithuania – and applies recent trade theories to a situation of a large and abrupt trade policy shock following the fall of the iron curtain. The Baltics offer a particularly good example, as the three Baltic economies were among the most isolated CEE economies (compared e.g. to Balkan and Visegrád countries) regarding the foreign trade with the West (Shen, 1994). The present paper evaluates welfare gains associated with the variety growth from the Baltic's breakout from the politically imposed economic isolation into the world trading system by calculating the compensating variation that results from changes in the set of domestic and imported goods (varieties) from EU Member States in the immediate period before and after the fall of the iron curtain. To the best of our knowledge, this is the first paper that estimates welfare gains of the variety growth from the trade integration associated with the fall of the iron curtain in the CEE. Despite the fact that the fall of the iron curtain was among the largest and most abrupt trade liberalisation shocks in the postwar European history, there are no empirical studies available in the literature for this particular region (CEE), this particular period (the fall of the iron curtain), and this particular component of welfare gains from the trade

integration (variety growth).

Our conceptual framework is based on Feenstra (1994); Broda and Weinstein (2006); Ardelean and Lugovskyy (2010); Soderbery (2015) and consists of computing and comparing variety-adjusted exact price indices for the Baltic countries' domestic goods and imports from the EU before and after the fall of the iron curtain. In the empirical analysis, we employ detailed domestic and foreign trade data for Baltic countries from 1988 until 1997. We define varieties as product lines at the 7-digit level, as these are the only data available for Baltics for the immediate period before and after the fall of the iron curtain.[3] Our estimates suggest that annual welfare gains from the import variety growth in the Baltics during the analysed ten-year period were equal to 0.94% of the GDP, which corresponds to an average annual welfare gain of 1.28% in Estonia, 0.73% in Latvia and and 0.79% Lithuania, in addition to traditional (comparative advantage) gains from trade. These results are new, as no comparable estimates on welfare gains from the variety growth for the particular region and the particular period are available in literature. Our main findings can be summarised in two points. First, total welfare gains from the trade liberalisation between the East and West were considerably larger for the CEE than estimated in neoclassical trade models due to additional gains from the import variety growth. Despite of being considerable, this aspect of welfare gains associated with the fall of the iron curtain has been neglected so far in the empirical literature and may be forgotten soon, as today – almost three decades after the fall of the iron curtain – the variety choice in the East seems nearly as large as in the West. Second, our findings are important not only for the assessment of the true gains from the CEE's integration into the world trading system, but they also provide an important 'laboratory' feedback to recent theories of the international trade which -in addition to the size and pattern of trade flows- identify also variety, quality, scope, markup, productivity and cost effects as important determinants of welfare gains from trade. Extreme trade liberalisation situations, such as the fall of the iron curtain in the CEE, are particularly useful for scrutinising these theories with regime switching data.

[3] A similar empirical strategy for identifying varieties has been used by Berlingieri (2013), who estimates variety gains associated with the fall of the iron curtain for trading partners in the West.

2. Domestic and imported varieties in the Baltics

2.1. Defining varieties

The definition of variety is central to our study as depending on this definition the estimated variety gains from trade can be (downward) biased. As shown by Blonigen and Soderbery (2010); Broda and Weinstein (2010), more narrow variety definitions typically yield larger welfare effects and vice versa.

In the empirical literature, varieties are usually defined based either according to the classification of horizontally differentiated products following Dixit and Stiglitz (1977), according to the product country of origin following Armington (1969), or a combination of both. Adopting a two-way classification – first, by detailed categories of products and second, by countries of origin – yields a nested unit of observation on the import side: a certain product category stemming from a particular country, see for example Amiti *et al.* (2017). More recent firm level evidence suggests that for the consumers' welfare, not only the country of origin and the set of products is important but, also the set of firms and the scope of traded products within these firms affect the consumer cost of living. For example, Bernard *et al.* (2009) show that changes in the extensive margin resulting from the entry and exit of firms, but also from a product turnover within existing firms, are mainly responsible for the import and export growth over longer time spans in the United States. Among others, Blonigen and Soderbery (2010) adopt a firm-level definition of variety. Blonigen and Soderbery (2010) define a specific make and model of automobiles as a variety, for example, Mazda 3 and Volkswagen Jetta are defined as different varieties of compact automobiles. Broda and Weinstein (2010); Hottman *et al.* (2016) use an even more disaggregated definition to study a new product appearance and an old product disappearance by distinguishing varieties according to the product bar code. This allows the authors to cover up to 1.4 million varieties consumed by approximately 55 000 USA households. Although, such data sets are very rich and offer a very detailed view of varieties, for most countries they are not available, as it is the case for centrally planned and emerging market economies in Eastern Europe for a period three decades ago.

In the present study, the definition of variety is determined by rather pragmatic factors related to the data availability. Given that no firm-level or scanner data are available for the three Baltic countries and their main trading partners for the analysed iron curtain period, in the present study we define 'varieties' as products on a certain lower level of classification (i.e. 7-digit) within a 'good' at a higher level of classification (i.e. 5-digit). The key advantage of our variety definition is that it allows for a comprehensive coverage

of all three Baltic countries for the immediate period before and after the fall of the iron curtain. Moreover, a common sense and the available empirical evidence suggest that the more relevant increase in varieties following the fall of the iron curtain was not an increase in the number of different firms exporting the same product from the West to the East, but rather the fact that truly new varieties and even goods became available to consumers in the CEE, such as previously unavailable types of exotic fruit or consumer electronics. This is illustrated in Figure 6 in Appendix, which depicts a girl Gaby from Eastern Germany, who never in her life has seen a real banana. The situation with the availability of many consumer goods and their varieties in former soviet republics, including Estonia, Latvia and Lithuania, was even worse.

In order to measure varieties empirically, in the present study we combine two data sets: the Eurostat reference database for external trade statistics production and dissemination (ComExt) with domestic industrial and agricultural product data. The ComExt Extra-EU trade data are available for all three Baltic countries' trade with each EU Member State for the period starting from 1988. These data are available in the Combined Nomenclature (CN) 8-digit classification, they are used to estimate consumer welfare gains due to a variety growth in imports from the EU. The industrial and agricultural product data are available only for Latvia for the period 1987-1994. These data are available in the 7-digit 'Obshchesoyuznyy klassifikator promyshlennoy i sel'skokhozyaystvennoy produktsii' (OKP) classification and are used to estimate changes in the cost of living due to changes in the choice set of domestic goods in Latvia. Using these data, goods are defined as products at the 5-digit product line and varieties as products at the 7-digit product line. Two types of variables provided in the two data sets are of particular interest for our study: the monetary value of each transaction and the physical quantity of traded products. Dividing values by quantities allows us to construct a unit cost (price) for goods and their varieties. We recognise that there are several caveats with combining these two data sets: differences in the classification of goods and varieties, differences in the (partially overlapping) time period and country coverage. Nevertheless, we believe that combining these two data sets allows us to explore important economic integration gains associated with the fall of the iron curtain, that have not been acknowledged in the literature yet. Moreover, as discussed by Lewrick *et al.* (2016); Amiti *et al.* (2017), by using a particular nested CES utility structure, welfare results are consistent and not affected by differences in data sources entering entering opposite parts of the utility nest.

When thinking about distinct horizontally differentiated varieties of consumption goods and gains from an increased choice set to consumers (either firms or households), it is useful to write the aggregate expenditure, $X_{gi}^{cc'}$, on variety i of good g produced in the origin country, c, sold in the destination country, c', (with possibly $c = c'$) as the product of the number of consumed varieties, $\#I_g^{cc'}$, and the average expenditure on each consumed variety, i, $\sum_{i \in a I_g} p_{gi}^{cc'} x_{gi}^{cc'} \Big/ \#I_g^{cc'}$ For our purpose, we define the intensive margin as the average expenditure on all of good g's varieties i, and the extensive margin as the number of distinct varieties, $\#I_g^{cc'}$, consumed. The main focus of the present study is on the extensive margin of domestic and foreign goods in the Baltics. The intensive margin will be used to measure the expenditure share and hence the relative consumer preference for each single variety.

2.2. Consumer choices before and after the fall of the iron curtain

As noted by Shleifer and Vishny (1991), during the soviet period, markets did not mirror consumer preferences, as literally all components of intensive and extensive margins of retail sales were controlled by central planners, resulting in an insufficient supply (excess demand) of many goods, x_{ig}^c, in presence of fixed (non-adjusting) prices, p_{ig}^c,[4] and rather little (compared to western standards) variety, $i \in I$, of each consumption good available. Also consumer testes, d_{gi}^c, were the object of central planners' distortions.

As regards the *intensive margin* of the consumption good supply, many of them were produced in insufficient amounts, resulting in an excess demand (Bergson, 1991). The main reason was that due to a low productivity and capacity constraints, in many sectors of consumption goods there were severe difficulties to produce a sufficient output, as a result of which many products and product varieties remained chronically unavailable in shops and hence could not be consumed by households (Weitzman, 1969). At the end of eighties, on every 100 households in Lithuania there were only 70 washing machines, 60 vacuum cleaners, 48 bicycles, 48 sewing machines and 44 tape recorders (Iwaskiw, 1996). The situation was only slightly better in Latvia: on every 100 households there were 89 washing machines and 70 vacuum cleaners (Iwaskiw, 1996). According to Bergson (1991), in 1985 there were only 36 passenger cars per 1 000 persons in the USSR, compared to 552 in the USA, 412 in Germany, 380 in France, 375 in Italy, 335 in Austria, 315 in Finland and 305 in the United Kingdom.

[4]Because prices were fixed by central planners, they could not adjust to equilibrate markets of goods with an excess demand (Manove, 1971).

Instead of increasing the supply of goods (which was not straightforward due to capacity constrains), central planners thought actively how to reduce demand instead. There were several ways how the state propaganda attempted to deal with the excess demand for many consumption goods that were unavailable in shops. One strategy was to promote the view of individual consumption as a waste of social resources and a '*remnant of a petty bourgeois way of thinking*'. A considerable effort was made by central planners to emphasise a public consumption over a private consumption. Soviet people were supposed to act in collectives – do their laundry at public laundries, use communal transport and eat in canteens. Therefore, washing machines and cars were in short supply and kitchens in people's flats were very small (Chernyshova, 2013). Another strategy was to hold the tide of consumers responsible for the shortage of consumption goods, as according to the reasoning of central planners, the demand for many consumption goods, e.g. electric domestic appliances, has climbed so fast in a short period of time that output simply could not keep up. A good example of a communist party's strategy to blame the short supply of consumption goods on the surge of demand rather than on underproduction is an article in the soviet newspaper *Rabotnitsa (1984)*: "*This is not the first time that the tide of consumer demand, sweeping the industry and overtaking all possible production growth rates, has washed us up on the empty shop shelves*". A further approach followed by central planners to restrain the final demand was to 'educate' consumers, which was done in several ways. Parents were advised to teach their children to become economical and limit their goods' demands. In line with the concept of rational consumption norms, such self-restraint was part of an internal discipline and in view of the growing excess demand it was argued by central planners that "*Needs must be reasonable. A commodity must know its place. Unrestrained needs are to be ashamed of and suppressed before they devour you.*" (Chernyshova, 2013).

As regards the *extensive margin* of the consumption good supply, those goods that were sufficiently available for purchase in shops were available to consumers in only few distinct varieties (Iwaskiw, 1996). Even if the minimum amount of goods necessary for survival could be found in shops, there was literally no variety or choice for consumers. This is also apparent in our data: as illustrated in Figure 2, there were only around 30 000 domestically produced varieties (defined as product lines at the 7-digit level) sold in Latvia at the end of eighties and beginning of nineties. More importantly, out of these 30 000 domestic varieties, only a small fraction was available for purchase in shops to consumers.

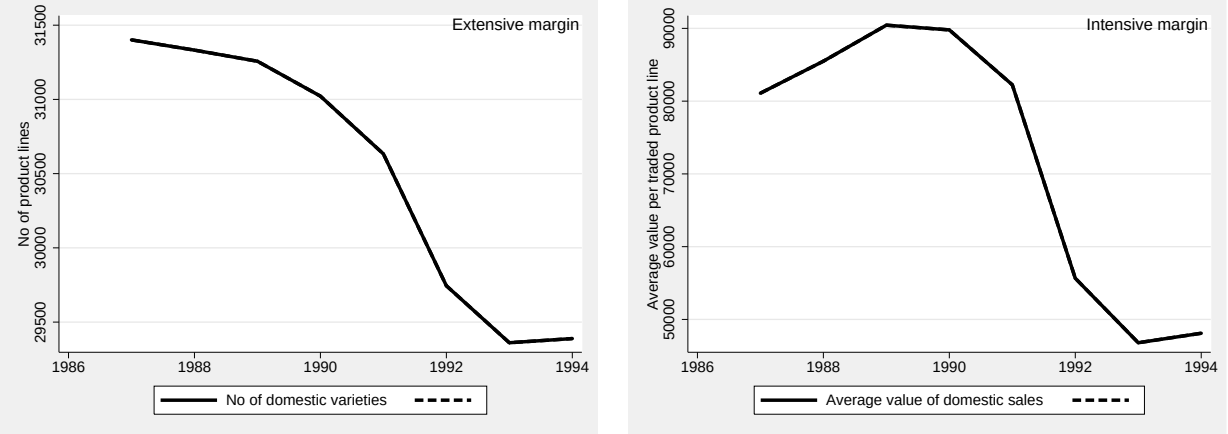

Figure 2: Domestic sales of domestically produced goods in Latvia, 1987-1994. Source: Industrial and agricultural product statistics of the USSR and the Republic of Latvia. Notes: The extensive margin is measured by the number of domestically traded product lines at the 7-digit level. The intensive margin is measured by the average value per retailed product in constant 1991 soviet rubles.

For comparison, Figure 3 shows domestic sales of domestically produced goods in the EU over the 1988-1997 period. As we can see on the left panel of Figure 3, many more varieties of consumer goods (measured as the number of domestically traded product lines at the 8-digit level) were available to consumers in the EU. While in 1988 EU consumers had a choice of more than 120 000 domestic varieties, the consumer choice set has increased to more than 140 000 in ten years until 1997. Note that in addition to these varieties in terms of different product codes, the EU imported many products from around the world, implying that the actual choice set of consumers was considerably larger when considering variation by a country of origin. The intensive margin (measured in ECU by the average value per a traded product line) is displayed on the right panel of Figure 3. In contrast to a declining variety and sales value in Latvia during the 1997-1994 period, both the extensive (variety) and extensive (value) margins increased significantly in the EU during the 1988-1997 period.

The example of passenger cars is particularly revealing, as only few varieties (models) of them were available to only few consumers in the USSR (around 10 times fewer than in the West, (Bergson, 1991)). In the soviet economy (which included Estonia, Latvia and Lithuania until 1991), there were four main brands of passenger cars covering around 96% of the private passenger car market in the USSR: Zaporozhets, Moskvitch, Zhiguli and Volga. Each automobile brand produced several models, 17 altogether in 1990. Most interestingly, there were only few car options (extras) that consumers could choose from when ordering (and waiting for) a new car. In fact, only two options were available to

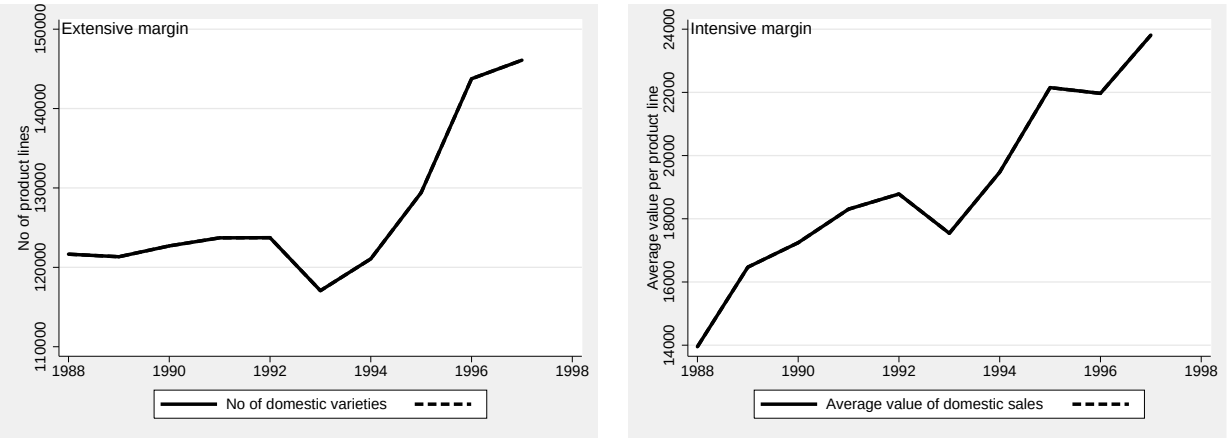

Figure 3: Domestic sales of domestically produced goods in the EU, 1988-1997. ComExt Intra-EU trade data. Notes: The extensive margin is measured by the number of domestically traded product lines at the CN 7-digit level. The intensive margin is measured in 1000 ECU by the average value per a traded product line.

consumers (at least in theory): inside colour and outside colour of the car. Counting each manufacturer option, e.g. black inside colour, red outside colour, of each car model as a separate variety, there were 219 passenger car varieties available to consumers in the soviet economy in 1990. For comparison, more than one hundred car manufacturers were selling passenger cars in the EU. According to the Revue Automobile (1990), there were 1029 passenger car models available to consumers in 1990. Most striking, when accounting for all the different car options (extras), such as different motorisations, many different inside and outside colours, air conditioning, electric windows, fog lights, split-folding rear seats, etc., consumers in the EU had a choice between many tens of thousands passenger car varieties. Hence,we have to compare 36 passenger cars per 1 000 persons in the USSR to 305-412 passenger cars per 1 000 persons in the EU, and 219 passenger car varieties in the USSR to many tens of thousands passenger car varieties available to consumers in the EU. The shortage of domestically produced cars and the lacking consumer choice between different car varieties is visible also in Table 4 in the Appendix, which reports the 20 most imported goods according to trade value in the Baltics from the EU after the opening of the iron curtain. In 1997, the three most imported goods were motor vehicle and gasoline for motor vehicles. Further, among top 20 imports from the EU in terms of trade value, 7 were related to motor vehicles.

Analogous to attempting to justify the chronical shortages of many consumption goods in shops (instead of increasing supply), also the lack of variety and consumer choices were justified (and even praised) in various ways by central planners: rational

consumption norms, standardisation of products, efficiency gains, functionality, etc. In order to justify lacking consumer choices and avoid possible negative impacts on the socialist system, central planners also actively sought to change the taste of consumers, bringing sartorial matters to the top of the ideological agenda; the communist party took it upon itself to define what was tasteful and contemporary. Generally, in the soviet system the concept of taste was an ideological tool deployed with the help of the communist party and the mass media to assist the state in its efforts to control society demands and to re-enforce the desirable behavioural and social norms (Chernyshova, 2013).

The clothing industry is a particularly good example of an ideologically-driven resistance of soviets to imported foreign goods from the West, because the concept of fashion had rather negative connotations in the soviet system. For this reason, in the official discourse of the soviet propaganda, the notion of fashion was often substituted with the notion of taste. Using the words of the state propaganda it was argued that "*it could be a bourgeois preoccupation, a capitalist trick to enslave the masses (especially women), and a manifestation of consumerism with its spiritual shallowness* (Weitzman, 1969). More generally, it was considered that fascination with foreign goods (particularly from the West) could damage socialist values, state authorities propagated it as "*a standard of living that is alien to us and shapes negative attitudes towards our moral values*" (Chernyshova, 2013).

Despite the considerable soviet propaganda' efforts, the wide availability of durable goods in the West made soviet consumers more and more aware of what they were actually missing/loosing (compare Figures 2 and 3). The soviets' inability to satisfy consumer needs became particularly evident towards 1990, when information flows between the East and West increased considerably and the significant differences in the standard of living became visible to almost everyone. The growing awareness of foregone consumption opportunities coincided with increasing difficulties to spend the earned income even on those consumption goods that used to be available in shops in past. Because of a decreasing consumption goods' supply and a rather limited choice (see Figure 2), many households were unable to convert the entire disposable income into consumption goods and hence suffered a welfare loss.

To satisfy the growing demand for westerns goods, about which Soviet consumers became more and more aware, and to fill the earning-spending gap, gradually non-state stores started to appear in Estonia, Latvia and Lithuania, in late-1980s and at the beginning of 1990s (Shleifer and Vishny, 1991). For most consumption goods, though,

Table 1: Ratio of market to state prices, 1990

Commodity	Ratio	Commodity	Ratio
Drugs	19.0	Linoleum	2.9
Covering wood	8.9	Sewing machine	2.8
Iron	5.6	Refrigerator	2.6
Beef	4.8	Rug	2.6
Men's winter shoes	4.8	Colour television	2.5
Women's winter shoes	4.5	Children's sweater	2.4
Automobile	4.4	Vodka	2.4
Women's jacket	3.7	Cement	2.3
Men's sweater	3.3	Brick	2.1
Coffee	3.0	Bookcase	2.0
Tea	3.0	Office desk	1.9

Source: Shleifer and Vishny (1991). Notes: All prices measured in 1990 soviet rubles.

prices in non-state stores were two, three or even twenty times higher than in state stores, because many goods in non-state stores were imported from the West (see Table 1). These – newly emerging non-state stores – was the main vehicle through which increasing imports of western goods reached consumers at the end of 1980s and beginning of 1990s.

Table 1 also provides a rough idea of how much more imported varieties of consumption goods were valued by soviet consumers compared to domestic (soviet) products. For example, in 1990 on average soviet consumers were willing to pay 4.5-4.8 times more for a pair of winter shoes imported from the West compared to locally produced winter shoes (Shleifer and Vishny, 1991).

2.3. Foreign trade policy

In the immediate period before and after the fall of the iron curtain, we can distinguish three qualitatively different subperiods in the Baltic's foreign trade policy with the EU: $\rightarrow$1991, 1992-1994 and 1995$\rightarrow$. In the period until 1991, when Estonia, Latvia and Lithuania were occupied and annexed by the soviet union, the foreign trade policy with the West was highly restrictive. All three Baltic countries restored their independence in 1991. In following years from 1992 until 1994, the three Baltic countries removed all ideologically-driven foreign trade policy restrictions, implying that no consumer was prohibited anymore to buy any type of consumption good in any amount from any foreign country, including western European countries. However, both exports from the Baltics to the West as well as imports from the West to the Baltics were subject to

tariff barriers. From 1995, when the Agreement on Free Trade and Trade Related Matters between Estonia, Latvia and Lithuania and the EU entered into force, practically all tariff barriers between Estonia, Latvia and Lithuania and the EU were abolished and a free trade regime was established.

In the first subperiod until 1991, despite of serious capacity constrains and inefficiencies in production to satisfy the local demand, imported goods – particularly from the West – were not welcome behind the iron curtain (Shen, 1994). On the one hand, central planners did not have sufficient reserves of a convertible currency to pay for imported goods from the West. On the other hand, as explained below in section 2.4, imports from the West were not welcome for purely ideological reasons. Hence, during this period the Baltic's foreign trade with the West was practically absent not because of prohibitive tariffs, but rather to avoid that imported goods from the West could contest the superiority of consumer products of the soviet system.

After decades of the soviet-imposed foreign trade isolation, all three Baltic states regained independence in 1991, which created opportunities to open their trading systems to the world and re-negotiate trade agreements with the West. Indeed, the foreign trade policy of Baltic countries started to change rapidly after the collapse of the Soviet Union. Soon after restoring their independence, all three Baltic countries removed all ideologically-driven foreign trade policy restrictions, implying that no consumer was prohibited anymore to buy any type of consumption good in any amount from any foreign country, including western European countries. Moreover, during this second subperiod, Baltic states signed several comprehensive trade and economic cooperation agreements with the EU. For example, the Agreement between Estonia, Latvia and Lithuania and the EEC on Trade and Commercial Economic Co-operation was singed on 11 May 1992 and entered into force on 1st February 1993.

Among the three Baltic economies, the most radical foreign trade policy liberalisation and economic restructuring took place in Estonia. The early adoption of a free trade regime, which was sustained throughout the 1990s, made Estonia somewhat akin to a European Hong Kong. As part of progressive market-oriented reforms, Estonia adopted a unilateral free trade-abolishing tariffs on all imports, including agricultural goods and within a few years reoriented its foreign economic relations completely from the East to the West. Estonian reforms in other areas of international economic relations were equally courageous and far-reaching and included the liberalisation of the foreign direct investment regime, current and capital account convertibility and the introduction of a

currency board, which has been sustained at the original parity for more than a decade (Shen, 1994). The impact of these market reforms curried out in Estonia on foreign trade flows is visible also in Figure 4, where particularly the extensive margin of Estonian imports and exports grew considerably faster than in Latvia and Lithuania.

The Baltic's foreign trade liberalisation with the EU was completed on 1st January 1995, when the Agreement on Free Trade and Trade Related Matters between Estonia, Latvia and Lithuania and the EU entered into force.The Free Trade Agreement aimed to promote not only trade, but also through the expansion of a mutual trade, a harmonious development of the economic relations between Estonia, Latvia and Lithuania and the EU to foster the advancement of economic activity, the improvement of living and employment conditions, increased productivity, financial stability and sustainable growth; to provide fair conditions of competition for the trade between the Baltics and the EU; to contribute in this way, by the removal of barriers to trade, to the harmonious development and expansion of trade in the Baltic Sea area; and to develop and intensify cooperation in the areas which are not covered by the Free Trade Agreement, especially in the promotion of investments, economic and scientific cooperation, economic aid in the environment protection.

2.4. Baltic's foreign trade with the EU

The foreign trade in general and trade with the West in particular played only a minor role in the Soviet economy. In 1985, for example, exports and imports from/to all foreign countries accounted for only 4 percent of the GDP and the large majority of the foreign trade took place with Council for Mutual Economic Assistance (COMECON) countries (Shen, 1994). The foreign trade with the West was particularly limited both in terms of the number of traded goods (and their varieties) and the total trade value. The main reason for low exports of manufacturing goods to the West was their inferior quality, because of which soviets were unable to export most of their manufactured goods. According to Zickel (1991), in 1987 only 18 percent of soviet manufactured goods met world technical standards. As result, only few manufacturing goods were exported to the West, whereas the natural gas and oil contributed to around one third of soviet's exports to the West (Zickel, 1991). Imports from the West were low mainly because of insufficient resources of a convertible currency and for purely ideological reasons.

The practically non-existing foreign trade with the EU is visible in Figure 4 (solid line in left panels), where we can see that fewer than 2 000 Combined Nomenclature (CN) 8-digit product lines from the EU were sold in each of the three Baltic countries in 1988.

Moreover, as can be seen from Table 3 in Appendix, among most imported goods from the EU only few were household consumption goods. The extensive margin of imports from the EU changed little until 1992. As regards exports, less than 1 000 CN 8-digit product lines were exported to the EU from the three Baltic countries during the same period (dashed line in left panels). Also the extensive margin of exports to EU changed little until 1992. For comparison, during the same period (1992) the EU imported 263 405 CN 8-digit product lines and exported 588 429 CN 8-digit product lines, which evidently highlights how limited trade with the West was behind the iron curtain.

The *variety (extensive) margin* of the foreign trade with the EU remained similar in all three Baltic countries until 1992, after which it started to grow rapidly. Soon after the fall of the iron curtain, which as explained in section 2.3, *de jure* took place in 1991, and opening the formerly autarkic trading system to the West increased the foreign trade with the EU significantly. Within the following five years until 1997, the number of CN 8-digit product lines imported from the EU increased to more than 9 000 in Estonia, almost 8 000 in Lithuania and more than 7 000 in Latvia (solid lines in left panels in Figure 4). Note that also the number of CN 8-digit product lines exported to the EU increased, though less significantly (dashed lines in left panels in Figure 4). This multifold increase in the extensive margin of trade with the EU – particularly imports – is the main interest of the present paper. Specifically, we attempt to quantify how this observed import variety growth contributed to consumer welfare gains after the fall of the iron curtain in the three Baltic countries.

Interestingly, the *intensive margin* of the foreign trade with the EU was larger for exports than for imports – the opposite as for the extensive margin (right panels in Figure 4). The average value per CN 8-digit product line exported from Latvia and Lithuania to the EU was around 1 500 ECU (dashed lines in right panels in Figure 4). Estonia recorded the highest increase in the intensive margin of exports to the EU – the average value per CN 8-digit product line increased from around 500 ECU in 1992 to more than 11 000 ECU in 1997. The intensive margin of imports from the EU was comparably low, though it also adjusted rather dynamically after the fall of the iron curtain. For example in Estonia, it halved from just over 400 ECU / product line in 1987 to just above 200 ECU / product line in 1992, after which it tripled to more than 600 ECU until 1997 (solid line in the top-right panel in Figure 4). The intensive margin of imports from the EU fluctuated less dramatically in the other two Baltic countries - Latvia and Lithuania.

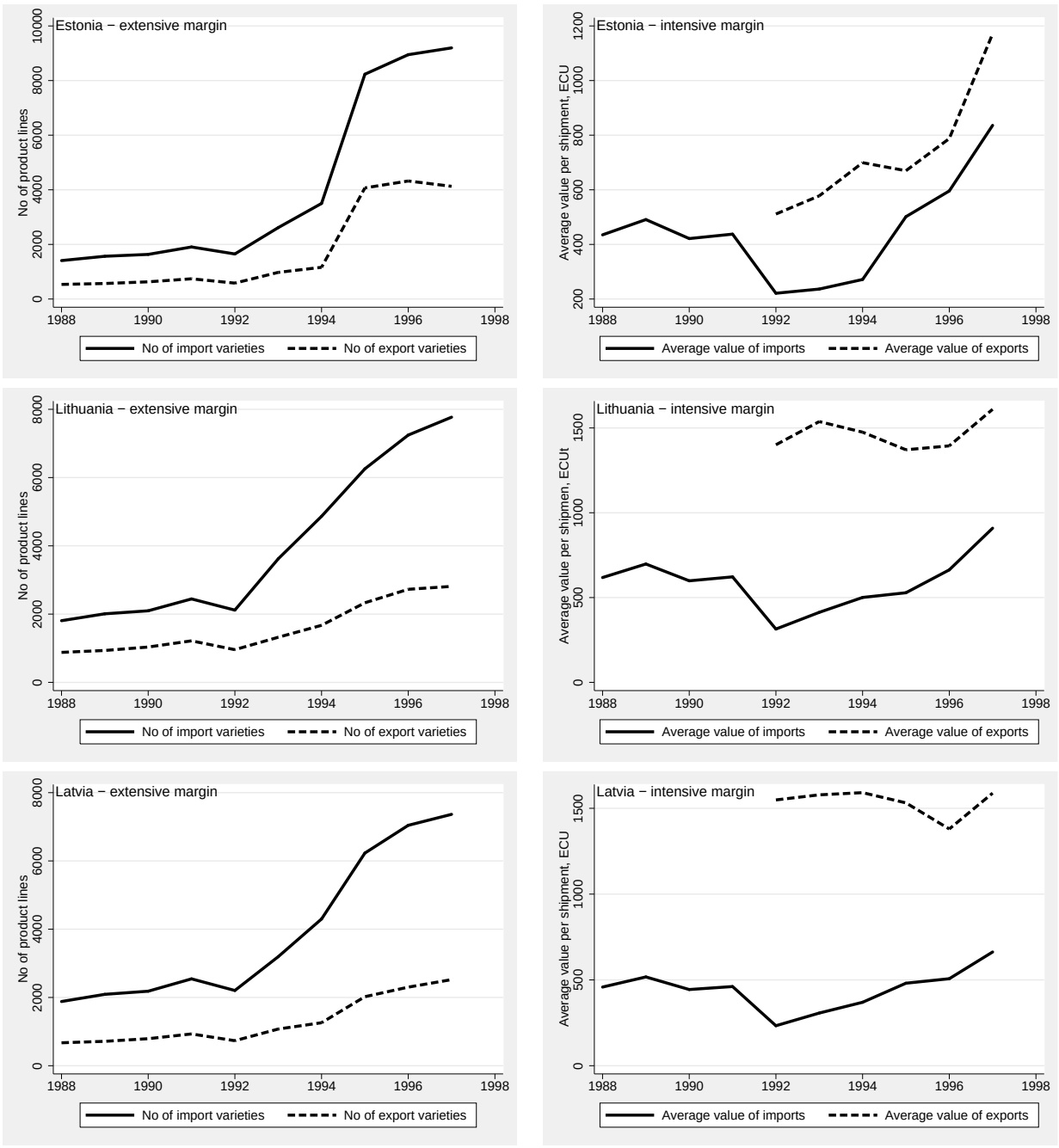

Figure 4: Imports and exports between Baltics (Estonia, Latvia and Lithuania) and the EU 1988-1997. Source: ComExt Extra-EU trade data. Notes: The extensive margin is measured by the number of traded product lines at the CN 7-digit level; the same product line traded with different EU trading partners is considered as one (the same) variety. The intensive margin is measured in 1000 ECU by the average value per a traded product line.

Not only the volume but also the structure of the Baltic's foreign trade with the

West changed significantly after the fall of the iron curtain. This is visible by comparing Tables 3 and 4 in Appendix. Whereas in 1988 grain (wheat, barley) and oil and gas pipes dominated imports from the EU, consumption goods that either there were not available and/or their variety choice set was rather narrow behind the iron curtain (motor cars and other motor vehicles, tractors, gasoline for motor cars, mobile telephones, telephonic or telegraphic switching apparatus, fully-automatic household washing machines) dominated Baltic's imports from the EU in 1997.

3. Conceptual framework

3.1. Consumer utility and love of variety

Following Amiti *et al.* (2017), we assume a nested three-tier CES utility function where at the first tier the representative consumer (either household or firm) in the CEE decides how much to consume of each good, at the second tier between domestic goods and imports, and at the third tier the consumption between varieties of a good. This setup has the advantage of allowing not only for a substitution possibility but also for different elasticities of substitution between different goods, between goods from different countries (e.g. domestic and imported goods) and between individual varieties.[5] Writing G_t for the set of goods (indexed by g) which are available to consumers at time t, the upper tier utility, U_t, in period t is then given by:

$$U_t = \left(\sum_{g \in G_t} d_g \left(X_{gt} \right)^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}} \; ; \; \kappa > 1 \tag{1}$$

where X_{gt} is the aggregate consumption of good g in period t, $d_g > 0$ is a consumer taste parameter of good g, and κ is the elasticity of substitution between goods.

The second tier sub-utility determines countries $c \in C$ (domestic and foreign suppliers) from which to source good g:

$$X_{gt} = \left(\sum_{c \in C_{gt}} d_g^c \left(X_{gt}^c \right)^{\frac{\gamma_g-1}{\gamma_g}} \right)^{\frac{\gamma_g}{\gamma_g-1}} \; ; \; \gamma_g > 1 \tag{2}$$

with γ_g denoting the elasticity of substitution between source countries of good g, X_{gt}^c denoting the aggregate quantity of good g sold in the CEE produced by the origin

[5] See section 2.2 for discussion in the CEE context.

country, $c \in C$. Hence, we allow for the likely case where there are substantial quality differences between goods from different origins, (think of domestic (soviet) products versus imported products from the West).

Of each good g, the origin country, c, sells differentiated varieties, $i \in I_{gt}^{c}$, in the CEE in time t. The asymmetric third tier sub-utility function for the consumption of variety i of good g can then be represented by:

$$X_{gt}^{c} = \left(\sum_{i \in I_{gt}^{c}} \left(d_{git}^{c} \right)^{\frac{1}{\sigma_g}} \left(x_{git}^{c} \right)^{\frac{\sigma_g - 1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g - 1}} \quad ; \quad \sigma_g > 1 \tag{3}$$

where σ_g is the elasticity of substitution between differentiated varieties of good g, x_{git} is the quantity of variety i consumed in period t, and $d_{git}^{c} > 0$ is a taste or quality parameter, which can be asymmetric across varieties. The preference parameter, d_{git}^{c}, explains why the representative consumer may prefer different amounts of closely substitutable varieties also when prices of these varieties are equal.

In the following, we use this nested CES utility system to derive an exact price index that precisely measures the cost of living and consumer utility. Note that, except for taste and elasticity parameters, all variables entering equations (1) - (3) are readily available in our data. Although we do not observe taste parameters, it turns out that they are not necessary for computing the consumer price index. All the information contained in these taste parameters is captured by expenditure shares.

3.2. Variety-aggregated exact price index

Consider a country of origin c and a good g. Assume that the quantities of individual varieties , x_{git}^{c}, are optimally chosen by the representative consumer such as to minimise expenditure $\sum_{i \in I_{gt}^{c}} p_{git}^{c} x_{git}^{c}$ subject to achieving utility $\overline{X_{gt}^{c}} \left(d_{git}^{c}, x_{git}^{c} \right) = 1$. Solution to this minimisation problem of (3) is standard and yields the corresponding CES price index:

$$P_{gt}^{c} = c_{gt}^{c} = \left(\sum_{i \in I_{gt}^{c}} d_{git}^{c} \left(p_{git}^{c} \right)^{1 - \sigma_g} \right)^{\frac{1}{1 - \sigma_g}} \tag{4}$$

where p_{git}^{c} is the price of variety i. Diewert (1976) refers to (4) as the minimum unit cost function, since it corresponds to the minimum expenditure required to obtain one unit of utility and measures the cost of living of a representative consumer. The minimum unit

cost function (4) is decreasing in the consumer taste, d^c_{git}, for the consumed variety i of good g, increasing in its price, p^c_{git}, and the elasticity of substitution between varieties, σ_g.

As shown in 7.1 in Appendix, using the approach of Feenstra (1994), changes in a variety adjusted exact price index between periods $t-1$ and t can be expressed as:

$$\frac{P^c_{gt}}{P^c_{gt-1}} = \prod_{i \in I_g} \left(\frac{p^c_{git}}{p^c_{git-1}} \right)^{w^c_{git}} \left(\frac{\lambda^c_{gt}}{\lambda^c_{gt-1}} \right)^{\frac{1}{\sigma_g - 1}} \tag{5}$$

where Sato (1976) and Vartia (1976) ideal log-change weights, w_{git}, at the variety level are defined as:

$$w^c_{git} = \left(\frac{s^c_{git} - s^c_{git-1}}{\ln s^c_{git} - \ln s^c_{git-1}} \right) \Bigg/ \sum_{i \in I_g} \frac{s^c_{git} - s^c_{git-1}}{\ln s^c_{git} - \ln s^c_{git-1}} \tag{6}$$

with corresponding expenditure shares, s_{git} and s_{git-1}, on each variety:

$$s^c_{git} \equiv \frac{p^c_{git} x^c_{git}}{\sum_{i \in I_g} p^c_{git} x^c_{git}}, \qquad s^c_{git-1} \equiv \frac{p^c_{git-1} x^c_{git-1}}{\sum_{i \in I_g} p^c_{git-1} x^c_{git-1}} \tag{7}$$

The last right-hand-side term in equation (5), $\left(\lambda_{gt}/\lambda_{gt-1}\right)^{1/(\sigma_g - 1)}$, measures the bias of the conventional exact price index with respect to the variety-adjusted exact price index. Variables λ^c_{gt} and λ^c_{gt-1} in the bias term are defined as:

$$\lambda^c_{gt} \equiv \frac{\sum_{i \in I_g} p^c_{git} x^c_{git}}{\sum_{i \in I_{gt}} p^c_{git} x^c_{git}}, \qquad \lambda^c_{gt-1} \equiv \frac{\sum_{i \in I_g} p^c_{git-1} x^c_{git-1}}{\sum_{i \in I_{gt-1}} p^c_{git-1} x^c_{git-1}} \tag{8}$$

where λ_{gt} measures the fraction of expenditure on 'common' varieties that are available in both periods, $\sum_{i \in I_g} p_{git} x_{git}$, relative to the set of new varieties available in period t, $\sum_{i \in I_{gt}} p_{git} x_{git}$, and λ_{gt-1} measures the fraction of expenditure on 'common' varieties, $\sum_{i \in I_g} p_{git-1} x_{git-1}$, relative to the set of old varieties available in period $t-1$, $\sum_{i \in I_{gt-1}} p_{git-1} x_{git-1}$.

3.3. Country-aggregated exact price index

Given the nested CES utility structure (1) - (3), as next we aggregate price indices (4) over all source countries $c \in C$ (domestic and foreign suppliers) that are selling good g in the CEE. Solution to this minimisation problem yields the corresponding country-aggregated CES price index for each good, g:

$$P_{gt} = c_{gt} = \left(\sum_{c \in C_{gt}} d_g^c \left(P_{gt}^c \right)^{1-\gamma_g} \right)^{\frac{1}{1-\gamma_g}} \tag{9}$$

Following the approach of Ardelean and Lugovskyy (2010) (which is analogous as computing change in the aggregated price index over varieties), the change in the aggregate price index between periods $t-1$ and t for good g sold in the CEE by all source countries can be expressed as:

$$\frac{P_{gt}}{P_{gt-1}} = \prod_{c \in C_g} \left(\frac{P_{gt}^c}{P_{gt-1}^c} \right)^{w_{gt}^c} \left(\frac{\Lambda_{gt}}{\Lambda_{gt-1}} \right)^{\frac{1}{\gamma_g - 1}} \tag{10}$$

where Sato-Vartia price weights defined over countries are:

$$w_{gt}^c = \left(\frac{S_{gt}^c - S_{gt-1}^c}{\ln S_{gt}^c - \ln S_{gt-1}^c} \right) \Bigg/ \sum_{c \in C_g} \frac{S_{gt}^c - S_{gt-1}^c}{\ln S_{gt}^c - \ln S_{gt-1}^c} \tag{11}$$

with corresponding expenditure shares, S_{gt}^c and S_{gt-1}^c, on good g from source country c:

$$S_{gt}^c \equiv \frac{P_{gt}^c X_{gt}^c}{\sum_{c \in C_g} P_{gt}^c X_{gt}^c}, \qquad S_{gt-1}^c \equiv \frac{P_{gt-1}^c X_{gt-1}^c}{\sum_{c \in C_g} P_{gt-1}^c X_{gt-1}^c} \tag{12}$$

and 'common' countries', $\overline{C_g} = C_{gt} \cap C_{gt-1}$, share that are selling good g in the CEE in both periods t and $t-1$:

$$\Lambda_{gt} \equiv \frac{\sum_{c \in \overline{C_g}} P_{gt}^c X_{gt}^c}{\sum_{c \in C_{gt}} P_{gt}^c X_{gt}^c}, \qquad \Lambda_{gt-1} \equiv \frac{\sum_{c \in \overline{C_g}} P_{gt-1}^c X_{gt-1}^c}{\sum_{c \in C_{gt-1}} P_{gt-1}^c X_{gt-1}^c} \tag{13}$$

In term Λ_{gt} numerator, $\sum_{c \in \overline{C_g}} P_{gt}^c X_{gt}^c$, comprises the expenditure on good g from source countries available at both time t and $t-1$. Denominator, $\sum_{c \in C_g} P_{gt}^c X_{gt}^c$, consists of expenditures on good g from countries belonging to sets C_{gt} and C_{gt-1}, respectively. In set C_{gt} common and new source countries are included, while in set C_{gt-1} common and disappearing source countries are included. Hence, terms (13) account for countries that start or stop exporting to the CEE between periods t and $t-1$. Λ_{gt} increases in new exporting countries starting to sell goods in the CEE, which lowers the price index (10), and vice versa.

3.4. Goods-aggregated exact price index

In a final step, we aggregate price indices (9) over goods. Solution to this minimisation problem yields the corresponding goods-aggregated CES price index:

$$P_t = c_t = \left(\sum_{g \in G} d_g \left(P_{gt} \right)^{1-\kappa} \right)^{\frac{1}{1-\kappa}} \tag{14}$$

Following the approach of Broda and Weinstein (2006) (which again is analogous to deriving change in the aggregated price index over varieties and countries), change in the aggregate price index between periods $t-1$ and t sold in the CEE can be expressed as:

$$\frac{P_t}{P_{t-1}} = \prod_{g \in G} \left(\frac{P_{gt}}{P_{gt-1}} \right)^{W^c_{gt}} \left(\frac{\Lambda_t}{\Lambda_{t-1}} \right)^{\frac{1}{\kappa-1}} \tag{15}$$

with Sato-Vartia price weights defined over goods:

$$W_{gt} = \left(\frac{S_{gt} - S_{gt-1}}{\ln S_{gt} - \ln S_{gt-1}} \right) \Bigg/ \sum_{g \in G} \frac{S_{gt} - S_{gt-1}}{\ln S_{gt} - \ln S_{gt-1}} \tag{16}$$

and corresponding expenditure shares, S_{gt} and S_{gt-1}, on good g in periods t and $t-1$, respectively:

$$S_{gt} \equiv \frac{P_{gt} X_{gt}}{\sum_{g \in G} P_{gt} X_{gt}}, \qquad S_{gt-1} \equiv \frac{P_{gt-1} X_{gt-1}}{\sum_{g \in G} P_{gt-1} X_{gt-1}} \tag{17}$$

and 'common' goods', $\overline{G} = G_t \cap G_{t-1}$, share that are sold in the CEE in both periods t and $t-1$:

$$\Lambda_t \equiv \frac{\sum_{g \in \overline{G}} P_{gt} X_{gt}}{\sum_{g \in G_t} P_{gt} X_{gt}}, \qquad \Lambda_{gt-1} \equiv \frac{\sum_{g \in \overline{G}} P_{gt-1} X_{gt-1}}{\sum_{g \in G_{t-1}} P_{gt-1} X_{gt-1}} \tag{18}$$

The numerator, $\sum_{g \in \overline{G}} P_{gt} X_{gt}$, of both Λ variables comprise the expenditure on 'common' goods available in both periods t and $t-1$, whereas the denominators of Λ_t and Λ_{t-1} consist of expenditures on goods belonging to sets G_t and G_{t-1}, respectively. In the G_t set, 'common' and new goods are included, while in the G_{t-1} set, 'common' and disappearing goods are included. Note that in most developed countries the last term in the goods-aggregated exact price index change (15) would be equal to one and hence disappear, as no new products are appearing (old products disappearing) at the aggregated level of goods, see e.g. Amiti *et al.* (2017). This is different in the CEE however, where after the fall of the iron curtain at the beginning of nineties entirely new goods (defined as traded

product lines at the 5-digit level) became available to consumers in the CEE via imports from the West.

3.5. Welfare gains

According to our approach outlined in sections (3.2)-(3.4), there are three potential sources of variety gains in the CEE: more varieties of products are available to consumers in the CEE (5), a larger set of producing countries are selling their products in the CEE (10), and more distinct goods are available to consumers in the CEE (15). Given our preference structure, aggregated welfare gains due to the variety growth can then be expressed as:

$$\triangle W = \left(\frac{\Lambda_t}{\Lambda_{t-1}} \right)^{-\frac{1}{\kappa-1}} - 1 \tag{19}$$

According to equation (19), the CEE's welfare gains from the variety growth are evaluated by weighting the inverse of weighted aggregate lambda ratios. As shown by Amiti *et al.* (2017), aggregate welfare gains due to the variety growth can be expressed as the relative difference between a conventional exact price index that ignores variety changes (see equation 28 in Appendix) and a variety-adjusted exact price index (see equation 33 in Appendix).

4. Estimation of elasticities

The estimation of variety gains from the trade integration according to the methodology outlined in section 3 is both data and parameter demanding and requires, among others, estimates of the elasticity of substitution between goods, source countries and varieties. We estimate the elasticity of substitution using the methodology of Soderbery (2015), which in turn is based on the work of Feenstra (1994) and Broda and Weinstein (2006).

4.1. Data generating process

To obtain the estimates of demand elasticities between varieties, σ_g, for each good, g, from observed quantities and prices, we need a model for both supply and demand, and make assumptions allowing for identification. Reconsider the asymmetric CES utility function which was shown in equation (3) and is reproduced here for the convenience of

reference:[6]

$$U_{gt} = \left(\sum_{i \in I_{gt}} d_{git}^{\frac{1}{\sigma_g}} x_{git}^{\frac{\sigma_g - 1}{\sigma_g}} \right)^{\frac{\sigma_g}{\sigma_g - 1}}. \tag{20}$$

As shown in equation (7), given a CES utility function at the third tier, the share of expenditure on a single variety $i \in I_g$ relative to the total expenditure on all varieties of good g equals

$$s_{git} \equiv \frac{p_{git} x_{git}}{\sum_{i \in I_g} p_{git} x_{git}} = \left(\frac{p_{git}}{c_{gt}} \right)^{1-\sigma_g} d_{git}, \tag{21}$$

where c_{gt} is the unit cost function from equation (4). This expenditure share derived from the consumer optimisation problem will be interpreted as the demand equation. We take logarithms and difference over time to obtain

$$\Delta \ln(s_{git}) = \phi_{gt} + (1 - \sigma) \Delta \ln(p_{git}) + \epsilon_{git}, \tag{22}$$

where $\phi_{gt} = (\sigma_g - 1) \ln \left[c_{gt}(d_{gt}) / c_{gt-1}(d_{gt-1}) \right]$ is a random effect common to all varieties within good g, and $\epsilon_{git} = \Delta \ln(d_{git})$ captures all remaining idiosyncratic disturbances to demand stemming from changes in taste for single varieties. Before estimating (22), the correlation between ϵ_{git}, prices and shares needs to be addressed. As quantities and prices are determined jointly by the intersection of demand and supply, employing the OLS estimator on equation (22) would lead to biased estimates.

To address this bias, a supply schedule is introduced as

$$\Delta \ln p_{git} = \psi_{gt} + \frac{\omega_g}{1 + \omega_g} \Delta \ln s_{git} + \delta_{git}, \tag{23}$$

where $\psi_{gt} = -\omega_g \Delta \ln E_{gt} / (1 + \omega_g)$ again is a random effect which depends on both the inverse supply elasticity ω_g (homogeneous across varieties within the good), and the total expenditure on the good, E_{gt}. The error term, $\delta_{git} = \Delta \ln(\xi_{git}) / (1 + \omega_{gt})$, captures all remaining variety-specific supply shocks.

Similar to how differencing over time removes cross-sectional time-invariant effects in a panel-setup, the supply and demand equations are differenced with respect to a reference variety $k \in I_g$ to remove good-specific terms, ϕ_{gt} and ψ_{gt}. Denoting this double differencing operator with Δ^k, and the differenced error terms as $\epsilon_{git}^k = \epsilon_{git} - \epsilon_{gkt}$ we

[6] In this subsection, for brevity, we omit the country superscript c.

obtain

$$\Delta^k \ln s_{git} \equiv \Delta \ln s_{git} - \Delta \ln s_{gkt} = -(\sigma - 1)\Delta^k \ln p_{git} + \epsilon^k_{git},$$

and

$$\Delta^k \ln p_{git} \equiv \Delta \ln p_{git} - \Delta \ln p_{gkt} = \frac{\omega_g}{1+\omega_g}\Delta^k \ln s_{git} + \delta^k_{git}. \tag{24}$$

A key assumption for identification is that the remaining demand and supply shocks to varieties are independent, such that $\mathrm{E}[\epsilon^k_{git}\delta^k_{git}] = 0$. We can write demand and supply bringing the error terms to one side, and multiply both equations to obtain

$$(\Delta^k \ln p_{git})^2 = \theta_1(\Delta^k \ln(s_{git}))^2 + \theta_2(\Delta^k \ln(s_{git})\ln(p_{git}))^2 + \epsilon^k_{git}\delta^k_{git}$$

or

$$Y_{git} = \theta_1 X_{1,git} + \theta_2 X_{2,git} + u_{git}, \tag{25}$$

where Y, X_1, X_2 and u are appropriately defined, and

$$\theta_1 = \frac{\omega_g}{(1+\omega_g)(\sigma_g - 1)} \qquad \text{and} \qquad \theta_2 = \frac{1-\omega_g(\sigma_g - 2)}{(1+\omega_g)(\sigma_g - 1)}. \tag{26}$$

Note that the variables in (26) are the second moments of changes in prices and expenditure shares, and the error term is the cross-moment of demand and supply shocks.

4.2. Estimators

As demand shocks are assumed to be independent, we have $\mathrm{E}[u_{git}] = 0$. Unfortunately, the error term is correlated with both prices and expenditure shares contained in X_1 and X_2, causing direct estimation of (26) to produce biased results.

Feenstra (1994) proposes a simple method to obtain unbiased estimates for θ_1, θ_2 and thereby for the elasticities σ_g and ω_g, by time-averaging equation (26) to obtain

$$\overline{Y}_{gi} = \theta_1 \overline{X}_{1,gi} + \theta_2 \overline{X}_{2,gi} + \overline{u}_{gi}, \tag{27}$$

which can be estimated by the OLS estimator or employing the WLS estimator with $1/T_{gi}$ as weights for an improved efficiency. This between estimation provides unbiased estimates as $\mathrm{plim}(\overline{u}_{gi})$=0, such that the error-term (and source of bias) disappears as $T \to \infty$, under the condition that X_1 and X_2 are not proportional. This estimator is an implementation of the GMM estimator approximating the moment condition, $\mathrm{E}[u_{git} = 0]$.

As argued by Broda and Weinstein (2006), however, this method frequently produces estimates of θ_1 and θ_2 which do not correspond to meaningful values for σ_g and ω_g. As a solution, they suggest to run a grid search over a set of possible values for σ_g and ω_g, translate this into values for θ_1 and θ_2, evaluate the GMM objective function and choose those parameter combination which minimises it. The grid-search itself is not free from problems, however. In practice, it turns out that the simple estimator of Feenstra (1994) fails because of reasons which also cause problems for the grid-search. As a result, the grid-search will very frequently end up with solutions which are close to the boundary of the grid, resulting in very high or very low elasticity estimates.

As shown by Soderbery (2015), the underlying problem of these issues is that the 'second step' of the above estimation method, which starts from the correlation and variation of expenditure shares contained in the time-averaged variables for each variety, gives an equal weight to each variety - apart from weighing by the number of observations. This tends to assign more weight to outliers, especially for those varieties (or entire data sets) where T is small. Soderbery (2010, 2015) shows that the Limited Information Maximum Likelihood (LIML) estimator is less sensitive to such small sample bias, and proposes a hybrid estimator which switches from the LIML to constrained the nonlinear LIML in cases where standard the LIML would produce meaningless estimates of the elasticities. Given these advantages of the LIML estimator, in the present study we follow Soderbery (2010, 2015) and use the hybrid LIML estimator.

4.3. Elasticity estimates

Using the hybrid LIML estimator of Soderbery (2015), we estimate the elasticities between varieties of different goods. Figure 5 shows the cumulative distribution function of our elasticity estimates, replacing estimates of σ in excess of 3.[7] The left panel in Figure 5 shows the results when defining goods at the 2-digit level, and varieties at the 5-digit level, and compares this to the estimates when defining goods at the lower 4-digit level and varieties on the same 5-digit level. As intuition would suggest, 5-digit varieties are more heterogeneous to consumers when combining them in a few 2-digit level goods and as a result the estimated elasticity of substitution is lower with goods defined at the 2-digit level. For example, about 20 percent of elasticities are lower than 1.5 with goods at the 4-digit level, whereas this is about 35 percent with goods at the 2-digit level. Reversely, virtually no 2-digit level good has an estimated elasticity above 2.5, whereas about 10 percent of the 4-digit level goods have. The right panel in Figure

[7] This is done in order to improve the visual tractability of the Figure.

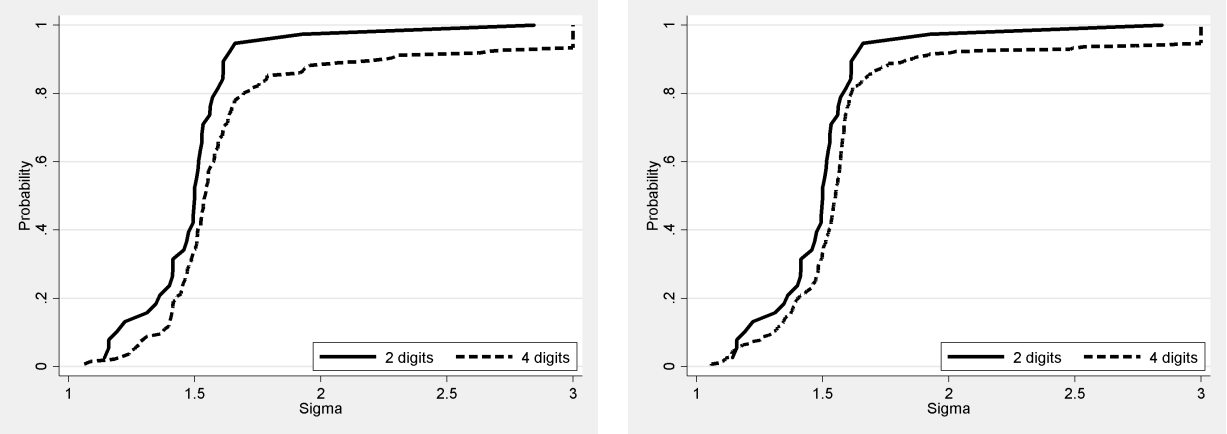

Figure 5: Cumulative distribution function of elasticity estimates. Source: Authors' estimates with the hybrid LIML estimator. Notes: Left panel: goods are defined at the 2-digit level and varieties at the 5-digit level (solid line); and goods at the 4-digit and varieties at the 5-digit level (dashed line). Right panel: goods are defined at the 2-digit level, varieties at the 5-digit level; and goods at the 4-digit and varieties at the 7-digit level (dashed line).

5 plots the distribution of elasticities with goods at the 2-digit level and varieties at the 5-digit level, but now compares it with goods defined at the 4-digit level and varieties at the 7-digit. Although, in both choices varieties are 2-levels of classification down from the goods level, we expect 7 digit varieties within 5 digit goods to be more substitutable compared to 5 digit varieties within 2-digit goods. Again this intuition is confirmed by our estimates.

It is not straightforward to find a suitable benchmark in literature with which to compare our estimation results. We are not aware of any study that estimates the elasticities of substitution for all traded goods for this particular region (CEE) and this particular period (fall of the iron curtain).

Compared to estimates for developed economies, our estimates are of the same order of magnitude as those available in the literature. For example, Feenstra *et al.* (2018) use disaggregated data for the US trade and domestic production to estimate macro and micro elasticities. As in our study, the macro estimates (higher level aggregation of goods) are lower than micro estimates (lower level aggregation of goods). Depending on estimator, in Feenstra *et al.* (2018) the median estimates of micro elasticities range between 1.54 and 3.24, whereas the median estimates of macro elasticities range between 1.39 and 2.36 for machinery. Berlingieri (2013) estimates the elasticity of substitution between varieties at 2.86 (median) for the period before and after the fall of the iron curtain. The estimated elasticities of Berlingieri (2013) are slightly higher than ours. Note, however,

that the estimates of Berlingieri (2013) are for CEE's goods in Western Europe (exports), whereas our estimates are for Western Europe's goods in CEE (imports), and hence are not directly comparable. The elasticity estimates for the US are in a similar range as those for the Western Europe (Feenstra *et al.*, 2018; Simonovska and Waugh, 2014). Feenstra *et al.* (2018) use disaggregated data for the US trade and domestic production to estimate elasticities of substitution. Depending on estimator, the median estimates of micro elasticities (lower level aggregation of goods aggregation) range between 1.54 and 3.24.

There are several reasons explaining why our estimated elasticities could be slightly lower than those in the literature for developed countries. First, the set of available goods/varieties in the West was considerably larger than in the East, implying that different varieties of the same good likely were closer substitutes in the West (higher sigma) than in the East (lower sigma). Another reason for slight differences in the magnitude of estimated elasticities could be in the definition of varieties. Whereas in our study varieties are defined as different goods at the seven digit product codes, most studies in the literature define varieties according to the country of origin. It is intuitive that, for example, table apples and juice apples (our study) are less substitutable than table apples from Spain and table apples from Italy (Broda and Weinstein, 2006). Moreover, even in those studies that define varieties as distinct product lines are not directly comparable to our data, because there were many less varieties available at any digit product line in the Baltics than in the West. It is intuitive that the more produc varieties are available at a given aggregation level (e.g. 7-digit), the more substitutable they are likely to be. Finally, a fundamental difference between our data and those for developed market economies lays in the underlying price structure for goods and services on each side of the iron curtain. Whereas in the West prices were to a certain degree (depending e.g. on the market structure) an outcome of market interactions between supply and demand, in the East they were sometimes set according to ideological convictions of the ruling communist party (see section 2.2). As a result, there were subsidised goods in the CEE, which were sold under production costs, e.g. bread, as well as there were marked-up goods, the price of which was maintained 'artificially' high, e.g. cars (Weitzman, 1969; Manove, 1971; Chernyshova, 2013). In addition, as detailed in section 2.2, many consumption goods and their varieties were simply not freely available in shops for any price.In order to ensure sensibility of our results in absence of benchmark estimates in the literature, we perform extensive sensitivity analyses and robustness checks with respect

to alternative classification of goods and varieties and alternative reference years for estimating consumer preferences (elasticity of substitution).

5. Results: welfare gains from the variety growth

We evaluate changes in consumer welfare due to changes in the set of available varieties from domestic and import sources in Estonia, Latvia and Lithuania in the immediate period before and after the fall of the iron curtain based on the two data sets described in section 2, the methodology outlined in section 3 and elasticities of substitution estimated in section 4. We use the ComExt Extra-EU trade data for all three Baltic countries' trade with each EU Member State to estimate welfare gains from the variety growth in Estonia, Latvia and Lithuania for the period 1988-1997. In order to account for changes in the consumer cost of living due to changes in the consumer choice set of domestic varieties, we use the industrial and agricultural product data for Latvia for the period 1988-1994, which are the only domestic data available for the Baltics for this period. Although these latter data are available only for Latvia covering the first two subperiods of the whole estimated period, they are valuable by providing us a rough idea about total changes in the consumer welfare due to changes in consumer choice sets of both imported and domestic varieties.

In order to account for the qualitatively important changes in the Baltic's foreign trade policy regime with the EU (see section 2.3), we split the estimated ten year period into three subperiods: 1989-1991, 1992-1994 and 1995-1997.[8] The estimated welfare gains from the variety growth from the Baltics's trade integration with the EU are reported in Table 2. The estimation results are reported for each of the three subperiods separately (columns 2-4) as well as aggregated for the whole 1989-1997 period (column 5). Whereas welfare gains due to the import variety growth are estimated for all three Baltic countries and all three sub-periods (rows '*foreign*'), welfare gains/losses due to changes in the consumption set of domestic varieties are estimated for Latvia for the first two sub-periods only, determined by the data availability (rows '*domestic*'); domestic results for Estonia and Lithuania are imputed using Latvia's estimates.

The estimated welfare gains from the variety growth from the Baltics's trade integration with the EU for the 1989-1997 period suggest that consumers in Estonia gained most among the three Baltic countries (last column in Table 2). Whereas the average annual

[8]The year 1988 is used as the benchmark against which we measure changes in the consumer cost of living due changes in the set of available varieties in 1989.

Table 2: Annual changes in the consumer welfare due to variety changes in the Baltics, 1989-1997

	1989-1991	1992-1994	1995-1997	1989-1997
Estonia, total	0.07	-	-	-
domestic	-0.01*	-	-	-
foreign	0.34	0.73	2.77	1.28
Latvia, total	0.07	0.34	-	-
domestic	-0.01	-0.08	-	-
foreign	0.34	0.81	1.03	0.73
Lithuania, total	0.07	-	-	-
domestic	-0.01*	-	-	-
foreign	0.34	1.12	0.90	0.79

Source: Authors' estimates using the methodology outlined in section 3. Notes: No data are available for evaluating changes in the consumer welfare due to domestic variety changes for Estonia (1989-1997), Lithuania (1989-1997) and Latvia (1995-1997). *Changes in domestic welfare gains for Estonia and Lithuania for the 1989-1991 period are proxied by Latvia's estimates.

decline in the consumer cost of living due to the import variety growth and the associated increase in welfare gains was 1.28% in Estonia, it accounted for 0.73% and 0.79% in Latvia and Lithuania, respectively. Although, our data do not allow to identify and decompose sources of the trade growth within extensive and intensive margins, likely, these higher welfare gains from the variety growth in Estonia are due to more liberal foreign trade policy compared to the other two Baltic countries in the beginning of nineties.

Decomposing welfare gains from the import variety growth into the three subperiods separately, it is interestingly to observe that during 1989-1991, estimated annual changes in the consumer cost of living were similarly moderate in Estonia, Latvia and Lithuania, amounting to 0.34% per year (see column 2 in Table 2). These results are little surprising though. As explained in section 2, Estonia, Latvia and Lithuania were occupied and annexed by the soviet union until 1991. As result, the foreign trade policy with the West was similarly restrictive in the three Baltic countries during this period, and there was rather little trade with the EU (see Figure 4).

In the following 1992-1994 subperiod, annual welfare gains from the import variety growth more than doubled in Estonia and Latvia (0.73% and 0.81%, respectively) and more than tripled in Lithuania (1.12%) (see column 3 in Table 2). These results are consistent with the restoration of independence and the foreign trade policy liberalisation in the Baltics in 1991. Estonia, Latvia and Lithuania removed all ideologically-driven foreign trade policy restrictions, which implied that no consumer was prohibited anymore

to buy any type of consumption good in any amount from any foreign country, including western European countries. However, both exports from the Baltics to the EU and imports from the EU to the Baltics were subject to tariff barriers, which were different across the three Baltic countries. As regards import tariffs, by far the most liberal was Estonia (see section 2.3).

Welfare gains from the import variety growth became more and more heterogenous across the three Baltic countries, reflecting among others differences in the foreign trade policy. They were considerably more heterogenous in the in the third estimated subperiod (1995-1997) compared to the first subperiod (1988-1991), when Estonia, Latvia and Lithuania all were part of the soviet union and hence had the same foreign trade policy. Whereas they almost quadrupled compared to 1992-1994 in Estonia, welfare gains from the import variety growth actually decreased in Lithuania compared to the previous subperiod (see column 4 in Table 2). In contrast, in Latvia they increased slightly. Although our data do not allow to identify sources of these differences between Estonia, Latvia and Lithuania, they seem to be related to differences in the implemented foreign trade policy. On January 1995, the Agreement on Free Trade and Trade Related Matters between Estonia, Latvia and Lithuania and the EU entered into force, implying that practically all tariff barriers between Estonia, Latvia and Lithuania and the EU were abolished and a free trade regime was established. Furthermore, compared to Latvia and Lithuania, Estonia has unilaterally abolished all import barriers to the foreign trade already before this Free Trade Agreement with the EU (see section 2.3).

Table 2 also reports annual changes in the consumer welfare due to changes in the domestic variety growth in Latvia. In both estimated subperiods for which data are available (1989-1991 and 1992-1994), the set of available domestic varieties of consumption goods actually declined in Latvia. This decline in variety has contributed negatively to the overall consumer welfare, -0.01% and -0.08% in 1989-1991 and 1992-1994, respectively. Because of smaller consumer choice set of domestic goods, also the total welfare gains due to changes in the consumption goods' variety were lower. In the first (1989-1991) subperiod, the total welfare gains due to decline in the domestic variety decreased from 0.34% to 0.07% of GDP per year in Latvia. Because of missing data, we use estimates for Latvia to calculate changes in the domestic variety of consumption goods for Estonia and Lithuania for the 1988-1991 period, as all three Baltic countries were part of the soviet union and hence had the same availability of the same set of consumption goods until 1991. In the second (1992-1994) subperiod, total welfare gains were 0.34% instead of

0.81% of GDP per year in Latvia. As for the third (1995-1997) subperiod, although we do not have data to estimate the associated welfare gains for this period, likely, changes in the consumer welfare due to changes in the domestic variety set have become positive again. As visible from Figure 2, the ongoing decrease of both extensive and intensive margins of trade came to halt in 1993 and even slightly increased between 1993 and 1994.

Again, it is not straightforward to find a suitable benchmark in literature with which to compare our results. We are not aware of any study that estimates the impact of changes in the consumer choice set on aggregate prices for this particular region (CEE) and this particular period (iron curtain). With respect to classical gains from trade, the two closest studies to ours are Levchenko and Zhang (2012) and Berlingieri (2013). Levchenko and Zhang (2012) simulate welfare gains from the trade integration in a hypothetical scenario, with a baseline assumption of preserving the iron curtain. Authors obtain substantial cumulative welfare gains for CEE economies (up to 15% of GDP). However, these results are based on a CGE model, which neglects the variety dimension of welfare gains from trade, and is parameterised with assumed/calibrated parameters. In light of these findings, our cumulative estimates of 7.3-12.8% of GDP over the estimated ten-year period seem to be sensible. In terms of variety gains from trade, more similar to ours is a study of Berlingieri (2013), who estimates welfare gains due to the variety growth associated with the fall of the iron curtain for trading partners in the West, and finds substantial variety gains from trade liberalisation with the CEE, e.g. the cumulative variety gains for the UK are estimated at 2% of GDP. Benkovskis and Rimgailaite (2011) find that after joining the EU, CEE economies significantly increased the quality and variety of goods and services exported to the EU market. However, Benkovskis and Rimgailaite (2011) focus on the export quality in a more recent period, when the impact of new goods and varieties from the West did not have as significant impact on consumer welfare anymore.

In the context of previous estimates in the literature for developed economies (Broda and Weinstein, 2004; Hummels and Klenow, 2005; Broda and Weinstein, 2010; Blonigen and Soderbery, 2010), our estimates are of the same order of magnitude or slightly higher. For example, Broda and Weinstein (2006) find that the unmeasured growth in the product variety has been an important source of gains from trade in the US over the 1972-2001 period. They estimate that the import bias in the conventional price index was 28% or 1.2 percentage points per year and welfare gains were equal to 2.6% of GDP.

When comparing these findings with those of literature, they need to be seen in

light of the initial pattern of the foreign trade, which was heavily restricted and biased towards the East in the Baltics. As detailed in section 2 and illustrated in Figure 4, only few commodities were imported in the Baltics from the EU before the fall of the iron curtain. In addition, given that imports from the West were scarce, on the black market they were marked up as luxury goods. An increase in the availability of western goods in post-autarkic markets in the East during the nineties and a decrease in prices for imported goods both contributed to a rapid increase in the demand for western goods. Given that most of the observed trade growth took place through the extensive margin (see Figure 4), our estimates of the variety growth and the associated welfare gains seem to be in a plausible range.

6. Conclusions

The fall of the iron curtain a quarter of a century ago has led to one of the largest and most abrupt trade policy liberalisations in the postwar European history. Virtually overnight, around a dozen of former centrally planned economies in the CEE opened up their markets to the world trading system. Attempts towards assessing the impact of the trade liberalisation on CEE economies have been limited to classical gains from trade. However, entirely new goods and varieties that became available in formerly centrally planned economies through the rapidly growing foreign trade with the West created additional welfare effects, which are not captured by neoclassical trade models. The present paper estimates the welfare effects operating through changes in the choice set of consumers following the fall of the iron curtain in the CEE. We use the example of Baltic countries – Estonia, Latvia and Lithuania – and apply recent trade theories to a situation of a large and abrupt trade policy shock following the fall of the iron curtain. Baltics is a particularly good example, as the three Baltic economies were among the most isolated CEE economies regarding the foreign trade with the West.

We apply the methodology of Feenstra (1994); Broda and Weinstein (2006); Ardelean and Lugovskyy (2010); Soderbery (2015) to domestic and international trade data for the period 1988-1997 to evaluate welfare gains associated with the variety growth from the Baltic's breakout from the politically imposed economic isolation into the world trading system by calculating the compensating variation that results from changes in the set of imported goods varieties from EU Member States in the immediate period after the fall of the iron curtain.

Our estimation results suggest that welfare gains from the variety growth from the

Baltics's trade integration with the EU during the 1988-1997 period were substantial. Whereas the average annual decline in the consumer cost of living due to the import variety growth and the associated increase in welfare gains was 1.28% in Estonia, it accounted for 0.73% and 0.79% in Latvia and Lithuania, respectively. Second, the variety of domestically produced and consumed goods declined during the same period, contributing negatively to the consumer welfare in the Baltics. In the first (1989-1991) subperiod, total welfare gains due to decline in the domestic variety decreased from 0.34% to 0.07% of GDP per year in Latvia. In the second (1992-1994) subperiod, total welfare gains were 0.34% instead of 0.81% of GDP per year.

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7. Appendix

7.1. Conventional exact price index

The conventional price index assumes that the set of product varieties and the quality and taste of varieties do not change over time. Without loss of generality, we can assume two periods, $t-1$ and t, which implies $I_{gt} = I_{gt-1}$ and $d_{git} = d_{git-1}$.[9] Following Diewert (1976), we define the conventional *exact* price index, P_g^{CEPI}, as the ratio of expenditures needed to obtain a fixed level of utility at the different set of prices in both periods:[10]

$$\triangle P_g^{CEPI} = \frac{P_{gt}^c}{P_{gt-1}^c} = \frac{c_{gt}}{c_{gt-1}} \tag{28}$$

Sato (1976) and Vartia (1976) have shown for the CES case that this conventional price index is equal to a weighted geometric mean of variety prices in both periods:

$$\triangle P_g^{CEPI} = \prod_{i \in I_g} \left(\frac{p_{git}}{p_{git-1}} \right)^{w_{git}} \tag{29}$$

where ideal log-change weights, w_{git}, at the variety level are defined as follows:

$$w_{git} = \left(\frac{s_{git} - s_{git-1}}{\ln s_{git} - \ln s_{git-1}} \right) \Bigg/ \sum_{i \in I_g} \frac{s_{git} - s_{git-1}}{\ln s_{git} - \ln s_{git-1}} \tag{30}$$

with corresponding expenditure shares, s_{git} and s_{git-1}, on each variety

$$s_{git} \equiv \frac{p_{git} x_{git}}{\sum_{i \in I_g} p_{git} x_{git}}, \qquad s_{git-1} \equiv \frac{p_{git-1} x_{git-1}}{\sum_{i \in I_g} p_{git-1} x_{git-1}} \tag{31}$$

This traditional price index is a useful benchmark against which to measure variety gains (or losses). A critical assumption underlying the exact price index of Sato (1976) and Vartia (1976) is that all varieties are available in both periods, i.e., the set of available varieties does not change over time, this assumption is relaxed in the variety-adjusted exact price index.

[9] In this section, for brevity, we omit the country superscript c.

[10] The cost-of-living price index is referred to as *exact*, because it exactly matches changes in the minimum unit-costs, c_g.

7.2. Variety-adjusted exact price index

Krugman (1980) was among the first who noted that increasing the set of horizontally differentiated varieties in the consumption basket may increase consumer welfare. Using a monopolistic competition framework with symmetric CES preferences, $d_{gi} = 1 \; \forall \; i \in I_g$ and symmetric prices , $p_{gt} \left(= p_g\right)$,[11] Krugman (1980) showed that an increase in the number of available varieties, I_{gt}, e.g. through a larger set of imported product variety, reduces the minimum unit cost, c_{gt}, which is required to achieve a given level of utility in (4). Or alternatively, an increase in the number of available varieties increases the level of utility, which can be achieved at cost c_{gt}.

Romer (1994) extended the Krugman (1980) model to allow for changes in the number of available varieties, e.g. due to a reduction in tariffs and hence fixed costs of accessing foreign markets. In order to account for the variety growth effect on welfare, Romer (1994) showed that the conventional exact price index, P_g^{CEPI}, has to be multiplied by the ratio of available variety sets in the two periods, which yields a symmetric variety-adjusted exact price index:

$$\triangle P_g^{VEPI} = \triangle P_g^{CEPI} \left(\frac{I_{gt-1}}{I_{gt}} \right)^{\frac{1}{\sigma_g - 1}} \tag{32}$$

According to the *Romer's* price index, (32), an increase in the number of varieties, I_{gt}, available in period t compared to the number of varieties, I_{gt-1}, available in period $t-1$ leads to a decrease in the exact price index, P_g^{VEPI}, relative to the conventional price index, P_g^{CEPI}.

As in Krugman (1980), varieties are symmetric (the same price and quantity) also in (32). A downside of this approach is that the variety-adjusted exact price index can yield substantial bias in cases when varieties are not symmetric. For example, if new varieties represent only a small share of the total expenditure on good g, then a simple count of varieties will grossly overestimate the true impact of the new varieties and vice versa.

Feenstra (1994) proposed a more general framework for cases when the (overlapping) set of *asymmetric* varieties changes between periods. Hence, Feenstra (1994) relaxed both the symmetry assumption of Krugman (1980) and Romer (1994) models, and the assumption of a constant set of varieties of Krugman (1980), implying that $I_{gt} \neq I_{gt-1}$. As above, the assumption that taste and substitutability parameters are constant over time, i.e. $d_{git} = d_{git-1} = d_{gi}$ and $\sigma_{gt} = \sigma_{gt-1} = \sigma_g$, is maintained.

[11] Assuming symmetric CES preferences, $d_{gi} = 1 \forall i \in I_g$ in combination with monopolistic competition between symmetric supplies of individual varieties implies that all varieties i of good g are equally priced at p_g.

In line with the definition of the exact cost-of-living price index, the asymmetric variety-adjusted price index of Feenstra (1994) equals the ratio of unit costs and uses weights, which are functions of expenditure shares, s_{git} and s_{git-1}, in the two periods, respectively. Feenstra (1994) has shown that using definitions of s_{git} and s_{git-1} given in equation (31), the expenditure share on each variety can be expressed as $s_{git}\left(I_{gt}\right) = s_{git}\left(I_g\right)\lambda_{gt}$ and $s_{git-1}\left(I_{gt-1}\right) = s_{git-1}\left(I_g\right)\lambda_{gt-1}$, with

$$\lambda_{gt} \equiv \frac{\sum_{i\in I_g} p_{git}x_{git}}{\sum_{i\in I_{gt}} p_{git}x_{git}}, \qquad \lambda_{gt-1} \equiv \frac{\sum_{i\in I_g} p_{git-1}x_{git-1}}{\sum_{i\in I_{gt-1}} p_{git-1}x_{git-1}}$$

The numerator, $\sum_{i\in I_g} p_{git}x_{git}$, of both λ variables comprise the expenditure on varieties available in both periods t and $t-1$. The denominators of λ_{gt} and λ_{gt-1} consist of expenditures on varieties belonging to the sets I_{gt} and I_{gt-1}, respectively. In I_{gt} set, common and new varieties are included, while in I_{gt-1} set, common and disappearing varieties are included. Substituting $s_{git}\left(I_g\right)\lambda_{gt}$ and $s_{git-1}\left(I_g\right)\lambda_{gt-1}$ into the the *Romer's* price index, (32) allows us to rewrite the asymmetric variety-adjusted price index as:

$$\triangle P_g^{VEPI} = \triangle P_g^{CEPI}\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g-1}} = \prod_{i\in I_g}\left(\frac{p_{git}}{p_{git-1}}\right)^{w_{git}}\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g-1}} \tag{33}$$

where term $\left(\lambda_{gt}/\lambda_{gt-1}\right)^{1/(\sigma_g-1)}$ measures the bias of the conventional exact price index, P_g^{CEPI}, with respect to the variety-adjust exact price index, P_g^{VEPI}. Variable λ_{gt} measures the fraction of expenditure on varieties that are available in both periods, $\sum_{i\in I_g} p_{git}x_{git}$, relative to the set of new varieties available in period t, $\sum_{i\in I_{gt}} p_{git}x_{git}$. Analogously, λ_{gt-1} measures the fraction of expenditure on varieties that are available in both periods, $\sum_{i\in I_g} p_{git-1}x_{git-1}$, relative to the set of old varieties available in period $t-1$, $\sum_{i\in I_{gt-1}} p_{git-1}x_{git-1}$.[12] Note that λ_{gt} is decreasing in the expenditure share of new varieties. The higher is the expenditure share of new varieties, the lower is λ_{gt}, and the lower is the variety-adjusted exact price index, P_g^{VEPI}, compared to the conventional exact price index, P_g^{CEPI}. Whereas high expenditures on new varieties lower the lambda ratio, high expenditures on disappearing varieties increase it. Further, the variety-adjusted exact price index (33) also depends on the good-specific elasticity of substitution between varieties, σ_g. The higher is σ_g – existing varieties are closer substitutes to new or disappearing varieties – the lower is the exponent, $1/\left(\sigma_g-1\right)$, implying that the inverse

[12] Alternatively, this can be interpreted as one minus the share of period t expenditure on new goods (not included in set I), $\sum_{i\in I_{gt}, i\notin I} p_{git}x_{git}$.

measure of product variety, $\left(\lambda_{gt}/\lambda_{gt-1}\right)^{1/(\sigma_g-1)}$, approaches unity, which implies that changes in the set of available varieties between periods $t-1$ and t will have smaller impact on the exact price index. In contrast, when σ_g is small, varieties are far substitutes, consumers value additional varieties a lot, and the disappear of varieties is very costly. In this case the exponent, as the whole bias term, approaches infinity implying that the difference between the conventional price index, P_g^{CEPI}, and the exact price index, P_g^{VEPI}, will be large.

7.3. Additional figures and tables

Figure 6 depicts a girl Gaby from the Eastern Germany, who never in her life has seen a real banana. The situation with the availability of different consumer goods and their varieties in former soviet republics, including Estonia, Latvia and Lithuania, was even worse.

An insufficient supply of many goods implied that shopping for desired consumption goods, whether a washing machine, a mixer, or a television set, never really became as simple or straightforward in the East as it was in the West (see Figure 7). While many goods were rationed,[13] the majority of other purchases involved queuing, which ranged in length from several hours (e.g. for food) to several years (e.g. for cars); often they required physical endurance or just sheer luck (Birman, 1989). According to Shleifer and Vishny (1991), 30 million man-years were spent in queues annually in the USSR - about 25 percent of the waking time of every adult. This in turn reduced the productive time spent on work and hence on producing goods and services, contributing in such way to the vicious circle of inefficiencies and a foregone output.

[13]For example, at the end of 1991, nearly every kind of food was rationed. Non-rationed foods and non-food consumer goods had virtually disappeared from state-owned stores (Shen, 1994).

Figure 6: Shopping for basic goods in the soviet economy. Source: Titanic, 1989/11. Notes: *My first banana* (translation from German) is one of the Eastern Germany Titanic Magazine's most widely known cover pages.

Figure 7: Shopping for basic goods a planning in the soviet economy in 1990. Source: Authors' photographs.

Table 3: 20 most imported goods in value terms in the Baltics from the EU in 1988

No	Product nc	Product description
1	10019099	Spelt, common wheat and meslin (excluding seed)
2	73051100	Line pipe of a kind used for oil or gas pipelines, having circular cross-sections and an external diameter of > 406,4 mm, of iron or steel, longitudinally submerged arc welded
3	73053100	Tubes and pipes having circular cross-sections and an external diameter of > 406,4 mm, of iron or steel, longitudinally welded
4	73043991	Tubes, pipes and hollow profiles, seamless, of circular cross-section, of iron or non-alloy steel, not cold-drawn or cold-rolled 'cold-reduced', of an external diameter of <= 168,3 mm
5	99SSS999	Confidential trade of SITC group 999
6	73043191	Precision tubes, seamless, of circular cross-section, of non-alloy steel, cold-drawn or cold-rolled 'cold-reduced'
7	10030090	Barley (excluding seed)
8	85152100	Fully or partly automatic machines for resistance welding of metals
9	84III300	Components of complete industrial plants of chapter 84; mechanical engineering and construction of means of transport; instrument engineering
10	73089099	Structures and parts of structures of iron or steel, N.E.S.
11	84III400	Components of complete industrial plants of chapter 84; chemical industry (including man-made fibres industry); rubber and plastics industry
12	39042200	Plasticised "polyvinyl chloride", in primary forms, mixed with other substances
13	85451100	Electrodes of graphite or other carbon, for electric furnaces
14	64035995	Men's footwear with outer soles and uppers of leather, with in-soles of >= 24 cm in length
15	84III200	Components of complete industrial plants of chapter 84; iron and steel industry; manufacture of metal articles excluding mechanical engineering and construction of means of transport
16	2032110	Frozen domestic swine carcases and half-carcases
17	84522900	Sewing machines, industrial type (excluding automatic units)
18	73064099	Tubes, pipes and hollow profiles, welded, having a circular cross-section, of stainless steel
19	28092000	Phosphoric acid; polyphosphoric acids, whether or not chemically defined
20	84262000	Tower cranes

Source: ComExt Extra-EU trade data, 1988.

Table 4: 20 most imported goods in value terms in the Baltics from the EU in 1997

No	Product nc	Product description
1	27100029	Motor spirit, with a lead content <= 0.013 g/l, with an octane number of >= 95, but < 98
2	87032319	Motor cars and other motor vehicles principally designed for the transport of persons, including station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine, of a cylinder capacity > 1.500 cmş but <= 3.000 cmş, new
3	87032390	Motor cars and other motor vehicles principally designed for the transport of persons, incl. station wagons and racing cars, with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity > 1.500 cmş but <= 3.000 cmş, used
4	87EEE004	Sets of goods of chapter 87
5	87012010	Road tractors for semi-trailers, new
6	30049019	Medicaments consisting of mixed or unmixed products for therapeutic or prophylactic purposes, put up for retail sale
7	85252091	Transmission apparatus, incorporating reception apparatus, for cellular networks 'mobile telephones'
8	43021100	Tanned or dressed furskins of mink, whole, with or without heads, tails or paws, not assembled
9	27100066	Gas oils of petroleum or bituminous minerals, with a sulphur content of <= 0,05% by weight
10	17019910	White sugar, containing in dry state>= 99,5% sucrose (excluding flavoured or coloured)
11	9012100	Roasted coffee (excluding decaffeinated)
12	15149090	Rape, colza or mustard oil and fractions thereof, whether or not refined, but not chemically modified (excluding for industrial uses and crude)
13	24022090	Cigarettes, containing tobacco (excluding containing cloves)
14	85173000	Telephonic or telegraphic switching apparatus
15	87042299	Motor vehicles for the transport of goods, with compression-ignition internal combustion piston engine "diesel or semi-diesel engine" of a gross vehicle weight > 5 t but <= 20 t, used
16	87089998	Parts and accessories for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, Motor vehicles for the transport of goods and special purpose motor vehicles, N.E.S.
17	84501111	Fully-automatic household or laundry-type front-loading washing machines, of a dry linen capacity <= 6 kg
18	21069092	Food preparations N.E.S., not containing milkfat, sucrose, isoglucose starch or glucose or containing less than 1.5% milkfat, less than 5% sucrose or isoglucose, less than 5% glucose or less than 5% starch
19	15171090	Margarine containing <= 10% milkfats (excluding liquid)
20	87012090	Road tractors for semi-trailers, used

Source: ComExt Extra-EU trade data, 1997.