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# INDUSTRIAL DEVELOPMENT AND THE CREATION OF AFFORDABLE VARIETY

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**Industrial development and the creation of affordable  
variety**

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## Table of contents

Abstract .....	1
1 Introduction .....	2
2 Why variety matters .....	4
2.1 The evolution of needs .....	4
2.2 Demand for variety .....	5
2.3 Satiation of demand.....	7
2.4 Serving an evolving demand: creating variety .....	10
3 Creating variety and making it affordable: the role of manufacturing .....	13
3.1 Innovation and search activities .....	13
3.2 Productivity gains.....	15
3.3 Bringing relative prices down .....	17
4 Affordable variety and welfare gains .....	19
4.1 The “narrow” view: increasing consumers’ surplus.....	20
4.2 The “broad” view .....	24
4.3 The dynamic view: affordable variety and structural change .....	31
5 Final remarks.....	33
6 References .....	35
Appendix .....	44

## List of Tables

Table 1	An overview of empirical studies on variety.....	44
Table 2	Review of studies on welfare gains from the introduction of new goods, subsequent quality improvements and price reductions.....	46

## List of Figures

Figure 1	Spending on food and non-alcoholic beverages by country income group in terms of budget share and total expenditure, 2011.....	5
Figure 2	Engel’s curve for three types of good proposed by Pasinetti .....	8
Figure 3	Vehicle ownership and per capita income in selected countries .....	9
Figure 4	Relative R&D expenditure intensity by major sectors of the economy in 2018 .....	15
Figure 5	Real value added per worker: manufacturing and total world, 1970-2012 .....	16
Figure 6	Evolution of value added prices: manufacturing and total. 1970=100. World, 1970-2012.....	18

## **Abstract**

The demand and supply of variety lies at the heart of modern economic activity. Shifts in consumer preferences drive the emergence of new products and, consequently, entirely new sectors. This paper reviews the literature and empirical evidence on the interlinkages that exist between demand diversification, the creation of variety and structural change – with an emphasis on the role manufacturing industries play in this process. The paper discusses how the interplay between innovation and productivity growth in manufacturing enables the rapid diffusion of new varieties of goods at increasingly affordable prices, leading to the creation of ‘affordable variety’. This perspective sheds light on the importance of manufacturing industries in fostering consumer welfare and, more broadly, sustainable development through the provision of affordable variety.

**Keywords:** variety, sustainable development, manufacturing, consumer demand

**JEL Codes:** B52, D11, O30

## 1 Introduction

A salient feature of economic development since the Industrial Revolution has been the continuous emergence of new sectors that are fundamentally different from the existing ones. From automobiles and aircrafts to computers and smartphones, these emerging industries have, in many cases, revolutionized the ways things have been done. The introduction of these goods in our daily lives has radically transformed the way we travel, communicate and even work. So have our diets and the medical care we receive. Interestingly, the new industries have typically been *added* to the economy rather than simply substituting pre-existing ones (Saviotti, Pyka, & Jun, 2016). Printing, for example, did not cease to exist after the emergence of the radio, television or computer. Manufacturing industries have been at the core of this process, being the prime providers of these new varieties and qualities of goods at increasingly affordable prices.

A growing strand of economic thinking is trying to understand the roots of this process and its broad implications for economic development. A general conclusion of this literature is that increased variety and income growth are closely connected in a bidirectional fashion. On the one hand, income gains lead to higher demand for variety. This becomes evident when one looks at consumption baskets across countries at different income levels. At low levels of income, any additional dollar tends to mostly concentrate on the acquisition of food items. As an individual's necessity for food is met, however, additional dollars tend to be increasingly distributed among other types of goods and services, such as furnishing, health, recreation and education. That is, the concentration of consumption expenditure in one single category (food) tends to fall as income rises, increasing the variety of consumption baskets.

On the other hand, however, changes in the variety of goods demanded are also related to the process of economic growth and the generation of new income. The increasing appetite for variety stimulates research activities that may result in product and process innovations which enable the production of more goods—including entirely new varieties—at decreasing prices. Such innovations, in turn, set in motion a process of structural change that promotes economic growth and further increases income, which again might lead to more changes in consumer preference, increasing demand for variety. Demand and supply of variety hence lie at the centre of a feedback loop of innovation and growth.

The manufacturing sector plays a key role in the feedback loop as it represents a hub for innovation—and thus variety creation—and productivity growth. This particular combination not only allows for new goods to be created in the sector, but supplies these goods at increasingly affordable prices. The result of this process is the creation of 'affordable variety': a

growing range of products that are available to consumers at prices that tend to decline over time relative to other sectors in the economy. Welfare gains can be considerable: access to new and improved ICT goods, for example, facilitates the way we communicate, work and collect information. The creation of other goods, such as new medicines or vaccines, has an even more direct impact on health and well-being.

In this paper, we present a literature review on the interlinking steps that bind the consumption and production of variety into a virtuous loop of growth. We review a number of recent contributions that emphasize the strong links tying together demand and supply factors in the process of economic development. We thereby place special attention on the role of industrial development in driving variety creation and the corresponding impact on welfare and living standards. Our analysis introduces an original angle to the study of the relationship between industrial development and welfare by taking the consumer perspective.

This paper is structured as follows. Section 2 presents the main arguments put forward in the literature on the significance of variety creation in fostering and sustaining economic development. First, we look at the consumption side and discuss how and why consumers demand more variety as their income rises. Secondly, we focus on the ‘consequences’ of increasing demand for variety from the production side, and examine how the interaction between demand and supply generates new products and improves the quality of existing ones, thereby driving structural change and economic growth. Section 3 focuses on the specific role manufacturing industries play in this process, creating new varieties of goods and making them affordable for an increasing number of people (that is, creating affordable variety). Finally, Section 4 discusses how the provision of affordable variety improves welfare. The impact on welfare is first analysed from a narrow perspective which only takes into consideration the *surplus* of consumers, regardless of other considerations related to consumer type or consumption goods. Subsequently, this approach is extended to examine other implications in terms of access to new goods, which are closely linked to broader development issues at the core of the UN Agenda 2030 for Sustainable Development as well as the dynamic implications in terms of structural change and economic growth. Section 5 concludes.

## 2 Why variety matters

Recent contributions from the economic literature place the creation of variety at the core of the growth process (Saviotti, 2001; Saviotti & Pyka, 2004a, 2004b). Demand *and* supply of new varieties of goods lie at the centre of a feedback loop that drives economic growth. In this section, we discuss the different mechanisms that connect demand for variety, production of variety and economic growth.

### 2.1 The evolution of needs

Over the past century, several economies have witnessed a true revolution in terms of the number of durable goods available to the average household. Investment in household appliances measured as a percentage of GDP has more than tripled during the last 100 years (Greenwood, Seshadri, & Yorukoglu, 2005), and this *revolution* is moving at an increasingly faster pace – the time it takes for new goods to be adopted by a given share of the population is dropping rapidly. While it took the telephone 64 years to be found in 40 per cent of U.S. households, it took the television only around 14 years to achieve the same penetration rate, and only 10 years for smartphones (DeGusta, 2012).

The creation of new consumer goods facilitates and improves the standard of living and drives the process of technological innovation and structural change. Over the last century, the goods and services available per person increased 16-fold, resulting in a remarkable impact on living standards (de Jong, 2015).

A solid finding in the economic literature is that as households become wealthier, the variety of goods and services they tend to demand increases. As income rises, the share of a household's budget expenditure dedicated to food falls. This relationship has typically been analysed on the basis of so-called Engel curves which relate to a household's level of expenditure on a given good and its level of income.<sup>1</sup>

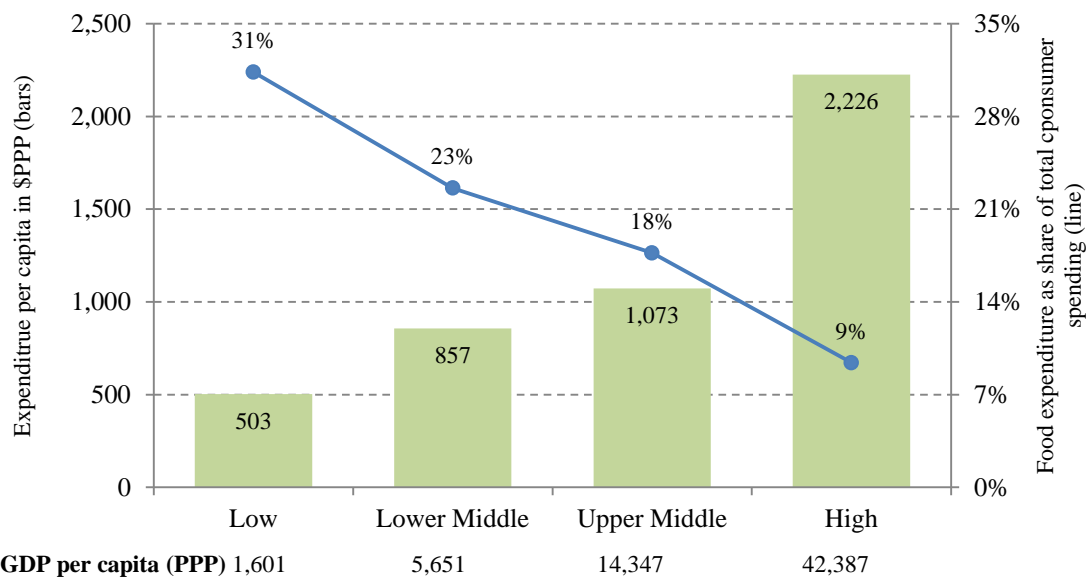
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<sup>1</sup> In 1856, Ernst Engel analysed the household expenditure of Belgium's working class. He found that food expenditure corresponded to between 62 per cent and 70 per cent of total household expenditure. This share gradually decreased for households with higher levels of income. This relationship has been confirmed for different time periods and countries (Chao & Utgoff, 2006; Chai & Moneta, 2014), as well as in cross-country comparisons (Clements, Selvanathan, & Selvanathan, 1996; Clements & Chen, 1996; Muhammad, Seale, Meade, & Regmi, 2011; Kaus, 2012; Banerjee & Duflo, 2007).



It is important to stress that as income rises, *absolute* expenditure on food does not fall (Saviotti, 2001). Rather, from each additional unit of increase in income, the share spent on food gradually decreases, causing the share of the budget spent on food to decline. Despite representing a lower share of budget expenditure, absolute expenditure increases. **Error! eference source not found.** clearly reflects this contrast of rising expenditure level and lower expenditure share on food consumption.

**Figure 1** Spending on food and non-alcoholic beverages by country income group in terms of budget share and total expenditure, 2011



Source: Authors' elaboration using ICP (2011) data.

In more general terms, Engel's analysis showed that the structure of consumption changes with the level of income in a systematic way (Falkinger & Zweimüller, 1996). Engel's original work made no assumption on how the expenditure not spent on food was distributed (Chai & Moneta, 2012). However, many empirical studies have since found that expenditure on non-food items becomes more varied and heterogeneous as income increases. In other words, consumers demand variety as their income rises.

## 2.2 Demand for variety

What explains this pattern? Drawing from psychology and biology, Witt (2001) distinguishes between 'basic needs' and 'wants' to explain the increasing demand for variety. 'Basic needs' satisfy human physiological needs that are 'part of the human genetic endowment'. These are needs such as food, water, clothing and housing – human necessities. A simpler or more complex combination of these goods fully satisfies these basic needs. These 'necessities' cannot

be substituted by any other good and they are prioritized over any non-necessity goods. The consumption of non-necessities is driven by ‘wants’ rather than ‘needs’. Therefore, at low levels of income, consumers dedicate a lower share of their income to non-necessity goods as a large share of their income is used to satisfy needs (Saviotti & Pyka, 2013). As income rises, a smaller share of total income is sufficient to satisfy basic needs.

Hence, necessities are prioritized over non-necessities. An implicit hierarchy thus exists in the consumption choices households make. Jackson (1984) refers to this as a ‘hierarchical demand system’. The hierarchy of preference implies that consumers only purchase a subset of all available commodities at any given moment, depending on their priority. At low levels of income, only a small fraction of all goods available is consumed as expenditure is concentrated on necessities. As demand for necessities becomes satiated (or satisfied), households begin to diversify their consumption among goods of lower priority, and non-necessities enter the consumption basket. As a result, the range—or variety—of goods consumed by wealthier households is higher than that of poorer households as a larger number of non-necessities enters into their consumption basket (Falkinger & Zweimüller, 1996).

As for which non-necessity goods will be consumed, the decision depends on the build-up of consumption knowledge, personal experience, social interaction, associative learning and inventiveness (Witt, 2001). Social interactions may also motivate patterns of consumption due to status-seeking behaviour or to comply with social norms (Woersdorfer, 2010, 2017).

An assessment of the existence of a ‘hierarchical model of demand’ requires finding empirical evidence on increased demand for variety as income rises. Jackson (1984) was among the first to attempt to measure variety and compare it to income levels, constructing an ‘Engel’s curve for variety’. He used the U.S. 1972/73 Consumer Expenditure Survey and found that the average number of products consumed by a household increases with its level of income. As households become richer, they demand more variety<sup>2</sup>.

Several later studies also found evidence that ‘consumers demand more diversity’ at higher levels of income – this conclusion holds when looking at different income groups within a country (Chai & Moneta, 2014; Chai, Rohde, & Silber, 2015; Chai & Moneta, 2012) and the average consumption across countries at different per capita levels (Theil & Finke, 1983; Frenken, Saviotti, & Trommetter, 1999; Clements, Wu, & Zhang, 2006; Drescher, Thiele, &

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<sup>2</sup> Variety is measured in many different ways in the literature. Jackson (1984) defines variety of consumption as the average number of products consumed by households, while other authors use measures such as entropy, the Herfindahl-Hirschman Index, the Gini-Simpson Index or the Gini Coefficient to capture variety of consumption.

Weiss, 2008; Yeon, Pyka, & Kim, 2016; Falkinger & Zweimüller, 1996)<sup>3</sup>. Additionally, as non-necessities become a larger share of consumer expenditure, we can expect the difference between consumer's individual consumption choices to grow. Chai et al. (2015) find that household expenditure at low levels of income is both less diversified and more homogenous as compared to higher levels. For a more detailed list of studies on variety of consumption, please refer to Table 2 in the Appendix.

A number of studies focuses specifically on the relationship between income and food variety, and find evidence of diet diversification and income level (Shonkwiler, Lee, & Taylor, 1987; Lee & Brown, 1989; Thiele & Weiss, 2003; Regmi & Meade, 2013). The studies find that at higher levels of income, households tend to consume higher quality food products, products that provide greater convenience (preprepared foods, for example), and premium quality food products (organic, fair trade, etc.). Households also tend to consume more high-quality food items as their income rises, diversifying their diet by moving from a more starch-based diet to include more meat, fruits and vegetables (Regmi & Meade, 2013). This increase in food variety has the additional benefit of improving nutrition and protecting against diseases, making its promotion an important component of health policy (Thiele & Weiss, 2003). As income rises, consumption of high-quality food products such as fruits and vegetables increases and nutrition improves. In this example, we see how the consumption of variety (in this case, varied diet) generates a non-monetary welfare gain (improved health). This type of variety effect is discussed in Section 4.2.

### **2.3 Satiation of demand**

The hierarchy of demand influences which goods are consumed first. As already mentioned above, necessities are prioritized over non-necessities. Consumers move to the consumption of non-necessities once their demand for necessities is satisfied or becomes saturated. Demand saturation describes a level of spending on a good beyond which household spending ceases to increase or continues to increase more slowly. It is the level of consumption at which the household has consumed 'enough' as the underlying 'need' for the good has been satiated (Chai, 2017). As more of a good is consumed, demand for it will become progressively more

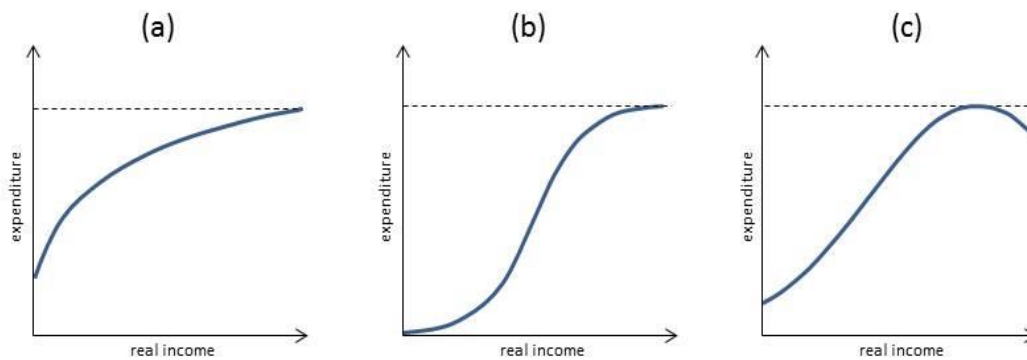
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<sup>3</sup> Clements et al. (2006) finds a positive income elasticity of demand for variety across countries in a sample of countries. Falkinger and Zweimüller (1996) also find that per capita income is positively linked to the number of products in the average consumption basket consumed across countries when including control variables to account for differences in consumption patterns between countries. The increase in variety of consumption is also verified over time. Chai and Moneta (2012) find that household expenditure in the UK became more diversified between 1960 and 2000, while also finding that the difference between the diversification of expenditure of low- and high-income households in the UK decreased. The measures for variety used in these studies are discussed in the appendix in more detail.

income inelastic. This process is known as the ‘Engel’s consumption cycle’. It is a process in which the income elasticity of demand for any good is higher at lower levels of consumption, but gradually decreases as more of the good is consumed (Foellmi & Zweimüller, 2008).

This principle was incorporated in Pasinetti’s (1981) framework to analyse economic development. Within a multi-sector model, Pasinetti distinguished three types of goods: (a) those necessary for physiological reasons or essential goods (necessities); (b) non-necessity goods; and (c) inferior goods. Figure 2 presents the level of consumption for each of these goods at different levels of income – their Engel’s curve. At low levels of income, a minimum level of consumption of necessities (a) is required for physiological reasons, while the consumption of non-necessities (b) will be close to zero.

**Figure 2** Engel’s curve for three types of good proposed by Pasinetti



Source: Pasinetti (1981)

From the S-shape (or partial S-shape) of the curve, we observe that the marginal increases in expenditure on the good decline after a given level of real income<sup>4</sup>. Figure 2 also indicates the existence of an ‘upper limit’ or a satiation point (the dotted line) of the consumption of the good – a level of consumption beyond which demand will no longer increase, regardless of further increases in income<sup>5</sup>. While satiation of the consumption of necessities begins to occur at lower levels of income, it typically appears at higher levels for non-necessities. As a result,

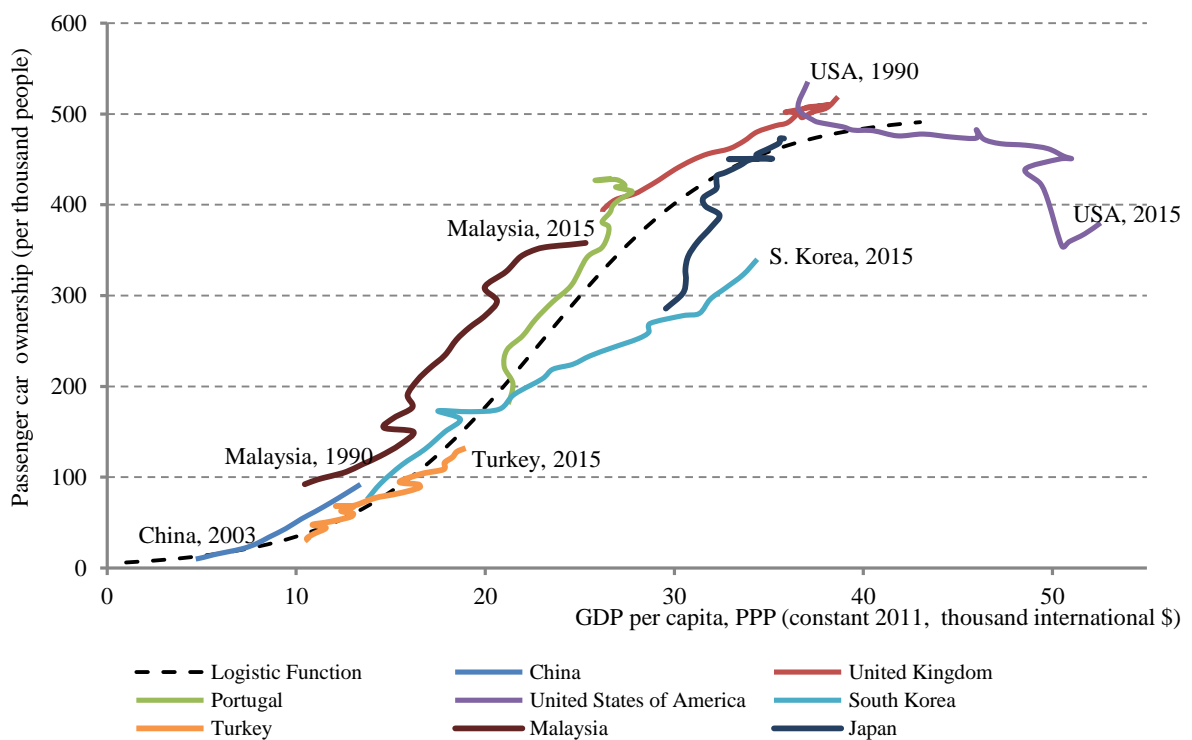
<sup>4</sup> The same S-shape of the Engel’s curve holds if we compare the adoption rate of a good in a household (share of household who own the good) and income level (2016). As a higher percentage of households obtain the good, the number of new households that will adopt that good declines. Further increases in the adoption of goods are based on quality improvements (discussed in the next section).

<sup>5</sup> Some theoretical contributions analysing economic growth through formal models have also incorporated this ‘upper limit’ of demand (Saviotti, 2001; Aoki & Yoshikawa, 2002). These models typically analyse demand saturation in the context of a closed economy. However, in an open economy setting, saturation of demand might be less of a problem in the short-run since demand saturates less rapidly than in closed economies (Saviotti & Frenken, 2008)

consumption becomes less concentrated on necessities and more distributed across a wider number of goods, leading to an increase in variety of what is consumed.

Empirical evidence indicates that satiation occurs across a wider array of goods and services and is not limited to necessities (Chai & Moneta, 2014). The case of automobiles provides an interesting example. Figure 3 presents the ownership of vehicles per 1,000 people and per capita income for a selected number of countries between 1990 and 2015 based on data from the Economist Intelligence Unit Data Tool. According to this data, vehicle ownership in the case of advanced economies also shows a tendency for stagnation. However, there is a great degree of heterogeneity among countries, ranging from a rate as high as 800 vehicles per thousand people in advanced economies (left panel) to less than one per thousand in developing countries (right panel).

**Figure 3** Vehicle ownership and per capita income in selected countries



*Source:* Authors' elaboration based on the Economist Intelligence Unit Data Tool (2017) and World Development Indicators (2017)

*Note:* Passenger car ownership refers to passenger car stock per 1,000 population.

By comparing car ownership over time, we observe an S-shaped curve. At lower levels of per capita income, ownership initially grows slowly. It then begins to rise more rapidly before slowing down. An Economist Intelligence Unit study (EIU Canback, 2016) denotes these stages as the ‘emerging’ phase to one of ‘high growth’ and to a ‘plateau’ as demand becomes increasingly saturated. While many developed countries appear to be entering the plateau stage, developing countries are witnessing a high growth in ownership<sup>6</sup>. This observation is consistent with the findings of Moneta and Stepanova (2017) that demand for necessities (food and beverages) in developing countries is saturated, but find no evidence of saturation for manufacturing goods. Developing countries have not yet reached income levels at which demand saturation for many manufacturing goods begins.

Despite observing satiation of demand for individual goods, aggregate demand does not become satiated. Saviotti (2001) attributes this to two principles: first, to the underlying hierarchy of wants in which consumers only satisfy higher priority wants only after lower priority wants have manifested themselves<sup>7</sup>; secondly, to the fact that new wants always emerge as previous ones are satiated. These are, respectively, the principle of ‘subordination of wants’ and of ‘emergence of wants’. As a result, when a consumer’s demand for a given good has been satisfied, a new want will emerge.

From the perspective of the demand side, demand for goods becomes increasingly saturated as higher quantities are consumed. From the perspective of the supply side, saturation of demand translates into a slowdown in the growth rate of sales as product ownership rises. Consequently, demand saturation may potentially create a ‘bottleneck’ for growth as demand for existing products slows down due to becoming saturated and as a result, the growth rate of demand declines as well (Chai, 2017).

## **2.4 Serving an evolving demand: creating variety**

Demand satiation creates a potential bottleneck for growth but at the same time generates powerful incentives for firms to react. As existing wants are satiated, new wants emerge, and firms will have incentives to create and introduce new goods into the market. The newly created goods will undergo their own ‘Engel’s consumption cycle’ and pass through a high-growth

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<sup>6</sup> The most impressive example is China, where car ownership has increased from below 0.38 to 16 per thousand people between 1960 and 2002, and the vehicle stock has increased 20-fold and appears to be far from the plateau (Dargay, Gately, & Sommer, 2007).

<sup>7</sup> Saviotti (Saviotti, 2001) refers to the *principle of subordination of wants* in which the satisfaction of a lower want allows for a higher want to manifest itself. Here, we use the term ‘hierarchy of wants’ to refer to the process in which higher priority needs/wants are satisfied first to make space for the consumption of lower priority wants.

phase before becoming saturated themselves (Chai & Moneta, 2014; Witt, 2001)<sup>8</sup>. Hence, the introduction of new goods temporarily counteracts the slowdown in growth of demand.

This process is referred to as the ‘satiating escape’ hypothesis or ‘escaping satiation dynamics’. ‘Satiating escape’ allows for overcoming the potential bottleneck in economic development by creating new sectors that provide compensation for the displacement caused by the imbalance in pre-existing sector (Saviotti, 2001; Saviotti & Frenken, 2008). The interaction between satiating demand (on the consumption side) and an incentive for product innovation (on the production side) is generated in a ‘satiating escape’ dynamic.

This dynamic, in turn, highlights the role satiating demand plays in pushing forward technological advancement and its centrality in a virtuous cycle of economic growth. As Saviotti and Pika (2013, p. 467) describe it, “(...) the declining economic potential of maturing sectors induces the creation of newer and more promising ones”. Hence, it is the inherent characteristics of demand (diversifying and saturating) to create an incentive for innovation. Through this incentive for innovation, demand plays a central role in the process of long-run growth and development (Falkinger & Zweimüller, 1996). Satiating demand and the supply of variety fosters the creation of innovation, which in turn promotes structural change and growth (see Section 3.1).

The viability of introducing new products depends on two conditions: 1) for consumers to have sufficient income to demand the product, and 2) preference for the good that will drive them to purchase it (Saviotti & Pyka, 2013). If these conditions are met, entrepreneurs will attempt to successfully establish firms that produce the new product, motivated by the expectation of a temporary monopoly and the supra normal profits of the market. In this sense, innovation is in part ‘demand-induced’ (Foellmi & Zweimüller, 2006).

New variety results from successful product innovation. We can distinguish between two types of new variety: related and unrelated<sup>9</sup>. What type of variety is created depends on whether the novelty is a variation of a product that already exists or whether it is a genuinely new good<sup>10</sup>. An expansion of related variety refers to variations of the same product differentiated by quality,

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<sup>8</sup> Note that this line of reasoning contrasts with the standard literature in which the restraining factor for growth is the diminishing returns on capital in production and in R&D technology (Aoki and Yoshikawa, 2002b)

<sup>9</sup> The concepts of related and unrelated variety were introduced in Frenken et al. (2007) and applied in Saviotti and Frenken (2008) and Yeon et al. (2016). Saviotti et al. (2016) refers to intra-sectorial differentiation and inter-sectorial variety, which corresponds to the related and unrelated variety concepts used in other studies. These, respectively, are created by ‘post-innovation’ improvements or ‘pervasive’ innovations. Content and Frenken (2016) present a comprehensive literature review of how the concept has been applied so far.

<sup>10</sup> Frenken et al. (1999) compare unrelated variety to the concept of diversity in biology (the number of different species in a given habitat) or the number of genuinely different goods in a given economy.

design and other product attributes. Additionally, price reductions have the potential to ‘push the ceiling’ of the demand for goods and expand the potential size of the market (Aoki & Yoshikawa, 2002). These variations alter the level of income for which the point of satiation of demand occurs by creating variations that cater to different segments, offering a temporary escape from the tendency of demand to stagnate (Witt, 2001).

The “postponing” effect of the creation of related variety can be illustrated by the case of automobiles. The car industry produces a large portfolio of different vehicles—from low-cost compact cars to luxury sedans—which cater to different market segments. In this case, the slowdown in the sales growth of different models occurs at different levels of income (EIU Canback, 2016). By continuously changing the types of automobiles sold in the market, sales can continue to expand at a fast pace.

Product differentiation, quality upgrading and price reductions ‘postpone’ the level of income at which growth starts decelerating. These mechanisms ‘push’ the saturation point to higher income levels. Chai and Moneta (2014) provide evidence for this by examining the changes in the Engels curves of different goods in the UK over three decades (1974-2001). Their results indicate changes in income which is linked to a slowdown in demand over time.

The creation of new varieties that cater to the lowest income segment of the market (“bottom of the pyramid”) also has the potential to expand market size. By creating specific products for this market segment, the level of income at which consumption of a given good starts can be lowered. The Tata Nano—a US\$ 2,000 car—is a good example in this regard. It was initially introduced to cater to an income segment that did not have access to more expensive vehicles. Innovations that make certain goods affordable to a larger share of the population has far-reaching impacts on consumers who gain access to these goods for the first time, an issue that will be discussed in further detail in Section 0.

The generation of related variety has the potential to expand the size of existing markets. However, it does not create new markets. Increases in unrelated variety results from product innovations that create uniquely new goods and new markets for these goods, leading to the emergence of new industries and sectors. Product innovation, in turn, is closely tied to investments in R&D and basic research (Aoki and Yoshikawa, 2002). The creation of genuinely new goods or the emergence of new industries changes the internal composition of the economy and is the key driving force behind structural change and sustaining economic growth.



Product innovation plays a substantial role in sustaining economic growth by expanding and creating markets. Process innovation, on the other hand, plays an important role in increasing labour productivity and changing relative prices in the economy (Krüger, 2008). Productivity gains, in turn, are essential in their role of reducing production cost and releasing resources that can be redirected towards innovation activities, thereby promoting the development of future products and process innovations in a self-reinforcing fashion. For this reason, the creation of new products (i.e. increases in available variety) and productivity growth in pre-existing industries are complementary rather than independent aspects of economic development. Both are required to sustain long-run economic growth (Saviotti & Frenken, 2008; Saviotti & Pyka, 2008).

### **3 Creating variety and making it affordable: the role of manufacturing**

Demand for variety is a key driver of innovation – but so is the firm’s own capacity to innovate. In this regard, manufacturing plays a special role: according to literature on structural change, it provides greater scope for innovation than other sectors (Kaldor, 1967; Chenery, Robinson, & Syrquin, 1986; Lavopa & Szirmai, 2012). In what follows, we provide evidence to support this notion. We show that the manufacturing sector is where most investment in innovation and search activities takes place. As a result, it is also the sector that produces the highest number of innovations – both in terms of products and processes.

Product innovations, if successful, increase the variety of goods available to consumers, spurring a feedback loop between the demand and supply of variety, generating economic growth. Process innovation, on the other hand, can result in productivity gains that enable continued investment in search activities and keeps the loop moving. While part of the resources released might be used for search activities, given adequate market conditions, others translate into price reductions. The interaction between innovation, productivity and price dynamics within manufacturing make the sector the prime provider of new and affordable goods in an economy.

#### **3.1 Innovation and search activities**

The creation of new goods occurs through search activities, or research activities. Search activities can be defined as activities based on which a firm “scans the external environment looking either for alternatives for to their present routines or for completely new opportunities” (Saviotti & Pyka, 2004b, p. 5). Search activities may result in the creation of new products (product innovation) as well as in process innovations, which generate productivity gains. Process innovations enable more efficient organization of production, resulting in productivity

gains which may feed back into additional resources for further search activities. Product innovations resulting in increased product differentiation or genuinely new product creations, on the other hand, have the potential to expand existing markets or to create entirely new ones.

Research and development (R&D) is commonly used as a proxy for search activities. As the concept of R&D is clearly defined, it is a measure more frequently recorded at the firm level, which facilitates its use as a measure of the intensity of search activities being conducted. In the vast majority of countries, R&D expenditure is predominantly concentrated in the manufacturing sector (Lavopa & Szirmai, 2012). Data show that in some countries, over 89 per cent of total R&D expenditure occurs within manufacturing industries.

Taking into account the size of the manufacturing sector relative to the rest of the economy, we can calculate an industry's R&D intensiveness. The R&D intensity indicator takes into consideration not only the industry's R&D expenditure as a share of total expenditure, but also its size relative to the economy. Manufacturing is around seven times more R&D intensive than other sectors (Figure 5). In a similar vein, Galindo-Rueda and Verger (2016) present a classification of activities (both manufacturing and non-manufacturing activities) according to level of R&D intensity. They find that most services display low R&D intensity<sup>11</sup>, while they dominate the manufacturing sector.

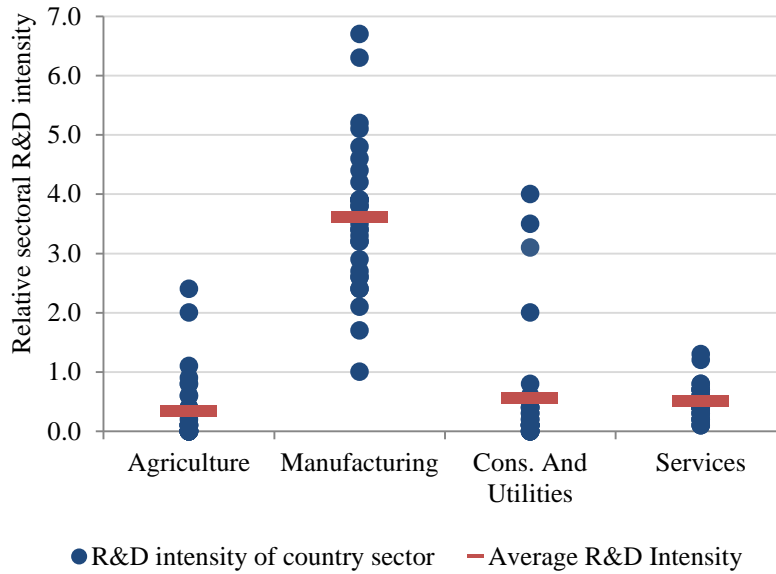
From the above discussion, it follows that manufacturing industries play a key role in expanding the variety of modern economies through research and innovation. While R&D expenditure and R&D intensity may not be sufficient to effectively characterize the innovative performance of firms (Galindo-Rueda & Verger, 2016), it is reasonable to expect a positive relationship between the two. Tassej (2013), for example, finds a positive correlation between R&D intensity and product and process innovations<sup>12</sup>.

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<sup>11</sup> Information and communication services and professional, scientific and technical activities are classified as R&D-intensive sectors.

<sup>12</sup> The concept of R&D intensity differs in each of the references. Lavopa and Szirmai (2012) look at the relative intensity of R&D, taking R&D expenditure in the sector and the sector's relative size in the economy into consideration. Tassej (2013) calculates R&D intensity as R&D expenditure divided by net sales, and Galindo-Rueda and Verger (2016) calculate it as R&D expenditure divided by gross value added.

**Figure 4** Relative R&D expenditure intensity by major sectors of the economy in 2018



Source: Authors' elaboration based on Lavopa and Szirmai (2012)

Note: The figure includes all OECD members plus China, Romania, Russia and South Africa. Relative R&D intensity is computed by dividing the sectoral shares of R&D on total R&D by the sectoral share of value added on GDP<sup>13</sup>. Formally;  $Relative\ intensity\ y_{ij} = (R_{ij}/R_j)/(Y_{ij}/Y_j)$  where  $R_{ij}$  stands for the R&D expenditures of sector  $i$  in country  $j$ ,  $R_j$  is total R&D expenditure of country  $j$ ,  $Y_{ij}$  is the value added of sector  $i$  in country  $j$  and,  $Y_j$  is the GDP of country  $j$ .

This conclusion is reinforced by other studies which specifically looked at sectoral indicators on product innovation and found that manufacturing firms are more likely to innovate than firms located in other sectors of the economy. In the United States, for example, 22 per cent of manufacturing firms reported products of process innovation as compared to only 8 per cent of non-manufacturing firms (Borouh, 2010; apud Hart, Ezell, & Atkinson, 2012).

### 3.2 Productivity gains

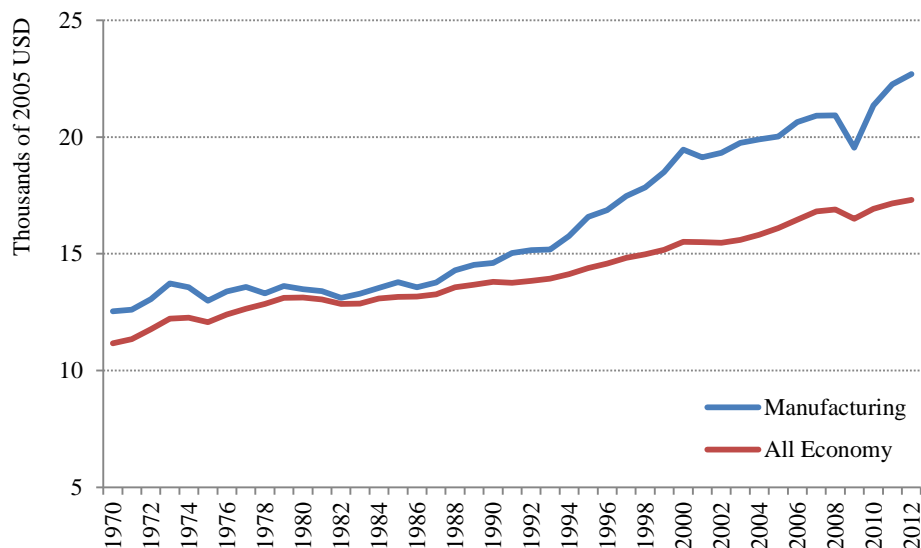
As suggested in the preceding section, the literature on variety creation highlights productivity as a key factor enabling product and process innovations. Search activities require resources to be initiated and sustained over time. According to Saviotti and Pyka (2008), additional resources for research can be conceived as the result of productivity gains in pre-existing industries. As productivity grows in sectors catering to saturated markets, released resources—

<sup>13</sup> Formally;  $RSRDI_{ij} = (R_{ij}/R_j)/(Y_{ij}/Y_j)$  where  $R_{ij}$  stands for the R&D expenditures of sector  $i$  in country  $j$ ,  $R_j$  is the total R&D expenditure of country  $j$ ,  $Y_{ij}$  is the value added of sector  $i$  in country  $j$  and,  $Y_j$  is the GDP of country  $j$ .

finance as well as labour—can shift towards emerging sectors catering to unsaturated markets that offer greater potential for growth<sup>14</sup>.

A long research tradition going back most notably to Kaldor (1967) posits that the scope for productivity gains may be markedly different across sectors, with manufacturing industries playing a more prominent role in driving economy-wide productivity. Szirmai et al. (2013) summarize their findings by highlighting that manufacturing offers special opportunities for capital accumulation due to its larger scope for mechanization and spatial concentration, and that manufacturing tends to be the key locus of technological progress which then diffuses to the rest of the economy. As a result of these properties, productivity levels and the scope for productivity growth tend to be higher in manufacturing than in other sectors.

**Figure 5 Real value added per worker: manufacturing and total world, 1970-2012**



*Note:* All values in current US\$; they refer to the unweighted average for the world. The relative price of manufactured goods is calculated as the relationship between the deflator of manufacturing industries and the total economy.

*Source:* Authors' elaboration based on the Manufacturing Value Added 2017 database (UNIDO, 2017).

Comparing manufacturing's productivity dynamism with that of the total economy over the last 42 years supports this notion. Figure 5 above shows that the real value added per worker in manufacturing is higher than in the entire economy and that this difference has been growing over time at the global level. More recently, Hart et al. (2012) find that manufacturing productivity rose more than 50 per cent faster than productivity in the rest of the private sector

<sup>14</sup> Conceptually, the mechanisms linking productivity to innovation and variety are akin to those linking agricultural productivity growth to the onset of industrialization in dual-sector models (A. W. Lewis, 1954).

in the United States between 2000 and 2010, in line with the evidence of a rising gap between the productivity of manufacturing and of non-manufacturing activities.

Productivity growth in manufacturing is therefore complementary to innovation and, with it, to the creation of variety and the emergence of new sectors: productivity gains provide the resources needed for innovation, which in turn raises productivity gains in the sector at a faster pace as compared with the rest of the economy (Saviotti & Frenken, 2008). The implications of the inter-linkages between productivity, innovation and variety for long-term structural change are discussed in Section 4.3.

### **3.3 Bringing relative prices down**

Productivity is not only linked to the innovation performance of firms as a by-product and enabling factor. It has significant consequences on prices, too. When an industry's productivity increases as a result of innovations that improve technology or organization, production costs—other things being equal—will decrease. Provided that firms in the industry face competition in product markets, the reduction in production costs can be expected to translate into a decline in prices. If conditions are in place for firms to innovate and compete on the market, increases in productivity can then be passed on to consumers in the form of lower prices.

Since not all industries display the same level of innovativeness and productivity gains, prices may be expected to evolve in different ways across sectors. Baumol (1967) was amongst the first to emphasize sectoral differences in productivity growth as a source of relative price changes. In his model of unbalanced growth, productivity growth is higher in technology-intensive activities than elsewhere in the economy, whereas production costs—in this case, labour costs—grow at a similar rate throughout the economy. Under these conditions, relative costs grow at a faster rate in low productivity sectors than in high productivity ones. Prices follow a similar pattern<sup>15</sup>.

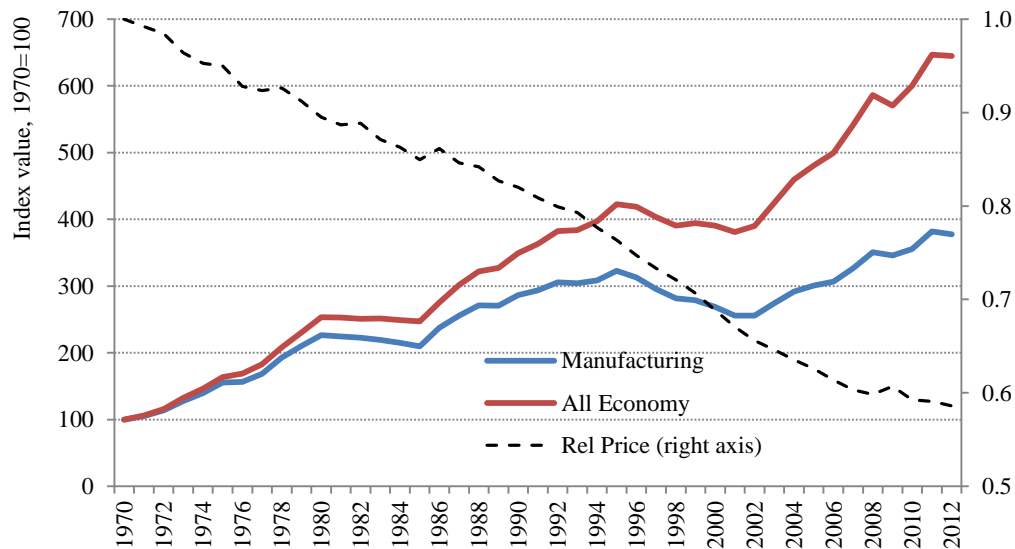
As discussed above (Section 3.2), the manufacturing sector displays markedly higher levels of productivity relative to other sectors, such as agriculture or services, owing to its higher potential for innovation, capital accumulation, scale economies and skill upgrading (Baumol, 1967; P. Lewis & Peng, 2017). Prices in the manufacturing sector may therefore be expected to grow at a slower rate over the course of time relative to prices in other sectors. Evidence on the evolution of prices for manufactured products relative to the rest of the economy over the course

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<sup>15</sup> More recently, Acemoglu and Guerrieri (2008) show that when the elasticity of substitution across sectors is lower than unity, relative price dynamics can also derive from differences in capital intensity between sectors.

of the past four decades supports this notion: the price of manufactured products tends to decrease relative to the rest of the economy (see Figure 6).

**Figure 6 Evolution of value added prices: manufacturing and total. 1970=100. World, 1970-2012**



Source: UNIDO elaboration based on the Manufacturing Value Added 2017 database (UNIDO, 2017).

Note: The series show the evolution of the implicit gross value added deflator for manufacturing and GDP with the base year 1970 (left axis) and division between the two (right axis).

The productivity-price nexus is also central in Matsuyama’s (2002) treatment of the emergence of mass consumption societies in industrialized economies after World War II. In competitive conditions, productivity growth in manufacturing—resulting from sector-specific dynamics of learning-by-doing—leads to a decrease in the price of consumer goods. As variety becomes affordable, the market expands. Moreover, productivity and market size are linked by a two-way causality. Productivity growth reduces prices, thus expanding the market for manufacturing products. Market size effects, in turn, enable the widespread introduction of increasing return technologies, leading to further productivity gains and relative price declines.

However, not all manufacturing goods experience price declines simultaneously. The fall in prices occurs first for those goods that are high priority and that—according to the hierarchy of wants discussed earlier—tend to be consumed by the vast majority of households. As prices of high priority goods decline, consumption starts shifting towards lower priority, non-essential items, following a ‘flying geese’ pattern. Markets for non-essential goods start expanding, thus enabling productivity growth in emerging industries as well as further price declines and market expansion (Matsuyama, 2002).

A cursory look at the historical record suggests that the price channel has been a significant driver of consumer welfare since the early stages of industrialization. The increase in purchasing power attributable to a fall in prices can be captured by looking at how many hours of work it would require an average worker to buy a given good. DeLong (2000), for instance, estimates that it took an average American worker 260 working hours to buy a one-speed bicycle in 1895, while the time-to-earn a bicycle had fallen to 7 hours in 2000 – a reduction by a factor of 36. According to the same estimate, the price of an Encyclopaedia Britannica fell from 140 hours in 1895 to 33 hours in 2000. While in this case the reduction is lower (about 4 times less), a household that substituted the Encyclopaedia for one that is freely available online has, in fact, become incommensurably richer (de Jong, 2015).

Today's expenditures include a number of goods that did not even exist at *any* price a century ago. New goods of better quality have most certainly confined the true cost of living, which implies that the standard of living may have increased considerably, more than what conventional measures indicate (de Jong, 2015). Section 4 provides further elaboration on these issues.

#### **4 Affordable variety and welfare gains**

The creation of new manufacturing goods and the quality upgrading of existing ones, together with the decline in their relative prices has a clear positive impact on our daily lives. However, capturing and quantifying these positive effects on human welfare can be a challenging task. An additional problem relates to the specific definition of welfare being used. In this section, we assess the welfare effects brought by the creation of affordable variety in manufacturing industries.

To do so, we start by taking a narrow conceptualization of welfare that focuses on how access to variety affects consumer surplus. The creation of variety and price reduction has quantifiable monetary value for consumers. In this case, we make no further refinements on who are the ultimate beneficiaries of this surplus. Next, we broaden the concept of welfare in order to integrate some key dimensions stressed in the current discussion on sustainable development. More specifically, we examine the role played by the creation of affordable variety in manufacturing industries in terms of poverty alleviation, food security and access to good quality medicines. To close the section, we take a dynamic perspective and discuss the important role played by the generation of affordable variety in driving structural change and sustaining economic growth.

#### 4.1 The “narrow” view: increasing consumers’ surplus

A narrow definition of welfare would limit itself to the changes that take place in consumer surplus. Substantial empirical work has been carried out to quantify the welfare implications of increased variety and quality of goods and price reductions. Consumer surplus refers to the positive difference between what consumers are willing to pay for a given good and its price on the market<sup>16</sup>. Changes that increase consumers’ surplus (or their social savings) positively affect their welfare.

The mechanisms described above can affect consumers’ welfare through three main channels: (a) declines in the relative price of goods they are already consuming; (b) improvements in the quality of goods they are already consuming and are not reflected in prices; and (c) the introduction of entirely new goods for which there were no substitutes before.

The empirical literature estimates the impact of these channels on welfare by relying on demand curves. Each channel can be *translated* into a product/price change. Using the good’s demand curve, it is possible to compare the current observed price and quantity to the initial situation and compare consumer surplus changes in these two scenarios. The magnitude of the change in consumer surplus is directly influenced by the shape of the demand curve, as well as by the magnitude of the price reduction. Table 2 in the Appendix provides a summary of the studies reviewed and their findings on the impact on consumer welfare.

Capturing the effect of a decline in prices on consumer surplus is straightforward. It directly affects product price and can be captured in the demand curve. Increased affordability allows consumers to attain the same level of welfare with a lower level of expenditure.

Higher product quality offered at the same price also represents a welfare gain to consumers. However, as price and product quality typically change simultaneously, it is difficult to disentangle the two effects. A common approach used in the literature to deal with this issue is the *hedonic* pricing method<sup>17</sup>. This method assumes that the price of a good is related to its characteristics or the services it provides. Hence, changes in quality can be captured by changes in the product’s attributes. For example, one possible measure of a car’s quality is its engine

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<sup>16</sup> Other studies rely on the use of the concept of “social savings”, a broader but closely related concept more commonly used in historical studies (see Bayoumi & Haacker, 2002; Leunig & Voth, 2011). The concept of social savings is frequently used in economic history literature to measure the impact of the introduction of a new good. Social savings is a much broader concept than consumer surplus, and requires less detailed information for estimation. Algebraically, it is calculated as the difference in cost (or price) of the task or a good with and without access to the technology multiplied by the quantity consumed when the technology becomes available. As it is more broadly defined, the social savings generated by a good is not dependent on the good’s estimated demand curve.

<sup>17</sup> There are several other approaches for quality adjustment. For a review, refer to OECD (2011).



power. When a car's engine power improves, the value or "price" consumers attribute to that characteristic also rises. Even if the final market price remains unaltered, it results in a welfare gain for consumers as valued qualities improve.

Hedonic price indices use statistical regressions to separate changes in prices that can be attributed to the additional price (and implicit cost) contributed by an improvement of a product's characteristics (such as engine power, processing speed, etc.) (Bresnahan & Gordon, 1996)<sup>18</sup>. Changing product characteristics are ascribed a price and then separated from the price of the "constant quality" product. By comparing the evolution of the "constant quality" price and the real change in prices, it is possible to capture the positive impact of quality change on welfare.

Many authors argue that the price deflators commonly used in regular statistics do not fully capture this type of effect (Nordhaus, 1994; Boskin, Dulberger, Gordon, Griliches, & Jorgenson, 1998; Hausman, 1999). Therefore, the welfare impact of related variety creation tends to be underestimated. Computing quality-adjusted price indices requires large amounts of detailed data (information on prices, quantities and attributes of each model of a certain good) (Raff & Trajtenberg, 1996). In part due to these requirements, hedonic price correction is frequently used for products undergoing rapid technological change only. However, in many cases, quality constant prices are not estimated even for rapidly changing products (OECD, 2011)<sup>19</sup>.

For this reason, hedonic price adjustments may not be accounted in case of short time windows or for comparing mature products that are not undergoing rapid quality improvements. However, welfare gains from improved quality may be very significant over a product's life cycle or longer time periods. Raff and Trajtenberg (1996), for instance, estimated the price reduction of automobiles in the early years of adoption, between 1906 and 1940. By pricing three different attributes of cars, the authors found that quality improvements in automobiles alone between 1906 and 1940 were equivalent to a 2 per cent real price reduction per year. The quality-adjusted price index calculated in the study found that the price of automobiles dropped

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<sup>18</sup> It should be noted that the hedonic approach has limitations and might be particularly ill suited to capture sharp changes in technology (Raff & Trajtenberg, 1996). Bresnahan and Gordon (1996) point out that hedonic quality-adjusted pricing is appropriate when comparing two products that are nearly perfect substitutes, but if they are not, hedonic pricing misses part of the cost of life improvement attributable to the welfare gains from access to a new good. Therefore, it is important for the products to be *quality-adjusted* close substitutes.

<sup>19</sup> Another underestimation to welfare generated by a given good is its late incorporation into price indexes. As a result, there is no price deflator for the early years after the good's creation, which is where a significant share of welfare is generated (Trajtenberg, 1989; Raff & Trajtenberg, 1996). Automobiles, for example, were not incorporated into the Consumer Price Index in the United States until 1940, when already 60 per cent of households owned a car. Refrigerators were included in 1934 when they were already found in 30 per cent of all households in the country (Costa, 2001)

by a factor of 10 over the period, while existing deflators measured the price reduction at around a factor of 3.

By focusing on the pricing of the characteristics of a given good, Nordhaus (1994) proposes a method to “leap across history” and estimate the welfare generated by improved product quality across different technologies. He estimated the quality-adjusted price index of lighting, using attributes such as the ratio of lumen-hour per BTUs. Based on these attributes, Nordhaus compared the cost of light produced in cave fires (used 500,000 years ago) with that of a florescent light bulbs<sup>20</sup>. By also estimating the growth in the ‘volume’ of light, he estimated the quality-adjusted price of lighting. His estimates suggest that the commonly used unit price of a lumen-hour was underestimated by a factor of 900-1600 between 1800 and 1990.

Nordhaus (2001) applies the same approach to the price of “computation power”, defined as the price per million standardized operations per second (MSOPS). Using historical records, he estimated the price of MSOPS using different technologies (from hand calculations to microprocessors). Based on this method, he found that MSOPS per constant US\$ 1 increased by a factor of 1-5 times trillion from 1900 to 2000. While the improvements proposed by Nordhaus are probably on the upper end of estimates, they highlight the significant and frequently ignored impacts of improving product quality on welfare. In fact, several other studies have reached similar conclusions. According to Hennessy & Patterson (2011), computer “quality” has rapidly increased since the early 1970s, with processing power increasing by a factor of 24,000 between 1978 and 2010. Muehlhauser & Rieber (2014) find that the price-performance ratio (cost per performance ‘unit’) of other attributes has also fallen drastically. The cost per Mb of RAM has dropped by a factor of 100,000, while the cost per Gb of hard drive capacity has reduced by a factor of 200,000 since 1980. Estimates for the years 2001-2005 conducted by Wasshausen & Moulton (2006) suggest that only one-third of the real price reduction was attributable to dropping unit values, while the remaining two-thirds was generated by access to higher performance computers for the same price. Between these years, the real market price of personal computers dropped at a rate of 4.9 per cent per year, while rising computer “quality” was equivalent to an additional 11.5 percentage point price drop per year, resulting in the quality-adjusted price index dropping at 16.4 per cent per year. These results show how rapid the quality improvements may be and the need for them to be accounted in the welfare evaluation.

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<sup>20</sup> According to Nordhaus’ estimates, the rate of efficiency increase between the adoption of open fires by man and the Paleolithic oil lamps was only of 0.0006 per cent per year. From there to the Ancient Babylonian lamp, efficiency evolved at 0.004 per cent per year. From Babylonia to candles in the early 19th century, improvements advanced at 0.04 per cent per year. Between 1800 and 1992, efficiency of lighting has improved 900 times (3.6 per cent per year).

One additional channel to consider is the very access to an increased number of choices when new goods are introduced into the market. As mentioned earlier, consumers demand variety; access to new goods in itself generates welfare gains<sup>21</sup>. Assessing this welfare gain is, once again, a difficult task. One approach used in the literature consists in estimating the welfare lost if the new product were to cease to exist – i.e. if the available quantity suddenly dropped to zero. Consumer surplus would be lost if the quantity fell to zero and the price rose to the reserve price. Welfare gain can also be measured as the additional income a representative consumer would need to attain, i.e. the level of utility he would have had if the good had never been invented – to “buy” the good at its “virtual price” (Kopecky & Greenwood, 2008). Additionally, to fully capture the welfare effect of the introduction of a new good, the representation of the existing good should incorporate the past quality improvements as well.

In both methods, the difficulty lies in assigning a “virtual price” to the good if it had not been produced at all. This “virtual price” depends on how the demand curve is defined. Different methods of demand curve construction are found in the literature, which may arrive at significantly different estimations of welfare. These differences are clearly illustrated by Goolsbee and Klenow (2006), who estimate the welfare generated by the introduction of the internet using linear and log-linear demand curves<sup>22</sup>. While the first method yields a welfare gain equivalent to 1.9 per cent to 2.9 per cent of total income, the second method delivers a much higher welfare gain of about 7.3 per cent to 26.8 per cent of consumers’ income.

Different variants of these methods have been used to assess the welfare impact of the introduction of different goods. Once again, the case of computers is a good example to illustrate this method. Using an adjusted log-linear utility function, Greenwood and Kopecky (2013) find that the welfare gains stemming from access to personal computers, namely subsequent quality improvements and price reductions, was equivalent to about 3 per cent of total consumer expenditure between 1977 and 2004.

The introduction of new goods provides additional welfare gains when it increases the variety of options available to consumers. This is a topic that has been extensively examined in the trade literature. As countries cannot produce all varieties of goods, they stand to gain from access to

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<sup>21</sup> For a review of how access to variety directly affects consumer welfare, refer to Hersh and Voth (2009).

<sup>22</sup> Similar “linearizing” approaches are used in several other studies, including Brynjolfsson (Brynjolfsson, 1996), Hausman (Hausman, 1999), Petrin (Petrin, 2002), Goolsbee and Petrin (Goolsbee & Petrin, 2004). They are used respectively to estimate the welfare gain from computers, cell phones, minivans, satellite TV and the internet.

foreign varieties through trade.<sup>23</sup> Feenstra (1994) was among the first to attempt to estimate the welfare gains derived from greater access to differentiated varieties of imported goods. This was done by “correcting” the price deflators of six imported goods by the United States to account for the gains generated from access to new varieties. The gain from access to new varieties is derived from comparing the “corrected price” (the “exact price index”) with the market price.

Broda and Weinstein generalize the approach proposed by Feenstra (1994) and estimate the overall gains from increased access to import variety for each world country (Broda & Weinstein, 2004). The authors estimate that welfare gains can be significant: equivalent to an increase of 27 per cent welfare in China and 25 per cent in Mexico between 1970 and 2000, for example. Broda and Weinstein (2006) use more detailed trade data to estimate the impact of import variety in the United States. The study concludes that the impact of new varieties between 1972 and 2001 on welfare in the United States was about US\$ 280 billion, or equivalent to 3 per cent of US GDP. Using the same method, Mohler and Seitz (2012) determine the welfare gains for European Union member states between 1999 and 2008. They find the gains to be equivalent to up to 2.8 per cent of GDP for the period (Estonia).

Overall, it seems that the welfare gains generated by the introduction of a new goods is highly dependent on the nature of the good being evaluated and the specific technique used to evaluate it. As expected, marginal product innovations (such as the introduction of a new cereal brand or a new type of car) generate less welfare gains than radical product innovations (such as personal computers). The estimated welfare gain is also highly dependent on the estimation method used and especially on the assumptions made concerning the product’s demand curve. Despite these caveats, an important conclusion from the literature is that the introduction of new varieties and qualities of goods positively impact consumers’ welfare.

#### **4.2 The “broad” view**

The discussion above provides strong evidence on the important role industrial development plays in improving consumer welfare by providing new and better goods that become more affordable over time. However, according to a long tradition in economics and political theory concerned with human and, more recently, sustainable development, equitable access to a variety of affordable consumption goods contributes to welfare in a broader sense, too. Broad perspectives place the human, social and environmental impact of consumption at the centre of

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<sup>23</sup> In this literature, goods of the same product type produced by different countries are of different variety as they have differing qualities. This is a different definition compared to that used in the previous sections of this study. In view of the “love-of-variety” assumption, more diverse import baskets will always result in increases of welfare.

analysis. This section focuses, first, on literature characterized by a pronounced normative bent, in which questions on the underlying nature and the consequences of consumption feature prominently. The remainder of the section discusses the role of equitable access to affordable products within the context of current debates on sustainable development and, in particular, the 2030 Agenda for Sustainable Development.

#### ***4.2.1 The instrumental role of affordable variety***

Normative approaches to welfare and consumption are based on an evaluation of wellbeing that does not focus on possessing the means for consumption, but on their use (Anand & Sen, 1998). The capability approach pioneered by Amartya Sen and Martha Nussbaum is perhaps the most prominent of such approaches in the economic development literature<sup>24</sup>. The capability approach does not limit itself to asking whether one has access to the means of consumption, but rather how vast the range of activities is that consumption enables. It requires considering the opportunities that consumption opens for people to pursue their goals (Sen, 2010).

Differences exist between various approaches, with some formulations of the capability approach being more prescriptive in the consideration of what constitutes a legitimate human end, and others being more subjective. Prescriptive accounts are explicitly concerned with the content of individual consumption choices: they shift the focus from wellbeing (or welfare) to the question of what constitutes “well-living”. One example is Nussbaum’s (1992) account, where the ‘life worth living’ is made possible by the attainment of a universal set of ten essential pre-requisites – or ‘functionings’, in Aristotelian jargon. Functionings are both basic human needs and fundamental ends of human life (Dowding, 2009). They include, for instance, the need to live a complete life that is not cut short by illness or violence; the need for adequate nutrition; as well as the possession of practical reason, or the ability for meaningful political participation (Nussbaum, 1992).

Sen (2001, 2010) proposes a more subjective approach to human ends, rooted in the idea of enabling all individuals to achieve their “capabilities”. If functionings are what people do—their objective states of being and doing—capabilities are what people are *free to* do or their opportunities (Dowding, 2009). In both approaches, the achievement of capabilities requires having access to material resources—including access to consumer goods—although resources are not an end in themselves. As Sen (2009, p. 253) puts it, the capability approach “focuses not

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<sup>24</sup> It is worth recalling that the view of capabilities proposed by Sen is conceptually very different from that discussed in the structural change literature, which focuses on how *productive* capabilities at the level of firms and economies shape patterns of structural and technological change.

just on the resources people have, in the form of owning [...] objects of convenience [but rather on] the *actual opportunities* a person has” (emphasis in the original). The idea of “capability” sums up the means by which people can achieve their chosen ends as well as their ability to do so (Dowding, 2009).

In this context, access to affordable goods for consumption is valuable insofar as it is a prerequisite for the achievement of broader human goals. It has instrumental value<sup>25</sup>. Consider the first two functionings, the satisfaction of which the capabilities approach identifies as being fundamental for the evaluation of welfare i.e. being able to live a complete life and having sound physical health (Nussbaum, 1992). These were confirmed in empirical studies as largely coinciding with the priorities of poverty-stricken households (Petesch, Shah, Chambers, & Narayan, 2000). The capability approach is not merely interested in whether people have access to the means of consumption: it is concerned with whether they have access to those means that best enable them to be healthy – such as, for instance quality-assured medicines, adequate sanitation or nutritious food.

#### ***4.2.2 Affordable variety in the sustainable development agenda***

The 2030 Agenda for Sustainable Development—a broad framework to guide the international community’s efforts in promoting welfare worldwide—is another normative perspective that helps us understand the instrumental role of affordable variety<sup>26</sup>. Its 17 Sustainable Development Goals (SDGs) are built on the recognition that social, economic and environmental objectives must be considered as being interconnected rather than standing on their own (Le Blanc, 2015). Aspirations that are central to the human development literature run in parallel to goals that pertain to the sphere of production as well as to goals aimed at preserving the environment. The creation of, and equitable access to affordable variety plays an important role in the attainment of the SDGs.

##### ***4.2.2.1 Goal 1: serving consumers at the bottom of the pyramid***

The eradication of poverty is a central issue in all normative conceptions of welfare. Poverty is widely recognized in the academic and policy literature as a multidimensional condition where income is but one constituent. As reflected in the mandate of SDG 1, poverty is characterized by a lack of disposable income, as well as poor health, lack of education, poor quality of work,

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<sup>25</sup> Another way of framing the role of affordable variety within normative discussions of welfare is to see it as the most proximate determinant of human functionings and capabilities, whereas ultimate determinants would arguably include the wider socio-economic conditions that enable individuals to flourish, such as openness of the political system, whether a country is governed according to the rule of law or how equitable the distribution of income is.

<sup>26</sup> The full text of the Agenda, part of Resolution 70/1 of the UN General Assembly, is available at: <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/89/PDF/N1529189.pdf?OpenElement>.

dearth of political influence, and extreme vulnerability to violence, climate-related events and other economic, social and environmental shocks and disasters<sup>27</sup> (Alkire & Santos, 2013). Any of these factors can contribute to the reinforcement of another, thereby triggering a vicious cycle of deprivation and ill-being. In countries where healthcare facilities are either costly or dysfunctional, for instance, the lack of disposable income can translate into poor health (or vice versa).

As recently emphasized in the literature on goods and service provision at the “bottom of the pyramid”, poverty is also characterized by inadequacy of consumption options<sup>28</sup>. Evidence shows that despite being willing to pay for basic consumer goods, the poor tend to have lower access to fewer varieties of essential goods compared with wealthier groups in society (Banerjee & Duflo, 2007; Prahalad & Hart, 2002). In addition, the available goods may be costly, hazardous to health, environmentally unsustainable or a combination of all three. Consider, for instance, reliance on solid fuels (such as biomass and coal) for domestic heating and cooking in vast swathes of rural areas in developing countries. The lack of alternative energy sources and appropriate technology is damaging to both the environment and the health of consumers.

Against this backdrop, affordable variety plays a role in poverty reduction acting via at least two mechanisms. In what we have termed a “narrow” sense, the diffusion of affordable variety contributes directly to poverty reduction via an increase in the (real) income at the disposal of consumers. The provision of consumer goods that are cheaper, owing to price declines in manufacturing, compared with those previously available on the market will increase the purchasing power of all consumers, including the poor. Other things being equal, the higher real income that results from access to increased affordable variety may help lift poor individuals and households above the poverty line.

In a broader sense, however, new varieties of products can be specifically designed to address the needs of lower-income segments of the population. Partly as a result of greater liberalization of low- and middle-income economies from the 1990s, there has been an increase in market-based strategies to deliver goods and services to the poor (Dolan, Johnstone-Louis, & Scott, 2012; Ramani, SadreGhazi, & Duysters, 2009). In this context, innovators that redesign products and delivery systems to adapt them to the needs of low-income communities can successfully reach poorer consumers and increase welfare ‘at the bottom of the pyramid’.

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<sup>27</sup> SDG 1 mandates to “end poverty *in all its forms* everywhere” (emphasis added).

<sup>28</sup> According to Prahalad (2006), who coined the term, the bottom of the pyramid encompasses individuals and households living on less than US\$2 a day.

Several cases of successful product innovations exist that reached the bottom of the pyramid, leading to improvements in consumer welfare.

Innovations in sanitation technology is one example. Access to sanitation goods represents a long-standing need in areas traditionally neglected by public and private sector providers alike. Innovations such as the Sulabh or the Calvert toilet models pioneered in India, for instance, represent environmentally sound solutions that meet the requirements of lower-income consumers at affordable prices (Kothandaram & Vishwanathan, 2008; Ramani, SadreGhazi, & Duysters, 2012). Another related example is the production of low-cost generic medicines by pharmaceutical firms in low- and middle-income countries. In the Philippines, for instance, the local firm RiteMed distributes affordable generics in a market previously dominated by high-cost originator brand drugs<sup>29</sup>. By 2007, RiteMed had carved out a significant share of the market by providing quality-assured generics at a fraction of the price of brand name medicines, with far-reaching social and economic benefits for consumers (Ganchero & Pavia, 2007).

In other cases, innovation has transformed previously inaccessible durable consumer goods, such as cars or computers, into items that may be within the reach of low-income communities. A well-known example is the Tata Nano. Regarded as the world's most affordable car, it was made available on the market in 2009 by the automotive division of Tata Group, Tata Motors Limited, at the retail price of US\$ 2,000. Classifiable as a 'frugal' innovation since it enables significant reductions in price while focusing on functionality, the car is a modular product that is manufactured by combining existing component technologies (Ray & Kanta Ray, 2011). The car responded to a large demand for affordable vehicles from low-income consumers that may have been able to afford motorbikes—an unsafe means of transport compared to a car—but could not afford one.

The Nano car may not be as fuel-efficient as other, more expensive products. Yet other examples highlight that product innovations can also significantly contribute to reducing the environmental impact of consumption. This is the case, for instance, with the diffusion of renewable energy mini-grid technology in rural villages at affordable prices (Eder, Mutsaerts, & Sriwannawit, 2015; Singh, 2016). Affordable variety can also help advance social inclusiveness. One example is that of Beijing-based manufacturer Tsinghua Tongfang that markets computers specifically designed for rural users at affordable prices. The Changfeng agricultural computer helps bridge the digital gap between China's rural and urban areas (Li & Zhou, 2008).

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<sup>29</sup> Generic medicines are copies of originator- or innovator-branded medicines. Generics have the same dosage form, therapeutic effect, delivery route, known risks and side effects as the originator drug, but tend to be much cheaper than originator products.



#### **4.2.2.2 Goal 2: Advancing food security**

Another area in which the affordable variety created by industrial development introduces important welfare gains to consumers relates to the provision of food products at affordable prices, contributing to the attainment of SGD 2. The goal mandates to “end hunger, achieve food security and improved nutrition, and promote sustainable agriculture”. Food security can be defined as consisting of five essential elements: availability of food in local markets; access to food by all households, both in urban and rural areas; effective utilization of food within the household – itself a function of food safety, as well as the intra-household distribution of available food resources; the stability of domestic food supply; and finally, the sustainability of the food system on which all of these components depend (Timmer, 2017).

It is through these lenses that the role of increased affordable variety in contributing to food security is to be understood. As discussed above, in a narrow sense, price effects are fundamental determinants of access to food for consumption. This arguably holds for two interrelated cases. The first is closely related to the increase in the purchasing power of consumers discussed earlier. The increased affordability of *all* consumer goods available on the market would, in principle, enable families to allocate more resources towards foodstuff.

In a more direct sense, however, price effects can also decrease the price of foodstuff itself: increased affordable variety may be expected to reduce the price for food and thereby increase access. The reduction in price for agricultural products may occur as a result of productivity increases in food manufacturing industries as well as in the rural sector as a result of technological change. The introduction of manufacturing goods and technology that reduce costs and enhance crop yields, such as agricultural machinery or fertilizers, can bring significant benefits to end-consumers of food products, contributing to overall food security (P. Pingali, 2007; Steckel & White, 2012).

The benefits resulting from greater variety in food consumption at affordable prices are not limited to real income gains. Affordable variety may enable households to expand and diversify their dietary intake over time, leading to improved nutrition – another key component of SDG 2. Several studies have focused specifically on the evolution of food expenditure and the relationship between food variety, nutrition and population health. They highlight that as income rises, demand for food diversifies; growing diversity in food consumption, in turn, seems to have a positive impact on nutrition (Lee & Brown, 1989; Thiele & Weiss, 2003).

It is worth noting that there are major trade-offs between the greater consumption possibilities opened by increased affordable variety and environmental sustainability. Rising demand for foodstuff contributes, in many instances, to the continued emission of greenhouse gasses into the atmosphere as well as increased pressure on land, freshwater resources and biodiversity.

#### ***4.2.2.3 Goal 3: Providing access to quality-assured medicines***

Goal 3 emphasizes the need to “ensure healthy lives and promote well-being for all”. Addressing public health priorities in emerging and developing countries requires ensuring equitable access to affordable, safe and quality-assured medicines and medical devices.<sup>30</sup> Yet in many low- and middle-income countries, access to essential medicines remains limited—if not entirely lacking—for a high proportion of the population.

The barriers to access to quality medicines in developing countries are significant. While public health facilities may provide medicines for free or at a very low cost, availability appears to be low (Cameron, Ewen, Ross-Degnan, Ball, & Laing, 2009). Moreover, coverage by social health insurance schemes remains scarce, especially in low-income contexts (Cameron, Mantel-Teeuwisse, Leufkens, & Laing, 2012). As a result, medicines are still primarily purchased via out-of-pocket payments in private facilities, where high prices represent an obstacle to access for many. When prices are too high, patients may be forced to forego treatment or may be pushed under the poverty line due to medicine purchases. Other important barriers identified in the literature include shortage of human resources, inadequate infrastructure, inefficient distribution models, especially in rural areas, and the under-funding of healthcare in government budgets (Mujinja, Mackintosh, Justin-Temu, & Wuyts, 2014; UNIDO, 2012).

Owing to the price effects discussed so far, affordable variety can make an important contribution to the improvement of equitable access to essential quality-assured medicines. Against this backdrop, supporting the emergence of local commercially viable manufacturing capabilities in countries with a comparative advantage in pharmaceutical production could contribute to increasing access. However, while the notion that the growth of a domestic pharmaceutical industry may have significant economic benefits seems largely uncontroversial, significant scepticism exists surrounding the notion that it might also benefit consumers. Kaplan (2011) provides a critical review of the issues, arguing in particular that local production in

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<sup>30</sup> Target 3.b specifically mandates the international community to “support the research and development of vaccines and medicines for the communicable and non-communicable disease that primarily affect developing countries, [and] provide access to affordable essential medicines and vaccines”.

countries with limited infrastructure and human capital is likely to entail higher prices for consumers and would therefore risk hampering access.

While evidence on the issue is admittedly scarce, some authors estimate that as long as the market for generics is large enough, local production thereof can be fully competitive. In a recent study, for instance, Chaudhuri and West (2015) provide a simulation exercise for a small African country, Ghana, based on data collected from small-scale, domestic-oriented Indian manufacturers. They estimate that to earn a profit margin similar to that of a representative small-scale Indian firm, a Ghanaian manufacturer—facing higher costs for equipment, energy and capital—would need an output 2.7 times greater than that of its Indian counterpart<sup>31</sup>. The sales volume found to be sufficient for production to be profitable in Ghana (400 million tablets) is significantly lower than previous estimates (1 to 1.5 billion tablets), which were judged unrealistic (The World Bank, 2008). Under the right set of conditions, cost disadvantages in low- and middle-income countries need not translate into higher prices being passed on to consumers.

### **4.3 The dynamic view: affordable variety and structural change**

The previous sections examined several important benefits industrial development brings in terms of improving consumer welfare and broad-based living standards through the provision of increased affordable variety. These benefits happen at a given point in time, when a new manufacturing good or a new quality is introduced in the market, or when the price of this variety declines sufficiently to become affordable for the vast majority of people. However, the most important effects of industrial development in our daily lives are dynamic in nature and arise from the interlinkages between the creation of affordable variety, the generation of incomes and the process of continuous transformation of the economy.

The immediate effect of an increase in the affordability of manufacturing goods is, as already stressed above, an increase in the amount of income that households can allocate to other goods. The way in which this additional income is allocated, however, depends to very large extent on the initial level of income. When households are poor, most of their income is allocated to the satisfaction of basic needs, such as food and shelter. As income grows, these necessities tend to be satisfied and part of the new income—the so called *discretionary* income—can be allocated

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<sup>31</sup> This applies to a particularly conservative price scenario, where market prices in Ghana are made to adhere to the international reference prices – considered to be the lowest prices at which medicines are bought and sold internationally.

to other types of expenditure. In such a case, demand diversifies away from necessities and moves towards other goods.

From a historical perspective, industrial development has played a key role in creating a critical mass of discretionary income to set in motion an unprecedented process of creation of new varieties and qualities of goods. Until the end of the 19<sup>th</sup> century, most people spent the largest share of their income on necessities. The possibility to purchase higher goods and services required the formation of discretionary income. This, in turn, was only possible through the growing efficiency of the process of producing existing goods that started with the Industrial Revolution. Improved efficiency together with increasing income that was created by the new sectors in terms of investment and wages explains the creation of discretionary income, which led to the process of growing product quality and differentiation in the last century (Saviotti & Pyka, 2013).

Income gains, regardless of their origin, are therefore associated with changes in the consumption patterns of households. This lies at the core of a flourishing new strand of economic thinking that relates the process of structural transformation and economic growth to the changes that evolve in household demand as household wealth increases. Following the pioneer studies of the German statistician Ernst Engel, this strand postulates a non-linear relationship between average income and the share of different consumption categories in consumption baskets. Some goods increase more than proportionally as income rises, while others saturate, leading to a continuous process of diversification of demand.

Diversification of demand, in turn, leads to the emergence of new industries and the creation of new variety in the economy, which is a key requirement for the long-term continuation of economic development (Saviotti & Pyka, 2004b). Newly introduced products or industries will temporarily enjoy higher growth of demand as their demand is not saturated and they have a higher growth of capital accumulation compared to old ones (Foellmi & Zweimüller, 2008). This, in turn, reduces the relative size of old sectors as new ones initially grow at a faster pace (Saviotti & Pyka, 2004a). From this perspective, there is a demand-driven incentive for innovation from the satiation-escape dynamic, which in turn is caused by the inherent behaviour of demand. In that sense, changes in the industrial composition of growing economies are caused by changes in expenditure patterns of households. That is, structural change is endogenously driven by demand (Chai & Moneta, 2012; Foellmi & Zweimüller, 2008; Lorentz, Ciarli, Savona, & Valente, 2016).

The process of structural change contributes to long-term economic growth when emerging industries show higher productivity than existing ones (Yeon et al., 2016). Economic growth, in turn, results in higher wages and higher disposable income and pushes demand even further. This new round of increased demand for variety drives new innovations and leads to new shifts in the structure of the economy in a virtuous growth dynamic. As Chai (2017, p. 5) accurately puts it: “Given that demand shifts are income-induced, a positive feedback loop emerges between evolving patterns of demand and structural changes that drive up household income”.

As new manufacturing industries consolidate, they also gain scale and increase efficiency through process and managerial innovations. This initiates a process of cumulative growth in which the expansion of manufacturing production leads to further improvements in efficiency due to learning dynamics, which in turn further accelerates the sector’s productivity growth (Kaldor, 1967).

Gains in productivity in already established industries reduce the prices of those goods that initially were only affordable to a few. Luxuries become necessities and an increasing number of people are able to access and consume them. As a result, demand for these products massifies and new income opportunities are created for firms serving that demand. In fact, both phenomena are intertwined: process innovations reduce manufacturing costs and enable tapping and proliferating mass consumption markets, while mass production facilitates further process innovations by increasing learning-by-doing and specialization benefits (Foellmi, Wuergler, & Zweimüller, 2014).

The process of production efficiency gains does not stop at that point. Even when goods have diffused across all consumers, inter-firm competition and the introduction of new innovations lead to further declines in price, now affecting the majority of consumers (the initial adopters and the mass that gained access with the previous decline in prices). Hence, the purchasing power of the vast majority of consumers increases, as does the discretionary income they can allocate to new varieties of non-essential manufacturing goods, restarting the circle anew.

## **5 Final remarks**

This paper has reviewed the main mechanisms linking the diversification of demand with the creation and diffusion of related and unrelated variety at increasingly affordable prices – and the central role manufacturing plays in this process. It has, in its various components, analysed the feedback loop that ties together demand and supply for variety to the dynamics of product and process innovation, productivity and price that characterize the creation of variety in manufacturing industries. It argues that the outcome of this loop is the creation of ‘affordable

variety’ – the diffusion of manufacturing goods of increasing quality and decreasing price throughout the economy.

Secondly, the consequences for consumer welfare deriving from access to new varieties of affordable goods have been discussed. The paper has reviewed literature moving from a ‘narrow’—and quantifiable—perspective on consumer welfare to a broader, more normative perspective on sustainable development, and found that the welfare gains from affordable variety for consumers tend to be considerable. Finally, taking the ‘dynamic’ view, the paper has analysed the long-term consequences of the diffusion of affordable variety on the economy as a whole, discussing the strong connection between the emergence of new products and patterns of structural transformation.

The originality of this paper’s contribution is twofold. First, it builds a conceptual bridge between research on the emergence of variety and that on the role of manufacturing in the growth process to shed light on the role of manufacturing in variety creation, leading to the definition of ‘affordable variety’ proposed here. In addition, the paper elaborates a traditionally under-appreciated aspect in discussions on industrial development, welfare and sustainable development – namely the potential of industrialization to directly enhance consumer welfare through the provision of final goods for consumption at affordable prices and increasing quality.

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## Appendix

**Table 1** An overview of empirical studies on variety

Reference	Variety Measure	Data characteristics	Data set and time period
<b>Consumption Basket</b>			
Jackson (1984)	Average number of products purchased by broad product category and income segment	US (304 categories)	Consumer Expenditure Survey, 1972/73
Theil & Finke (1983)	Entropy and HH index	Cross-country (30)	
Falkinger & Zweimüller (1996)	Count index and HH index	Cross-country (57 countries and 91 consumption items)	ICP, 1980
Clements et al.(2006)	Entropy (between group and within group)	Cross-country (45 countries, 8 categories)	Selvanathan and Selvanathan (2003)
Chai et al.(2015)	Gini-Simpson index, entropy and Gini coefficient	UK (5,000 households and 12 expenditure categories)	Household consumption survey, 2001
Chai & Moneta (2012)	Gini coefficient	UK Time Series (approx. 7,000, 12 expenditure categories)	Household consumption survey, 1960-2000
Moneta & Chai (2014)	Income elasticity per product category	UK Time Series (approx. 7,000, 12 expenditure categories)	Household consumption survey, 1960-2000
Moneta & Stepanova (2017)	Gini-Simpson index	Cross-country (91 countries and 106 consumption items)	Global Consumption Database, 2010
<b>Consumption Basket: specific studies on food variety</b>			
Shonkwiler et al.(1987)	Average number of items purchased	USA (683 households)	Survey of Household Food Consumption, 1977/78
Lee & Brown (1989)	Entropy and HH index	USA (1,061 households, 19 food groups)	Consumer Expenditure Survey, 1981
Jekanowski and Binkley (2000)	Entropy and HH index	US (484 products, 54 markets areas)	Sales and Managing Variety Inc., 1990



Moon et al. (2002)	Count index and entropy	Bulgaria (2,133 households)	National Household Survey, 1997
Thiele & Weiss (2003)	Berry index (Gini-Simpson index), Entropy	Germany (4,632 households, 149 food products)	Food variety, 1995
Drescher et al.(2008)	Entropy	Germany (3,240 household and 182 varieties of soft drinks)	Consumer Panel Research Data, 1993
Regmi & Meade (2013)	-	Cross-country (between 60 and 144 countries)	ICP, 1980/1996/2005
<b>Trade Data</b>			
Funke and Ruhwedel (2001)	Product variety measures based on Feenstra (1994)	Cross-country (19 OECD members, six-digit trade data)	Import and export data, 1989-1996
Broda and Weinstein (2004)	Growth in average number of import suppliers at 4-digits	Cross-country (31 countries, four-digit STIC trade data)	Import data, 1972-1997
Saviotti and Frenken (2008)	Entropy (divided into related and unrelated variety based on trade classification)	Cross-country (20 OECD members, three-digit trade data)	Import and export data, 1961-2004
<b>Production data</b>			
Yeon et al. (2016)	Entropy (for top 70% of output)	Republic of Korea time series (18 sectors divided into intermediate consumption, exports and consumption expenditure)	Input-output data, 1960-2010
<b>Others types of data</b>			
Frenken et al. (1999)	Entropy and Weitzman's max. likelihood procedure	Products characteristics of aircraft, helicopters, motorcycles and microcomputers	Various sources, various times periods

**Table 2 Review of studies on welfare gains from the introduction of new goods, subsequent quality improvements and price reductions**

<b>Welfare from accessing new imported varieties</b>			
<b>Study</b>	<b>Good</b>	<b>Period</b>	<b>Welfare gain</b>
Broda and Weinstein (2004)	New foreign varieties	Various, 1972-1997	3% US, 27% China, 25% Mexico
Broda and Weinstein (2006)	New foreign varieties	US, 1972-2001	2.2-2.6% US
Mohler and Seitz (2012)	New foreign varieties	EU-27, 1999-2008	2.8% Estonia, -0.4% France and 0.59% Spain
<b>Welfare from new varieties</b>			
<b>Study</b>	<b>Good</b>	<b>Period</b>	<b>Welfare gain</b>
Hausman (1996)	Apple-Cinnamon Cheerios (cereal brand)	1992	0.002%
Brynjolfsson (1996)	Personal computers	1987	US\$ 50-70 billion (0.2-0.3% of GDP per year)
Hausman (1999)	Cellphone	1988-1996	0.46-0.9% (\$24-49 billion in aggregate)
Petrin (2002)	Minivan	1984-1988	0.029% (\$ 2.8 billion in aggregate)
Goolsbee and Petrin (2004)	Satellite TV	2001	0.035% (\$125-190 per consumer per year)
	Cable TV	2001	\$50 per consumer per year or \$3-4 billion in aggregate
Goolsbee and Klenow (2006)	Internet	2005	2-3% (linear demand) or 7.3-26.8% (log-linear demand) of income
Leunig and Voth (2011)	Cotton yarn	1784-1820	5.4-6.1% of consumer expenditure
	Automobile	1908-1929	1.2-3.5% of consumer expenditure
Dittmar (2011)	Printed Books	1495-1545	4.7% of total personal expenditure
		1495-1695	10.7% of total personal expenditure
Greenwood and Kopecky (2013)	Personal computers	1977-2004	2.19-3.3% (or 0.2% of GDP) of total personal expenditure
	Electricity	-	92% of total personal expenditure



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