WILLIAM BAUMOL AND THE COST DISEASE

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ABSTRACT

The Baumol effect follows from simple but deep microeconomic reasoning. All prices are relative prices, so if some goods are getting cheaper, others must be getting more expensive. Simple. But in transferring our attention about the cause of rising prices from stagnating sectors to progressive sectors, the Baumol effect radically changes our understanding of the causes, consequences, and evaluation of rising prices. Even today, the power of the Baumol effect to explain price changes through different time periods and places is underestimated. Throughout his career, Baumol returned to this simple idea many times, making it a key to his thought and his evolving views on long-term economic development.

Keywords: Baumol effect; cost disease; services; inflation; stagnation

INTRODUCTION

William Baumol didn't invent the cost disease but over a period of nearly half a century, beginning with Baumol and Bowen (1965) and ending with Baumol (2012), he returned to the idea multiple times elaborating its principles, applying it to new fields, and tested its implications until it became, to his delight, Baumol's cost disease.[1]

The bulk of Baumol and Bowen's (1966) monumental analysis of the performing arts were the collections of data – everything from the earnings and expenditure of the New York Philharmonic orchestra from 1895 to 1964 (p. 293) to the size of Broadway casts from 1895 to 1964 (p. 476). What caught the public's

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enduring attention, however, was a handful of pages seemingly explaining "the economic dilemma" with a powerful yet simple theory.[2]

In 1826, when Beethoven's String Quartet No. 14 was first played, it took four people 40 minutes to produce a performance. In 2010, it still took four people 40 minutes to produce a performance. Stated differently, in the nearly 200 years between 1826 and 2010, there was no growth in string quartet labor productivity. In 1826, it took 2.66 labor hours (4 people $\times$ 40/60 hours) to produce one unit of output, and in 2010, it took 2.66 labor hours to produce one unit of output.

Fortunately, most other sectors of the economy have experienced substantial growth in labor productivity since 1826. We can measure growth in labor productivity in the economy as a whole by looking at the growth in real wages. In 1826, the average hourly wage for a production worker was \$1.14. In 2010, the average wage for a production worker was \$26.44, approximately 23 times higher in real (inflation-adjusted) terms.

Growth in average labor productivity has a surprising implication: it makes the output of slow productivity-growth sectors (relatively) more expensive. In 1826, the average wage of \$1.14 meant that the 2.66 hours needed to produce a performance of Beethoven's String Quartet No. 14 had an opportunity cost of just \$3.02.[3] At a wage of \$26.44, the 2.66 hours of labor in music production had an opportunity cost of \$70.33.[4] Thus, in 2010, it was 23 times (70.33/3.02) more expensive to produce a performance of Beethoven's String Quartet No. 14 than in 1826. In other words, one had to give up more other goods and services to produce a music performance in 2010 than one did in 1826. Why? Simply because, in 2010, society was better at producing other goods and services than in 1826.

The random vicissitudes of science and technology mean that we shouldn't be surprised that labor productivity grows faster in some industries at some times than in others. But the relatively slow productivity growth of the quartet players appears to be systematic rather than an accidental matter of chance as Baumol and Bowen (1966) explain:

> The characteristic of live performance which precludes substantial changes in its mode of operation is that the work of the performer is an end in itself, not a means for the production of some good. When a customer purchases a typewriter, he usually neither knows nor cares how many man-hours of what kind of labor went into its manufacture. Any innovation which reduces the number of man-hours embodied in one such machine makes absolutely no difference to its buyer – except, of course, insofar as this affects its price. But in live performance matters are quite different. The performers' labors themselves constitute the end product which the audience purchases …. For, unlike workers in manufacturing, performers are not intermediaries between raw material and the completed commodity – their activities are themselves the consumers' good.
>
> […] Human ingenuity has devised ways to reduce the labor necessary to produce an automobile, but no one has yet succeeded in decreasing the human effort expended at a live performance of 45-minute Schubert quarter much below a total of three man-hours. Baumol and Bowen (1966, p. 164).

The systematic nature of differential productivity growth led Baumol and Bowen (1965, 1966) and Baumol (1967) to make predictions about future price increases. In addition to the arts, they predicted relative price increases for

education, police, hospitals, social services, and inspection/repair services. It's often claimed that economists aren't good at predicting, let alone at predicting trends 50 years in the future, but all of these predictions were accurate (e.g., see Baumol, 2012; Helland & Tabarrok, 2019 for details). The rising relative price of health care and education are well known, and the trend was at least 50 years old when Baumol and Bowen wrote but consider some of the less obvious predictions. Fig. 1 shows the prices of cars and car repairs (normalized to 100) since 1950. The price of new vehicles has fallen (quality adjusted) while the price of car repair has increased.

I recently bought a car for $30,000 and then bashed the passenger door on a barrier around a tight corner in an underground parking lot. The damage was superficial, the door worked fine. Nevertheless, fixing it costs $3000, about 10% of the value of the entire car! Differential productivity growth is to blame. It took far fewer labor hours to make the door than to fix the door and the difference has increased over time. As a result, there is an interesting prediction – the number of "totaled" cars will increase over time as a fraction of accidents, that is, it's an implication of Baumol's cost disease that the number of cars not worth repairing increases over time, holding accident severity constant.[5]

Cobblers and tailors used to be more common because it used to make sense to repair shoes and clothes. Today it is cheaper to throw old shoes and clothes out and buy new ones than to repair them. Contrary to my "thrifty" mother, it's unlikely that changing tastes explain these differences. It's not that the young

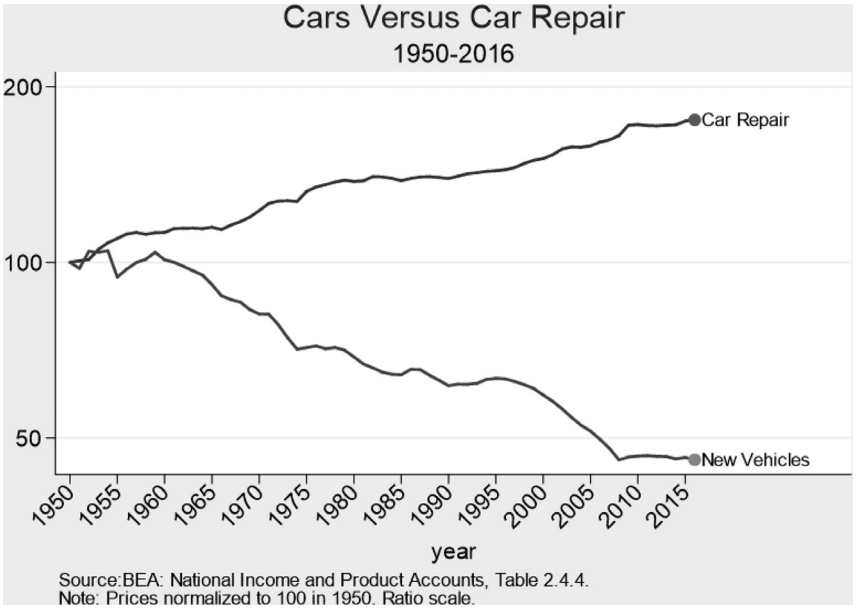


Fig. 1. Cars Versus Car Repair (1950–2016).

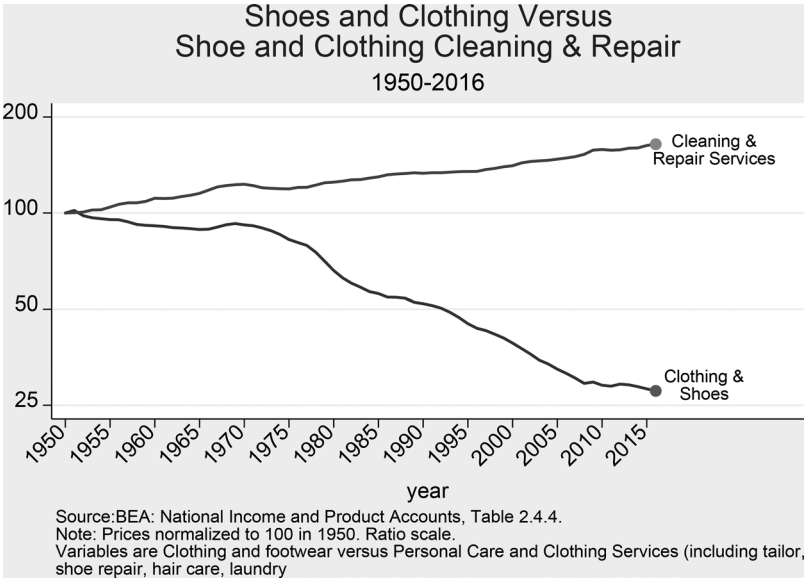


Fig. 2. Shoes and Clothing Versus Shoe and Clothing Cleaning and Repair (1950–2016).

are less thrifty than previous generations but that it's become more wasteful to repair than to buy because of changing prices. As shown in Fig. 2, the real price of clothes has decreased over time while the price of tailoring has increased. Put another way, if in 1950 a unit of tailoring had an opportunity cost of a unit of clothes (units defined appropriately) then in 2016 a unit of tailoring cost six units of clothing. Since tailoring has become more expensive relative to buying, when clothes wear down fewer people repair and more buy.

Although Baumol and Bowen (1965, 1966) and Baumol (1967) should be credited with making accurate long-run predictions about the prices of education, health care, repair services, and so forth, they incorrectly predicted quantities. Here, their predictions are more opaque but, especially in the early work, there is a clear sense that increased prices meant reduced quantities and that this was lamentable. The titles of the early papers, for example, refer to "economic problems," "dilemmas," and "crisis." Twentieth Century Fund, which supported Baumol and Bowen (1966), had the goal of drawing attention to the "arts crisis" (Besharov 2005) and in this they were successful. Throsby (1994), for example, noted that the cost disease "has been widely seized upon in a number of countries as spelling doom for the live arts …."[6] Yet when we consider the cost disease sectors, one of the striking features is that in many cases (not all) quantities have expanded even as prices have risen.

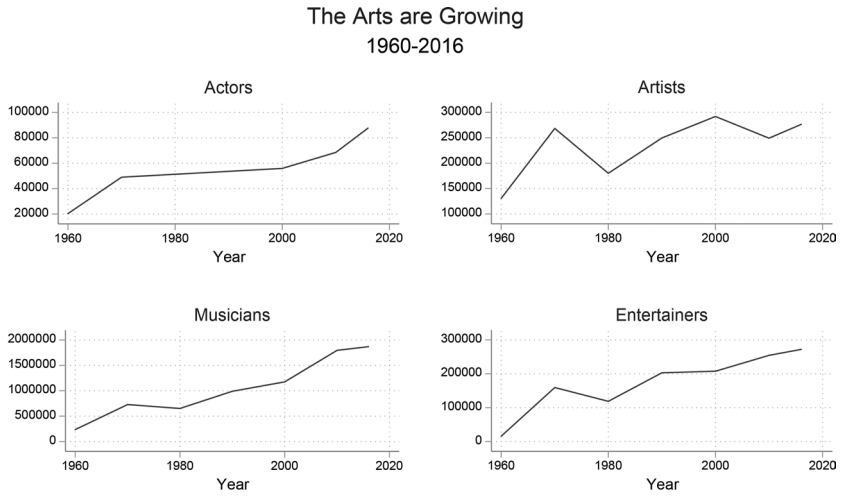
Despite increases in price, for example, the number of teachers and the number of physicians has increased in per-capita terms in the United States (Helland &

Tabarrok, 2019). What about the arts? After 50 years of the Baumol effect, have the arts been devastated as one might expect from Baumol and Bowen (1966)? No. Measured by a variety of real metrics, the arts are growing as a share of the economy. Between 1960 and 2016, the US labor force increased by a factor of 2.3. During the same period, the number of actors increased by a factor of 4, the number of artists kept pace at a factor of 2.1, musicians increased by a factor of 7, and entertainers (not including actors, musicians, or other major categories) increased by a factor of 17 (see Fig. 3). The increase in the number of "entertainers" not falling into traditional categories is notable because it shows the poverty of measuring growth in the arts by focusing on the arts of yesteryear (Cowen, 1996, Cowen & Grier, 1996).

Even in the categories that might seem most amenable to decline, symphonies and Broadway shows, the numbers are up. There were 65 symphony orchestras in the United States in 1965 and by one count over a thousand in 2020 and weekly attendance at Broadway shows is up not down.[7]

The failure of Baumol and Bowen (1966) to predict the continued vitality of the arts should not be marked as a failure of the Baumol effect. Indeed, it is one of the *virtues* of the Baumol effect that it can explain rising prices and rising quantities. All other theories of rising prices have difficulty in explaining a combination of rising prices and quantities and must rely on additional ad-hoc hypotheses, a point I will return to later.

More generally, the Baumol effect is not a "crisis," a "problem," or a "disease."[8] To understand this, a graphical depiction of the Baumol effect is useful.



Note: IPUMS data, occ1950 codes 1, 4, 57, 51 clockwise from top left.
Note that some categories include teachers, e.g. musicians and music teachers.
Entertainers are entertainers not elsewhere counted.
For comparison the US Labor Force increased by a factor of 2.3 during this period.

Fig. 3. The Arts Are Growing (1960–2016).

THE BAUMOL EFFECT IN A GRAPH

It's surprising that Baumol always explained the Baumol effect using simple stories like that of the string quartet or a graphical or mathematical model with a linear production function because the most natural model is the standard production possibilities frontier as shown in Fig. 3.[9] The curve PPF_1 shows all the combinations of cars and education that are available to society at time one. More cars mean less education and vice versa. Suppose that society chooses to consume at point (a). At point (a), the tradeoff between cars and education is given by the slope of the tangent line. In other words, the slope of the tangent shows the opportunity cost of education in terms of cars. In a market economy, the slope of the tangent is also the relative price of education. Now imagine that productivity increases so that at time 2, society can produce more of both goods. As a result, the PPF shifts outwards. We assume, however, that productivity growth is not even. Productivity improves more for cars than for education, giving us PPF_2. Suppose that society chooses to consume the two goods in similar proportions as at time 1, so consumption is now at the point (b). At point (b), the relative price of education has risen dramatically. This is the Baumol effect.

But note that at point (b), society is consuming more cars and more education. The Baumol effect is sometimes called the "cost disease." But that's a poor term because price increases driven by productivity growth are never bad – an expanding PPF is always good, and the Baumol effect is driven by an expanding PPF, albeit one that expands unevenly.

The economy depicted in Fig. 4 contains deep lessons. One lesson is that all prices cannot fall. Behind the veil of money, prices are ultimately relative prices – prices tell how many cars society must give up to get education. But if cars become cheaper and society can buy more cars by giving up the same amount of education, then education must have become more expensive – it takes more cars to buy the same amount of education.

The contrary intuition that all prices must fall with economic growth comes from thinking about prices as a measure of affordability. When a price falls, people are pleased because that good has become more affordable. Over a short period of time when incomes are fairly constant, the relative price and affordability signal work in the same direction – goods that fall in price are more affordable, and goods that rise in price are less affordable. But over a long period of time, prices cannot be interpreted as measures of affordability. At point (b) in Figure 4, education has risen in price and become *more* affordable.

Thus, the Baumol effect can explain rising prices and rising quantities. Indeed, rising prices and quantities should be considered the baseline prediction of the model. Many other theories have been proposed for rising prices in particular sectors of the economy. In education, for example, rising prices are often blamed on unions, government purchases or waste and mismanagement (Helland & Tabarrok, 2019). Yet, if any of these theories were true, we would expect consumers to consume *less* education as prices increased. To reconcile rising prices with rising quantities, alternative theories must propose auxiliary hypotheses, which explain why, even as rising prices decrease the quantity demanded, the demand

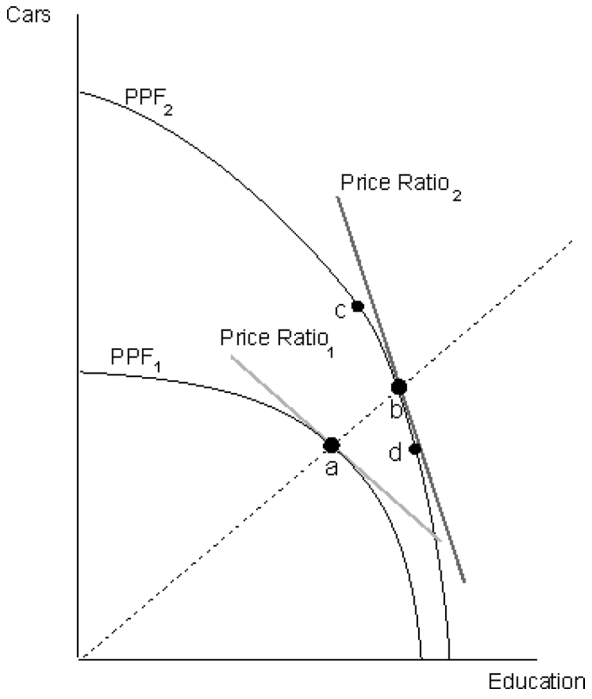


Fig. 4. The Baumol Effect.
Note: At time 1, society can consume any combination of cars and education along the production possibilities frontier PPF_1. Suppose point (a) is chosen. At point (a), the relative price of education, the opportunity cost, is given by the slope of the tangent. At time 2, productivity has increased for cars much more than for education. Suppose we continue to consume a similar proportion of the two goods at point (b). Even though we can and do consume more of both goods, the relative price of education, given by the slope of the tangent at (b) has increased. Points (c) and (d) describe how prices change if consumers want to spend a smaller or larger share of their income on education as income increases.

for education is increasing by more than enough to offset. It could, of course, be possible that, for example, increasing credentialism increased the demand for education at just the same time as increasing prices reduced the quantity demanded but it is more difficult to believe that similar coincidences also occurred for health care, professional services, and hairstyling.

A related virtue of the Baumol effect is that it relies on "primitives" in contrast to other theories that are much more time and place-specific. In particular, if there are different rates of productivity growth in the goods and labor-service sector then the Baumol effect ought to apply regardless of almost all laws, institutions, or practices. Health care prices, for example, are rising in most countries and have been doing so for a long time. Thus, theories that rely on Medicaid,

Medicare, insurance, unions, "country-specific effects" such as culture and many other time, and place-specific factors have difficulty explaining the slow but relentless increase in price around the world. Rising health-care prices are even seen in veterinary care, despite very different legal and institutional contexts (Einav, Finkelstein, & Gupta, 2017).[10] Indeed, the Baumol effect should apply even in non-market economies. In fact, Rubinstein, Baumol, and Baumol (1992) showed that, as best as could be measured, prices for the performing arts were rising in the Soviet Union as in the United States. The only major differences were that the rate of growth was slower, as should be expected due to lower productivity growth, and in the Soviet Union some of the pressures showed up in increasing shortages rather than in increasing prices. Few theories have as broad a level of applicability as the Baumol effect.

The Baumol effect is consistent with rising prices and quantities but if there are good substitutes for the good rising in price the substitution effect will dominate. For example, we noted that car repair has risen in price and declined in quantity. Why? Because there are good substitutes for repaired cars, namely new cars. Moreover, the quality of cars has increased over time – in part due to the higher cost of car repair – so car repair has become less necessary. In the case of education and health care, there are no obvious substitutes but the Baumol effect does imply that, when possible, we will substitute toward those aspects of education and health care, which are increasing in productivity. Thus, it's often been noted that American health care is notably expensive and focused on pharmaceuticals and high-tech. The Baumol effect suggests that the latter are a consequence not a cause of the former.

Fig. 4 has another lesson. By plotting the price ratios at (a) and (b), we have assumed that consumers consume the two goods in the same proportion over time. But suppose that as income increases, consumers want less education, such as at point (c). In this case, the price effect will be smaller. However, if consumers want more education as income increases, such as at point (d), the price effect will be larger. The share effect is independent of the Baumol effect because it would still occur even if productivity growth were balanced. What drives the share effect is the idea implicit in the shape of the PPF curve that some resources are better at producing cars and others are better at producing education. Naturally, we produce education using the resources that are best at producing education. As we produce more and more education, however, we must draw on resources that are less well-suited to education production, so the price of education must increase. The share effect will not be relevant for many goods and services that can be produced without specialized resources, but it may be relevant for some goods and services. Moreover, as income has increased, consumers have chosen to buy more education and healthcare, so the share effect will magnify the Baumol effect.

If we graph the prices of the two goods shown in Fig. 4, over time we will see a graph like that in Fig. 5. Looking at such graphs, our attention naturally is drawn to the rising cost of good 2, in this case education. Why are costs rising so quickly? Entranced by such graphs, we may enter into a detailed analysis of

the special factors of sector 2 production – regulation, unionization, government purchases, insurance, international trade, and so forth – to try to explain the dramatic increase in costs. Yet the rising costs in the stagnant sector are simply a reflection of increased productivity in the progressive sector. Thus, another deep lesson of the Baumol effect is that to understand why costs in the stagnant sector are rising, we must look away from the stagnating sector and toward the progressive sector.

Looking at the progressive sector tells us that prices in the stagnating sector should grow fast when productivity in the progressive sector is growing fast. In other words, contrary to intuition, prices in the stagnating sector should increase fastest when economic growth is high. Surprisingly, this implication of the Baumol effect has not been tested formally.

Fig. 4 assumes that consumers continue to buy Cars and Education in roughly equal proportions over time. The theory doesn't guarantee this, as it depends on consumer preferences and the possibilities for technological substitution. Domestic servants, for example, have become less common over time because consumers substituted into capital-intensive replacements such as dishwashers, clothes washers and robotic vacuum cleaners. Much of this was driven by exogenous technological growth but some of the growth was likely endogenous, that is, high wages for domestic servants encouraged R&D in servant substitutes.[11] Consumers continued to buy "Cars" and "Education" in roughly equal proportions seems reasonable, however, if we define the two goods more broadly as goods from the progressive and stagnating sector.

Moreover, in the very long run, it seems likely that consumers become satiated with the good that is falling in price, leading them to spend more on the good

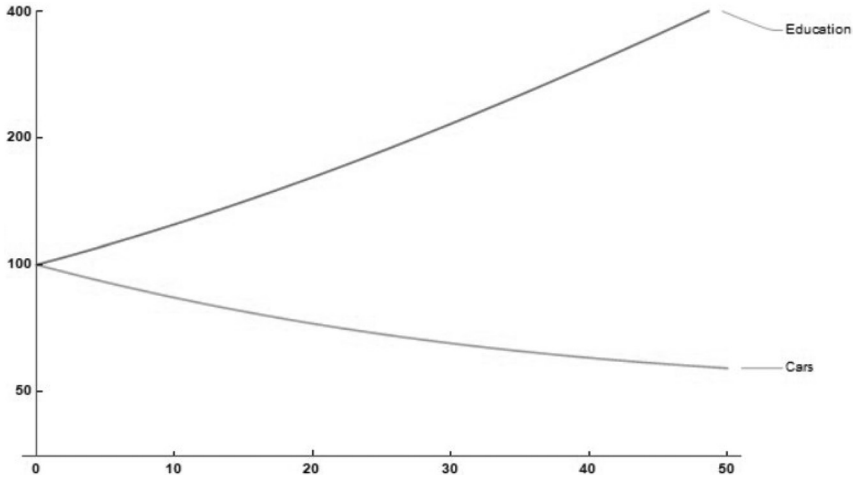


Fig. 5. Prices in the Stagnating Sector Versus the Progressive Sector.

which is rising in price. Thus, as prices fall in the progressive sector, spending on that sector will eventually fall and spending on goods from the stagnating sector will increase. In fact, consumers in developed economies are spending a greater share of their income on health and education and less on manufactured goods over time. But this means that growth in the progressive sector applies to a smaller and smaller share of the economy, that is, growth overall falls as does growth in wages. Massive productivity improvements in an industry that is becoming a smaller and smaller share of the economy do not do much to increase average wages. Thus, the Baumol effect contains the seeds of its own destruction, although the seeds may take a long time to germinate. Vollrath (2020) estimates that the shift over time to the slower-growing service sector has had a small but significant effect on lowering overall economic growth.

THE BAUMOL EFFECT AND THE BALASSA–SAMUELSON EFFECT

The Balassa–Samuelson effect says that the price level is lower in the developing world (Balassa, 1964; Samuelson, 1964). Why? For less than $1, I have had a haircut from a street barber in Mumbai that was every bit as good as an $18 haircut in Toronto. On the other hand, iPhones in Mumbai sell for about the same price as anywhere else in the world. More generally, non-tradable, typically services sell for less in the developing world and tradable goods sell for about the same price everywhere; hence, the price level on average is lower in the developing world.

Poor countries are poor because their *average* labor productivity is low but for many services average productivity isn't lower in poorer countries. Barbers, chefs, and string quartet players are about as productive in the developing world as in the developed world. The developing world is poor, because it has lower productivity in manufactured goods, such as computers, cars, and aircraft. Labor of the same quality, however, must sell for the same price in the same country. Thus, wages in all sectors are pulled down by the low average productivity of labor in manufactured goods. As a result, barbers, chefs, and string quartet players will have much lower wages relative to their productivity in the developing than in the developed world. Hence, it's smart to get a haircut in a poor country.

Returning to Fig. 4, we can now interpret point (a) as the relative price of goods (cars) and services (education) in a developing country and point (b) as the relative price in a more developed country. The relative price of services increases with development (movement from a to b) but in which country would you rather live? In short, the Baumol effect is the inter-temporal version of the Balassa–Samuelson effect.[12] The past is a poorer country.

The fact that the goods that are rising in relative price in developed countries – education, health care, labor services in general – are also the goods that are cheaper in poorer countries should lend credence to the Baumol effect, that is, it is the slower growth in the productivity of services that accounts for the change in prices over time and not some special factor such as regulation, unions, insurance, management, and so forth.

THE BAUMOL EFFECT AND THE LINDER THEOREM

Travelers to developing countries notice that haircuts and restaurant meals are cheap and often something else. Life in developing countries seems slower, more tranquil, and less harried. Meals are longer, conversations deeper, time seems to move less quickly. Development seems to be accompanied by fast food, fast talking and even fast walking (Levine & Norenzayan, 1999). In The Harried Leisure Class, Staffan Linder (1970) proved a theorem that Baumol (1973) generalized. As productivity increases, as measured by wages, so does the opportunity cost of leisure or more generally, time. A higher price of time encourages us to economize on time, so as wages rise, we schedule our time more carefully with time planners, "to do" lists, calendaring and incessant notifications. We consume more quickly and we consume more goods that are quick to consume so "fast food" becomes the norm and we choose to watch television or movies "on demand" rather than read books or go to plays or live music performances. We consume multiple goods at the same time as when we eat and watch, talk and drive, and exercise and listen.

The theorem can be seen from the optimal consumption rule which says consume goods x and y until their marginal utilities per dollar are equal.

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

Thus if Px rises we have:

$$\frac{MU_x}{P_x} < \frac{MU_y}{P_y}$$

And the consumer responds by consuming less of x (increasing MU_x) and more of y (decreasing MU_y) until equilibrium is reestablished. Linder notes that goods and services take time to consume, and time is limited so the price of good x should include not just its money price but also its time price, the wage rate multiplied by the time it takes to consume the good t_x. Thus, the optimal consumption rule becomes:

$$\frac{MU_x}{P_x + wt_x} = \frac{MU_y}{P_y + wt_y}$$

Now assume (without loss of generality) that $t_x > t_y$ and that w increases. The increase in w increases the full price of x causing the consumer to consume less of x and more of y. Or, as Baumol (1973, p. 630) put it, "rising productivity decreases the demand for commodities whose consumption is expensive in time."

As with the Baumol effect, there are qualifications and additional considerations. Most notably, since the Baumol effect and Linder theorem are both driven by an increase in productivity, consumers are not made worse off by the respective increase in prices. The choice to consume fewer time-intensive goods as wages increase is welfare-maximizing.[13] It is also true that time is not entirely fixed.

Time-saving devices such as faster internet or supersonic aircraft are possible. We can also increase life expectancy giving us more time to enjoy our greater productivity of goods and services (Hall & Jones, 2007). Indeed, we are consuming more leisure over time. Nevertheless, the power of the Linder theorem should be evident. One reason we consume more leisure than in the past is that we manage our time at higher levels of intensity than in the past. A search at Amazon for "time management," for example, leads to over 10,000 hits. It is also the case that leisure, especially passive leisure such as watching television, has become more concentrated in people with lower incomes (Aguiar & Hurst, 2009).

Aside from a similar structure, the Baumol effect and Linder theorem have another connection. The goods for which the Baumol effect predicts an increase in the relative (money) price are the labor services, the goods for which "the work of the performer is an end in itself, not a means for the production of some good." But these goods tend also to be the goods which are rising in time-price. It would be somewhat peculiar, for example, if an hour of acting could be consumed in less than an hour.[14] Thus, as Baumol (1973) noted live performance may be subject to two challenges simultaneously – an increasing money price due to the Baumol effect and an increasing time price due to the Linder theorem.

EMPIRICAL EVIDENCE ON THE BAUMOL EFFECT

The Baumol effect is difficult to deny. In her autobiography, Agatha Christie (2012) discusses how she never thought she would ever be wealthy enough to own a car, nor so poor that she wouldn't have servants, thus neatly summarizing differential productivity growth and its consequences. It's clear that a variety of labor services are cheaper in poor countries and that these are the same types of services that were cheaper in the past. Barbers earn more today than one hundred years ago because *other* professions have become more productive not because barbers have become more productive.[15] As noted above, Baumol's predictions about the rising price industries – education, health care, repair, and inspection services – appear to have been born out in the data.

More formally, Nordhaus (2006) shows that prices fall in industries with higher total factor productivity.[16] Nordhaus writes:

> Baumol's hypothesis of a cost-price disease due to slow productivity growth is definitely confirmed by the data. Industries with relatively low productivity growth ("stagnant industries") show a percentage-point for percentage-point higher growth in relative prices. This result indicates that most of the economic gains from higher productivity growth are passed on to consumers in lower prices. Moreover, differences in productivity over the long term of a half century explain around 85 percent of the variance in relative price movements for well-measured industries. While the underlying forces driving technological change remain a challenge, the impacts of differential technological change on prices stand out clearly.

Thus, the Baumol effect has strong empirical support but it doesn't follow that the Baumol effect is the answer to the questions we want to ask. Most notably, why are expenditures for health care and education rising? The Baumol effect offers an explanation in principle but is the Baumol effect large enough in

practice to explain the increase in health and education expenditures? And are other explanations for rising expenditures ruled out? Could aging or rent-seeking not also explain the results? Taking the theory to the data turns out to be quite difficult. What, for example, is the price of health care? What is the productivity of health care?

We don't know the price of health care because we don't have a unit of health care. Productivity is difficult to estimate because few health care services remain the same over time. It's not obvious that health care productivity has declined, all considered. (It's clearer, however, that education productivity has declined relative to other industries.[17]) One approach might be to focus on specific procedures which have remained relatively constant over time. What is the cost of one hour of diagnostic work of a primary-care physician, for example? It's clear that productivity in diagnosis has not increased and the price of this service has increased dramatically, as one can tell by examining physician salaries which have grown rapidly in the past 50 years (Helland & Tabarrok, 2019). Another example of a relatively stable medical service is nursing home care. Stewart, Grabowski, and Lakdawalla (2009) show that annual private-pay nursing homes prices grew by 7.5% annually between 1977 and 2004. These are nominal price increases but they are higher than growth in either the medical CPI (6.5%) or the overall CPI (4.3%). The bulk of costs in nursing homes are labor costs (Cawley, Grabowski, & Hirth 2006; Zinn, 1993) so the story fits the Baumol effect. It's also notable that over this period people were getting healthier which, all else equal, would have suggested lower costs.

Instead of looking at specific services, many papers in the literature have tried to estimate the fraction of health care expenditure accountable by the Baumol effect. The typical procedure regresses the growth of health care expenditure on a variety of variables such as the growth of the elderly population and a Baumol effect variable, typically defined as the difference between growth in economy-wide wages and labor productivity (e.g., Bates & Santerre, 2013; Colombier, 2017; Hartwig, 2008; Nose, 2017 for an application to education).

Most studies find that the Baumol effect is a statistically significant factor in rising health care expenditures but differences arise on how important a factor with Hartwig (2008), for example, finding bigger effects than Colombier (2017) or Bates and Santerre (2012). The estimation procedure in these papers, however, relies too much on implementing Baumol's simple model, which was only meant to illustrate ideas rather than to form the foundation for an estimation procedure.

Baumol assumed, for example, that there was only one type of labor and that economy-wide wage rates grew at the rate of the progressive sector. Thus, the idea of the "Baumol variable" (the difference between growth in economy-wide wages and labor productivity) is that wages are assumed to grow at the rate of the progressive sector which is above the rate of productivity growth in the economy as a whole because the latter also includes the stagnating sector. The assumption is acceptable in a simple model and it makes sense in an economy dominated by the progressive sector but the assumption becomes less viable over time as the stagnating sector grows and economy-wide productivity declines. Economy-wide wages cannot grow faster than economy-wide productivity so the "Baumol variable" must approach zero as the economy grows.

In addition, Baumol assumed that labor in all sectors was substitutable. This was an acceptable assumption when thinking about barbers who could switch between say barbering and the mid-twentieth century manufacturing sector. Labor in the health care sector, however, will often by highly skilled. Thus, there are multiple "Baumol variables" and the one for health care workers should compare high-skill wages with the productivity of high-skill workers. In the United States, for example, as across much of the world, the wages of skilled labor have increased faster than the wages of (relatively) unskilled labor. One plausible hypothesis is that high-tech sectors demand high-skilled labor, which drives up the wage rate for high-skilled labor. The high-tech sector can pay the higher wages and still sell at lower prices over time because of productivity improvements but the stagnating sectors such as health care and education must pay the higher wages without an increase in productivity and thus must raise prices. Helland and Tabarrok (2019) show that price increases appear to have been the largest in industries with low productivity that use a lot of skilled labor.

Overall, while advances have been made, the Baumol effect has not yet been well tested by advanced statistical methods. This author is more convinced by the following argument. The Baumol effect is the only major hypothesis, which explains why the repair of cars and the repair of people should both have risen in price over the last half-century.

CONCLUSION

The Baumol effect follows from simple but deep microeconomic reasoning. All prices are relative prices so if some goods are getting cheaper, others must be getting more expensive. Simple. But in transferring our attention about the cause of rising prices from stagnating sectors to progressive sectors, the Baumol effect radically changes our understanding of the causes, consequences, and evaluation of rising prices.

NOTES

1. Towse (1997) collects Baumol's major papers on the so-called cost-disease. Baumol (1989) expresses his delight at the term "Baumol's cost disease." Baumol and Bowen (1965) footnote 7 notes that "There is, of course, nothing new in the following observations of differential rates of productivity change on costs and prices." And they cite, as an example, Scitovsky and Scitovsky (1959), which does contain a clear explanation of the basic idea although the pessimism which later made T. Scitovsky famous ("The Joyless Economy") leads them to several predictions which appear peculiar today such as a decline in the earnings and prestige of the professions and much more do-it-yourself repair work which would cut into the leisure time of the professional classes. The pessimism in the Scitovsky and Scitovsky article, essentially a failure to consider the income effect, carried over to Baumol and Bowen (1965).

2. The next several paragraphs draw with only minor changes from Helland and Tabarrok (2019).

3. Wage data are from Lawrence H. Officer and Samuel H. Williamson, "Annual Wages in the United States, 1774–Present," *Measuring Worth*, 2018.

4. Using wages of skilled workers such as orchestra musicians will change the absolute numbers but have less impact on the relative change between 1826 and 2010.

5. For some evidence, see Gorzelany (2018).
6. Quoted in Besharov 2005.
7. On symphonies see the count in Bolton (1992) for 1965 and Wikipedia https://en.wikipedia.org/wiki/List_of_symphony_orchestras_in_the_United_States for 2020. Broadway attendance figures are given in Baumol and Bowen, Table III-1 and https://www.broadwayleague.com/research/grosses-broadway-nyc/.
8. Baumol's later works, for example, Baumol (2012) became more optimistic about the Baumol effect noting "Yes, we can afford it."
9. Bradford (1969) used the PPF noting that it implied Baumol was too pessimistic. The description of the PPF used here draws from Helland and Tabarrok (2019).
10. It's notable that high prices seem to be causing consumers to seek pet insurance (Sullivan, 2018) rather than insurance driving high prices, which is often posited in the popular press (e.g., Perry, 2018).
11. Domestic servants still are common in developing economies so the technological substitutes clearly don't dominate domestic servants at all wage levels.
12. Or the Balassa–Samuelson effect is the cross-country version of the Baumol effect.
13. Of course, auxiliary assumptions about externalities or other special features of time-intensive goods could reverse this conclusion but then it would be the auxiliary assumptions driving the result not the rise in time price per se.
14. Although we can speed up a recording.
15. Similarly, barbers in rich countries earn more than barbers in poor countries because other professions in rich countries are more productive not because barbers in rich countries are more productive. A proposition that may be tested by moving a barber from a poor to a rich country.
16. See also the earlier paper by Baumol, Blackman, and Wolff (1985) and Helland and Tabarrok (2019) who verify in a larger dataset.
17. Note that it does not suffice to say that productivity has increased in education because what is taught is more valuable over time. That might be true but there are a few reasons why teaching better material should raise costs.

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