

Helping thy neighbour: productivity, welfare and international trade

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Abstract

We describe the relation between welfare growth and productivity growth. We argue that differences in productivity and productivity growth between sectors or countries are irrelevant from a policy perspective. Specialisation is based on the comparative advantages of countries. Since, by nature, some sectors witness higher productivity growth than others, so do countries. Although, at the global level, productivity growth and welfare growth are two sides of the same coin, at the national level they are not. The welfare effects of productivity growth in part leak away to consumers in other countries because technological progress is translated into a decline of export prices relative to import prices. Or stated differently, importing countries benefit from the lower prices due to technological innovations in exporting countries. These terms of trade effects of productivity growth on welfare do not only exist in theory. Empirically, we find significant and large terms of trade effects. Our overall conclusion is that once this trade perspective is taken into account, productivity is less attractive as a primary policy goal for governments. The primary task for governments is rather to create an environment in which private agents can explore the comparative advantages they have.

JEL classifications: D60, F43, O38

Key words: welfare, comparative advantages, terms of trade, productivity, economic policy

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INTRODUCTION

The targets for economic policy-making tend to vary over time. Whereas since the 1970s, at least in Europe, the main goals for economic policy were directed towards improving government finance and the reduction of unemployment, more recently productivity growth has reappeared in the spotlight. The impressive upsurge in productivity growth on the other side of the Atlantic gave incentives for European countries to replicate this American success. The strategic goal of the Lisbon European Council in 2000 “to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion” underlines this.

However, although by definition, productivity and employment growth combined provide the basis for economic growth, taking productivity growth as a policy target is not self-evident for four reasons. Firstly, in particular in a European context, improving labour market participation remains important and, at least, as urgent as productivity growth. For instance, the lower number of hours worked in the Netherlands completely explains the welfare gap between the Netherlands and the US. In fact, the Netherlands is even more productive in terms of GDP per hour worked. The ageing of the population in OECD countries not so much diminishes, but *strengthens* the importance of making better use of available labour supplies. Secondly, policy geared towards higher productivity growth could turn out to be considerably more difficult than that towards participation. For instance, the risk of government failure in innovation policy is more than imaginary. This chapter deals with productivity in relation to international trade: from the trade perspective we derive our third argument. Countries specialise on the basis of comparative advantages, which by definition implies that some countries have a higher productivity growth than others. Thus, for policy purposes, productivity differences between sectors or countries alone are largely irrelevant. Policy induced productivity growth can, in the absence of market failures, even lead an economy away from its comparative advantage and thereby have negative effects on welfare. Our last argument why productivity is not an appropriate policy goal is that the welfare effects of higher productivity in the exposed sectors in a global economy will in part leak away to consumers in other countries through a deterioration in the terms of trade. In the presence of terms of trade effects, productivity growth

leads to higher real GDP growth, but to a lesser extent to the growth of real income. This is not only a theoretical case, our empirical results indicate that these terms of trade effects can be substantial.

This chapter deals with the last two arguments and has the following outline. Firstly, we discuss the implications of productivity growth from the perspective of ‘traditional’ trade theory and we consider the relation between welfare growth and productivity growth. Then, we discuss to what extent more recent theoretical insights affect our earlier conclusions. Finally, we present some empirical evidence as to the terms of trade effects of higher productivity growth.

PRODUCTIVITY, COMPARATIVE ADVANTAGE AND THE TERMS OF TRADE

At the global level, productivity growth is an important determinant of welfare growth. More production can directly be used to increase consumption, or to increase investment leading to higher future output and consumption possibilities. However, at the national level the link between production growth and consumption growth is not as straightforward. The development of the terms of trade (export prices relative to import prices) determines to what extent output growth is reflected in a real income growth and hence is available for domestic consumption growth. In this section we show that changes in the terms of trade are directly linked to differences in productivity growth across countries.

Trade is an important determinant of a country’s welfare. Trade opens up markets and provides the opportunity for decoupling the production and consumption structure of a country. Trade allows for specialisation in production, which can boost productivity and welfare. In 1776, Adam Smith already emphasised that an increased size of the market permits a greater degree of specialisation and therefore leads to higher productivity. Some time later, Ricardo¹ introduced the concept of comparative advantage, the corner stone of international trade theory. Trade models show that, starting from an autarky position, opening up to trade is beneficiary to all countries involved. Even if a country has an absolute productivity disadvantage in the production of all commodities, it will profit from trade by specialising in the good where it has a comparative advantage; that is which it can produce *relatively* most efficient.

¹ The classic reference is David Ricardo, the Principles of Political Economy and Taxation first published in 1817.

For instance, in the famous Heckscher-Ohlin-Samuelson model of international trade (the so-called HOS-model), countries export the commodities that use its abundant production factor most intensively. Countries with an abundant labour supply produce labour intensive goods and will have a relative low labour productivity, whereas capital abundant countries produce goods that require high labour productivity. Hence, productivity differences between countries are the result of differences in the availability of endowments.

The original HOS-model made the assumption that countries differ only in their relative factor availability. This implies that all countries have access to a universal technology stock. Technologies (e.g. production functions) differ between sectors of industry but not between countries. This assumption together with the insight that countries implicitly trade the production factors embedded in the commodities lead to the factor price equalisation theorem. This theorem states that prices of factors are equalised between countries. Hence, the law of one price does not only hold for commodities, but also for production factors. What are the implications when we analyse the welfare effects of technological change?

Assume that the world economy is made up of two countries and that two sectors of industry exist, a dynamic sector (“manufacturing”) with technological change, and a traditional sector (“agriculture”) without technological change. Technological progress in manufacturing leads to an increase in the production possibilities in manufacturing and to a decline of the per unit production costs in manufacturing. Competition guarantees that the lower costs are reflected in a decline of the output prices in manufacturing relative to the output prices of agricultural products. Also farmers see their consumption price index decline and therefore profit from the technological progress in manufacturing. The same holds for countries that trade with each other and produce according to their comparative advantages. Countries which are completely specialised in agriculture do not experience any productivity growth but see real income (their ability to consume) rise because of declining manufacturing output prices. Whether or not the country specialising in the dynamic sector has a higher welfare growth than the country specialising in the traditional sector depends on price and income elasticities of the different commodities and not on the specialisation pattern itself.²

² In extreme cases a high output growth rate can be combined with a declining welfare. This so called immiserizing growth can occur when a sectoral high productivity growth is combined with low price and income elasticity of demand for the output of this sector (Baghwati, 1958). In this paper we will not pay attention to these extreme cases.

Hence, the HOS-analysis leads to a fascinating conclusion. Technological change may lead to different growth rates of per capita output between countries but has an ambiguous effect on the growth rates of welfare. It cannot be taken for granted that the country with the highest output growth rate will experience the highest welfare growth. The wedge between output growth and welfare growth results from change in the terms of trade.

What are the policy implications of this analysis? The first lesson is that welfare growth is something different than productivity growth. Although at the global level productivity growth is a determinant of welfare growth, at a national level it can be welfare enhancing to specialise in a sector of industry with low productivity growth. Specialising according to the comparative advantage is equivalent to maximising welfare growth and levels; even when this means specialising in non-dynamic sectors of industry.

IMPLICATIONS OF RECENT TRADE AND GROWTH THEORY

In reality, the world is more complicated than the above analysis suggests. Most products are not perfect substitutes but differ in quality and price. Most markets are not perfectly competitive; firms try to create some (temporary) market power. Setting prices above marginal costs is a necessity for enterprises to compensate for the sunk cost of investment in physical and human capital and investment in innovations. Rents are needed to survive in a dynamic environment where permanent innovation is needed to maintain a position in the market. Modern economic theory has captured many of these elements in the analytical framework.

Modern trade models: product differentiation

New trade models include the introduction of product differentiation (see, for instance, Helpman and Krugman, 1989 and 1990). This weakens the assumption of perfect competition. In these newer models, the relevant market structure is monopolistic competition which allows for temporary rents for producers. These kinds of models overcome the empirical shortcoming of the HOS-model. The latter predicts that countries will be either an importer or an exporter of a commodity, whereas in reality two way trade is more the rule rather than the exception.

Modern trade models are mostly based on so-called Dixit-Stiglitz preferences, which presume that consumers like to choose and thus have a preference for differentiated products

(see Dixit and Stiglitz, 1977). Such models are able to explain two-way trade. This so-called love of variety approach creates a separate market for every variant of a product and gives the producer a degree of market power in his own niche market. This gives firms an incentive to differentiate their products from those of their competitors and, in so doing, maintain their position in the market. Hence, producers try to improve their products relative to the competitor's products. As long as the market is contestable, competition will make mobile resources flow towards the most productive sectors, equalising the reward for the mobile factors across sectors.

In monopolistic competition models, firms can have temporary rents as a result of innovation. As a consequence, the terms of trade effects can be less severe than in the case of perfect competition. However, similar to the previous section, these rents are always temporary. In the long run, these rents induce the entry of other (foreign) firms that produce a slightly different product. The enhanced competition reduces the monopolistic rents, and prices converge to the long run equilibrium, in which margins just make up for the sunk cost of the investment in innovation activities. Therefore, in the long run these models suggest that terms of trade dynamics transfer the gains of productivity increases to (foreign) consumers. Surprisingly, it is competition which drives product differentiation and it is also competition that, in the long run, causes gains to be passed on to consumers, domestic and foreign. Consequently, the conclusions from the HOS-model remain unchanged.

Country specific circumstances and competitiveness

Countries differ both in 'natural' (natural resources, geographical position etc.) and historically grown circumstances (accumulated capital, knowledge stock). To what extent does this more realistic view alter our conclusions? In this setting, specialisation patterns are not entirely determined by the factor endowments, but depend on the country's specific circumstances as well. These circumstances can even cause a developed country to specialise in the traditional sector such as agriculture. Whether or not this is a problem or beneficiary for the welfare of a country depends both on supply side (e.g. technology) and demand side (e.g. preferences) developments.

Countries can have problems if they specialise in sectors in which, at the global level, income and preferences driven demand growth is lower than the technology driven supply

growth. Such a sector will permanently experience a surplus of labour. In case of rigid labour markets there are two options. The first is that the sector will become overstaffed and hence marginal productivity and income will decrease. The second is that labour will become unemployed.

Problems will be less severe if a country specialises in sectors in which demand grows quickly. Firms will take expectations with respect to future demand into consideration when making investment decisions. Governments can influence the specific circumstances by public investments, and thereby support in such a way that the economy specialises in sectors in which demand growth is (more) in line with supply growth. But can governments identify these opportunities? Usually, governments lack the relevant information, which means that the risks of picking losers are quite substantial. For example, Baldwin and Robert-Nicoud (2002) point to the fact that governments will pick losers rather than winners because losers have more incentives to lobby than firms that can survive without the help of government. Potentially, there could be a role for government if investments are not made because of coordination problems between private agents. To avoid the potential costs associated with picking the wrong sectors, a government should, in fact, ask market prices for public services in the case of public investments directed to specific sectors, regions or firms. If firms refuse or are not able to pay for the public services, there are apparently not enough potential benefits for the individual firm, signalling that they are losers instead of future winners. Only if the one who profits is the one who pays wasting taxpayers' money is avoided.

In fact, in models with specific national circumstances, factor price equalisation between countries does not take place due to the differences in production possibilities between countries. However, in the long run, the fruits of innovation will be passed on to domestic and foreign consumers, because production factors are still paid their marginal product. These models bring theory of innovation closer to reality, but the conclusion with respect to technology, terms of trade and welfare do not really differ from our earlier conclusions.

New growth theory

A final branch of the literature of relevance to the welfare effects of productivity growth is new growth theory. In new growth models, which have been developed since the mid-eighties, long-term economic growth is explained as a result of explicit economic behaviour (e.g. Romer,

1986). Technology is no longer exogenous and global, but directly related to economic processes in economies. In these models, a specific production factor (e.g. knowledge, R&D, blueprints) can be accumulated without diminishing returns. Purposeful investment in this production factor by economic agents aims at reaching a market position. This enables them – at least temporarily – to exploit market power by setting prices above marginal costs. In the absence of market failures these rents will be just sufficient to pay the investment back.

If technological development is endogenous and (in part) related to the economic process in a country, then countries can indeed have an advantage over their competitors by successful technological progress. The market power that this generates might indeed limit terms of trade effects. Again, we expect this effect to be only temporary, because the rents resulting from successful innovation induce innovation from competitors, which increases competition and forces producers to pass the fruits of the innovation to domestic and foreign consumers. In the absence of market failures this also holds for R&D investments. In competitive markets, the investments in innovative activities (e.g. R&D) can be paid by the rents accrued when selling the results. R&D has become an economic activity in itself, which has to compete for scarce endowments. Labour working in R&D cannot be active in other sectors. And it is only optimal for a country to specialise in R&D (or let us say in R&D intensive industries) when the country has a comparative advantage in these sectors of industry.

The importance of the new growth literature for innovation policy comes from the possibilities to address market failures in R&D markets. National and international spillovers can be important and lead to an underinvestment in R&D. Government policy can indeed play a useful role in countering market failure due to external effects, information failures, incomplete markets etc. But when it comes to the welfare effects of high productivity growth, the story remains to a large extent unchanged. After all, competition is a major driver behind innovation. But competition forces enterprises to pass the fruits of innovation on to domestic as well as foreign consumers as well. Hence, in the long run, the welfare gains of the higher productivity growth through being specialised in dynamic sectors is rather small. In the next section we will show that this is not only a theoretical point, but is also relevant in the real world.

SOME EMPIRICAL EVIDENCE

The observations in the previous section suggest that, according to more recent theories, terms of trade effects are likely to be less than can be expected from the HOS-model. Nevertheless, in the longer term, they are still likely to occur. Like with all puddings, the proof of this one will be in the empirical eating: the magnitude of the extent in which trade redistributes productivity gains over countries remains an empirical matter. In this section we first discuss an empirical analysis performed by the Bayoumi and Haacker (2002) of the welfare effects of the falling prices of ICT. This serves as an example of the welfare effects of a global new technological innovation. Then, we show our own empirical exercise. In this exercise, we analyse the impact of productivity changes of countries on relative prices over a long period. Such an exercise captures all elements that were presented in the previous section, such as specific factors, monopolistic competition and endogenous growth. Our results indicate that productivity growth leads to terms of trade effects that in the long term have substantial effects on the level of welfare.

The welfare effects of the ICT revolution

The recent innovations in ICT can be seen as an example of a positive global technology shock. Most (western) countries have access to the new technological innovation. Yet, not each country produces ICT. Who has benefited from the surge in ICT?

The recent surge in productivity in the ICT sector has contributed quite significantly to the acceleration of GDP growth in ICT producing countries (see Chapter 6 for a further analysis). For example, in the US, TFP growth in the ICT sector was responsible for 25% of the acceleration of overall US labour productivity growth. Despite these productivity gains, increases in wages and profits in the ICT sector were quite modest. Fierce competition forced ICT producers to translate productivity gains into lower prices. Indeed prices of computers declined rapidly relative to other goods and services. Especially, if quality adjustments are taken into account, by using hedonic prices, the price declines of computers are substantial.

Cheaper ICT induced firms to invest in ICT and substitute other production factors for ICT. Capital deepening in ICT equipment has been a major source of productivity growth in the late 1990s. For example, Van Ark (2001) shows that both the ICT-using and ICT-producing sector contributed between 0.5 and 0.9 percentage points to real GDP growth in a sample of developed countries.

However, not only domestic users benefit from cheaper ICT equipment. Also foreign firms and foreign consumers cash in on the lower prices of ICT. The welfare distribution this brings about received far less attention. An exception is Bayoumi and Haacker (2002), which divides the welfare gain of ICT production into a production and a terms-of-trade component for 29 countries.³ Bayoumi and Haacker (2002) find that welfare benefits mainly accrue to users of ICT, not to producers, because of falling relative prices. We show their result for the fifteen countries with the highest growth of domestic demand (welfare). Further, we show how these countries received these gains: by production of ICT (contribution of ICT production to real GDP) or by buying cheap ICT abroad (contribution of terms of trade).

Table 1: The Impact of falling ICT prices on GDP and Domestic Demand. 1996-2000, annual contributions to change in growth rates, percentage points.

	Domestic demand	GDP	terms of trade
United States	0.39	0.28	0.11
Sweden	0.31	-0.10	0.41
United Kingdom	0.31	0.30	0.01
Singapore	0.30	6.71	-6.41
Canada	0.28	0.10	0.18
Korea	0.28	0.85	-0.57
Australia	0.25	0.03	0.22
Norway	0.22	0.03	0.19
Denmark	0.21	-0.01	0.22
Finland	0.21	-0.09	0.30
Israel	0.21	0.27	-0.06
Malaysia	0.21	3.31	-3.10
Hong Kong	0.20	0.20	0.00
Ireland	0.20	2.10	-1.90
Netherlands	0.19	0.13	0.06

Source: Bayoumi and Haacker (2002)

Table 1 shows that producing ICT is not a requirement to benefit from welfare gains of ICT. Of the five most specialised ICT countries only Singapore makes it to our top ten. The other countries with a yearly contribution of ICT of more than 1% point to real GDP growth (Ireland, the Philippines, Malaysia and Thailand) suffered such terms of trade losses that the growth of

³ Bayoumi and Haacker deflate output of the ICT sector and purchases of ICT with U.S. hedonic prices of ICT to adjust quality improvements of ICT identical in all countries. This implies that the reported figures should be interpreted as upper bound estimates of the terms-of-trade effects. Their results are published in IMF (2001) as well.

welfare is lower than 0.20% a year. Some of the non-ICT producing countries do, however, appear in our table. In Denmark and Australia, the ICT sector is smaller than 1% of GDP. To conclude, a number of highly ICT specialising countries experienced large terms of trade losses, whereas the productivity gains in the ICT sector have gone mainly to ICT-using countries.

The ICT example shows that technology-driven productivity growth in a sector of industry leads to a decline of output prices in this sector relative to other sectors and, therefore, to welfare gains for all consumers who directly or indirectly (in case of an intermediate product) buy the product in question. Indeed, it is competition on domestic and foreign markets which forces producers to enter the rat race called innovation and it is the same competition which forces producers to pass the fruits of this innovation on to domestic and foreign consumers.

The relation between productivity growth differences on relative price changes

We test empirically to what extent (international) competition eventually forces firms to translate productivity gains into lower prices. We cover different time spans to analyse if and how fast competition forces changes in marginal costs to be translated into lower prices. Thus, do countries with higher productivity growth relative to others experience a fall of their export prices relative to their competitors? We test this hypothesis by estimating the simple equation:

$$(1) \quad \Delta \ln(P_{i,t} / P_{c,t}) = \alpha \Delta \ln(LP_{i,t} / LP_{oecd,t}) + e_t$$

Where $P_{i,t}/P_{c,t}$ is export prices in dollar terms of manufacturing goods of country i relative to the export prices of competitiveness-weighted average of 42 countries.⁴ An increase in this index implies a real effective appreciation, which indicates an improvement of the terms of trade of country i at time t . $LP_{i,t}/LP_{oecd,t}$ is the productivity index of country i relative to the OECD average.

We included 25 OECD countries over the period 1971-2002 in our sample. Due to data limitations, we excluded the Czech Republic, Hungary, Poland, Greece and Slovakia. For Mexico, we included data for the period 1984-2002. All data are from the OECD. Firstly, we estimated equation (1) for yearly growth rates. This gives an impression to what extent productivity increases are translated into lower prices within a year. We repeated this exercise

for two sub-samples to obtain an impression of the robustness of the relation. However, imperfect competition may lead to temporary monopoly rents and hence slower adjustment of prices. We constructed 4 years periods to see to what extent productivity increases lead to lower prices in a four years period. Finally, we estimated the relation for the whole sample period. Table 2 reports the results.

Table 2: The impact of productivity growth on relative export prices

	a	<i>t-statistic</i>	<i>R2-adjusted</i>	<i>Number of obs.</i>
Yearly, 1971-2002	-0.26***	-2.98	0.01	787
Yearly, 1971-1986	-0.31**	-2.34	0.00	387
Yearly, 1987-2002	-0.23*	-1.86	0.01	400
4-years, 1971-2002	-0.59***	-3.67	0.05	197
4-years, 1971-1986	-0.58**	-2.44	0.02	97
4-years, 1986-2002	-0.59***	-2.80	0.07	100
32-years, 1971-2002	-0.91***	-3.25	0.27	25

*, ** and *** denotes significance at the 10%, 5% and 1% level, respectively.

Growth of productivity has a significant effect on relative export prices. Within a year, about a quarter of productivity growth in a country is translated into lower export prices. Productivity changes are not translated completely into prices instantaneously indicating some degree of monopolistic competition or specific factors. However, in the long run competition forces prices to decline further. In a four year period, this share has increased to almost 60%. This result corresponds with that of Acemoglu and Ventura (2001), who find that a 1% -point faster growth is associated with a 0.6 %-point deterioration in the terms of trade. Our results are quite robust for sub-samples. Over the whole period, 90% of productivity growth has been translated into lower export prices. Hence, in the long run terms of trade effects caused by country specific productivity gains have a significant impact on welfare. Of course, the benefits of higher productivity have not vanished. Other countries, with lower productivity growth have had positive welfare effects due to improved terms of trade. Hence foreign consumers benefited from the relative price declines. Again, this exercise illustrates the importance of taking the terms of trade effects into the productivity analysis and policy making.

⁴ See Durand (1992) for a extensive description of the construction of competitiveness weighted export price indices.

CONCLUSION AND POLICY IMPLICATIONS

At the global level, technological progress and welfare growth are two sides of the same coin. However, this does not necessarily mean that it is beneficial for a country to be specialised in sectors of industry with a high productivity growth. The welfare gains from trade come from the specialisation in accordance with the comparative advantage of countries. Because productivity growth inherently differs between sectors of industry, this, by definition, implies that some countries will witness higher productivity growth than others. This, however, does not automatically imply that the low productivity growth country will experience a lower welfare growth.

Relative international prices react on differences in productivity growth between countries. In competitive domestic and international markets, productivity growth in a sector will be transferred into lower output and export prices. Consequently, productivity growth will in part leak away to consumers in other countries. Importing countries, which themselves do not experience any productivity growth, benefit because they are making use of the cheaper products produced elsewhere. Hence, in the long run, the welfare effects of productivity growth are partly offset by a deterioration of the terms of trade of a country.

This is not only a theoretical case. Our empirical analysis shows that, not only in the long run, but also in the short run, terms of trade effects are substantial. Overall, the welfare effects of a relatively high productivity growth are smaller than expected at first sight. This underlines all the more the importance of careful analysis when embarking on a government quest for higher productivity growth. If not, then higher productivity would not only imply an attractive present for consumers in other countries, but an actual burden on the welfare of the consumers in the country in question. Helping thy neighbour and begging thy citizen seems hardly the required motto for policy making in the 21st century.

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