

ICT: Trade in services and small countries

Abstract

This paper discusses how ICT-enabled trade in services such as education, entertainment and health affects their quality in small economies with shallow domestic markets. Consumer services need to be provided locally, but some of the content can be digitised and transmitted over long distances. A general equilibrium model of two asymmetric countries is developed and numerical simulations presented. Trade broadens the variety of content in the small country, but variety may be reduced in the large country due to fixed cost of entering foreign markets. Trade leads to a more equal distribution of income both between the small and the large country and within the small country.

JEL codes: D23, F12, F13, R12, R13.

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1 Introduction

The exhibition in relation to the World Summit on the Information Society organised by the ITU in Geneva December 2003 featured a Russian mobile health clinic, complete with laboratory, equipment for scanning patients and for satellite communication with a medical services centre. The clinic was intended for use in Siberia and other sparsely populated areas of Russia. ICT-enabled networks were able to help diagnose and monitor the SARS epidemic in real time during the outbreak in 2003 (WHO, 2003), and modern ICT technology has played an important role in organizing recent popular uprisings in former Soviet republics. These are anecdotal evidence on the potential impact of ICT on society.

In general telemedicine, distance learning, satellite television and radio, e-commerce and m-commerce and many more ICT-enabled activities have radically changed people's access to information all over the world. Even in poor villages in Africa the introduction of mobile telephones have improved peoples' lives in many ways, not least in terms of time saved through getting information over the mobile phone rather than getting it directly from the source (Waverman et al 2005). Since people act on the basis of what they know, access to information is crucial for work performance as well as consumer welfare.

This paper focuses on the impact of ICT on the content of information-intensive consumer services. Services such as entertainment and finance are highly information-intensive and have a long tradition of providing their services over electronic networks a broad variety of services over electronic networks. Radio, television and the internet have given the remotest village access to star performances in the arts. And e-banking has given villagers access to a broad variety of financial instruments and payment systems they would otherwise have had to travel to the nearest city to access. Will other information-intensive services such as education experience a similar development as entertainment with the

diffusion of ICT in schools, universities and private homes? If so, what is the impact on consumers and service providers?

The impact is likely to be strongest felt in small and remote countries. As is well known, the degree of specialization is limited by the size of the market. In education this means that small countries have few universities and students have less choice in terms of which disciplines and courses to study. A recent study by the OECD (2004) documents that internationalization of higher education has accelerated over the past two decades as measured by students studying abroad, establishment of campuses abroad and cross-border supply of courses and programs. According to the OECD (2001), more than a third of the member countries' population between the age of 25 and 60 participated in adult education and training in 1998. Furthermore, demand for adult training is growing rapidly as the labour market becomes more flexible and technological progress creates the need for frequent skills upgrading and updating. Universities, regional colleges, large companies and a number of specialised suppliers have entered the adult learning market in recent years providing flexible packages of e-learning and traditional learning. E-learning alone seems to be inadequate and in most cases there is a need for complementary traditional learning. The same goes for a number of other information-intensive services where ICT and international trade mainly improve the richness of the content of the service, but do not eliminate the need for the occasional face to face interaction between customer and service provider.

The question analyzed in this paper is the following, taking the example from education services: How will better access to information affect a) the diversity of content in education; b) the role of the local teacher/lecturer; c) the demand for her services; d) her relative income? These questions are closely related and are therefore analysed in a general equilibrium framework where information-intensive services inputs are packaged or bundled by local providers but ICT allows them to source intermediate inputs from outside suppliers.

The rest of the paper is organised as follows: The next section briefly discusses related work and presents some relevant data. Section three develops the model in a closed economy and analyses its properties. The model is extended to a two-region setting with exogenously declining (iceberg) transport costs in section four, where I also present numerical simulations. I take as given that there are communication networks in place in the same way as trade models take as given that adequate transport infrastructure exists. Section five summarises and concludes.

2 Relation to previous research

The media and entertainment sectors are frontrunners in terms of adoption of ICT and content is traded. In small countries in particular broadcasters, for example, have been able to provide their audiences with a broad variety of programs through imports of content. According to a recent report, the market share of foreign channels in the European television market is marginal in the large countries (Germany, the UK, France, Italy and Spain) but very large in the small countries. The foreign share was more than 80 per cent in Luxembourg, more than 50 per cent in Cyprus and between 40 and 50 per cent in Ireland, Austria, Belgium and Estonia (Lange, 2004). Hence, with access to foreign channels and content, the diversity of television programs available to the public can be similar in small and big countries.

Better access to information is usually modelled as a reduction of costs of acquiring information; i.e. reduced transaction costs. A growing body of research on the relationship between transaction costs, trade and location finds that economic activities in which vertical linkages between firms are important tend to cluster and a centre-periphery pattern is formed where the centre pays the highest wages.¹ Vertical linkages in the model developed here stem

¹ See for example Fujita, Krugman and Venables (1999) for a comprehensive presentation.

from the assumption that services are provided by a local supplier or agent who sources content locally and abroad.

The clustering effect has raised concern that small countries will be unable to benefit from further trade liberalisation in goods and services or technological development that reduces trade costs. On the other hand, since a small market limits the extent of specialisation and therefore the variety of intermediate services, one would expect that the potential gains from trade are larger in small than in big and diversified economies. A Work Programme on Small Economies has been established in the WTO in order to assess the special problems facing these countries in which services often constitute the mainstay of the economy. This paper contributes to shedding light on the small economies issue by constructing an asymmetric model containing one large and one small country and analysing how fixed and variable trade costs affect trade flows, variety of services, income distribution and welfare in the two countries.

There are to my knowledge no published papers that explicitly analyse trade in consumer services in an asymmetric general equilibrium framework. There are, however studies in related areas which I briefly discuss in the following. Trade in business services over electronic networks has been analysed by Harris (1998). He applied a small open economy model with two factors of production; skilled and unskilled labour. Digitised information is a perfect substitute to directly communicated information in this model and differentiated business services are produced by skilled workers only. A major finding is that an increase in the supply of skilled labour leads to an increase in the skill premium. This effect also occurs with a virtual increase in the supply of skilled workers through trade in business services over the Internet. I argue that this outcome is due to the small open economy setting where output prices are unaffected by changes in local costs. In contrast, when trade in services is embedded in a two-country general equilibrium framework as it is in

my model, output prices adjust to changes in costs, and the usual downward sloping relation between the skill premium and supply of skilled workers is restored.

Cross-border trade in information-intensive services typically requires computer software that must be frequently upgraded, information often has to be translated to a different language or a different context, and exports may involve continuous market research on the part of the exporter. In addition it is quite common to establish a sales office or even a campus in the case of higher education in the export market. These expenditures are independent on the volume of exports (up to a capacity limit point) and can therefore be seen as a fixed cost of servicing a foreign market. The cost of software for distance learning for example can be between \$16 000 and \$150 000 dollars per year (Anderson, 2003).

The impact of fixed trade costs on trade flows, market concentration and welfare is studied in Venables (1994) in a Dixit-Stiglitz type model with symmetric countries, one production factor and two sectors; one constant returns sector and one Dixit-Stiglitz type sector. He shows that trade liberalisation, modelled as a decline in variable iceberg trade costs increases the proportion of trading firms and reduces the total population of active firms, as the average size of the firm increases when an additional fixed cost is introduced. The model developed in this paper builds on Venables (1994), but differs from it in two significant ways. First, I study asymmetric countries since my motivation is to shed light on the small economies issue. Second, the sectors that I focus on require skilled workers in most positions, often with specific skills and qualifications. I therefore introduce two categories of workers, unskilled that can only be employed in the constant returns to scale (CRS) sector, and skilled that can work in both sectors. This feature of the model prevents agglomeration of the intermediate services sector in the large economy. The reason is that as skilled workers move from the CRS sector to the differentiated services sector, the marginal product of skilled workers in the CRS sector increases and so does the skill premium. The small economy will

then always have a sufficient wage cost advantage to retain some service producers. This is in stark contrast to the standard economic geography models where a core-periphery pattern forms spontaneously in symmetric countries when transport costs have reached a critical level.

As opposed to most models of trade where scale matters, I find that it is the small trading partner that gains the most from trade. This is because gains from trade arise from access to a broader variety of services, and the increase in variety is largest in the small country. Big countries in contrast may end up with less variety in intermediate services if the sector becomes more concentrated with larger but fewer firms and the number of imported services are not sufficient to compensate. I argue that events such as the dotcom-bubble may permanently change the market structure if it results in a euphoria-driven entry into export markets of a critical number of firms. A shake-out of firms will result, but the remaining firms will be profitable and the trade regime will be sustained once established even if the consolidation reduces welfare in the large markets.

3 The model - autarky

The economy has three sectors, labelled X, Y and Z. The X-sector produces complex consumer services such as entertainment, health and education. Its technology is assemblage or bundling of differentiated intermediate service inputs. These inputs are produced by the Z-sector, which consists of n firms each producing one service using skilled labour only. I apply the standard Dixit-Stiglitz framework where there is a fixed cost involved in the production of each differentiated service. Taking the example of a TV channel it bundles news, documentary, films, music performances, series, reality programs etc. into information and entertainment packages. Lecturers and physicians in principle do similar bundling of

content into courses and treatment respectively. As lecturers will know, the cost of preparing a lecture is much higher than the cost of delivering it and the marginal cost per student may be small once the lecture has been prepared. By the same token the fixed cost of producing information-intensive content that can be digitised is large compared to the marginal cost of servicing an additional consumer (Shapiro and Varian, 1999). The Y-sector represents an aggregation of perfectly competitive industries producing goods and services employing both unskilled and skilled workers. The number of unskilled and skilled workers in the economy is given exogenously. Equations (1)-(3) describe the technology in the three sectors:

$$Y = L^\alpha S_y^{1-\alpha} \quad (1)$$

$$X = \left[\sum_{i=1}^n z_i^\rho \right]^{1/\rho} \quad (2)$$

$$z_i = f + \frac{1}{b} s_i \quad (3)$$

Equation (1) is a standard Cobb-Douglas constant returns to scale production function where L represents unskilled and S skilled labour. Equation (2) represents the familiar Dixit-Stiglitz formulation where production increases both with the quantity of each input, z_i , and the number of inputs, n . The elasticity of substitution between any pair of intermediate services is given by $\varepsilon \equiv 1/(1 - \rho)$ and is assumed to be larger than unity. Each firm in the Z-sector produces its service subject to an increasing returns technology given by equation (3) where f is a fixed cost in terms of skilled labour. As usual in Dixit-Stiglitz models, only one firm produces each input and each firm produces only one product. The number n thus represents both the number of firms in the Z-sector and the number of differentiated services being

supplied to the X-sector. The standard mark-up price rule $q = bv/\rho$ follows from profit maximisation, where v is the unit cost of skilled labour. I further assume that there is free entry and exit of firms in the Z-sector. The number of firms will in that case adjust to the condition that the profit of the last firm entering is zero. The zero profit condition is the same for all firms due to symmetry and reads $q = fv/z + bv$. Inserting this in the mark-up price rule yields the unique size of the service producing firm:

$$z = \frac{f}{b} \frac{\rho}{(1-\rho)} \quad (4)$$

Inserting (4) in (2) yields output in the consumer services sector as an increasing function of the variety of inputs:

$$X = n^{1/\rho} \frac{f\rho}{b(1-\rho)} \quad (5)$$

The X-sector is competitive, implying marginal cost pricing as given by equation (6). The change in costs in the X-sector as a consequence of additional varieties of intermediate inputs is a forward linkage from the Z-sector to the X-sector.

$$P_x = qn^{(\rho-1)/\rho} = \frac{bv}{\rho} n^{(\rho-1)/\rho} \text{ where } \frac{\partial P_x}{\partial n} < 0; \frac{\partial^2 P_x}{\partial n^2} > 0 \quad (6)$$

Consumers have identical preferences described by a Cobb-Douglas utility function as depicted in equation (7), which implies that consumers spend a fixed share of their income on each good. Equation (8) shows the share spent on X-sector services.

$$U = Y^\sigma X^{(1-\sigma)} \quad (7)$$

$$P_x X = (1 - \sigma)(wL + vS) \quad (8)$$

I finally turn to the labour market in order to close the model. Employment of skilled labour in the Z- and Y-sectors, and the skilled labour market equilibrium are given by the following three conditions:²

$$S_z = n(f + bz) = \frac{nf}{1 - \rho} = \frac{(1 - \sigma)(wL + vS)}{v} \quad (9)$$

$$S_y = \frac{(1 - \alpha)P_y Y}{v} = \frac{(1 - \alpha)\sigma(wL + vS)}{v} \quad (10)$$

$$S_y + S_z = S \quad (11)$$

Inserting (9) and (10) in (11) yields the allocation of skilled workers between sectors Y and Z:

$$S_y = \frac{(1 - \alpha)\sigma}{1 - \alpha\sigma} S; \quad S_z = \frac{(1 - \sigma)}{1 - \alpha\sigma} S \quad (12)$$

Allocation of skilled labour depends on the technology in the Y-sector and consumer preferences. The less skill-intensive the Y-sector and the higher the income share consumers

² The last part of equation (9) is derived from combining (5), (6) and (8).

spend on X-products, the more skilled workers are employed in the Z-sector. The number of services produced in the economy is determined by (9) and (12):

$$n = \frac{(1-\rho)}{f} \frac{(1-\sigma)}{(1-\alpha\sigma)} S \quad (13)$$

The number of Z-sector firms is larger the larger the stock of skilled workers, the smaller the fixed cost of producing services and the smaller the elasticity of substitution between intermediate services in the assembly industry. The intuition behind the latter point is that when services can be easily substituted, there is little to gain from having additional varieties. The linkage between the elasticity of substitution in the X-sector and the number of firms in the Z-sector is an externality between the two sectors. However, since ρ also appears in the mark-up rate on the marginal cost of z , the externality is internalised by the market and it is therefore termed a pecuniary externality.

The skill premium, defined as the income earned by skilled workers over and above that of unskilled workers, can be found by using (10) and (12). We notice that it declines with the relative endowment of skilled labour, but it does not depend on the size of the total labour force as long as the ratio L/S is constant.

$$\frac{v}{w} = \frac{(1-\alpha\sigma)}{\alpha\sigma} \frac{L}{S} \quad (14)$$

In order to assess the relation between market size and real income, I deflate the wage rates by the price index $P = (P_x/\sigma)^\sigma (P_y/(1-\sigma))^{1-\sigma}$ where P_y is the marginal cost in the Y-sector

given by $P_y = (w/\alpha)^\alpha (v/(1-\alpha))^{1-\alpha}$ and P_x is given by equation (6). Setting unskilled labour as the numeraire ($w = 1$), using (13) and (14) and collecting parameters, the price index reads:

$$P = \Psi \left(\frac{L}{S} \right)^{1-\alpha\sigma} S^{(\rho-1)(1-\sigma)/\rho} \quad (15)$$

where Ψ is a positive constant. We notice that the price index declines with a proportionate increase in L and S . This is because an increase in the absolute number of skilled workers increases the number of differentiated intermediate services (equation 13) and thus lowers the price of X (equation 6).

A proportionate increase in the stock of skilled and unskilled labour can also be interpreted as the integration of two countries with the same relative factor endowments. Integration will result in a larger number of varieties of inputs to the X -sector in both countries, which in turn yields a lower price of X and higher real wages in both countries. If the two countries differ in size, let us label them Big and Small, we see from (13) that the per cent increase in variety of services inputs in Small will be S_{big}/S_{small} while the per cent increase will be the inverse of this ratio in Big, so P_x will decline more in Small. Finally, real wages will be the same in both countries after integration, meaning that income will increase the most in Small, since it had lower real wages in autarky.

Full integration of the services markets is, however, not technologically feasible. Not all information can be digitised and transmitted across space. Complex information is often context- and relation-specific and can only be effectively communicated through direct interaction. I therefore analyse the impact of partial integration by introducing trade costs in the next section. It is of particular interest to investigate whether small countries will gain relatively more also in the more realistic framework of partial integration.

4 The two-region case

In this section I explore the welfare and income distribution effects of trade between the Big and Small country. Y-sector goods are freely traded and I make the usual assumption that labour is perfectly mobile within a country, but cannot move between countries. Consumer services most often are produced and consumed at the same time and in the same space, and the X-sector is therefore modelled as non-tradable. The two countries have the same production technology in the Y and Z-sectors described by equations (1) and (3) respectively. Z-sector services can be digitised and transmitted between the two countries subject to an iceberg transport cost, $t > 1$, reflecting the loss of information when digitised. In order to service the other country, the Z-sector service firm needs to incur a fixed trade cost denoted g that comes on top of the fixed costs f of running a firm. Some service providers may choose to export, while others may choose to service the local market only. I denote the share of Z-sector firms that makes the investment g and exports, θ , where $0 \leq \theta \leq 1$. The share is endogenously determined in the model. The X-sector now assembles both local and imported differentiated services. All variables related to Small are denoted with an asterisk. Equation (3) applies to the service providers that service the local market only, while the service exporters' production function reads:

$$z_i = f + g + \frac{1}{b} s_i \quad (16)$$

There is free entry and exit in both countries, such that the non-profit condition for the exporting firm reads $q = (f + g)v/z + bv$ and the unique size of the exporting service firm becomes:

$$z = \frac{(f+g)}{b} \frac{\rho}{(1-\rho)} \quad (17)$$

Obviously, the exporting firm is larger than the firm producing for the local market only. There are now two possible types of producer service firms in each market; firms servicing the home market only, and exporting firms servicing both countries. The more firms that enter the export market, the larger the average firm size. The market clearing condition for each type of firm reads:

$$\frac{q^{-\varepsilon}}{P_x^{1-\varepsilon}} E = \frac{f\rho}{b(1-\rho)} \quad (18a)$$

$$\frac{q^{-\varepsilon}}{P_x^{1-\varepsilon}} E + \frac{q^{-\varepsilon}\tau}{P_x^{*(1-\varepsilon)}} E^* = \frac{(f+g)\rho}{b(1-\rho)} \quad (18b)$$

$$\frac{q^{*- \varepsilon}}{P_x^{*1-\varepsilon}} E^* = \frac{f\rho}{b(1-\rho)} \quad (18c)$$

$$\frac{q^{*- \varepsilon}}{P_x^{*1-\varepsilon}} E^* + \frac{q^{*- \varepsilon}\tau}{P_x^{(1-\varepsilon)}} E = \frac{(f+g)\rho}{b(1-\rho)} \quad (18d)$$

The left-hand side of the equations represents demand facing each firm where E denotes the X-sector's expenditure on intermediates. The cost index of the X-sector is given by

$$P_x = [nq^{1-\varepsilon} + \theta^* n^* \tau q^{*1-\varepsilon}]^{1/(1-\varepsilon)} \quad \text{and} \quad P_x^* = [\theta n \tau q^{1-\varepsilon} + n^* q^{*1-\varepsilon}]^{1/(1-\varepsilon)}. \quad \text{I define } \tau = t^{1-\varepsilon}; 0 < \tau < 1,$$

which makes it possible to present the results for the full range of transport costs from unity to infinity. Note that all relevant information is maintained during transport when $\tau = 1$, while no relevant information is maintained during transport when $\tau = 0$. The price of an exported service is multiplied by τ in order to account for losses during digitisation and transmission.

The right-hand side of the equations represents the unique size of the firm when the zero profit condition is satisfied.

Although this is not a dynamic model, I present the change from $\tau = 0$ to $\tau = 1$ as a continuous decline in transport costs due to exogenous developments in ICT. Trade has two distinct effects on demand facing each firm. The first is new demand from foreign X-sector firms as represented by the additional term in equations (18b) and (18d). This only affects firms that incur the fixed cost g and enter the foreign market. The second effect works through the price index and affects all firms, whether or not they choose to export. A change in the number services assembled affects the price index P_x – an increase in n reduces it while a reduction in n raises the price index.³ We also note that for all $\tau < 1$, the change in the price index is larger if a local than if a foreign firm enters or exits the market. Also an increase in τ reduces the price indices in both countries. From (18) we see that a decline in the price index will shift the demand curve facing each Z-sector firm to the left, reducing their profitability. However, since a lower price will increase consumer expenditure on X, there will also be a shift in demand facing each firm to the right, increasing their profitability. The impact of a change in the number of services (n) on the price index is a forward linkage from the Z-sector to the X-sector while the corresponding shift in demand facing each Z-sector firm is a backward linkage from the X-sector to the Z-sector. This linkage structure is an important property of the model that drives many of the results as will be further discussed below.

Inspection of the four market clearing conditions represented by (18a) - (18d) reveals that all of them can be satisfied simultaneously only when $\tau = g / f$. This is a case that could

³ Compare equation (6) to the price indices above and recall that $\varepsilon > 1$.

only occur by coincidence, and I therefore disregard the possibility that all four types of firms can coexist in the two regions.⁴ We are then left with six possibilities:

- 1) $\theta^* = 1$ and $\theta = 1$; all firms in both countries export;
- 2) $\theta^* = 1$ and $0 \leq \theta \leq 1$; all firms in Small export while some firms in Big export;
- 3) $\theta^* = 1$ and $\theta = 0$; all firms in Small export while no firms in Big export;
- 4) $\theta^* = 0$ and $0 \leq \theta \leq 1$; no firms in Small export while some firms in Big export;
- 5) $0 \leq \theta^* \leq 1$ and $\theta = 1$; some firms in Small export while all firms in Big export;
- 6) $0 \leq \theta^* \leq 1$ and $\theta = 0$; some firms in Small export while no firm in Big export.

Let us start by exploring at what level of transport costs the first firm will enter the export market when the initial situation is autarky. The individual firm will not take the impact of its own actions on prices into account. Thus, a firm in Big will break out of autarky and start exporting to Small if its mark-up on exports covers the fixed cost g : $(b/\rho)^*(q^{-\varepsilon}\tau E^*/P_x^{*1-\varepsilon}) \geq g$ where the ratio in the first bracket is the mark-up rate and the ratio in the second bracket represents the firm's export volume. Inserting the autarky price index in Small $P_x^{*1-\varepsilon} = n^* q^{*1-\varepsilon}$ in the entry condition, we get $\tilde{v}^{-\varepsilon} b \tau E^* / \rho n^* q^* \geq g$. $E^*/n^* q^*$ represents purchases per local firm in Small in autarky and is given by equation (4). Inserting this in the entry condition and rearranging, we get the critical level of τ above which trade will

⁴ Venables (1994) avoids this problem by assuming that the elasticity of substitution between pairs of goods from the same country is higher than between goods from different countries. Although this may be plausible also for some services, it is less plausible for intermediate services such as course modules, directly broadcasted sports or cultural events, diagnostic tests etc. There is also a possibility that $\tau = \tau(g)$, a possibility I leave for future research.

take place:⁵ $\tau \geq \tilde{v}^{-\varepsilon}(1-\rho)g/f$. We have from (14) that in autarky the relative wages of skilled workers are $\tilde{v} = \tilde{w}\tilde{L}/\tilde{S}$ and relative wages of unskilled workers (when measured in physical units of sector Y products) are $\tilde{w} = (\tilde{S}/\tilde{L})^{1-\alpha}$, where $L/L^* \equiv \tilde{L}$; $S/S^* \equiv \tilde{S}$. The condition for the first firm in Big to break out of autarky is then given by (19a) and the equivalent for the first firm in Small by (19b):

$$\tau \geq \left(\frac{\tilde{L}}{\tilde{S}} \right)^{\alpha\varepsilon} \frac{g}{\varepsilon f} \quad (19a)$$

$$\tau \geq \left(\frac{\tilde{L}}{\tilde{S}} \right)^{-\alpha\varepsilon} \frac{g}{\varepsilon f} \quad (19b)$$

The higher the fixed costs of entering the export market, the higher τ must be in order for exporters to enter the market. If $\tilde{S} = \tilde{L}$, the entry condition is the same in the two countries, otherwise the country that are relatively abundant in skills will start exporting intermediate services first, whatever the relative size of the markets. The model thus predicts that Hong Kong, for example, will export intermediate services such as interactive learning programs or analyses of medical tests to Chinese universities and hospitals respectively before mainland China starts exporting the same kind of services to Hong Kong. Or more generally it predicts that small, skills-abundant countries will become intermediate service providers to larger, less skill-abundant trading partners. Conditions (19) tell us under which circumstances autarky will no longer be a stable equilibrium but it does not tell us which pattern of specialisation and trade will result after trade has been initiated.

⁵ Recall that τ increases with falling transport costs.

Assume that a share θ of Z-sector firms in Big enters the export market first. Then either all or none firms in Small will enter the export market.⁶ We can find at which level of transport costs the first firm in Small starts exporting in the same way as (19) was derived. A firm in Small will break even in the Big market even if it enters on its own when $(b/\rho) * (q^{*-\varepsilon} \tau E / P_x^{1-\varepsilon}) \geq g$. We have that $P_x^{1-\varepsilon} = nq^{1-\varepsilon}$ and the expression E/nq represents purchases per local firm in Big and is given by equation (4). The relative price of Z-sector services is equal to the relative wages of skilled labour and can be found by combining (18a), (18b) and (18c), i.e. the zero profit conditions in the trade regime prevailing before the first firm in Small enter the export market. This yields $v/v^* = (\tau f / g)^{1/\varepsilon}$. Inserting this in the entry condition and solving for τ yield the critical level of transport costs at which trade regime 4 becomes unstable:

$$\tau \geq \frac{g}{f} \left(\frac{1}{\varepsilon} \right)^{1/2} \quad (20)$$

Comparing conditions (19b) and (20) reveals that when the two countries have the same relative factor endowments or Small is relatively abundant in skilled labour, condition (20) is more restrictive than (19b). This is because once some firms in Big start to export, the price index in Small declines due to the additional number of varieties imported, shifting demand facing each firm to the left. Profits are reduced, discouraging expansion into the export market. However, there is also the effect that the average size of Z-sector firms in Big increases, the number of firms declines and the profitability of each firm increases, creating more space for foreign firms to enter the market. Eventually the latter effect starts to

⁶ Recall that all four types of firms cannot exist at the same time unless $\tau = g/f$.

dominate and firms in Small enter the export market. This brief analysis shows that two-way trade will arise once transport costs have reached a critical level. If for example $g = 0.4$, $f = 1$ and $\varepsilon = 4$ (the values applied in the numerical simulations presented below), then the critical level of τ as defined by condition (20) is 0.2 ($t = 1.7$), increasing to 0.5 ($t = 1.25$) if $g = f$. Thus, if the fixed cost of entering the market is high, transport costs must come down significantly for two-way trade to commence. The cost of transporting information over the Internet is presumably low once the infrastructure is in place and I will focus on the cases where condition (20) is satisfied; i.e. trade regimes 1 and 2.⁷

The model cannot be solved analytically, but the equilibrium conditions in each market can be derived and the model can be solved numerically. Starting with the labour market, employment of skilled labour in the intermediate service sector in Big is given by equation (21) where the first term represents firms producing for the home market only and the second term represents exporting firms.

$$S_z = (1 - \theta) \frac{nf}{1 - \rho} + \theta \frac{n(f + g)}{1 - \rho} = \frac{n(f + \theta g)}{1 - \rho} \quad (21)$$

The equilibrium condition in the skilled labour market is then found by combining equations (21), (11) and the first order conditions for profit maximisation in the Y-sector which are $L = \alpha P_y Y / w$ and $S_y = (1 - \alpha) P_y Y / v$ in Big and equivalent for Small. Equation (22) combines the equilibrium conditions for the skilled labour market in the two countries.

⁷ Trade regime 5 is also one with two-way trade, but it is only an equilibrium if Small is not too small. Since I am interested in the impact of globalisation on small economies, I do not analyse this case.

$$\frac{n}{n^*} = \frac{(\alpha v S - (1-\alpha)wL)}{(\alpha v^* S^* - (1-\alpha)w^* L^*)} \frac{(f + \theta^* g)v^*}{(f + \theta g)v} \quad (22)$$

Balance in the market for goods produced by the Y-sector yields $P_y(Y + Y^*) = \sigma(wL + vS + w^* L^* + v^* S^*)$ which, reorganising and using the first-order condition mentioned above, can be expressed as:

$$\frac{1-\alpha\sigma}{\alpha\sigma} = \frac{vS + v^* S^*}{wL + w^* L^*} \quad (23)$$

Finally, Y-sector goods are freely traded and fetch the same price in both regions, which yields the equilibrium condition:

$$P_y = \left(\frac{w}{\alpha}\right)^\alpha \left(\frac{v}{1-\alpha}\right)^{1-\alpha} = \left(\frac{w^*}{\alpha}\right)^\alpha \left(\frac{v^*}{1-\alpha}\right)^{1-\alpha} \quad \text{or} \quad \left(\frac{w}{w^*}\right)^\alpha = \left(\frac{v^*}{v}\right)^{1-\alpha} \quad (24)$$

It is convenient to express the variables in terms of relative wages and endowments, since these are the variables that matter in a trade model. I therefore introduce the following definitions: $n/n^* \equiv \tilde{n}$; $v/v^* \equiv \tilde{v}$; $w/w^* \equiv \tilde{w}$. Using these definitions equations (22), (23) and (24) can be written as:

$$\tilde{w} = \tilde{v}^{(\alpha-1)/\alpha} \quad (25)$$

$$\tilde{n}\tilde{v} = \frac{(f + \theta^* g) \left[(1-\alpha\sigma)(\tilde{w}\tilde{L} + 1)\tilde{v}\tilde{S} - (1-\alpha)\sigma(\tilde{v}\tilde{S} + 1)\tilde{w}\tilde{L} \right]}{(f + \theta g) \left[(1-\alpha\sigma)(\tilde{w}\tilde{L} + 1) - (1-\alpha)\sigma(\tilde{v}\tilde{S} + 1) \right]} \quad (26)$$

Equilibrium in the market for intermediate services depends on the trade regime and includes the relevant combination of the four zero profit conditions spelled out in equations (18). I consider each of the two trade regimes 1 and 2.

4.1 All firms in both regions export

This trade regime is similar to the standard economic geography model but the fixed cost of differentiated goods is $g + f$ rather than just f . However, the introduction of the sector-specific factor L in the Y -sector distinguishes it from the standard model. The CRS production function implies that marginal product of skilled workers increases in the Y -sector if a skilled worker moves to the Z -sector, and thus the wage rate of skilled workers increases, discouraging further labour movements. This is a stabilising force in the model, which ensures a positive number of intermediate services firms in both countries as a stable equilibrium for the full range of transport costs. In contrast in standard models of trade in intermediate differentiated products subject to transport costs, a core-periphery structure forms spontaneously when transport costs have reached a critical level (e.g. Krugman and Venables, 1995).⁸ When all firms in both regions export, equilibrium in the intermediate services markets requires that (18b) and (18d) are satisfied simultaneously, which yields:

$$\left(\frac{v}{v^*}\right)^{-\varepsilon} = \frac{\tau E/E^* + (P_x/P_x^*)^{1-\varepsilon}}{E/E^* + \tau(P_x/P_x^*)^{1-\varepsilon}} \quad \text{or expressed in terms of the endogenous variables:}$$

⁸ A standard model with sufficiently diminishing return to labour in agriculture also yields a stable symmetric equilibrium for all values of transport costs (Fujita et al., 1999), chapter 14.

$$\frac{(1 - \tilde{v}^{-\varepsilon} \tau) (\tilde{n} \tilde{v}^{1-\varepsilon} + \tau)}{(\tilde{n} \tilde{v}^{1-\varepsilon} \tau + 1) (\tilde{v}^{-\varepsilon} - \tau)} = \frac{\alpha \sigma (\tilde{v} \tilde{S} + 1) \tilde{w} \tilde{L} + (1 - \alpha \sigma) (\tilde{w} \tilde{L} + 1) \tilde{v} \tilde{S}}{\alpha \sigma (\tilde{v} \tilde{S} + 1) + (1 - \alpha \sigma) (\tilde{w} \tilde{L} + 1)} \quad (27)$$

The market equilibrium is given by equations (25), (26), (27) setting $\theta = \theta^* = 1$. It can immediately be observed from (27) and (25) that if $\tau = 1$ (no information is lost during trade), factor prices are equalised, no matter what the relative endowments are. The results derived in section 2 then apply. In the symmetric case where $\tilde{S} = \tilde{L} = 1$, the solution to the model is $\tilde{n} = \tilde{v} = \tilde{w} = 1$ for all $\tau \in (0,1)$. As already pointed out, this is in stark contrast to the standard model.

This is how far an analytical solution takes us. I therefore present a stylised numerical solution to the model. I focus on the scale effect and solve the model when Big and Small have the same relative factor endowments, but Big is ten times larger; $\tilde{S} = \tilde{L} = 10$.⁹ The other key exogenous variables of interest are the fixed cost of entering a distant market and the transport costs τ , which may also be interpreted as a digital disadvantage ratio.

When all firms in both regions incur the fixed cost g and start to export, the immediate effect is a shake-out of Z-sector firms as the size of firms has increased from $f\rho/b(1-\rho)$ to $(f+g)\rho/b(1-\rho)$. In the simulation the total number of firms in the two countries combined drops from 95 (86 in Big and 9 in Small) in autarky to 68 with trade. This amounts to a more than 20 per cent loss of variety in Big but almost an 8-fold increase in variety in Small compared to autarky. This result appears to be in line with observed patterns in the entertainment and media industry in recent years where mergers and acquisitions have been

⁹ The model is simulated in GAMS software. Parameter values in all simulations are the following: $\alpha = 0.7$, $\rho = 0.75$, $\sigma = 0.6$, $f = 1$, $g = 0.4$. The qualitative results are robust to changes in the parameter values. The working paper version of the paper also includes simulations where Big is relatively abundant in skills.

common and the leading producers of content for the entertainment industry have become larger and service more countries. Also in the distant learning business it is a common practice to establish joint ventures or other forms of cooperation among leading universities servicing this market (Anderson, 2003). The initial reduction in the total number of firms is obviously larger the larger is g . In addition the larger is g the lower t must be before firms start to export.

What happens after trade has commenced and τ increases further (transport costs declines) is the following: i) The price indices decline in both countries, shifting demand facing each firm to the left. The derivative of $P_x^{1-\varepsilon}$ with respect to τ is $n^* q^{*(1-\varepsilon)}$, while the corresponding derivative for $P_x^{*1-\varepsilon}$ is $nq^{(1-\varepsilon)}$. Since $n > n^*$ and Small imports more varieties than Large, the reduction in the price index is larger in Small. ii) Lower costs in the X-sector leads to lower consumer prices and more demand for X-services; i.e. and increase in E and E^* , shifting demand facing each firm to the right. The price of consumer services in Small declines by about 29 percent as τ increases from zero to 0.25, and by another 14 percent as τ increases from 0.25 to 0.5. At high transport costs, the transport cost advantage of being in the larger market outweighs the wage cost advantage in the smaller market. The net effect of i) and ii) in Big is therefore an outward shift in demand facing each firm, increasing their profits and creating space for new entries. This induces workers to move from the Y-sector to the Z-sector, raising skilled wages further. In Small the net effect of i) and ii) is a downward shift in demand facing each firm, reducing their profits and inducing some local firms to exit. Skilled workers move to the Y-sector, reducing skilled wages. Thus, as transport costs decline, the transport cost advantage of being located in Big deteriorates while the wage cost advantage of being located in Small increases. Eventually the wage cost advantage in Small outweighs the transport cost advantage in Big, and the net effect of i) and ii) in the two countries are reversed.

Figure 1 depicts the adjustments to changes in τ in the Z-sector, while Fig. 2 depicts the corresponding adjustments in the labour market. The transport cost parameter τ is given along the horizontal axis, and transport costs decline as we move from the left to the right. The relative number of services produced in each region is depicted on the right-hand vertical axis, while import penetration is given on the left-hand vertical axis.

For the parameter chosen here, the effect is not dramatic – the relative number of firms increases from 10 in autarky to about 11.75 at its peak. Import penetration in both regions keeps rising as transport costs come down and the relative price of imported intermediates, (inclusive of transport costs) declines. Import penetration in Big increases to about 9 percent when transport costs are eliminated, while imports account for more than 90 percent of the market in Small if transport costs are eliminated. This corresponds to the observation that there are relatively few foreign produced programs on American television, while the foreign content on Norwegian television is high. Furthermore, some two decades ago when trade in content was limited, there were only enough programmes to broadcast for five hours a day (between six and eleven in the evening) on one channel in Norway. Nordic cooperation in telemedicine also suggests that providers in small countries export in order to cover even the fixed cost f , and that many varieties will be imported.

Figure 2 shows that the burden of adjustments induced by closer integration of intermediate services markets mainly falls on skilled labour in Small. Initially there is a sharp fall in the skill premium in Small, reflecting the exit of Z-sector firms and reallocation of skilled workers to the Y-sector. Skilled workers in Small also fall behind their colleagues in Big, while unskilled workers in Small gain both relative to skilled workers in Small and relative to unskilled workers in Big. Income distribution becomes more equal in Small, while it does not change much in Big.

We finally notice from Figs. 1 and 2 that there is a numerical solution to the model at high transport costs, while expressions (19) indicate that a firm will break out of autarky and start exporting only when τ has reached 0.1 ($t = 2.15$) for the parameter values chosen in the simulation. This result corresponds to the Big-push literature (e.g. Murphy et al. 1989) where a trading equilibrium is sustained once it is established even if no single firm would break out of autarky on its own. Coordinated entry may be encouraged by policy measures, for example subsidising g , but it can also happen as a result of euphoria such as the dotcom-bubble. This will be further discussed in the welfare section below.

4.2 *Some firms in Big, all firms in Small export*

When all firms in Small and some firms in Big export, $\theta^* = 1$ and $0 \leq \theta \leq 1$. Relative wages are then determined from (18a), (18b) (18d) and (25) which yield:

$$\tilde{v} = \left[\frac{(g+f)\tau}{g+f\tau^2} \right]^{1/\varepsilon} ; \quad \tilde{w} = \left[\frac{(g+f)\tau}{g+f\tau^2} \right]^{(\alpha-1)/\alpha\varepsilon} \quad (28)$$

We note that relative wages now depend on the fixed costs and transport costs only. The relative wage of skilled workers is a concave function of τ which peaks at $\left[(g/f)^{1/2}(g+f)/2g \right]^{1/\varepsilon}$ when $\tau = (g/f)^{1/2}$. The relative wages of unskilled workers is a convex function of τ and bottoms out at $\left[(g/f)^{1/2}(g+f)/2g \right]^{(\alpha-1)/\alpha\varepsilon}$ when $\tau = (g/f)^{1/2}$. Hence, in this trade regime we are able to find the analytical relation between relative wages and transport costs as depicted in Fig 4 below. The shape of the curves is similar to those depicted in Fig 2, but there are some important differences. At high transport costs it is now Small that has the highest skilled wages and the highest skill premium, but relative factor prices are

reversed at $g/f = \tau$.¹⁰ This is because a larger share of the skilled labour force is employed in the Z-sector in Small than in Big at high transport costs. Firms in Big then have both a wage cost and a transport cost advantage and the driving forces as τ increases are the same as those described section 3.1 above, but the adjustment process is less dramatic. We finally notice that for $\tau = 1$, $\tilde{w} = \tilde{v} = 1$ and thus relative wages converges after having reached their optimum for $\tau = (g/f)^{1/2}$. The relative number of Z-sector firms and the share of such firms exporting in Big can be found numerically by combining equations (18a), (18b), (24) and (29).

Adjustments in the intermediate services markets as transport costs come down are illustrated in Fig. 3. First notice that τ has to increase to about 0.2 before a coordinated entry by all firms in Small and some firms in Big is feasible. This corresponds to condition (20), and the entry point is further to the right the larger is the fixed entry cost g . The relative number of services $\tilde{n}$ peaks when $\tau = (g/f)^{1/2}$, corresponding to the optima of relative wages. The $\tilde{n}$ -curve follows the same pattern but is flatter and lies everywhere above the corresponding curve depicted in Fig. 1 (it ranges between 13 and 13.6 in the numerical example). This is due to the fact that between 80 and 90 percent of firms in Big does not export, as indicated by the curve depicting the value of θ (left-hand scale) and there are thus more intermediate services firms in Big (and in the world) in this case than in case 1.

The relative number of services *assembled* in the two regions, $(n + n^*)/(\theta n + n^*)$, declines at a decelerating rate as transport costs come down and θ increases, improving the relative variety of intermediate services in Small. As in the previous scenario, import penetration increases continuously in both regions as transport costs come down. Interestingly, while θ increases with τ , it never reaches unity; quite far from it. There will in

¹⁰ Factor price reversal occurs as transport costs come down if $g < f$.

other words not be a spontaneous shift to case 1, which consequently is feasible only if there is a coordinated entry into the export market by all firms. Empirical examples of small countries specialising in sophisticated services and paying higher wages than their major trading partners are Luxemburg and Hong Kong. But also developing small countries such as Barbados have a relatively large and diverse services export sector (WTO, 2002).

4.3 Welfare

I finally compare the level of welfare of skilled and unskilled workers in trade regimes 1, 2 and autarky. Welfare levels are measured by inserting the quantity consumed of X and Y in the utility function (7) for skilled and unskilled workers respectively. The quantity consumed is given by $Y_{u-s}^* = \sigma w^* / P_y$, $Y_s^* = \sigma v^* / P_y$, $X_{u-s}^* = (1 - \sigma)w^* / P_x$ and $X_s^* = (1 - \sigma)v^* / P_x$, and equivalent for Big. Subscript *u-s* denotes unskilled and subscript *s* denotes skilled workers. Figure 5 depicts this measure of welfare in Small in the two trade regimes compared to autarky which is represented by the horizontal lines, the lower line for unskilled workers and the upper line for skilled workers. At low transport costs, both skilled and unskilled workers are best off in case 1, followed by case 2, which in turn is better than autarky. At high transport costs, however, unskilled workers prefer case 1, but autarky is better than case 2, while skilled workers are better off in case 2, but prefer autarky to case 1. In both trade regimes the welfare of unskilled workers increases continuously with τ . This is the case also for skilled workers in case 1, while in case 2 their welfare declines to the point of factor price reversal and then increases continuously with τ . In Big, both skilled and unskilled workers have a higher level of welfare in autarky than in case 1, while the level of welfare in case 2 is about the same as in autarky. The reason is the lower variety of available intermediate services in case 1.

5 Summary and conclusions

In this paper I have demonstrated that trade in intermediate service inputs enhances the quality and lowers the price of consumer services in small economies, reducing the gap in access to services between centre and periphery. In addition income distribution tends to become more equal both within small economies and between centre and periphery. Once adequate infrastructure is in place, therefore, there appears to be little reason for small economies to worry about marginalisation due to ICT.

When a new technology, e.g. the Internet opens the opportunity to engage in services trade, the initial response by firms determines what trade regime will emerge. If all firms respond by getting connected and expand their markets simultaneously, this trade regime can be sustained after a shake-out of firms and at a cost to consumers in big markets. The Internet-hype followed by the recent consolidation could be a case in point. If on the other hand firms take a more cautious wait-and-see approach, a limited number of firms will enter distant markets initially. More firms will follow suit as transport costs decline further, but many firms will still confine themselves to servicing the local market even if transport costs are totally eliminated. An event such as the Internet-hype can in other words have a lasting impact on the structure of the services market.

The four questions posed in the introduction can now be answered. Trade in intermediate services will improve the quality of for example education and health in small markets tremendously. However, the local teachers, lecturers or practitioners will increasingly convey information produced outside the country and work as intermediaries between local pupils/students/patients and external specialists. In the process their relative wages will be undermined and local celebrities may shine less.

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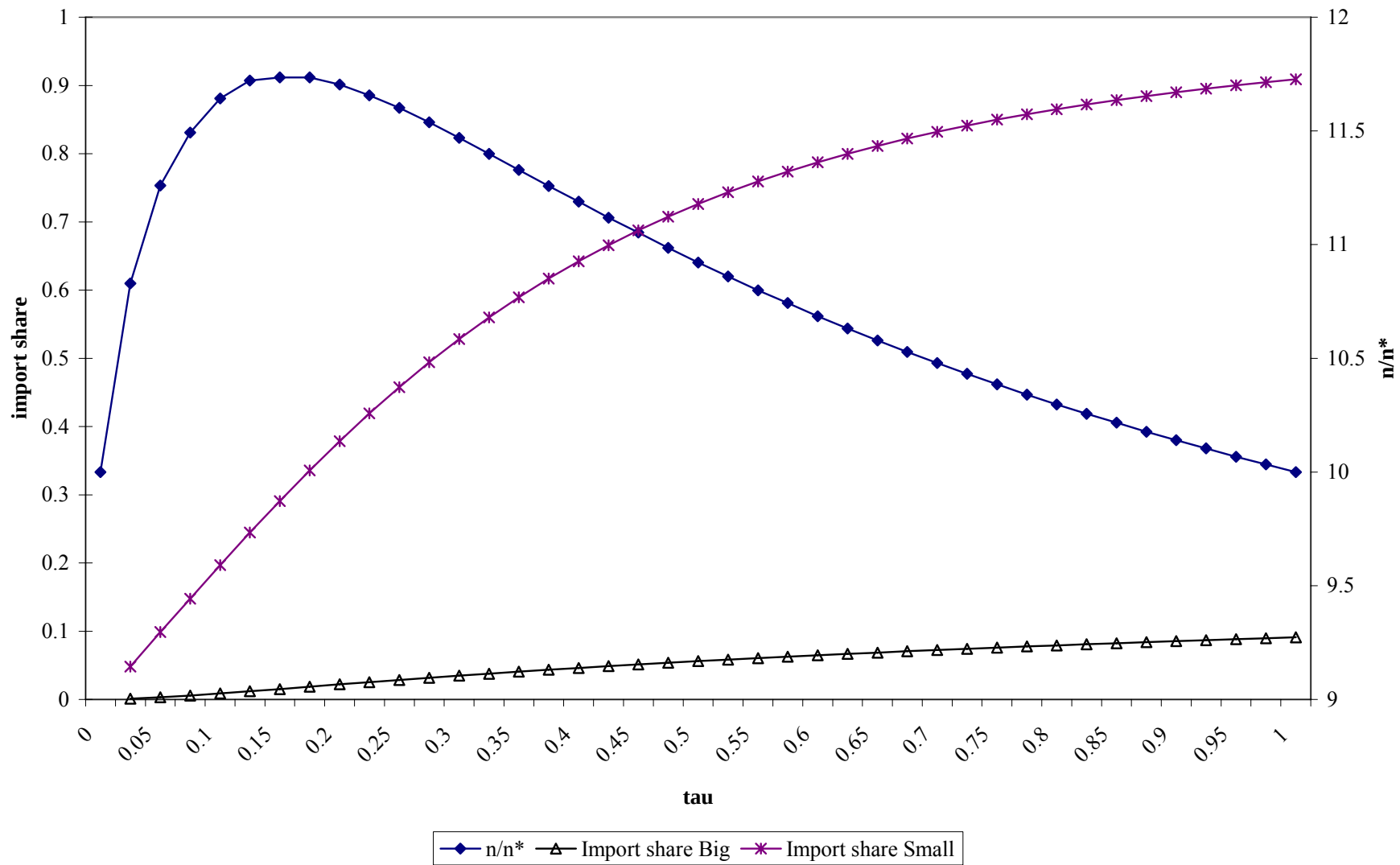


Figure 1: Adjustments in the Z-sector

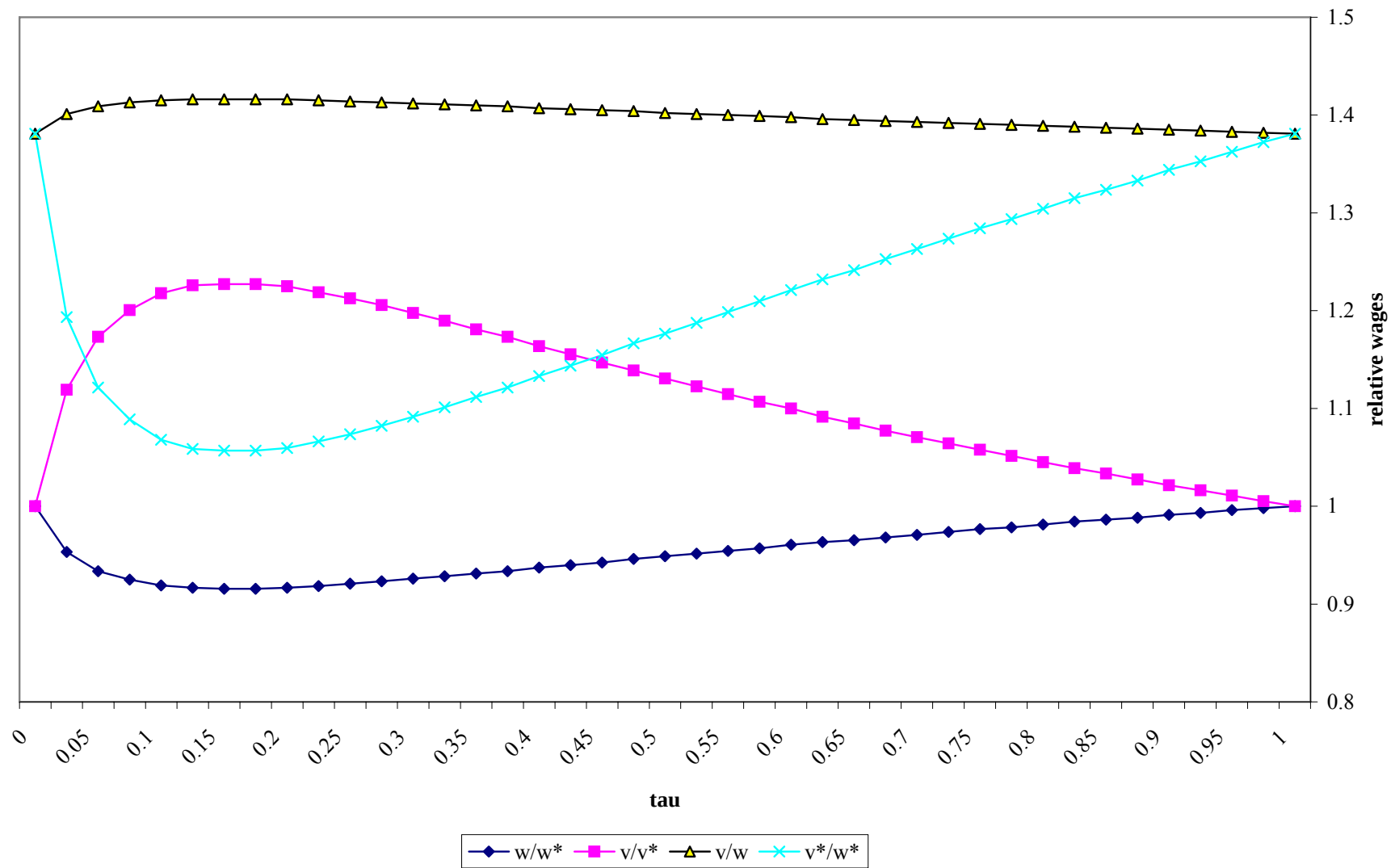


Figure 2: Adjustments in wages

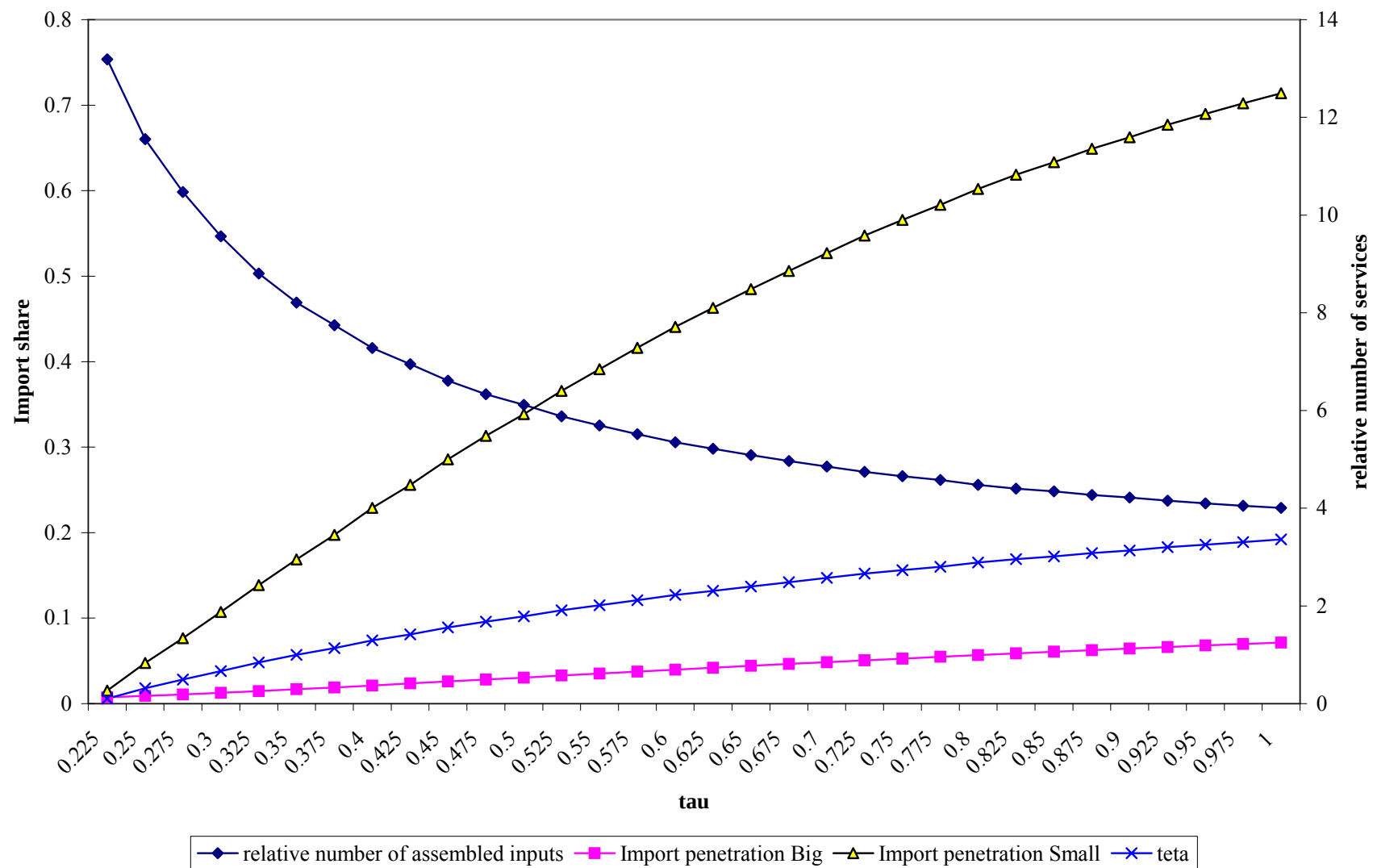


Figure 3: Adjustments in Z-sector

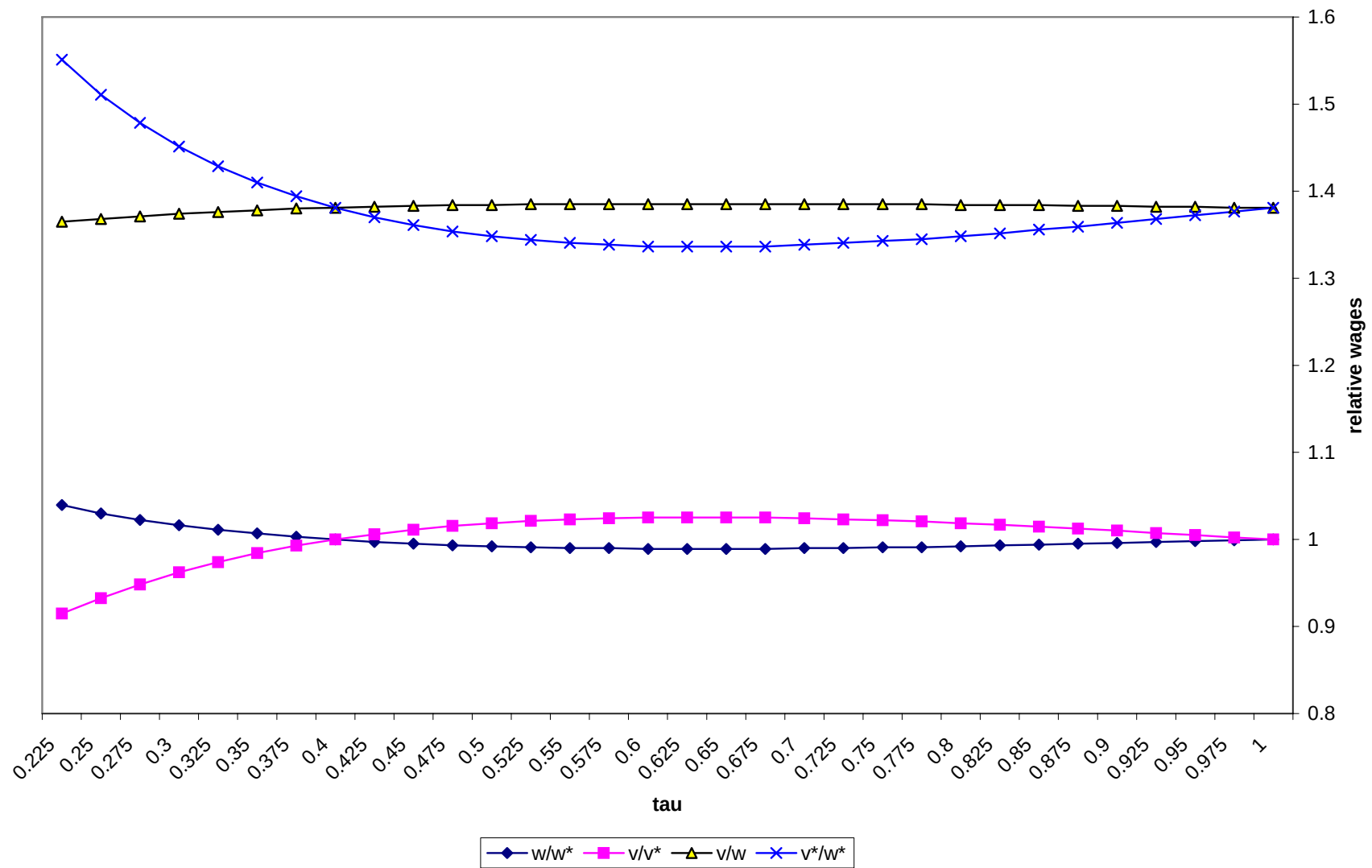


Figure 4: Adjustments in wages

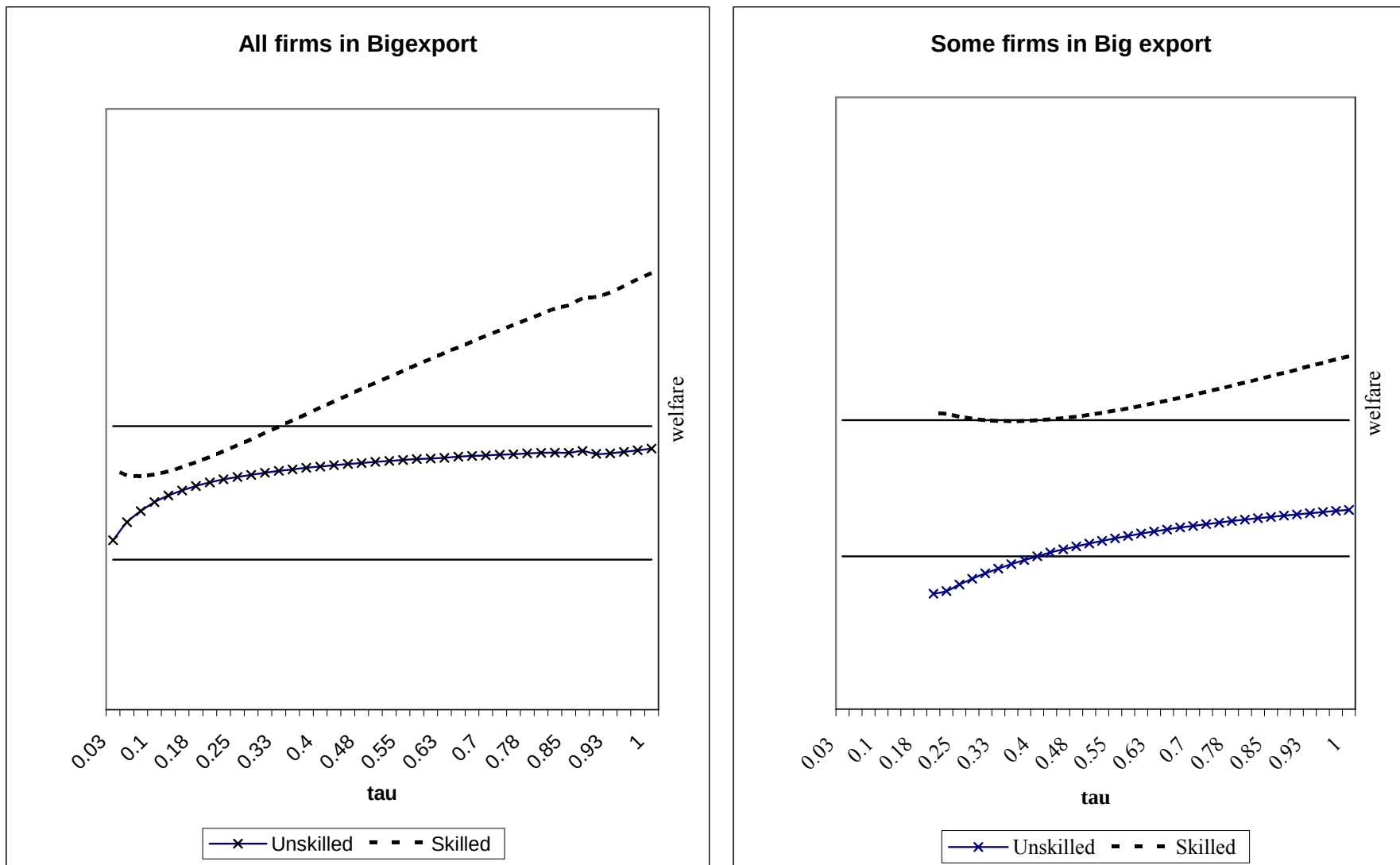


Figure 5: Welfare implications