Globalisation and wage inequality

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Abstract

This paper explores the potential future impact of globalisation on relative wages, using WorldScan. The focus is on wage inequality in Japan, Western Europe and the United States. Inequality rises for several reasons: barriers to trade fall, and in developing countries demand patterns change and at the same time workers shift from traditional low-productivity toward modern high-productivity activities. Even though inequality does not rise dramatically, one should not ignore the characteristics of the growth process in developing countries: trade liberalisation is not only reason behind growing inequality. Another interesting result is the different impact on industrialized countries. Simulations show that the United States is least sensitive to falling trade barriers and changes in developing countries. The impact on Japan and Western Europe is larger.

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1. Introduction[1]

Increasing income inequality in the United States and high unemployment among low-skilled workers in continental Europe have stirred up concerns about the process of globalisation. The fear is that low-skilled workers suffer from intensified linkages between developed and developing countries. The ongoing process of globalisation might deteriorate the position of low-skilled workers even further.

Many economists do not share this fear and point out that international trade seems to have a small impact on income inequality. Trade increases the relative price of skill-intensive goods and generates implicit net imports of low-skilled labour. However, studies on historical trade statistics suggest that international trade can only partly explain increasing income inequality. Trade flows between developed and developing countries appear to be too small to seriously hurt low-skilled workers in industrialised countries.

For this reason research also focusses on alternative explanations of increasing income inequality. Biased technical change is often mentioned as the main determinant. Still, for at least three reasons, further analysis of the impact of trade is called for. First, to assume technical change to be exogenous is unsatisfactory. A more fruitful approach is to endogenise technical change. International trade could then very well play an important role. Second, empirical studies mainly consider historical periods, but cannot tell the future impact of globalisation. Some economies, mainly in South-East Asia, have done very well in recent past. They certainly have set an example for other developing countries. Now that China and India have chosen for market-based development as well, growth of developing countries will affect the group of rich countries more than ever before. In this context the approach of Lawrence (1996) is particularly interesting. He tries to gauge the upper limit on the future impact of trade on wages, by assuming that in the future trade might induce the United States to completely specialise in skill-intensive industries. Third, Leamer points out that in the Heckscher-Ohlin-Samuelson theory the size of trade flows is immaterial, and the subsequent discussion has revealed that the relation between trade flows and relative wages is basically an empirical matter. In this context Krugman (1995) has laid down the challenge to "produce a general equilibrium model with plausible factor shares and substitution elasticities" to show that a limited volume of trade can (potentially) have a large effect on relative factor prices.

This paper presents simulations with WorldScan, a global general equilibrium model, to explore

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[1] This paper elaborates on work presented at the symposium 'Globalisation and employment patterns: policies, theory and evidence', organised by the OECD Development Centre and the Centre for Economic Policy Research. The current paper benefits much from contributions of the participants, especially Stephen Seager and Robert Lawrence, and from comments by André de Jong en Hans Timmer .

the potential future impact of globalisation on relative wages. The focus is on wage inequality in Japan, Western Europe and the United States. Inequality rises for several reasons: barriers to trade fall, and in developing countries demand patterns shift and the (relative) employment of low-skilled and high-skilled workers changes. The simulations with the model are embedded in a globalisation scenario. It aims to show the linkages between the OECD countries on the one hand and emerging economies on the other hand. For that reason it assumes high growth in many developing countries and almost complete trade liberalisation, so that during the scenario period, 1995-2020, the linkages intensify and the impact of emerging economies on the OECD countries is allowed to be potentially significant. The so-called Globalisation scenario extrapolates and probably exaggerates current globalisation tendencies. In this setting the simulations lean towards Lawrence-like experiments that try to establish the maximum effect of trade on wages.

WorldScan has not been constructed to take up Krugman's challenge, even though it can, or to prove the claim that relative wages can change drastically in response to only limited trade. In fact, the model – with reasonable factor shares and elasticities – fails to produce drastic changes in relative factor prices. The experiment reveals that the impact of trade between poor and rich countries on relative wages is modest, if substitution possibilities between low-skilled and high-skilled workers are ample. The conclusion is that also in next decades, relative wages in developed economies will not be set in Beijing, even if developing countries grow fast or start to grow fast.

However, the simulations add some new insights to the discussion about trade and wages. The model allows to differentiate between several sources behind falling relative wages of low-skilled workers. When discussing wage inequality and future changes therein, one cannot ignore the characteristics of the growth process in developing countries. For example, the reallocation of labour from low-productivity, informal sectors to high-productivity sectors in these countries contribute to falling relative wages of low-skilled workers in developed countries. The results also show that one-sided attention to the United States is potentially misleading. The United States is least vulnerable to falling trade barriers and changes in developing countries. The impact on Japan and Western Europe is larger. This outcome largely reflects differences in production and specialization patterns. The United States is more specialized in skill-intensive production, especially production of services. Besides, Japan and Western Europe impose and face higher trade barriers. For this reason the effects of trade liberalisation are stronger for Japan and Western Europe that they are for the United States.

First, in section 2, the Globalisation scenario, its characteristics and trends, will be discussed briefly. Then section 3 goes into the properties of the model. The results of the simulations are presented in section 4 and the conclusions are reiterated in section 5.

2. The Globalisation scenario: main characteristics and trends

The simulations in section 4 are variations on a so-called Globalisation scenario. They are not necessarily independent of the characteristics of this scenario. Therefore we discuss the main characteristics briefly.[2]

The Globalisation scenario is optimistic about future economic progress in both developed and developing regions. In this scenario many poor countries catch up, though not completely, with rich countries. Non-OECD countries grow at a per capita rate of 5%, see Table 2.2. Only few countries have been able to maintain such a growth rate for two decennia or more. However, this is not the only reason for the sometimes drastic changes that the scenario projects.

Table 2.2 Average growth rates between 1995 and 2020

region	OECD	non OECD	global
total	2.6	6.5	3.7
per capita	2.2	5.0	2.4

The scenario emphasizes globalisation tendencies. International specialisation becomes more and more pronounced during the scenario period in response to liberalisation of goods markets and lower transport costs. Besides, especially in developing countries factor endowments are projected to change significantly. The Globalisation scenario also emphasizes market-oriented policies in the world economy To attain and sustain high growth rates developing countries should pursue sound domestic policies. Countries that do not create favourable conditions for market-based development, are likely to fail. For example, developing economies must open up to allow foreign goods and foreign investment. In the scenario, trade liberalisation is not confined to trade blocs, but applies globally. The OECD countries open up their markets further. Whereas barriers to trade in manufacturing goods are already low, agriculture is still heavily protected. Mainly developing countries stand to benefit from (partial) liberalisation of agriculture.

The Globalisation scenario is akin to the High Growth scenario, which CPB and OECD have constructed for their collaborative study on globalisation and the consequences for the OECD countries (OECD, 1997). The idea behind both scenarios is that when developing countries grow fast or start to grow rapidly, the linkages between the OECD and the non-OECD countries intensify. Fast development outside the OECD area and liberalization of capital, goods and service markets produce closer economic integration of rich and poor countries. More generally, the scenario extrapolates and probably exaggerates the current globalization tendencies.

[2] CPB (1999) provides more details of the Globalisation scenario.

Even though the Globalisation scenario is perhaps not the most plausible one, we take it as point of departure. The reason is that it stresses that linkages between developed and developing regions can become stronger and spillovers between these regions can become larger. The simulations therefore demonstrate whether the future effect of trade on wages can be large, even though it has been small up to now. In this setting they lean toward the Lawrence-like experiments that try to gauge the upper limit of this effect.

Table 2.1 Characteristics of Globalisation scenario

Economy	*high economic growth rates*
Politics	*market-oriented policies* *trade liberalization*
Technology	*rapid technical change* *catching-up of developing regions*
Labour	*more education* *reallocation from informal, low-productivity sectors*
Consumer preferences	*convergence of consumer patterns*

In the Globalisation scenario several tendencies are at work that increase the wage inequality in the rich countries. First, *trade liberalisation* intensifies international specialisation. The OECD countries will specialise more in relatively skill-intensive production, raising demand for high-skilled workers and their relative wage. Second, *demand changes* also affect the position of low-skilled and high-skilled workers. In developing countries demand shifts from agriculture to services. The production of domestic services is skill-intensive, whereas agriculture employs relatively many low-skilled workers. Third, the process of development is partly driven by *sectoral reallocation of labour*: from informal, low-productivity sectors to formal, high-productivity sectors. Many workers in developing countries are engaged in informal, low-productivity activities, working on the land or providing simple services in cities. They do not have access to new capital and productive technologies or lack the skills to work with these. These workers are predominantly low-skilled. The reallocation from informal to formal sectors implies that overall the supply of low-skilled workers – in efficiency units – rises. This depresses the low-skilled wage in developing countries and indirectly in the OECD.

In section 4 the contribution of international factors to wage inequality will be examined in detail. The WorldScan model allows to distinguish the separate effect of each factor. Before that the next section briefly goes into the relevant characteristics of model.

3. WorldScan: a global applied general equilibrium model

WorldScan has been developed to construct scenarios. To avoid extrapolation of current trends or reproduction of the current situation, WorldScan relies on the neoclassical *theories of growth and international trade*. Changes in economic growth and international specialisation patterns evolve from changes in (relative) endowments. The emphasis on the long run also manifests itself in the broad definition of sectors. WorldScan distinguishes 7 sectors. This is a relatively small number compared to other AGE models. Over a long period of two decades or more the character of products and branches of industry change drastically. Current statistical definitions of products and branches of industry are likely to become irrelevant at the end of scenario period. For this reason, WorldScan uses broad aggregates (see also Box 1).

Sectors in WorldScan differ from each other in at least one other respect. First, the structure of demand is dissimilar. For example, some sectors produce both consumption and investment goods, while others produce consumption goods only. Second, factor requirements are dissimilar. Different sectors within a region have different factor requirements, but they are more or less similar across regions. This means that if a sector is relatively capital intensive in one region, it is also likely to be relatively capital intensive in other regions. Sectoral restructuring can easily be linked to changes in relative endowments and changes in (region-specific) demand patterns. This also holds because in WorldScan substitution elasticities between domestic and foreign goods are believed to be high in the long run, at least much higher than in the short run.

The standard neoclassical *theory of growth* distinguishes three factors to explain changes in production: physical capital, labour, and technology. A major problem is that technology is unobservable, let alone, that changes in technology can be explained or predicted easily. A model should not rely too heavily on technical progress when projecting the future state of affairs. WorldScan augments the simple growth model in three ways. First, WorldScan allows overall technology to differ across countries.[3] Second, the model distinguishes two types of labour: high-skilled and low-skilled labour. Sectors differ according to the intensity with which they use high-skilled and low-skilled labour. Countries can raise per capita growth by schooling and training the labour force. Third, in developing countries part of the labour force works in a low-productivity, informal sector. In this sector workers do not have access to capital and technology. Reallocation of labour from the low-productivity sector to the high-productivity sectors enables countries to raise per capita growth as well. In principle, all these three factors affect the

[3] WorldScan deviates in one other important respect from the orthodox model of economic growth. It allows for technological catching-up conditional on exogenous factors like education. This feature of the model has been ignored: it is not particularly relevant in this study: the growth rates (of technology) concur with the ideas behind the Globalisation scenario and are thus exogenous.

performance of a region only temporarily. Catching-up, training of low-skilled workers and reallocating labour to the high-productivity sector do not raise the growth rate indefinitely. Nevertheless, they are important in the Globalisation scenario. Adjustments in the economies of developing regions take a great deal of time and will surely show up in the growth rates of these regions in the period under consideration.

Box 1 WorldScan, a global general equilibrium model

At the heart of WorldScan are the neoclassical theories of economic growth and international trade. The core of the model is extended to add realism to scenarios. In doing so, we aim at bridging the gap between academic and policy discussions. The extensions include:

- convergence of productivity levels conditional on factors like investment in physical and human capital;
- an Armington trade specification, explaining two-way trade and allowing market power to determine trade patterns in the medium run, while allowing Heckscher-Ohlin mechanisms in the long run;
- consumption patterns depending upon per capita income, and developing towards a universal pattern;
- a Lewis-type low-productivity sector in developing regions, from which the high-productivity economy can draw labour, enabling high growth for a long period.

The model distinguishes the following regions, sectors and productive factors (see appendix B for a detailed, regional and sectoral classification):

Regions	*Sectors*	*Productive factors*
United States	Agriculture	*Primary inputs*
Western Europe	Raw Materials	Low-skilled labour
Japan	Intermediate goods	High-skilled labour
Pacific OECD	Consumer goods	Capital
Eastern Europe	Capital goods	(fixed factor)
Former Soviet Union	Trade and Transport	
Middle East and North Africa	Services	*Intermediate inputs*
Sub-Saharan Africa		all sectors
Latin America		
China		
South-East Asia		
South Asia and Rest		

Education and reallocation of workers not only explain the performance of developing countries, but also affect production and specialisation patterns in line with standard *theory of international trade*. Workers in the informal, low-productivity sector are predominantly low-skilled. When more workers find employment in the high-productivity sectors, the (relative) wage of low-skilled workers falls and mainly sectors that intensively employ low-skilled workers

expand. Obviously, education has an opposite effect. Either effect can dominate. In some developing countries wages of low-skilled workers lag behind the wage of high-skilled workers and in other regions the skill premium decreases.

To understand changes in relative wages in response to sectoral changes Table 3.1 gives for several important sectors the skill intensity (the ratio of high-skilled to low-skilled employment). These intensities are scaled by the ratio for services. The latter sector is the most skill-intensive sector, so that the percentages in Table 3.1 are typically smaller than 100.

Table 3.1 Sectoral ratios of high-skilled to low-skilled employment in 1995
relative to the ratio in the sector services (%)

	Agriculture	Consumer goods	Intermediate goods	Capital goods
Japan	44.8	63.5	91.0	97.6
Pacific OECD	47.7	54.3	62.0	89.5
United States	42.8	47.0	56.5	104.5
Western Europe	43.6	51.5	64.2	85.3

Source: WorldScan, based on GTAP

Agriculture (including food processing) employs relatively few high-skilled workers, whereas capital goods and services (including the government) absorb many high-skilled workers. The consequence is that when demand shifts away from agriculture and towards services, relative demand for low-skilled worker falls. The table makes clear that the differences between manufacturing and services and within manufacturing are not nearly as large as the difference between agriculture and the other sectors. The results in next section will reflect this characteristic of the data.

The differences among the four OECD regions would not have been large, if it were not for the high skill-intensity of Japanese production of intermediate goods. Note that the sectoral differences within manufacturing are largest in the United States and are smallest in Japan.

data

WorldScan has been calibrated on the GTAP data base, version 4 (McDougall et al., 1998). From this data set we not only derive the demand, production and trade patterns, but also the labour and capital intensity of the different sectors for 1995. Besides, this version of the database distinguishes wage payments to low-skilled and high-skilled workers. We combine the sectoral data from GTAP with macroeconomic data from Barro and Lee (1993). Whereas GTAP uses occupational classifications to distinguish between low-skilled and high-skilled workers, Barro and Lee allow us to distinguish these two types on basis of educational classifications. Workers

are labelled high-skilled when they have completed secondary education or better. Clearly, the two sources give incompatible definitions of low-skilled and high-skilled workers. We use the Barro-Lee data at an aggregate level to characterise differences in education between regions and use the GTAP data at a sectoral level to characterise differences in production technology between sectors.

Ahuja and Filmer(1995) have revised the data of Barro and Lee and also provide projections for many developing countries. We lack projections for the OECD, Eastern Europe and the Former Soviet Union. From the high enrolment rates since the sixties we have drawn the conclusion that the growth in the human capital stock in these regions is relatively low (see Table A.2 in Appendix A). The data on the size of the informal sector are obtained from the World Bank (1995) and the ILO (1998).[4]

substitution elasticities

The results of the model depend on substitution possibilities in production and consumption. Production technology is described by a nested CES function. The upper level distinguishes between value added and intermediate goods. The substitution elasticity between these two broad categories is 0.8. At the lower level value added is described by Cobb-Douglas function of the primary productive factors -- capital, low-skilled labour and high-skilled labour -- whereas intermediate goods are combined according to a CES function with again a substitution elasticity of 0.8. The utility function, from which demand for different consumption categories is derived, has been given a Cobb-Douglas specification. The substitution elasticity between any pair of consumption categories is therefore unity.

Traded, foreign goods are not perfect substitutes for domestic goods, and this also affects the outcome of simulations. The substitution between goods from different origins is not perfect. WorldScan employs an Armington-type assumption. However, the price elasticities of demand considerably increase over time, and depend on the market share. When the market share is virtually nil, the elasticity is highest and equal to the substitution elasticity between goods of different origin, and when the market share is unity, the elasticity equals the price elasticity of *total* demand (one). The model employs different assumptions for raw materials, agriculture, manufacturing and services. The long-run substitution elasticities in the benchmark case are 9, 9, 7, and 5, respectively.

[4] See also Lejour and Tang (1999).

4. The future impact of trade on wage inequality

Developed and developing economies are currently very dissimilar. The difference is not only being rich or being poor. In many developing countries the share of agriculture in total employment is more than 50%, protection by means of import tariffs is relatively high, and by western standards education is poor. In the Globalisation scenario this will change significantly: developed and developing countries tend to converge in more than one respect. Compared to the profound changes in emerging economies, the impact of these changes on the OECD countries is only minor.

Nevertheless, the contingency that trade with developing countries may deteriorate the position of low-skilled workers even further, is a cause of concern. This section considers the future impact of trade between OECD countries and emerging economies. WorldScan allows us to gauge the separate effect of trade liberalisation as well as the effect of changes in demand and the composition of labour supply.

4.1 Trade barriers, demand and endowments

The simulations in this section relate to various assumptions that underlie the Globalisation scenario. These assumptions will be altered to see what impact they have on wages of low-skilled and high-skilled workers in three regions, Japan, the United States and Western Europe. Specifically, three assumptions have been changed sequentially:

I global trade liberalisation;
II higher outflow from low-productivity to high-productivity sectors in less-developed countries;
III changes in the consumption patterns in non-OECD economies.

Before presenting the results of these simulations, the assumptions and changes therein will be discussed in a bit more detail.

trade liberalisation

The Globalisation scenario assumes global trade liberalisation. For manufacturing goods trade taxes become gradually lower, starting in 2000, and are abolished at the end of the scenario period, 2020. For primary goods protection is also reduced, so that in 2020 tariff and subsidy rates are slashed to half of their initial value. Trade taxes are part of the GTAP data set. Trade liberalisation pertains to ordinary import tariffs and export taxes, and does not include non-tariff barriers. It only applies to manufacturing, agriculture, energy and raw materials. Data for barriers of trade in services are not available.

Table 4.1 shows the trade barriers for Japan, the United States and Western Europe in 1995 when importing agricultural and manufacturing goods and when exporting manufacturing goods.

They are the sum of import tariffs and export taxes weighted with bilateral trade flows.

Table 4.1 Trade barriers for Japan, the United States and Western Europe, 1992

	imports from		exports to	
	OECD	non-OECD	OECD	non-OECD
	agriculture			
Japan	89.8	20.1	7.2	4.8
United States	4.0	8.3	63.4	25.9
Western Europe	25.0	21.6	10.7	-9.6
	manufacturing			
Japan	2.9	2.2	3.9	15.0
United States	2.3	6.2	2.9	9.8
Western Europe	4.9	6.7	4.3	12.2

Source: WorldScan, based on GTAP

The table shows that Japan and Western Europe protect agriculture very heavily, partly at the expense of the United States. For manufacturing almost the opposite is true. Generally, the trade taxes for imports from the non-OECD are lower than for exports to that area. The United States is in slightly more favourable position to export manufacturing products to developing countries than either Japan or Western Europe. Japan faces relatively high trade taxes when exporting to non-OECD economies, but also when exporting to OECD member states. Surprising is however that Japan appears to be relatively open. This does not concur with the general perception that foreigners cannot easily penetrate Japanese markets.

The data thus tell that Japan levies lower tariffs on imported manufacturing goods than it faces when exporting. This will turn out to affect the results of the simulations. Even though Japan is already specialised to a relatively high degree, it will even specialise further when trade is liberalised worldwide. Besides, and perhaps more importantly, in the Globalisation scenario protection of agriculture becomes significantly less. In Japan and Western Europe this sector will contract even further, whereas in the United States agriculture benefits from liberalisation.

Employment and demand patterns in the non-OECD

The Globalisation scenario will be compared to a scenario in which the situation in 2020 is to a large degree a mere reproduction of 1992. This alternative scenario does not assume further trade liberalisation but instead assumes that import tariffs and export taxes remain in tact. Furthermore, in the Globalisation scenario the emerging economies profoundly change and in particular Asia sees huge shifts in employment and demand patterns, but in this alternative scenario these patterns are frozen from 1995 onwards.

Table 4.2 Employment and demand patterns in the non-OECD
situation in 1995 and changes in 2020 according to the Globalisation scenario

	low-productive workers		skill-*ex*tensive consumption	
	% of total labour supply		% of total consumption	
	level	change	level	change
Former Soviet Union & Eastern Europe	4.1	-0.9	29.6	-13.7
Latin America	25.0	-17.1	35.4	-16.5
Asia	59.0	-26.9	42.5	-24.9
global	43.0	-16.7	21.1	-6.2

Table 4.2 shows the resulting differences between the Globalisation scenario and the alternative scenario for low-productive workers, consumption of skill-*ex*tensive goods and savings. The outflow from the low-productivity sector is sometimes impressive in the Globalisation scenario. In Asia the share of low-productive workers in total supply falls from 59.0% to 22.1%. In the non-OECD economies consumption of skill-intensive goods increases. Demand shifts towards for example domestic services and away from agricultural and consumer goods. Converging consumption patterns decreases the global share of the latter consumption category from 21.1% to 14.9%.

The projected changes in demand and employment patterns are sometimes drastic, but historically they are not exceptional. Many developing countries have already seen within the last 25 years huge shifts in the structure of demand and production. A typical pattern of development is the decline of agriculture. For example in Korea it took less than 25 years for the share of agriculture in GDP to fall from 25% to 7%. Other countries that have not expanded as fast as Korea, have nevertheless seen the share of agriculture decrease substantially. In China the share

has fallen from 34% in 1970 to 19% in 1993, and in India from 45% to 31%.[5] One important reason, in WorldScan the main reason, for this share to fall is of course that consumption is income-inelastic. In the scenario demand shifts away from agriculture and away from skill-*ex*tensive goods.

4.2 Wage inequality in Japan, the United States and Western Europe

The shocks to emerging economies, as they have been outlined in Tables 4.1 and 4.2, typically decrease the wage of high-skilled workers relative to the wage of low-skilled workers in the OECD. The downward pressure on the wage of low-skilled workers could in reality lead to or even be absorbed by falling unemployment. The simulation however ignores this complication. The unemployment rate is (nearly) constant and wages move to equal labour demand and labour supply, minus unemployment. The shocks will thus affect only the ratio of high-skilled to low-skilled wages.

Table 4.3 Wages of high-skilled workers in the OECD in 2020
relative to wages of low-skilled workers (%)

	Japan	United States	Western Europe
increase in response to			
trade liberalisation	2.4	0.3	1.1
less low-productivity workers	0.2	0.2	0.2
higher demand for skill-*in*tensive goods	2.0	0.6	2.0
total	4.6	1.1	3.3
increase with similar production functions			
total	4.2	1.1	3.4
level in the Globalisation scenario			
	161.5	160.5	161.2

Table 4.3 presents the results of the three simulations for Japan, the United States and Western Europe at the end of the scenario period. The total impact of the three shocks reveals that Japan is affected most, and the United States least. In Japan the wage ratio increases with 4.6%-points, whereas in the United States the ratio rises with 1.1%-points. The impact on Western Europe is in between that on Japan and that on the United States.

[5] World Bank (1995), Development indicators, Table 9

The impact on the United States is much smaller than Lawrence (1996) finds when simulating a scenario in which the United States becomes completely specialized. In Lawrence's scenario the wage of college workers would increase 7.5% relative to the wage of high-school workers. This corresponds roughly in terms of the current results to an increase of (0.075*160.1=) 12% percentage points.

For two reasons the United States has to fear less from trade with emerging economies than either Japan or Western Europe so far as wage inequality is concerned. The first reason is that removing *trade barriers* deteriorates the relative position of the United States to export skill-intensive goods. The trade taxes that Japan and Western Europe currently face when exporting to the non-OECD are higher than the United States encounter. Therefore exports of these two regions increases more when these taxes are abolished.

The second reason is that the *sectoral structure* is different. In the United States the share of domestic (often non-traded) services in total employment is relatively higher, whereas the share of skill-*ex*tensive sectors – in particular agricultural and consumer goods – is relatively lower. This is a consequence of different demand patterns in United States on the one hand and in Japan and Western Europe on the other hand. The differences in structure are reinforced by heavy protection of agriculture in Japan and Western Europe. Even though agriculture is not a large sector in terms of employment or value-added, low-skilled workers benefit from protection of this sector.

In the pure, simple Heckscher-Ohlin-Samuelson theory of trade factor prices are tightly linked to goods prices, so that changes in consumption patterns or endowments in an incompletely specialised, small economy do not lead to changes in relative factor prices. For example, an increase in expenditure on non-tradeables induces sectoral adjustment, but does not affect relative factor prices. In WorldScan, or in any applied general-equilibrium model, the determination of factor prices is more subtle than the simple theory. The law of one price does not hold, so that domestic conditions, most notably consumption patterns and endowments, are also relevant for the determination of factor prices. An applied general-equilibrium model thus forces to consider different arguments than the pure theory of international trade would suggest. In this particular case, the (initial) sectoral employment patterns matter. In the United States employment both in agriculture and in manufacturing is less than it is in Japan and Western Europe.

The different impact on the three regions could also follow from different production technologies. If sectors converge with regard to the skill-intensity of production – employment of high-skilled workers relative to that of low-skilled workers – , the impact of trade on wages becomes less. Thus, less pronounced differences among sectors in the United States could explain the lower impact on wage inequality. Table 4.3 shows this is not the case. It reports the overall result of the simulations when one and the same sector in Japan, United States and Western Europe produces according to a similar technology as far as the skill intensity is

concerned.[6] The overall result hardly changes only slightly. The total impact on Japan and the United States becomes less, whereas the effect on wage inequality in Western Europe becomes larger. More importantly, the table shows that different production technologies are not the reasons behind the different results.

The impact of shifting employment and demand patterns on the one hand and the effect of trade barriers on the other hand should only be compared with great care. The projections for demand and employment patterns as well as for trade barriers are highly uncertain. Also, the regional variation in the shocks is bound to have a different impact on Japan, the United States and Western Europe. Nevertheless, Table 4.3 suggests that an assessment of the future impact of globalisation, in particular on the position of low-skilled workers in the rich countries, should not ignore the characteristics of the development process of poor countries. Changes in demand and employment patterns in developing countries are inevitable, and tend to depress the relative wage of low-skilled workers. Note that the modest impact of lower trade barriers can also result from a potentially significant underestimation of the trade barriers.

Substitution between manufacturing goods and between low-skilled and high-skilled workers

In WorldScan substitution possibilities between manufacturing goods from different origin are not perfect. This cushions changes in relative wages. The model has been run with doubled long-run substitution elasticities for manufacturing and services. The upper panel of Table 4.4 shows that better substitution between domestic and foreign goods leads to a significantly higher impact of trade on wages. The total impact of the wage ratio in Japan rises from 4.6%-points to 7.5%-points, in the United States from 1.1% to 1.7% and in Western Europe from 3.3% to 4.2%.

Trade with developing countries changes relative wages in developed countries, but not stunningly so. The result of trade liberalisation and changing demand and employment patterns outside the OECD is that the relative wage of low-skilled workers grows less with at most 0.2% on average each year. The recent experience in the United States and also in the United Kingdom is that the growth difference between wages of low-skilled and high-skilled workers exceeds

[6] See Appendix A for a more detailed, technical explanation.

0.2% considerably.[7] Besides, experiments with the model reveal that changes in the composition of the labour supply (i.e. education of low-skilled workers) and asymmetric technical change affect relative wages more than trade with developing countries.[8]

One of the reasons that the simulations with the model uncover an only modest impact of trade on relative wages, can be found in substitution between low-skilled and high-skilled workers in production. The lower panel of Table 4.4 show the results of similar simulations where the substitution elasticity between low-skilled and high-skilled workers has been lowered from 1¼ to ¾ while maintaining the increased substitution elasticities between goods of different origin. When substitution possibilities are limited the relative wage responds more to the various shocks as to induce firms to hire low-skilled workers. The total impact on the wage ratio then (almost) doubles. The results are thus very sensitive for the assumption about substitution possibilities between low-skilled and high-skilled workers. Which substitution elasticity is appropriate, is another matter. Wood (1994) and also Lawrence (1996) discuss this elasticity. It seems that ¾ is low, perhaps too low.

Substitution possibilities are not the only elements of uncertainty. Most obviously, the results apply to the distant and also uncertain future. They highly depend on the scenario. For example, the consumption patterns in Japan and Western Europe are projected not to change. However, these regions might see a shift towards the consumption of services, so that their consumption patterns converge towards that in the United States. When employment patterns adjust accordingly, the result might disappear that wage inequality in Japan and Western Europe is more sensitive than in the United States for increased trade with developing countries. Another qualification has already been mentioned. The trade barriers are likely to be underestimated. The data for (non-tariff) barriers are either lacking or poor. Besides, the simulations assume that trade liberalisation only applies to agriculture and to manufacturing and ignore restrictions on trade in services. The negative effect of trade on low-skilled wages is then larger, because the production of services is skill-intensive.

[7] The OECD (1996) reports that in the United States the upper earning limit of the ninth decile of workers has grown between 1979 and 1995 on average 1% higher than the upper limit of the fifth decile and almost 2% higher than the upper limit of the first decile. The United Kingdom has seen a similar development.

[8] See CPB (1997).

Table 4.4 Wages of high-skilled worker in OECD in 2020
relative to wages of low-skilled workers (%)

Better substitution between goods from different origin (Elasticities double)			
country	Japan	United States	Western Europe
increase in response to			
trade liberalisation	3.9	0.8	1.5
less low-productivity workers	-0.1	0.2	0.2
higher demand for skill-*in*tensive goods	3.7	0.7	2.6
total	7.5	1.7	4.2
And *worse substitution between low-skilled and high-skilled* (Elasticity goes from 1¼ to ¾)			
country	Japan	United States	Western Europe
increase in response to			
trade liberalisation	6.0	1.2	2.4
less low-productivity workers	0.1	0.6	0.7
higher demand for skill-*in*tensive goods	6.1	1.2	4.3
total	12.2	3.0	7.4

4.3 Eliminating low-skilled intensive manufacturing in the OECD

The simulations in the previous subsection serve at least two purposes. First, they must show *how* developing regions can have an impact on wage inequality in developed regions. The conclusion is that, aside from the obvious candidate trade liberalisation and more specialisation, demand changes in developing regions may also deteriorate the position of low-skilled workers in the OECD. Second, the simulations must show *if* developing region can have a potentially large impact on wage inequality between high-skilled and low-skilled workers. The conclusion is that the impact strongly depends on substitution elasticities and for reasonable values of substitution parameters the impact does not seem very large.[9]

To show 'if' does not require to show 'how'. The assumptions about trade liberalisation, labour reallocation and demand patterns are not essential when trying to derive the upper limit of the impact that trade between developing and developed regions may have on wages in the developed regions. To gauge thus upper limit we have run a simulation in which that parts of manufacturing (are forced to) disappear that most intensively use low-skilled labour. More specifically, in this simulation one manufacturing sector, consumer goods, is driven out of

[9] A third purpose of the simulations is to show whether the impact differs within the group of rich countries. Here the conclusion is that the United States has to fear less than either Japan or Western Europe.

business (by means of a production tax) within the group of rich countries and consumer goods are completely produced in the poor countries. Table 4.5 shows the results.

Table 4.5 Eliminating low-skilled intensive manufacturing in the OECD
changes in the skill premium

country	Japan	United States	Western Europe
change in skill premium	5.8	3.8	5.1
skill premium	162.8	163.2	163.1

Table 4.5 immediately shows that even eliminating that part of manufacturing that use low-skilled workers most intensively, does not produce ‘large numbers’. The results must be compared to those in Table 4.3, since the two both sets of results have been derived for similar model parameters. The total effect in Table 4.5 is larger that in Table 4.3. Especially for the United States the effect becomes larger: the United States becomes in this respect more like Japan and Western Europe. The difference between the two sets of simulations is agriculture. Whereas in the previous simulations agriculture in the United States benefits from removing trade restrictions (in Japan and Europe), in the current simulations agriculture is initially unaffected. Nevertheless, the outcome of this experiment confirms that Japan and Western Europe are more sensitive than the United States to changes in production and trade patterns. This conclusion does not depend on what happens to agriculture in these three regions.

5 Conclusions

In the United States and the United Kingdom income inequality is rising, whereas in continental Europe unemployment among low-skilled workers is high. A common fear is that the process of globalisation is undermining and will continue to undermine the position of low-skilled workers on the labour market. The prospect of rapid growth in many developing countries only aggravates it. This paper does not take away this fear, but certainly does nothing to feed it. Even in an optimistic scenario in which developing countries are projected to grow fast and the linkages between OECD and non-OECD countries intensify, the impact of trade on wages is not exactly worrying.

Nevertheless, the conclusion that trade with developing countries tends to increase wage inequality is unavoidable. Trade liberalisation increases imports of skill-*ex*tensive goods by developed countries, lowers demand for low-skilled workers and depresses their wage relative to the wage of high-skilled workers. However, lower barriers to trade are not the only reason behind more wage inequality. In developing countries demand shifts from skill-*ex*tensive to skill-*in*tensive goods. Moreover, the process of development is partly driven by reallocation of workers: from informal, low-productivity sectors to formal, high-productivity sectors. These workers are predominantly low-skilled. The reallocation from informal to formal sectors implies that overall the supply of low-skilled workers – in efficiency units – rises. These changes in demand and employment patterns appear to be at least as important as trade liberalisation for the relative wage differences in OECD countries.

Trade liberalisation has less impact on wage inequality in the United States then it has in Japan and Western Europe. Employment in the United States is more concentrated in the production of often non-tradeable services, whereas employment in the other two regions is still found more in agriculture and manufacturing. Besides, Japan and Western Europe face higher import tariffs when exporting and levy higher tariffs when importing. For these two reasons low-skilled workers in Japan and Western Europe have to fear more from globalisation than their counterparts in the United States.

References

Ahuja, V. and D. Filmer (1995), Educational attainment in developing countries: new estimates and projections disaggregated by gender; a background paper for the World Development Report, 1995, The World Bank, Washington DC.

Barro, R.J. and J-W. Lee (1993), "International Comparisons of Educational Attainment", *NBER Working Paper No. 4349.*

CPB (1999), *WorldScan: the core model*, The Hague.

Harris J.R. and M.P. Todaro (1970), Migration, unemployment and development: a two-sector analysis, *American Economic Review*, 60, 1

Hertel, T.W. (ed.) (1997), *Global trade analysis; Modeling and applications*, Cambridge University Press, New York

Hu, Z., and M.S. Kahn (1997), Why is China growing so fast?, *IMF staff papers*, 44, 1

ILO (1998), *ILO Labour Statistics Database,* Geneva.
- *Chapter 1, Total and economically active population,*
Chapter 2 - Employment, Table 2F - Paid employment in manufacturing
Chapter 5 - Wages, Table 5B - Wages in manufacturing.

Krugman, P.R. (1995), Technology, trade and factor prices, *NBER Working Paper 5355.*

Lawrence, R.Z. (1996), *Single world, divided nations? International trade and OECD labor markets*, Brookings Institution Press, Washington D.C.

Leamer, E.E. (1994), Trade,wages and revolving door ideas, *NBER Working Paper 4716.*

Lejour, A.M., and P.J.G. Tang (1999), *The informal sector: a source of growth*, CPB Research Memorandum 153.

Lewis W.A. (1958), Economic development with unlimited supply of labour, *The Manchester School*, 26, 1

McDougall, R.A., A. Elbehri, and T.P. Truong (1998).*Global Trade Assistance and Protection: The GTAP 4 Data Base, Center for Global Trade Analysis*, Purdue University.

OECD (1996), *Employment Outlook*, Paris, July

OECD (1997), *The world in2020; Towards a new global age*, Paris

Wood, A. (1994), *North-South trade; Employment and inequality*, Clarendon Press, Oxford

World Bank (1995), *World Development Report 1995*, Oxford University Press, Oxford

Appendix A The model

WorldScan is a multi-sector, multi-region, dynamic applied general equilibrium model for the world economy. The long-run outcomes are readily interpretable with neoclassical trade and growth theory. Box 1 summarizes the main characteristics of the model. This appendix highlights some important ingredients of the model. See for a more complete characterisation of the model CPB (1999).

The informal, low-productivity sector

The approach in which economic development is fuelled by sectoral reallocation originates in the analysis of Lewis (1958). It has been extended, and applied to rural-urban migration, by Harris and Todaro (1970). Lewis distinguishes two sectors. One is a modern, *capitalist sector*. This sector grows in response to ongoing capital accumulation and technological progress and demands more and more labour. The other is a traditional, *subsistence sector*. In this sector the marginal productivity of labour is relatively low.

WorldScan also distinguishes in developing countries a traditional, low-productivity sector and modern, high-productivity sectors. Technical progress and capital accumulation augment labour productivity in the modern sectors and increase income. As a result the wages in the traditional sectors fall behind the wages in the modern sectors. This induces a flow from the low-productivity sector to the high-productivity sectors. Lewis assumes an *infinitely elastic supply of labour*: Workers flow out of the traditional sector into the modern sector at the going wage rate. In WorldScan is the response to the relative wage difference between the two sectors is finite, and set equal to 2.

The World Bank (1995, Table A.3.1) gives for numerous countries the share of wage and non-wage workers in total working population. The share of non-wage workers in developing countries exceeds by far the share in developed countries. In beginning of the 90's the share was in China 84% and in India 75.4%, whereas in the United States the share is less than 10%. The number of non-wage workers is an indication for employment in the informal, low-productivity sector. The raw data have been adjusted for a natural share of non-wage workers and a natural unemployment rate. The 'natural' share and the 'natural' rate are set equal to the average values for the OECD. From these data we also derive the allocation of low-productivity workers over agriculture and services.

Table A1 Low-productivity sectors in developing countries value added, employment and GDP per capita in 1995

	Latin America	Middle East	Sub-Saharan Africa	China	South-East Asia	South-Asia & Rest
informal sector % of total value added	1.9	1.5	8.2	19.0	4.3	14.1
informal employment % of labour supply	25.2	23.8	60.0	63.4	37.7	61.9
informal agrarian employment % of informal employment	39.4	50.6	68.8	85.6	55.1	80.1

Source: own calculations, based on McDougall et al. (1998), Worldbank (1995) and ILO (1998)

Supply of low-skilled and high-skilled workers

The data for the supply of low-skilled and high-skilled workers at a regional level have been taken from Barro and Lee (1993) and Ahuja and Filmer (1995). Workers are labelled high-skilled when they have completed at least secondary education. Ahuja and Filmer have revised the data of Barro and Lee and also provide projections for many developing countries. We lack projections for the OECD, Eastern Europe and the Former Soviet Union. From the high enrolment rates since the sixties we have drawn the conclusion that the growth in the human capital stock (the number of workers with secondary education or better) in these regions is relatively low. A further problem is that according to the Barro-Lee data the differences between these regions are huge. This may very well reflect statistical problems. For the time being the number of high-skilled workers for each of the 6 regions has been set at the average value for the OECD, Eastern Europe and the Former Soviet Union. Table A.2 shows the share of low-skilled workers in the total labour supply for various regions both at the beginning and at the end of the scenario period.

Table A.2 Number of low-skilled workers
% of total labour supply

region	1995	2020
OECD	63.9	63.9
transition regions	63.9	63.9
Latin America	82.5	71.6
Asia	85.2	79.5
global	81.2	77.8

Input intensities

GTAP provides at a sectoral level wage payments of low-skilled and high-skilled workers. We use these data, first, to classify the 16 manufacturing sectors in GTAP in three categories, and second, to derive the skill ratios per sector and region.

The concordance between 16 manufacturing sectors in GTAP 4 and three sectors in WorldScan - Consumer Goods, Intermediate Goods and Capital Goods - is based on the skill ratios of these sectors. For the OECD regions together the ratio of payments of low-skill labour to high-skilled labour is as follows

Table A.3 Wage payment ratio of low to high-skilled labour in the OECD relative to the average wage ratio in manufacturing

	0.8	0.9	0.9	1.0	1.1	1.1	1.2
sector	P_C	OME	ELE	CRP	OTN	PPP	MVH
	1.5	1.5	1.6	1.6	1.6		
sector	FMP	NMM	I_S	OMF	NFM		
	1.9	2.2	2.6	2.7			
sector	LUM	TEX	LEA	WAP			

source : Mc Dougall et al (1998) and own calculations

tex=Textiles, wap=wearing apparel, lea=Leather products, lum=Wood products, ppp=Paper products, publishing, p_c=Petroleum, coal products, crp=Chemical, rubber, plastic products, nmm=Mineral products nec, i_s=Ferrous metals, nfm=Metals nec, fmp= Metal products, mvh=Motor vehicles and parts, otn=Transport equipment nec, ele=Electronic equipment, ome=Machinery and equipment nec, omf=Manufactures nec.

Based on these outcomes we classify the sectors in the first row in Table A3 as Capital Goods, in the second row as Intermediate Goods and in the third row as Consumer Goods.

We compared these data with wage data of the ILO (1998). These are were average wage data in these 16 industries. Wage data are of course no perfect indication for skill intensities. However, the comparison more or less confirmed this classification.

Second we used the wage payment data to derive the skill intensities in our 7 sectors in WorldScan, based on the concordance in Appendix B. More precisely, we used the data to derive the relative skill intensifies between the sectors. We did not derive the absolute skill intensities because the macro ratio of wage payments of low-skilled to high-skilled workers base on the GTAP data does not necessarily correspond to the division of ratio of low-skilled versus high-skilled on the supply side and our a reasonable wage ratio. Given our labour supply data based on Barro and Lee (1993) and Ahuja and Filmer (1995), and an imposed wage ratio of 0.625 we scaled all GTAP wage payments. We did not modify the sum of wage payment of low and high-skilled labour in a sector. Table A4 shows that these skill ratio's differ per region. The skill ratio's for the manufacturing sectors are

Table A4 Sectoral skill intensities in manufacturing for 1995 relative to average skill intensities in manufacturing

region	Consumer Goods	Intermediate Goods	Capital Goods
United States	2.28	1.74	0.79
Japan	1.66	1.00	0.92
Pacific OECD	1.89	1.44	0.78
Western Europe	1.75	1.25	0.84
Eastern Europe	1.41	1.22	0.78
Former Soviet Union	1.48	1.24	0.87
Middle East & North Africa	1.29	1.11	0.84
Sub-Saharan Africa	1.26	1.05	0.89
Latin America	1.24	1.13	0.89
China	1.09	1.27	0.86
South-East Asia	1.61	1.24	0.84
South Asia & Rest	1.16	1.09	0.86
oecd	1.87	1.31	0.84
global	1.89	1.30	0.82

source: McDougall et al. (1998)

The skill-intensities for Consumer Goods are significantly lower than for Intermediate and Capital Goods, except for China. The larger deviation of the skill intensities in Consumer Goods from the average skill intensities compared to Capital Goods reflects the relative importance of Capital Goods in total value added of manufacturing.

Table 4.4 also reports results of simulations with what is called identical production technologies. In this instance the relative skill intensities in manufacturing are equal in all OECD regions.

Employment

Table A.5 shows employment patterns for Japan, the United States and Western Europe in 1995. Employment in the United States is concentrated in the service sector, whereas in Japan and Western Europe agriculture and manufacturing account for a larger share of total employment. In Pacific OECD agriculture is relatively important for employment, and manufacturing

relatively less important.

Table A.5 Employment in the OECD in 1995
% of total employment

sector	Agriculture	Manufacturing	Services
Japan	5.6	23.1	71.3
Pacific OECD	7.3	18.8	73.9
United States	3.6	20.6	75.9
Western Europe	6.1	25.8	68.1

Consumption
Total consumption is allocated over all products in accordance with the Cobb-Douglas specification of the utility function given the budget constraint. This leads to the standard demand equations for a particular region,

$$C_s = \gamma_s C \tag{1}$$

where indices for time have been suppressed and C_s denotes nominal consumption of good *s*, *C* total consumption expenditure and γ_{sS} the share of good *s*. Consumption patterns in the different regions tend to converge,

$$\gamma_s = \gamma_s^* + \left(\gamma_{s,0} - \gamma_s^*\right)\left(\frac{c_{-1}}{c_0}\right)^{-\mu}, \quad \mu \geq 0 \tag{2}$$

where the subscript *0* denotes the starting year, *-1* indicates the previous year, γ_s^* is the common share of consumption category *s* in total consumption, and *c* real consumption per capita in a region. The different shares γ, γ* and γ_0 add up to one, when summed over *s*.

Imperfect substitution between domestic and foreign goods
In the manufacturing sectors – the consumer, intermediate and capital goods products from a different origin are imperfect substitutes. The share of region *i* in expenditure by region *j* (s_{ij}) equals

$$s_{ij} = \sigma_{ij}\left(\frac{p_{ij}}{p_j}\right)^{1-\varepsilon}, \tag{3}$$

where σ_{ij} denotes a preference variable, ϵ a substitution parameter, p_{ij} the price of the good supplied by region *i*, and p_j an ideal price index for expenditure by region *j*,

$$p_j = \left[\sum_h \sigma_{hj}\left(p_{hj}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{4}$$

The 'preferences' change over time. Habit formation might be an explanation for this. The

preferences are a function of the lagged market share and the share a region would have in the absence of trade taxes and transport cost in the starting (calibration) year (Σ),

$$\sigma_{ij} = \left(s_{ij,-1}\right)^{1-\theta} \left(\Sigma_{ij}\right)^{\theta} \quad (5)$$

In the short run the substitution elasticity is in between 1 and ϵ, depending on the market share. The long-run price elasticity exceeds the short-term elasticity. The upper bound on the long-run elasticity is $(\epsilon\text{-}1)/\theta + 1$ rather than ϵ.

Appendix B Regional and sectoral concordances

1	United States
2	Japan
3	Western Europe
	United Kingdom, Germany, Denmark, Sweden, Finland, Rest of European Union, EFTA
4	Pacific OECD
	Australia, New Zealand, Canada
5	Eastern Europe
6	Former Soviet Union
7	Middle East and North Africa
	Turkey, Rest of Middle East, Morocco, Rest of North Africa
8	Sub-Saharan Africa
	South African Customs Union, Rest of Southern Africa, Rest of Sub-Saharan Africa
9	Latin America
	Central America and Carribean, Mexico, Argentina, Brazil, Chile, Uruguay, Venezuela, Colombia, Rest of South America
10	China
	China, Hong Kong
11	South East Asia
	Republic of Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, Taiwan, Vietnam
12	South Asia & Rest
	India, Sri Lanka, Rest of South Asia, Rest of the World

1	Agriculture and food production
	Paddy rice, Wheat, Grains, Cereal Grains, Non grain crops, Vegetables, Oil seeds, Sugar cane Plant-based fibres, Crops, Bovine cattle, Animal products, Raw milk,, Wool, Forestry, Fisheries, Processed rice, Meat products, Vegetable Oils, Dairy products, Sugar, Other food products, Beverages and tobacco
2	Raw Materials
	Oil, Gas, Coal, Minerals
3	Consumption goods
	Textiles, Wearing apparels, Leather etc, Wood products
4	Intermediate goods
	Fabricated metal products, Nonmetallic minerals, Ferrous metals, Nonferrous metals, Rest of manufacturing
5	Capital goods
	Chemical, rubbers and plastics, Pulp paper, Petroleum and coal, Transport industries Machinery and equipment, Electronic equipment Motor vehicles and parts,
6	Services
	Electricity, Gas manufacture and distribution, Water, Construction, Financial, business and recreational services, Public administration, education and health, Dwellings
7	Trade and Transport
	Trade and Transport