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Trade with China and Impacts on North American Wages

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1 Introduction

There is extensive debate on the causes of growing real wage disparity of skilled and unskilled labor in developed countries since the 1980s. This period of rising income inequality also observed large immigration of low-skilled workers from developing countries, and a surge of low-priced imports with greater low-skill intensity. While there is general consensus that globalization impacts relative demand for skilled and unskilled labor, there is little agreement on the magnitude of effects on the growing wage disparity. Some authors argue that trade and migration have significant impacts on trade (Feenstra and Hanson, 1996), while others disagree (Lawrence and Slaughter, 1993; Krugman and Lawrence, 1994). Several factors affecting the demand and supply of labor are discussed in the literature. The supply of unskilled labor relative to skilled may have changed due to: i) disproportionate migration of unskilled workers from developing countries (Butcher and Card, 1991); ii) increase in education (Wheeler, 2005), each having opposing effects. The relative demand for unskilled labor may have decreased due to: i) skill-biased technological changes (Card and DiNardo, 2002); ii) larger imports and outsourcing of unskilled-labor intensive products (Leamer, 1994); iii) changes in specialization towards greater skill-intensity (Wood, 1998).

This paper studies impacts of China's growth on skill premium in North America. China's economic reform in the late 1970s and 1980s transformed China from a small, agricultural-based economy to a large player in the global market. Market-oriented outlook and rapid liberalization contributed to significant growth in output. In 1978 China's exports were only 0.75% of total

world exports, which increased to 3% in the mid-1990s and to more than 6% by 2004[1]. The ratio of total trade to GDP increased from 15 to 70[2]. At this time China also observed substantial growth in resources. Rapid population growth (3%) during the 1960s (before the adoption of China's one-child policy) resulted in large increase of the workforce during the 1980s and 1990s. In addition, increased capital investments through foreign inflows as well as public investments expanded the resource base facilitating sustained growth in output.

Economic reforms made China a leading exporter of manufacturing goods, and North America the leading importing counterpart. Of China's total exports in manufacturing 30% goes to North America. Correspondingly, 10% of USA's total imports are from China, of which 95% comprises of manufacturing goods[3]. Using detailed data on 131 manufacturing categories, Sachs et. al. (1994) finds that increases in Chinese imports results in employment loss by 7% in production jobs in manufacturing. Mankiw (2003) in his advisory note to the administration point out that trade with China is a significant reason for increase in North American exports and economic growth; however, he acknowledges directly affected workers who suffer job loss. Bronfenbrenner et. al. (2001) provides a detailed overview of industries that have engaged in offshoring production in China, and the large negative impacts on manufacturing employment in the USA. The question we seek in this paper is to what extent the growth and liberalization of China may have contributed to the growing wage disparity in North America. We aim to

[1] Author's calculation using WDI

[2] Author's calculation using the Penn World Tables indicator on Openness

[3] Author's calculation using GTAP Database v7

investigate impacts on overall production, trade, changes in specialization, and detailed impacts on real returns to workers across various skill types.

The goal of this paper is to develop an integrated framework that can analyze impacts on international trade on domestic changes in relative factor returns. This requires a global analytical tool that integrates information on production, trade and employment. As such the Global Trade Analysis Projects (GTAP) CGE model becomes ideal for analysis. The model is complemented with a global dataset derived from national input-output tables, as well as macroeconomic data from international sources. We complement this with a special dataset obtained from the International Labor Organization (ILO) that further disaggregates labor across skill-types. Weingarden & Tsigas (2010) develops this new dataset that provides information on wages and employment for occupation and industry pairs for 48 countries and 16 aggregated commodities. Total labor payments in GTAP 7 Data Base is split into 5 categories: i) senior officials, manager, and professionals; ii) technicians and associate professionals; iii) clerks; iv) service and shop workers; and v) skilled agricultural workers, machine operators, assemblers, craft workers, etc. This dataset forms the basis to split total expenditure on labor obtained from country IO tables into expenditure on each occupation type for each industry. This dataset facilitates the unique opportunity to analyze data at a detailed occupational level and distinguish differential impacts across workers at different levels of the skill chain.

2 Data and Methodology

The database of Tsigas and Weingarden (T&W, 2010) includes calculated labor payments split across five occupational categories. This section provides an overview of this database, revisions needed to use this dataset for our particular application, and methodology of its incorporation to the standard GTAP database.

2.1 The sectors, starting point is China

Since the application in this paper is looking at shocks of the Chinese economy we are especially looking at the availability of sectors in this country. In the database of T&W the sectoral focus is on the ISIC Rev3 classification of which an overview can be found in table A1 of Appendix A. The Chinese employment data for 2002 are available from the *2007 Labor Statistical Yearbook.* We have extended the calculated employment in the T&W database from seven to twelve sectors. The mapping between the sectors in this yearbook to the ISIC Rev-3 can be found in table A2 of Appendix A. For all but H: Hotels and restaurants the essential ISIC Rev-3 sectors have a reasonable mapping between the two classifications. In order to have a full coverage of the economy we assume that ISIC Rev-3 sector H: Hotels and restaurants has the same skill split across five occupational categories than the sum of the ISIC sectors K: Real estate, renting and business activities and O: Other community, social and personal services. This gives us in total ten GTAP related sectors, for which a mapping from the ISIC Rev-3 sectors to these GTAP sectors can be found in Table A3 of Appendix A.

For these five new sectors we followed the procedure to disaggregate the employment by occupation described in the paper of T&W: “we approximated the distribution of workers in a given occupation with 2006 statistics on the distribution of education by sector and occupation

by education". Some minor mapping differences appear between the two tables in the *2007 Labor Statistical Yearbook,* which can be found in table A4.

In the T&W database only seven ISIC rev-3 sectors are available for China since there are no corresponding wage levels for these sectors. We have therefore made some simple assumptions for the wage levels per five occupational categories of these sectors. An overview of these assumptions for China (and for other countries) can be found in table A5 of the Appendix.

2.2 The countries: availability of the data in countries with these sectors

The aim of choosing the countries for the database is to have a reasonable coverage of the regions used in the application. We distinguish six countries/regions: China (CHN), North America (NAM), European Union 27 (EU27), Oceania (OCE), Other Asia (RAS) and Rest of World (ROW)[4]. The condition is obviously the availability of the sectors mentioned in section 2 for which both numbers of employees and wages are available[5]. Apart from this restriction we couldn't use data from countries with an ISIC Rev-2 industry composition and/or an ISCO 68 occupation classification. Similar to the procedure we used for China, we have used information of countries that do have the required employment data, but not all the wage data per sector. For those sectors and countries we have done a simple estimation of the wage levels using (average) wages of similar sectors[6]. For a complete overview of the countries used in this database and the assumptions for the wage levels we refer to table A4 of the Appendix.

[4] For a full mapping between 112 countries of GTAP 7.1 and these regions we refer to table A5.

[5] With this restriction we haven't included the potential information of 47 countries which have employment data without sufficient wage information, as mentioned in the paper of T&W.

[6] It is to be decided what procedure will be used to estimate these wages, including the wage levels for the 47 countries which are not yet included in the T&W database.

In this table we have marked the countries which represent the regions (China is the only separate country). Note that Mexico is part of Rest of World and not North America. For the employment data of the United States a correction had to be made in the employment data. Job category 3 (Technicians and associate professionals) are apparently included in category 1/ 2 (Senior officials and managers and Professionals). Separation per sector has taken place using ILO data from 2000[7]. Rest of Asia is only represented by three countries: Japan, Korea and the Philippines. Efforts from T&W to include India in the database haven't resulted in enough sectors to include this country in this region. This may result in an overestimation of the skilled ratio for this region. For EU27 the coverage of the number of countries seems to be sufficient, although it is not pleasant that important EU countries like France, Italy and Spain are not included in this dataset, whereas employment data for these countries are available[8] . The Rest of World is rather poorly represented, especially by African countries. This may again lead to an overestimation of the skilled ratio. There are potential countries with data, but due to lack of sectoral information they can't be included in the database.

2.3 Final data preparation

A final calculation is needed to aggregate the countries to the regions. Since the wages are expressed in national currencies we have converted them to US dollars, using the exchange rates of 2006. This is not entirely correct, since the calculated values do not necessarily equal the

[7] Checking of this approach is needed, since the 2000 data are on ISCO-68 and ISIC Rev-2 basis.

[8] An estimation procedure for the wage levels for these countries will be discussed.

actual value of labor payments in that year[9]. However, since we are only interested in the five category skill shares per sector and region, we assume that the weights of the respective country don't deviate too much from the actual weights.

2.4 Methodology of incorporating labor splits into GTAP 7.1 Data Base

The five skill category skill split shares are then used on an aggregated GTAP 7.1 Data Base, with the same regions and sectors as we have used here. By preserving the original labor payments data in GTAP 7.1 Data Base, we make sure that the new labor splits are created on the data from all the 112 GTAP regions and 57 GTAP sectors within the aggregated regions and sectors used in this exercise. This enables us to have new skill shares (which can even add up to the original definitions of the skill shares) for the global economy. This results in what we call the AGG_GTAP_7.1_LAB database. We assume that the elasticities of transformation (currently assumed for skilled and unskilled labor) are equal for the underlying new skill categories.

We split the total labor payments, which are retained as in the original GTAP 7.1 Data Base, using the split-shares for the five labor categories. In order to discuss the methodology used to split, we let subscripts *i, j, k* and *r* to denote the indices pertaining to the sets of aggregate labor, Produced commodities (*PROD_COMM*), labor categories and regions, respectively.

[9] As can be seen in Table 2 of the paper of T&W not all countries have wage data for 2006. Attention is needed for the values of Turkey. In order to get a plausible result we had to divide the exchange rate by 1000 and even then the calculated labor payments are much higher than the labor payments of that country in 2004. Efforts may be needed to replace wage levels of 1992 by a more recent year.

For this, we begin with the sector-wise and region-wise expenditure on labor incurred by the producers, at agent's prices, i.e., $EVFA_{i,j,r}$, which are multiplied by category-level split-shares ($\theta_{k,j,r}$) to obtain the category-level payments ($EVFAR_{k,j,r}$), as shown in equation 1

$$EVFAR_{k,j,r} = EVFA_{i,j,r} * \theta_{k,j,r} \quad \text{--(1)}$$

Secondly, these category-specific payments are obtained at market prices ($VFMR_{k,j,r}$) by assuming that the power of factor taxes on aggregate labor payments ($TF_{i,j,r}$) is applicable for all labor categories as shown in equations 2 and 3.

$$TF_{i.j,r} = \frac{VFM_{i,j,r}}{EVFA_{i,j,r}} \quad \text{--(2)}$$

$$VFMR_{k,j,r} = TF_{i,j,r} * EVFAR_{k,j,r} \quad \text{--(3)}$$

Finally, the power of taxes on labor income ($TO_{i,r}$) in GTAP 7.1 Data Base is imposed across the labor categories to obtain the category-level labor output in each region ($EVOAR_{k,r}$) as shown in equations 4 and 5.

$$TO_{i,r} = \frac{EVOA_{i,r}}{\sum j \in PROD_{COMM} VFM_{i,j,r}} \quad \text{--(4)}$$

$$EVOAR_{k,r} = TO_{i,r} * \sum_{j \in PROD_{COMM}} VFM_{i,j,r} \quad \text{--(5)}$$

3 Experimental Design

We design a base case scenario that estimates the counterfactual where China did not develop to be a giant player in global trade. We project the Chinese economy to grow and open at the same rate as the OIEs between 1977 and 2004. With these projections we compare actual estimates on growth and liberalization of China using the national IO table of China in the GTAP Database v7 of 2004. This provides estimates on China's accelerated growth and liberalization during this period which forms the basis for calculating shocks. We are then able to simulate China's relative accelerated growth and openness on the Chinese economy and her trading partners. The sections below detail data and methodology used to develop the base case.

3.1 What if China did not grow?

Suppose that China did not grow to be the large country it is in terms of human and capital resources. How would world trade and the pattern of production change for industrial economies? To analyze this we project the economy of China to 1977, the year before China's liberalization. Then we assume that China grew much slowly, precisely at the rate of the OIEs, between 1977 and 2004. The base scenario is compared with actual observations of China's growth and liberalization as portrayed in the 2004 GTAP Database.

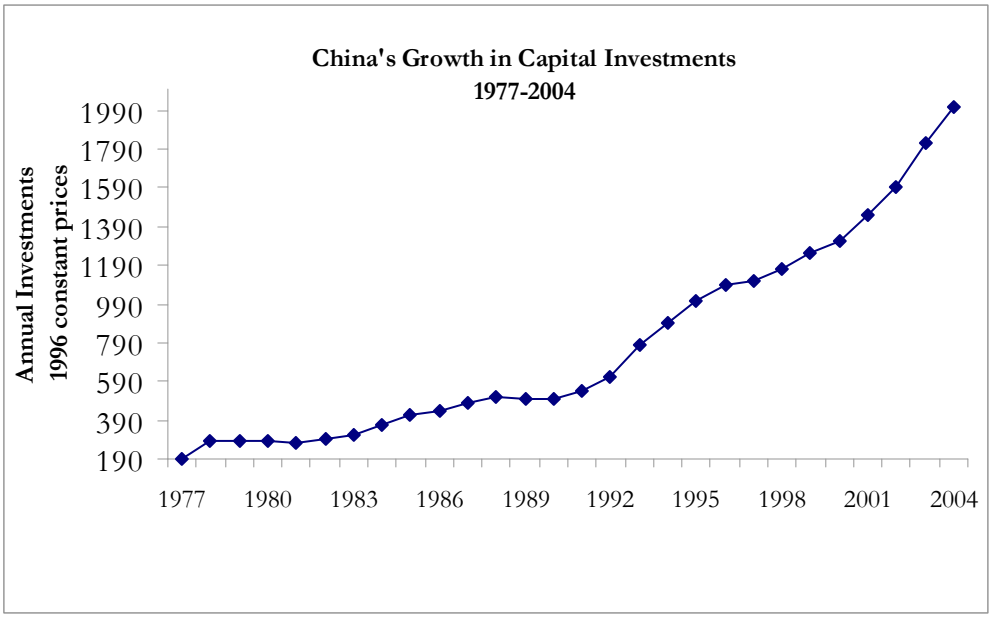
China grew tremendously in the size of labor in the next three decades, and at the present accounts for more than one-sixth of the world's population. Data from the Penn World Tables (PWT) indicate that China's population grew from a size of about 950 million to 1.3 billion

between 1977 to 2004. The growth rate was moderated from nearly 2% annual rate to 1.2% following the implementation of China's one-child policy on urban families in 1978. To project the economy at a slower rate of growth, we assume that China grew at a rate equal to the average growth rate of the OIEs between the same periods. With the new rate of growth China's population would have been smaller by 13% than it was in 2004. These estimates are used to shock the population and supply of labor in the model.

The supply of capital resources grew even more rapidly in China during the same period. Estimates on capital stock data are obtained using capital investment data. We gather data on aggregate capital investments to real GDP ratio from the Penn World Tables (PWT) to develop estimates on capital stock growth. Figure 1 depicts annual capital investments in China between 1977-2004. This data becomes the basis for developing estimates on aggregate capital stocks. The Perpetual Inventory Method is used to estimate capital stock in China[10]. Capital growth accelerated during the early 1980s, 1990s, and the new millennium. The early 1980s saw large inflow of foreign investments and development of private enterprises; in the early 1990s trade and investment grew rapidly leading to large GDP growth as well. Reversing this rapid growth of capital in the Chinese economy to make it comparable to the OIEs implies that China would have been smaller by 70% than it is in 2004, which is implemented as part of the smaller growth scenario in the model.

[10] The capital stock at a particular year is calculated as a share-weighted average of investments and the initial period capital stock, where the weights increase with time. We take the year 1977 to be the beginning of the period. Following the Hall and Jones (1999) approach, the initial period of capital stock is calculated as, $K_0 = I_0 /(g+\delta)$, where I_0 , is the investment in 1977, g is the average year-by-year growth rate of investments, and δ is the rate of depreciation which is set to be 4%.

Figure 1



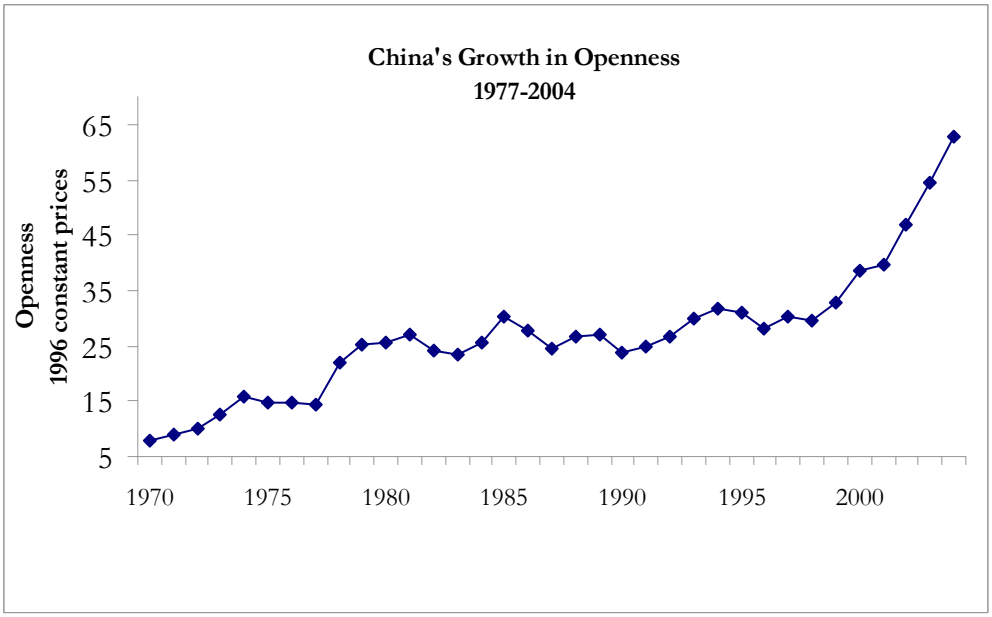
Source: Using data from Penn World Tables 6.3. I=ki*rgdpl/100, where rgdpl is the real GDP per capita at 1996 constant prices, ki is the investment share of rgdpl, and I is the calculated aggregate investments.

3.2 What if China did not open?

As China transitioned to a market-based economy in the year 1978, trade expanded largely in a multilateral dimension. Following significant changes in trade policies, China liberalized consistently in the following decades. Figure 2 shows growth in China's openness from 1970-2004. As is evident from the figure, China's participation in the global market accelerated in the late 1970s, late 1990s and early millennium. Trade relative to GDP increased from 30% in the early 1990s to 63% by 2004. China began by exporting more manufacturing goods, as well as textiles and apparel with the phasing out of the MFA quotas. In the new millennium China also expanded enormously on trade in services and high-technology equipments. Imports of raw materials and intermediate manufacturing goods from ASEAN and newly-industrialized economies also grew tremendously.

China's multilateral integration in 1978 marks significant changes in the pattern of global trade flows. For instance, China gained large shares of market in developed economies, and as a result economies, such as the USA and Japan saw a reversal of trade balances from surpluses to deficits. Existing work also underscores diversion of trade away from neighboring Asian countries to China. What are the implications of China's openness in developed countries and competing developing countries? The second scenario explores the case where China did not open. This is implemented by first introducing a closure swap that fixes a newly-defined variable of openness, which is total trade relative to GDP in China. Openness is shocked to calibrate tariff shocks that restrict trade growth in China at a similar pace as the OIEs between 1978-2004. The calibrated tariff shocks are then simulated to generate trade restricted trade openness in China.

Figure 2



Source: Using data from Penn World Tables 6.3. Openness is measured as the ratio of aggregate trade, i..e exports plus imports, to real GDP at 1996 constant prices.

4 China's Growth and Liberalization

This section presents impacts of China's accelerated growth and liberalization in China and North America.

4.1 Impacts on the Chinese Economy

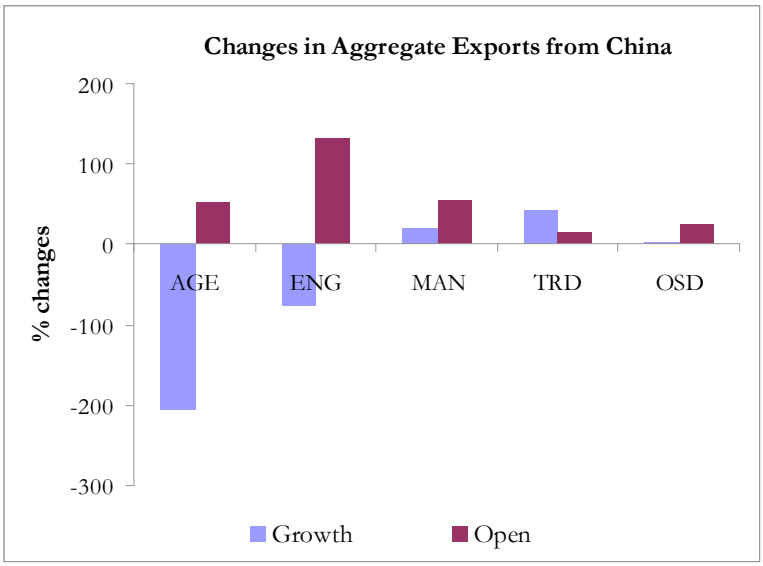
China's growth in population and capital resources results in rapid growth of China's output. Simulation results indicate that China's production of agriculture, manufacturing goods and services increases between 50-75% between 1978-2004. Most of the unskilled labor resources are allocated towards the production of agriculture, that has 60% of cost-share in this sector. Capital resources are directed towards the manufacturing and services sectors that are relatively

more capital intensive; the cost-share of capital input into the manufacturing sector is about 68%, and approximately 75% for most services sectors. A significant portion of the increase in domestic production is further fed back as intermediate inputs into the production process to complement the expanded resource-base in China. There is also substantial increase in imported intermediates to support the growth in output in China.

China's reliance on imported agricultural products increases quickly as China's demand for food rises. Domestic production of food alone becomes insufficient to sustain the rapid growth in population, which increases the volume of food imports. The value of food imports further rises since food prices increases due to both demand and supply side factors. The simulation projects that average real per capita income of labor in China rises by about 50% leading to a growing middle-income population that demands more and better quality food. Returns to labor rises relative to returns to capital, since capital grows faster in China than labor between 1978-2004. The increased abundance of capital expands production which correspondingly requires greater supply of both skilled and unskilled labor. Larger derived demand for labor pushes returns to labor upwards. It is an actual observation that real per capita income grew from less than USD 250 in 1978 to USD 3590 in 2004 at PPP in China (WDI, 2010), which contributed to the rise in domestic and import demand for consumption goods. Model results indicate that welfare measured in equivalent-variation terms increases by USD 840 billion as a result of China's growth and openness.

Growth in output corresponds with tremendous growth in exports. As the supply curve shifts right, China can produce goods at lower prices, which translates into greater competitiveness. China observes significant expansion of manufacturing exports; increases in the availability of low-technology capital resources and the growth in low-skilled labor makes the Chinese economy ideal for producing low-cost manufacturing goods. Today China's exports in manufacturing comprises of 91% of total Chinese exports. Most of these goods are exported to North America (30%), European Union (23%), and Asia (33%) (GTAP Database v7). Liberalization of import taxes imposed on Chinese products have an even larger effect on manufacturing exports, as shown in Figure 3 that compares impacts of growth and openness for various sectors. Lower trade costs opens borders of China to the rest of the world allowing her to have increased participation in global production sharing. China imports large volume of intermediates of manufacturing goods. 79% of China's imports constitute of imports in manufacturing good; most of these goods are obtained from Asia (69%), while some are obtained from the European Union (15%) and North America (9%) (GTAP Database v7).

Figure 3



4.2 Impacts on the West

China's growth transcends to other economies through trade and investment in the GTAP model. China grows to become large a trading partner of North America, European Union, and Asia. In the rest of the analysis we keep our focus to North America; impacts to European Union member countries and Oceania are qualitatively similar to a large extent with some differences. As China becomes a large and open economy, North America outsources most of its requirements of manufacturing goods to China. Trade in manufacturing increases by USD 138 billion. Today 96% of North America's total imports from China comprises of manufacturing goods. Trade in manufacturing goods however does not become a one-way integration, but there are correspondingly large increases in exports to China. North America's exports to China increases by USD 35 billion, most of which reflects trade-in-intermediates.

Changes in trade pattern have implications for specialization in production in North America. Table 1 decomposes impacts on production into the external effects of growth and openness. Growth has a significant positive impact on the production of agricultural and extraction commodities, which is primarily in response to China's growing demand for food. Output declines for a few sectors, including manufacturing goods which indicates a direct effect of greater imports from China. As China liberalizes, trading costs fall which has the most significant impact on manufacturing exports to North America. North America responds by substituting away from manufacturing production and producing more services. Particularly, transportation, storage, and communication, financial intermediation, business services sector, and public administration expenditures, as North America specializes away from manufacturing goods that enjoy greater liberal trade with China. As illustrated in Table 2, other industrial economies of Europe and Oceania also substitute away from manufacturing goods and becomes more specialized in services.

Table 1

Changes in Production in North America

Growth & Openness Effects

Sectors	Growth + Openness	Growth	Openness
AGE	2.57	2.26	0.31
ENG	1.59	1.28	0.31
MAN	-0.75	-0.16	-0.59
UTL	-0.13	-0.05	-0.08

CNS	-0.4	-0.51	0.11
TRD	-0.03	-0.05	0.03
TRC	0.45	0.08	0.37
FNI	0.12	0.01	0.11
OBR	0.18	0.04	0.14
OSD	0.14	0.05	0.09

Table 2

Changes in Production in North America, European Union and Oceania

Sectors	NAM	EU27	OCE
AGE	2.57	0.79	3.65
ENG	1.59	2.27	2.86
MAN	-0.75	-0.69	-2.41
UTL	-0.13	-0.14	-0.42
CNS	-0.4	-0.6	-0.17
TRD	-0.03	0.16	0.14
TRC	0.45	1.31	0.08
FNI	0.12	0.38	0.19
OBR	0.18	0.1	-0.02
OSD	0.14	0.08	0.42

As North America exports more to China, there are changes in their exports to the rest of the world. Proportion of exports to China increases between 75-100% relative to earlier levels. Subsequent changes in trade across sectors and countries are depicted in Figure 4. Except for manufacturing, changes in exports are mostly positive. As North America specializes to producing more agriculture and services, they also export more to other countries. Only exports of manufacturing goods decline, since large volumes of semi-processed goods are now exported to China. Table 3 shows sector-specific imports of intermediates. Looking down the column we see that the agriculture sector now imports more of all inputs as it also supplies more. Looking across the column for manufacturing goods it can be seen that imported manufacturing intermediates (which is largely from China) serves as inputs to all industries. The availability of low-cost manufacturing imports contracts domestic production which has negative impacts producers and employees.

Figure 4

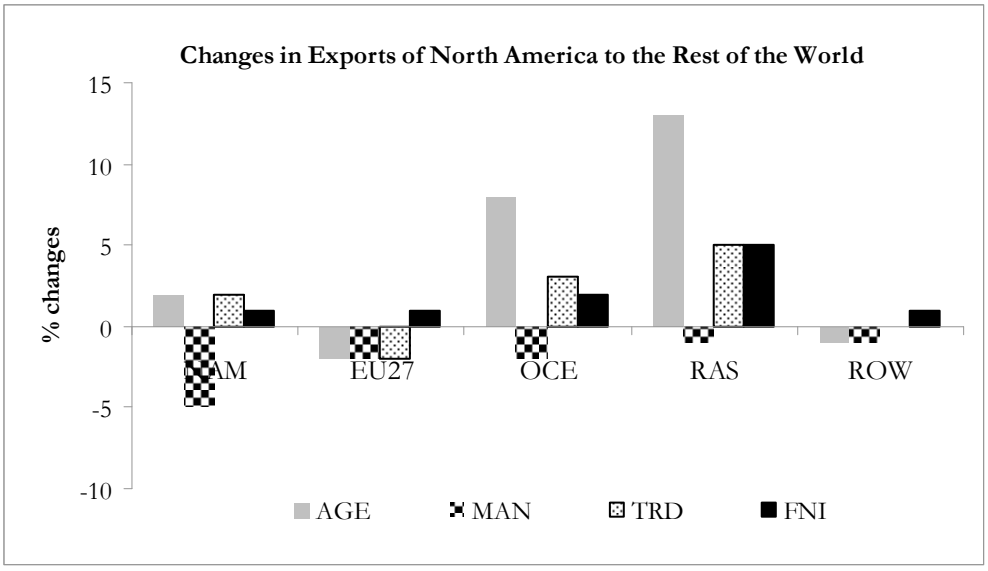


Table 3

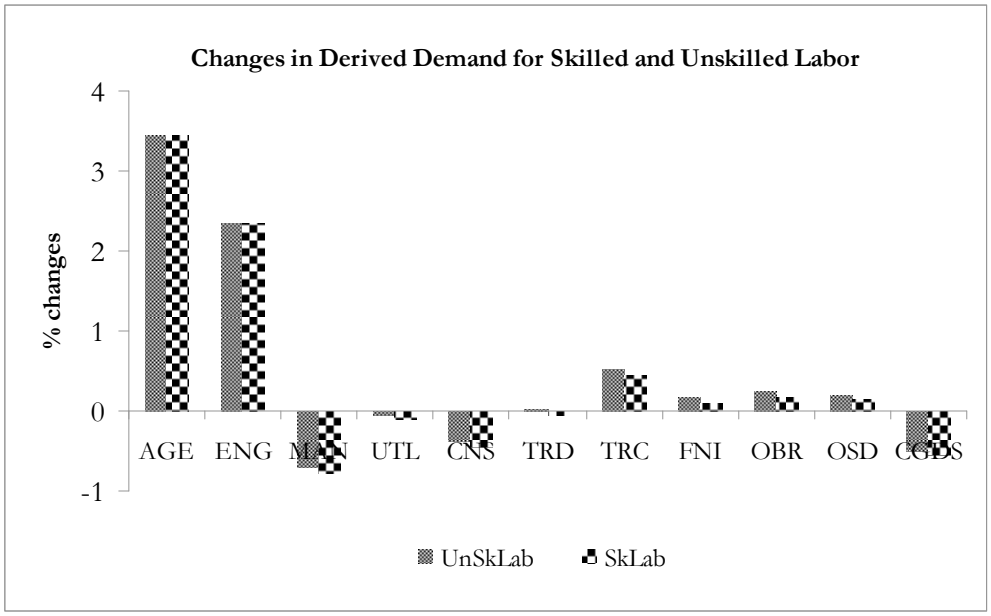
% Changes in value of Firms Purchases of Imports

Sectors	AGE	ENG	MAN	TRD	OSD
AGE	0.8	-0.1	-2.5	-1.6	-1.4
ENG	0.4	-0.6	-1.8	-2.1	-1.7
MAN	5.5	3.9	2	2.8	3.1
TRD	0.3	-0.7	-3.1	-2.3	-2.2
OSD	1.9	1.1	-1.3	-0.7	-0.6

4.3 The debate about wage competition

Let's now take a look at the impacts on factors of production in NAM. Derived demand for labor increases in agriculture, extraction and services as shown in Figure 5. Among service industries demand rises particularly for the transport and communication sector and for other business services sector. Demand for factors decline in the manufacturing sector, since production of manufacturing goods in NAM declines. Reallocation of factors across industries impacts returns.

Figure 5



Nominal returns increases for all factors. Returns to skilled and unskilled labor increases by 1.50% and 1.44%, respectively, as in Table 4. The small difference on the impact on prices is due to differences in labor intensity across sectors. While the agricultural and manufacturing sector is relatively unskilled labor intensive, some of the services sectors, such as financial intermediation and other business services are relatively more skilled labor intensive. Effects on real returns are smaller in magnitude since there is a general rise in the price of commodities in North America. Real returns to unskilled labor fall slightly, and there is a negligible impact on real returns to skilled wages. Small positive impacts on the real returns to skilled labor and capital are indicative of a shift in specialization away from low-cost manufacturing to higher cost services. This is also consistent with the Stolper-Samuelson theorem since factor prices moves together with product prices.

Table 4

Changes in Nominal and Real Returns to Factors in North America

Sectors	Nominal (%)	Real (%)
UnskLab	1.44	-0.05
SkLab	1.5	0.002
Capital	1.54	0.05

4.4 The debate about wage competition with the new data

The data that further splits labor into 5 skill types provides a more detailed view of labor employed in different sectors of production. It is now possible to investigate differential impacts on wages across these various skill types. Table 5 compares cost shares of endowment inputs for total production in China and North America. The old database suggests that in China of the total 36% of budget share spent on labor, 27% goes to unskilled labor and 9% to unskilled labor in CHN. The newly-developed data further shows that 3% goes to unskilled clerks, 4% to unskilled service and shop workers, 26% goes to the unskilled remaining (i.e. agricultural workers, machine operators, assemblers, craft workers, etc), and the rest 8% is approximately equally split between the two categories of skilled managers and professionals. In North America about 71% of the total expenditure of firms is on labor, with a higher share of 40% going to skilled labor, mainly since the proportion of skilled labor in North America is higher. Skilled managers take the higher share of labor earnings of 25%, which is expected since CEOs and managers usually earn large premiums from company profits. Unskilled remaining is twice as large as each of the other unskilled categories. Note that for both countries the magnitude of the ratios of skilled-

unskilled is well retained in the old database, which confirms that the earlier data that was based on econometric estimates rather than country-specific survey data were reasonably accurate.

Table 5

Cost Share of Factors in China and North Americath

China				North America			
Land	2	Land	2	Land	0.3	Land	0.3
UnskLab	27	UnskCL	3	UnskLab	31	UnskCL	10
		UnskWRK	4			UnskWRK	9
		UnskREM	22			UnskREM	16
SkLab	9	SkMNG	4	SkLab	40	SkMNG	25
		SkPROF	4			SkPROF	12
Capital	60	Capital	60	Capital	28	Capital	28

Figure 6 decomposes the 5 labor types across various sectors in North America, illustrating the distribution of workers in each skill type. Most skilled workers are employed in public administration and other business services; some are employed in financial intermediation and the manufacturing sector. The greatest proportion of unskilled service and shop workers are employed in trade, and the largest proportion of unskilled remaining are employed in the manufacturing and construction sector. For China the distribution of labor appears relatively more uniform, particularly since the two sectors of manufacturing and public administration dominate in size. A sizeable portion of the remaining unskilled workers are also employed in agriculture, as shown in Figure 7.

Figure 6

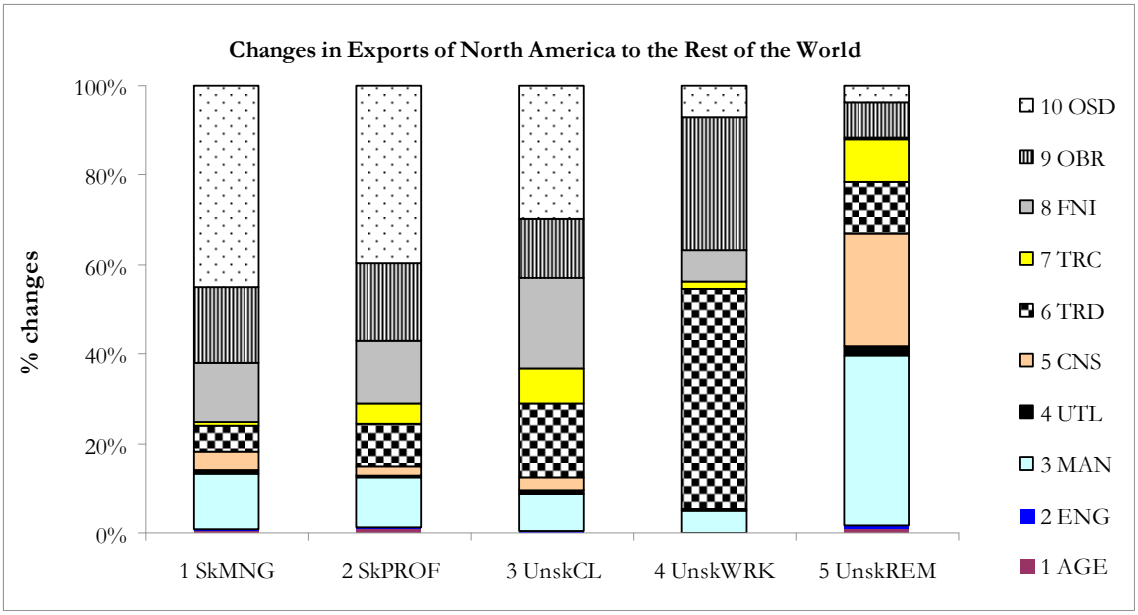


Figure 7

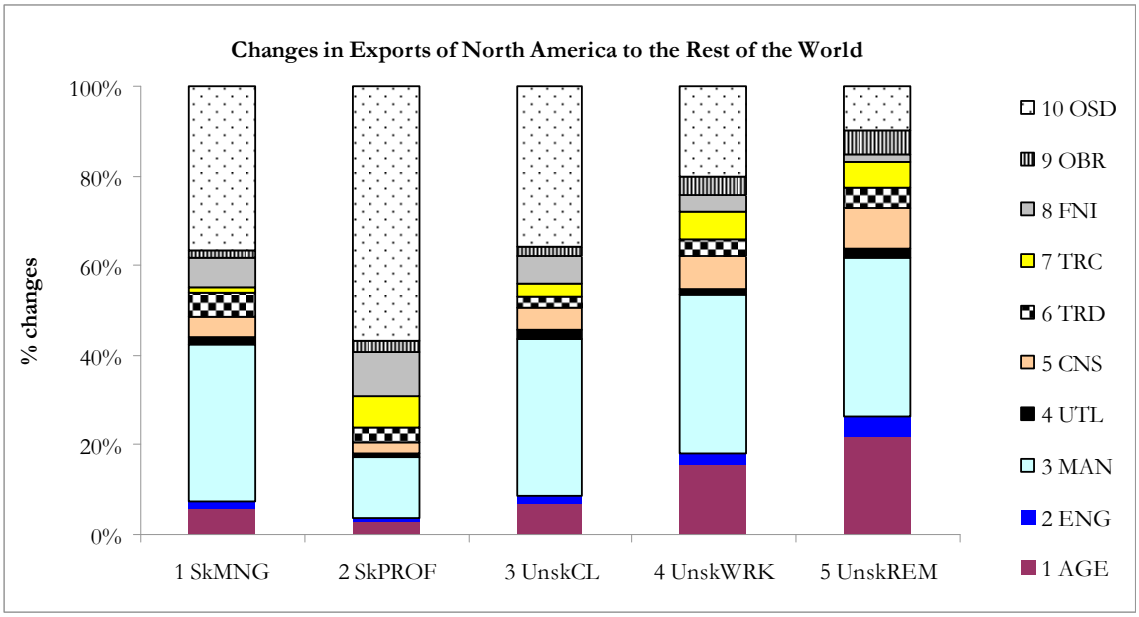


Table 6 shows changes in the market price and real returns to labor in North America. Impacts on nominal factor returns to skilled labor are slightly larger than the 1.5% increase estimated before. Disaggregating across more unskilled types it can be seen that much of the impacts are driven by the relatively smaller increase in nominal wages of unskilled remaining mostly employed in the manufacturing sector in North America. Impacts on real returns are much drastic for unskilled remaining workers. There is a steep fall in real returns by 0.26% which was not captured from earlier estimates. New evidence illustrates that unskilled remaining workers who are mostly employed in manufacturing and construction suffers substantial welfare loss, while there is no significant impact on other categories of unskilled workers. Increases in manufacturing imports from China reduce relative competitiveness of domestic sectors which negatively impacts workers, particularly in the assembly line of manufacturing production.

Table 6

Changes in Nominal and Real Returns to Factors in North America

Sectors	Nominal (%)	Real (%)
UnskCL	1.58	0.04
UnskWRK	1.56	0.03
UnskREM	1.28	-0.26
SkMNG	1.56	0.03
SkPROF	1.59	0.06

5 Next Steps and Conclusion

Using a specialized dataset that disaggregates labor across skill types in each industry, this paper provides a new perspective on impacts in North America from China's growth and openness. Real returns to low-skilled labor who are mostly employed in the manufacturing sector falls in North America. As North America imports more of manufacturing goods from China, their specialization pattern becomes more service-oriented that are less skilled-intensive. The decrease in derived demand of unskilled workers leads to a decline in real returns. Returns to other types of unskilled labor, and all categories of skilled labor, rises.

The overall impact of China's growth and liberalization is positive for North America and other industrial economies. Welfare increases in North America, EU, and Oceania by USD 22.7 billion, USD 23 billion, and USD 5.5 billion, respectively. The regional impact on low income RAS (USD 41 billion) and RAS (USD 80 billion) are also positive…..

References

Bronfenbrenner, Kate, James Burke, Stephanie Luce, Robert Hickey, Tom Juravich, Elissa Braunstein, and Jerry Epstein, (2001). "Impact of U.S.-China Trade Relations on Workers, Wages, and Employment". *U.S.-China Security Review Commission/U.S. Trade Deficit Review Commission*, Pilot Study Report.

Butcher, Kristin and David Card (1991). "Immigration and Wages: Evidence from the 1980's". *The American Economic Review*, 81 (2).

Card, David and John Dinardo (2002). "Skill-Biased Technological Change and Rising Wage Inequality". *Journal of Labor Economics*, 20 (4), 733-783.

Feenstra and Hanson (1996). "Globalization, Outsourcing, and Wage Inequality". T*he American Economic Review*, 86 (2), 240-245.

Hall, Robert, and Charles Jones (1999). "Why do some countries produce so much more output per worker than others?" *Quarterly Journal of Economics*, 114, 83–116.

Hertel, T. W., editor (1997). Global Trade Analysis, Modeling and Applications. *Cambridge University Press*.

Katz, Lawrence (1999). "Technological Change, Computerization, and the Wage Structure". *Unpublished Manuscript*. Cambridge, MA: Harvard University.

Katz, Lawrence and David Autor (1999). "Changes in the Wage Structure and Earnings Inequality". Chapter 26, *Handbook of Labor Economics*, 3 (A), 1463-1555.

Krugman, Paul and Robert Lawrence Krugman (1994). "Trade, Jobs and Wages". *Scientific American*, 270 (4), 44-9.

Lawrence, Robert (2007). "Slow Real Wage Growth and US Income Inequality: Is Trade to Blame?". *Peterson Institute for International Economics*, Working Paper.

Leamer, Edward (1996). "Wage Inequality from International Competition and Technological Change: Theory and Country Experience." T*he American Economic Review*, 86 (2), 309-314.

Mankiw, Gregory (2003). "China's Trade and U. S. Manufacturing Jobs". *Testimony before the House Committee on Ways and Means*, Washington, D.C.

Naughton, Barry and Nicholas Lardy (1996). "China's Emergence and Prospects as a Trading Nation". *Brookings Papers on Economic Activity*, 1996 (2), 273-344.

Sachs, Jeffrey, Howard Shatz, Alan Deardorff, and Robert E. Hall (1994). "Trade and Jobs in US Manufacturing". *Brookings Papers on Economic Activity*, 1994 (1), 1-84.

Wood, Adrian (1998). "Globalisation and the Rise in Labor Market Inequalities". *The Economic Journal*, 108 (450), 1463-1482.

Wood, Adrian (1995). “How Trade Hurt Unskilled Workers”. The Economic Journal, 9 (3), 57-80.

Wheeler, Christopher (2005). “Evidence on Wage Inequality, Worker Education, and Technology”. Federal Reserve Bank of St. Louis, 87 (3), 375-93.

Appendix A: Tables with mappings for sectors and countries

Table A1: Sectors according to International Standard Industrial Classification of all Economic Activities (ISIC-Rev. 3)

Tabulation category A	Agriculture, Hunting and Forestry
Tabulation category B	Fishing
Tabulation category C	Mining and Quarrying
Tabulation category D	Manufacturing
Tabulation category E	Electricity, Gas and Water Supply
Tabulation category F	Construction
Tabulation category G	Wholesale and Retail Trade; Repair of Motor Vehicles, Motorcycles and Personal and Household Goods
Tabulation category H	Hotels and Restaurants
Tabulation category I	Transport, Storage and Communications
Tabulation category J	Financial Intermediation
Tabulation category K	Real Estate, Renting and Business Activities
Tabulation category L	Public Administration and Defence; Compulsory Social Security
Tabulation category M	Education
Tabulation category N	Health and Social Work
Tabulation category O	Other Community, Social and Personal Service Activities
Tabulation category P	Private Households with Employed Persons
Tabulation category Q	Extra-Territorial Organizations and Bodies
Additional category X	Not classifiable by economic activity

Table A2 Mapping employment between China *2007 Labor statistical Yearbook* and ISIC Rev-3[11]

China	ISIC Rev-3
Farming, Forestry, Animal Husbandry and Fishery	A: Agriculture, hunting and forestry + B: Fishing
Mining and Quarrying	C: Mining and quarrying
Manufacturing	D: Manufacturing
Production and Supply of Electricity, Gas and Water	E: Electricity, gas and water supply
Construction	F: Construction
Wholesale and Retail Trade & Catering Service	G: Wholesale and retail trade; repair of motor vehicles, personal and household goods
Not available	H: Hotels and restaurants
Transport, Storage, Post and Telecommunications	I: Transport, storage and communications
Finance and Insurance	J: Financial intermediation
Real Estate Trade	K: Real estate, renting and business activities
Government agencies, Party Agencies and Social Organizations	L: Public administration and defense; social security
Education, culture and Arts, Radio, Film and Television	M: Education
Social Services + Health Care, Sporting and Social Welfare	N: Health and social work
Others	O: Other community, social and personal services

Table A3: Concordance between 10 broad GTAP sectors and 13 ISIC Rev-3 sectors

Code	Description	ISIC Rev-3 Tabulation category
AGE	Agriculture incl. Fishing	A
ENG	Mining and Quarrying	C
MAN	Manufacturing	D
UTL	Electricity, Gas and Water Supply	E
CNS	Construction	F
TRD	Trade	G
TRC	Transport, Storage and Communications	I
FNI	Financial Intermediation	J
OBR	Business services nec	H + K + O
OSD	Public admin. and defence, education, health	L + M + N

[11] The original table in the Labor statistical Yearbook also contains a numbers for Geological Prospecting & Water Conservancy and for Scientific Research and Polytechnical Services, which are not included in the mapping. The underlying numbers of the sectors in the table don't add up to the published total of more than 737 million persons. More than 100 million persons are not classified.

Table A4: Mapping educational attainment composition of employment by sector and employment in China

Table 1-49, Educational att. of employment by sector	Table 1-6, Employment
Farming, Forestry, Animal Husbandry and Fishery	Farming, Forestry, Animal Husbandry and Fishery
Mining and Quarrying	Mining and Quarrying
Manufacturing	Manufacturing
Production and Supply of Electricity, Gas and Water	Production and Supply of Electricity, Gas and Water
Construction	Construction
Wholesale and Retail Trade & Catering Service	Wholesale and Retail Trade & Catering Service
Transport, Storage, Post and Telecommunications	Transport, Storage, Post and Telecommunications
Banking	Finance and insurance
Real Estate	Real Estate Trade
Public Administration and Social Org.	Government agencies, Party Agencies and Social Organizations
Education	Education, culture and Arts, Radio, Film and Television
Public health, soc. security, social welfare	Social Services + Health Care, Sporting and Social Welfare
Public and other services	Others

Table A5: Used countries with mapping to regions and missing wage level estimations

GTAP code	descr. / sector	letter	AB	C	D	E	F	G	H	I	J	K	L	M	N	O
AUS	Australia	OCE														
NZL	New Zealand	OCE	O													
XOC	Rest of Oceania	OCE														
CHN	China	CHN						(I+K)/2	NA		(I+K)/2		(I+K)/2	(I+K)/2	(I+K)/2	(I+K)/2
HKG	Hong Kong	RAS														
JPN	Japan	RAS										J	(M+N)/2			J
KOR	Korea	RAS											(M+N)/2			
TWN	Taiwan	RAS														
XEA	Rest of East Asia	RAS														
KHM	Cambodia	RAS														
IDN	Indonesia	RAS														
LAO	Lao People's Rep.	RAS														
MYS	Malaysia	RAS														
PHL	Philippines	RAS														
SGP	Singapore	RAS														
THA	Thailand	RAS														
VNM	Viet Nam	RAS														
XSE	Rest of SE Asia	RAS														
BGD	Bangladesh	RAS														
IND	India	RAS														
PAK	Pakistan	RAS														
LKA	Sri Lanka	RAS														
XSA	Rest of South Asia	RAS														
CAN	Canada	NAM														
USA	United States	NAM														
MEX	Mexico	ROW														
XNA	Rest of N. America	NAM														
ARG	Argentina	ROW														
BOL	Bolivia	ROW	Ave	Ave	Ave											Ave
BRA	Brazil	ROW														
CHL	Chile	ROW														
COL	Colombia	ROW														
ECU	Ecuador	ROW														
PRY	Paraguay	ROW														
PER	Peru	ROW	F													
URY	Uruguay	ROW														
VEN	Venezuela	ROW														
XSM	Rest of S. America	ROW														
CRI	Costa Rica	ROW														
GTM	Guatemala	ROW														
NIC	Nicaragua	ROW						(F+I)/2	(F+I)/2							
PAN	Panama	ROW														
XCA	Rest of C. America	ROW														
XCB	Caribbean	ROW														
AUT	Austria	EU27														
BEL	Belgium	EU27														
CYP	Cyprus	EU27														
CZE	Czech Republic	EU27														
DNK	Denmark	EU27														
EST	Estonia	EU27														
FIN	Finland	EU27														
FRA	France	EU27														
DEU	Germany	EU27											O			
GRC	Greece	EU27														
HUN	Hungary	EU27														
IRL	Ireland	EU27														
ITA	Italy	EU27														
LVA	Latvia	EU27														
LTU	Lithuania	EU27														
LUX	Luxembourg	EU27														
MLT	Malta	EU27														
NLD	Netherlands	EU27														
POL	Poland	EU27														
PRT	Portugal	EU27	C										O			
SVK	Slovakia	EU27														
SVN	Slovenia	EU27														
ESP	Spain	EU27														
SWE	Sweden	EU27									K		O			
GBR	United Kingdom	EU27														
CHE	Switzerland	ROW														
NOR	Norway	ROW														
XEF	Rest of EFTA	ROW														
ALB	Albania	ROW														
BGR	Bulgaria	EU27														
BLR	Belarus	ROW														
HRV	Croatia	ROW														
ROU	Romania	EU27														

Table A5: Used countries with mapping to application regions and wage level estimations (cont.)

GTAP code, descr. / sector letter			AB	C	D	E	F	G	H	I	J	K	L	M	N	O
RUS	Russian Federation	ROW														
UKR	Ukraine	ROW														
XEE	Rest of East. Europe	ROW														
XER	Rest of Europe	ROW														
KAZ	Kazakhstan	ROW														
KGZ	Kyrgyzstan	ROW														
XSU	Rest of FSU	ROW														
ARM	Armenia	ROW														
AZE	Azerbaijan	ROW														
GEO	Georgia	ROW														
IRN	Iran	ROW														
TUR	Turkey	ROW						(F+I)/2	(F+I)/2							
XWS	Rest of Western Asia	ROW														
EGY	Egypt	ROW														
MAR	Morocco	ROW														
TUN	Tunisia	ROW														
XNF	Rest of North Africa	ROW														
NGA	Nigeria	ROW														
SEN	Senegal	ROW														
XWF	Rest of W. Africa	ROW														
XCF	Central Africa	ROW														
XAC	South Central Africa	ROW														
ETH	Ethiopia	ROW														
MDG	Madagascar	ROW														
MWI	Malawi	ROW														
MUS	Mauritius	ROW														
MOZ	Mozambique	ROW														
TZA	Tanzania	ROW														
UGA	Uganda	ROW														
ZMB	Zambia	ROW														
ZWE	Zimbabwe	ROW														
XEC	Rest of Eastern Africa	ROW														
BWA	Botswana	ROW														
ZAF	South Africa	ROW														
XSC	Rest of South Africa	ROW														

Notes:

1) Means that that labor payments of this country are used to calculate the final labor split share per sector in the corresponding region. The specification in the cells indicate that the wage level of that sector in that country is calculated using the value(s) of the indicated other sectors.

2) The meaning of the codes in the third column can be found in table ..... The letters in the first row refer to ISIC Rev-3 code (see table A1)