A Cross-country Database For Sectoral Employment And Productivity in Asia and Latin America, 1950-2005

Timmer, Marcel P.; Vries, Gaaitzen J. de

University of Groningen

Groningen Growth and Development Centre

RuG

A Cross-country Database For Sectoral Employment And Productivity In Asia and Latin America, 1950-2005

Research Memorandum GD-98

Marcel P. Timmer and Gaaitzen J. de Vries

RESEARCH MEMORANDUM

A Cross-country Database For Sectoral Employment And Productivity In Asia and Latin America, 1950-2005.

Research Memorandum GD-98

Marcel P. Timmer and Gaaitzen J. de Vries

Groningen Growth and Development Centre

August 2007

A Cross-Country Database For Sectoral Employment And Productivity In Asia And Latin America, 1950-2005

by Marcel P. Timmer and Gaaitzen J. de Vries [*]

Groningen Growth and Development Centre,
University of Groningen

August 2007

Abstract

This paper presents a new panel data set with annual time series of value added and persons employed for ten sectors of the economy. The database allows for consistent comparisons of output, employment and productivity trends in developing countries in Asia and Latin America during the period 1950-2005. It is based on an in-depth country-by-country study of available statistics to ensure consistency over time, across countries and across variables. Compared to the World Bank World Development Indicators, it offers more sectoral detail in the services sector, and longer and consistent time-series, in particular for employment. The new data set can be useful for a wide range of studies into the patterns and determinants of economic growth. In an illustrative analysis we identify accelerations and decelerations in economic growth and perform a sectoral decomposition analysis. We find that accelerations in aggregate growth are mainly explained by productivity increases within sectors, not by reallocation of employment to more productive sectors. Challenging conventional wisdom, productivity improvements in market services appear to be more important than productivity growth in manufacturing.

Keywords*:* cross-country database, growth, productivity, sectoral reallocation

JEL Classification: O11, O14, O47

[*] Marcel Timmer (corresponding author) is Associate Professor at the Groningen Growth and Development Centre at the University of Groningen; his e-mail address is m.p.timmer@rug.nl. Gaaitzen de Vries is Researcher at the Groningen Growth and Development Centre at the University of Groningen; his e-mail address is g.j.de.vries@rug.nl. We would like to thank Bart van Ark, Dirk Bezemer, and Ewout Frankema for comments, and André A. Hofman, Erik Monnikhof, and Nanno Mulder for their work on an earlier version of the data set.

Cross-country studies of growth have moved from explaining average trends in long-term growth between countries to study the determinants of growth accelerations and growth collapses within countries. This new literature arose out of the observation that GDP per capita in most developing countries does not follow a single time trend, but is highly unstable over time (Pritchett, 2000). In a parallel development, empirical growth researchers and growth theorists have rediscovered the importance of sectoral development patterns, resuming the long tradition set out by Clark, Kaldor and Kuznets which reached a "plateau" after the work by Chenery and associates (Chenery et al. 1986). In this work changes in the sectoral composition of production and employment and their interaction with the pattern of productivity growth feature prominently.[1] An important example is the study by Temple and Woessmann (2006) of the significance of structural change in generating growth by the reallocation of labor towards sectors with higher marginal productivity.[2] Linked to this is a renewed interest in the development patterns of particular sectors such as agriculture (Gollin et al., 2002; World Bank 2007) and manufacturing (Imbs and Wacziarg, 2003; Jones and Olken, 2005).

Unfortunately, these new lines of research are hampered by the unavailability of a longitudinal sectoral database for developing economies. Various international organizations such as the World Bank, the United Nations and the Asian Development Bank collect sectoral data and make it publicly available, but series are often short (starting only in the 1980s or 90s), not consistent over time and across countries, and have little sectoral detail. A particular example of inconsistency is the fact that according to the WDI, in 1990 the share of agricultural workers in Argentina, Bolivia, Columbia and Peru is less than 2 percent of the total labor force. This is not so surprising once one discovers that these estimates are based on surveys of urban areas only. For Colombia this share is suddenly jumping to 22 percent in 2001 which can be attributed to a shift in the underlying survey used (now covering both urban and rural areas). In this paper we fill the current data gap by presenting consistent and long-run time series of sectoral data on value added (at constant and current prices) and persons employed for a set of nineteen developing economies in Asia and Latin America. In particular this database includes ten sectors of each economy and allows for a distinction between agriculture, manufacturing, other non-manufacturing industries, market services and non-market services. It covers a period over more than 5 decades, from 1950 to 2005. This so-called *GGDC 10-sector database* provides sectoral detail to the long-run macro data in Maddison (2003). And it is a complement to a sectoral database for OECD countries that is available through the EU KLEMS project (www.euklems.net, see Timmer et al. 2007) and a previous study by van Ark (1996).[3] Data and detailed documentation of sources and methods of the *GGDC 10-sector database* are publicly available through http://www.ggdc.net/dseries/10-sector.html.

In building the database, we draw on a wide array of national statistical sources. Section I describes data contents, selection criteria and sources of the database. In section II, the *GGDC 10-sector database* is compared with the World Bank *World Development Indicators* (WDI) which is the most comprehensive international database including sectoral output and employment series. In that section, we make both level and growth comparisons using simple time-series statistics. The comparison uncovers several inconsistencies in the series from WDI, in particular concerning employment. The attractiveness of the GGDC 10-sector database is illustrated by a study of sectoral

[1] See Chenery et al (1986) for a description of the much wider notion of "structural transformation", including changes in structure of demand, trade and intermediate inputs.
[2] See also Ngai and Pissarides (2007) for multi-sector growth models.
[3] See www.ggdc.net for other databases and www.euklems.net for the EU KLEMS database described in Timmer et al. (2007).

contributions to long-run economic growth. Following Hausmann et al. (2005), section III decomposes accelerations and decelerations in growth (measured as GDP per worker). A change in aggregate productivity could come from the reallocation of resources to more productive sectors, or alternatively, by increases of productivity within sectors. Our findings indicate that growth accelerations in developing countries are largely explained by productivity increases within sectors (for 80% on average). Market services and manufacturing are the main contributors to aggregate productivity accelerations. But contrary to conventional wisdom, market services contribute more to growth accelerations and growth decelerations than manufacturing.

1. The GGDC 10-Sector Database

In this section we present the *GGDC 10-sector database.* The database is constructed on the basis of an in-depth study of available statistical sources on a country-by-country basis. We discuss the contents of the database, the selection procedure of the sources, and the methods used to ensure intertemporal, international and internal consistency. Compliance with consistency requirements is important to ensure the usefulness of the database in long-term analyses of growth and productivity.

1.1 Contents

Below, Table 1 gives an overview of the contents of the *GGDC 10-sector database*. The data set consists of ten Asian countries and nine Latin American countries. It includes annual data on gross value added at both current and constant prices from 1950 to 2005. It also includes data on persons employed, which allows the derivation of labor productivity (value added per worker) trends. The database covers the ten main sectors of the economy as defined in the International Standard Industrial Classification, Revision 2 (ISIC rev. 2). Together these ten sectors cover the total economy. Data and detailed documentation of sources and methods are publicly available through http://www.ggdc.net/dseries/10-sector.html.

1.2 Construction of variables

Gross value added in current and constant prices is taken from the National Accounts of the various countries. As these have all been compiled according to the UN System of National Accounts, international comparability is high, in principle (ISWGNA, 1993). However, national statistical institutes (NSIs) frequently change their methodologies. In the National Accounts, GDP series are periodically revised which includes changes in the coverage of activities (for example after a full economic census has been carried out and "new" activities have been discovered), changes in the methods of calculation (for example the inclusion of software expenditures as investment rather than intermediate consumption), and changes in base year of the prices used for calculating volume growth rates.[4] For sectoral GDP our general approach is to start with GDP levels for the most recent available benchmark year, expressed in that year's prices, from the National Accounts provided by the National Statistical Institute or Central Bank. Historical national accounts series were subsequently linked to

[4] In most developing countries a fixed-base Laspeyres volume index is used and this base is usually updated every 5 or 10 years.

Table 1 Coverage of GGDC 10-sector database

Asian countries	Hong Kong (China), India, Indonesia, Japan, Korea (Rep. of), Malaysia, Philippines, Singapore, Taiwan, Thailand
Latin American countries	Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Venezuela (Rep. Bol.)
Sectors (ISIC rev. 2)	
1)	Agriculture, hunting, forestry and fishing
2)	Mining and quarrying
3)	Manufacturing
4)	Electricity, gas and water
5)	Construction
6)	Wholesale and retail trade, hotels and restaurants
7)	Transport, storage and communication
8)	Finance, insurance, real estate and business services
9)	Community, social and personal services
10)	Government services
Time Period (annual)	1950-2005
Variables	Gross value added at constant prices Gross value added at current prices Persons employed
Principal Sources	National Accounts Population Censuses Business Surveys Labor Force Surveys
Available at:	http://www.ggdc.net/dseries/10-sector.html

this benchmark year.[5] This linking procedure ensures that growth rates of individual series are retained although absolute levels are adjusted according to the most recent information and methods. Employment in our data set is defined as 'all persons employed', thus including all paid employees, but also self-employed and family workers.[6] Labor input is normally not available from a country's national accounts as they are not part of the System of National Accounts.[7] Two different primary sources of employment exist, namely labor force surveys (LFS) with data collected at the household level, and business surveys which are based on firm-level questionnaires. Both have their advantages and disadvantages as a source for annual sectoral employment trends.

The LFS is a comprehensive and well-established source with substantive international harmonization of concepts as it uses definitions set out by the International Labor Organization (ILO), although sampling size and techniques may still differ substantially between countries. They cover employees as well as self-employed and family-labor. The main problem of labor force surveys is the

[5] Because of the application of fixed-base Laspeyres volume indexes by most statistical offices, linked sectoral GDP does not add up to total GDP for earlier periods.
[6] Ideally, hours worked should be collected as well, but this data is irregular and sparse and only covers the formal sector.

limited consistency with output data from the national accounts, especially at the sectoral level due the relatively small sample size. In addition, the sample is sometimes restricted to particular regional areas, such as urban areas.

Information from business surveys is often more consistent with value added measures in the national accounts, as output series for the national accounts are also based on this source. However, while the coverage by business surveys is reasonably accurate for goods producing industries, it is not always for services. Moreover business surveys typically only cover firms who surpass a certain threshold (for example, >20 employees or above a certain turnover level). This excludes smaller firms, which are especially abundant in developing countries. Another limitation is that data on self-employed and unpaid family members are usually not collected. This is problematic for sectors like agriculture and informal parts of the economy, where these categories make up a significant share of total employment. Business surveys are therefore not well suited to provide employment statistics by sector which covers the total economy.

Therefore we often use an alternative source based on household questionnaires but with a much larger coverage than the samples of the LFS: the population census. This ensures full coverage of the working population and a much more reliable sectoral breakdown than from the LFS.[8] However, typically population censuses are quinquennial or decennial and cannot be used to derive annual trends. Therefore we use the population census to indicate absolute levels of employment, and use LFS and business surveys to indicate trends in between. This is the general strategy followed for most countries, but not all. The data appendix provides a detailed discussion of the construction of the employment and value added series on a country-by-country basis.

1.3 Consistency

In constructing the database, we paid careful attention to three checks on consistency, namely intertemporal consistency, international consistency, and internal consistency. Our time series of gross value added and employment are consistent over time (that is, *intertemporal consistent*). Through our linking procedure as described above, major breaks in the series have been repaired. *International consistency* of the cross-country sectoral data is ensured through the system of national accounts for value added, the employment concept of persons engaged and the use of a harmonized sectoral classification. We classify activities into ten sectors, using the International Standard Industrial Classification (ISIC), Revision 2. The industrial classification used in the national primary data sources is based on this classification or is directly related to it.

Finally, for the derivation of meaningful productivity measures, the labor input and output measures should cover the same activities (that is, being *internally consistent*). As we use persons employed as our employment concept rather than employees, and base our employment numbers on large-scale surveys, overlap in coverage of the employment statistics and value added from the National Accounts is maximized. However, a notable exception is the own-account production of housing services by owner-occupiers. For this an imputation of rent is made and added to GDP in

[7] Most OECD countries nowadays provide sectoral employment figures alongside GDP in the national accounts but this practice has not been adopted by less-developed countries.

[8] Official population censuses data for 1950, 1960 and 1970 appear to be unreliable in Latin America. In order to remedy this problem we used the harmonized population census results published by PREALC (1982). This study makes adjustments in order for the population censuses to be reliable and comparable within and between countries (for example correcting for age limitations, reference periods, ISIC revisions, workers entering the labor market, unspecified workers and on the underestimation of agricultural workers).

many countries, according to the System of National Accounts. This imputed production does not have an employment equivalent and should preferably not be included in output for the purposes of labor productivity comparisons.[9] Therefore, the *GGDC 10-sector database* presents separate series for imputed rents. In the comparison of the new database with the World Development Indicators (section II), and in our illustrative analysis in section III we excluded imputed rents.

2. Comparison With World Development Indicators 2006

The World Bank *World Development Indicators* (WDI) and the Asian Development Bank *Key indicators* provide data on both value added and persons employed at a sectoral level. A third international source, the United Nations *National Account Statistics*, provide sectoral data on value added but not employment. Since the ADB *Key Indicators* data only cover Asian countries and is far from complete, we focus on a comparison of the *GGDC 10-sector database* with the WDI 2006 in this section.[10]

The World Development Indicators provide time series of value added for four main sectors (agriculture, manufacturing, other industry, and services) of the economy, and time series of persons employed for three sectors of the economy (agriculture, industry, and services). Thus, WDI has less sectoral detail as compared with the *GGDC 10-sector database*, in particular in the services sector which typically covers more than halve of the labor force. Value added in the WDI is derived from national accounts data. Consequently the WDI and GGDC series are highly correlated.[11]

The high correlation between WDI and the *GGDC 10-sector database* does not hold for series of persons employed. Sectoral employment in WDI 2006 is strikingly different from the new data set. Persons employed in the WDI are obtained from ILO *Key Indicators of the Labor Market* (Fourth edition). We meticulously traced the WDI sectoral employment series back to national sources through the ILO documentation. We find that in some cases basic national sources have been mixed. In addition, some basic sources contain breaks due to changes in methodology or coverage. These breaks are flagged in the original ILO tables but have been inserted into WDI without adequate warning or smoothing. As a result, the WDI series lack intertemporal and international consistency.

Table 2 compares employment data from the WDI and the *GGDC 10-sector database* for the year 1990 as an example. Differences in the sectoral employment shares are given in the last three columns. These differ greatly, especially for Latin-America. For a number of Latin American economies WDI is based on labor force surveys that cover urban agglomerations only. Urban labor force surveys are not representative of the sectoral employment structure in an economy. A particularly striking example is the extremely low employment share in agriculture in 1990 in Argentina, Bolivia, Colombia, and Peru according to WDI 2006 (less than 2 percent). Based on

[9] Typically, imputed rents are included in the output of the financial and business services sector and frequently increase output in this sector by 50 percent or more without any labor input equivalent. Worse, this percentage varies over time and across countries.

[10] The data base presented in the ADB Key Indicators provides less sectoral detail and shorter time series (only 18 years). In addition, it contains some unresolved breaks, and has an incomplete coverage of employment. For example, in 1993 both India and Indonesia switched to a different base year in their national accounts and these series are not linked in the ADB database.

[11] Value added series in WDI go back to 1965 and contain only few unusual breaks. Series of value added in WDI 2006 for agriculture in Colombia and Korea are negatively correlated with ours, and we find a low

population censuses, the *GGDC 10-sector database* estimates the 1990 agricultural employment share at more plausible levels: for Argentina at 11 percent, Bolivia at 43 percent, Colombia at 30 percent, and Peru at 31 percent.[12].

Table 2 Share of Sectoral Persons Employed (in percentages) for 1990 according to WDI 2006 and the *GGDC 10-sector database*

	WDI			*GGDC 10-sector database*			Difference (WDI –*GGDC 10-sector database*)		
	Agr	Ind	Serv	Agr	Ind	Serv	Agr	Ind	Serv
Argentina (a)	0	33	66	11	26	62	-11	7	4
Bolivia	1	25	73	43	15	41	-42	10	32
Brazil	23	23	55	25	23	51	-3	-1	3
Chile	19	25	56	18	28	54	1	-3	2
Colombia	1	31	68	30	20	50	-29	11	18
Costa Rica	26	26	48	29	28	43	-3	-2	4
Mexico	23	28	40	23	29	48	-1	-1	-8
Peru	1	27	72	31	18	51	-30	10	20
Venezuela	13	25	61	13	25	62	0	0	0
Hong Kong	1	37	62	1	37	62	0	0	0
India	69	14	17	67	13	21	2	1	-3
Indonesia	56	14	30	50	17	33	6	-3	-3
Japan	7	34	58	9	34	57	-2	0	1
Korea, Rep.	18	35	47	18	35	47	0	0	0
Malaysia	26	28	47	26	28	46	0	0	0
Philippines	45	15	40	44	15	41	1	0	-1
Singapore (a)	0	35	64	1	37	62	0	-2	2
Taiwan	na	na	na	13	41	46	na	na	na
Thailand	64	14	23	59	16	25	5	-2	2

Note: data refers to 1990, except for (a) Argentina 1991 and Singapore 1991, because of missing data in WDI 2006. Agr(iculture), Ind(ustry), Serv(ices). Employment shares might not add up to 100 due to rounding, and (only for Mexico in WDI) because of workers who cannot be classified by economic activity.
Source: WDI from WDI 2006 series "Employment in Agriculture (percentage of total employment)", "Employment in Industry (percentage of total employment)", and "Employment in Services (percentage of total employment)". Share of persons employed for *GGDC 10-sector database* are authors own calculations.

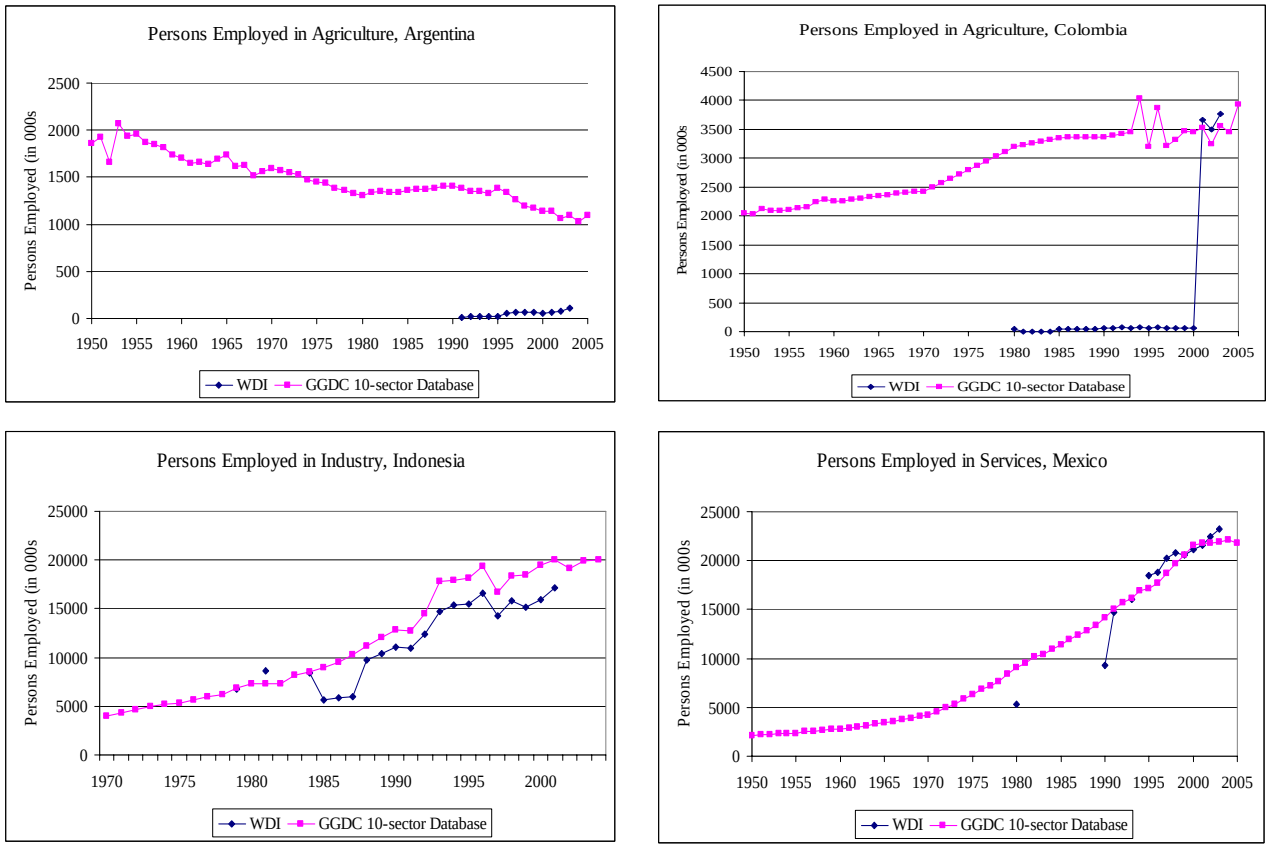
Next, figure 1 compares time series of persons employed for a selection of countries during 1950-2005. Two things are noticeable. First, annual employment time series in WDI contain gaps so no period average can be calculated. Second, striking differences in the numbers of persons employed can be found, not only for agriculture which might be expected given the findings of Table 2, but also for industry and services. In Argentina, WDI underreports the number of persons employed in agriculture because an urban labor force survey is used. In Colombia, the number of persons employed in agriculture is underreported until 2001. From 2001 onwards, persons employed in WDI suddenly jumps as the coverage of the labor force survey expanded its coverage from 7 cities to the

correlation for Japan and Bolivia between WDI 2006 time series and our series. The GGDC series correlate highly with the series from the UN National Accounts Main Database.

[12] But other reasons for differences exist as well. For example, the WDI employment figure for agriculture in Thailand is based on a labor force survey held in August and hence prone to seasonal fluctuations in the agricultural labor force. In the GGDC database an adjustment is made for seasonal fluctuations by also including data from the August round of the survey. Also note that employment shares in WDI do not always add up to 100% because of workers who cannot be classified by economic activity are not allocated (e.g. Mexico in Table 2).

total economy. In Indonesia, time series are more comparable although a break in de series is present from 1986 to 1988. During that period, the source data of WDI excludes mining, public utilities, and construction from the industry sector. From 1989 onwards it is again included. In Mexico several observations are missing in WDI and between 1990 and 1991 a sudden break takes place. From 1991 onwards persons employed in WDI becomes much more comparable with the estimates in the *GGDC 10-sector Database*. Appendix table 1 presents further comparisons of growth rates in persons employed.

Figure 1. Persons Employed, selected countries



Source: WDI 2006 and GGDC 10-Sector Database

3. Sectoral Origins of Accelerations and Decelerations in Economic Growth

In this section, we illustrate the usefulness of the *GGDC 10-sector database* by an analysis of the sectoral origins of long-run accelerations and decelerations in aggregate GDP per worker. Recently, various authors have studied sources of growth accelerations and decelerations that occur in countries over time.[13] Using growth accounting techniques, Jones and Olken (2005) conclude that factor accumulation and utilization explain no more than one-third of the total change in growth accelerations and growth decelerations in a large country sample. This leaves productivity growth as

the primary explanation of changes in growth. Aggregate productivity growth comes from resource reallocation from less to more productive industries or from productivity improvements within industries. Jones and Olken (2005) find large moves of labor into manufacturing during high-growth episodes and large moves out of manufacturing during growth decelerations. These findings suggest that changes in the allocation of resources lie behind changes in aggregate growth. But due to lacking sectoral data, they were unable to test this hypothesis.

With the *GGDC 10-sector database*, we are able to test whether changes in the allocation of resources lie behind growth accelerations and decelerations in Asia and Latin America as suggested by Jones and Olken (2005). We first employ a filter introduced by Hausmann et al. (2005) to determine accelerations and decelerations, and next perform a shift-share analysis following Chenery, Robinson, and Syrquin (1986). The shift-share analysis decomposes growth in GDP per worker into improvements within industries and improvements in the reallocation of labor across industries.

We employ a filter introduced by Hausmann et al. (2005) to select accelerations and decelerations in GDP per worker. The functioning of this filter is explained in Appendix 2. It selects growth accelerations as periods where growth is high and more than 3 percent above previous-period growth. In a similar manner, decelerations are selected using the filter. Our results indicate that the number of accelerations and decelerations in GDP per worker is large (see appendix table 2). In total, Asian and Latin American countries experienced 28 accelerations in GDP per worker and 19 decelerations from 1950 to 2005. That finding, as well as the initiations of growth accelerations across countries is similar to Hausmann et al. (2005).

Aggregate productivity growth can occur within sectors or result from sectoral employment reallocation. Their relative importance can be fairly easily assessed by decomposing growth using a shift-share analysis following Chenery et al. (1986). [14] The traditional shift-share analysis (Chenery et al. 1986) is given by:

$$P^T - P^0 = \sum_{i=1}^{n} (P_i^T - P_i^0).\bar{S}_i + \sum_{i=1}^{n} (S_i^T - S_i^0).\overline{P}_i \qquad (1)$$

With P being labor productivity, S_i sectoral employment shares in the i-th sector (1,…,10), T indicating the end of a period, 0 the beginning of a period, and a bar indicating period average. The first term on the right hand side measures the contribution of within-sector productivity growth (intra effect). The second term on the right hand side measures the contribution of sectoral reallocation of employment to aggregate productivity growth (shift effect).

Although this traditional decomposition is useful for indicating the importance of sectoral reallocations for aggregate growth, it is not insightful for determining the contributions of individual sectors. But to test the relative importance of various sectors for aggregate growth, as suggested by Jones and Olken (2005), sectoral contributions are needed. In the traditional procedure, all expanding sectors contribute to aggregate growth, even when they have below-average productivity levels. But if labor is moving to a less productive industry (e.g. from manufacturing to personal services), this

[13] See e.g. Pritchett (2000), Hausmann et al. (2005) and Jones and Olken (2005).

[14] A more dynamic analysis would recognize the endogeneity of structural change, induced by many factors including productivity growth within sectors, demand elasticities, trade patterns, and changes in world prices (see also Temple and Woessmann 2006). Our aim in this section is to measure the direct contribution of sectors and we do not make claims about causality.

should show up as a negative contribution from the expansion of the less-productive sector. To this end, we divide sectors into expanding and shrinking and calculate the shift effect relative to the average productivity level of the shrinking sectors.[15] The decomposition in (1) is modified as follows:

$$P^T - P^0 = \sum_{i \varepsilon K,J} (P_i^T - P_i^0).\bar{S}_i + \sum_{i \varepsilon K} (S_i^T - S_i^0).(\overline{P}_i - \overline{P}_J) \qquad (2)$$

with average labor productivity in shrinking sectors $\overline{P_J} = \frac{\sum_{i \in J} (S_i^T - S_i^0)\overline{P_i}}{\sum_{i \in J} (S_i^T - S_i^0)}$, K the set of expanding sectors and J the set of shrinking sectors.

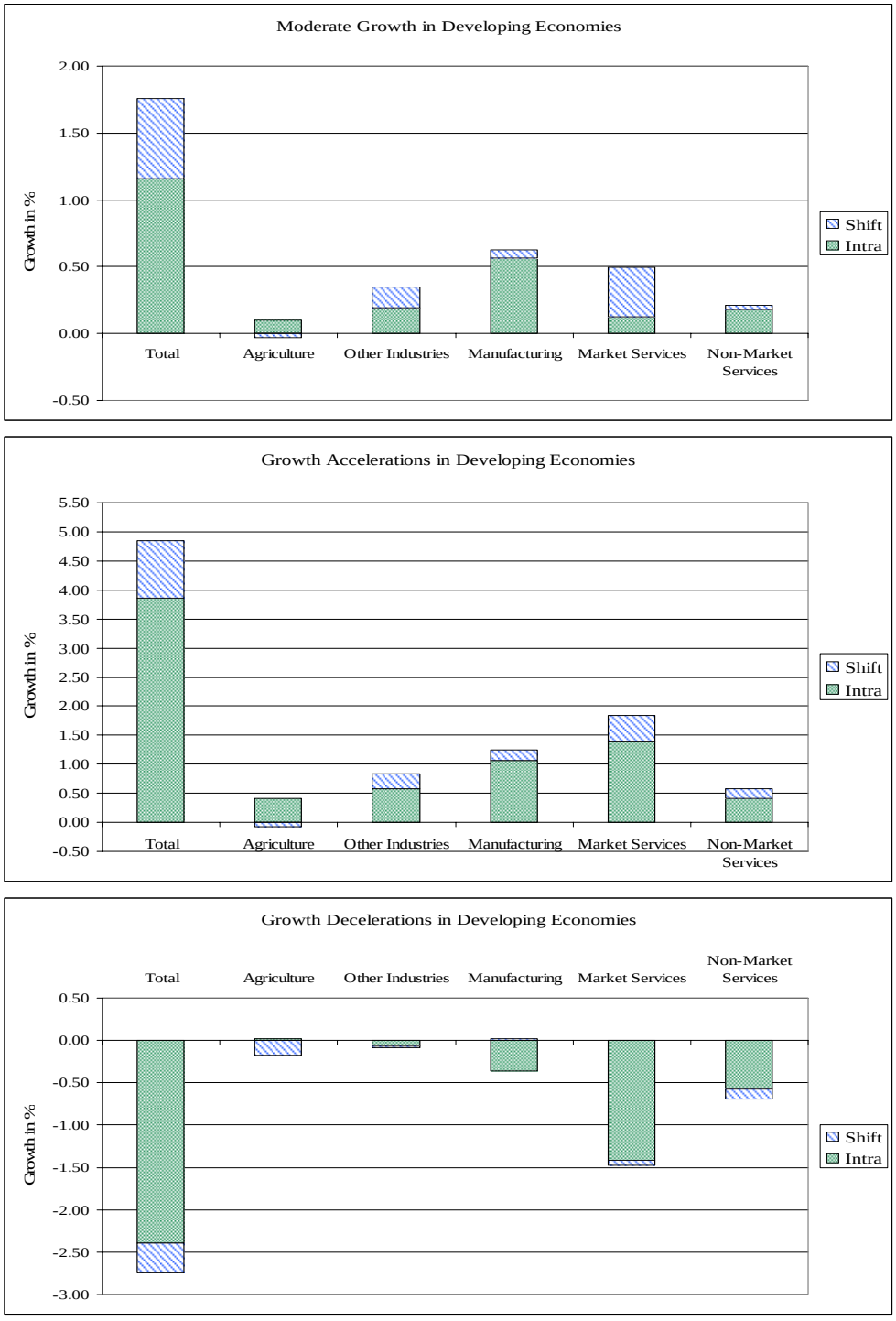
Growth accelerations and decelerations are decomposed into sectoral contributions using expression (2).[16] For the decomposition we used all sectoral detail present in the *GGDC 10-sector database*, but in the results displayed below we aggregated up (after performing the shift-share analysis) to five sectors in order for the analysis to remain tractable.[17] In Figure 2 we present the contribution of each sector to aggregate growth averaged across our nineteen countries.

Our benchmark case is periods of moderate aggregate growth. Moderate growth reflects "normal" growth in GDP per worker, typically between 0 and 3 percent. In our data set, the average growth for such periods in developing countries is 1.8 percent. The top panel of figure 2 presents average results from the shift-share decomposition for moderate growth periods. The figure reads as follows. Aggregate productivity growth in the total economy is given by the first column. This is divided into two parts: the change in GDP per worker due to productivity changes within sectors (intra), and the change in employment share of sectors (shift). The next columns indicate the percentage contribution of the five sectors to aggregate growth again divided into an intra- and a shift-effect. The shift-effect of each sector adds up to the total shift-effect, and similarly for intra-effects.

Several results are noticeable from the top panel. First, moderate growth is for two-third "explained" by increases of productivity within sectors (the intra-effect). One-third of growth originates from the expansion of more productive sectors (shift-effect). Second, manufacturing is the main contributor to growth, but underlying the contribution of manufacturing is not so much its expansion but rather the productivity improvements within manufacturing. In contrast, the expansion of market services in employment terms is principally responsible for the positive shift-effect as market services expanded considerably and have higher productivity levels than the rest of the economy.[18]

[15] See van Ark and Timmer (2003) for a more elaborate discussion.
[16] A full set of decompositions is found in appendix table 3.
[17] "Other industries" include mining, public utilities, and construction. "Market services" include wholesale and retail trade, transport and communication and financial services. "Non-market services" include community, social and personal services and government services. Note that some activities in non-market services are nevertheless traded through markets. For example many personal services, but also private education and health services should be part of "market services". However, our data is not detailed enough to distinguish market from non-market in these sectors. They are relatively small compared to the non-market part of this sector, although this will differ across countries and over time.
[18] This result is not due to use of a fixed base volume index. We rebased sectoral series each period and used mid-year prices for each period to minimize this problem. Unfortunately, rebasing periods is not possible for countries that experienced hyperinflation. In these instances, we aimed at mid-year base prices during the total time period covered (i.e. 1980 prices).

Figure 2 Shift-Share decomposition of growth periods



Notes: Figures shown are averages of growth regimes in countries. Source: Authors own calculations based upon *GGDC 10-sector database*.

During growth accelerations (second panel of figure 2), the within-sector contribution (intra) to growth increases. Average growth in GDP per worker during accelerations is 4.8 percent annually, which is for about 80 percent explained by within-sector contributions, and for the remaining 20 percent by the expansion of more productive sectors. Hence, when growth accelerates the contribution from sectoral employment reallocation decreases in importance. In part, increasing sectoral

productivity might be due to increased capacity utilization, but given the longevity of many growth accelerations (14 years on average) it is more likely that this improvement is structural. Periods of acceleration are characterized by successful catching-up through imitation and transfers of technology from more advanced countries, which stimulates productivity growth within sectors.

On average across all countries, improvements in agricultural productivity appear to have contributed little to accelerations in aggregate GDP per worker as indicated by the modest intra-effect. However, looking at the country-specific contributions in appendix table 3, it follows that for two highly successful countries (South-Korea and Taiwan), a dynamic agricultural sector has been important for high growth, especially in South-Korea.[19]

Perhaps surprisingly, the main contributor to rapid increases in GDP per worker is market services and not manufacturing. Market services contribute approximately 38 percent of aggregate growth per worker, whereas manufacturing accounts for only 26 percent. Hence, productivity improvements in market services are more important than productivity increases in manufacturing during growth accelerations.

A growth deceleration is associated with a dominant intra effect (bottom panel of figure 2). Market services are the main contributor to decelerations in GDP per worker, accounting for 54 percent of the decrease, mainly through a decline in productivity growth. As decelerations last shorter than upturns (8 years on average), the strong intra effect is likely due in part to large adjustment costs that reduce efficiency, rather than a secular decline. In addition, it is often acknowledged that during downturns displaced workers from manufacturing find new jobs in agriculture and services (Jones and Olken 2005). Our results indeed show that the expansion of agriculture and market services led to a negative shift effect. Nevertheless, this shift effect is small and explains only 13 percent of the decrease in GDP per worker.

4. Concluding remarks

This paper presents the *GGDC 10-sector database*. This is a new panel data set with long-run time series of value added, output deflators, and persons employed based on national statistical sources. It covers nineteen developing economies in Asia and Latin America for the period from 1950 to 2005 and ten sectors of each economy. We compare the *GGDC 10-sector database* with the World Development Indicators 2006 (WDI). Our comparison suggests several inconsistencies in the employment data of the WDI which are corrected for in the *GGDC 10-sector database*. Still, major statistical problems remain. Productivity in agriculture in poor countries might be biased downward by systematic over-measurement of the labor input. Farm households are often engaged in both agricultural and non-agricultural activities. As we measure labor input in persons engaged, rather than hours, time devoted to each activity is not measured. Even more so, while agricultural labor input might be overestimated, output might be underestimated due to poor coverage of home-production destined for own-consumption.[20] Also there are well-known output measurement problems for various market services industries, in particular finance and business services. And in many non-market

[19] However, this finding should be taken with caution, as part of the labor productivity growth in agriculture has been achieved by shedding of marginal workers. Disguised unemployment in this sector was particularly high in the 1960s.

[20] See e.g. Parente, Rogerson and Wright (2000) and Schmitt (1989).

services, output volumes are measured by an index of inputs, leading to zero productivity growth by construction (see e.g. Griliches, 1992).

In demonstrating the usefulness of the database, we decompose GDP per worker in developing economies during growth accelerations and decelerations. Our findings indicate that growth accelerations are largely explained by productivity increases within sectors. Market services and manufacturing are major contributors during accelerations, and market services appear to be the most important source. This challenges common wisdom regarding the lack of productivity growth in the services sector. Nevertheless, given the output measurement problems in services, this result should be considered with care. At a minimum, our results indicate that market services play a more dynamic role in economic growth than hitherto acknowledged and these industries deserve more attention in studies of the sectoral origins of aggregate growth. We believe that the GGDC 10-sector database for developing countries introduced in this paper, and its complementary databases for advanced economies at the GGDC-website, provide a useful starting point in this type of analyses.

References

Ark, H.H. van (1996), "Sectoral Growth Accounting and Structural Change in Post-War Europe", in B. van Ark and N.F.R. Crafts, eds., *Quantitative Aspects of Post-War European Economic Growth*. CEPR/Cambridge University Press, pp. 84-164.

Ark, H.H. van, and M.P. Timmer (2003), "*Asia's Productivity Performance and Potential: the Contribution of Sectors and Structural Change*." Available at http://www.eco.rug.nl/~ark/pdf/Asia%20paper4.pdf

Chenery, H., Robinson, S., and Syrquin, M. (1986), *Industrialization and Growth, a Comparative Study*. Oxford University Press.

Easterly, W., Kremer, M., Pritchett, L., Summers, L.H. (1993), "Good policy or good luck? Country growth performance and temporary shocks." *Journal of Monetary Economics*, vol. 32, pp. 459-83.

Gollin, D., S. Parente, R. Rogerson (2002), "The Role of Agriculture in Development," *American Economic Review Papers and Proceedings*, vol. 92(2) May 2002: 160-164.

Griliches, Z. (1992), *Output Measurement in the Service Sectors*, (ed.), NBER, Studies in Income and Wealth, Volume 56, Chicago: University of Chicago Press.

Hausmann, R., Pritchett, L., Rodrik, D. (2005), Growth Accelerations, *Journal of Economic Growth*, vol. 10, pp. 303-329.

Imbs, J. and R. Wacziarg (2003), "Stages of Diversification" *American Economic Review*, vol. 93(1).

ISWGNA (1993) System of National Accounts (Brussels/Luxembourg, New York, Paris, Washington: D.C Comission of the European Communities-Eurostat, International Monetary Fund, OECD, United Nations).

Jones, B.F., and Olken, B.A. (2005), The Anatomy of Start-Stop Growth, *NBER Working Paper #11528*, National Bureau of Economic Research. Forthcoming in *the Review of Economics and Statistics*.

Maddison, A. (2003), "The World Economy: A Millennial Perspective. OECD Development Centre, Paris.

Ngai, L. R. and Pissarides, C. (2007), "Structural change in a multisector model of growth", *American Economic Review*, 97 (1). pp. 429-443.

Parente, S.L., R. Rogerson and R. Wright (2000), "Homework in Development Economics: Household Production and the Wealth of Nations," *Journal of Political Economy*, University of Chicago Press, vol. 108(4), pages 680-687, August.

PREALC (1982), *Mercado de Trabajo en Cifras*, ILO. PREALC.

Pritchett, L. (2000), Understanding Patterns of Economic Growth: Searching for Hills among Plateaus, Mountains and Plains, *The World Bank Economic Review*, vol. 14 (2), pp. 221-250.

Schmitt, G. (1989), "Simon Kuznets' "Sectoral Shares in Labor Force": A Different Explanation of His (I + S)/A Ratio," *The American Economic Review*, Vol. 79 (5), pp. 1262-1276.

Temple, J. and L. Woessmann (2006), "Dualism and cross-country growth regressions," *Journal of Economic Growth*, vol. 11 pp. 187-228.

Timmer, M.P., M. O'Mahony and B. van Ark (2007) The EU KLEMS Growth and Productivity Accounts: An Overview, mimeo, University of Groningen & University of Birmingham, March 2007, downloadable at www.euklems.net.

World Bank (2006), World Development Indicators 2006.

World Bank (2007), *World Development Report 2008: Agriculture for Development*.

Appendices

Appendix table 1 Growth rates persons employed during 1980-2003 (annual average, in %)

	WDI			*GGDC 10-sector database*,			Difference (WDI – *GGDC 10-sector database*)		
	Agr	Ind	Serv	Agr	Ind	Serv	Agr	Ind	Serv
Argentina	na	na	na	-0.8	-1.7	2.2	na	na	na
Bolivia	na	na	na	0.6	3.7	4.5	na	na	na
Brazil	na	na	na	-0.9	1.1	4.0	na	na	na
Chile	1.5	2.3	2.5	0.2	2.0	4.1	1.3	0.3	-1.6
Colombia	15.7	1.3	3.4	0.5	2.1	3.4	15.2	-0.8	0.0
Costa Rica	0.9	3.2	4.6	0.7	2.8	4.5	0.2	0.4	0.1
Mexico	1	3.9	6.9	0.3	2.4	3.8	0.7	1.5	3.1
Peru	na	na	na	1.3	0.8	3.0	na	na	na
Venezuela	2.3	2.3	4.6	1.9	1.0	3.4	0.4	1.3	1.2
Hong Kong	-6.8	-3	4	-8.0	-3.1	3.9	1.2	0.1	0.1
India	na	na	na	1.4	3.8	3.4	na	na	na
Indonesia	1.8	2.7	3.9	1.0	4.5	3.4	0.8	-1.8	0.5
Japan	-2.8	-0.1	1.6	-2.9	-0.4	1.6	0.1	0.3	0.0
Korea, Rep.	-3.9	1.7	4.3	-3.8	1.9	4.4	-0.1	-0.2	-0.1
Malaysia	-1	4.4	4.6	-1.3	5.0	4.6	0.3	-0.6	0.0
Philippines	na	na	na	1.5	2.8	4.3	na	na	na
Singapore	-5.4	1.1	3.6	-6.0	2.0	3.4	0.6	-0.9	0.2
Taiwan	na	na	na	-2.6	0.8	3.6	na	na	na
Thailand	-0.2	4.6	4.5	0.3	4.6	4.5	-0.5	0.0	0.0

Note: na = not available. Agr(iculture), Ind(ustry), Serv(ices).
Source: Constructed on basis of WDI 2006 multiplying sectoral shares and total labor force. The time series of total labor force is titled “Labor Force, Total” in the WDI 2006. For sectoral employment series, see Table 2. Growth rates in persons employed for *GGDC 10-sector database* are authors own calculations.

Appendix 2. Identifying Upturns and Downturns in GDP per Worker

We employ a filter introduced by Hausmann et al. (2005) to select accelerations and decelerations in GDP per worker.[21] This filter is constructed as follows. First, the change in the growth of GDP per worker *g* at time *t* is the change in growth over 5-year periods,[22] given by:

$$\Delta g_{t,5} = \overline{g}_{t,t+5} - \overline{g}_{t-5,t} \qquad (1)$$

Next, we identify the following growth regime whenever:

1) $\overline{g}_{t_b,t_e} \geq 3\%$ Growth Accelerations

2) $\overline{g}_{t_b,t_e} \leq 0\%$ Growth Decelerations

Time starts at t_b, the beginning of the growth regime and stops at t_e, the end of the growth period. Identification of a growth period in year t is subject to the following conditions:

s.t. $\Delta g_{t,n} \geq |3\%|$ A considerable change in the five year average linear growth rate

s.t. either $y_{t_e} \geq \max(y_i), i < t_e$ Post acceleration output per worker exceeds pre-episode peak

or $y_{t_e} \leq \max(y_i), i < t_e$ Post deceleration output per worker is below pre-episode peak

This filter identifies two growth periods (that is accelerations and decelerations), and moderate growth refers to periods where there is no acceleration or deceleration in growth. The significance of changes in growth periods are further tested using spline regression analysis and found to be significant.
In addition to the filter, we also look at the average growth before a break in GDP per worker occurs. If growth is above 3% per annum, or below 0% this period is also selected as an acceleration or deceleration. This addition to the filter is relevant for several Asian countries that experienced an uninterrupted acceleration in GDP per worker throughout our data set (i.e. Korea and Taiwan).

[21] Our filter is somewhat different from the filter introduced by Hausmann et al. (2005). We extended the filter to incorporate growth decelerations. Some parameters of the filter are slightly different. The time horizon in this paper is shorter which increases the possibility of a growth acceleration and deceleration, but the identification of a growth regime is stricter reducing the possibilities. To some extent both cancel out.

[22] A five year horizon is chosen in order to mitigate business cycle effects. We study linear growth rates for consistency in this paper. The shift-share analysis decomposes linear growth. Following Easterly et al. (1993) we could also use growth rates from the logarithm of GDP per worker, or we could follow Jones and Olken (2005) and Hausmann et al. (2005) and estimate growth rates as the least square average. Alternative estimates of growth rates only give slightly different results.

Appendix table 2, displayed below, shows the resulting growth periods in Asia and Latin America.

Appendix Table 2 Start of Growth Periods in Asia and Latin America

Country	Year of Break by Type		
	Growth Acceleration	Moderate Growth	Growth Deceleration
Hong Kong	1975, 1998	1993	
India	1979	1960	1970
Indonesia	1970, 2001		1996
Japan	1960	1990	
Korea, Rep. Of	1963		
Malaysia	1975	1997	
Philippines	1971	1986	1976
Singapore	1970	1996	
Taiwan (China)	1963		
Thailand	1961, 1985	1979, 2001	1996
Argentina	1990	1950	1980, 1998
Bolivia	1950, 1959	1969, 1987	1954, 1982
Brazil	1950, 1966	1961, 1992	1980
Chile	1976, 1985	1950, 1997	1971, 1981
Colombia	1993	1950, 2001	1987, 1997
Costa Rica	1950	1958	
Mexico	1950, 1977	1957, 1988	1981
Peru	1960, 1991, 1999	1983	1974, 1987, 1995
Venezuela	1950	1988, 2001	1957, 1992

Note: Start of growth regime estimated using the extended filter from Hausmann et al. (2005), described above.

Appendix Table 3 Period Results by Country

Country	Period	Average Annual Productivity Growth (in %)	Explained by (in percentage points):		Sectoral contribution (intra + shift-effect)				
			Total Intra-effect	Total Shift-effect	Agriculture	Other Industries	Manufacturing	Market Services	Non-market Services
Hong Kong	1975-1993	4.71	3.63	1.08	0.06	0.44	2.08	1.97	0.17
	1993-1998	0.98	-0.53	1.51	-0.04	0.15	0.58	-0.27	0.57
	1998-2005	4.41	3.81	0.60	0.00	0.15	0.13	3.88	0.24
India	1960-1970	2.93	1.86	1.07	-0.01	0.40	0.65	1.27	0.61
	1970-1979	-0.44	1.29	-1.72	-0.15	0.21	-0.07	0.33	-0.76
	1979-2004	3.65	2.44	1.21	0.00	0.37	0.62	1.34	1.32
Indonesia	1970-1996	4.08	0.37	3.71	0.00	0.75	1.48	1.51	0.33
	1996-2001	-0.74	-1.09	0.35	0.00	-0.03	-0.18	-0.74	0.20
	2001-2005	3.66	3.65	0.01	-0.02	-0.07	1.70	1.56	0.50
Japan	1960-1990	4.74	4.58	0.16	0.71	0.31	1.53	1.77	0.42
	1990-2003	1.22	1.10	0.12	0.01	-0.15	0.76	0.42	0.18
Korea	1963-2005	4.45	5.19	-0.74	2.50	0.44	1.77	0.07	-0.32
Malaysia	1975-1997	4.51	4.86	-0.35	1.40	0.97	0.69	1.21	0.23
	1997-2005	2.36	2.74	-0.38	0.00	0.38	1.54	0.47	-0.04
Philippines	1971-1976	4.62	4.44	0.18	-0.25	1.94	1.18	1.30	0.46
	1976-1986	-2.38	-1.79	-0.59	0.00	-0.59	-0.22	-1.06	-0.51
	1986-2005	1.35	0.67	0.68	0.00	0.12	0.31	0.72	0.21
Singapore	1970-1996	4.38	3.68	0.70	0.16	0.37	1.02	2.35	0.47
	1996-2005	2.05	1.98	0.07	0.00	-0.21	0.94	1.26	0.07
Taiwan	1963-2005	5.30	5.33	-0.03	1.43	0.32	1.36	1.45	0.73
Thailand	1961-1979	4.97	2.27	2.71	0.00	0.54	1.68	1.82	0.94
	1979-1985	1.31	1.05	0.26	0.00	0.46	0.43	0.26	0.16
	1985-1996	6.77	4.17	2.61	0.68	0.79	2.52	2.47	0.32
	1996-2001	-1.06	-1.66	0.60	0.22	-0.01	0.07	-1.40	0.06
	2001-2005	2.96	1.79	1.17	0.00	0.36	1.88	0.54	0.19

Country	Period	Average Annual Productivity Growth (in %)	Explained by (in percentage points):		Sectoral contribution (intro + shift-effect)				
			Total Intra-effect	Total Shift-effect	Agriculture	Other Industries	Manufacturing	Market Services	Non-market Services
Argentina	1950-1980	1.41	1.08	0.32	0.31	0.12	0.47	0.44	0.06
	1980-1990	-2.94	-2.94	0.00	0.00	-0.30	-0.49	-1.36	-0.79
	1990-1998	5.35	5.58	-0.23	0.47	1.06	1.82	1.86	0.15
	1998-2005	-0.82	-0.47	-0.35	0.24	0.01	0.22	-1.05	-0.23
Bolivia	1950-1954	3.80	1.66	2.15	0.40	0.87	1.26	0.95	0.33
	1954-1959	-1.32	1.15	-2.46	-2.41	0.36	0.37	0.23	0.13
Bolivia	1959-1969	4.13	1.80	2.33	0.31	1.31	0.85	0.95	0.72
	1969-1982	1.22	-0.64	1.86	0.63	-0.29	0.19	0.44	0.25
	1982-1987	-5.55	-4.61	-0.95	0.00	-0.20	-0.09	-1.87	-3.39
	1987-2003	0.82	0.90	-0.08	0.61	0.99	-0.37	-0.83	0.42
Brazil	1950-1961	4.77	3.10	1.67	0.00	0.56	1.71	1.06	1.43
	1961-1966	1.81	-0.07	1.88	0.00	0.30	0.34	0.82	0.36
	1966-1980	5.43	3.51	1.92	0.00	1.10	1.56	1.59	1.17
	1980-1992	-1.91	-2.33	0.42	0.19	0.04	-0.84	-0.90	-0.40
	1992-2005	0.79	0.81	-0.02	0.49	0.30	0.39	-0.54	0.15
Chile	1950-1971	2.55	2.27	0.28	0.00	0.60	1.08	0.60	0.27
	1971-1976	-3.27	-3.35	0.08	0.00	-0.80	-1.73	-0.90	0.16
	1976-1981	6.75	5.92	0.83	0.53	1.43	2.40	2.50	-0.11
	1981-1985	-6.45	-5.54	-0.92	-0.66	-0.15	-0.42	-2.81	-2.42
	1985-1997	4.17	3.60	0.57	0.95	1.00	0.57	1.15	0.49
	1997-2005	0.96	1.44	-0.48	0.00	0.82	0.77	-0.45	-0.18
Colombia	1950-1987	2.84	1.62	1.22	0.00	0.34	0.61	1.34	0.54
	1987-1993	-1.13	-2.09	0.96	0.00	-0.45	-0.36	-0.22	-0.09
	1993-1997	4.04	3.70	0.35	0.56	0.98	0.54	0.75	1.22
	1997-2001	-3.12	-2.01	-1.10	0.00	-0.32	0.07	-2.57	-0.31
	2001-2005	1.24	1.88	-0.64	0.00	1.13	0.34	-0.46	0.23
Costa Rica	1950-1958	5.85	4.35	1.50	0.00	0.44	1.07	2.87	1.47
	1958-2005	1.31	0.07	1.24	0.00	0.10	0.51	0.72	-0.01

Country	Period	Average Annual Productivity Growth (in %)	Explained by (in percentage points):		Sectoral contribution (intra + shift-effect)				
			Total Intra-effect	Total Shift-effect	Agriculture	Other Industries	Manufacturing	Market Services	Non-market Services
Mexico	1950-1957	5.29	4.28	1.01	0.84	0.21	0.88	2.87	0.49
	1957-1977	2.45	0.96	1.49	0.00	0.22	0.62	1.21	0.40
	1977-1981	3.69	2.18	1.51	0.43	0.50	0.46	2.07	0.24
	1981-1988	-3.31	-3.65	0.34	0.00	-0.28	-0.62	-1.87	-0.53
	1988-2005	1.09	0.06	1.02	0.18	0.04	0.38	0.48	0.01
Peru	1960-1974	3.78	2.63	1.15	0.00	0.38	0.98	1.68	0.74
	1974-1983	-2.39	-3.44	1.05	0.00	-0.10	-0.45	-1.29	-0.55
	1983-1987	2.72	1.51	1.22	0.00	0.37	1.02	0.86	0.47
	1987-1991	-9.77	-10.54	0.77	0.00	-0.65	-2.04	-4.49	-2.59
	1991-1995	9.62	10.61	-0.99	-1.55	2.09	1.60	6.16	1.33
	1995-1999	-0.63	-1.13	0.50	0.00	0.67	0.33	-1.38	-0.24
	1999-2005	3.08	2.86	0.21	-0.21	0.70	0.82	1.30	0.47
Venezuela	1950-1957	5.49	4.06	1.43	0.00	3.48	0.75	1.09	0.17
	1957-1988	-0.82	-0.51	-0.31	0.00	-0.58	0.17	-0.30	-0.12
	1988-1992	1.54	-0.25	1.79	0.15	1.24	-0.18	0.11	0.22
	1992-2001	-2.24	1.21	-3.45	0.00	1.59	0.33	-3.91	-0.26
	2001-2005	2.54	4.39	-1.84	-0.63	0.26	1.16	2.00	-0.25

Papers issued in the series of the Groningen Growth and Development Centre

All papers are available in pdf-format on the internet: http://www.ggdc.net/

536 (GD-1) Maddison, Angus and Harry van Ooststroom, The International Comparison of Value Added, Productivity and Purchasing Power Parities in Agriculture (1993)

537 (GD-2) Mulder, Nanno and Angus Maddison, The International Comparison of Performance in Distribution: Value Added, Labour Productivity and PPPs in Mexican and US Wholesale and Retail Trade 1975/7 (1993)

538 (GD-3) Szirmai, Adam, Comparative Performance in Indonesian Manufacturing, 1975-90 (1993)

549 (GD-4) de Jong, Herman J., Prices, Real Value Added and Productivity in Dutch Manufacturing, 1921-1960 (1993)

550 (GD-5) Beintema, Nienke and Bart van Ark, Comparative Productivity in East and West German Manufacturing before Reunification (1993)

567 (GD-6) Maddison, Angus and Bart van Ark, The International Comparison of Real Product and Productivity (1994)

568 (GD-7) de Jong, Gjalt, An International Comparison of Real Output and Labour Productivity in Manufacturing in Ecuador and the United States, 1980 (1994)

569 (GD-8) van Ark, Bart and Angus Maddison, An International Comparison of Real Output, Purchasing Power and Labour Productivity in Manufacturing Industries: Brazil, Mexico and the USA in 1975 (1994) (second edition)

570 (GD-9) Maddison, Angus, Standardised Estimates of Fixed Capital Stock: A Six Country Comparison (1994)

571 (GD-10) van Ark, Bart and Remco D.J. Kouwenhoven, Productivity in French Manufacturing: An International Comparative Perspective (1994)

572 (GD-11) Gersbach, Hans and Bart van Ark, Micro Foundations for International Productivity Comparisons (1994)

573 (GD-12) Albers, Ronald, Adrian Clemens and Peter Groote, Can Growth Theory Contribute to Our Understanding of Nineteenth Century Economic Dynamics (1994)

574 (GD-13) de Jong, Herman J. and Ronald Albers, Industrial Output and Labour Productivity in the Netherlands, 1913-1929: Some Neglected Issues (1994)

575 (GD-14) Mulder, Nanno, New Perspectives on Service Output and Productivity: A Comparison of French and US Productivity in Transport, Communications Wholesale and Retail Trade (1994)

576 (GD-15) Maddison, Angus, Economic Growth and Standards of Living in the Twentieth Century (1994)

577 (GD-16) Gales, Ben, In Foreign Parts: Free-Standing Companies in the Netherlands around the First World War (1994)

578 (GD-17) Mulder, Nanno, Output and Productivity in Brazilian Distribution: A Comparative View (1994)

579 (GD-18) Mulder, Nanno, Transport and Communication in Mexico and the United States: Value Added, Purchasing Power Parities and Productivity (1994)

580 (GD-19) Mulder, Nanno, Transport and Communications Output and Productivity in Brazil and the USA, 1950-1990 (1995)

581 (GD-20) Szirmai, Adam and Ren Ruoen, China's Manufacturing Performance in Comparative Perspective, 1980-1992 (1995)

GD-21 Fremdling, Rainer, Anglo-German Rivalry on Coal Markets in France, the Netherlands and Germany, 1850-1913 (December 1995)

GD-22 Tassenaar, Vincent, Regional Differences in Standard of Living in the Netherlands, 1800-1875, A Study Based on Anthropometric Data (December 1995)

GD-23 van Ark, Bart, Sectoral Growth Accounting and Structural Change in Postwar Europe (December 1995)

GD-24 Groote, Peter, Jan Jacobs and Jan Egbert Sturm, Output Responses to Infrastructure in the Netherlands, 1850-1913 (December 1995)

GD-25 Groote, Peter, Ronald Albers and Herman de Jong, A Standardised Time Series of the Stock of Fixed Capital in the Netherlands, 1900-1995 (May 1996)

GD-26 van Ark, Bart and Herman de Jong, Accounting for Economic Growth in the Netherlands since 1913 (May 1996)

GD-27 Maddison, Angus and D.S. Prasada Rao, A Generalized Approach to International Comparisons of Agricultural Output and Productivity (May 1996)

GD-28 van Ark, Bart, Issues in Measurement and International Comparison of Productivity - An Overview (May 1996)

GD-29 Kouwenhoven, Remco, A Comparison of Soviet and US Industrial Performance, 1928-90 (May 1996)

GD-30 Fremdling, Rainer, Industrial Revolution and Scientific and Technological Progress (December 1996)

GD-31 Timmer, Marcel, On the Reliability of Unit Value Ratios in International Comparisons (December 1996)

GD-32 de Jong, Gjalt, Canada's Post-War Manufacturing Performance: A Comparison with the United States (December 1996)

GD-33 Lindlar, Ludger, “1968” and the German Economy (January 1997)

GD-34 Albers, Ronald, Human Capital and Economic Growth: Operationalising Growth Theory, with Special Reference to The Netherlands in the 19th Century (June 1997)

GD-35 Brinkman, Henk-Jan, J.W. Drukker and Brigitte Slot, GDP per Capita and the Biological Standard of Living in Contemporary Developing Countries (June 1997)

GD-36 de Jong, Herman, and Antoon Soete, Comparative Productivity and Structural Change in Belgian and Dutch Manufacturing, 1937-1987 (June 1997)

GD-37 Timmer, M.P., and A. Szirmai, Growth and Divergence in Manufacturing Performance in South and East Asia (June 1997)

GD-38 van Ark, B., and J. de Haan, The Delta-Model Revisited: Recent Trends in the Structural Performance of the Dutch Economy (December 1997)

GD-39 van der Eng, P., Economics Benefits from Colonial Assets: The Case of the Netherlands and Indonesia, 1870-1958 (June 1998)

GD-40 Timmer, Marcel P., Catch Up Patterns in Newly Industrializing Countries. An International Comparison of Manufacturing Productivity in Taiwan, 1961-1993 (July 1998)

GD-41 van Ark, Bart, Economic Growth and Labour Productivity in Europe: Half a Century of East-West Comparisons (October 1999)

GD-42 Smits, Jan Pieter, Herman de Jong and Bart van Ark, Three Phases of Dutch Economic Growth and Technological Change, 1815-1997 (October 1999)

GD-43 Fremdling, Rainer, Historical Precedents of Global Markets (October 1999)

GD-44 van Ark, Bart, Lourens Broersma and Gjalt de Jong, Innovation in Services. Overview of Data Sources and Analytical Structures (October 1999)

GD-45 Broersma, Lourens and Robert McGuckin, The Impact of Computers on Productivity in the Trade Sector: Explorations with Dutch Microdata (October 1999, Revised version June 2000)

GD-46 Sleifer, Jaap, Separated Unity: The East and West German Industrial Sector in 1936 (November 1999)

GD-47 Rao, D.S. Prasada and Marcel Timmer, Multilateralisation of Manufacturing Sector Comparisons: Issues, Methods and Empirical Results (July 2000)

GD-48 Vikström, Peter, Long term Patterns in Swedish Growth and Structural Change, 1870-1990 (July 2001)

GD-49 Wu, Harry X., Comparative labour productivity performance in Chinese manufacturing, 1952-1997: An ICOP PPP Approach (July 2001)

GD-50 Monnikhof, Erik and Bart van Ark, New Estimates of Labour Productivity in the Manufacturing Sectors of Czech Republic, Hungary and Poland, 1996 (January 2002)

GD-51 van Ark, Bart, Robert Inklaar and Marcel Timmer, The Canada-US Manufacturing Gap Revisited: New ICOP Results (January 2002)

GD-52 Mulder, Nanno, Sylvie Montout and Luis Peres Lopes, Brazil and Mexico's Manufacturing Performance in International Perspective, 1970-98 (January 2002)

GD-53 Szirmai, Adam, Francis Yamfwa and Chibwe Lwamba, Zambian Manufacturing Performance in Comparative Perspective (January 2002)

GD-54 Fremdling, Rainer, European Railways 1825-2001, an Overview (August 2002)

GD-55 Fremdling, Rainer, Foreign Trade-Transfer-Adaptation: The British Iron Making Technology on the Continent (Belgium and France) (August 2002)

GD-56 van Ark, Bart, Johanna Melka, Nanno Mulder, Marcel Timmer and Gerard Ypma, ICT Investments and Growth Accounts for the European Union 1980-2000 (September 2002)

GD-57 Sleifer, Jaap, A Benchmark Comparison of East and West German Industrial Labour Productivity in 1954 (October 2002)

GD-58 van Dijk, Michiel, South African Manufacturing Performance in International Perspective, 1970-1999 (November 2002)

GD-59 Szirmai, A., M. Prins and W. Schulte, Tanzanian Manufacturing Performance in Comparative Perspective (November 2002)

GD-60 van Ark, Bart, Robert Inklaar and Robert McGuckin, "Changing Gear" Productivity, ICT and Services: Europe and the United States (December 2002)

GD-61 Los, Bart and Timmer, Marcel, The 'Appropriate Technology' Explanation of Productivity Growth Differentials: An Empirical Approach (April 2003)

GD-62 Hill, Robert J., Constructing Price Indexes Across Space and Time: The Case of the European Union (May 2003)

GD-63 Stuivenwold, Edwin and Marcel P. Timmer, Manufacturing Performance in Indonesia, South Korea and Taiwan before and after the Crisis; An International Perspective, 1980-2000 (July 2003)

GD-64 Inklaar, Robert, Harry Wu and Bart van Ark, "Losing Ground", Japanese Labour Productivity and Unit Labour Cost in Manufacturing in Comparison to the U.S. (July 2003)

GD-65 van Mulligen, Peter-Hein, Alternative Price Indices for Computers in the Netherlands using Scanner Data (July 2003)

GD-66 van Ark, Bart, The Productivity Problem of the Dutch Economy: Implications for Economic and Social Policies and Business Strategy (September 2003)

GD-67 Timmer, Marcel, Gerard Ypma and Bart van Ark, IT in the European Union, Driving Productivity Divergence?

GD-68 Inklaar, Robert, Mary O'Mahony and Marcel P. Timmer, ICT and Europe's Productivity Performance, Industry-level Growth Accounts Comparisons with the United States (December 2003)

GD-69 van Ark, Bart and Marcin Piatkowski, Productivity, Innnovation and ICT in Old and New Europe (March 2004)

GD-70 Dietzenbacher, Erik, Alex Hoen, Bart Los and Jan Meist, International Convergence and Divergence of Material Input Structures: An Industry-level Perspective (April 2004)

GD-71 van Ark, Bart, Ewout Frankema and Hedwig Duteweerd, Productivity and Employment Growth: An Empirical Review of Long and Medium Run Evidence (May 2004)

GD-72 Edquist, Harald, The Swedish ICT Miracle: Myth or Reality? (May 2004)

GD-73 Hill, Robert and Marcel Timmer, Standard Errors as Weights in Multilateral Price Indices (November 2004)

GD-74 Inklaar, Robert, Cyclical productivity in Europe and the United States, Evaluating the evidence on returns to scale and input utilization (April 2005)

GD-75 van Ark, Bart, Does the European Union Need to Revive Productivity Growth? (April 2005)

GD-76 Timmer, Marcel and Robert Inklaar, Productivity Differentials in the US and EU Distributive Trade Sector: Statistical Myth or Reality? (April 2005)

GD-77 Fremdling, Rainer, The German Industrial Census of 1936: Statistics as Preparation for the War (August 2005)

GD-78 McGuckin, Robert and Bart van Ark, Productivity and Participation: An International Comparison (August 2005)

GD-79 Inklaar, Robert and Bart van Ark, Catching Up or Getting Stuck? Europe's Troubles to Exploit ICT's Productivity Potential (September 2005)

GD-80 van Ark, Bart, Edwin Stuivenwold and Gerard Ypma, Unit Labour Costs, Productivity and International Competitiveness (August 2005)

GD-81 Frankema, Ewout, The Colonial Origins of Inequality: Exploring the Causes and Consequences of Land Distribution (July 2006)

GD-82 Timmer, Marcel, Gerard Ypma and Bart van Ark, PPPs for Industry Output: A New Dataset for International Comparisons (March 2007)

GD-83 Timmer, Marcel and Gerard Ypma, Productivity Levels in Distributive Trades: A New ICOP Dataset for OECD Countries (April 2005)

GD-85 Ypma, Gerard, Productivity Levels in Transport, Storage and Communication: A New ICOP 1997 Data Set (July 2007)

GD-86 Frankema, Ewout, and Jutta Bolt, Measuring and Analysing Educational Inequality: The Distribution of Grade Enrolment Rates in Latin America and Sub-Saharan Africa (April 2006)

GD-87 Azeez Erumban, Abdul, Lifetimes of Machinery and Equipment. Evidence from Dutch Manufacturing (July 2006)

GD-88 Castaldi, Carolina and Sandro Sapio, The Properties of Sectoral Growth: Evidence from Four Large European Economies (October 2006)

GD-89 Inklaar, Robert, Marcel Timmer and Bart van Ark, Mind the Gap! International Comparisons of Productivity in Services and Goods Production (October 2006)

GD-90 Fremdling, Rainer, Herman de Jong and Marcel Timmer, Censuses compared. A New Benchmark for British and German Manufacturing 1935/1936 (April 2007)

GD-91 Akkermans, Dirk, Carolina Castaldi and Bart Los, Do 'Liberal Market Economies' Really Innovate More Radically than 'Coordinated Market Economies'? Hall & Soskice Reconsidered (March 2007)

GD-93 Frankema, Ewout and Daan Marks, Was It Really "Growth with Equity" under Soeharto? A Theil Analysis of Indonesian Income Inequality, 1961-2002 (July 2007)

GD-94a Fremdling, Rainer, (Re)Construction Site of German Historical National Accounts: Machine Building: A New Benchmark before World War I (July 2007)

GD-94b Fremdling, Rainer, (Re)Construction Site of German Historical National Accounts: German Industrial Employment 1925, 1933, 1936 and 1939: A New Benchmark for 1936 and a Note on Hoffmann's Tales (July 2007)

GD-95 Feenstra, Robert C., Alan Heston, Marcel P. Timmer and Haiyan Deng, Estimating Real Production and Expenditures Across Nations: A Proposal for Improving the Penn World Tables (July 2007)

GD-96 Erumban, Abdul A, Productivity and Unit Labor Cost in Indian Manufacturing

A Comparative Perspective (October 2007)

GD-97 Wulfgramm, Melike, Solidarity as an Engine for Economic Change: The impact of Swedish and US political ideology on wage differentials and structural change (June 2007)

Groningen Growth and Development Centre Research Monographs

Monographs marked * are also available in pdf-format on the internet: http://www.ggdc.net/

No. 1* van Ark, Bart, International Comparisons of Output and Productivity: Manufacturing Productivity Performance of Ten Countries from 1950 to 1990 (1993) (http://www.eco.rug.nl/GGDC/ThesisArk.html)

No. 2 Pilat, Dirk, The Economics of Catch-Up: The Experience of Japan and Korea (1993)

No. 3 Hofman, André, Latin American Economic Development. A Causal Analysis in Historical Perspective (1998)

No. 4 Mulder, Nanno, The Economic Performance of the Service Sector in Brazil, Mexico and the United States (1999)

No. 5* Smits, Jan-Pieter, Edwin Horlings and Jan Luiten van Zanden, Dutch GNP and Its Components, 1800-1913 (2000) (http://www.eco.rug.nl/GGDC/PUB/dutchgnp.pdf)