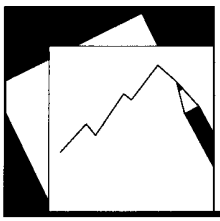
WP/15/48



IMF Working Paper

The Level of Productivity in Traded and Non-Traded Sectors for a Large Panel of Countries

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INTERNATIONAL MONETARY FUND

 WP/15/48

IMF Working Paper

Research Department

The Level of Productivity in Traded and Non-Traded Sectors for a Large Panel of Countries[1]

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February 2015

Abstract

This paper explains in detail the construction of series for productivity in the traded and non-traded sectors for a panel of 56 countries spanning 1989–2012. The *level* of productivity in each sector is defined as real value added per worker in constant 2005 Purchasing Power Parity (PPP) U.S. dollars. To construct these series, we collect industry-level data from several sources, and classify individual industries as traded/non-traded using their ratio of exports to value added. Finally, we aggregate the industry data up to a traded sector and a non-traded sector, accordingly. This new dataset has two main advantages relative to existing datasets: (i) it defines more finely the traded/non-traded sectors, by drawing on much more disaggregated industry source data; and (ii) it allows for meaningful comparisons of the level of productivity across countries/sectors because sectoral productivity is adjusted by its own price level.

JEL Classification Numbers: F41, F43

Keywords: Sectoral Productivity, Traded and Non-Traded Sectors, Purchasing Power Parity

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[1] We thank Gaaitzen de Vries for guidance on the datasets from Groningen Growth and Development Centre, WIOD and W/EU KLEMS and Steve Phillips for suggestions. We are also grateful to Andrew Berg and other IMF colleagues who offered helpful comments.

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I. INTRODUCTION

In this paper we explain in detail the construction of an annual database of productivity in the traded and non-traded sectors across a panel of 56 countries. We measure productivity as real value added per worker in constant 2005 Purchasing Power Parity (PPP) U.S. dollars in each of the two sectors. Thus, current value added per worker is adjusted for changes of prices over time as well as for differences in Price Level Index (PLI) across sectors and countries. We report real value added per worker in 2005 U.S. dollars at market exchange rates for 14 countries[3] for which we did not find disaggregated PLI data. We study labor productivity, rather than further decomposing it into contributions of capital per worker and total factor productivity (TFP), since such decomposition entails estimating each sector's capital stock which is very hard to measure. Henceforth, "productivity" stands for "labor productivity".

Most of the existing literature has focused on constructing productivity series for traded and non-traded sectors for OECD countries due to limited data availability. Examples of that literature are De Gregorio, Giovannini and Wolf (1994), Canzoneri and others (1999), MacDonald and Ricci (2007) or Lee and Tang (2007) to name a few. Other papers went beyond OECD countries, by using the World Bank's 3-sector database (Choudhri and Khan, 2005) or at most based on a 6-sector disaggregation (Ricci, Milesi-Ferretti and Lee, 2008). Recently, IMF staff (Dabla-Norris and others, 2013) published a new sectoral productivity dataset that uses the World Bank's 3-sector data together with a 10-sector database from the Groningen Growth and Development Center (GGDC) that is also partly used in the dataset introduced here.

The dataset detailed here has two main advantages relative to those cited above when attempting to measure and compare productivity of traded and non-traded sectors across countries:

1) The use of more disaggregated data (mostly 35-industry level and 10-industry level for a few countries) for a wide set of countries beyond OECD. This allows for a finer classification of the traded and non-traded sectors, particularly regarding services (an extreme example is the World Bank 3-sector database, where all services have to be classified as non-traded).

2) We construct series for the level of productivity in the traded and non-traded sectors that are fully comparable across time periods, countries and sectors. All of the above except Era-Dabla-Norris and others (2013) construct productivity indices or use market exchange rates to convert values across countries, ignoring cross-country price differences. In Figure 11 of Era-Dabla-Norris and others (2013), productivity is adjusted for the economy-wide Price Level Index (PLI), which is a step in the right direction. However, we show that there are large and systematic differences in PLIs across sectors. In that case, adjusting by the economy-wide price level index alone does not allow for meaningful comparisons of the level of productivity in different sectors across countries.

[3] Those are: Bolivia, Colombia, Costa Rica, Iceland, Israel, Malaysia, New Zealand, Norway, Peru, Philippines, Singapore, Switzerland, Taiwan, Province of China, and Thailand. See Table 3 for details.

We believe this new dataset will be useful in many applications, such as analysis of real exchange rates, sectoral dynamics, assessing structural reforms targeted at either traded or non-traded sectors, among others.

This paper is organized as follows: Section II presents the definition of sectoral productivity that we measure in the data, Section III details the various sources of data, Section IV explains the classification of individual industries into traded or non-traded sectors, and Section V discusses broad patterns in the data.

II. MEASURING PRODUCTIVITY IN TRADED AND NON-TRADED SECTORS

Consider an economy that is divided into multiple industries. An industry, i, is either said to be traded ($i \epsilon T$) if it produces traded goods, or non-traded ($i \epsilon N$)[4], in the case it produces non-traded goods. Let labor productivity at time t in the traded sector and in the non-traded sector be y_t^T and y_t^N , respectively, such that,

$$y_t^T = \sum_{i \in T} \frac{VA_{i,t}}{PVA_{i,t}} \frac{ER_{2005}}{PLI_{i,2005}} \Big/ \sum_{i \in T} L_{i,t} \quad (1)$$

$$y_t^N = \sum_{i \in N} \frac{VA_{i,t}}{PVA_{i,t}} \frac{ER_{2005}}{PLI_{i,2005}} \Big/ \sum_{i \in N} L_{i,t} \quad (2)$$

Where:

- $PLI_{i,2005}$ is the price level index of gross output[5] of each industry i in 2005 in units of U.S. GDP price, i.e. U.S. GDP is used as the *numeraire* and has price level equal to 1;
- ER_{2005} is the average nominal exchange rate of USD per LCU in 2005;
- $VA_{i,t}$ is gross value added in local currency units (LCU) at time t for each industry i. Gross value added is defined as the total revenue of the industry subtracted by purchases of materials and services used in the production process;
- $PVA_{i,t}$ is the price index of gross value added at time t for each industry i, using 2005 as base year;
- $L_{i,t}$ is total employment (number of engaged people)[6] at time t for each industry i;

[4] T and N are sectors or lists of industries that are traded and non-traded, respectively.
[5] Ideally, we should use gross value added PLIs, which are, unfortunately, not available at the level of disaggregation of interest. However, differences between gross output PLIs and gross value added PLIs are small where direct comparisons were possible, except in manufacturing where differences can be sizeable depending on the country. Industry-level PPPs are just the ratio of the industry-level PLI and the exchange rate.
[6] Ideally, we would like to use hours worked rather than the number of engaged workers. However, sectoral data on hours worked was not available for all the countries in our dataset.

The next Section describes in detail the source for each of the five variables presented above.

III. Disaggregated Industry-Level Data

We collected data from a variety of sources for value added and employment. These different sources have different methodologies, potentially giving rise to lack of cross-country comparability. To deal with that, we started by creating a master dataset and computed (1) and (2) from the source which had the most comparable data for as many countries as possible. Then, we used alternative sources that extended the master dataset for some countries, in which case we computed (1) and (2) separately for each additional source, and spliced the master dataset with the newly calculated changes in productivity for each sector.

In the following two sub-sections, we describe sources for the variables described in Section II grouped into "Price Level Indices (PLI) and Exchange Rates" and "Value Added and Employment."

A. Price Level Indices and Exchange Rates

We collect data for Price Level Indices (PLI) at the industry level and exchange rates for each country in 2005. Data on $PLI_{i,2005}$ is from Groningen Growth and Development Center (GGDC) and is detailed in Inklaar and Timmer (2012). PLIs are available at the 35-industry level for 42 countries.

Data is downloadable at: http://www.rug.nl/research/ggdc/data/ggdc-productivity-level-database.

Data on ER_{2005} comes from the World Development Indicators database, and is calculated as the annual average of monthly exchange rates in terms of LCU per U.S. dollar.

Data is downloadable at: http://data.worldbank.org/indicator/PA.NUS.FCRF.

B. Value Added and Employment

The most complete and consistent data source for value added at current and constant prices and employment that we found was the World Input-Output Database (WIOD) as described in Timmer (2012). Consequently, we chose data sourced from WIOD as the starting point for our productivity dataset. We then supplemented this master dataset with additional sources that follow the same industrial classification as WIOD, namely W/EU KLEMS, OECD's STructural ANalysis Database (STAN) and data from Groningen Growth and Development Center (GGDC). We generally followed the rule of first adding W/EU KLEMS, then STAN and, finally, GGDC sourced data (in turn and when available). All of these use International Standard Industrial Classification Revision 3 (ISIC Rev. 3), although at different levels of disaggregation in the case of GGDC. In particular, WIOD divides the economy in 35 industries while the GGDC 10-sector database only has a 10-industry break-down. As a rule, we constructed labor productivity series for the traded and non-traded sectors using the highest level of disaggregation

available. Table 1 presents the ISIC Rev. 3 industrial classification and the corresponding aggregation level for all sources that follow ISIC Rev. 3 classification.

Additionally, EU KLEMS and STAN make recent data available (after 2009) under a different industry classification (ISIC Rev. 4). We used that data to extend the time-series for a few available countries. The two classifications can only be directly linked at 4-digit level, which is a higher level of disaggregation than the data we have (2-digit at most). However, most changes in classification happen within main industry blocks. Thus, we chose to aggregate both ISIC Rev. 4 and Rev. 3 data and link the two classifications at the 12-industry level. We then classified each of these 12 industries as traded or non-traded based on export data for Rev. 3 data at that level of aggregation (See Section III for details). We believe that these links, albeit imperfect, should not change in meaningful ways the conclusions for productivity of the aggregated traded and non-traded sectors. Table 2 shows ISIC Rev. 4 classification across the two sources and how that was linked back to ISIC Rev. 3 classification.

All these extensions allowed us to expand the initial dataset of 40 countries spanning 1995–2009 (based on WIOD) to our final unbalanced panel of 56 countries covering 1989–2012. Table 3 summarizes the different sources for value added, value added deflators and employment by country.

For some individual countries there may well exist superior quality data, although this could not be verified on a country-by-country basis. Moreover, all the sources used here are panel datasets themselves constructed with the goal of making comparisons across countries and time. Such comparisons are only possible by imposing uniform methods and assumptions to national sourced data giving rise to potential differences between data from the two sources.

Below, we present additional detail for each specific data source used.

- **World Input-Output Database (WIOD)**

WIOD covers 27 European Union (EU) countries and 13 other major economies[7] from 1995 to 2009. WIOD is harmonized in terms of industry-classifications both across time and countries, with a break-down of 35 industries. We specifically use the Socio-Economic Accounts (SEA) in WIOD, which contain gross value added at current and constant prices and price deflators of gross value added by industry. WIOD also provides detailed data on total employment and includes hours worked for some countries. Industries are defined according to the International Standard Industrial Classification (ISIC) Revision 3. See Timmer (2012) for additional details.

Data is downloadable at: http://www.wiod.org/database/index.htm.

[7] EU countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and United Kingdom. Others: Canada, United States, Brazil, Mexico, China, India, Japan, South Korea, Australia, Taiwan, Turkey, Indonesia, and Russia.

- **W/EU KLEMS**

The EU KLEMS database, O'Mahony & Timmer (2009), documents sectoral gross value added, at constant and current prices, and employment across a wide set of countries. EU KLEMS has two sets of data that follow European NACE Rev. 1 and Rev. 2 classification, which correspond to ISIC Rev. 3 and Rev. 4 classification. Data is available for OECD countries[8] during 1970–2010[9], and from around 1995 onwards for most new EU member states[10]. European NACE Rev. 1 based data is easily linked to WIOD's 35-industry level data. EU KLEMS European NACE Rev. 2 (ISIC Rev. 4) data was linked to the rest of our dataset by aggregating industries into the 12 main blocks detailed in Table 2.

WKLEMS[11] is another parallel project that extends EU KLEMS data for Canada, Japan, Russia and the United States, and can be easily linked to WIOD dataset since it follows the same ISIC Rev. 3 classification.

Data is downloadable at: http://euklems.net/ and http://www.worldklems.net/data.htm.

- **STructural ANalysis (STAN)**

STAN reports disaggregated industry-level data for member-countries of the Organization for Economic Co-operation and Development (OECD). We extract data on gross value added in current prices, as well as gross value added deflators and employment. Similarly to EU KLEMS, STAN follows both ISIC Rev. 3, for older data, and Rev. 4, for the latest data. STAN's ISIC Rev. 3 provides data for 32 OECD countries up to 2009 and Rev. 4 provides data for 14 OECD countries[12] up to 2011.

Generally, STAN's ISIC Rev. 3 data is available at the same disaggregation level of both WIOD and EU KLEMS ISIC Rev. 3 dataset. However, for some countries we found missing values for a few industries for either gross value added or employment. In those cases, we gathered data at a larger level of disaggregation, and thus departed from the standard 35-industry level. We used 23-industry aggregation for Norway before 2007 and 11-industry aggregation for the Czech

[8] Euro area countries: Austria, Belgium, Denmark, Spain, Finland, France, United Kingdom, Germany, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, and Sweden. Others: Australia, Canada, Japan, Korea, and United States.

[9] Except for Finland (up to 2012); the Netherlands (up to 2011); and Japan (up to 2009). We couldn't use some countries' Rev. 4 based data because of missing series (frequently employment). See Table 3 for coverage by country.

[10] New EU member states include Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, and Slovenia.

[11] WKLEMS covers Canada (1961–2008), Japan (1973–2009), Russia (1995–2009), and United States (1947–2010).

[12] STAN's ISIC Rev. 4 countries coverage is: Austria, Belgium, Czech Republic, Germany, Denmark, Finland, France, Hungary, Italy, South Korea, Netherlands, Norway, Slovenia, Sweden and United States. As was the case with EU KLEMS, we couldn't use some countries' Rev. 4 based data because of missing series (frequently employment). See Table 3 for coverage by country.

Republic, Iceland, Israel, New Zealand and Norway (2007–2009). Links between these different industry breakdowns are presented in Table 1.

In order to link the STAN Rev. 4 based data to the rest of our dataset, we aggregated the different industries into 12 main blocks detailed in Table 2.

Data is downloadable at: http://stats.oecd.org/Index.aspx?DataSetCode=STAN08BIS%20.

- **Groningen Growth and Development Center (GGDC)**

The GGDC 10-Sector Database for Latin America and Asia (see Timmer and de Vries, 2007), and for Africa (G. J. de Vries, Timmer, and K. de Vries, 2013) provides a comparable dataset on sectoral gross value added at current and constant prices, and persons employed[13] in several countries of Asia, Latin America, and Africa.

For some countries, GGDC only provides value added or employment for the sum of "Community, Social and Personal Services" and "Government Services," rather than their breakdown. Since these industries are both non-traded we aggregated their real value added and employment and considered them as a single industry. Table 1 shows how the 10-industry classification can be linked to the 35-industry classification in WIOD, EU KLEMS and STAN.

For BRIC countries (Brazil, Russia, India, and China), we used a new dataset with 35-industry level value added and employment series that is available as an appendix to Research Memorandum 121 of the Groningen Growth and Development Center (see de Vries, Erumban, Timmer, Voskoboynikov, and Xu 2012), denoted as GD-121 hence forth.

Data is downloadable at:

http://www.rug.nl/research/ggdc/data/ggdc-productivity-level-database,
http://www.rug.nl/research/ggdc/data/africa-sector-database,
http://ggdc.eldoc.ub.rug.nl/root/WorkPap/2011/GD-121/?pLanguage=en&pFullItemRecord=ON.

IV. Constructing Productivity of Traded and Non-traded Sectors

A. Assigning Industries to Traded and to Non-Traded Sectors

The next step to compute productivities of the traded and non-traded sectors using equations (1) and (2) is defining the sets of traded and non-traded industries.

We followed three different approaches in that regard:

a) Our first approach, which we denote by "Benchmark", makes use of export data at the industry level from WIOD's Input-Output matrices for the period 1995–2011 (See Section II.A

[13] This is the only instance in which we used persons employed rather than persons engaged.

for a list). Following De Gregorio and others (1994), we first calculate the export to gross value added ratio across all countries for each industry at each point in time, then we calculate the average ratio per industry across all time periods, and finally we classify an industry as tradable if the average export to value added ratio is greater than 10 percent. In particular:

$$\text{Industry } i \text{ is traded } (i \epsilon T) \text{ if } \sum_{t=1995}^{2011} \frac{\sum_c X_{i,t}^c}{\sum_c VA_{i,t}^c} \Big/ (2011-1995+1) > 10\% \qquad (3)$$

Otherwise we include industry i in the non-traded sector. $X_{i,t}^c$ and $VA_{i,t}^c$ denote exports and value added in industry i, country c and time t.

Below we report the five industries for which the ratio in (3) is highest and lowest:

Industries	Code	Ratio
Electrical And Optical Equipment	30t33	153.8%
Textiles And Textile Products, Leather, Leather Products and Footwear	17t19	117.5%
Machinery And Equipment, N.E.C.	29	111.6%
Chemicals And Chemical Products	24	111.0%
Manufacturing Nec; Recycling	36t37	96.0%
Education	M	0.90%
Public Administration and Defense Compulsory Social Security	L	0.82%
Private Households With Employed Persons	P	0.33%
Real Estate Activities	70	0.32%
Health And Social Work	N	0.20%

We make three general assumptions when using the decision rule in (3). Underlying all three assumptions is the belief that tradability is inherent to the good/service being sold.

Firstly, tradability of an industry is not country specific, i.e. the fact that a given country does not export cars does not mean that cars are not a traded good. Secondly, tradability does not change over time[14]. We opted to keep industry assignment fixed through time in order to ensure that changes in the definition of traded and non-traded sector would not drive the path of the relative productivities between the two sectors. The third and last key assumption lies in measuring tradability of each industry based on its output rather than its inputs by looking at exports, rather than imports or the sum of exports and imports (often used as a measure of openness of an economy). In reality, many non-traded industries use some tradable goods as inputs, e.g. a barber buys scissors and hair-products. If scissors and hair-products are imported and constitute more than 10% of value added, we could end up classifying barber shops as a traded industry. On the other hand, hair-cut exports should certainly be lower than 10% of the barber's value added.

A complete list of the assignment of industries can be seen in Table 4, column (a). Note that the "Benchmark" approach assigns to the traded sector not only all manufacturing industries, agriculture, mining, and transportation as in De Gregorio et al. (1994), but also a few services

[14] In fact, the ratio of exports to value added for some year t, $(\sum_c X_{i,t}^c / \sum_c VA_{i,t}^c)$, seems to have a clear trend in the case of a few "services" industries, such as "Financial Intermediation".

industries that were considered non-traded in other studies. This difference stems from the fact that most other papers we have seen, including De Gregorio et al. (1994) and Ricci and others (2008), use input data that is more aggregated (either 8- or 6- or even 3-industry level) than the one we use (35- or 10-industry level). The use of finer-level industry data should allow a more accurate identification of traded and non-traded sectors. Hence, we encourage researchers using this dataset to use our preferred "Benchmark" classification. We include two alternative classifications for comparability with the literature and to check robustness of results to the "Benchmark" classification.

b) A second approach, "Goods-Producing", includes all goods producing industries in the traded sector: Agriculture, Hunting, Forestry and Fishing, (*AtB*); Mining and Quarrying, (*C*); and Manufacturing (industry *D*, sub-industries *15t37*). This approach follows closely what other papers have done in defining all service industries as non-traded. Table 4, column (b) shows the resulting classification under this approach.

c) A third approach, "Manufacturing", identifies Manufacturing (industry D, sub-industries 15t37) as the only traded industry and excludes Agriculture, Hunting, Forestry and Fishing (AtB), and Mining and Quarrying (C) data from both the traded and the non-traded sectors. Value added in Agriculture and Mining is more volatile due to frequent cost and price shocks that could be erroneously identified as increases or decreases of productivity if the time-series price deflator fails to capture accurately those movements. Table 4, column (c) shows the resulting classification under this approach.

B. Does Adjusting for Purchasing Power Parity (PPP) Matter?

We construct real value added per worker in 2005 PPP U.S. dollars as a measure of the level of productivity in each sector. The PPP adjustment at the industry level is an important feature of this dataset, without which both the level and the evolution of productivity differentials across traded and non-traded sectors could be significantly different.

PPPs are typically used to adjust the level of GDP of different countries to make them comparable. If we were to use these GDP PPPs, we would effectively assume away differences in prices across the traded and non-traded sectors. However, we can see from Figure 1 that the price ratio between non-traded and traded goods is not the same across countries but in fact varies greatly. Moreover, it is apparent from Figure 1 that this price ratio is positively related with the level of income, i.e. higher income countries have a higher price of non-traded to traded goods. Note a further point implicit in Figure 1: as one would expect, the cross-country dispersion of the price level of the non-traded sector is wider than the price dispersion for the traded sector. We regard this fact an important check of the PLI data and of our identification of traded and non-traded sectors.

Ignoring these price differentials would lead to upward biased estimates of the level of the productivity differential between traded and non-traded sectors for richer countries and downward biased estimates for poorer countries. In Figure 2, we show the ratio of PPP-adjusted

to non PPP-adjusted (using just market exchange rates) productivity levels in 2005 for both the traded (left panel) and non-traded (right panel) for five broad and potentially heterogeneous groups of countries. There we confirm that for Other OECD and Euro Area the ratio is close to 1 (even below for non-traded sector) whereas for Asia, Latin America and Transition countries that ratio is above one in both traded and non-traded sectors. Note that the corrections are more important in the case of the non-traded sector. This reflects the fact, noted above, that prices of non-traded goods differ more across countries than do prices of traded goods.

Moreover, the PPP adjustment at the industry level could also potentially change the time-series of productivity differentials of traded and non-traded sectors if the growth rate of value added varies across industries. Figure 3 shows the average growth rate of productivity differentials between traded and non-traded sectors across the same five groups of countries presented in Figure 2. We provide two numbers: "PPP" which stands for the average growth rate of PPP-adjusted productivity differentials and "Mkt" which stands for average growth rate of un-adjusted productivity differentials. In Latin America productivity differentials grew more under PPP adjustment than otherwise, whereas in "Transition" countries and "Other OECD" the reverse is true.

V. PATTERNS IN TRADED AND NON-TRADED SECTOR PRODUCTIVITY

We now present and discuss general patterns in the cross section of the level of productivity in both sectors and its evolution over time.

Countries in the dataset are grouped into the same five categories that were introduced in the previous section: Euro Area, Asia, Latin America, Transition, and Other OECD (OECD economies not in any of the other groups)[15]. These country groupings were created with the single purpose of illustrating aggregate patterns in the data.

Table 5 shows broad summary statistics for productivity in the traded, non-traded and the differential for each of these groupings. There we present both the levels in 2005 (equally-weighted averages) and the average yearly change over the sample.

In some figures discussed below, we present data for a selected set of countries within each of these groupings. Readers ultimately interested in country-level details should consult the figures in the Appendix. There, we present a comprehensive set of charts for all the data, organized by sector and country, and for the three different definitions of traded and non-traded sectors as discussed in Section III.A.

[15] South Africa is the only country in the dataset that is not included in one of the five groups presented in Table 5, and its data can be visualized in the Appendix figures.

A. Differences in the Levels of Productivity

The level of productivity in 2005 was remarkably different across countries and regions. Figures 4A–C show the level of productivity in the traded and non-traded for a select sample of countries within each grouping, as well as the differential in 2005. All numbers presented there are computed under the "Benchmark" approach (top panel of Table 5), our preferred classification of the traded sector.

Consider first the traded sector. In both the Euro Area and Other OECD a worker in the traded sector produced more than 70,000 PPP U.S. dollars of value added during 2005 (except Cyprus, Malta, Portugal, Greece and Spain in the Euro Area with levels ranging from 36,000-65,000 and Turkey in Other OECD at 28,000 PPP USD per worker). The average for all countries in each group was 79,710 for the Euro Area and 88,722 for Other OECD group. On the other hand, some countries in Asia had very low productivity in the traded sector, such as China and India with 8,000 and 4,000 USD per worker, respectively. In that group, Japan and Korea had a higher level of productivity (73,000 and 52,000, respectively) and so the average stands somewhere in between at 28,581 USD per worker in 2005. Latin America and Transition countries had intermediate levels of productivity at 32,946 and 29,591, respectively.

The level of productivity in the non-traded sector is less heterogeneous across countries than in the traded sector. This is driven in part by the larger price adjustment in the non-traded sector, as discussed previously. Latin America fares particularly poorly in this sector, at 19,510 USD per worker, resulting in the largest log productivity differential between traded and non-traded sectors at 52 percent. The Euro Area and Other OECD show the largest averages for the level of productivity in the non-traded sector at 58,838 and 54,180 USD per worker, respectively. There is a clear pattern in productivity differentials: more advanced countries have in general much larger differentials (30 percent and 49 percent for Euro Area and Other OECD). Asia and Transition countries at 2 percent and -15 percent had substantially lower productivity differentials. These numbers computed from average productivity of traded and non-traded sectors hide the huge cross-country heterogeneity in productivity differentials in the two sectors. At the two extremes, India has a negative differential of 132 percent, whereas Chile a positive differential of 70 percent. When looking across different classifications of traded and non-traded sectors, Asia fares better when looking at "Manufacturing" alone (bottom panel in Table 5). Productivity differentials are also much more homogeneous in that case, with the notable exception of the large negative average differential in Transition countries.

B. Evolution of Productivity in the Traded and Non-Traded Sectors

We turn to the analysis of patterns in the evolution of productivity in the traded and non-traded sectors. Figure 4 shows the pattern of the evolution of both traded (left panels) and non-traded (right panels) for selected countries within each of the five regions introduced previously. Here, productivities are normalized to 100 in 2005 for easier comparison through time.

Among the Euro Area, Germany saw its productivity in the non-traded sector increase faster than other countries, while in the traded sector several countries had faster growth than Germany. In the Other OECD grouping, several countries saw large increases in their traded sector productivities while in the non-traded sector the performance was more uneven (e.g. Denmark had only a modest increase in the sample period). In Asia, the most noteworthy fact is the exponential increase in productivity across both sectors in China. India saw considerable growth as well, particularly in the traded sector, while Japan experienced only modest growth in the non-traded sector. Previously we pointed that the level of non-traded sector productivity in Latin America was relatively low in 2005. At the same time its evolution was equally disappointing, with Brazil and Mexico exhibiting declines. Finally, in Transition countries the traded sector increased its productivity robustly, while the non-traded sector fared less favorably with the exception of Estonia.

Productivity growth in traded and non-traded sectors was very uneven across groups of countries (see Table 5). The average growth rates in the traded sector ranged from 4.8 percent in Asia to 1.9 percent in the Euro Area, while in the non-traded sector the range was 2.6 percent in Asia and 0.2 percent in Latin America. Note that these broad patterns hold across the preferred "Benchmark" approach as well as the two alternative approaches used to define the traded and non-traded sectors.

Productivity differentials between the traded and non-traded sector increased in all groups of countries. In the Euro Area it increased the least (on average 1.5–1.6 percent), while in Transition economies it increased the most (3.2–3.6 percent). The dispersion in growth rates is large, not only across countries but within each country's experience over time as well. Some countries experienced very sharp changes in growth rates within the sample period (e.g. China, South Africa, or Chile to name a few).

VI. CONCLUSION

We constructed a dataset of the *level* of value added per worker in the traded and non-traded sectors for a large panel of countries, spanning up to 20+ years. As we measure it, productivity can be directly compared across countries and sectors because we not only account for changes of prices through time, but also for price level differences across sectors. This dataset relies on detailed disaggregated industry-level data, which is then aggregated to create a traded and a non-traded sector, using clear criteria that were previously introduced in the literature.

Figure 6 gives a one plot summary of this dataset. We show the level of productivities in both the traded (left panel) and non-traded (right panel) sectors for six major world economies: China, Germany, Japan, India, Russia and the U.S.A. One cannot fail to notice the sheer difference in levels of productivity, but also some remarkable growth experiences, particularly in the case of China.

We make this dataset available to other researchers in the hope of contributing to a serious treatment and study of multi-country differences across traded and non-traded sector

productivities. This data can be used to analyze issues such as competitiveness, real exchange rates, structural reform needs, among other topics.

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Table 1. ISIC Rev. 3 Industry Classification Across Sources

Industries	ISIC Rev.3	WIOD/ STAN	W/EU KLEMS	STAN 23-level	STAN 11-level	GGDC 10-level
Agriculture, Hunting, Forestry And Fishing	01t05	AtB	AtB	01t05	01t05	AtB
Mining And Quarrying	10t14	C	C	10t14	10t14	C
Food Products, Beverages And Tobacco	15t16	15t16	15t16	15t16	15t37	D
Textiles and Textile	17t18	17t18	17t19	17t19		
Leather and Footwear	19	19				
Wood And Products Of Wood And Cork	20	20	20	20		
Pulp, Paper, Paper Products, Printing And Publishing	21t22	21t22	21t22	21t22		
Coke, Refined Petroleum Products And Nuclear Fuel	23	23	23	23t25		
Chemicals And Chemical Products	24	24	24			
Rubber And Plastics Products	25	25	25			
Other Non-Metallic Mineral Products	26	26	26	26		
Basic Metals And Fabricated Metal Products	27t28	27t28	27t28	27t28		
Machinery And Equipment, N.E.C.	29	29	29	29		
Electrical And Optical Equipment	30t33	30t33	30t33	30t33		
Transport Equipment	34t35	34t35	34t35	34t35		
Manufacturing Nec; Recycling	36t37	36t37	36t37	36t37		
Electricity Gas And Water Supply	40t41	E	E	40t41	40t41	E
Construction	45	F	F	45	45	F
Sale, Maintenance And Repair of Motor Vehicles; Retail Sale of Fuel	50	50	50	50t52	50t52	GH
Wholesale, Trade And Commission Excl. Motor Vehicles	51	51	51			
Retail Trade Excl Motor Vehicles; Repair Of Household Goods	52	52	52			
Hotels And Restaurants	55	H	H	55	55	
Land Transport, Transport via Pipelines	60	60	60t63	60t63	60t64	I
Water Transport	61	61				
Air Transport	62	62				
Supporting and Auxiliary Transport Activities	63	63				
Post And Telecommunications	64	64	64	64		
Financial Intermediation	65t67	J	J	65t67	65t67	JtK
Real Estate Activities	70	70	70	70	70t74	
Renting Of M And Equipment And Other Business Activities	71t74	71t74	71t74	71t74		
Public Administration And Defense Compulsory Social Security	75	L	L	75t95	75t95	LtP
Education	80	M	M			
Health And Social Work	85	N	N			
Other Community Social And Personal Service Activities	90t93	O	O			
Private Households With Employed Persons	95	P	P			

Note: STAN basic data has 35-industry break-down (Column 3). For some countries, STAN only reported data for 23- or 11-industry (Columns 4 and 5). See Section II.C for details. GD-121 has the same breakdown as WIOD.

Table 2. ISIC Rev. 4 Industry Classification Across Sources and Link to ISIC Rev. 3

Industries	ISIC Rev. 4	EU KLEMS	STAN	ISIC Rev. 4 12- level	ISIC Rev. 3 12-level
Agriculture, Hunting, Forestry And Fishing	01t03	A	A	I1	AtB
Mining And Quarrying	05t09	B	B	I2	C
Manufacturing	10t33	C	C	I3	D
Electricity, Gas, Steam And Air Conditioning Supply	35	DtE	DtE	I4	E
Water Supply; Sewerage, Waste Management and Remediation	36t39				
Construction	41t43	F	F	I5	F
Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles	45	45	45	I6	50,52, H
Retail Trade, Except of Motor Vehicles and Motorcycles	47	47	47		
Accommodation and Food Service Activities	55t56	I	I		
Wholesale, except of Motor Vehicles and Motorcycles	46	46	46	I7	51
Information and Communication	58t63	J	J		
Land Transport and Transport Via Pipelines	49	49t52	49t52	I8	60t63
Water Transport	50				
Air Transport	51				
Warehousing and Support Activities for Transportation	52				
Postal and Courier Activities	53	53	53	I9	64
Financial and Insurance Activities	64t66	K	K	I10	J
Real Estate Activities, Renting and Business Activities		L	L	I11	70t74
Professional, Scientific, Technical, Administrative and Support Services	68t82	M-N	M-N		
Community Social and Personal Services	84t99	OtT	OtT	I12	LtP

Table 3. Data Sources for Value Added, Deflators and Employment by Country

	WIOD	EU KLEMS/ WKLEMS	STAN	GGDC/ GD121
Argentina				1989-2005
Australia	1995-2009	1989-1994		
Austria	1995-2009	1989-1994 2010§	2011§	
Belgium	1995-2009	1989-1994 2010§	2011§	
Bolivia*				1989-2005
Brazil	1995-2009			1989-1994
Bulgaria	1995-2009			
Canada	1995-2009	1989-1994		
Chile				1989-2005
China	1995-2009			1989-1994
Colombia*				1989-2005
Costa Rica*				1989-2005
Cyprus	1995-2009			
Czech Republic	1995-2009			
Denmark	1995-2009	1989-1994		
Estonia	1995-2009			
Finland	1995-2009	1989-1994 2010-2012§		
France	1995-2009	1989-1994		
Germany	1995-2009	1989-1994 2010§		
Greece	1995-2009	1989-1994		
Hungary	1995-2009	1992-1994		
Iceland*			1991-2008	
India	1995-2009			1989-1994
Indonesia	1995-2009			1989-1994
Ireland	1995-2009	1989-1994		
Israel*			2000-2008	
Italy	1995-2009	1989-1994 2010§		
Japan		1989-2009		
Korea, Rep.	1995-2009	1989-1994		
Latvia	1995-2009			
Lithuania	1995-2009			
Luxembourg	1995-2009	1989-1994		
Malta	1995-2009			
Malaysia*				1989-2005
Mexico	1995-2009			1989-1994
Netherlands	1995-2009	1989-1994 2010-2011§		
New Zealand*			1989-2008	
Norway*			1989-2009 2010-2011§	
Peru*				1991-2005
Philippines*				1989-2005
Poland	1995-2009			
Portugal	1995-2009	1989-1994		
Romania	1995-2009			
Russian Federation		1995-2009		

Note: (*) no available sectoral PLIs; (§) ISIC Rev. 4 data.

Table 3. Data Sources for Value Added, Deflators and Employment by Country (concluded)

	WIOD	EU KLEMS/ WKLEMS	STAN	GGDC/ GD121
Singapore*				1989-2005
Slovak Republic	1995-2009			
Slovenia	1995-2009			
South Africa				1989-2010
Spain	1995-2009	1989-1994		
Sweden	1995-2009	1989-1994		
Switzerland*			1991-2008	
Taiwan, Province of China*	1995-2009			1989-1994
Thailand*				1989-2005
Turkey	1995-2009			
United Kingdom	1995-2009	1989-1994 2010§		
United States		1989-2010		

Note: (*) no available sectoral PPP; (§) ISIC Rev. 4 data.

Table 4. Industry Classification: Traded (T) or Non-Traded (N)

Industries ISIC Rev. 3	Code	Classification		
		(a)	(b)	(c)
Agriculture, Hunting, Forestry And Fishing	01t05	**T**	**T**	.
Mining And Quarrying	10t14	**T**	**T**	.
Manufacturing	15t37	**T**	**T**	**T**
…Food, Beverages and Tobacco	15t16			
…Textiles and Textile	17t18			
…Leather and Footwear	19			
…Wood And Products Of Wood And Cork	20			
…Pulp, Paper, Paper Products, Printing And Publishing	21t22			
…Coke, Refined Petroleum Products And Nuclear Fuel	23			
…Chemicals And Chemical Products	24			
…Rubber And Plastics Products	25			
…Other Non-Metallic Mineral Products	26			
…Basic Metals And Fabricated Metal Products	27t28			
…Machinery And Equipment, N.E.C.	29			
…Electrical And Optical Equipment	30t33			
…Transport Equipment	34t35			
…Manufacturing Nec; Recycling	36t37			
Electricity Gas And Water Supply	40t41	N	N	N
Construction	45	N	N	N
Sale, Maintenance And Repair Of Motor Vehicles; Retail Sale Of Fuel	50	N	N	N
Wholesale, Trade And Commission Excl. Motor Vehicles	51	**T**	N	N
Retail Trade Excl. Motor Vehicles; Repair Of Household Goods	52	N	N	N
Hotels And Restaurants	55	N	N	N
Land Transport, Transport via Pipelines	60	**T**	N	N
Water Transport	61	**T**	N	N
Air Transport	62	**T**	N	N
Supporting and Auxiliary Transport Activities	63	**T**	N	N
Post And Telecommunications	64	N	N	N
Financial Intermediation	65t67	**T**	N	N
Real Estate Activities	70	N	N	N
Renting Of Machinery And Eq. And Other Business Activities	71t74	**T**	N	N
Public Administration And Defense Compulsory Social Security	75	N	N	N
Education	80	N	N	N
Health And Social Work	85	N	N	N
Other Community Social And Personal Service Activities	90t93	N	N	N
Private Households With Employed Persons	95	N	N	N

Table 5. Productivity of Traded and Non-Traded Sectors by Group of Countries

Benchmark	Traded		Non-Traded		Differential	
	Level	Change	Level	Change	Level	Change
All Sample	56263	3.2%	43406	1.0%	26%	2.2%
Euro Area	79710	1.9%	58838	0.5%	30%	1.5%
Other OECD	88722	2.7%	54180	0.8%	49%	1.9%
Asia	28581	4.8%	28142	2.6%	2%	2.2%
Latin America	32946	2.9%	19510	0.2%	52%	2.6%
Transition	29591	4.5%	34531	1.4%	-15%	3.2%
Goods-Producing	Traded		Non-Traded		Differential	
	Level	Change	Level	Change	Level	Change
All Sample	57368	3.7%	47914	1.2%	18%	2.5%
Euro Area	79470	2.3%	65624	0.7%	19%	1.6%
Other OECD	107553	3.4%	61419	1.2%	56%	2.2%
Asia	29820	5.2%	28885	2.7%	3%	2.5%
Latin America	31671	3.5%	22089	0.3%	36%	3.2%
Transition	22437	5.2%	37020	1.6%	-50%	3.6%
Manufacturing	Traded		Non-Traded		Differential	
	Level	Change	Level	Change	Level	Change
All Sample	61571	3.4%	47914	1.2%	25%	2.2%
Euro Area	90393	2.2%	65624	0.7%	32%	1.5%
Other OECD	93465	2.9%	61419	1.2%	42%	1.7%
Asia	41980	5.4%	28885	2.7%	37%	2.7%
Latin America	32825	2.6%	22089	0.3%	40%	2.3%
Transition	26774	4.9%	37020	1.6%	-32%	3.3%

Note: "Level" is Value Added per engaged person in 2005 PPP USD except for the “Differential” which is the natural logarithm of the ratio of average productivity levels in the traded and non-traded sectors in %, “Change” is the average yearly change in %. Euro Area: Austria, Belgium, France, Germany, Italy, Luxembourg, Netherlands, Finland, Greece, Ireland, Malta, Portugal, Spain and Cyprus; Other OECD: United States, United Kingdom, Denmark, Sweden, Canada, Turkey, Australia; Asia: China, Indonesia, India, Japan and Korea; Latin America: Argentina, Brazil, Chile and Mexico; Transition: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russian Federation, Slovak Republic and Slovenia.

Figure 1. Price Levels of Traded and Non-Traded Sectors in 2005 (US GDP=1)

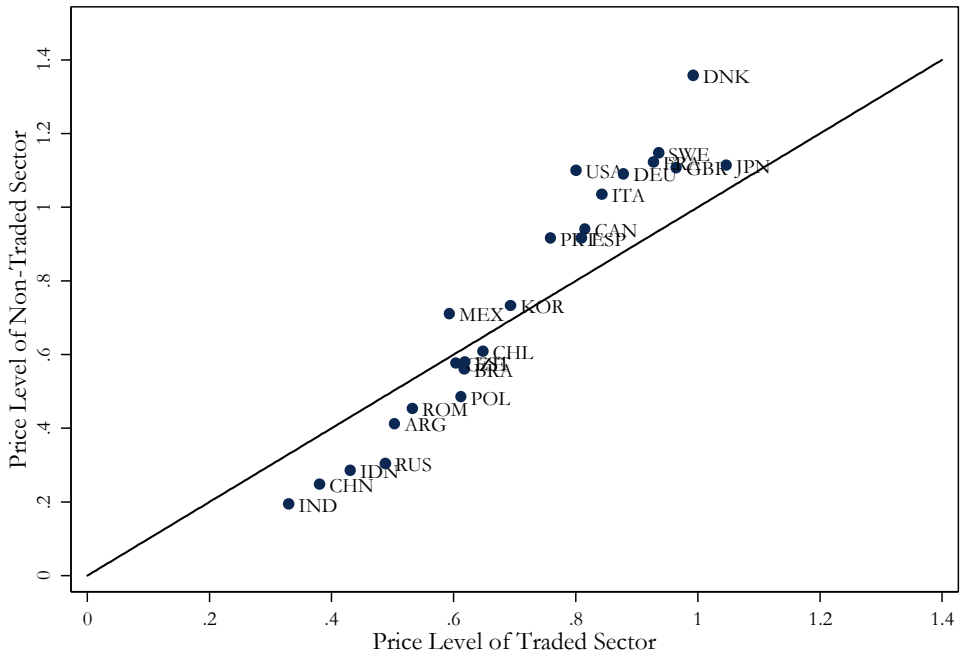


Figure 2. Ratio of PPP-adjusted to unadjusted ("Market") Productivity in 2005

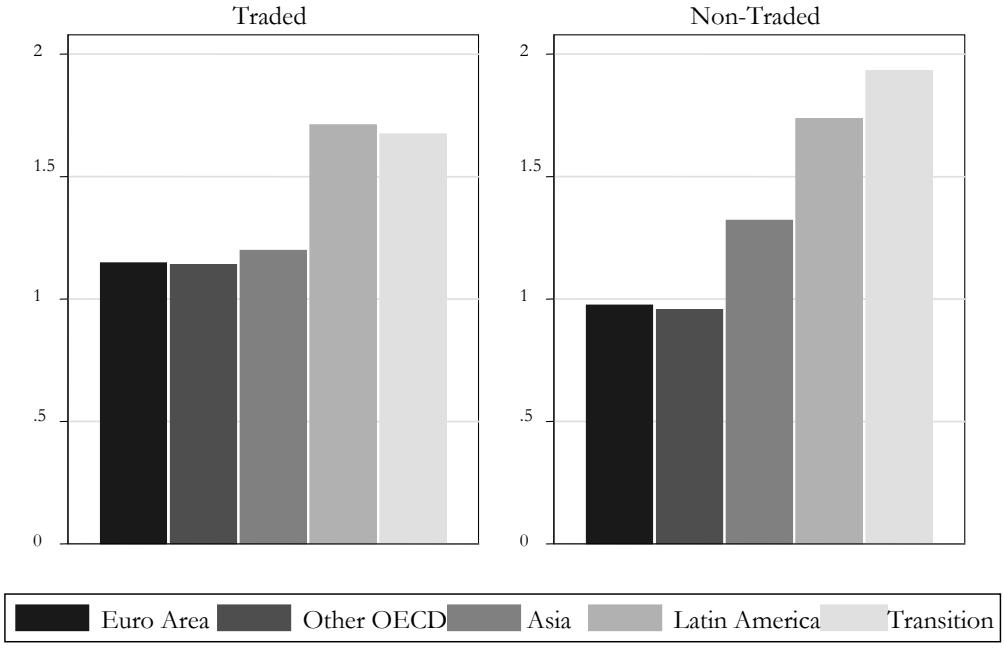
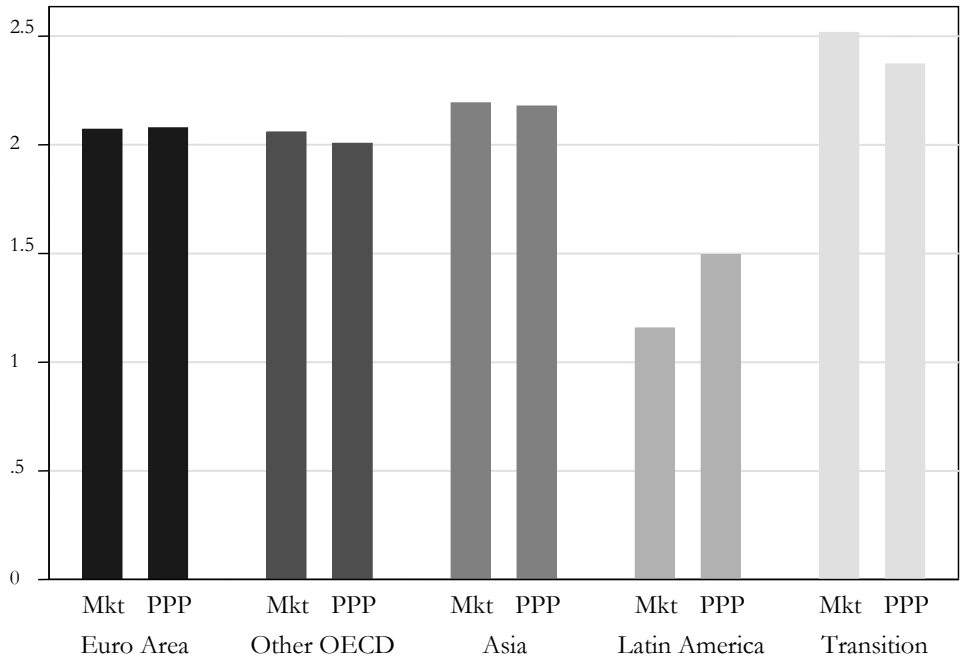
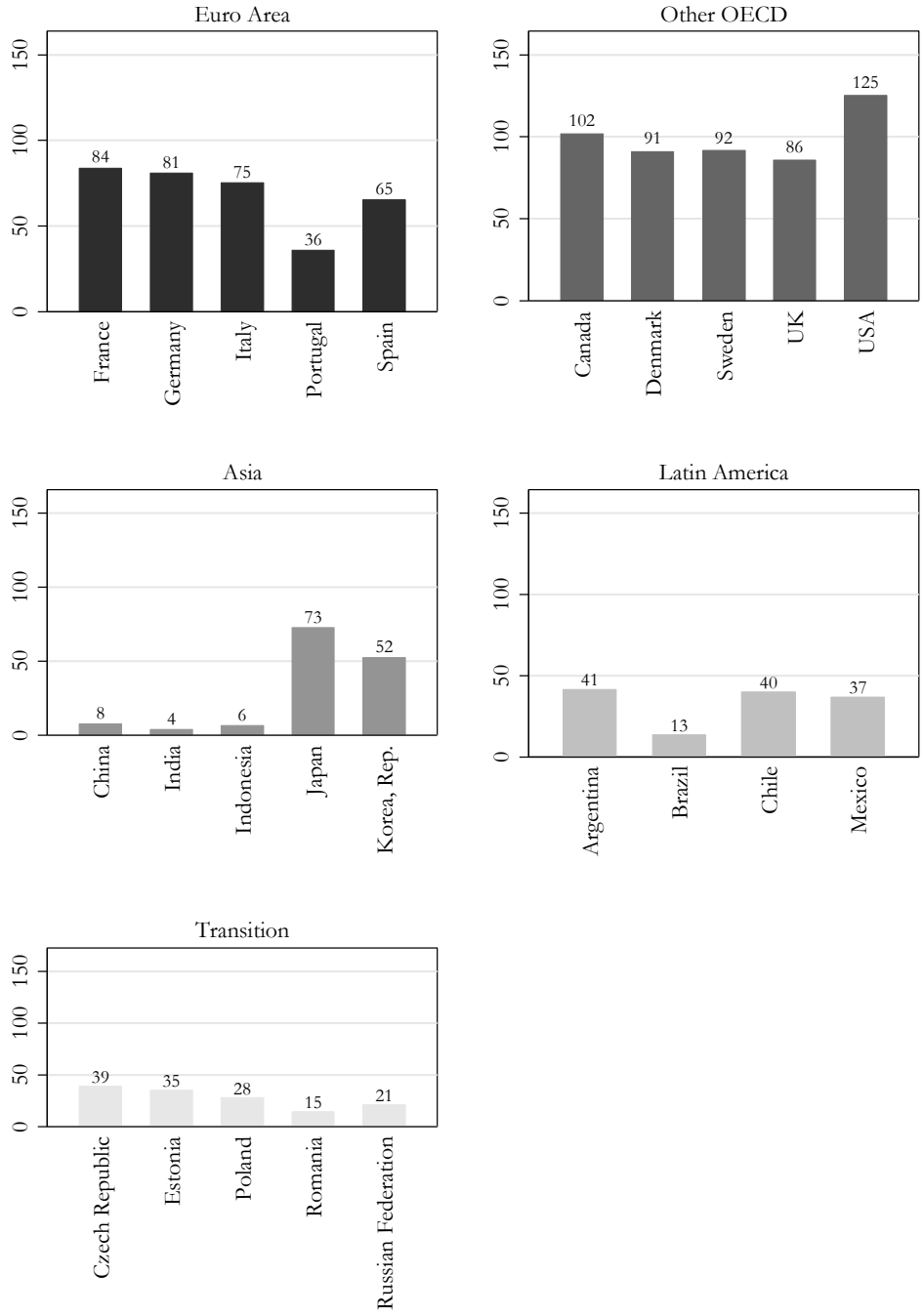


Figure 3. Productivity Differential Growth Rate, 1990–2012[16], unadjusted ("Mkt") and PPP-adjusted, %



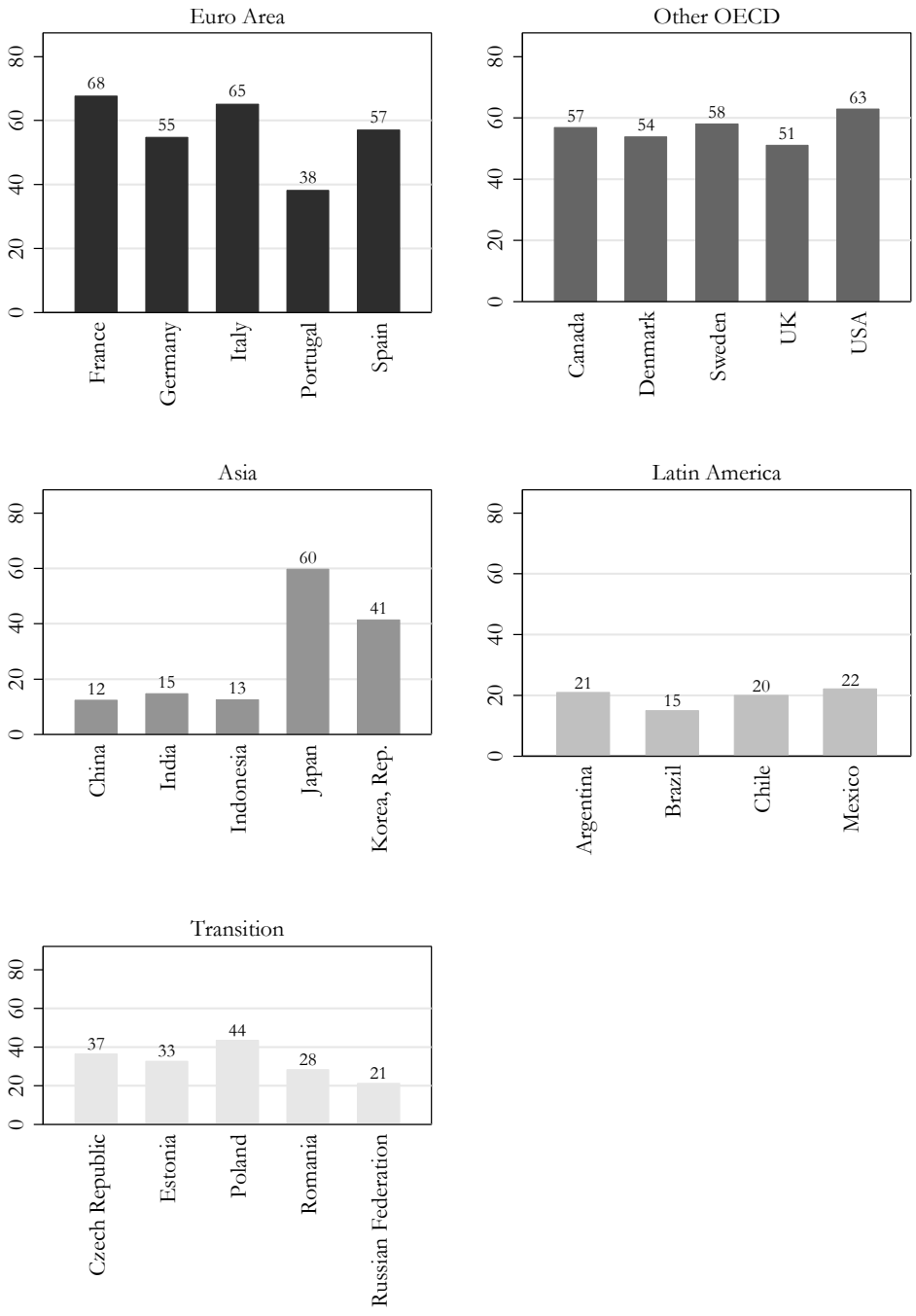
[16] Or largest sample available.

Figure 4A. Traded Sector Productivity in 2005, th. USD PPP per worker



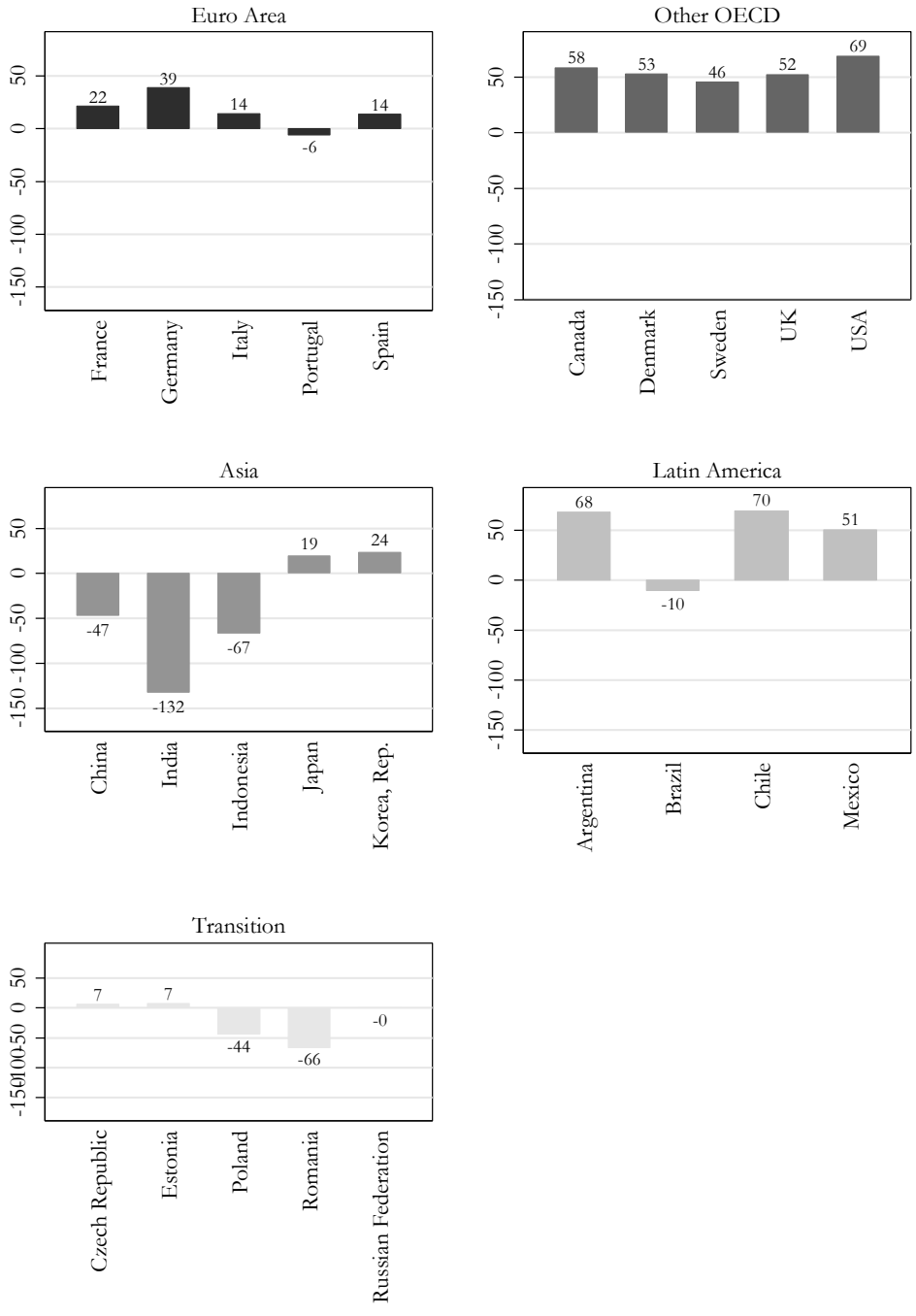
Note: Under "Benchmark" classification as defined in Table 4.

Figure 4B. Non-Traded Sector Productivity in 2005, th. USD PPP per worker



Note: Under "Benchmark" classification as defined in Table 4.

Figure 4C. Log Productivity Differential between Traded and Non-Traded Sector in 2005, %



Note: Under "Benchmark" classification as defined in Table 4.

Figure 5. Evolution of Productivity in the Traded and Non-Traded Sectors (2005 = 100)
Note change of scale from left to right panels

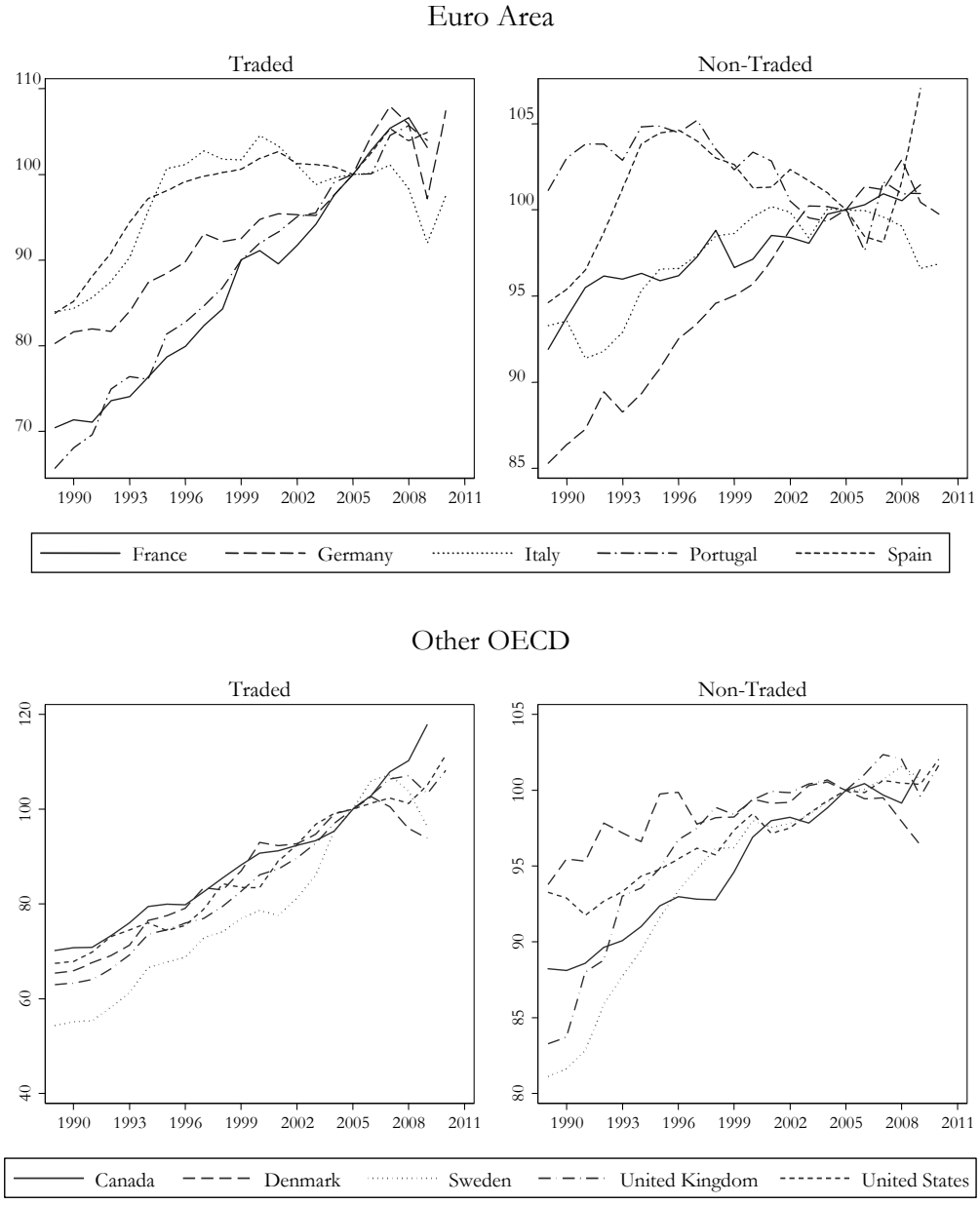
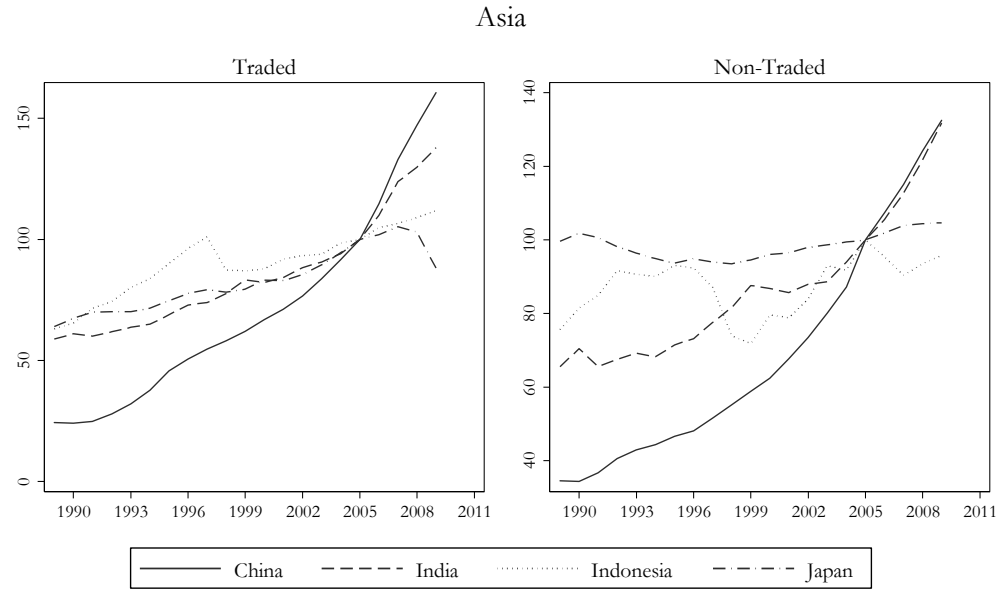


Figure 5. Evolution of Productivity in the Traded and Non-Traded Sectors (2005 = 100)
Note change of scale from left to right panels (continued)



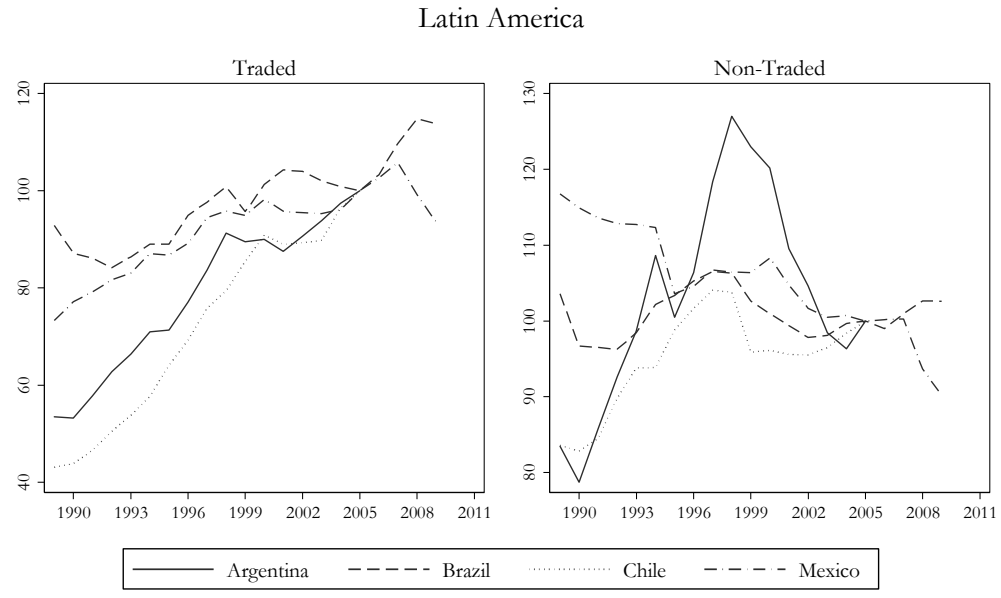


Figure 5. Evolution of Productivity in the Traded and Non-Traded Sectors (2005 = 100) Note change of scale from left to right panels (concluded)

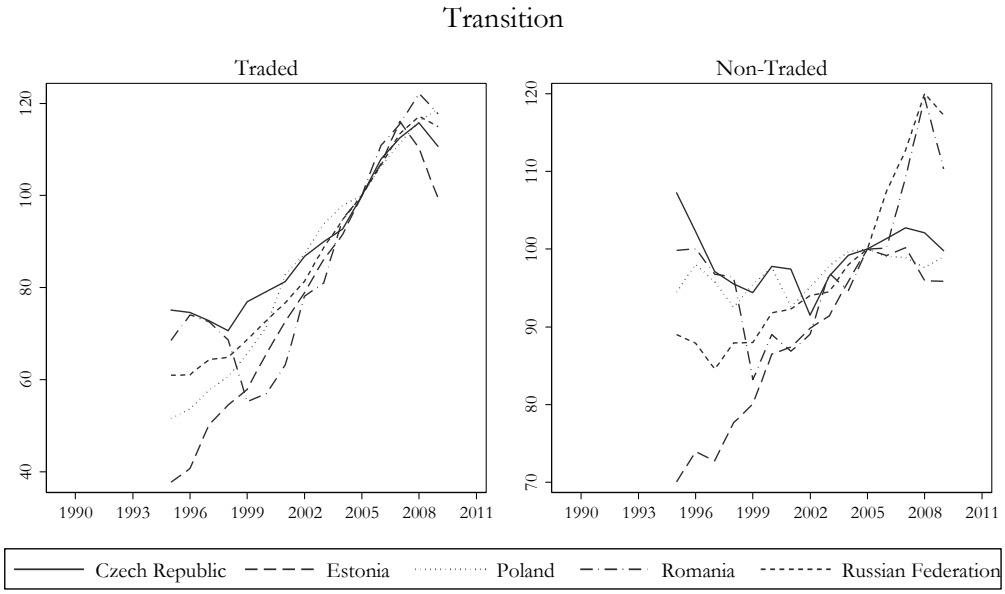
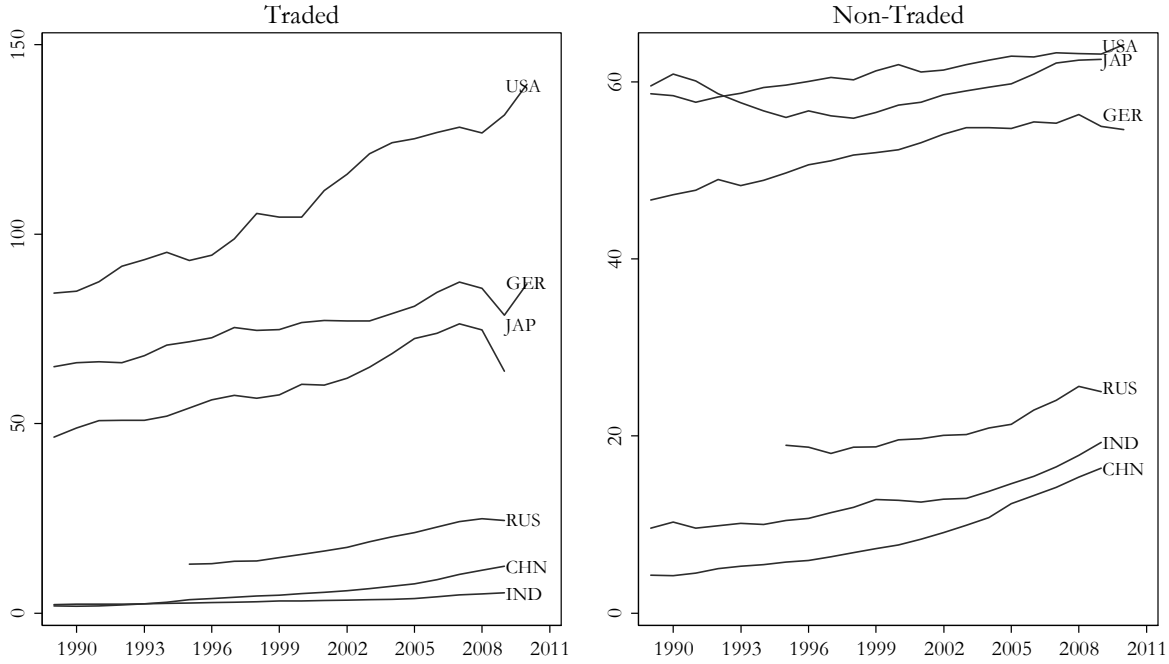
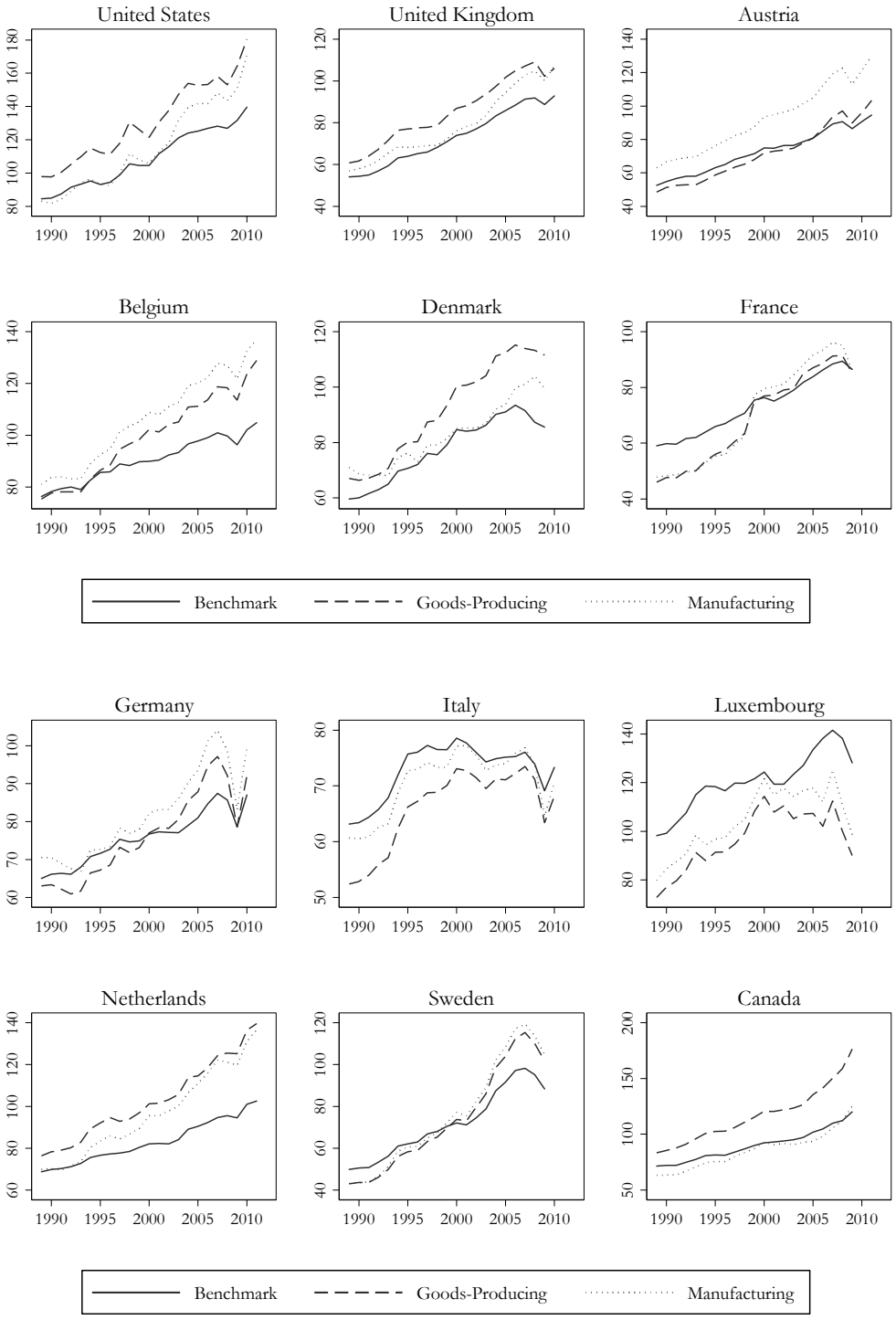


Figure 6. Productivity in the Traded and Non-Traded Sectors, th. USD PPP per worker. Note change of scale from left to right panels



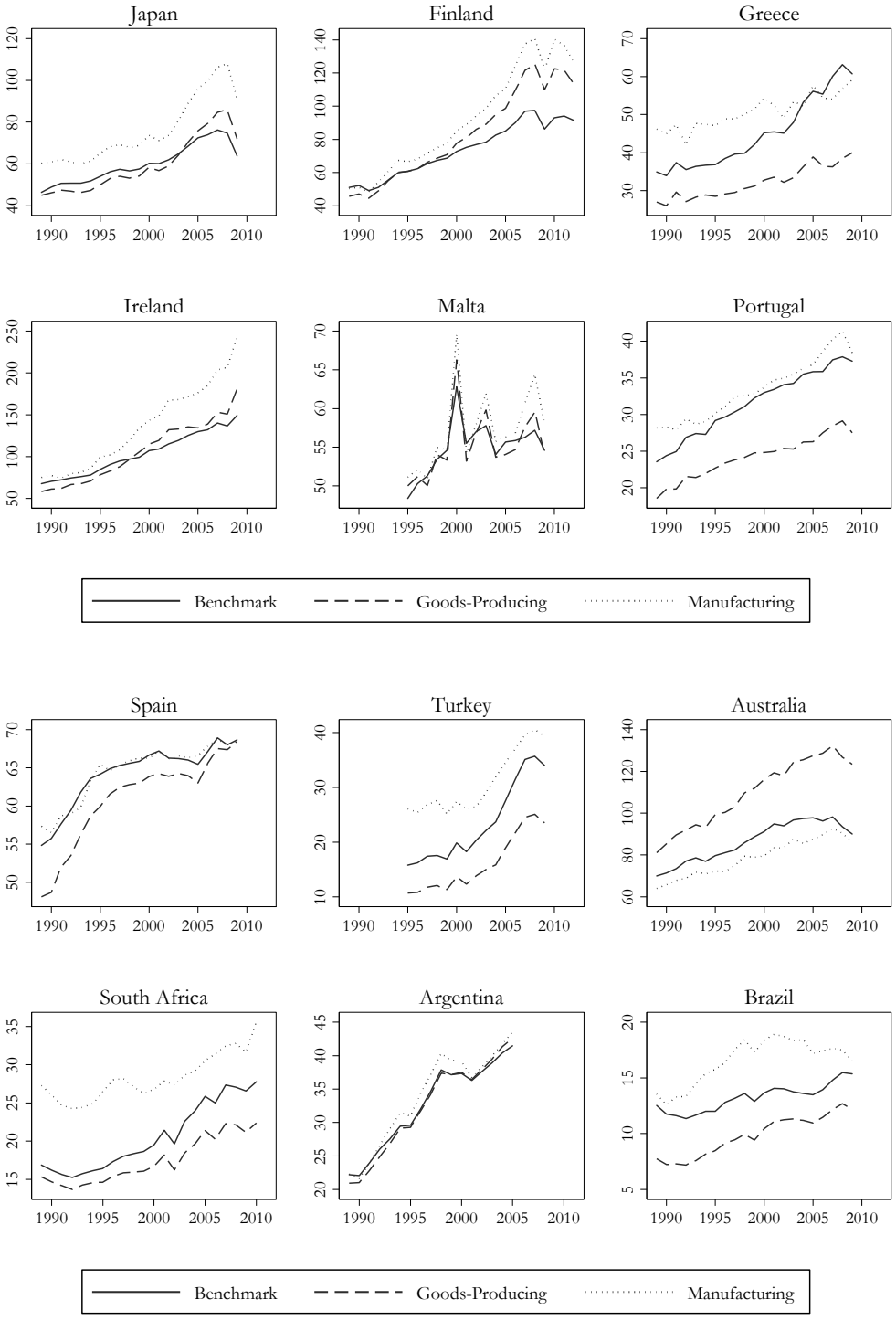
I. APPENDIX

Figure A1. Productivity in the Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications



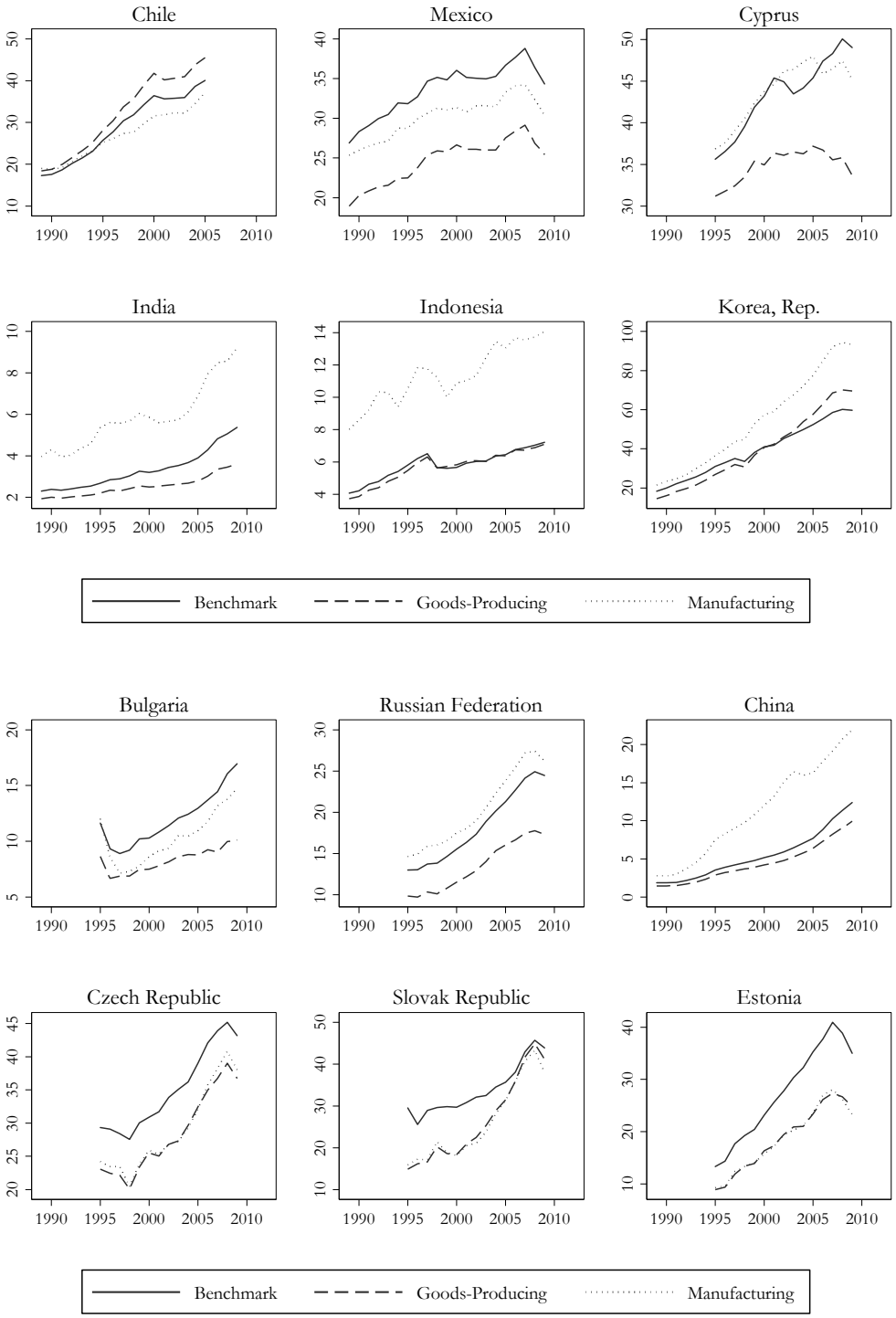
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A1. Productivity in the Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (continued)



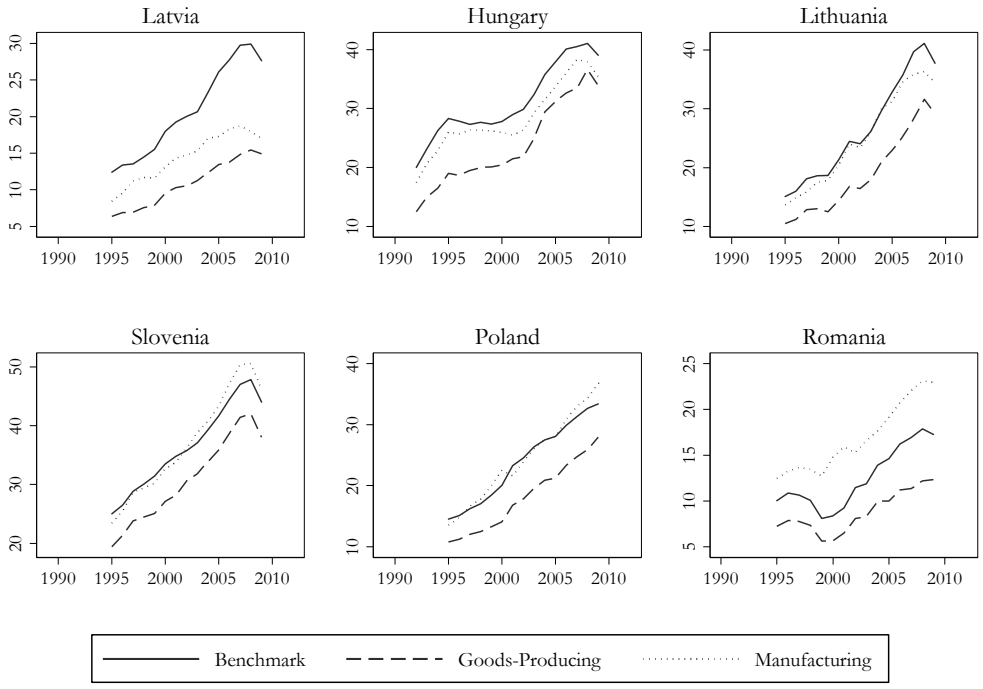
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A1. Productivity in the Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (continued)



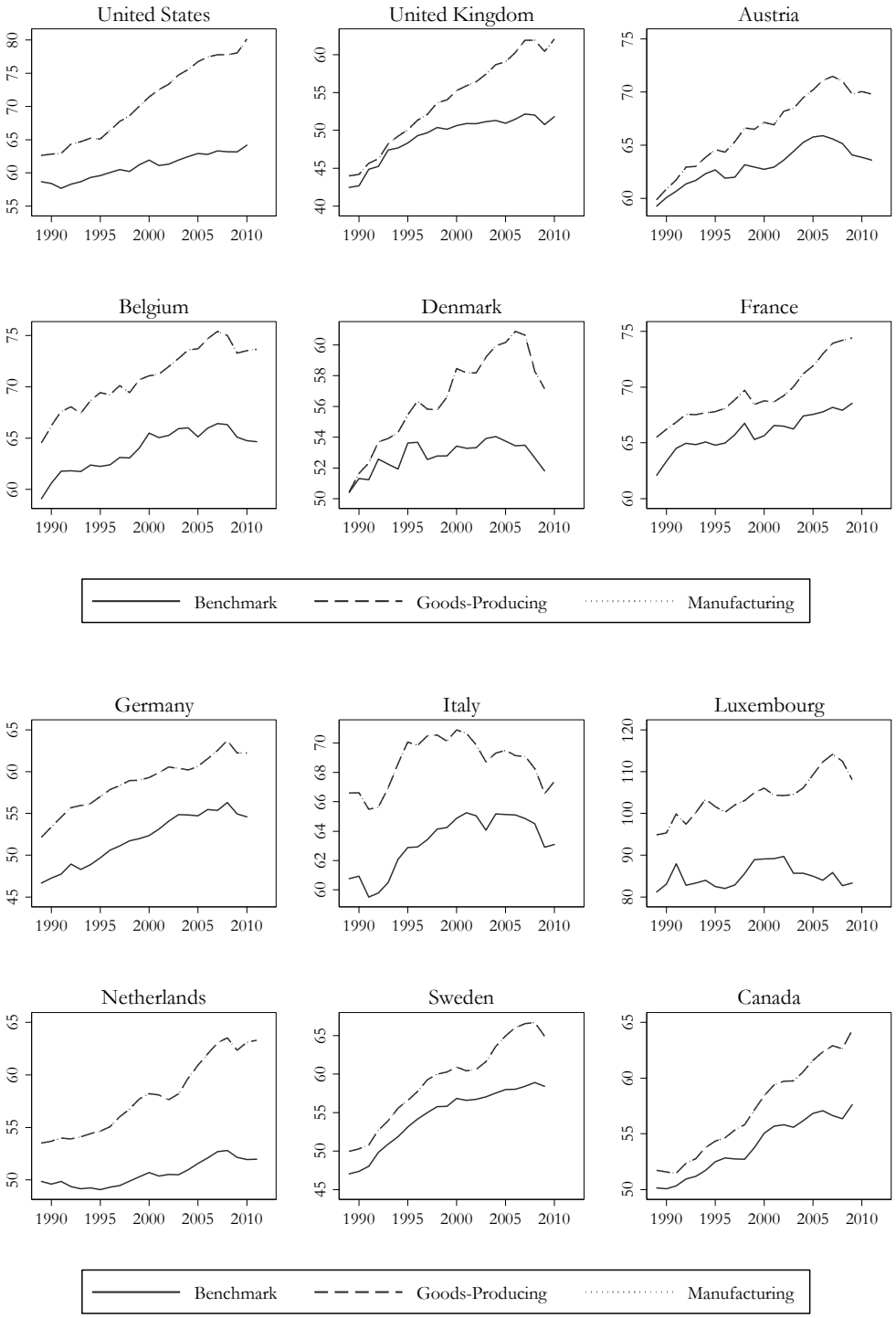
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A1. Productivity in the Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (concluded)



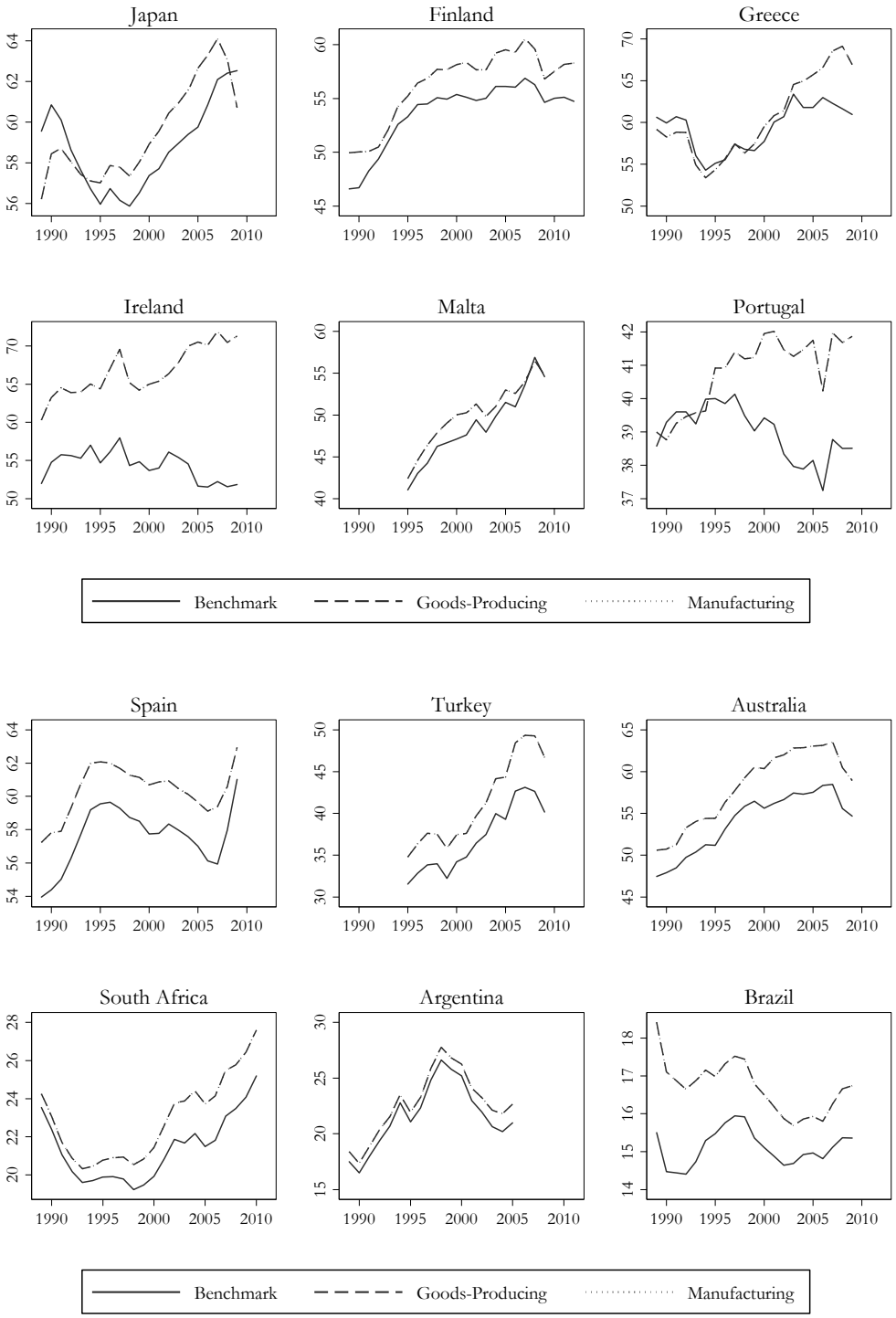
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A2. Productivity in the Non-Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications



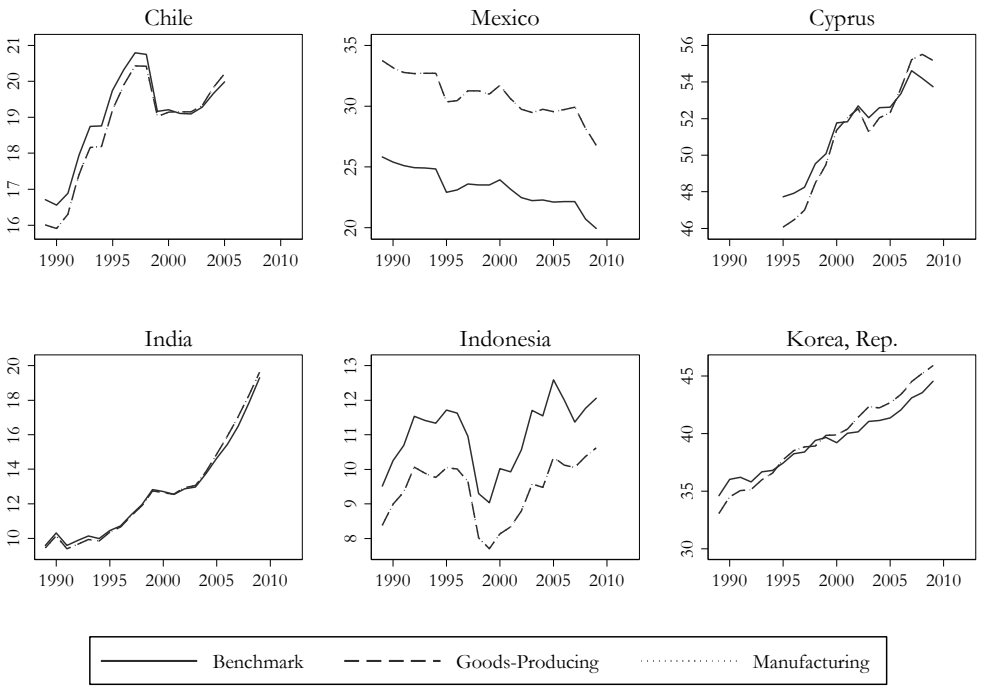
Note: Classifications "Goods-Producing" and "Manufacturing" define the non-traded sector in the same way (see Table 4).

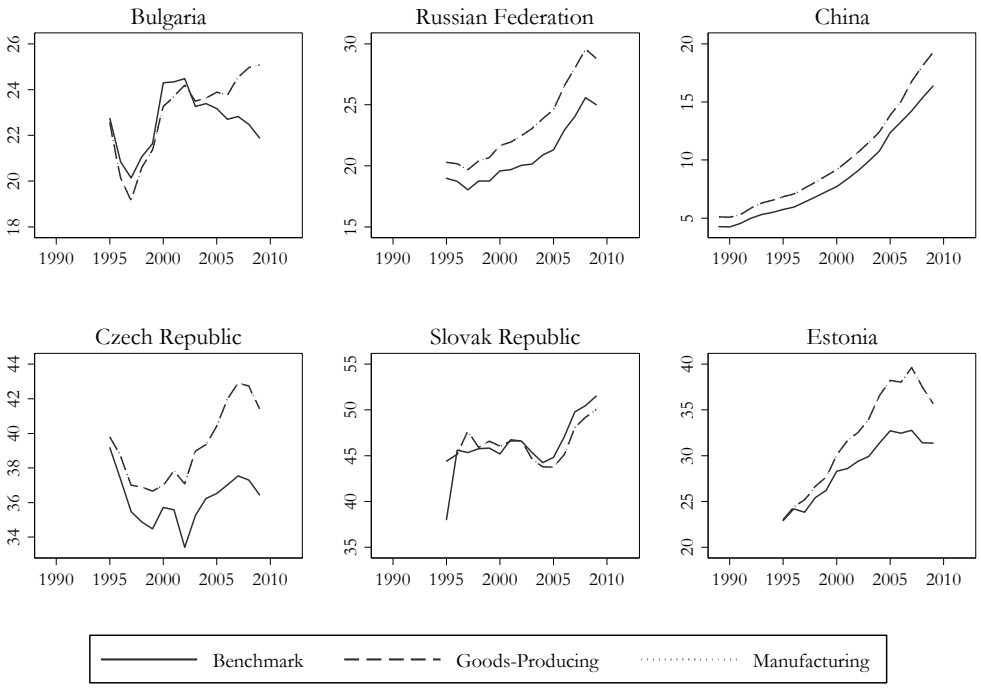
Figure A2. Productivity in the Non-Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (continued)



Note: Classifications "Goods-Producing" and "Manufacturing" define the non-traded sector in the same way (see Table 4).

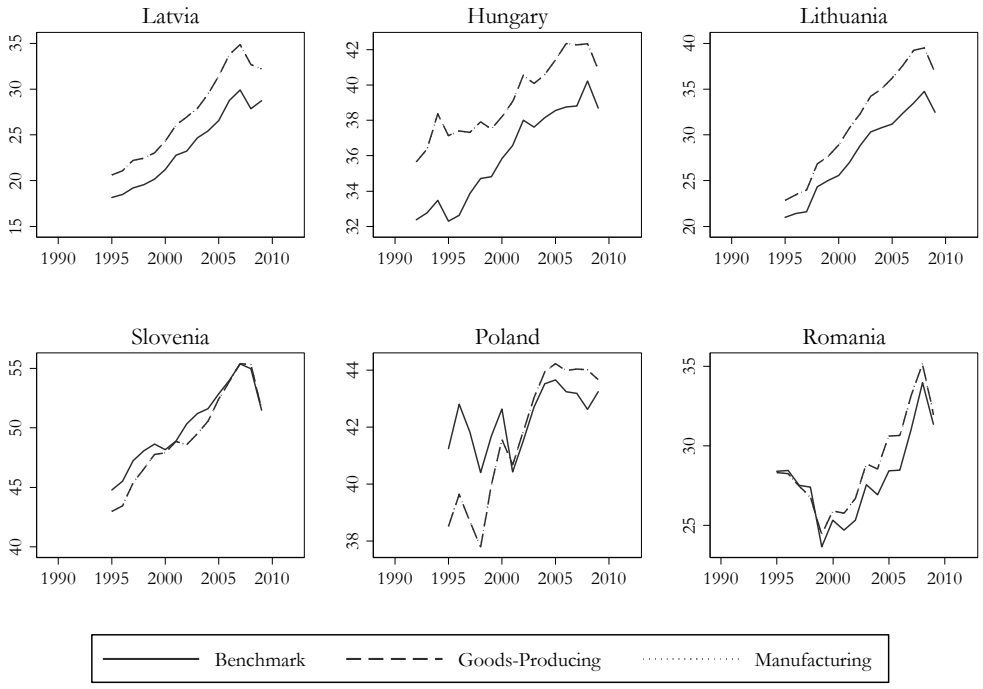
Figure A2. Productivity in the Non-Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (continued)





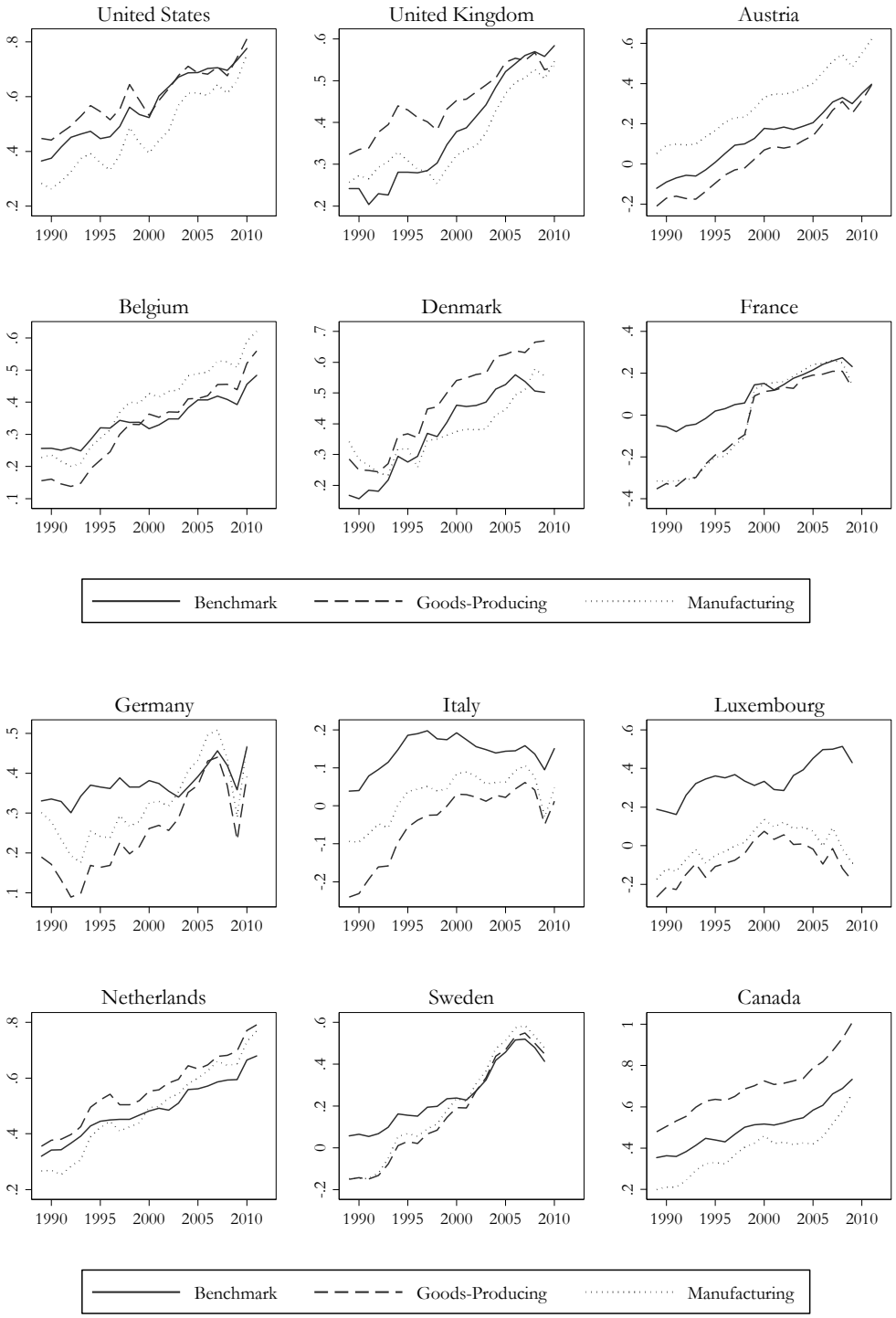
Note: Classifications "Goods-Producing" and "Manufacturing" define the non-traded sector in the same way (see Table 4).

Figure A2. Productivity in the Non-Traded Sector in 2005 PPP th. USD Across Alternative Industry Classifications (concluded)



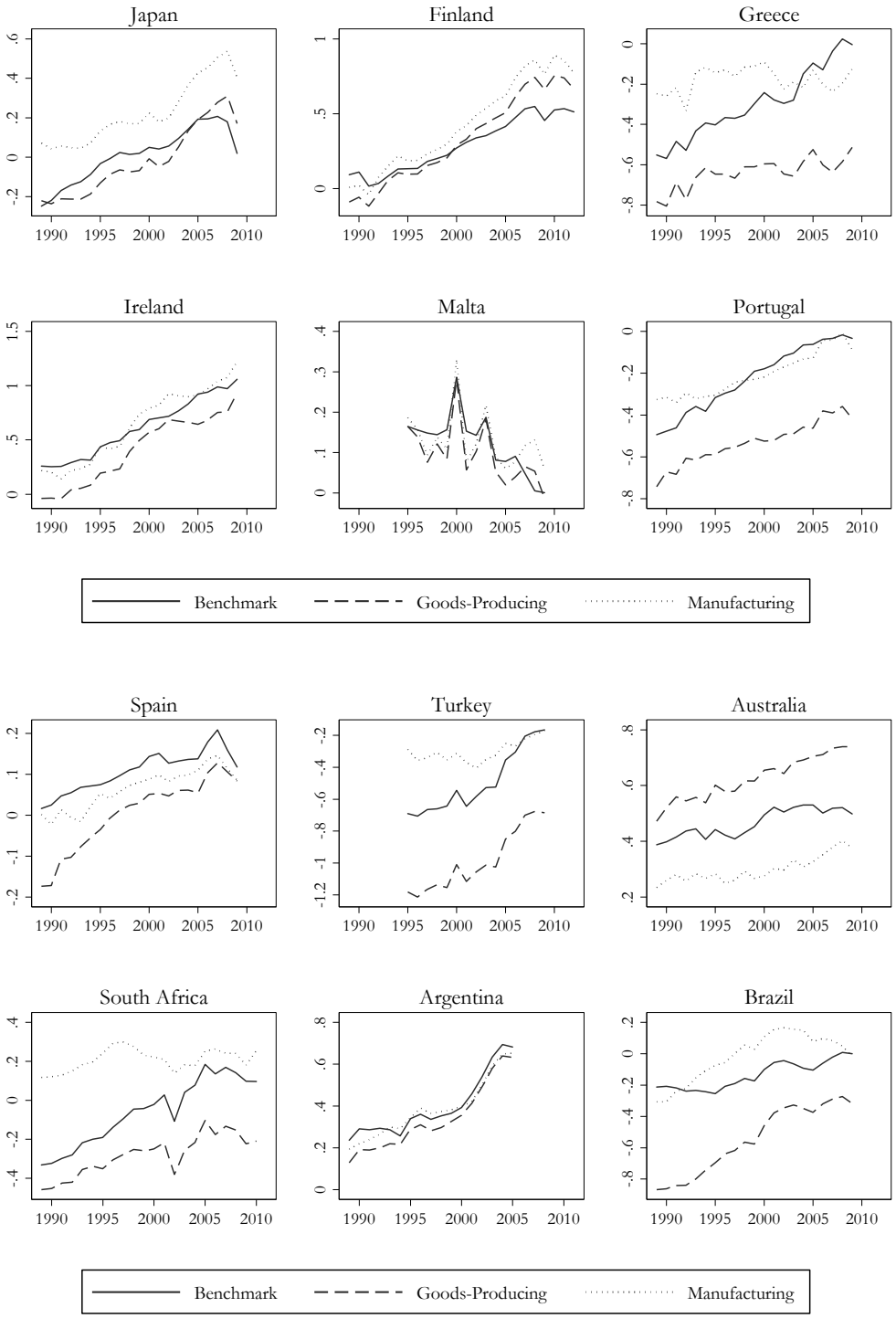
Note: Classifications "Goods-Producing" and "Manufacturing" define the non-traded sector in the same way (see Table 4).

Figure A3. Productivity Differential in 2005 PPP th. USD Across Alternative Industry Classifications



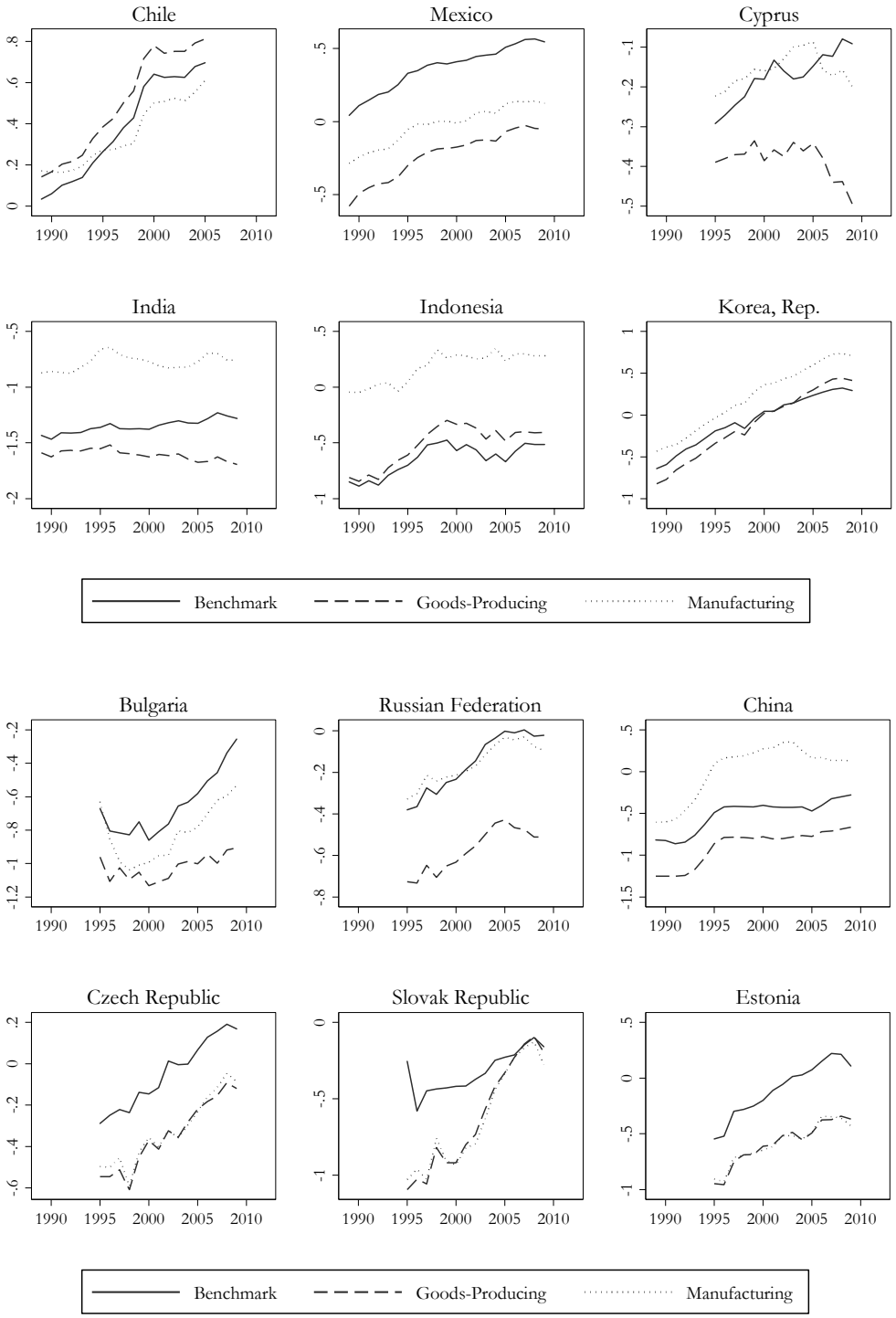
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A3. Productivity Differential in 2005 PPP th. USD Across Alternative Industry Classifications (continued)



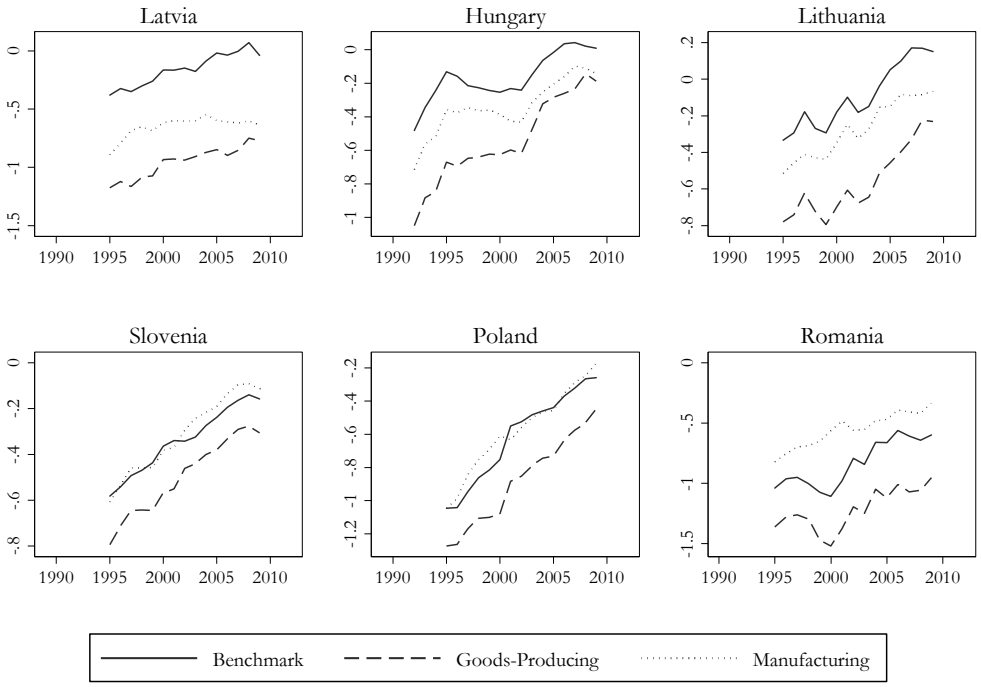
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A3. Productivity Differential in 2005 PPP th. USD Across Alternative Industry Classifications (continued)



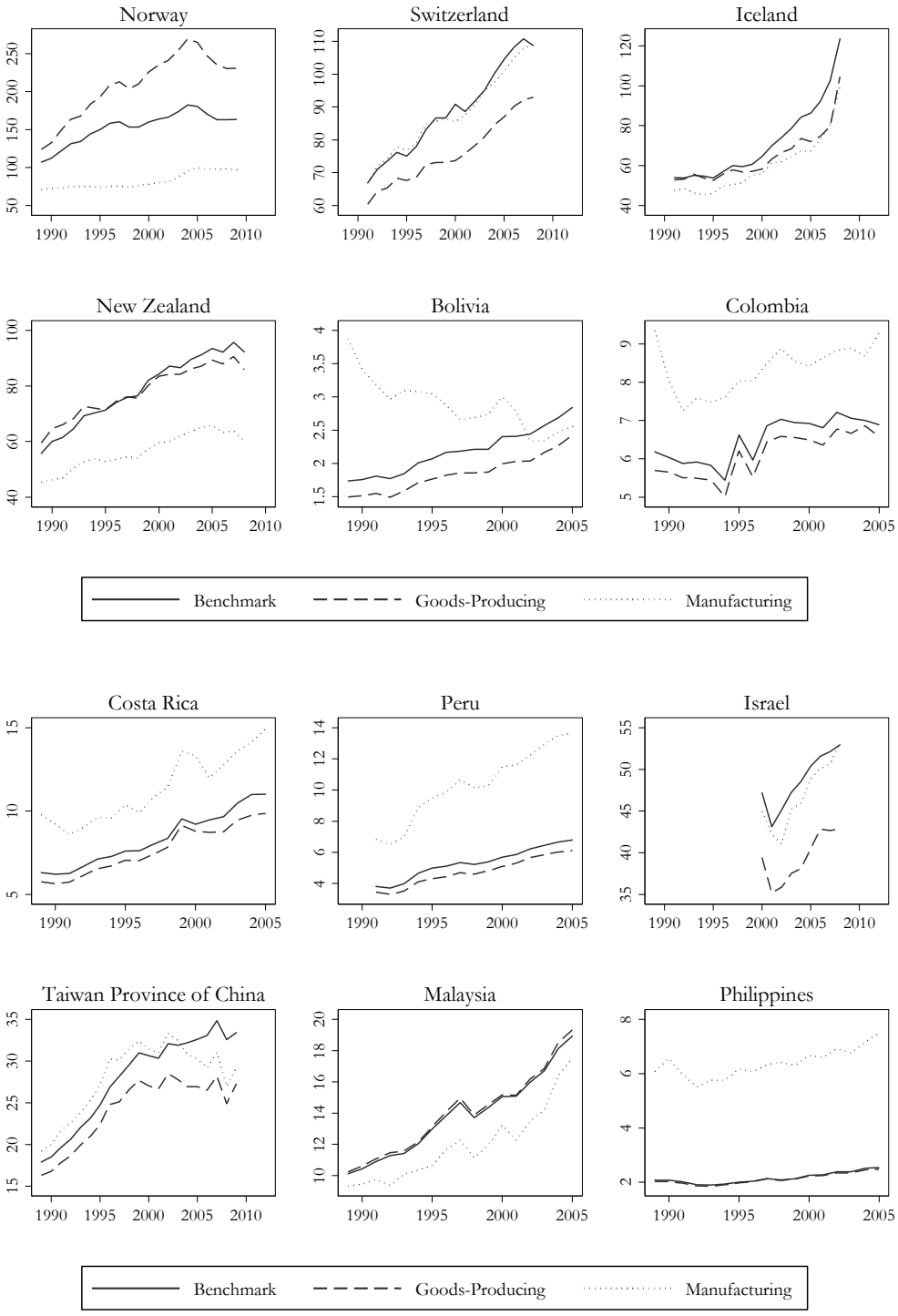
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A3. Productivity Differential in 2005 PPP th. USD Across Alternative Industry Classifications (concluded)



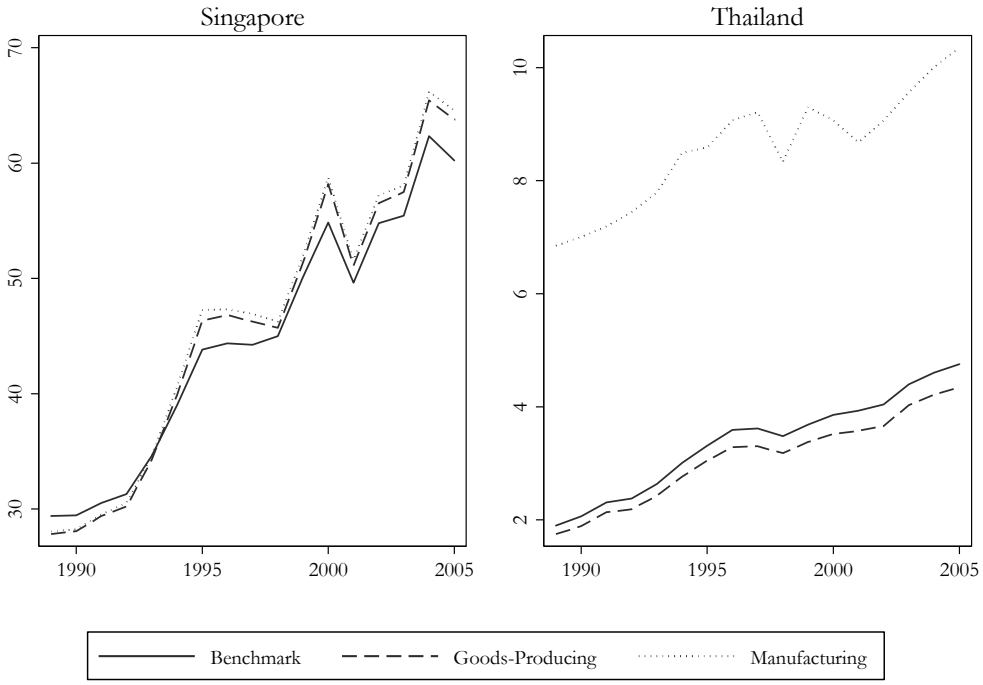
Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A4. Productivity in the Traded Sector in 2005 th. USD Across Alternative Industry Classifications



Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A4. Productivity in the Traded Sector in 2005 th. USD Across Alternative Industry Classifications (concluded)



Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A5. Productivity in the Non-Traded Sector in 2005 th. USD Across Alternative Industry Classifications

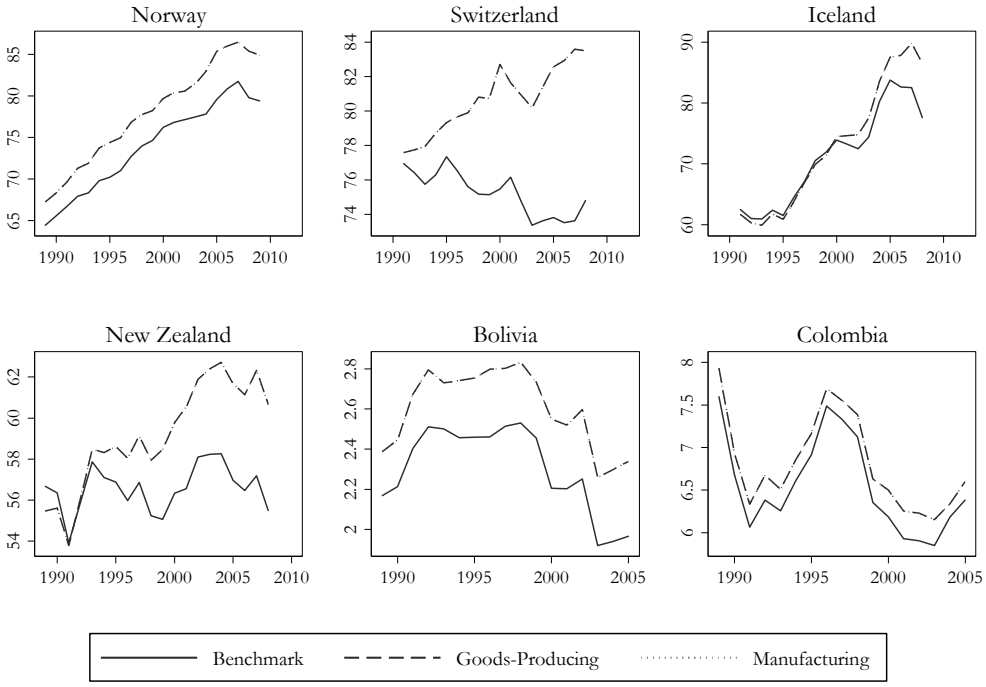
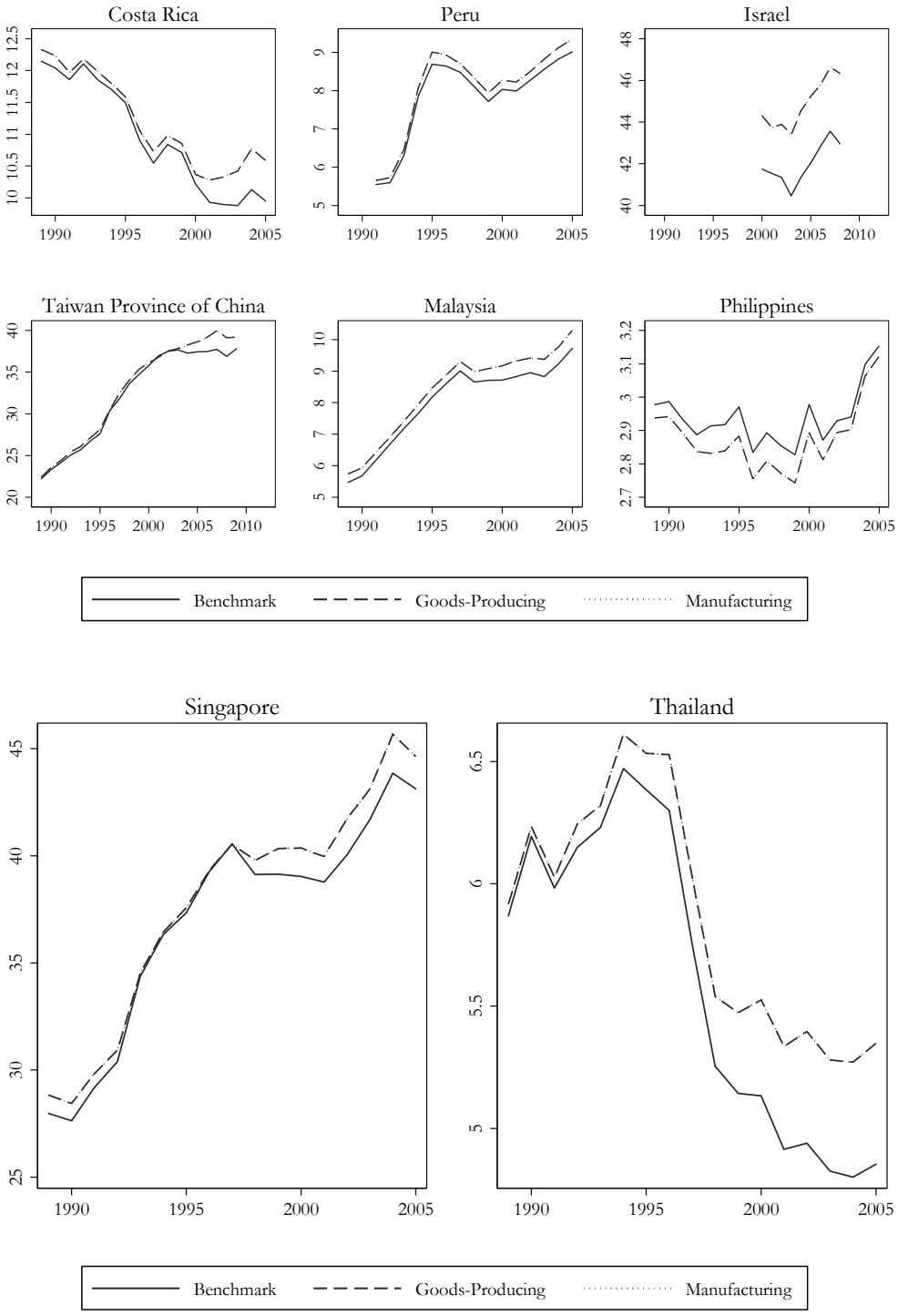
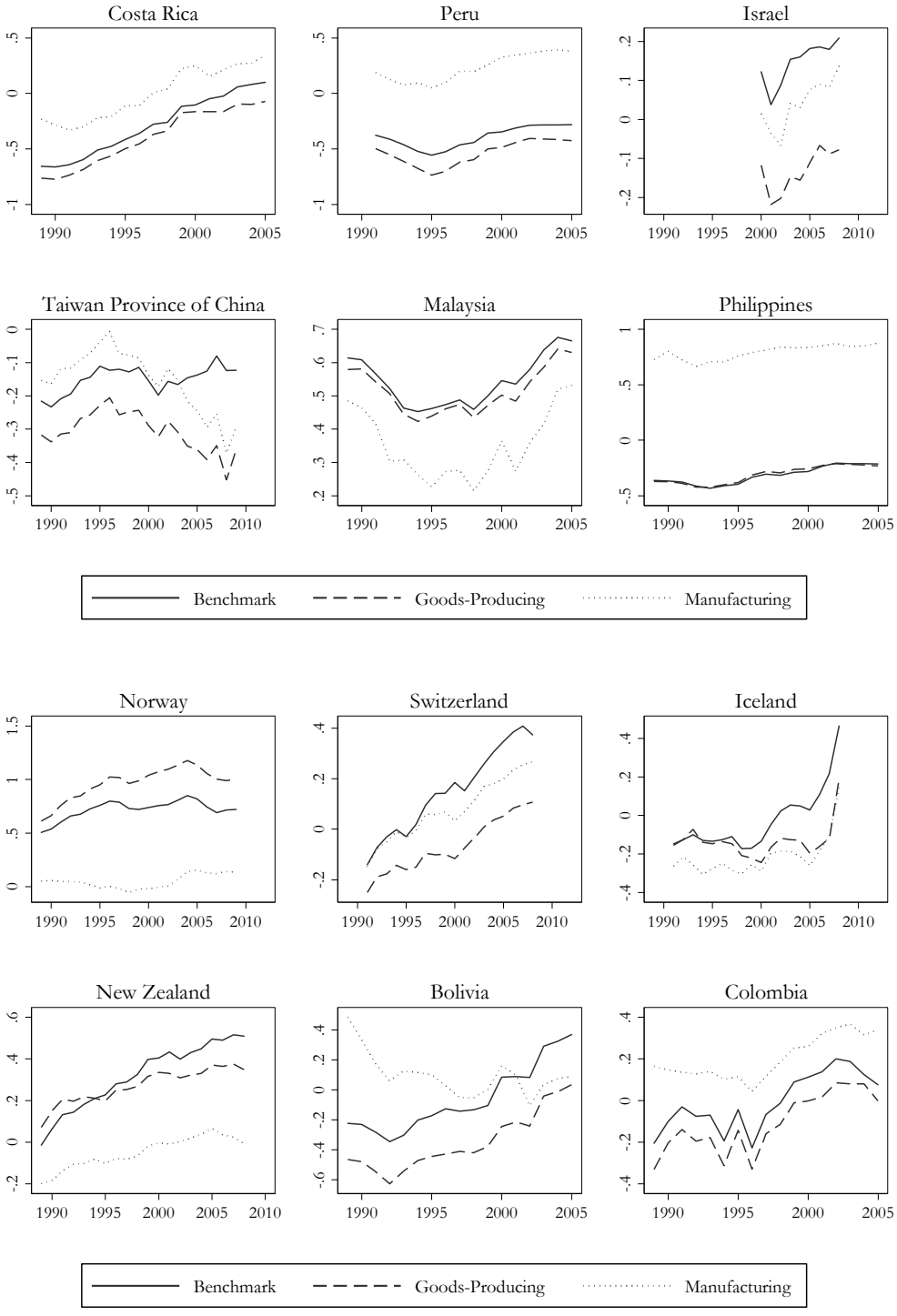


Figure A5. Productivity in the Non-Traded Sector in 2005 th. USD Across Alternative Industry Classifications (concluded)



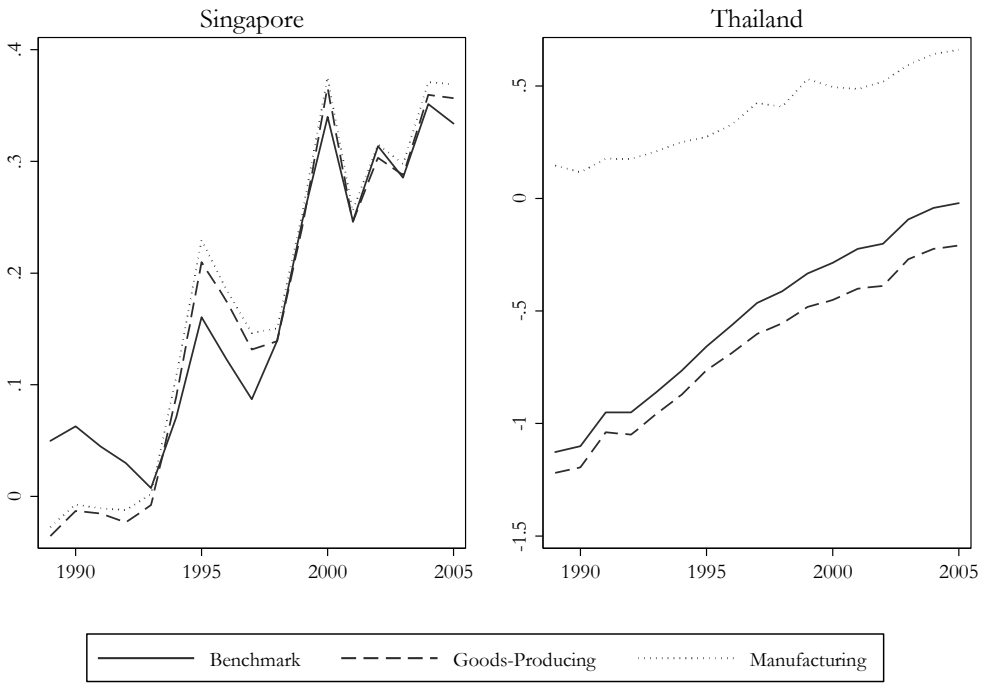
Note: Classifications "Goods-Producing" and "Manufacturing" define the non-traded sector in the same way (see Table 4).

Figure A6. Productivity Differential Across Alternative Industry Classifications



Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.

Figure A6. Productivity Differential in 2005 th. USD Across Alternative Industry Classifications (concluded)



Note: Classifications "Benchmark", "Goods-Producing" and "Manufacturing" are defined in Table 4.