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ECONOMIC SHOCKS AND CHANGES IN GLOBAL PRODUCTION STRUCTURE: METHODS FOR MEASURING ECONOMIC RESILIENCE

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March 2017

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Keywords: Economic resiliency, Structural changes, Input-output, Global value chains

JEL classification: C14, D57, E12, F47

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Conventional studies into the impacts of economic shocks using global input-output tables (sensitivity analyses) assume stable production structures and thus, only reveal the marginal impacts of changes in final demand. However, when economic shocks occur, whether at home or abroad, economic agents are expected to react to reduce the negative impact or amplify the positive effects. The ability of a country to contain economic losses can be defined as the resilience to economic shocks. Using the OECD's annual Inter-Country Input-Output (ICIO) tables, 1995 to 2011, this paper investigates the relationship between changes in final demand and production structures for 61 economies. Our findings are summarized as follows. Production and final demand structures tend to change to reduce the negative feedbacks from final demand shocks. During economic downturns, structures tend to change so that the dependency on domestic services increases, while the dependency on domestic demand for goods, and the dependency on foreign demand for domestic goods and services, both decrease. Therefore, the domestic service sector seems to play a key role in temporarily containing the negative feedback. Countries that are able to prop up their economy by domestic service sectors instead of domestic goods and foreign sectors are more resilient to negative economic shocks.

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* This represents views of authors and not necessarily those of the OECD and IDE-JETRO.

1. Introduction

In recent years, economies of most countries have become more dependent on final demand abroad and foreign intermediate supplies. According to the literature on business cycle synchronization via production networks, idiosyncratic shocks to firms or disaggregated sectors do not remain confined to where they originate, rather such shocks may propagate to the whole economy, affecting the output of other sectors and regions (Acemoglu, et al., 2012; Carvalho, 2014; Roson and Sartori, 2016). And rising trade intensities among countries has led to more inter-country synchronization of business cycles (Rana, et al 2012; Berdiev and Chang, 2015). These findings imply that economic shocks are no longer confined in a country, rather cascade to other countries, and that the structure of global production networks is likely to affect economic resilience, i.e., the ability of a country to alleviate economic losses in the aftermath of shocks.

When an economic crisis or a devastating natural disaster occurs, final expenditure (i.e., GDP consisting consumption, investment and inventories) decreases. Most reactions of public agencies to such negative shocks are on final demand-side. For example, public agencies are expected to increase public final expenditure and investment, to support private investment by changing interest rates, to make a stimulus package for household consumption, and/or to provide tax incentives and subsidies on production and products. On the other hand, firms' reactions are expected to change the production structures. For example, firms are likely to change the amount of mixed income, labour and capital inputs, labour-capital ratio, and/or procurement patterns. At macro-economic level, these changes in economic agents' behaviour can bring about changes in the economic supply and demand structure, and can be associated with the degree of economic resilience.

Although conventional studies using global input-output tables (sensitivity analyses) are useful to evaluate the impact of economic shocks, [1] they assume stable production structures and thus, only reveal the marginal impacts of changes in final demand. As mentioned above, however, when economic shocks occur, whether at home or abroad, economic agents are expected to react to reduce the negative feedbacks or amplify the positive effects. Does the structure change to reduce the effect of the shocks or to amplify them? Using the OECD's annual Inter-Country Input-Output (ICIO) tables, 1995 to 2011, this study investigates the relationship between economic shocks and structural changes, and examines whether the structural changes contribute to containing the negative feedbacks from economic shocks.

Our empirical approach has two steps. First, we estimate predicted value-added based on a counter-factual model which is constructed under the assumption that production and final demand structure remains the same with the previous year. The difference between the actual and predicted values indicates the contribution of structural changes. If this difference is positive, it means that the production and final demand structures tend to change to increase value added, and vice versa. Second, we investigate the actual-predicted values using econometric tools with two approaches. The first approach is based on a nonparametric regression analysis between the actual and predicted growth of value-added. In the second approach, we decompose value-added into three final demand sources: value-added generated from domestic goods demand, domestic services demand, and foreign final demand. We investigate the relationship between final demand shocks and the structural changes in these three components.

There are many previous studies which have analysed the relationship between economic shocks and the volatility of macroeconomic variables (GDP, consumption, employment, and so on) to evaluate economic resilience. Since a resilient economy is often defined as an economy in which the deviation between actual and potential output is relatively small by giving a series of shocks (Drew et al, 2004; Duval et al, 2004; Elbourne et al, 2008), the study on economic resiliency with regard to macroeconomics

[1] See, for example, Miller and Blair (2009), Okuyama and Santos (2014), and Arto et al (2015).

is quite related to the study on business cycle fluctuations. [2] For example, Duval et al (2004) estimated the gap of actual and potential GDP using 20 OECD countries from 1982 to 2003, and investigated the relationship between the gap and the characteristics of labour and product market regulations. They found that a country employing policies and institutions associated with rigidities in labour product market tends to dampen the initial impact of shocks but to make their effects more persistent. On the other hand, there are several studies that use a dynamic stochastic general equilibrium model (DSGE) to investigate the degree of economic resilience (Drew et al, 2004; Elbourne et al, 2008; Ernst et al, 2007). These studies calculate the deviation of actual values (output, consumption, employment, etc.) from their expected (or potential) equilibrium values due to exogenous shocks, and investigate the effects of labour and product markets flexibility on the magnitude of the deviation by changing model parameters for the rigidity of price and wage.

Compared to the previous studies, our study has several features. First, we investigate the relationship between economic shocks and changes in the production and final demand structure. The potential GDP used in Duval et al (2004) is similar to the predicted value-added used in our study. However, it differs in that the potential GDP is estimated using production function under given exogenous supply shocks, but our predicted value-added is calculated using the structure of production and consumption patterns under given final demand shocks. Hence, our approach can take into account the changes in not only production function, but consumption patterns due to final demand shocks, and examine whether these changes contribute to alleviate economic losses. Second, the reactions of economic agencies are expected to differ between negative and positive shocks and to depend on the magnitude of shocks. Economic agencies are expected to change their behaviour to amplify the positive effect from shocks and to contain the negative effect from shocks. Previous studies do not consider this asymmetry of economic shocks. We separate negative and positive economic shocks to take into account asymmetric effects of economic shocks, and investigate the relationship between resilient reactions and the magnitude of negative shocks. Finally, taking advantage of I-O framework, we decompose the gap between the actual and predicted value-added by final demand source. When negative shocks occur, it is expected that the dependency of foreign final demand decrease and the dependency of domestic demand increase in order to reduce the domestic economic losses. With these possibilities in mind, we decompose the actual-predicted gap into the three components: domestic goods demand, domestic services demand, and foreign final demand part. As a result, we found that during the economic slowdown phase, the production and final demand structures tend to change temporarily to increase the value-added induced by domestic services demand, but to decrease the value-added induced by both domestic goods demand and foreign final demand. Increasing the dependency on domestic services demand in the economic slowdown phase contributes to containing domestic economic losses.

The remainder of this paper is structured as follows. Section 2 describes the methodology to measure the degree of economic resilience. Section 3 reports the empirical results, and Section 4 summarizes our findings.

2. Model and data

2.1 Inter-Country Input-Output (ICIO) model

This section defines economic shocks and structural changes using the ICIO model, and describes the predicted value-added under the assumption that the structure remains the same with the previous year.

2. OECD (2014a) and OECD (2014b) discuss better social and economic policies to better withstand environmental, political, economic and social shocks.

In this paper, economic shocks are defined as the changes in total final demand, and we use the following standard ICIO model to define the production and final demand structure.

Based on a two-country (R, S), two-sector (1, 2) ICIO model, the relationship between value-added and final demand is represented as

$$\begin{bmatrix} V_1^R \\ V_2^R \\ V_1^S \\ V_2^S \end{bmatrix} = \begin{bmatrix} \hat{v}_1^R & & & \\ & \hat{v}_2^R & & \\ & & \hat{v}_1^S & \\ & & & \hat{v}_2^S \end{bmatrix} \begin{bmatrix} (1-a_{11}^{RR}) & -a_{12}^{RR} & -a_{11}^{RS} & -a_{12}^{RS} \\ -a_{21}^{RR} & (1-a_{22}^{RR}) & -a_{21}^{RS} & -a_{22}^{RS} \\ -a_{11}^{SR} & -a_{12}^{SR} & (1-a_{11}^{SS}) & -a_{12}^{SS} \\ -a_{21}^{SR} & -a_{22}^{SR} & -a_{21}^{SS} & (1-a_{22}^{SS}) \end{bmatrix}^{-1} \begin{bmatrix} f_1^{RR} + f_1^{RS} \\ f_2^{RR} + f_2^{RS} \\ f_1^{SR} + f_1^{SR} \\ f_2^{SS} + f_2^{SS} \end{bmatrix}, \quad (1)$$

where V_i^c is the value-added of sector $i \in \{1,2\}$ in country $c \in \{R,S\}$. a_{ij}^{cd} is the input coefficients. Since both countries are open for external trade, their goods are consumed in home country and/or other countries. f_i^{cd} indicates the final demand of country $d \in \{R,S\}$ for goods produced by sector $i \in \{1,2\}$ of country $c \in \{R,S\}$.

The vector-matrix notation of *N*-sector and *M*-country ICIO model is

$$\mathbf{V}_t = \hat{\mathbf{v}}_t \mathbf{L}_t \left[\mathbf{F}_{1t} + \mathbf{F}_{2t} + \cdots + \mathbf{F}_{ct} + \cdots + \mathbf{F}_{Mt} \right], (t = 1,2,\ldots,T) \quad (2)$$

where *t* denotes time, and $\mathbf{V}_t$ and $\mathbf{F}_{ct}$ ($c = 1,2,\ldots,M$) represent $NM \times 1$ vectors of value-added and final demand, respectively. $\hat{\mathbf{v}}_t$ and $\mathbf{L}_t$ represent $NM \times NM$ matrices of value-added ratios and the Leontief inverse. To represent the composition of final demand by county, we rewrite the vector $\mathbf{F}_{ct}$ ($c = 1,2,\ldots,M$) as

$$\mathbf{F}_{ct} = \left(\frac{\mathbf{F}_{ct}}{f_{ct}} \right) f_{ct} = \Phi_{ct} f_{ct}, (t = 1,2,\ldots,T;\ c = 1,2,\ldots,M) \quad (3)$$

where f_{ct} is the total final demand of country c (1 by 1), and $\Phi_{ct} \equiv \mathbf{F}_{ct} / f_{ct}$ represents a $NM \times 1$ vector of the share of final demand by product group times origin country. Substituting Equation (3) into Equation (2), we obtain

$$\begin{aligned} \mathbf{V}_t &= \hat{\mathbf{v}}_t \mathbf{L}_t \left[\Phi_{1t} f_{1t} + \Phi_{2t} f_{2t} + \cdots + \Phi_{ct} f_{ct} + \cdots + \Phi_{Mt} f_{Mt} \right] \\ &= function\,(\hat{\mathbf{v}}_t, \mathbf{L}_t, \Phi_{ct}, f_{ct}; c \in \{1,2,\ldots,M\}). \end{aligned} \quad (4)$$

Given the total final demand of each country ($f_{ct}, c \in \{1,2,\ldots,M\}$), which is nearly equal to the gross domestic products, value-added can be determined by the Leontief inverse matrix ($\mathbf{L}_t$), the share of final demand for each product (Φ_{ct}, $c \in \{1,2,\ldots,M\}$), and the value-added ratios ($\hat{\mathbf{v}}_t$). These determinants can be considered as the production and final demand structure to produce value-added. In this paper, structural changes are defined as the changes in these factors ($\hat{\mathbf{v}}_t, \mathbf{L}_t, \Phi_{ct}$).

Given the total final demand at time *t*, the predicted value-added under the production structure of previous year *t* - 1 can be measured as follows:

$$\begin{aligned}\mathbf{V}_t^* &= \hat{\mathbf{v}}_{t-1}\mathbf{L}_{t-1}\left[\Phi_{1t-1}f_{1t} + \Phi_{2t-1}f_{2t} + \cdots + \Phi_{1t-1}f_{Mt}\right] \\ &= \textit{function}\,(\mathbf{v}_{t-1}, \mathbf{L}_{t-1}, \Phi_{c,t-1}, f_{ct}; c \in \{1,2,\ldots,M\}\end{aligned} \tag{5}$$

where $\mathbf{V}_t^*$ denotes the predicted value-added. The difference between the actual and predicted value-added is

$$\mathbf{V}_t - \mathbf{V}_t^* = \sum_{c=1}^{M}(\hat{\mathbf{v}}_t\mathbf{L}_t\Phi_{ct} - \hat{\mathbf{v}}_{t-1}\mathbf{L}_{t-1}\Phi_{ct-1})f_{ct}\,,\ (t = 1,2,\ldots,T\,), \tag{6}$$

which indicates the contribution of structural changes to the value-added. If this difference is positive (negative), the structure changes to increase (decrease) the value-added.

2.2 OECD's ICIO database

The data used to build the model are obtained from the 2015 edition of OECD ICIO tables.[3] The tables cover all OECD countries and 27 non-member economies (including all G20 countries) and the years from 1995 to 2011. Tables 1 and 2 show the sector and country coverage. The original sector coverage of the ICIO tables is 34 sectors. However, in the absence of highly accurate data for some countries at the 34-sector level, we use the eight-aggregated sector and four-aggregated region classifications for our empirical analysis.

Table 1: Industry coverage
Table 2: Country coverage

Since the OECD's ICIO database is based on U.S. dollars at current prices, we need to convert the data to national currencies at constant prices. Otherwise, the contribution of structural changes defined in Equation (6) could include not only the contribution of structural changes, but also changes in prices and exchange rates. Moreover, policy makers tend to base their reactions to shocks on information in their national currency; hence, we must reckon with value-added in national currencies. As Figure 1 shows, the national currency-based value-added behaves differently in behaviour from the U.S. dollar-based value-added from 1996 to 2002 for Australia, Germany, UK, and Russia, and from 2008 to 2011 for Canada and Japan.[4] The difference appears to be caused by changes in exchange rates. In this paper, we first calculate the actual and predicted value-added based on the U.S. dollar at current prices, and then convert them into the national currency at constant prices, using total value-added prices and exchange rates by country.

Figure 1: Total value-added in US dollar and in the national currency

3. Exploring empirical evidence of economic resilience

How does the production and final demand structure change when economic shocks occur? Do structural changes contribute to reducing the negative effect of the shocks or to amplifying them? Using the actual and predicted value-added in the national currency at constant prices, described in the previous section, this section investigates the relationship between economic shocks (final demand shocks) and changes in the production and final demand structure and explores empirical evidence of economic resilience. Towards this end, we employ two approaches. First, in section 3.1, we compare the actual and

3. See http://www.oecd.org/sti/ind/input-outputtables.htm .

4. The exchange rates are obtained from the OECD National Accounts and the UNSD (United Nations Statistical Division) National Accounts. The GDP deflators are constructed as GDP at current price divided by GDP at constant price, which are obtained from the National Accounts data of the United Nations (UNSNA).

predicted value-added growth rate, using nonparametric estimation methods. It is expected that the economic agencies will react differently to positive and negative shocks and will be likely to change their behaviour to amplify the positive effect and contain the negative effect of shocks. Nonparametric methods allow us to deal with the asymmetric nature of positive and negative final demand shocks. Second, in section 3.2, we decompose value-added by final demand source: value-added generated from domestic goods demand, domestic services demand and foreign final demand. During an economic crisis, it is possible that the dependency on final demand decreases and the dependency on domestic demand increases to contain domestic economic losses. We examine this possibility in the second approach. In Section 3.3, we use labour compensation data instead of value-added data, and examine the relationship between structural changes and economic shocks using the same empirical approach as Section 3.1 and Section 3.2.

3.1 First approach: Actual vs predicted growth

Nonparametric regression

Based on the predicted value-added described in Equation (5), we define the actual and predicted value-added growth rate as follows:

$$\text{Actual value-added growth for country } c: \; gV_{c,t} \equiv \frac{\sum_i (V_{i,c,t} - V_{i,c,t-1})}{\sum_i V_{i,c,t-1}},$$

$$\text{Predicted value-added growth for country } c: \; gV^*_{c,t} \equiv \frac{\sum_i (V^*_{i,c,t} - V_{i,c,t-1})}{\sum_i V_{i,c,t-1}},$$

where *i*, *c* and *t* denote a sector, country and year, respectively. Note that the value-added ($V_{c,t}$) is reckoned in the national currency at constant prices in 2005. Without changes in the production and final demand structure from t to $t-1$, these predicted growth rates could be the same as the actual rates. The difference between the actual and predicted growth rates indicates the contribution of structural change to the actual value-added growth.

Figure 2: Actual and predicted growth rates

Figure 2 shows the relationship between the actual and predicted growth rate. The horizontal axis represents the predicted growth and the vertical axis, the actual growth. The dashed line is a line with slope one (i.e. where predicted growth = observed growth). Deviation from the dashed line shows the difference between actual and predicted values and indicates the contribution of production and final demand structural changes. When observations are plotted at C, the actual growth is greater than the predicted growth, indicating that changes in production and final demand structure contribute to containing the negative feedbacks. In contrast, when observations are plotted at D, this means the actual growth is smaller than the predicted growth, indicating that the structure tends to change to amplify the negative feedbacks. In the same way, in the case of A (B), the positive impact is increased (decreased) by changes in the production and final demand structure.

When economic shocks occur at time *t*, the predicted growth rates are expected to decrease compared to the previous year, while economic agencies are expected to react to the negative shocks and to change their behaviour to reduce the negative feedbacks. For example, public agencies are expected to increase public final expenditure and investment, to support private investment by changing interest rates, to stimulate household consumption and/or to provide tax incentives and subsidies for production. These changes in the behaviour of public agencies can bring about changes in the share of the final demand for

each product ($\Phi_{c,t-1}$). On the other hand, firms are expected to change the amount of mixed income, labour and capital inputs, labour-capital ratio and/or procurement patterns. These changes in firm behaviour can bring about changes in the production structure ($\mathbf{L}_t, \Phi_{ct}, \hat{\mathbf{v}}_t$) at the macro-economic level. If these changes in behaviour help contain the negative feedbacks from economic shocks, observations are likely to be plotted more around C than D (Figure 2).

Since the relationship between actual and predicted growth rates is expected to be non-linear and asymmetric between phases of upward and downward growth, we employ a nonparametric regression model as follows

$$gV_{c,t} = \pi\left(gV_{c,t}^{*}\right) + \mu_c + \varepsilon_{c,t} \tag{7}$$

where μ_c and $\varepsilon_{i,c,t}$ represent a country-fixed effect and error term, respectively. $\pi(\cdot)$ represents a function of the predicted value-added growth. We estimate the functional form non-parametrically, using data variation across countries and years. The sample size is the sum of the number of countries and years.

Figure 3: Nonparametric estimation results

Figure 3 reports the estimation results of Equation (7).[5] The vertical axis represents the (county-demeaned) actual value-added growth rate and the horizontal axis, the (county-demeaned) predicted value-added growth rate. The blue line is the estimated line, the red line is a line with slope one and the grey interval indicates the 90% confidence interval.

In the case of the US dollar basis (Panel II), the estimated lines are significantly below the red line in the third quadrant and significantly above the red line in the second quadrant, indicating that both negative and positive shocks tend to be amplified by structural changes. This result is the opposite of the economic resilience we expected. However, since these observations are plotted symmetrically around the red line, it seems that in the case of the US dollar base at current prices, there is no clear relationship between economic shocks and structural changes. On the other hand, in the case of national currency base at constant prices (Panel I), the estimated line is significantly above in the third quadrant, indicating that the negative feedback tends to be reduced by structural changes. By controlling for changes in prices and exchange rates, we can see evidence of economic resilience from the relationship between actual and predicted value-added growth. Although the estimated line curves downwards to the second and fourth quadrant, this is thought to be because of an outlier (sample of Saudi Arabia in 2009). Figure 4 shows the results of nonparametric regression by region. The estimated line for each group is significantly above the red line in the third quadrant, and hence we can see evidence of economic resilience by country group.

Figure 4: Nonparametric estimation results (By region)

Comparison between actual and predicted value-added growth by country

While the above nonparametric regression is appropriate for an analysis of world-wide trend for the relationship between the actual and predicted growth, it cannot reveal the country-specific characteristics. Since our sample size is too small to conduct nonparametric regression by country, we visualize the time series plots of the actual and predicted growth by country in Figure 5. Owing to space constraints, we show

5. We use the local polynomial regression method (Cleveland, et al., 1992).

charts only for major countries (G8 countries, Australia, China, India, and Spain). The charts for the remaining countries are available in Supplementary Appendix I.

Figures 5a – 5c: Comparison between actual and predicted value-added growth

These figures have two charts for each country. One is a line chart which shows the time series behaviour of actual and predicted growth, and the second is a bar chart with diamond plots. The diamond plots describe the difference between the actual and predicted growth for each year, $gV_{c,t} - gV_{c,t}^{*}$, which indicates the contribution of structural changes to the growth of value-added from year *t* and *t*-1. The bar chart shows a breakdown of the difference $gV_{c,t} - gV_{c,t}^{*}$ by eight-aggregated industry, and shows the contribution of eight industries to the difference. The sum of each bar chart is expressed by the diamond. Positive and negative values in a bar chart for year *t* indicate that owing to structural changes from *t* to *t*-1, even if the total final demand at *t* is the same as at *t*-1, industries with positive values would be able to produce more value-added at *t* than at *t*-1; on the contrary, industries with negative values could reduce it at *t* compared with *t*-1. For example, the bar charts for China and India tend to show goods industries (S1-S5) with negative values and service industries with positive values for many years. This means that structures in these countries tend to change to increase value-added in service sectors relatively more than in goods sectors, implying that these countries are likely to shift to the service economy.

How have production and final demand structures changed when large economic shocks occur? As shown in the line chart in Figure 5, we observe a large decrease in the value-added growth during the US financial crisis (2007-2009) for many countries. Let us take the cases of Spain and Germany. Spain experienced a sharp decrease in value-added growth during 2007-2009, while actual growth was greater than predicted growth, which is calculated under the assumption that the production and final demand structure are the same as in the previous year. That is, a decrease in value-added growth was large but less than expected. The below bar chart shows what is behind this result. Owing to structural changes during economic crises, Spain's business service (S7) and personal service sectors (S8) were able to produce more value-added than in the previous year, and this contributed to reduce the negative feedback from the final demand shocks. Likewise, Germany too experienced a large decrease in value-added growth during 2007-2009. However, unlike Spain, actual growth was smaller than the predicted growth, indicating that the production and final demand structure changed such that it amplified the negative feedback from the final demand shocks. As shown in the accompanying bar charts, the personal service sector (S8) was able to produce more value-added because of the structural changes. However, the contribution of material manufacturing (S3) and machinery manufacturing fell by more than the increase in the contribution of the personal service sector. As a result, actual growth in Germany fell below the predicted growth owing to structural changes.

Let us take a look at the other countries' results. When growth rates declined sharply, countries with a positive value of the diamond ($gV_{c,t} - gV_{c,t}^{*} > 0$) were France, US, Italy, Spain, Japan and China. Countries with a negative value of the diamond ($gV_{c,t} - gV_{c,t}^{*} < 0$) were Canada, Germany, UK, India, Australia and Russia. While the former group of countries experienced structural changes that reduced the adverse impact of negative final demand shocks, the latter group experienced structural changes that amplified the negative feedbacks. We also found that during an economic crisis, most countries experienced an increase in the contribution of service sectors (S6, S7, S8) and a decrease in the contribution of the goods sectors (S1-S5). In the former group of countries (e.g. Spain), the positive contribution of service sectors tends to be larger than the negative contribution of goods sectors. On the contrary, in the latter group of countries (e.g. Germany), the negative contribution of goods sectors tends to be relatively large.

Our findings from this section can be summarized as follows. First, the production and final demand structure tends to change to reduce the negative impacts of final demand shocks. Second, when economic shocks occur, the structure tends to change to increase the value-added of service sectors, and to decrease the value-added of goods sectors. Therefore, the temporary shift from goods to services sectors seems to play a key role in propping up the economy and preventing a steep decline in economic performance.

3.2 Second approach: Decomposition of value-added by final demand source

The results of the first approach show that the production and final demand structure tend to change to amplify the negative final demand shocks in the goods sectors, while in the services sectors, the structure tends to change to contain negative final demand shocks. In other words, value-added induced by services demand seems to be less sensitive to negative final demand shocks than value-added induced by goods demand. Furthermore, there is a possibility that when shocks occur, the dependency on foreign final demand decreases and that on domestic demand increases to reduce domestic economic losses. With these possibilities in mind, in the second approach, we decompose the actual and predicted value-added into three components: value-added generated from domestic goods demand ($V_{DG,c,t}$); value-added generated from domestic services demand ($V_{DS,c,t}$); and value-added generated from foreign final demand for goods & services ($V_{FO,c,t}$):

$$\begin{aligned} V_{c,t} &= \sum_{i=1}^{34}\sum_{s\in\Omega^{Goods}}\mathbf{B}_t(ci,s)\Phi_{c,s,t}f_{ct} + \sum_{i=1}^{34}\sum_{s\in\Omega^{Services}}\mathbf{B}_t(ci,s)\Phi_{c,s,t}f_{ct} + \sum_{i=1}^{34}\sum_{k\neq c}\sum_{s\in\Omega^{Goods}\cup\Omega^{Services}}\mathbf{B}_t(ci,s)\Phi_{k,s,t}f_{kt} \\ &= V_{DG,c,t} + V_{DS,c,t} + V_{FO,c,t} \end{aligned} \quad (8)$$

$$\begin{aligned} V^*_{c,t} &= \sum_{i=1}^{34}\sum_{s\in\Omega^{Goods}}\mathbf{B}_{t-1}(ci,s)\Phi_{c,s,t-1}f_{ct} + \sum_{i=1}^{34}\sum_{s\in\Omega^{Services}}\mathbf{B}_{t-1}(ci,s)\Phi_{c,s,t-1}f_{ct} + \sum_{i=1}^{34}\sum_{k\neq c}\sum_{s\in\Omega^{Goods}\cup\Omega^{Services}}\mathbf{B}_{t-1}(ci,s)\Phi_{k,s,t-1}f_{kt} \\ &= V^*_{DG,c,t} + V^*_{DS,c,t} + V^*_{FO,c,t} \end{aligned} \quad (9)$$

where Ω^{Goods} and $\Omega^{Services}$ denote the sets of goods (non-service) sectors and service sectors, respectively. The asterisk (*) denotes the predicted values under the production and final demand structure in the previous year. The definition of goods and services sectors is described in Table 1.

Taking the difference between the actual and predicted values, and rearranging these equations, we obtain the following decompositions:

$$\begin{aligned} \tilde{V}_{c,t} \equiv \frac{V_{c,t}-V^*_{c,t}}{V_{c,t}} &= \frac{V_{DG,c,t}-V^*_{DG,c,t}}{V_{c,t}} + \frac{V_{DS,c,t}-V^*_{DS,c,t}}{V_{c,t}} + \frac{V_{FO,c,t}-V^*_{FO,c,t}}{V_{c,t}} \\ &= \tilde{V}_{DG,c,t} + \tilde{V}_{DS,c,t} + \tilde{V}_{FO,c,t} \end{aligned} \quad (10)$$

The difference between the actual and predicted value-added indicates the contribution of production structural change to the actual value-added. For example, if $\tilde{V}_{c,t}$ is 0.03, this means that structural changes between t and $t-1$ contribute to increasing value-added in country c by 3%. The three components of the right hand side in Equation (10) indicate the contribution of domestic goods demand (*DG*), domestic service demand (*DS*), and foreign demand (*FO*). Suppose that $\tilde{V}_{DG,c,t}$ is -0.03, $\tilde{V}_{DS,c,t}$ is 0.03 and $\tilde{V}_{FO,c,t}$ is

0. In this example, changes in production and final demand structure could lead to a decrease of value-added induced by domestic goods demand by -3% and to an increase of value-added induced by domestic service demand by 3%, while value-added induced by foreign demand is not influenced by the changing production structure. In the second approach, we investigate the relationship between these three components in Equation (10) and economic shocks by country and explore empirical evidence of economic resilience.

Figure 6 shows the decomposition results of value-added by country. Panels (I), (II) and (III) in this figure indicate the contribution of structural changes in domestic goods demand ($\tilde{V}_{DG,c,t}$), the domestic services demand ($\tilde{V}_{DS,c,t}$), and in the foreign final demand ($\tilde{V}_{FO,c,t}$), respectively. From a broader perspective, the production and final demand structures in many countries tend to change to increase dependency on foreign final demand and decrease the dependency on domestic goods demand. This trend indicates that the world economy tends to deepen and expand economic interdependence among countries. However, during economic crises, such as the Asian financial crisis (around 1998), the collapse of dotcom bubble (around 2000) and the US financial crisis (around 2009), the dependency on foreign final demand decreased and that on domestic services demand increased. In the Asian financial crisis, many Asian countries experienced structural changes to decrease their value-added induced by foreign final demand and increase their value-added induced by domestic services demand. During the US financial crisis, this phenomenon was seen in most countries. These findings from Figure 6 give rise to the hypothesis that when negative final demand shocks occur, the production and final demand structures tend to change temporarily to decrease the dependency on both domestic goods demand and foreign final demand and increase the dependency on domestic services demand. This increase in domestic services demand dependency can contribute to containing domestic economic losses arising from negative final demand shocks.

Figure 6: Decomposition of value-added by final demand source by country

To verify the above hypothesis concerning the relationship between negative final demand shocks and production and final demand structural changes, we conduct an econometric analysis using the following symmetric and asymmetric regression models:

Symmetric model

$$\begin{aligned}
&\text{(a) } \tilde{V}_{c,t} = \beta\, dFD_{c,t} + \varepsilon_{c,t} \\
&\text{(b) } \tilde{V}_{DG,c,t} = \beta_{DG}\, dFD_{c,t} + \varepsilon_{c,t} \\
&\text{(c) } \tilde{V}_{DS,c,t} = \beta_{DS}\, dFD_{c,t} + \varepsilon_{c,t} \\
&\text{(d) } \tilde{V}_{FO,c,t} = \beta_{FO}\, dFD_{c,t} + \varepsilon_{c,t}
\end{aligned} \tag{11}$$

Asymmetric model

$$\begin{aligned}
&\text{(a) } \tilde{V}_{c,t} = \beta_1 (dFD_{c,t} \times NEG_{c,t}) + \beta_2 (dFD_{c,t} \times POS_{c,t}) + \varepsilon_{c,t} \\
&\text{(b) } \tilde{V}_{DG,c,t} = \beta_{1,DG} (dFD_{c,t} \times NEG_{c,t}) + \beta_{2,DG} (dFD_{c,t} \times POS_{c,t}) + \varepsilon_{c,t} \\
&\text{(c) } \tilde{V}_{DS,c,t} = \beta_{1,DS} (dFD_{c,t} \times NEG_{c,t}) + \beta_{2,DS} (dFD_{c,t} \times POS_{c,t}) + \varepsilon_{c,t} \\
&\text{(d) } \tilde{V}_{FO,c,t} = \beta_{1,FO} (dFD_{c,t} \times NEG_{c,t}) + \beta_{2,FO} (dFD_{c,t} \times POS_{c,t}) + \varepsilon_{c,t},
\end{aligned} \tag{12}$$

where $dFD_{c,t}$ denotes changes in the growth of total final demand of country *c*, representing the magnitude of final demand shocks for country *c* at time *t*:

$$dFD_{c,t} \equiv \left(\frac{f_{c,t} - f_{c,t-1}}{f_{c,t}} - \frac{f_{c,t-1} - f_{c,t-2}}{f_{c,t-1}} \right).$$

$f_{c,t}$ represents the total final demand of country *c* at time *t*. $dFD_{c,t} > 0$ means that the economy is in the expansion or recovery phase, and $dFD_{c,t} < 0$ means that the economy is in the slowdown phase. The magnitude of $dFD_{c,t}$ indicates the size of positive or negative shocks. $NEG_{c,t}$ and $POS_{c,t}$ denote dummy variables such that $NEG_{c,t} = 1$ if $dFD_{c,t}$ is negative, and $POS_{c,t} = 1$ if $dFD_{c,t}$ is positive. The models (a) to (d) differ with respect to the left-hand side variable which shows the contribution of structural changes to value-added by final demand source. The asymmetric model allows us to distinguish between the effect of positive and negative final demand shocks on structural changes. The coefficients with positive sign mean that final demand shocks, whether positive or negative shocks, are amplified by changing the production and final demand structure. The coefficients with negative sign mean that final demand shocks are contained by changing the production and final demand structure.

Table 3: Regression results

Table 3 reports the estimation results of the symmetric and asymmetric models. The panels from (a) to (d) in this table correspond to the regression models (a) to (d) in Equations (11) and (12). The estimates of models (b), (c), and (d) represent a breakdown of model (a)'s coefficients. In the symmetric model, the coefficient of the model (a) is positive and significant, while in the asymmetric model, the coefficients of $dFD_{c,t} \times NEG_{c,t}$ is 0.0152 and insignificant and the coefficient of $dFD_{c,t} \times POS_{c,t}$ is 0.0555 and significant. The likelihood ratio (LR) test shows that these two coefficients are significantly different. These results indicate that during the period that final demand growth increases compared with the previous year (i.e. the economic expansion or recovery phase), a one-point increase in the degree of positive shocks leads to changes in the production and final demand structure, and these structural changes tend to increase value-added by 5.6%. On the other hand, during the period that final demand growth decreases compared with the previous year (i.e. the economic slowdown phase), there is no significant relationship between the degree of negative shocks and structural changes, and the negative final demand shocks are not necessarily amplified by structural changes.

The asymmetric model (b), domestic goods model ($\tilde{V}_{DG,c,t}$), shows that the coefficients are 0.0297 for $dFD_{c,t} \times NEG_{c,t}$ and 0.0133 for $dFD_{c,t} \times POS_{c,t}$, and these are significant. During the phase of economic expansion, a one-point increase of the degree of the positive shocks brings about an increase in value-added induced by domestic goods demand by 1.3%, through structural changes. On the other hand, during an economic slowdown, a one-point increase in the degree of negative shocks brings about a decrease in value-added induced by domestic goods demand by 3%. According to the LR test, the figures 1.3% and 3% are significantly different. It seems that final demand shocks whether positive or negative, tend to be amplified by changing the production and final demand structures; however, the negative final demand shocks have a greater effect on value-added induced by domestic goods demand than the positive shocks.

As in the results for domestic goods demand, the coefficients of the asymmetric model (d) (foreign final demand) are positive and significant. However, these two coefficients are not significantly different. Final demand shocks, whether positive or negative, tend to be amplified by changing the production and final demand structures.

The above results with respect to domestic goods demand (b) and foreign final demand (d) show that structural changes during an economic slowdown do not contribute to containing the negative impact on the value-added generated by the domestic goods and foreign final demands. However, the results of the domestic service demand model (c) show the opposite of the results from the models (b) and (d). Model (c) (domestic services demand) has negative and significant coefficients which are -0.0639 for $dFD_{c,t} \times NEG_{c,t}$ and -0.0245 $dFD_{c,t} \times POS_{c,t}$, respectively. These results indicate that decreasing the growth of final demand tends to change the production and final demand structure to increase the value-added induced by domestic services demand. It appears the structure tends to change to reduce the impact of the positive or negative final demand shocks on the value-added induced by domestic services demand. In other words, the value-added induced by domestic services demand is less affected by final demand shocks (whether positive or negative), compared with the value-added induced by domestic goods demand and foreign final demand. Moreover, the LR test shows that there is a significant difference between these two coefficients, indicating that the marginal effect of containing the negative impact (-0.0639) is significantly greater than the one containing the positive feedback (-0.0245). Therefore, the value-added induced by domestic service demand is relatively resilient to negative final demand shocks.

Table 4: Regression results by two-period

Table 4 shows the estimation results for two sample periods. Panels (I) and (II) report the results for the period 1997 to 2004 and 2004 to 2011, respectively. In the former period, the coefficients of the model (a) (Total) are 0.053 for $dFD_{c,t} \times NEG_{c,t}$ and 0.066 for $dFD_{c,t} \times POS_{c,t}$, and there is no significant difference between these two coefficients. This indicates that the impact of final demand shocks, whether positive or negative tends to be amplified by changing the production and final demand structures. There is no asymmetric effect on value-added between positive and negative final demand shocks. On the other hand, in the latter period, the coefficient of $dFD_{c,t} \times NEG_{c,t}$ is negative but insignificant, and the one of $dFD_{c,t} \times POS_{c,t}$ is positive and significant. This indicates that the positive impact of final demand shocks are amplified by changing the production and final demand structures, while the negative impact is not necessarily amplified by the structural changes. This means that the world economy during 2004–2011 experienced more resilient changes in the production and final demand structures in reaction to negative final demand shocks.

Comparing the coefficients of (b), (c) and (d) between the two periods 1997–2004 and 2004–2011, we observe several changes in these coefficients. First, in the case of the domestic goods demand model (b), the coefficient of $dFD_{c,t} \times NEG_{c,t}$ decreases from 0.045 to 0.020, indicating that negative final demand shocks to the value-added induced by domestic goods demand is less amplified by changing the structure during 2004–2011 than during 1997–2004. Second, in the case of the domestic services demand modal (c), the absolute values of the coefficients become large in the latter period, implying that final demand shocks, whether positive or negative, lead to a larger change in the structure to decrease the negative impact from the shocks, and consequently the value-added induced by domestic services demand is less affected by final demand shocks. Finally, in the case of the foreign demand model (d), the magnitude of the coefficients becomes large in the latter periods. In addition, according to the results of the LR test, there is no significant difference between the two coefficients in the former period. On the other hand, in the latter period, the coefficient of $dFD_{c,t} \times POS_{c,t}$ is significantly larger than that of $dFD_{c,t} \times NEG_{c,t}$. It seems that positive or negative demand shocks to the value-added induced by foreign demand tend to be more amplified by changing the production and final demand structures. However, in the latter period, the amplification effect of negative shocks is significantly smaller than the effect of positive shocks. Therefore, according to the comparative analysis of the two periods, in recent years, the world economy has tended to

change the production and final demand structure to become more flexible, to contain the negative feedback.

3.3 Labour compensation

The OECD's ICIO database contains not only value-added but also labour compensation data by country and industry, from 1995 to 2011. Using the labour compensation ratios which is the labour compensation divided by gross output, instead of the value-added ratios, we conduct a similar comparative analysis of the actual-predicted values as in the previous section.

Figure B1 in Appendix B shows the nonparametric regression results using the labour compensation data. The estimated line for each group is significantly above the red line in the third quadrant, indicating that structural changes tend to reduce the negative impact on the growth in labour compensations. Figures B2 to B4 show the time series plots of the actual and predicted growth by country, which correspond to Figure 5 of the value-added version. As is the case of value-added, the service sector plays a key role for reducing the negative feedbacks to labour compensations. However, the growth of labour compensation appears to be more stable and less sensitive to final demand shocks. During the US financial crisis, the difference between actual and predicted growth was definitely larger in the case of labour compensation than in the case of value-added in France, Germany, Italy, Japan, and Russia. Furthermore, according to the regression analysis using labour compensation data (shown in Table B1 and B2 of Appendix B), the coefficients of the domestic service demand model (c) are negative and significant, and these absolute values are greater than those in the case of value-added. These results indicate that final demand shocks to labour compensations tend to be more reduced through structural changes than the shocks to value-added. In other words, labour compensation is more resilient to the final demand shocks.

How should we interpret these results? Value-added consists of (1) labour compensations, (2) consumption of capital, (3) net operating surplus plus mixed income, and (4) tax less subsidies on production. It is probable that while value-added is expected to decrease because of negative final demand shocks, the decrease in labour compensation is probably smaller than the decrease in the remaining value-added components because in general it is difficult to cut labour income in a short time. As a result, negative shocks lead to an increase in the share of labour compensation in the value-added and consequently yield the result that labour compensation ratios increased relatively more than the value-added ratios.

4. Summary and discussion

While economic shocks can lead to an increase or decrease in GDP, economic agents are expected to react to reduce the negative impact or amplify the positive effects. The ability of a country to contain the economic losses can be defined as the resilience to economic shocks. This paper empirically investigates the relationship between economic shocks and structural changes, and examines whether the structural changes contribute to containing the negative feedback from economic shocks, using the standard ICIO model and the OECD's ICIO tables from 1995 to 2011.

Our findings can be summarized as follows. First, the production and final demand structures, which are constructed using the standard ICIO model, tend to change to reduce the negative effects of final demand shocks. When economic shocks occur, the structure tends to change to increase the dependency on the value-added of service sectors and to decrease the dependency on the value-added of goods sectors. Therefore, the temporary shift from goods to services sectors seems to play a key role in preventing a steep

decline in economic performance. Second, during an economic slowdown, the structure tends to change temporarily to increase the value-added induced by domestic services demand but decreases the value-added induced by both domestic goods demand and foreign final demand. Increasing the dependency on domestic services demand in an economic slowdown contributes to containing domestic economic losses. Third, based on the comparative analysis of the periods 1997 – 2004 and 2004 – 2011, in recent years, the world economy has tended to change the structure to become more flexible to contain the negative impact. Finally, we examine the resiliency of labour compensation instead of value-added, using the same empirical approach. We find that compared with the result for value-added, labour compensation is more resilient to final demand shocks.

In sum, during a downturn in total domestic final demand, countries that are able to prop up the economy through the domestic service sectors instead of domestic goods and foreign sectors are more resilient to negative shocks.

A note about why the dependency on foreign demand decreases during a downturn. In this phase, domestic goods demand is likely to decrease more than services. This decrease can lead to a fall in international trade because foreign demand is mainly for goods and the share of service trade is quite small. Therefore, a decline in domestic goods demand in many countries can lead to a decline in the dependency on foreign final demand. These findings are consistent to the discussion in the literature on business cycle synchronization (Rana, et al 2012; Berdiev and Chang, 2015) which have found that increasing international trade has led to more inter-country synchronization of business cycles. In a downturn, the propping-up by the domestic service sector seems to play a key role in temporarily containing the negative feedback.

Finally, let us look at the components of the production and final demand structure. As shown in Section 2.1, the structure we defined consists of the value-added ratios, the Leontief inverse matrix, and the composition of final demand. Which of these is a key driver of structural changes? This paper was not able to analyse this in the framework of the actual-predicted value-added comparison. However, we can show changes in these components over time. According to the median absolute percentage changes (MAPE) in these three components shown in Tables A5 and A6 of Appendix A, the value-added ratios are stable over the whole period at around 2%. The MAPEs of domestic parts of the Leontief multiplier and final demand are approximately 10% and 8%, respectively. The MAPEs of foreign parts of the Leontief multiplier and final demand are approximately 18% and 33%, respectively. Therefore, judging from the results, it is probable that the foreign part of final demand is a key driver of structural changes in the downturn phase.

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SUPPLEMENTARY APPENDIX

Supplementary Appendix I: Comparison between the actual and predicted value-added growth for 61 countries.

Supplementary Appendix II: Comparison between the actual and predicted labour compensation growth for 61 countries.

Table 1: Industry coverage

	Aggregated code			OECD ICIO tables Original code	
		8-aggregated industry code	Industry Description	Industry Code	Industry Description
Goods sectors	S1	**AGRI**	Agriculture	C01T05	Agriculture, hunting, forestry and fishing
	S2	**MINING**	Mining	C10T14	Mining and quarrying
	S3	**MTR.MF**	Materials manufacturing	C29	Machinery and equipment, nec
				C30T33X	Computer, Electronic and optical equipment
				C31	Electrical machinery and apparatus, nec
				C34	Motor vehicles, trailers and semi-trailers
				C35	Other transport equipment
	S4	**MACH.MF**	Machinery manufacturing	C20	Wood and products of wood and cork
				C21T22	Pulp, paper, paper products, printing and publishing
				C23	Coke, refined petroleum products and nuclear fuel
				C24	Chemicals and chemical products
				C25	Rubber and plastics products
				C26	Other non-metallic mineral products
				C27	Basic metals
				C28	Fabricated metal products
	S5	**OTH.MF**	Other manufacturing	C15T16	Food products, beverages and tobacco
				C17T19	Textiles, textile products, leather and footwear
				C36T37	Manufacturing nec; recycling
Services sectors	S6	**UTL.CSTR**	Utility and construction	C40T41	Electricity, gas and water supply
				C45	Construction
	S7	**BUS.SV**	Business services	C50T52	Wholesale and retail trade; repairs
				C55	Hotels and restaurants
				C60T63	Transport and storage
				C64	Post and telecommunications
				C65T67	Financial intermediation
				C70	Real estate activities
				C71	Renting of machinery and equipment
				C72	Computer and related activities
				C73T74	R&D and other business activities
	S8	**PSN.SV**	Personal services	C75	Public admin. and defence; compulsory social security
				C80	Education
				C85	Health and social work
				C90T93	Other community, social and personal services
				C95	Private households with employed persons

Table 2: Country coverage and definition of four regions

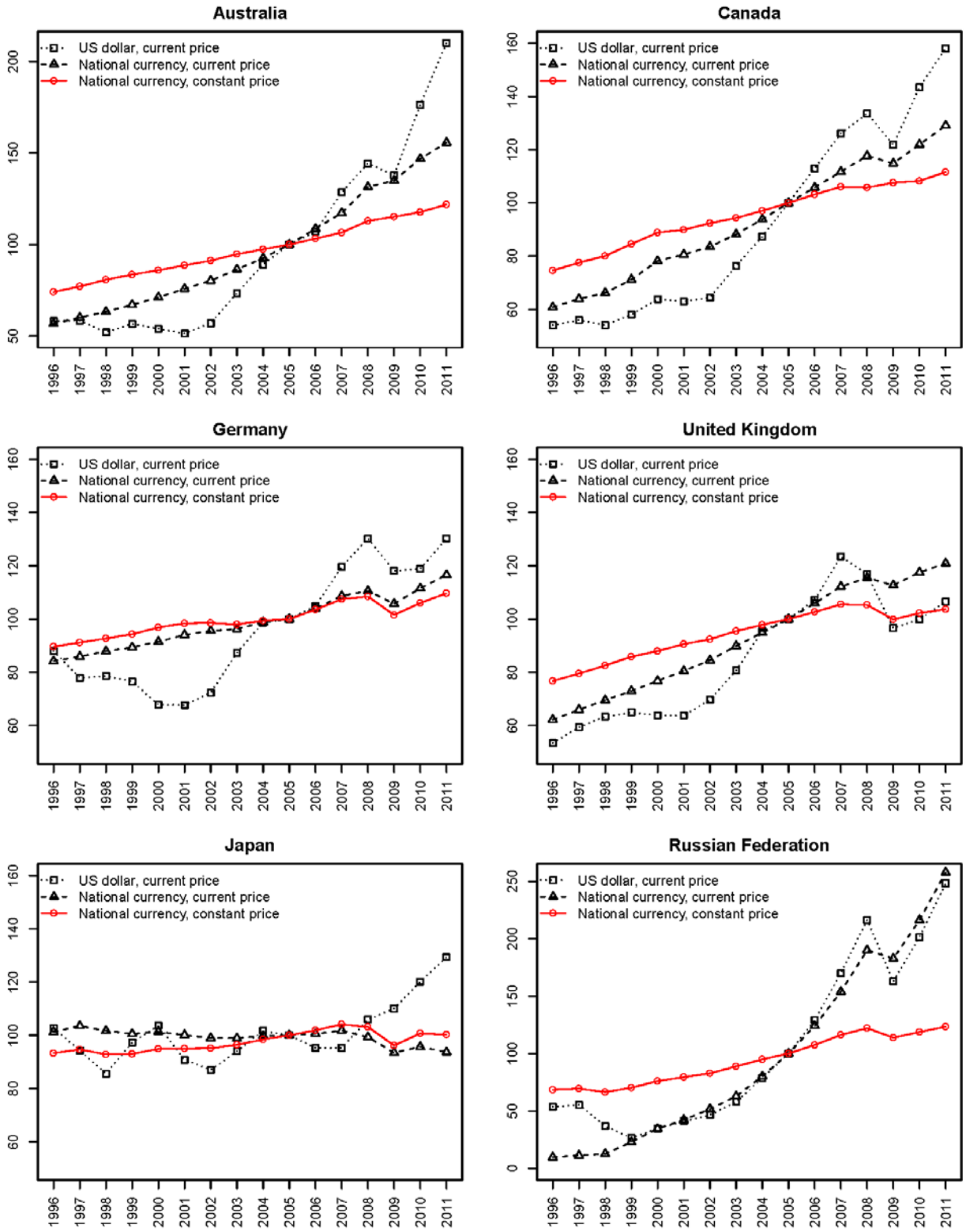
(I) Country coverage of OECD's ICIO tables

Country code	Description (OECD countries)	Country code	Description (Non-OECD countries)
AUS	Australia	ARG	Argentina
AUT	Austria	BGR	Bulgaria
BEL	Belgium	BRA	Brazil
CAN	Canada	BRN	Brunei Darussalam
CHL	Chile	CHN	China
CZE	Czech Republic	CHN.DOM	China Domestic sales only
DNK	Denmark	CHN.PRO	China Processing
EST	Estonia	CHN.NPR	China Non processing goods exporters
FIN	Finland	COL	Colombia
FRA	France	CRI	Costa Rica
DEU	Germany	CYP	Cyprus
GRC	Greece	HKG	Hong Kong SAR
HUN	Hungary	HRV	Croatia
ISL	Iceland	IDN	Indonesia
IRL	Ireland	IND	India
ISR	Israel	KHM	Cambodia
ITA	Italy	LTU	Lithuania
JPN	Japan	LVA	Latvia
KOR	Korea	MLT	Malta
LUX	Luxembourg	MYS	Malaysia
MEX	Mexico	PHL	Philippines
MEX.GMF	Mexico Global Manufacturing	ROU	Romania
MEX.NGM	Mexico Non-Global Manufacturing	RUS	Russian Federation
NLD	Netherlands	SAU	Saudi Arabia
NZL	New Zealand	SGP	Singapore
NOR	Norway	THA	Thailand
POL	Poland	TUN	Tunisia
PRT	Portugal	TWN	Chinese Taipei
SVK	Slovak Republic	VNM	Viet Nam
SVN	Slovenia	ZAF	South Africa
ESP	Spain	RoW	Rest of the world
SWE	Sweden		
CHE	Switzerland		
TUR	Turkey		
GBR	United Kingdom		
USA	United States		

(II) The definition of four regions

Group	Country codes
Americas:	ARG, BRA, CAN, CHL,COL,CRI, MEX, USA
EU+:	EU28, CHE, NOR
East & South East Asia:	JPN, KOR, BRN, CHN, HKG, IDN, KHM, MYS, PHL, SGP, THA, TWN, VNM.
Others:	AUS, ISL, ISR, NZL, TUR, IND, RUS, SAU, TUN, ZAF, RoW

Figure 1: Total value-added in US dollar and in national currency



Note: Total value-added is normalized to 100 at 2005.

Figure 2: Actual and predicted growth rates

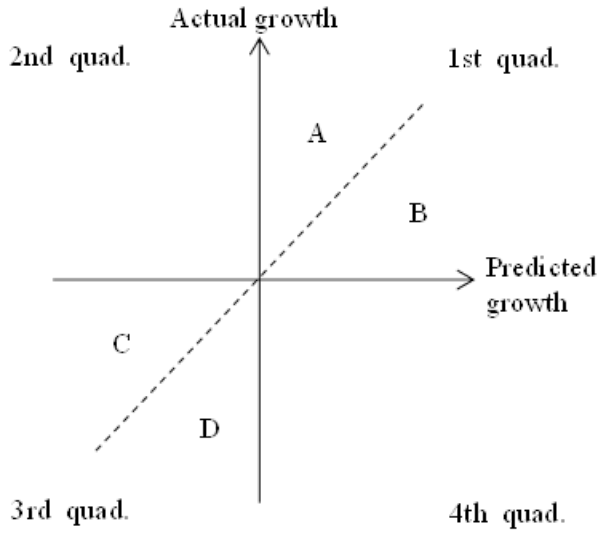
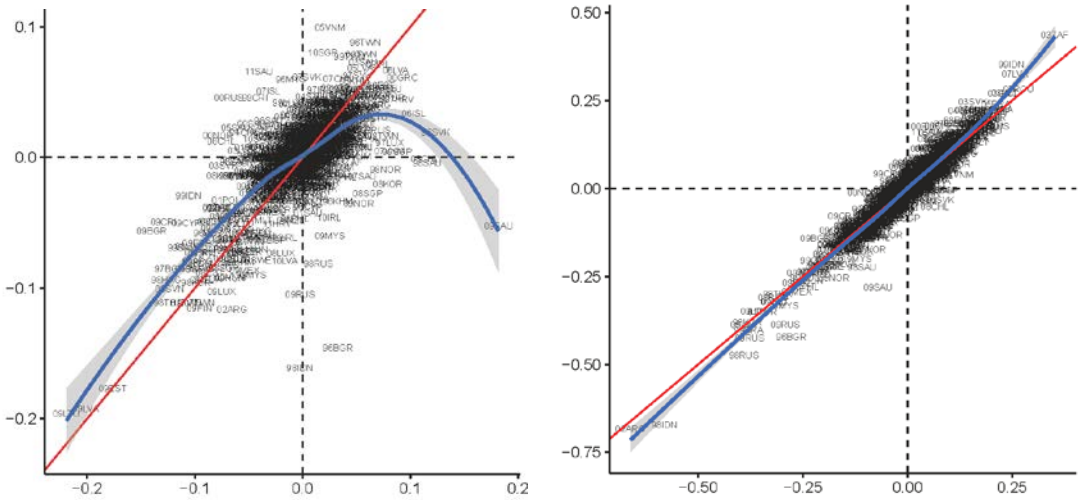


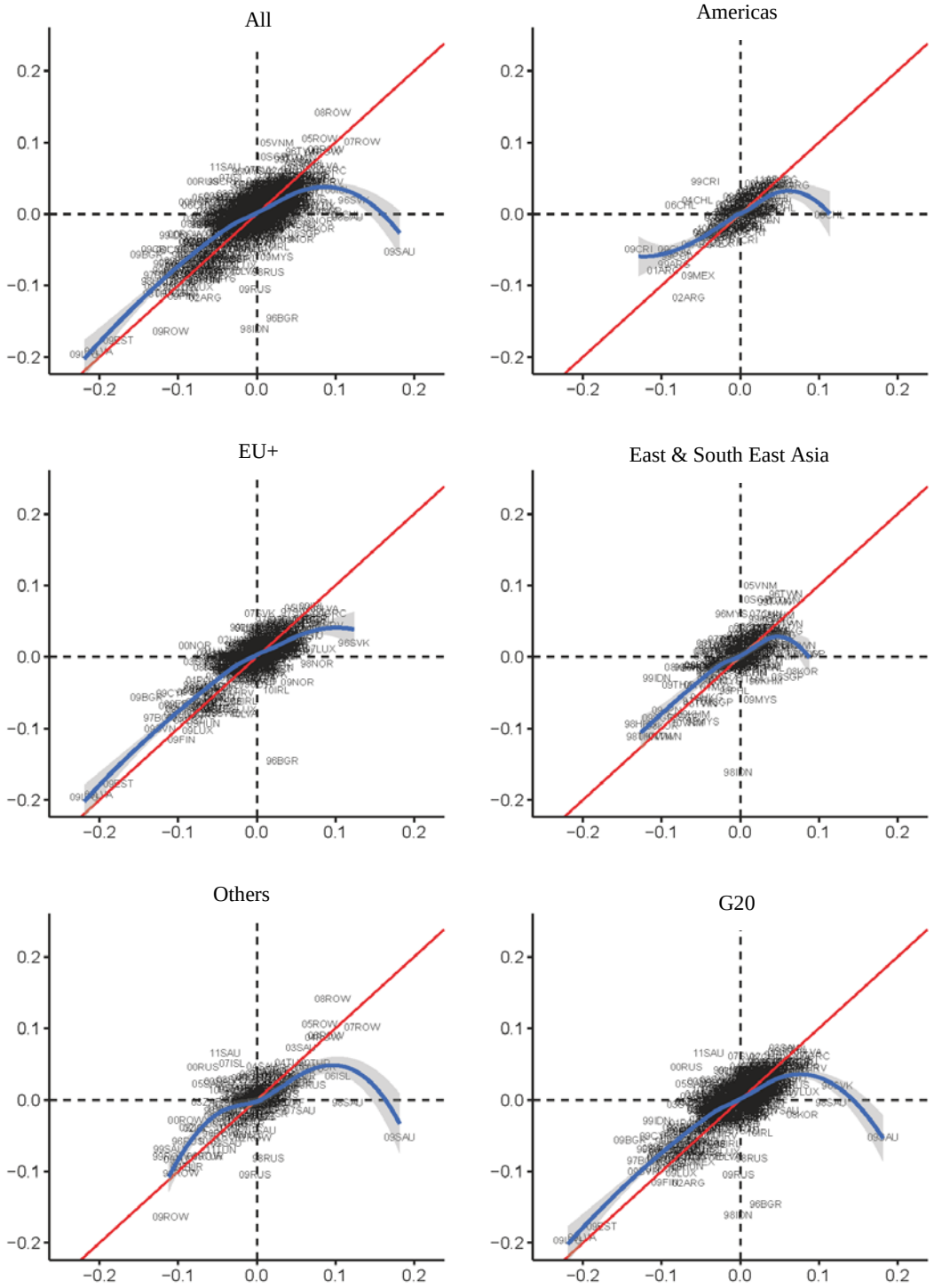
Figure 3: Nonparametric estimation results

(I) National Currency Base at Constant Prices (II) US Dollar Base at Current Prices



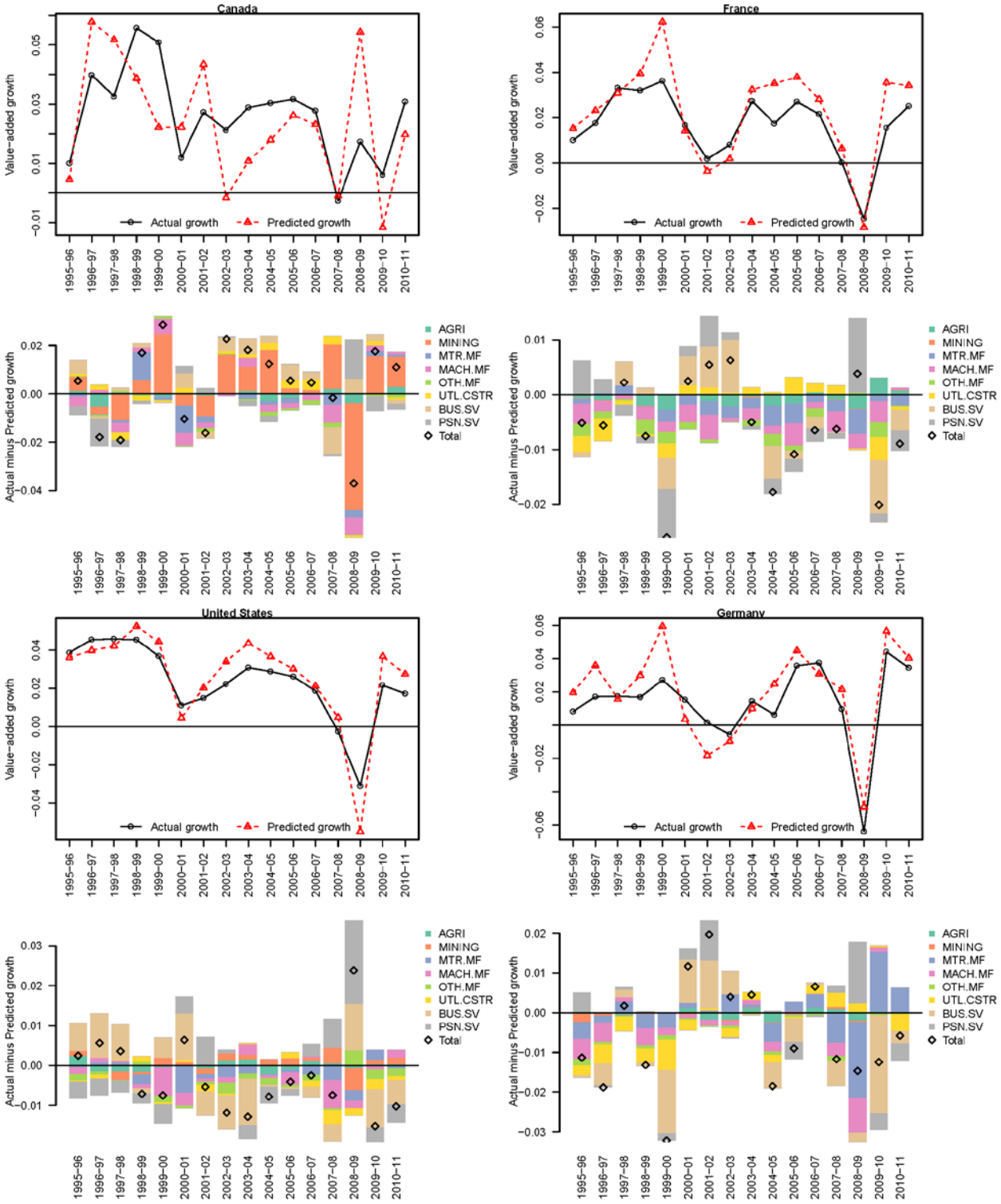
Note: Horizontal axis is the (country-demeaned) predicted value-added growth, and vertical axis is the (country-demeaned) actual value-added growth. Brunei Darussalam is dropped from the sample. The sample size is 976 (= 60 countries * 16 years). The red line is a line with slope 1, and the grey interval indicates the 90% confidence interval.

Figure 4: Nonparametric estimation results by region (National currency base at constant prices in 2005)



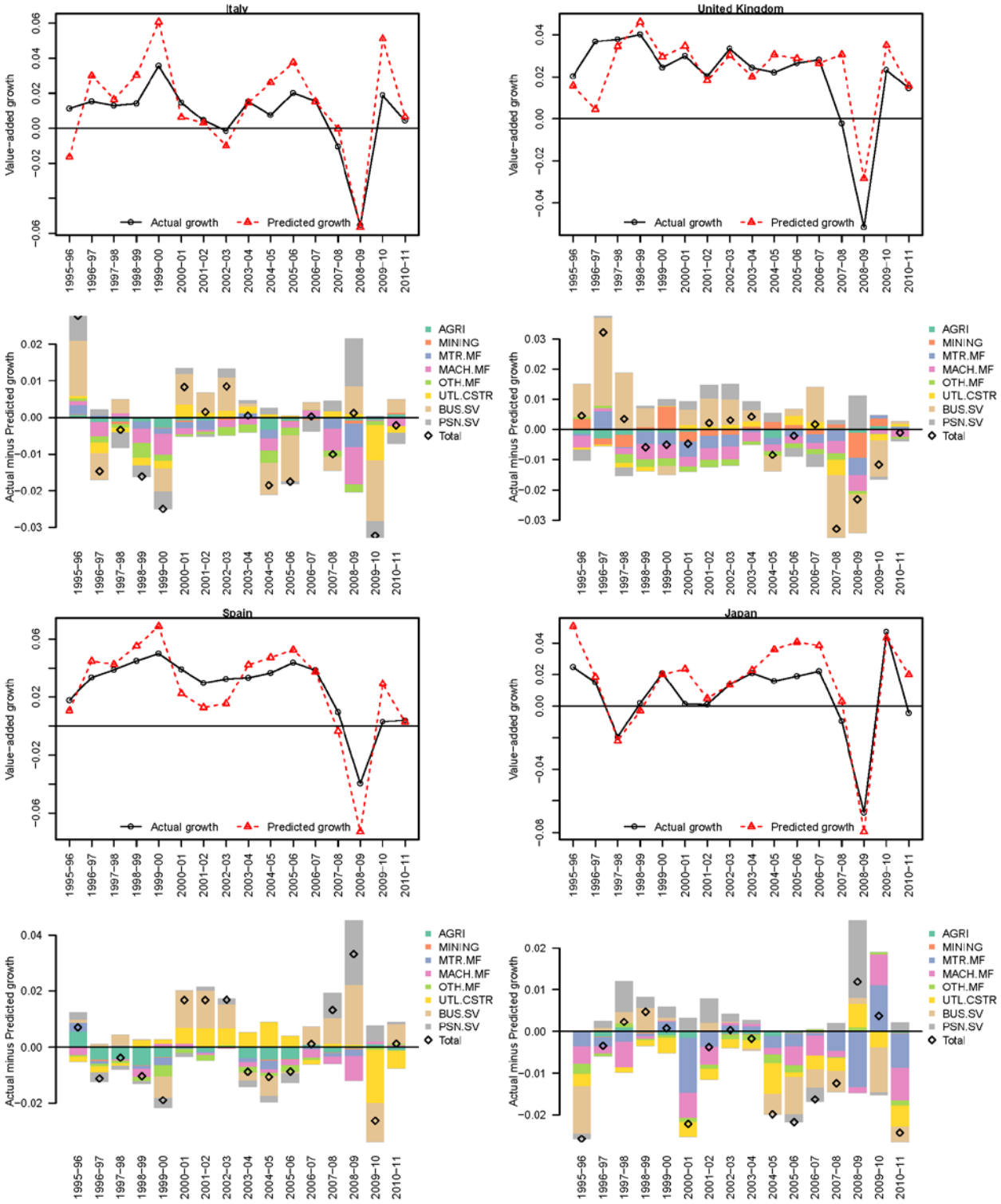
Note: Horizontal axis is the (country-demeaned) predicted value-added growth, and vertical axis is the (country-demeaned) actual value-added growth. The red line is a line with slope 1, and the grey interval indicates the 90% confidence interval. Brunei Darussalam is dropped from the sample. The definition of each group is described in Table 2, Panel (II).

Figure 5a: Comparison between actual and predicted value-added growth (1/3)



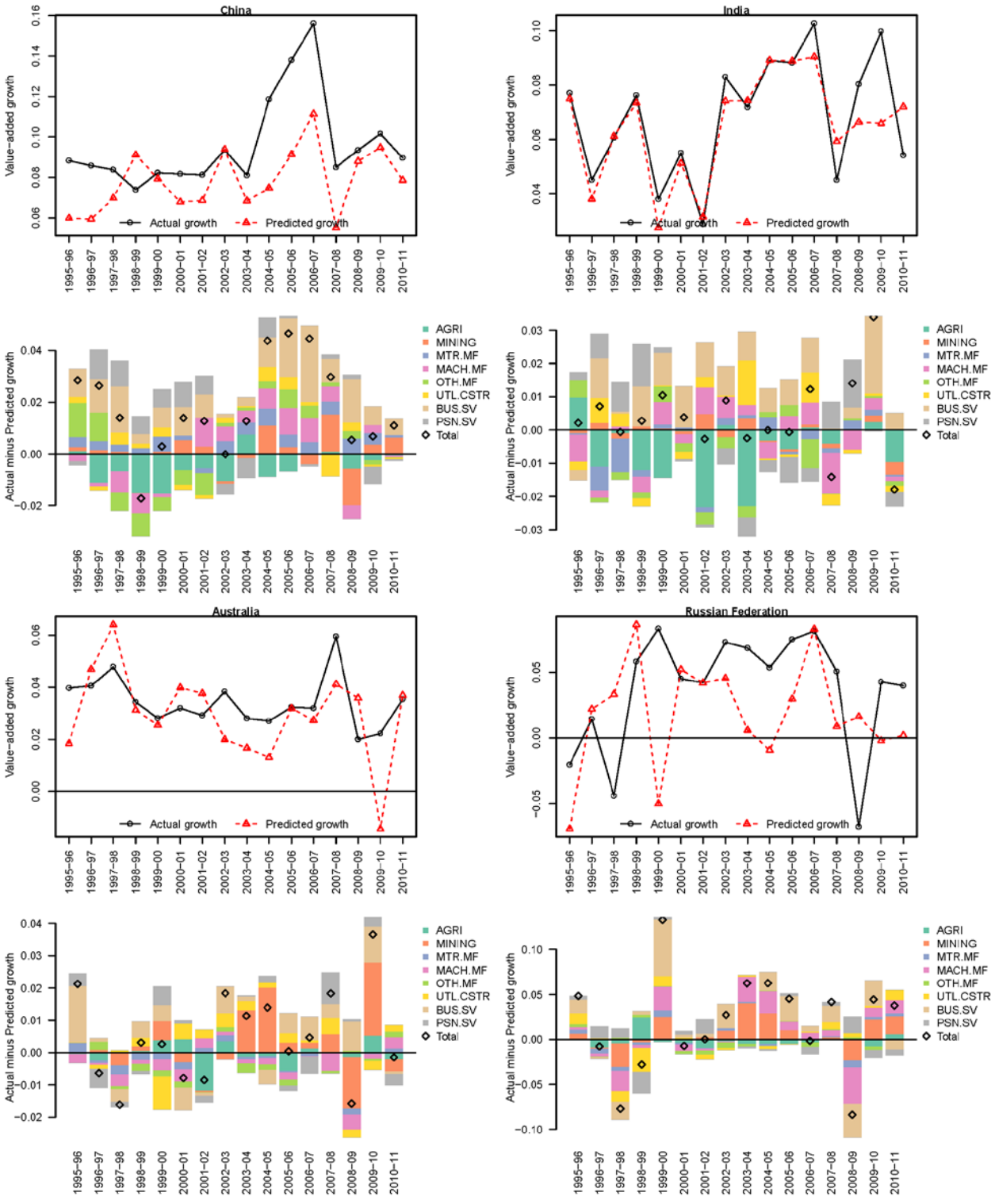
Note: National currency base at constant prices in 2005. The definition of eight aggregated industries is described in Table 1.

Figure 5b: Comparison between actual and predicted value-added growth (2/3)



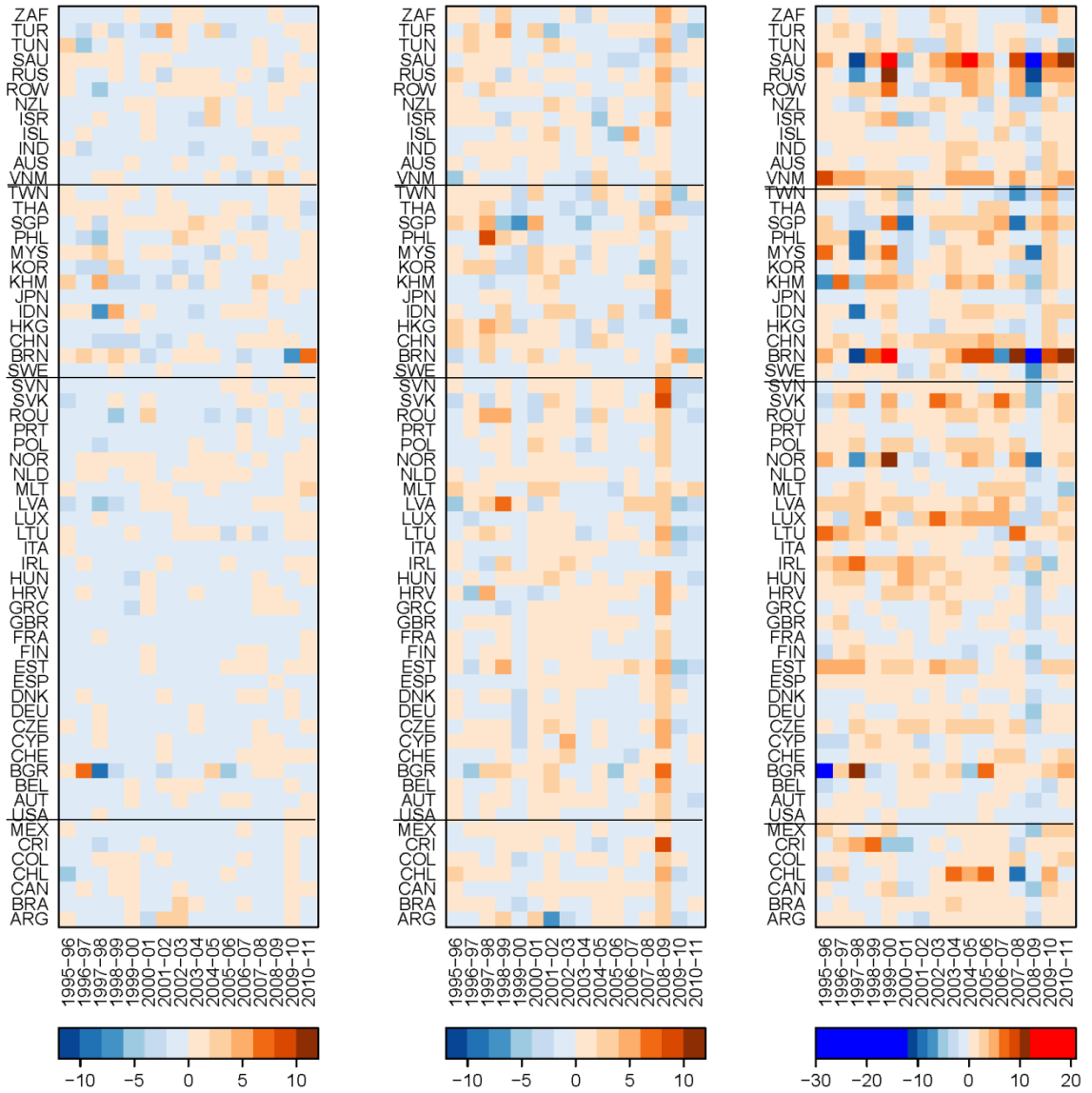
Note: National currency base at constant prices in 2005. The definition of eight aggregated industries is described in Table 1.

Figure 5c: Comparison between actual and predicted value-added growth (3/3)



Note: National currency base at constant price in 2005. The definition of eight aggregated industries is described in Table 1

Figure 6: Decomposition of value-added by final demand source by country



(I) Contribution of structural changes to value-added induced by domestic **goods** demand. ($\tilde{V}_{DG,c,t}$)

(II) Contribution of structural changes to value-added induced by domestic **services** demand. ($\tilde{V}_{DS,c,t}$)

(III) Contribution of structural changes to value-added induced by **foreign** final demand. ($\tilde{V}_{FO,c,t}$)

Note: The numerical values for each panel are provided in Tables A1-A4 in Appendix A.

Table 3: Regression results

-The relationship between final demand shocks and structural changes-

		Symmetric Model			Asymmetric Model		
	Explanatory variable	Coeffiecient		StdErr	Coeffiecient		StdErr
(a) Total	dFD	0.0376	***	(0.0067)			
	dFD*Nega				0.0152		(0.0100)
	dFD*Posi				0.0555	***	(0.0089)
	LR test (Null: Sym. model = Asym. model): p-value 0.0027						
(b) Domestic goods demand	dFD	0.0206	***	(0.0025)			
	dFD*Nega				0.0297	***	(0.0038)
	dFD*Posi				0.0133	***	(0.0034)
	LR test (Null: Sym. model = Asym. model): p-value 0.0011						
(c) Domestic services demand	dFD	-0.0420	***	(0.0038)			
	dFD*Nega				-0.0639	***	(0.0056)
	dFD*Posi				-0.0245	***	(0.0050)
	LR test (Null: Sym. model = Asym. model): p-value 0.0000002						
(d) Foreign final demand	dFD	0.0591	***	(0.0064)			
	dFD*Nega				0.0494	***	(0.0096)
	dFD*Posi				0.0668	***	(0.0086)
	LR test (Null: Sym. model = Asym. model): p-value 0.1767						

Note: The sample size is 930 (61 countries + ROW, 15 years) for each regression. The asterisks *** denote 1% significant level. These panels (a) to (d) correspond to the models (a) to (d) in Equations (12) and (13). The null hypothesis of the likelihood ratio (LR) test is that dFD*Nega and dFD*Posi have the same coefficient.

Table 4: Two-period Regression results

-The relationship between final demand shocks and structural changes-

(I) Sample from 1997 to 2004

1997-2004		Symmetric Model			Asymmetric Model		
	Explanatory variable	Coeffiecient		StdErr	Coeffiecient		StdErr
(a) Total	dFD	0.0615	***	(0.0079)			
	dFD*Nega				0.0532	***	(0.0133)
	dFD*Posi				0.0660	***	(0.0098)
	LR test (Null: Sym. model = Asym. model): p-value 0.4391						
(b) Domestic goods demand	dFD	0.0253	***	(0.0038)			
	dFD*Nega				0.0446	***	(0.0063)
	dFD*Posi				0.0149	***	(0.0046)
	LR test (Null: Sym. model = Asym. model): p-value 0.0001						
(c) Domestic services demand	dFD	-0.0116	**	(0.0050)			
	dFD*Nega				-0.0265	***	(0.0085)
	dFD*Posi				-0.0036		(0.0062)
	LR test (Null: Sym. model = Asym. model): p-value 0.0296						
(d) Foreign final demand	dFD	0.0478	***	(0.0079)			
	dFD*Nega				0.0350	***	(0.0133)
	dFD*Posi				0.0547	***	(0.0097)
	LR test (Null: Sym. model = Asym. model): p-value 0.2320						

(II) Sample from 2004 to 2011

2004-2011		Symmetric Model			Asymmetric Model		
	Explanatory variable	Coeffiecient		StdErr	Coeffiecient		StdErr
(a) Total	dFD	0.0113		(0.0104)			
	dFD*Nega				-0.0139		(0.0138)
	dFD*Posi				0.0425	***	(0.0154)
	LR test (Null: Sym. model = Asym. model): p-value 0.0065						
(b) Domestic goods demand	dFD	0.0159	***	(0.0031)			
	dFD*Nega				0.0195	***	(0.0042)
	dFD*Posi				0.0113	**	(0.0047)
	LR test (Null: Sym. model = Asym. model): p-value 0.1949						
(c) Domestic services demand	dFD	-0.0749	***	(0.0051)			
	dFD*Nega				-0.0850	***	(0.0069)
	dFD*Posi				-0.0623	***	(0.0076)
	LR test (Null: Sym. model = Asym. model): p-value 0.0276						
(d) Foreign final demand	dFD	0.0703	***	(0.0098)			
	dFD*Nega				0.0516	***	(0.0132)
	dFD*Posi				0.0935	***	(0.0146)
	LR test (Null: Sym. model = Asym. model): p-value 0.0329						

Note: The sample size is 496 (61 countries + ROW, 8 years) for each regression. The asterisks ** (***) denote 5% (1%) significant level. These panels (a) to (d) correspond to the models (a) to (d) in Equations (12) and (13). The null hypothesis of the likelihood ratio (LR) test is that dFD*Nega and dFD*Posi have the same coefficient.

APPENDIX A

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Table A1: Contribution of production and final demand structure changes to value-added

(%)	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
ARG	−0.24	−1.02	0.16	0.99	0.80	1.50	−5.98	−0.86	−2.94	−0.30	0.14	−0.50	1.44	0.97	−1.17	0.55
AUS	2.05	−0.61	−1.55	0.29	0.26	−0.76	−0.82	1.76	1.10	1.36	0.04	0.45	1.73	−1.55	3.58	−0.15
AUT	−1.69	−1.24	1.52	0.42	−1.36	0.22	2.26	0.22	0.21	−0.66	0.30	0.38	−0.50	−0.53	−2.26	−1.12
BEL	−2.58	−1.69	0.15	−0.37	−3.09	0.41	2.10	1.44	−0.05	−1.52	−0.86	−0.10	−2.05	1.77	−2.27	−1.07
BGR	−19.97	4.55	6.20	−2.77	−1.50	−0.23	3.34	0.59	0.08	−1.56	−1.06	1.23	2.05	9.13	2.00	2.29
BRA	0.20	−0.23	0.01	−2.85	0.27	−1.37	1.46	1.05	1.70	2.46	0.82	−0.26	−0.56	0.22	0.84	0.58
BRN	2.06	2.38	−7.58	8.06	22.97	−1.30	−2.81	4.03	5.94	10.13	9.06	−7.51	8.57	−31.34	5.92	13.27
CAN	0.53	−1.73	−1.86	1.61	2.73	−1.02	−1.57	2.23	1.76	1.21	0.53	0.45	−0.16	−3.64	1.75	1.08
CHE	−1.95	−2.89	0.48	−0.71	−1.51	0.65	2.23	0.19	−0.38	−1.72	−0.24	0.11	2.74	1.64	0.34	3.16
CHL	−3.69	1.42	−1.08	1.77	−0.36	−2.25	−0.63	0.72	7.41	2.87	8.84	−1.60	−10.60	4.06	2.38	−1.71
CHN	2.62	2.43	1.29	−1.60	0.27	1.29	1.18	−0.01	1.17	3.92	4.10	3.86	2.74	0.50	0.61	1.01
COL	0.79	0.49	−0.94	2.65	−0.45	−2.54	−0.98	−1.94	2.23	2.04	−0.95	1.39	1.52	0.44	1.91	1.81
CRI	−1.65	1.30	2.25	8.57	−3.55	−3.76	−2.20	0.48	−3.12	−2.48	0.22	1.73	−2.23	8.35	1.39	−0.75
CYP	−4.49	−1.83	2.85	2.61	−2.85	1.25	−2.46	3.03	−0.35	−0.45	−1.64	−1.83	−0.25	5.70	−2.84	0.53
CZE	1.48	−1.13	5.02	−0.26	−1.48	3.20	5.05	0.71	2.30	3.12	1.90	1.06	3.93	−0.34	−1.90	0.00
DEU	−1.13	−1.85	0.17	−1.30	−3.14	1.14	1.97	0.39	0.44	−1.84	−0.87	0.63	−1.16	−1.57	−1.20	−0.56
DNK	0.10	−2.57	−0.81	2.19	−0.98	0.83	−0.33	1.79	−0.99	−0.84	−2.10	−1.33	1.02	0.42	−0.83	−1.55
ESP	0.69	−1.08	−0.36	−0.99	−1.80	1.61	1.63	1.64	−0.85	−1.02	−0.84	0.11	1.31	3.45	−2.61	0.12
EST	4.43	2.80	5.37	4.45	1.24	4.25	0.35	4.63	1.87	2.45	0.73	3.75	2.48	2.87	−1.63	−0.46
FIN	−2.61	−0.65	3.02	1.09	−1.85	0.82	0.12	−1.04	−0.33	−3.80	−0.86	0.63	−1.31	−3.22	−3.38	−2.15
FRA	−0.51	−0.55	0.21	−0.73	−2.51	0.24	0.54	0.62	−0.49	−1.74	−1.06	−0.64	−0.63	0.39	−1.98	−0.87
GBR	0.45	3.10	0.33	−0.57	−0.49	−0.45	0.21	0.29	0.42	−0.82	−0.21	0.16	−3.29	−2.44	−1.15	−0.11
GRC	−0.32	−0.63	−1.20	−0.85	−3.03	0.64	0.91	3.08	2.29	0.32	−1.93	−2.15	0.04	3.15	−1.19	−0.99
HKG	3.97	0.80	2.66	1.71	−0.45	−0.07	0.77	−3.00	−2.77	1.97	−1.77	−2.57	−4.99	−2.17	−2.62	−2.81
HRV	1.76	−3.42	5.62	−1.61	1.31	0.77	−1.27	2.65	2.93	1.22	0.54	0.06	1.16	3.35	0.47	−1.84
HUN	−0.37	2.60	−0.65	−0.26	−1.10	6.46	5.90	0.51	2.30	1.32	−1.59	2.27	−0.15	−1.69	−1.18	−0.23
IDN	2.67	−0.38	−17.37	8.15	0.91	−1.74	2.86	2.81	−2.78	0.39	5.08	0.16	−0.96	3.14	2.11	1.19
IND	0.20	0.68	−0.06	0.26	1.00	0.36	−0.26	0.82	−0.23	−0.01	−0.06	1.11	−1.35	1.29	3.08	−1.70
IRL	2.37	4.84	2.65	4.40	1.58	5.00	5.05	5.24	0.65	−1.38	−0.43	1.30	−2.96	0.47	−5.45	1.04
ISL	−1.90	0.19	−0.43	0.49	−1.70	2.63	3.59	−2.12	−0.89	−2.10	−6.74	7.32	−1.64	−0.37	−0.15	−0.55
ISR	1.77	2.17	2.49	−0.86	4.30	−2.20	−3.67	−0.42	−0.69	−0.91	0.11	−0.64	3.42	3.12	0.32	−1.93
ITA	2.74	−1.45	−0.34	−1.59	−2.41	0.81	0.15	0.84	0.05	−1.84	−1.72	0.03	−1.01	0.13	−3.18	−0.22
JPN	−2.52	−0.34	0.23	0.47	0.07	−2.21	−0.37	0.03	−0.17	−1.95	−2.13	−1.59	−1.25	1.28	0.36	−2.44
KHM	−4.85	5.10	−1.89	1.08	0.90	4.49	0.54	−1.18	2.43	2.30	3.21	1.73	7.21	−0.54	0.65	1.58
KOR	−0.85	−0.06	−0.18	1.62	−0.15	−2.01	1.63	0.86	1.45	0.70	−0.41	−1.14	−10.19	0.80	1.66	−1.17
LTU	4.41	3.34	3.61	2.33	3.44	0.92	1.43	2.19	−0.31	0.72	−1.86	−1.08	2.55	4.61	−2.31	0.99
LUX	−1.55	−5.21	1.46	6.64	0.01	−1.32	4.10	7.39	1.43	3.26	5.58	3.91	−3.89	−1.29	1.07	0.88
LVA	−2.52	2.36	1.15	3.90	2.94	−0.65	1.72	−0.42	−0.57	2.34	−0.78	5.71	5.07	2.38	−5.34	−0.58
MEX	0.86	0.87	−1.26	1.87	1.89	0.78	0.46	−1.42	−0.47	0.94	0.98	−0.07	−0.64	−3.11	1.72	1.34
MLT	1.47	2.47	3.48	−0.12	−1.39	2.32	4.17	−1.66	−3.31	−1.46	−1.66	3.13	2.77	0.91	1.15	0.11
MYS	7.22	0.33	−3.51	2.50	1.52	−0.28	1.55	0.22	0.28	−0.54	1.82	1.36	4.57	−7.74	1.73	1.26
NLD	−1.24	−1.12	0.31	−0.01	−0.00	1.16	1.35	1.00	0.52	0.32	−1.35	0.49	0.42	−1.05	−1.26	−0.26
NOR	3.58	−0.47	−7.28	5.45	10.38	0.55	−1.03	−0.42	0.72	5.32	1.94	−2.68	5.79	−7.61	1.20	3.55
NZL	1.07	−0.15	−3.05	−1.03	−1.37	0.82	1.75	2.85	0.33	−0.95	−2.46	2.02	−4.02	0.61	1.23	−1.17
PHL	0.98	−1.39	−3.71	5.17	−0.53	−4.80	−0.81	−0.57	0.88	0.96	4.84	3.39	−0.60	0.65	0.65	−1.32
POL	−1.42	−1.19	1.31	−1.14	0.81	4.27	−0.69	−1.36	0.61	3.80	−0.30	0.66	2.14	0.32	−0.06	−0.14
PRT	−0.08	−0.94	−0.19	−0.40	−1.27	0.99	1.95	1.78	−1.46	−1.98	−0.35	0.36	−1.82	2.82	−1.84	1.45
ROU	−3.33	0.26	1.89	−0.10	0.73	0.02	2.58	0.17	0.55	2.58	1.16	1.99	2.13	2.67	−0.96	0.66
ROW	1.41	0.21	0.94	4.54	7.25	0.20	−3.19	−1.47	1.56	3.45	1.46	−1.40	4.92	−4.14	2.07	2.62
RUS	4.95	−0.75	−8.08	−2.65	12.29	−0.67	0.01	2.54	5.85	5.95	4.21	−0.15	3.98	−8.97	4.28	3.63
SAU	5.19	1.91	−9.22	7.02	9.23	−2.27	0.34	3.76	5.99	10.41	1.28	−4.40	7.99	−21.33	7.75	11.96
SGP	2.89	1.60	−0.21	−6.94	1.07	−2.46	0.02	2.79	1.21	3.24	3.48	3.96	−7.61	2.95	6.27	1.24
SVK	−8.26	2.62	0.62	1.60	2.45	−2.63	3.07	8.15	3.34	0.48	3.00	6.76	3.35	2.78	−1.97	0.19
SVN	−0.17	0.07	1.27	−0.63	−1.51	2.25	2.72	1.03	−0.57	−0.60	−0.33	0.66	0.16	2.60	−3.93	−0.87
SWE	1.73	−1.52	−0.58	0.10	−1.12	−2.94	1.03	2.51	1.22	−2.54	−0.43	−0.55	−2.58	−4.17	1.77	1.07
THA	1.83	−0.96	1.34	−0.56	−4.23	−3.03	2.48	0.74	−0.98	−3.43	5.19	4.24	−4.21	3.99	−0.12	−4.37
TUN	3.58	−0.08	0.38	2.38	−1.44	−0.03	−0.43	−0.08	0.35	0.65	−1.25	−1.15	1.01	1.25	−1.82	−2.43
TUR	−0.05	1.69	2.92	−1.94	−2.24	−0.84	−0.47	−0.17	0.60	1.45	−1.44	0.67	0.73	1.28	−2.33	−3.52
TWN	1.67	0.16	−2.35	2.00	1.19	−1.45	0.35	−2.49	−3.42	−0.17	−1.26	−2.76	−6.43	0.50	−0.62	−2.05
USA	0.24	0.54	0.35	−0.67	−0.72	0.64	−0.52	−1.16	−1.24	−0.75	−0.39	−0.24	−0.74	2.46	−1.48	−1.01
VNM	2.59	5.39	3.86	1.71	2.37	2.57	−1.30	−2.04	1.03	8.66	2.61	−4.59	6.08	6.23	0.24	4.18
ZAF	−1.04	0.59	−1.91	0.51	0.18	−2.18	−3.51	5.75	0.50	0.10	−2.96	−1.80	−4.61	4.05	4.43	−0.57

Table A2: Contribution of production and final demand structure changes to value-added induced by domestic goods demand

(%)	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
ARG	0.32	−0.37	−0.81	−0.93	0.15	−2.35	3.41	2.69	−1.83	−0.81	−0.91	−0.62	−0.76	−0.03	1.11	−0.39
AUS	−0.21	−0.39	−0.43	−1.01	0.01	−0.17	−0.31	1.17	−0.80	−0.63	1.15	−0.52	−1.13	−0.26	0.34	−0.00
AUT	−0.84	−0.93	−0.42	−0.14	0.07	−0.29	−0.04	0.09	−0.10	−0.15	0.05	0.28	−0.14	−0.03	−0.16	0.35
BEL	−0.05	−0.13	−0.09	−0.39	0.01	−0.39	0.00	0.27	0.18	−0.25	−0.16	−0.32	−0.71	−0.28	1.09	−0.42
BGR	0.98	6.66	−8.27	−3.97	−1.04	−0.78	−2.13	−0.78	−1.29	2.08	−4.50	−1.33	0.01	1.73	−0.34	−0.10
BRA	−1.04	−1.53	−1.13	−0.90	1.82	−0.88	−0.61	2.28	0.81	−0.87	−0.45	0.85	−0.07	−1.16	0.91	−1.73
BRN	1.27	2.07	0.62	3.07	0.65	−3.00	−0.03	1.88	1.39	1.69	−0.18	−2.27	−1.75	−1.84	−7.08	7.14
CAN	−0.60	0.35	−0.96	0.62	1.11	−0.63	−0.19	0.78	−0.23	−0.15	−0.67	−0.26	−0.25	−0.93	0.16	0.26
CHE	−0.39	−0.65	−0.36	−1.08	−1.10	−0.06	0.29	−0.43	−0.20	−0.09	−0.16	0.01	0.27	0.17	0.07	0.08
CHL	−4.20	−0.90	−0.60	0.30	0.31	−1.73	−0.04	−0.24	−0.03	−0.24	0.27	−1.30	−1.40	−0.22	0.96	−0.56
CHN	−1.78	−1.75	−2.14	−2.21	−2.28	−0.77	−2.16	−1.04	0.00	−1.50	−1.13	1.05	1.09	0.51	0.24	−0.23
COL	−1.34	−1.18	0.43	0.41	1.20	−0.14	0.04	−0.66	−0.32	−0.20	−0.73	0.00	−0.68	−0.78	0.29	−0.44
CRI	−0.64	−0.16	−2.25	−0.14	−0.56	0.31	−0.79	−0.46	−0.31	−0.35	−0.12	−0.16	−0.41	−0.29	1.36	−0.52
CYP	−1.77	−0.62	0.89	−0.11	−0.49	−0.20	0.55	−0.26	−0.44	−1.24	−0.98	−0.54	0.01	0.63	−0.14	−0.00
CZE	0.77	−1.01	0.03	−0.91	−0.66	−0.41	−0.17	−1.69	0.50	−0.19	−0.20	−0.10	0.45	−1.40	−0.23	0.37
DEU	−0.64	−0.33	0.12	−0.24	−0.20	−0.07	−0.35	−0.31	0.04	−0.79	−0.01	−0.09	−0.46	−0.97	0.36	−0.01
DNK	−0.45	0.08	−0.39	−0.49	−0.16	−0.22	0.03	−0.31	−0.18	−0.40	−0.54	0.16	0.13	−0.88	0.21	−0.52
ESP	−0.12	−0.88	−0.64	−0.88	−1.61	−0.07	−0.44	−0.46	−0.84	−0.78	−0.83	−0.29	−0.20	0.09	−0.44	−0.07
EST	−0.28	−1.09	−1.17	−0.14	−0.74	0.52	−0.03	−0.15	−0.89	−0.40	0.41	0.10	0.57	−0.20	0.34	0.77
FIN	−1.13	−0.17	−0.07	−0.02	−0.12	0.14	−0.29	−0.49	−0.23	−0.14	−0.51	0.03	0.31	−0.82	−0.21	0.14
FRA	−0.57	−0.56	0.36	−0.29	−0.67	−0.31	−0.37	−0.50	−0.37	−0.66	−0.71	−0.14	−0.04	−0.52	−0.31	0.10
GBR	−0.23	−0.04	−0.14	−0.83	−0.79	−0.66	−0.52	−0.78	−0.84	−0.40	−0.39	−0.62	−0.68	−0.78	−0.15	−0.21
GRC	−0.11	−1.24	−0.48	−0.60	−2.12	0.50	−0.03	−0.43	−0.53	−0.12	−0.98	−0.84	0.53	0.71	1.21	−0.34
HKG	−0.54	−0.38	−0.04	−0.15	0.14	−0.37	−0.13	−0.18	−0.11	−0.01	−0.26	−0.41	−0.33	0.06	−0.09	−0.34
HRV	−1.51	0.56	−0.04	−0.62	−0.30	0.53	−0.53	−1.49	0.14	−0.08	−0.56	−0.38	0.39	1.15	−0.32	−0.12
HUN	−0.38	−0.69	−1.60	−0.93	−2.10	0.43	−0.33	−0.31	−0.33	−0.76	−0.63	−0.23	0.13	−1.49	−0.04	0.70
IDN	0.63	0.65	−6.33	5.46	−1.23	0.27	−0.78	−0.23	−2.07	−1.57	0.48	0.58	0.31	−0.31	−0.60	−0.41
IND	0.54	−2.33	−1.41	−1.89	−0.71	−0.85	−1.47	−0.02	−3.30	−1.02	−0.50	−0.77	−2.12	0.72	−0.48	−1.79
IRL	−0.30	0.79	−0.31	−0.52	−1.67	−0.88	0.59	−0.32	−1.43	−0.18	0.05	−0.09	−0.52	−0.53	0.81	1.27
ISL	−1.45	0.16	−0.81	−0.38	−0.98	0.39	−0.44	−0.15	−1.44	−1.03	−0.48	−0.43	1.05	1.11	0.31	−1.18
ISR	−0.47	−0.13	0.73	−0.76	−1.14	0.37	−0.64	−0.75	−3.61	3.48	−0.39	0.43	−0.20	−0.01	−0.46	−0.87
ITA	0.14	−0.10	−0.01	−0.26	−1.27	−0.53	−0.18	−0.44	−0.54	−0.90	−0.53	−0.07	−0.53	−0.78	−0.15	−0.26
JPN	−0.52	−0.24	−0.57	−0.70	−0.07	−1.06	−1.13	−0.04	−0.15	−0.76	−0.29	−0.55	0.25	−1.06	0.52	−0.99
KHM	2.91	−0.12	5.19	−2.86	−3.84	−0.27	−3.69	1.57	−2.20	0.93	−1.13	−0.63	2.29	1.60	0.06	0.79
KOR	−0.69	−2.91	−2.79	2.56	−0.13	−0.86	−0.09	−3.37	−0.27	0.22	−0.53	−0.74	−1.92	−0.54	1.77	0.14
LTU	0.01	−1.71	−1.23	−0.76	0.92	−0.35	−0.43	0.31	1.23	0.64	−2.71	0.34	−2.07	−1.99	1.49	1.53
LUX	−0.20	−0.31	0.01	−0.27	−0.13	−0.10	−0.09	0.00	−0.04	−0.20	−0.04	−0.16	−0.02	−0.72	0.61	0.12
LVA	−2.31	−1.15	−4.34	−2.46	−0.24	0.24	0.29	0.27	−1.20	−0.25	−0.68	−1.28	0.26	1.66	0.33	−0.06
MEX	0.09	−0.42	−1.09	−0.75	−1.14	−0.07	−0.36	−0.58	−0.34	−0.58	−0.03	0.08	−0.43	−0.68	0.29	0.47
MLT	0.18	−0.42	−0.23	−0.50	−0.31	0.79	0.95	−1.84	−1.82	0.29	−0.69	−0.96	−0.73	−0.30	1.61	2.57
MYS	0.73	0.53	3.69	0.07	−1.52	0.56	1.13	−0.58	−0.18	−2.58	1.75	−0.04	0.42	−1.77	−0.17	0.86
NLD	−0.05	0.37	0.27	−0.39	0.15	0.88	−0.70	0.27	0.14	0.05	0.10	0.11	−0.96	−0.40	0.68	0.35
NOR	−0.43	0.21	0.07	0.11	0.78	0.29	−0.12	−0.34	0.69	0.68	0.65	−0.66	0.66	−1.47	0.83	0.29
NZL	−0.26	−0.72	−0.45	−0.23	0.40	0.10	−0.42	−0.38	−0.45	2.19	−0.82	0.76	−1.50	0.73	−0.02	−0.14
PHL	−1.82	−3.64	−4.07	1.65	−1.73	−0.11	−0.08	2.48	0.30	0.07	−1.89	0.54	1.11	−0.26	−1.36	0.69
POL	−1.11	−1.45	−3.11	−1.10	−1.17	−0.85	−1.12	−0.42	0.99	−0.63	−1.15	0.10	−0.75	−0.24	−0.59	0.37
PRT	−0.43	−1.29	−0.84	−0.41	−0.77	−0.12	−0.18	−0.10	−0.41	−0.56	−0.55	0.07	−0.34	0.02	−0.07	−0.02
ROU	−1.17	−0.67	−1.79	−4.57	−1.74	2.12	−1.13	−1.46	−0.40	−3.60	−0.24	−2.34	−0.73	0.07	−1.26	0.22
ROW	0.28	−1.01	−4.73	−0.19	−0.73	−0.27	0.67	0.62	1.44	0.04	0.25	−1.06	−0.66	0.74	1.71	−0.20
RUS	1.28	−1.25	−1.84	1.16	−0.47	0.10	−2.11	0.18	0.84	0.34	−1.10	0.24	−1.11	−2.60	1.32	1.02
SAU	0.45	0.16	0.19	1.15	−1.58	0.19	0.33	−0.72	−1.36	−1.73	−0.75	−0.87	0.64	−0.12	0.59	−0.50
SGP	−1.85	0.56	−2.68	1.92	0.85	0.17	1.27	0.71	2.66	0.20	0.45	−1.09	−2.07	−1.63	0.52	−0.23
SVK	−2.40	−1.86	−1.23	0.51	−1.51	0.18	−0.95	−0.20	−0.62	−1.19	−0.68	0.82	0.11	−1.36	0.20	−0.01
SVN	−0.55	−0.36	−0.09	−1.00	−0.46	−0.46	−0.30	−0.19	−0.36	−1.02	0.01	0.01	−0.36	0.20	0.34	0.24
SWE	−0.08	−0.64	−0.15	0.11	−0.04	−0.34	0.05	−0.15	−0.15	−0.45	−0.15	0.26	−0.58	−0.90	0.87	−0.00
THA	0.09	0.14	0.70	0.01	−1.70	−0.63	1.46	1.82	−1.44	−0.73	0.88	0.50	−0.74	0.79	0.73	−2.18
TUN	3.14	−4.37	−0.56	0.28	−0.62	−1.68	−1.42	0.97	−0.21	−0.44	−0.53	−1.12	0.39	−0.34	−1.57	0.85
TUR	−1.74	−3.94	0.51	−3.53	−1.47	−3.49	4.96	0.56	−1.11	2.38	−2.38	−0.89	−1.21	−0.16	0.41	0.43
TWN	0.03	−0.91	−0.58	0.31	0.23	−0.44	0.55	−0.11	−0.36	−1.35	−0.59	−0.48	−0.59	0.27	0.11	−0.03
USA	−0.24	−0.02	0.01	−0.11	−0.64	−0.55	−0.36	−0.38	−0.12	−0.29	−0.39	−0.24	−0.77	−0.27	0.21	0.16
VNM	−1.07	−1.08	0.85	0.19	−0.17	−0.77	−0.50	−0.91	−1.47	0.76	−1.15	−3.82	1.94	2.12	−1.33	0.35
ZAF	−1.52	−0.84	−0.34	−1.33	0.05	−0.39	−0.99	1.00	1.32	−1.16	−1.41	−0.85	−1.99	1.35	−0.38	−0.69

Table A3: Contribution of production and final demand structure changes to value-added induced by domestic services demand

(%)	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
ARG	−1.31	−1.15	0.73	2.24	−0.24	3.94	−6.08	−3.70	−1.52	0.38	0.96	−0.43	0.86	3.65	−3.22	−0.44
AUS	0.80	−0.81	0.08	0.49	−0.38	0.95	0.20	−0.36	−0.28	0.07	−0.81	−0.05	1.28	1.91	−0.13	−0.82
AUT	0.04	−0.65	0.32	0.03	−1.36	0.15	1.34	0.28	0.75	0.11	−0.42	−0.69	0.14	2.65	−1.11	−2.19
BEL	0.03	−0.72	−0.31	0.65	−1.89	0.38	2.01	0.57	−0.70	0.42	−0.36	0.06	−1.95	4.04	−1.32	−0.91
BGR	−1.80	−4.18	2.87	3.72	0.15	0.28	2.34	−0.60	−0.92	0.78	−4.08	1.70	0.50	7.26	−0.21	−1.95
BRA	1.55	0.99	1.22	−0.86	−2.74	−0.71	1.30	−1.76	−1.14	1.52	0.51	−1.16	−1.62	3.36	−1.72	0.99
BRN	−3.78	−1.47	3.25	−1.24	1.38	2.47	−1.35	0.40	−0.76	−1.22	−0.01	1.41	−0.66	0.52	4.88	−4.20
CAN	0.19	−1.95	−0.07	−0.78	−1.05	1.62	0.62	0.23	0.39	0.12	0.87	0.67	0.25	2.73	−0.60	−0.95
CHE	−0.12	−1.16	−0.08	0.28	−0.93	0.17	1.70	2.22	−0.77	−1.26	−0.88	−2.87	0.22	1.65	−0.45	0.20
CHL	3.04	0.07	0.53	1.83	−1.08	−0.08	0.63	−0.53	−0.23	−0.94	0.79	−0.99	−0.69	5.30	−3.18	−0.89
CHN	2.73	1.25	3.14	1.02	0.42	0.74	1.33	−1.20	−2.28	2.04	1.20	−0.06	−0.85	1.54	−1.92	−0.12
COL	1.54	1.33	−0.50	1.43	−2.65	−1.04	0.13	−0.96	1.06	0.70	−0.84	0.48	−0.06	2.40	0.11	−1.63
CRI	−0.82	−1.04	−1.29	1.30	1.28	0.77	−0.26	0.09	−1.11	−2.94	−0.52	1.37	0.35	8.63	−0.82	−0.45
CYP	0.35	0.98	0.27	0.34	−2.52	0.72	−0.38	4.35	−1.66	1.33	−0.45	−1.32	−0.84	5.86	−1.08	0.74
CZE	−1.25	0.37	1.60	0.14	−2.41	0.40	2.85	1.54	−0.90	1.13	−0.22	−0.77	0.32	4.39	−2.25	−1.82
DEU	0.31	−1.06	−0.65	−0.40	−2.08	0.45	1.54	0.06	−0.33	−0.50	−1.05	−0.46	−0.43	3.67	−1.58	−1.27
DNK	1.02	−1.02	0.21	1.14	−2.14	0.54	−0.21	1.76	−0.39	−1.16	−1.17	−1.04	0.37	3.85	0.59	−0.01
ESP	−0.44	−0.82	−0.49	−0.27	−0.55	0.79	1.53	1.03	0.13	0.08	−0.06	−0.14	1.25	3.91	−2.06	−1.03
EST	0.33	−2.09	1.80	4.16	−1.30	1.02	−0.31	0.56	0.12	0.73	0.81	2.58	1.58	5.78	−4.30	−3.60
FIN	0.71	−0.51	0.12	1.00	−1.78	0.52	0.54	0.04	0.04	−1.59	−0.05	−0.78	−1.14	3.37	−1.49	−1.19
FRA	0.45	−0.25	−0.86	0.18	−1.23	0.36	1.07	0.96	0.08	−0.08	0.27	−0.06	−0.62	2.78	−1.23	−1.47
GBR	−0.24	0.72	0.53	0.67	−0.08	0.98	0.92	0.77	0.83	0.15	0.16	0.20	−0.88	1.83	−1.06	−0.38
GRC	−0.10	−0.58	−0.55	−2.18	−0.40	0.52	1.63	1.75	0.55	0.82	−0.28	−1.87	−0.59	4.63	−1.34	−0.11
HKG	3.49	1.69	4.05	2.63	−2.27	1.09	1.32	−0.03	−3.21	1.30	−2.29	−1.14	−1.11	−0.35	−5.22	−1.54
HRV	1.38	−4.90	4.39	−0.16	−1.42	−2.19	−1.44	1.34	1.13	1.10	0.05	0.85	−0.20	4.23	0.69	−0.78
HUN	−1.97	0.10	−1.41	0.96	0.26	1.21	2.90	0.44	−0.54	0.92	−1.95	1.10	0.43	4.14	−1.66	−2.29
IDN	0.24	−1.84	−1.91	2.62	−1.22	−0.94	3.68	2.68	−0.86	−0.08	2.19	−0.49	−2.83	5.36	−0.63	−1.01
IND	−0.25	2.00	1.01	1.46	0.69	0.74	0.42	−0.33	0.49	−1.11	−0.81	0.38	−0.32	1.43	−0.38	−0.68
IRL	0.66	−0.56	−3.73	2.04	−0.37	1.57	1.80	2.15	1.08	−1.54	−0.55	−1.86	−0.32	−1.14	−1.77	−0.99
ISL	−1.61	−0.27	−1.10	1.20	−0.09	0.56	3.04	−0.44	0.02	−1.30	−4.40	4.83	−1.56	0.91	−1.57	−0.29
ISR	1.25	0.73	0.03	−2.45	0.44	1.79	−0.12	1.76	1.51	−4.14	0.64	−1.31	1.32	4.48	−0.41	−1.18
ITA	1.18	−0.97	−0.45	−0.06	−0.92	0.87	0.84	1.04	0.29	0.11	−0.98	−0.19	0.61	3.54	−2.44	−0.65
JPN	−0.80	−0.09	1.21	1.03	−0.58	0.70	1.06	−0.18	−0.67	−0.43	−1.14	−0.20	−1.35	4.77	−1.68	−0.51
KHM	−0.32	−1.53	−2.39	−1.89	−0.20	1.11	2.24	−1.48	−0.60	−1.38	−0.27	0.48	1.50	2.47	−1.71	−1.03
KOR	0.01	2.62	3.52	−2.06	−2.86	2.02	0.99	3.62	−1.38	0.01	−0.21	−0.31	−4.32	3.96	−3.30	−1.36
LTU	−1.69	0.73	2.78	1.60	−0.02	0.63	1.45	0.90	−2.63	−1.52	0.92	1.38	−1.93	5.53	−5.37	−3.28
LUX	−1.56	−2.22	−0.99	−1.06	−0.94	1.02	1.20	0.91	−1.06	−0.92	0.02	−0.87	−0.30	3.06	−1.85	−1.13
LVA	−4.15	1.45	3.27	6.07	0.03	−3.61	0.61	−1.13	−1.09	−0.49	−0.17	2.76	2.92	3.36	−4.44	−3.72
MEX	−1.84	0.10	0.22	1.29	0.85	1.89	1.04	0.12	−0.60	0.28	−0.19	−0.17	−0.19	1.99	−1.30	−1.70
MLT	2.89	1.84	1.07	−0.27	−1.52	3.23	3.40	−0.19	−0.36	−0.91	−3.88	1.27	−0.24	2.23	1.29	2.50
MYS	0.39	−1.34	1.50	−0.61	−3.84	2.13	0.56	0.31	−2.89	1.39	−0.43	−0.02	1.71	3.69	−1.59	−1.22
NLD	0.07	−0.07	0.60	0.34	0.45	1.14	1.45	0.83	0.65	0.40	−0.31	0.20	−0.38	1.47	−1.46	−0.77
NOR	−0.24	−0.89	−1.09	2.00	−0.88	1.03	1.33	0.59	−1.53	−0.73	−1.10	−0.14	−0.22	3.45	−1.13	−0.68
NZL	1.17	0.86	−0.51	−1.37	−1.01	−0.11	2.16	1.03	−0.33	−3.71	0.71	−0.59	−0.33	3.23	−1.31	−0.27
PHL	−0.78	−0.76	8.70	2.12	1.23	−2.55	−0.29	−1.01	−0.37	0.15	1.33	1.05	−0.36	2.87	−0.72	−1.35
POL	−0.90	−1.14	0.89	1.80	−0.94	3.09	0.70	−1.58	−2.84	1.50	−1.34	−1.06	0.73	2.42	−0.89	−1.55
PRT	−0.05	0.34	−0.20	0.16	−0.45	1.24	1.87	1.24	−0.77	0.18	−0.69	−0.20	−1.03	3.90	−1.87	−0.32
ROU	−1.07	0.14	4.91	4.72	−1.09	−2.69	1.91	1.20	−2.57	3.31	−0.51	1.84	1.55	3.49	−0.78	−2.26
ROW	0.50	−0.36	2.36	1.64	0.44	0.98	−1.34	−1.98	0.98	−0.98	−1.06	0.02	0.42	2.28	−1.17	0.62
RUS	2.47	0.61	0.08	−2.15	1.53	−0.35	1.95	0.32	−0.49	−0.36	1.51	−0.43	0.74	4.34	−2.02	−1.69
SAU	−0.60	0.69	1.74	0.00	−1.39	1.77	−0.34	−0.64	0.62	−0.34	−2.66	−2.03	−1.65	3.90	0.87	0.97
SGP	2.12	1.67	5.84	−4.87	−6.68	5.98	−0.60	−0.33	−4.65	−0.47	−0.30	0.09	3.87	1.62	0.52	−0.97
SVK	−2.24	1.73	−2.38	1.80	−0.54	−2.68	2.16	1.84	−0.28	0.11	0.22	−0.46	0.26	8.61	−2.73	−1.89
SVN	0.67	−0.05	−0.03	1.13	−1.84	1.67	1.07	0.05	−1.40	0.33	0.29	−0.75	−0.14	6.44	−2.77	−2.63
SWE	0.67	−0.70	−0.95	−0.09	−1.35	0.69	1.27	0.58	0.01	−0.74	−0.78	−1.02	−0.16	3.42	−1.70	0.06
THA	1.83	0.24	3.26	−1.10	−2.58	−0.28	−0.63	−2.06	−1.03	−2.32	0.72	1.41	−2.86	4.74	−3.56	−2.10
TUN	0.03	3.08	0.52	0.02	−1.18	−0.66	3.38	1.51	−1.47	−0.01	−0.23	−1.72	−2.89	5.32	−2.05	0.77
TUR	−0.27	2.28	1.18	5.19	−1.86	3.67	−5.17	−0.83	−0.32	−1.77	1.11	1.43	0.83	2.63	−2.38	−4.53
TWN	0.75	0.37	0.21	0.60	−2.73	3.28	−0.97	−0.99	−3.56	2.13	0.06	−0.24	0.31	3.81	−4.88	0.20
USA	0.18	−0.20	0.03	−0.39	−0.42	1.42	0.37	−0.02	−0.98	−0.39	−0.16	0.11	0.16	3.05	−1.69	−1.13
VNM	−5.12	0.90	−1.73	−0.61	−1.35	1.14	−1.44	−1.35	−2.92	2.33	−0.45	−1.55	−0.66	3.52	−0.67	−0.81
ZAF	0.73	0.68	−0.67	3.14	−1.39	−0.39	−1.02	1.32	−2.10	0.21	−1.18	−0.51	−0.86	5.09	0.48	−0.36

Table A4: Contribution of production and final demand structure changes to value-added induced by foreign final (goods & services) demand

(%)	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008	2008–2009	2009–2010	2010–2011
ARG	0.75	0.50	0.25	−0.32	0.90	−0.09	−3.31	0.15	0.40	0.13	0.09	0.54	1.35	−2.65	0.94	1.38
AUS	1.46	0.59	−1.19	0.81	0.63	−1.54	−0.71	0.95	2.18	1.93	−0.30	1.03	1.58	−3.20	3.37	0.68
AUT	−0.90	0.34	1.62	0.54	−0.07	0.35	0.96	−0.16	−0.44	−0.61	0.67	0.79	−0.50	−3.14	−0.99	0.71
BEL	−2.56	−0.85	0.55	−0.62	−1.21	0.42	0.09	0.60	0.47	−1.69	−0.34	0.16	0.60	−1.99	−2.04	0.26
BGR	−19.16	2.08	11.61	−2.51	−0.61	0.27	3.13	1.97	2.29	−4.42	7.52	0.86	1.54	0.13	2.56	4.34
BRA	−0.31	0.31	−0.08	−1.08	1.20	0.22	0.77	0.53	2.02	1.81	0.76	0.05	1.13	−1.98	1.64	1.32
BRN	4.56	1.79	−11.45	6.23	20.94	−0.77	−1.43	1.75	5.31	9.66	9.25	−6.65	10.98	−30.02	8.12	10.33
CAN	0.94	−0.12	−0.82	1.77	2.67	−2.01	−2.00	1.22	1.61	1.24	0.33	0.04	−0.16	−5.44	2.19	1.76
CHE	−1.44	−1.08	0.93	0.09	0.52	0.54	0.25	−1.60	0.59	−0.37	0.81	2.97	2.25	−0.18	0.72	2.87
CHL	−2.53	2.25	−1.01	−0.36	0.41	−0.44	−1.23	1.50	7.67	4.05	7.78	0.69	−8.50	−1.02	4.60	−0.26
CHN	1.67	2.92	0.30	−0.42	2.13	1.32	2.00	2.22	3.44	3.38	4.03	2.87	2.51	−1.55	2.29	1.36
COL	0.58	0.34	−0.87	0.81	1.00	−1.36	−1.15	−0.32	1.49	1.53	0.63	0.91	2.26	−1.17	1.51	3.88
CRI	−0.19	2.50	5.79	7.41	−4.27	−4.85	−1.15	0.85	−1.71	0.80	0.86	0.52	−2.16	0.00	0.85	0.22
CYP	−3.07	−2.19	1.70	2.38	0.16	0.73	−2.64	−1.06	1.74	−0.54	−0.20	0.03	0.58	−0.79	−1.62	−0.21
CZE	1.96	−0.49	3.38	0.51	1.59	3.22	2.36	0.86	2.71	2.17	2.32	1.94	3.16	−3.32	0.57	1.45
DEU	−0.80	−0.46	0.70	−0.66	−0.86	0.76	0.78	0.65	0.74	−0.56	0.19	1.18	−0.27	−4.27	0.03	0.72
DNK	−0.48	−1.63	−0.63	1.54	1.32	0.51	−0.16	0.34	−0.42	0.72	−0.39	−0.45	0.51	−2.56	−1.64	−1.01
ESP	1.24	0.61	0.76	0.17	0.35	0.88	0.53	1.07	−0.14	−0.32	0.06	0.53	0.25	−0.55	−0.11	1.21
EST	4.38	5.98	4.74	0.43	3.28	2.71	0.70	4.23	2.64	2.11	−0.49	1.07	0.34	−2.71	2.33	2.37
FIN	−2.19	0.02	2.97	0.11	0.04	0.15	−0.13	−0.59	−0.13	−2.07	−0.30	1.37	−0.48	−5.76	−1.69	−1.10
FRA	−0.39	0.25	0.72	−0.62	−0.61	0.19	−0.16	0.16	−0.21	−1.00	−0.62	−0.44	0.04	−1.87	−0.44	0.50
GBR	0.92	2.41	−0.06	−0.40	0.37	−0.78	−0.20	0.30	0.42	−0.57	0.03	0.58	−1.73	−3.49	0.06	0.48
GRC	−0.12	1.19	−0.18	1.94	−0.51	−0.37	−0.69	1.76	2.26	−0.39	−0.68	0.56	0.10	−2.19	−1.06	−0.53
HKG	1.03	−0.51	−1.35	−0.76	1.67	−0.79	−0.41	−2.79	0.55	0.69	0.78	−1.01	−3.56	−1.88	2.70	−0.93
HRV	1.89	0.93	1.27	−0.83	3.03	2.43	0.69	2.80	1.66	0.20	1.05	−0.40	0.97	−2.03	0.11	−0.94
HUN	1.99	3.19	2.36	−0.29	0.74	4.82	3.33	0.38	3.16	1.16	0.98	1.41	−0.71	−4.33	0.52	1.36
IDN	1.81	0.81	−9.13	0.07	3.36	−1.07	−0.04	0.35	0.14	2.04	2.41	0.07	1.56	−1.90	3.33	2.61
IND	−0.10	1.01	0.35	0.68	1.03	0.47	0.79	1.17	2.58	2.13	1.25	1.50	1.10	−0.86	3.95	0.77
IRL	2.01	4.61	6.69	2.88	3.63	4.31	2.66	3.41	1.00	0.34	0.08	3.25	−2.13	2.13	−4.50	0.76
ISL	1.16	0.30	1.49	−0.33	−0.64	1.67	0.99	−1.52	0.53	0.23	−1.85	2.92	−1.14	−2.38	1.11	0.92
ISR	0.99	1.57	1.73	2.35	4.99	−4.35	−2.91	−1.43	1.41	−0.24	−0.14	0.24	2.30	−1.35	1.19	0.11
ITA	1.43	−0.39	0.13	−1.28	−0.23	0.48	−0.52	0.24	0.31	−1.05	−0.21	0.28	−1.09	−2.64	−0.59	0.69
JPN	−1.19	−0.01	−0.41	0.14	0.72	−1.84	−0.30	0.25	0.65	−0.76	−0.70	−0.84	−0.16	−2.43	1.52	−0.94
KHM	−7.44	6.75	−4.69	5.84	4.94	3.64	1.98	−1.26	5.24	2.75	4.61	1.88	3.42	−4.62	2.31	1.81
KOR	−0.17	0.24	−0.91	1.11	2.84	−3.17	0.74	0.61	3.11	0.47	0.33	−0.10	−3.95	−2.62	3.19	0.05
LTU	6.09	4.31	2.06	1.49	2.54	0.65	0.41	0.98	1.09	1.61	−0.07	−2.80	6.55	1.06	1.58	2.75
LUX	0.20	−2.68	2.45	7.97	1.08	−2.23	2.99	6.48	2.53	4.38	5.60	4.94	−3.58	−3.62	2.30	1.89
LVA	3.95	2.05	2.21	0.29	3.14	2.72	0.82	0.44	1.72	3.07	0.07	4.24	1.89	−2.65	−1.22	3.19
MEX	2.60	1.20	−0.39	1.33	2.17	−1.04	−0.22	−0.96	0.48	1.23	1.20	0.02	−0.02	−4.43	2.73	2.56
MLT	−1.60	1.05	2.64	0.65	0.45	−1.70	−0.18	0.37	−1.13	−0.84	2.92	2.82	3.74	−1.02	−1.74	−4.96
MYS	6.10	1.14	−8.70	3.04	6.88	−2.97	−0.14	0.49	3.35	0.64	0.50	1.43	2.44	−9.66	3.50	1.63
NLD	−1.26	−1.42	−0.57	0.03	−0.60	−0.86	0.59	−0.10	−0.28	−0.13	−1.14	0.18	1.76	−2.12	−0.47	0.17
NOR	4.25	0.21	−6.27	3.35	10.48	−0.77	−2.23	−0.67	1.56	5.37	2.40	−1.88	5.35	−9.58	1.50	3.95
NZL	0.17	−0.29	−2.09	0.57	−0.76	0.82	0.00	2.20	1.11	0.57	−2.35	1.85	−2.20	−3.35	2.56	−0.76
PHL	3.57	3.01	−8.34	1.40	−0.02	−2.14	−0.44	−2.05	0.95	0.74	5.40	1.80	−1.36	−1.96	2.73	−0.66
POL	0.60	1.40	3.53	−1.85	2.93	2.03	−0.28	0.64	2.46	2.92	2.19	1.61	2.16	−1.86	1.43	1.04
PRT	0.40	0.02	0.84	−0.14	−0.05	−0.13	0.27	0.63	−0.28	−1.59	0.89	0.49	−0.46	−1.10	0.10	1.80
ROU	−1.09	0.79	−1.23	−0.25	3.56	0.60	1.81	0.43	3.52	2.88	1.91	2.48	1.31	−0.88	1.07	2.70
ROW	0.63	1.58	3.31	3.09	7.54	−0.51	−2.51	−0.11	−0.85	4.39	2.28	−0.36	5.16	−7.17	1.53	2.20
RUS	1.20	−0.11	−6.31	−1.66	11.23	−0.43	0.18	2.04	5.49	5.97	3.80	0.04	4.34	−10.72	4.98	4.30
SAU	5.33	1.06	−11.15	5.87	12.21	−4.23	0.36	5.12	6.74	12.47	4.69	−1.50	8.99	−25.11	6.28	11.49
SGP	2.62	−0.63	−3.38	−3.98	6.90	−8.61	−0.66	2.41	3.19	3.51	3.33	4.96	−9.40	2.96	5.23	2.44
SVK	−3.62	2.75	4.22	−0.70	4.50	−0.13	1.86	6.51	4.24	1.56	3.46	6.40	2.99	−4.47	0.56	2.10
SVN	−0.28	0.48	1.39	−0.75	0.79	1.04	1.95	1.17	1.20	0.09	−0.63	1.41	0.65	−4.04	−1.50	1.52
SWE	1.14	−0.17	0.51	0.09	0.27	−3.29	−0.29	2.08	1.36	−1.35	0.50	0.21	−1.84	−6.69	2.60	1.01
THA	−0.09	−1.34	−2.62	0.53	0.05	−2.12	1.65	0.98	1.50	−0.38	3.59	2.33	−0.62	−1.55	2.71	−0.09
TUN	0.41	1.21	0.42	2.08	0.36	2.31	−2.38	−2.57	2.04	1.10	−0.49	1.69	3.51	−3.73	1.80	−4.05
TUR	1.97	3.35	1.23	−3.61	1.08	−1.01	−0.26	0.10	2.03	0.84	−0.16	0.13	1.11	−1.18	−0.35	0.58
TWN	0.90	0.70	−1.98	1.09	3.69	−4.29	0.77	−1.40	0.50	−0.95	−0.74	−2.05	−6.15	−3.58	4.14	−2.22
USA	0.30	0.76	0.30	−0.18	0.34	−0.23	−0.54	−0.75	−0.14	−0.08	0.16	−0.11	−0.13	−0.33	−0.00	−0.03
VNM	8.78	5.57	4.74	2.14	3.89	2.20	0.65	0.22	5.42	5.57	4.21	0.78	4.80	0.59	2.24	4.65
ZAF	−0.24	0.76	−0.90	−1.31	1.52	−1.40	−1.49	3.43	1.29	1.05	−0.37	−0.44	−1.77	−2.39	4.33	0.48

Table A5: Median absolute percentage changes in the production and final demand structure (compared to the previous year, %)

	Value added ratios	Leontief (Domestic part)	Leontief (Foreign part)	Composition of domestic final	Composition of foreign final
1995-1996	1.745	9.487	18.872	6.843	33.180
1996-1997	1.804	9.291	17.833	7.280	29.823
1997-1998	1.955	10.993	20.014	8.302	33.721
1998-1999	2.071	9.845	18.551	8.026	35.261
1999-2000	2.370	12.597	22.766	8.749	36.947
2000-2001	2.074	11.249	19.642	8.096	35.722
2001-2002	2.098	9.348	17.299	6.952	33.822
2002-2003	2.075	11.020	18.849	7.792	34.758
2003-2004	2.039	9.754	19.057	6.932	35.623
2004-2005	2.179	11.285	18.518	7.167	33.794
2005-2006	2.230	9.586	17.491	6.396	33.578
2006-2007	2.082	8.936	16.066	6.756	30.859
2007-2008	2.574	11.876	20.071	8.383	36.536
2008-2009	2.840	14.474	21.417	13.029	36.348
2009-2010	2.248	10.238	19.115	8.111	32.702
2010-2011	1.217	7.950	15.335	5.948	29.132
Stdev	0.357	1.601	1.845	1.605	2.335
Mean	2.100	10.496	18.806	7.798	33.863

Note: Stdev and Mean denote the standard deviation and mean for each column.

Table A6: Median absolute changes in the production and final demand structure (compared to the previous year)

	Value added ratios	Leontief (Domestic part)	Leontief (Foreign part)	Composition of domestic final demand	Composition of foreign final demand
1995-1996	0.00811	0.00052	0.0000018	0.00062	0.0000006
1996-1997	0.00805	0.00051	0.0000018	0.00061	0.0000006
1997-1998	0.00873	0.00062	0.0000021	0.00067	0.0000007
1998-1999	0.00899	0.00055	0.0000021	0.00066	0.0000007
1999-2000	0.01027	0.00071	0.0000026	0.00077	0.0000007
2000-2001	0.00857	0.00065	0.0000024	0.00074	0.0000007
2001-2002	0.00854	0.00054	0.0000022	0.00062	0.0000007
2002-2003	0.00865	0.00064	0.0000024	0.00067	0.0000007
2003-2004	0.00871	0.00056	0.0000024	0.00060	0.0000007
2004-2005	0.00872	0.00068	0.0000026	0.00065	0.0000008
2005-2006	0.00917	0.00055	0.0000025	0.00057	0.0000008
2006-2007	0.00808	0.00053	0.0000025	0.00060	0.0000007
2007-2008	0.01028	0.00071	0.0000032	0.00071	0.0000009
2008-2009	0.01143	0.00083	0.0000034	0.00108	0.0000009
2009-2010	0.00915	0.00062	0.0000029	0.00073	0.0000007
2010-2011	0.00509	0.00047	0.0000024	0.00055	0.0000007
Stdev	0.00134	0.00009	0.0000004	0.00012	0.0000001
Mean	0.00878	0.00060	0.0000025	0.00068	0.0000007

Note: Stdev and Mean denote the standard deviation and mean for each column.

APPENDIX B: RESULTS USING LABOUR COMPENSATION DATA

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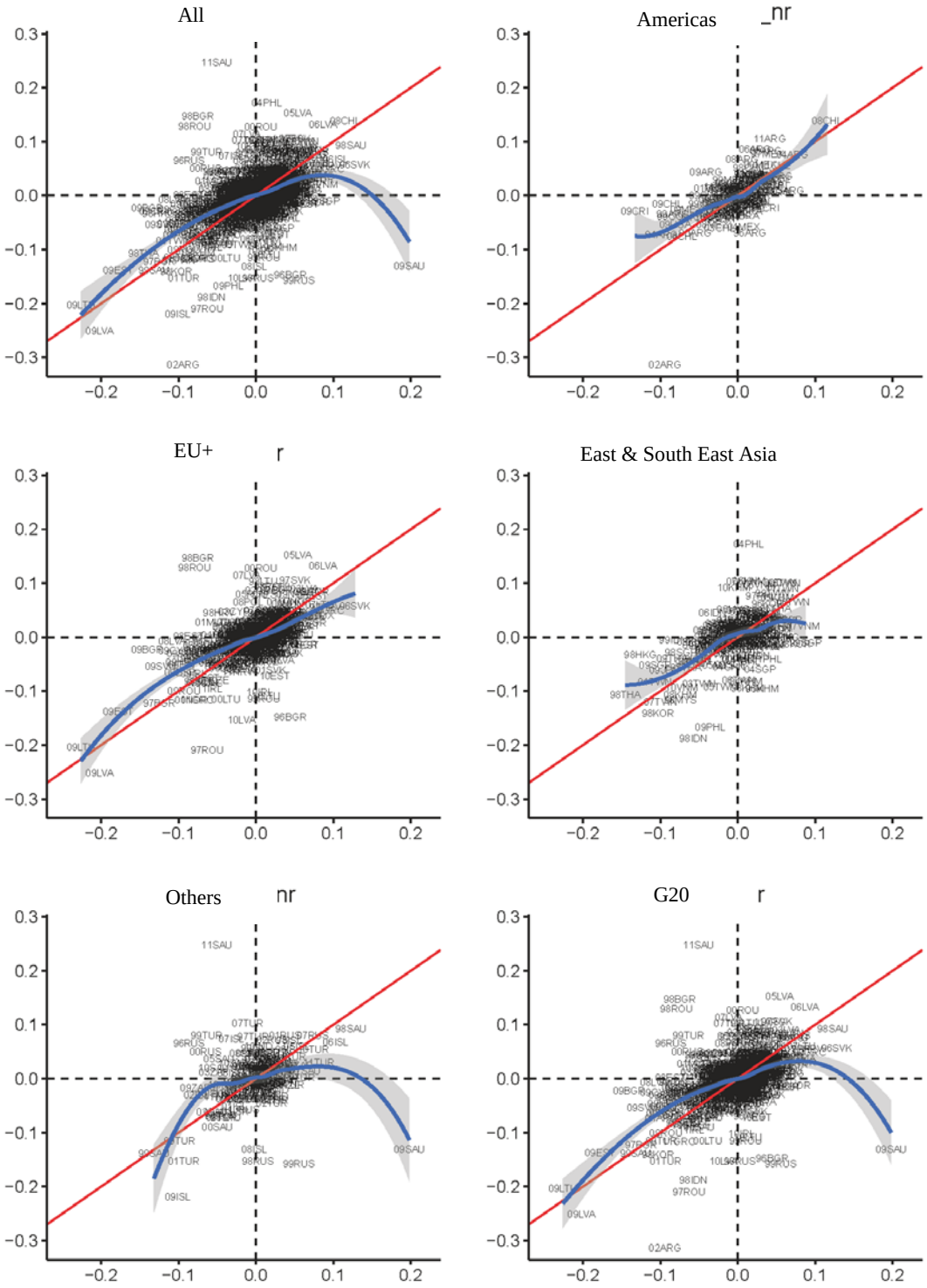
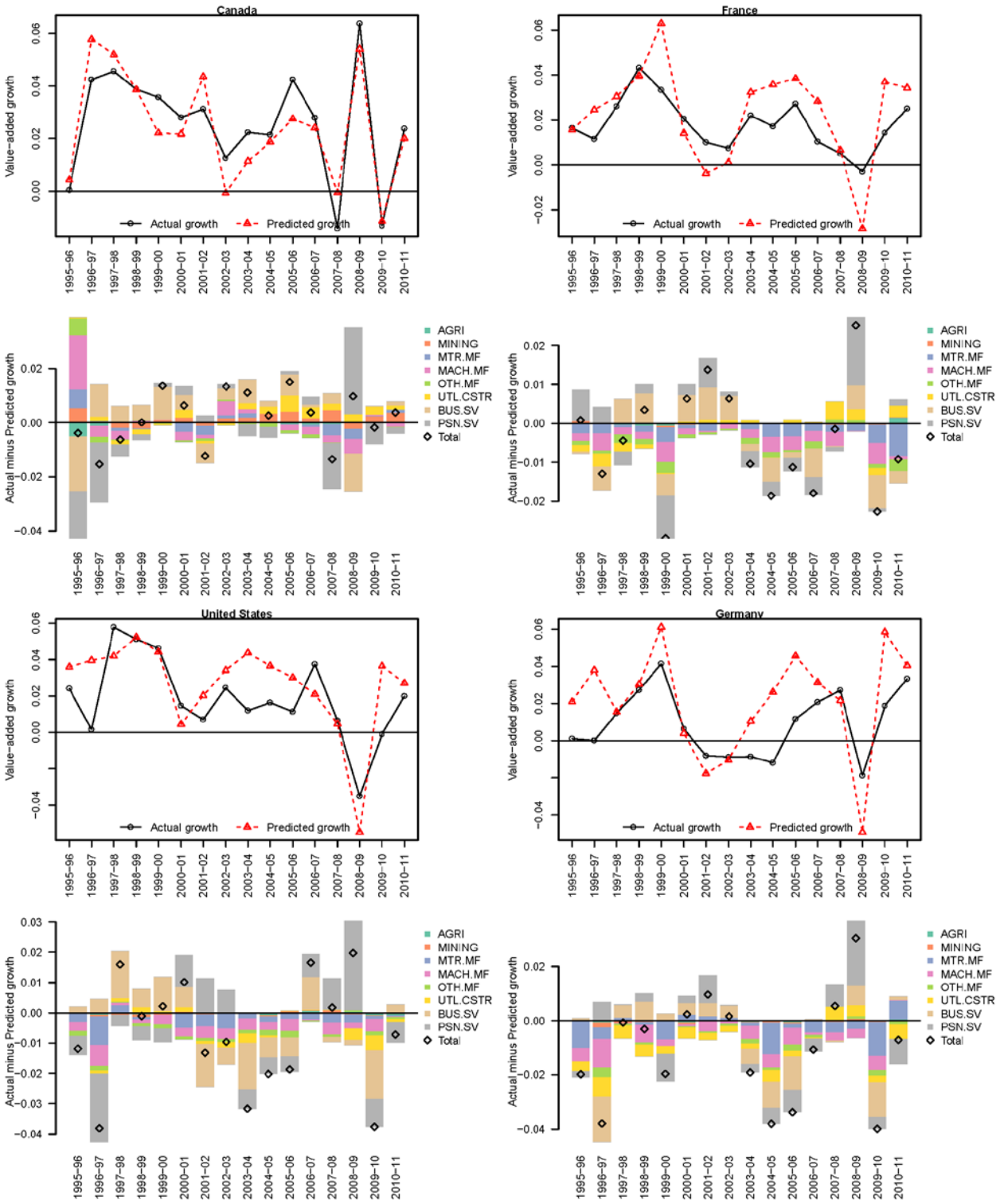
Figure B1: Nonparametric estimation results by region (National currency base at constant prices in 2005; Labour compensation)



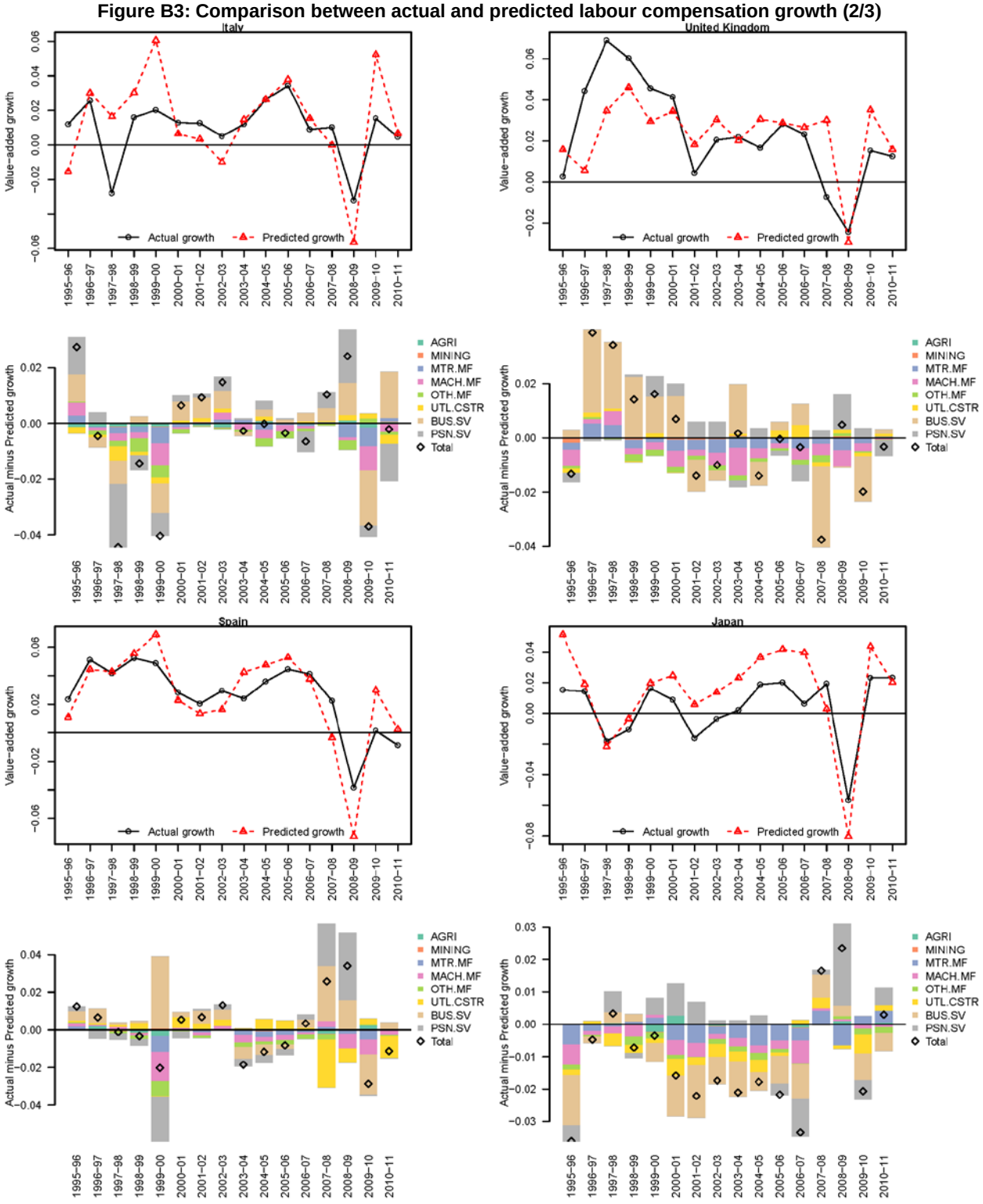
Note: Horizontal axis is the (country-demeaned) predicted labour compensation growth, and vertical axis is the (country-demeaned) actual labour compensation growth. The red line is a line with slope 1, and the grey interval indicates the 90% confidence interval. Brunei Darussalam is dropped from the sample. The definition of each group is described in Table 2, Panel (II).

Figure B2: Comparison between actual and predicted labour compensation growth (1/3)



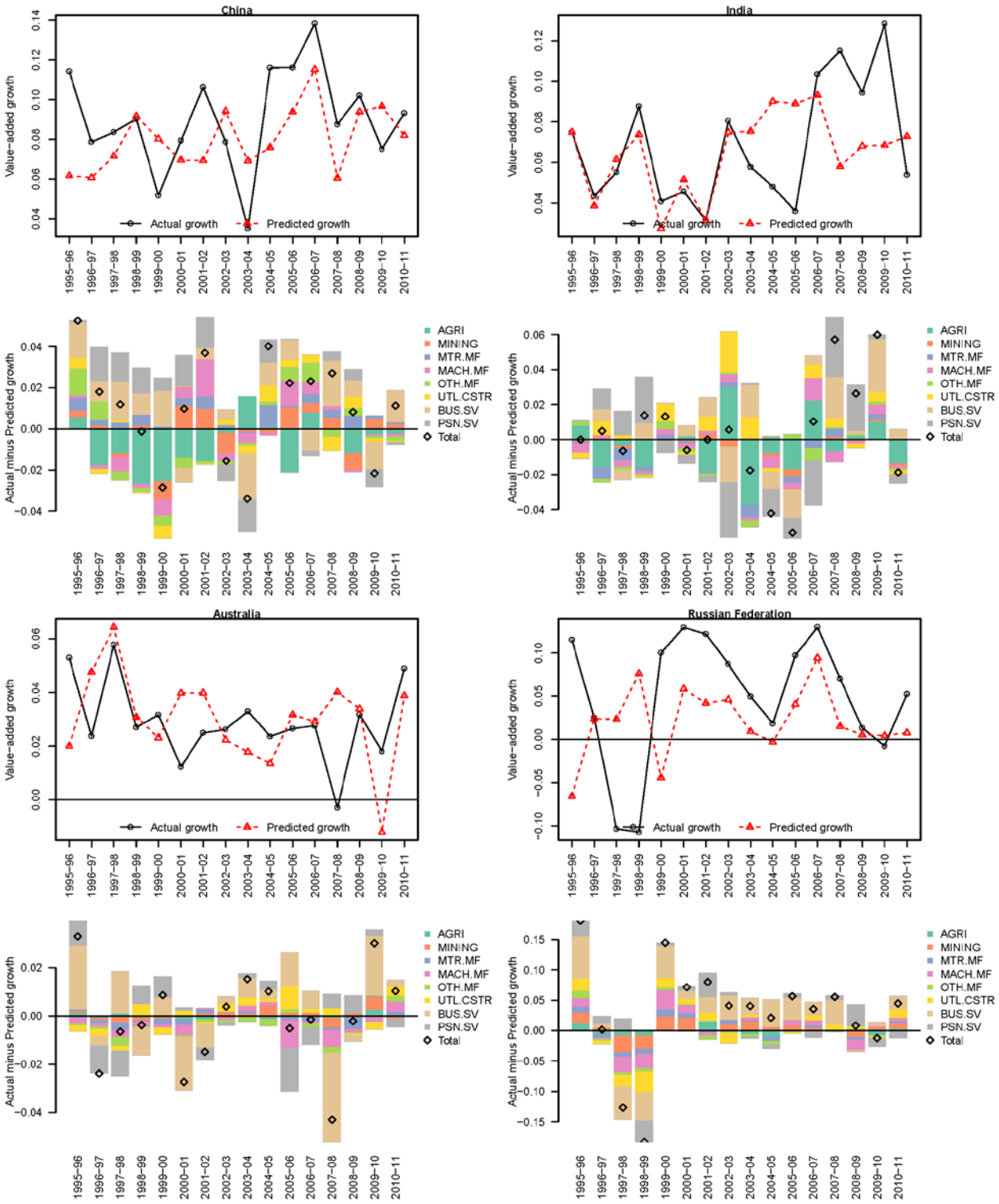
Note: National currency base at constant prices in 2005. The definition of eight aggregated industries is described in Table 1

Figure B3: Comparison between actual and predicted labour compensation growth (2/3)



Note: National currency base at constant prices in 2005. The definition of eight aggregated industries is described in Table 1

Figure B4: Comparison between actual and predicted labour compensation growth (3/3)



Note: National currency base at constant prices in 2005. The definition of eight aggregated industries is described in Table 1.

Table B1: Regression results (Labour compensation)

-The relationship between final demand shocks & structural changes-

		Symmetric Model		Asymmetric Model	
	Explanatory variable	Coeffiecient	StdErr	Coeffiecient	StdErr
(a) Total	dFD	0.0042	(0.0098)		
	dFD*Nega			-0.0109	(0.0148)
	dFD*Posi			0.0162	(0.0132)
	LR test (Null: Sym. model = Asym. model): p-value 0.1709				
(b) Domestic goods demand	dFD	0.0194 ***	(0.0027)		
	dFD*Nega			0.0304 ***	(0.0040)
	dFD*Posi			0.0106 ***	(0.0036)
	LR test (Null: Sym. model = Asym. model): p-value 0.0002				
(c) Domestic services demand	dFD	-0.0605 ***	(0.0063)		
	dFD*Nega			-0.0852 ***	(0.0094)
	dFD*Posi			-0.0407 ***	(0.0084)
	LR test (Null: Sym. model = Asym. model): p-value 0.0005				
(d) Foreign final demand	dFD	0.0453 ***	(0.0050)		
	dFD*Nega			0.0439 ***	(0.0075)
	dFD*Posi			0.0463 ***	(0.0067)
	LR test (Null: Sym. model = Asym. model): p-value 0.8100				

Note: The explained variable is based on labour compensation data. The sample size is 930 (61 countries + ROW, 15 years) for each regression. The asterisks *** (**, *) denote 1% (5%, 10%) significance level. These panels (a) to (d) correspond to the models (a) to (d) in Equations (12) and (13) in the main paper. The null hypothesis of the likelihood ratio (LR) test is that dFD*Nega and dFD*Posi have the same coefficient.

Table B2: Two-period regression results (Labour compensation)

-The relationship between final demand shocks and structural changes-

(I) Sample from 1997 to 2004

1997-2004		Symmetric Model			Asymmetric Model		
	Explanatory variable	Coeffiecient		StdErr	Coeffiecient		StdErr
(a) Total	dFD	0.0542	***	(0.0125)			
	dFD*Nega				0.0730	***	(0.0211)
	dFD*Posi				0.0442	***	(0.0154)
	LR test (Null: Sym. model = Asym. model): p-value 0.2693						
(b) Domestic goods demand	dFD	0.0274	***	(0.0041)			
	dFD*Nega				0.0534	***	(0.0068)
	dFD*Posi				0.0134	***	(0.0050)
	LR test (Null: Sym. model = Asym. model): p-value 0.000003						
(c) Domestic services demand	dFD	-0.0221	***	(0.0083)			
	dFD*Nega				-0.0314	**	(0.0140)
	dFD*Posi				-0.0171	*	(0.0103)
	LR test (Null: Sym. model = Asym. model): p-value 0.4112						
(d) Foreign final demand	dFD	0.0489	***	(0.0062)			
	dFD*Nega				0.0509	***	(0.0106)
	dFD*Posi				0.0479	***	(0.0078)
	LR test (Null: Sym. model = Asym. model): p-value 0.8165						

(II) Sample from 2004 to 2011

2004-2011		Symmetric Model			Asymmetric Model		
	Explanatory variable	Coeffiecient		StdErr	Coeffiecient		StdErr
(a) Total	dFD	-0.0566	**	(0.0143)			
	dFD*Nega				-0.0700	***	(0.0192)
	dFD*Posi				-0.0401	*	(0.0213)
	LR test (Null: Sym. model = Asym. model): p-value 0.2962						
(b) Domestic goods demand	dFD	0.0099	***	(0.0035)			
	dFD*Nega				0.0142	***	(0.0047)
	dFD*Posi				0.0046		(0.0052)
	LR test (Null: Sym. model = Asym. model): p-value 0.1702						
(c) Domestic services demand	dFD	-0.1035	***	(0.0088)			
	dFD*Nega				-0.1164	***	(0.0118)
	dFD*Posi				-0.0875	***	(0.0132)
	LR test (Null: Sym. model = Asym. model): p-value 0.1027						
(d) Foreign final demand	dFD	0.0369	***	(0.0075)			
	dFD*Nega				0.0322	***	(0.0101)
	dFD*Posi				0.0428	***	(0.0112)
	LR test (Null: Sym. model = Asym. model): p-value 0.4817						

Note: The explained variable is based on labour compensation data. The sample size is 496 (61 countries + ROW, 8 years) for each regression. The asterisks *** (**, *) denote 1% (5%, 10%) significant level. These panels (a) to (d) correspond to the models (a) to (d) in Equations (12) and (13) in the main paper. The null hypothesis of the likelihood ratio (LR) test is that dFD*Nega and dFD*Posi have the same coefficient.